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# Nursing Informatics 2016

eHealth for All: Every Level Collaboration – From Project  
to Realization

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# Message from the Scientific Committee

On behalf of the Scientific Program Committee, I extend a warm welcome to the IMIA-NI members, students, practitioners, informatics researchers, industry partners, and others interested in health and nursing informatics who have come to attend the NI 2016, 13th International Congress on Nursing Informatics.

NI 2016 is a biennial conference of the IMIA-NI and the leading scientific meeting for health and nursing informatics research and practice. NI 2016 presents work not only from the discipline of nursing but also from many other disciplines and specialties including both basic and applied informatics.

The theme of NI 2016 is *eHealth for all: Every level collaboration – From project to realization*. The theme reflects the major challenges we face in healthcare today, that is, the need to collaborate at every level to achieve our goal of *Health For All*. NI 2016 offers a variety of topics on the conference theme.

The mission of the Scientific Program Committee is to solicit for, evaluate and schedule NI 2016 conference program to be consistent with the goal of the IMIA-NI. We received 445 submissions for papers, posters, short communications, panels, workshops, demonstrations, student competitions and tutorials from more than 40 countries. Each submission was reviewed by three reviewers selected from a panel of more than 963 experts. Reviewers' feedback was provided to the authors and every effort was made to ensure the best submissions given the constraints of the conference timetable. In the end, a total of 332 submissions were selected.

The result of the Scientific Program Committee's activity is reflected in the Conference Program and Proceedings. The proceedings contain OA full papers, indexed in MEDLINE, and also workshops, panels and posters summaries.

The Scientific Program Committee has prepared a wonderful program. We have six keynote speakers addressing the state-of-the-art for health and nursing informatics ranging from data, to healthcare delivery to the policy level. There are 24 paper sessions, 20 poster sessions, 23 panel discussions, 14 workshops, 1 demonstration, 8 tutorials and 6 student competitions to attend. The exhibit hall will provide attendees with the opportunity to learn about the latest products and services in health and nursing information and information technology. The NI 2016 is adding two new features, a Wearable Fashion Show and an Interoperability Showcase. The Wearable Fashion Show will present how technology and fashion can be merged for healthcare. The Interoperability Showcase will present how EHR Applications, Devices and Apps communicate patient data electronically using HL7 standards and IHE profiles. This showcase is jointly organized by the HL7 Nurses Work Group with HL7 PCWG EHRWG, CICWG and Associations such as IMIA-NI, ICN, HIMSS and IHE. I hope that all participants have the opportunity to learn from and network with others through tutorials, keynotes, paper sessions, poster sessions, panel discussions, and workshops and find new and exciting ideas to inspire them.

I am very grateful to the contributors for their contributions and the reviewers for providing expert reviews. I am especially grateful to Patrick Weber, Chair of the NI 2016 Local Organizing Committee, and Maria Muller-Staub and Margie Kennedy, Co-chairs of the Scientific Program Committee, for their leadership and strong support.

We are in Geneva, Switzerland and I hope you find some time before or after the conference to enjoy this beautiful city and country.

Hyeoun-Ae Park, PhD, RN, FAAN Chair, Scientific Program Committee  
Professor in College of Nursing and Systems Biomedical Informatics Research Center  
Seoul National University

## Preface

We welcome the Nursing Informatics Community to Geneva, Switzerland. Geneva is known as the “city of peace.” It is the home of more than twenty international organizations and has more international flavor and influence than any other city of its size. Geneva lives and breathes international collaboration and networking. It is a privilege that Geneva is hosting the 13th International Conference on Nursing Informatics from June 25–29, 2016.

The theme of the conference is “eHealth for all”, for nurses and all health and social care professionals who use information to support their practice, from the bedside to the boardroom, from idea to implementation. The conference is cutting-edge and is combined with a social media event, a digital health summer school and an eHealth fashion show bringing healthcare fully into the new digital age.

The Scientific Program has over 340 presentations as tutorials, keynotes, submitted papers, panel presentations, workshops and poster sessions. A quick reading through the program shows the richness and scientific achievements realized by the foremost international experts in our field: smartphone Medication Apps for patients with chronic diseases, robotic assistance in medication management, intelligent wardrobes, low-cost wearables for fatigue and back stress management, big data analytics for optimizing work processes, consumer eHealth literacy tools, routine data mining tools, eHealth competence frameworks for educating nurses and many other challenging contribution to the state-of-art in nursing informatics.

We thank the Scientific Committee, led by Dr. Hyeoun Ae Park (chair), Dr. Maria Müller-Staub (co-chair) and Dr. Margie Kennedy (co-chair) for the high-quality selection of papers and contributions. We thank the Local Organizing Committee, led by Patrick Weber (chair) for putting a vibrant conference into reality.

We welcome you in Geneva on Sunday, June 26. The Giant Fountain in the middle of Lake Geneva symbolizes the wealth of energy and ideas the city and the conference will bring to you.

Paula Procter, Walter Sermeus, Patrick Weber

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# Contents

Message from the Scientific Committee <i>Hyeoun-Ae Park</i>	v
Preface <i>Paula Procter, Walter Sermeus and Patrick Weber</i>	vii
Organization	ix
<b>Full Papers</b>	
<b><i>Clinical IT to Promote eHealth</i></b>	
Determining Optimal Nursing Resources in Relation to Functions During the Oulu University Hospital Nurse Staffing Management Project <i>Pia Liljamo, Päivi Lavander and Pirjo Kejonen</i>	3
Making Patient Risk Visible: Implementation of a Nursing Document Information System to Improve Patient Safety <i>Panfeng Wang, Hongjun Zhang, Baohua Li and Keke Lin</i>	8
Electronic Nursing Documentation: Patient Care Continuity Using the Clinical Care Classification System (CCC) <i>Luann Whittenburg and Aunchisa Meetim</i>	13
Transforming Clinical Documentation in EHRs for 2020: Recommendations from University of Minnesota's Big Data Conference Working Group <i>Charlotte Weaver and Ann O'Brien</i>	18
Nurses' Information Seeking Behavior for Clinical Practice: A Case Study in a Developing Country <i>Masoumeh Sarbaz, Khalil Kimiafar, Abbas Sheikhtaheri, Zhila Taherzadeh and Saeid Eslami</i>	23
Homecare Nurses' Decision-Making During Admission Care Planning <i>Paulina Sockolow, Ellen J. Bass, Carl L. Eberle and Kathryn H. Bowles</i>	28
Online Information Seeking Behaviour by Nurses and Physicians: A Cross-Sectional Study <i>Paschalina Lialiou and John Mantas</i>	33
Studying the HIT-Complexity Interchange <i>Craig E. Kuziemsky, Elizabeth M. Borycki and Andre W. Kushniruk</i>	38
Competency Skills Assessment: Successes and Areas for Improvement Identified During Collaboration Between Informaticists and a National Organization <i>Carolyn Sipes, Kathy Hunter, Dee McGonigle, Toni Hebda, Taryn Hill and Jean Lamblin</i>	43

Promoting mHealth in Nursing Practice in China <i>Yisi Liu, Ying Wu and Yang Gong</i>	48
A Quantitative Study Investigating the Effects of Computerised Clinical Decision Support in the Emergency Department <i>Paula Bennett and Nicholas Hardiker</i>	53
An Analysis of the Factor Model on the Workload of Nursing Staff Using a Hospital Management Tool <i>Kikue Sato, Koji Yamashita, Mituko Goshima, Tomohiro Kuroda, Yasutomi Kinosada and Akitoshi Seiyama</i>	58
Measuring Nursing Value from the Electronic Health Record <i>John M. Welton and Ellen M. Harper</i>	63
Biometric Attendance and Big Data Analysis for Optimizing Work Processes <i>Neetu Verma, Teenu Xavier and Deepak Agrawal</i>	68
Networking Hospital ePrescribing: A Systemic View of Digitalization of Medicines' Use in England <i>Valentina Lichtner, Ralph Hibberd and Tony Cornford</i>	73
Evaluating Nurses Acceptance of Hospital Information Systems: A Case Study of a Tertiary Care Hospital <i>Mohamed Khalifa</i>	78
Using Mixed Methods in Health Information Technology Evaluation <i>Paulina Sockolow, Dawn Dowding, Rebecca Randell and Jesus Favela</i>	83
The Evaluation Imperative <i>Lynn M. Nagle</i>	88
User-Centered Design Practices to Redesign a Nursing e-Chart in Line with the Nursing Process <i>Maria B. Schachner, Francisco J. Recondo, Zulma A. González, Janine A. Sommer, Enrique Stanziola, Fernando D. Gassino, Mariana Simón, Gastón E. López and Sonia E. Benítez</i>	93
Using Clinical Decision Support and Dashboard Technology to Improve Heart Team Efficiency and Accuracy in a Transcatheter Aortic Valve Implantation (TAVI) Program <i>Sarah Clarke, Marisa L. Wilson and Mary Terhaar</i>	98
Enhancing Patient Safety Using Clinical Nursing Data: A Pilot Study <i>Jeeyae Choi and Jeungok E. Choi</i>	103
The Integrated Patient's Self-Care Process Model <i>Marija Milavec Kapun, Olga Šusteršič and Vladislav Rajkovič</i>	108
Use of Nurses in Tele-Consultation for Patients in Remote Areas <i>Metilda Robin, Teenu Xavier and Deepak Agrawal</i>	113
Evaluation of Acceptance of Nursing Information System in a German and American Hospital <i>Anne-Maria Vollmer, Hans-Ulrich Prokosch, Scott Evans and Kathryn Kuttler</i>	118

Advancing Nursing Informatics in the Next Decade: Recommendations from an International Survey	123
<i>Maxim Topaz, Charlene Ronquillo, Laura-Maria Peltonen, Lisiane Pruinelli, Raymond Francis Sarmiento, Martha K. Badger, Samira Ali, Adrienne Lewis, Mattias Georgsson, Eunjoo Jeon, Jude L. Tayaben, Chiu-Hsiang Kuo, Tasneem Islam, Janine Sommer, Hyunggu Jung, Gabrielle Jacklin Eler and Dari Alhuwail</i>	
Functionality of Triggers for Epilepsy Patients Assessed by Text and Data Mining of Medical and Nursing Records	128
<i>Eija Kivekäs, Ulla-Mari Kimmunen, Pekka Paananen, Reetta Kälviäinen, Kaisa Haatainen and Kaija Saranto</i>	
Computerization of a Nursing Chart According to the Nursing Process	133
<i>Maria B. Schachner, Zulma A. González, Janine A. Sommer, Francisco J. Recondo, Fernando D. Gassino, Daniel R. Luna and Sonia E. Benítez</i>	
Utilizing Health Analytics in Improving Emergency Room Performance	138
<i>Mohamed Khalifa</i>	
Analyzing 30-Day Readmission Rate for Heart Failure Using Different Predictive Models	143
<i>Satish Mahajan, Prabir Burman and Michael Hogarth</i>	
Quality Evaluation of Nursing Observation Based on a Survey of Nursing Documents Using NursingNAVI® Contents in JAPAN	148
<i>Satoko Tsuru, Miho Omori, Manami Inoue and Fumiko Wako</i>	
<b><i>eHealth in Its Different Aspects</i></b>	
The Role of Nurses in E-Health: The MobiGuide Project Experience	153
<i>Enea Parimbelli, Lucia Sacchi, Roxana Budasu, Carlo Napolitano, Mor Peleg and Silvana Quaglini</i>	
Tripartite Governance: Enabling Successful Implementations with Vulnerable Populations	158
<i>Margaret Ann Kennedy</i>	
Nurses' Contribution to Health Information Technology of Iran's 2025 Health Map: A Review of the Document	163
<i>Farahnaz Sadoughi, Tania Azadi and Tannaz Azadi</i>	
National eHealth Implementation: Country Experience	168
<i>Gudrun Audur Hardardottir and Asta Thoroddsen</i>	
Health@Home Moves All About the House!	173
<i>Gail R. Casper, Patricia F. Brennan, Catherine Arnott Smith, Nicole E. Werner and Yuqi He</i>	
Older Consumers' Readiness for e-Health in New Zealand	178
<i>Michelle Honey, Susan Waterworth and Htein Aung</i>	

Evolving National Strategy Driving Nursing Informatics in New Zealand <i>Michelle Honey and Lucy Westbrooke</i>	183
Nursing Telehealth, Caring from a Distance <i>Lars Botin and Christian Nøhr</i>	188
Using Education Technology as a Proactive Approach to Healthy Ageing <i>Daragh Rodger, Anne Spencer and Pamela Hussey</i>	193
Using the Virtual Reality World of Second Life to Promote Patient Engagement <i>Elizabeth Weiner, Patricia Trangenstein, Ryan McNew and Jeffry Gordon</i>	198
The Development Process of eHealth Strategy for Nurses in Finland <i>Outi Ahonen, Pirkko Kouri, Ulla-Mari Kinnunen, Kristiina Junttila, Pia Liljamo, Dinah Arifulla and Kaija Saranto</i>	203
A Study on the Effectiveness of XMOOC Teaching in Improving Practical Nursing Teaching <i>Hongwei Zhou, Wan Qiu, Jiyin Zhu, Jing Feng, Wenjing Gong and Wenwei Le</i>	208
The « Intelligent Wardrobe » <i>Philipp Schaad, Saskia Basler, Meriam Medini, Ivan Wissler, Thomas Bürkle and Michael Lehmann</i>	213
Implementing Innovation: The Creation of an iUnit and the Role of Nursing <i>Victoria L. Tiase, Rosemary Ventura, Daniel Sorbello and Kenya Robinson</i>	218
Nursing Informatics Research Priorities for the Future: Recommendations from an International Survey <i>Laura-Maria Peltonen, Maxim Topaz, Charlene Ronquillo, Lisiane Pruinelli, Raymond Francis Sarmiento, Martha K. Badger, Samira Ali, Adrienne Lewis, Mattias Georgsson, Eunjoo Jeon, Jude L. Tayaben, Chiu-Hsiang Kuo, Tasneem Islam, Janine Sommer, Hyunggu Jung, Gabrielle Jacklin Eler and Dari Alhuwail</i>	222
Ten Demands of Improved Usability in eHealth and Some Progress – Co-Creation by Health and Social Care Professionals <i>Isabella Scandurra and David Liljequist</i>	227
A Personal Health Network for Chemotherapy Care Coordination: Evaluation of Usability Among Patients <i>Katherine K. Kim, Janice F. Bell, Richard Bold, Andra Davis, Victoria Ngo, Sarah C. Reed and Jill G. Joseph</i>	232
The Nursing Informatician’s Role in Mediating Technology Related Health Literacies <i>Ramona Nelson and Heather D. Carter-Templeton</i>	237
Discovering eHealth Technology: An Innovative Interprofessional Graduate Student Learning Experience <i>Krista Estes, Eric Gilliam, Sarah Knapfel, Chanmi Lee and Diane Skiba</i>	242



Clinical Simulation in the Development of eHealth: In-Situ and Laboratory Simulation	247
<i>Sanne Jensen and Elizabeth M. Borycki</i>	
<b><i>Education in Health IT</i></b>	
Project Management: Essential Skill of Nurse Informaticists	252
<i>Carolyn Sipes</i>	
Elements of Scenario-Based Learning on Suicidal Patient Care Using Real-Time Video	257
<i>Chuehfen Lu, Hueying Lee, Shuhui Hsu and Inmei Shu</i>	
Gamification of Clinical Routine: The Dr. Fill Approach	262
<i>Mark Bukowski, Martin Kühn, Xiaoqing Zhao, Ralf Bettermann and Stephan Jonas</i>	
Evaluation of a Statewide HIV-HCV-STD Online Clinical Education Program by Healthcare Providers – A Comparison of Nursing and Other Disciplines	267
<i>Dongwen Wang and Amneris E. Luque</i>	
Persuasive Technology in Nursing Education About Pain	272
<i>Ana Graziela Alvarez, Grace T.M. Dal Sasso and Sriram Iyengar</i>	
Issues for Deployment of Mobile Learning by Nurses in Australian Healthcare Settings	277
<i>Carey Mather and Elizabeth Cummings</i>	
Interprofessional Student Perspectives of Online Social Networks in Health and Business Education	282
<i>Glynda Doyle, Cyri Jones and Leanne Currie</i>	
Knowledge Transfer in Health Care Through Digitally Collecting Learning Experiences – Results of <i>Witra Care</i>	287
<i>Marianne Behrends, Thomas Kupka, Regina Schmeer, Iris Meyenburg-Altward and Michael Marscholke</i>	
Operationalizing the TANIC and NICA-L3/L4 Tools to Improve Informatics Competencies	292
<i>Carolyn Sipes, Dee McGonigle, Kathy Hunter, Toni Hebda, Taryn Hill and Jean Lamblin</i>	
Information Literacy in a Digital Era: Understanding the Impact of Mobile Information for Undergraduate Nursing Students	297
<i>Glynda J. Doyle, Karen E. Furlong and Loretta Secco</i>	
Integrating Informatics Content into the Nursing Curriculum	302
<i>Elizabeth Weiner, Patricia Trangenstein, Jeffrey Gordon and Ryan McNew</i>	
Preparing the Next Generation of Advanced Practice Nurses for Connected Care	307
<i>Diane J. Skiba, Amy J. Barton, Krista Estes, Eric Gilliam, Sarah Knapfel, Chanmi Lee, Gina Moore and Katy Trinkley</i>	

Technology Readiness of Early Career Nurse Trainees: Utilization of the Technology Readiness Index (TRI) <i>Michelle Odlum</i>	314
Development and Evaluation for Active Learning Instructional Design of Epidemiology in Nursing Informatics Field <i>Yukie Majima</i>	319
Changing Educational Paths in an Informatics Course According to the Needs and Expectations of Nursing Degree Students <i>Zulma A. González, María B. Schachner, María A. Tattone and Sonia E. Benítez</i>	324
Embedding Nursing Informatics Education into an Australian Undergraduate Nursing Degree <i>Elizabeth Cummings, Eun Hee Shin, Carey Mather and Evelyn Hovenga</i>	329
Using Co-Design with Nursing Students to Create Educational Apps for Clinical Training <i>Siobhan O'Connor and Tom Andrews</i>	334
Educational Requirements for Mobile Applications in Nursing: Applying the User-Task-Context Matrix to Identify User Classes and Contexts of Use <i>Elizabeth M. Borycki, Andre W. Kushniruk, Paul Turner, Johanna Kaipio and Elizabeth Cummings</i>	339
Social Media Training for Professional Identity Development in Undergraduate Nurses <i>Carey Mather, Elizabeth Cummings and Linda Nichols</i>	344
 <b><i>Interoperability and Translational IT</i></b>	
Exchange of Information Between Hospital and Home Health Care: A Longitudinal Perspective <i>Ragnhild Hellesø, Line Melby, Berit Brattheim and Pieter Toussaint</i>	349
Use of Patient Portals in Older Adults: A Comparison of Three Samples <i>Eun-Shim Nahm, Knar Sagherian and Shijun Zhu</i>	354
Medication Information Flow in Home Care <i>Teija Norri-Sederholm, Kaija Saranto and Heikki Paakkonen</i>	359
Using Dashboard Technology and Clinical Decision Support Systems to Improve Heart Team Efficiency and Accuracy: Review of the Literature <i>Sarah Clarke, Marisa L. Wilson and Mary Terhaar</i>	364
Checking the Quality of Detailed Clinical Models: Instrument Application <i>Denice van Munster, Irene Krediet and William Goossen</i>	367
Low-Cost Wearable for Fatigue and Back-Stress Measurement in Nursing <i>Halim I. Baquapuri, Ali Wajdan, Ekaterina Kutafina, Berno Misgeld and Stephan M. Jonas</i>	372

Smart Glasses in Nursing Training – Redundant Gadget or Precious Tool? A Pilot Study	377
<i>Michael Marschollek, Christoph Barthel, Marianne Behrends, Regina Schmeer, Iris Meyenburg-Altward and Marcus Becker</i>	
Clustering the Whole-Person Health Data to Predict Liver Transplant Survival	382
<i>Lisiane Pruinelli, Karen A. Monsen, Gyorgy J. Simon and Bonnie L. Westra</i>	
Integration and Analysis of Heterogeneous Colorectal Cancer Data for Translational Research	387
<i>Jitendra Jonnagaddala, Joanne L. Croucher, Toni Rose Jue, Nicola S. Meagher, Lena Caruso, Robyn Ward and Nicholas J. Hawkins</i>	
A Workflow Framework for Health Management in Daily Living Settings	392
<i>Mustafa Ozkaynak, Jacqueline Jones, Jason Weiss, Patrick Klem and Blaine Reeder</i>	
Feasibility of the Rule-Based Approach to Creating Complex Pictograms	397
<i>Jaemin Kim, Vineet Fnu, Elizabeth Bell and Hyeoneui Kim</i>	
Identifying Outliers in Data from Patient Record	402
<i>Dieter Baumberger and Reto Buergin</i>	
Analysis of the Nursing Documentation in Use in Portugal – Building a Clinical Data Model of Nursing Centered on the Management of Treatment Regimen	407
<i>Inês Cruz, Fernanda Bastos, Filipe Pereira, Abel Silva and Paulino Sousa</i>	
Advancing the Digital Health Discourse for Nurse Leaders	412
<i>Sally Remus</i>	
Adaptive Practice: Next Generation Evidence-Based Practice in Digital Environments	417
<i>Margaret Ann Kennedy</i>	
Robotic Assistance in Medication Management: Development and Evaluation of a Prototype	422
<i>Marco Schweitzer and Alexander Hoerbst</i>	
<b>Standards</b>	
Strategic Deployment of Clinical Models	427
<i>William Goossen</i>	
Towards a HPV Vaccine Knowledgebase for Patient Education Content	432
<i>Dennis Wang, Rachel Cunningham, Julie Boom, Muhammad Amith and Cui Tao</i>	
The Pilot Evaluation of Using the International Classification for Nursing Practice® (ICNP) as the Electronic Nursing Data Exchange Standardization in Taiwan	437
<i>I-Ching Hou and Meng-Jun Chen</i>	
Development and Evaluation of an Adolescents' Depression Ontology for Analyzing Social Data	442
<i>Hyesil Jung, Hyeoun-Ae Park and Tae-Min Song</i>	

Developing a Semantic Model to Describe Physical Activity Data <i>Hyeoneui Kim, Jihoon Kim, Edna Shenvi, Jimmy Quach, Brian Sutjiadi, Alex Richardson and Ko-Wei Lin</i>	447
Event Reports Promoting Root Cause Analysis <i>Swananda Pandit and Yang Gong</i>	452
Outcome Calculations Based on Nursing Documentation in the First Generation of Electronic Health Records in the Netherlands <i>Wolter Paans, Maria Müller-Staub and Wim P. Krijnen</i>	457
Testing of Triggers by Data Mining of Epilepsy Patients' Structured Nursing Records <i>Ulla-Mari Kimmunen, Eija Kivekäs, Pekka Paananen, Reetta Kälviäinen and Kaija Saranto</i>	461
Standardized Nursing Documentation Supports Evidence-Based Nursing Management <i>Minna Mykkänen, Merja Miettinen and Kaija Saranto</i>	466
Harmonising Nursing Terminologies Using a Conceptual Framework <i>Kay Jansen, Tae Youn Kim, Amy Coenen, Virginia Saba and Nicholas Hardiker</i>	471
Rationale for Quantification in Nursing Services Using the International Council of Nurses Nurse-Patient Summary <i>Edward J. Halloran, John Welton, H. Lee Bastin and Kennedy Onori</i>	476
 <b><i>Mobile Health</i></b>	
Usability Evaluation of a Prototype Mobile App for Health Management for Persons Living with HIV <i>Rebecca Schnall, Suzanne Bakken, William Brown III, Alex Carballo-Diequez and Sarah Iribarren</i>	481
Mobile and Wearable Technology Needs for Aging in Place: Perspectives from Older Adults and Their Caregivers and Providers <i>Jing Wang, Deidra Carroll, Michelle Peck, Sahiti Myneni and Yang Gong</i>	486
A Systematic Review and Meta-Analysis of Intervention for Pediatric Obesity Using Mobile Technology <i>Jisan Lee, Meihua Piao, Ahjung Byun and Jeongeun Kim</i>	491
Evaluating the Feasibility of Using Mobile Devices for Nurse Documentation <i>Maria B. Schachner, Janine A. Sommer, Zulma A. González, Daniel R. Luna and Sonia E. Benítez</i>	495
TextWithSurgeryPatients – A Research Hypothesis in Enhancing Education and Physical Assessment for Abdominal Surgical Patients <i>Margaret Hansen</i>	500
A Mobile Care Coordination System for the Management of Complex Chronic Disease <i>Sarah Haynes and Katherine K. Kim</i>	505

Mobile Apps Providing Tailored Nursing Interventions for Patients with Metabolic Syndrome	510
<i>Eunjoo Jeon, Hyeoun-Ae Park, Soojung Jo, Hannah Kang and Joo Yun Lee</i>	
What Features of Smartphone Medication Applications Are Patients with Chronic Diseases and Caregivers Looking for?	515
<i>Yisi Liu, Liuyu Wang, Polun Chang, Karen V. Lamb, Yanyan Cui and Ying Wu</i>	
Ambulance Protocols: A Mobile Solution	520
<i>Eleonora Losiouk, Silvana Quaglini, Enrico Visetti, Francesca Perfetti and Giordano Lanzola</i>	

### ***Experiences***

Quantifying Eye Tracking Between Skilled Nurses and Nursing Students in Intravenous Injection	525
<i>Yasuko Maekawa, Yukie Majima and Masato Soga</i>	
Heuristic Evaluation of a mHealth Diabetes Self-Management System Using Disease Specific Patient Profiles	530
<i>Mattias Georgsson and Nancy Staggers</i>	
Improving Patients Experience in Paediatric Emergency Waiting Room	535
<i>Frederic Ehrler, Johan Siebert, Rolf Wipfli, Cyrille Duret, Alain Gervais and Christian Lovis</i>	
Towards Integrating the Principlist and Casuist Approaches to Ethical Decisions via Multi-Criterial Support	540
<i>Mette Kjer Kaltoft, Jesper Bo Nielsen, Glenn Salkeld and Jack Dowie</i>	
Dementia and Robotics: People with Advancing Dementia and Their Carers Driving an Exploration into an Engineering Solution to Maintaining Safe Exercise Regimes	545
<i>Carol Cooper, Jacques Penders and Paula M. Procter</i>	

### **Social Media & Participatory Health Conference**

#### ***Full Papers***

A Data Mining Approach for Exploring Correlates of Self-Reported Comparative Physical Activity Levels of Urban Latinos	553
<i>Sunmoo Yoon, Manuel C. Co Jr., Niurka Suero-Tejeda and Suzanne Bakken</i>	
Decision Support System of Nursing Human Resources Allocation in General Wards Based on Hospital Information System	558
<i>Hong Chen, Shangping Zhao and Ling Feng</i>	
Integrating Social Media and Mobile Sensor Data for Clinical Decision Support: Concept and Requirements	562
<i>Kerstin Denecke</i>	

Development of an Online Platform to Support the Network of Caregivers of People with Dementia <i>Renée Verwey, Miranda van Berlo, Saskia Duymelinck, Sarah Willard and Erik van Rossum</i>	567
Social Media Use Among Nurses: Literature Review <i>Ariana Anamaria Cordoş and Sorana D. Bolboacă</i>	572
Patient Participation in Chronic Pain Management Through Social Media: A Clinical Study <i>Mark Merolli, Kathleen Gray and Fernando Martin-Sanchez</i>	577
Consumer Health Informatics in the Context of Engaged Citizens and eHealth Services – A New CHI Meta Model <i>Martin Wiesner, Lena Griebel, Kurt Becker and Monika Pobiruchin</i>	582
Diabetes Applications for Arabic Speakers: A Critical Review of Available Apps for Android and iOS Operated Smartphones <i>Dari Alhuwail</i>	587
Capturing Provenance, Evolution and Modification of Clinical Protocols via a Heterogeneous, Semantic Social Network <i>Nick Portokallidis, George Drosatos and Eleni Kaldoudi</i>	592
Effectiveness of an Internet Community for Severely Obese Women <i>Taridzo Chomutare, Eirik Årsand and Gunnar Hartvigsen</i>	597
 <b><i>Panels and Workshops</i></b>	
Social Media as Catalyzer for Connected Health: Hype or Hope? Perspectives from IMIA Working Groups <i>Luis Fernandez-Luque, Vivian Vilmarlund, Elizabeth Borycki, Stefan Schulz, Craig Kuziemsky, Michael Marschollek and Casimir A. Kulikowski</i>	602
Gamified Design for Health Workshop <i>Guido Giunti</i>	605
Panel: Big Data & Social Media for Empowering Patients with Diabetes <i>Luis Fernandez-Luque, Yelena Mejova, Miguel-Angel Mayer, Per Erlend Hasvold and Surabhi Joshi</i>	607
A Faculty Peer Network for Integrating Consumer Health Solutions in Nursing Education: Contextual Influences and Perspectives <i>Glynda Doyle</i>	610
 <b><i>Posters</i></b>	
Use of Social Media in Facilitating Health Care Research Among Nursing and Allied Health Undergraduates in Sri Lanka <i>S.N. Silva</i>	613
Effects of Using Multimedia Situational Teaching in Establish Nurse-Patient Relationship for New Nurses <i>Jing-Yi Lin and Hui-Fen Chen</i>	615

Nurses Guidelines for Using Social Media by Finnish Nurses Association <i>Dinah Arifulla, Johanna Olli and Merja Merasto</i>	617
Development of a Multimedia Dysphagia Assessment Learning System Using Responsive Web Design: From e-Learning to m-Learning <i>Hui-Chi Huang and Sophie Huey-Ming Guo</i>	619
A Social Media-Based Mindful Yoga Program for Pregnant Women in Taiwan <i>Sophie Huey-Ming Guo, Chia-Wen Lee, Chien-Ming Tsao and Hung-Chun Hsing</i>	621
Public Use of Mobile Medical Applications: A Case Study on Cloud-Based Medical Service of Taiwan <i>Chen-Luan Lu and Yu-Hua Yan</i>	623
The New Issue of Social Media in Education and Health Behavior Change – Virtual Visit of Tele-Nursing <i>Bi-Lian Chen</i>	625
User-Centric eHealth Tool to Address the Psychosocial Effects of Sickle Cell Disease <i>David-Zacharie Issom, Gunnar Hartvigsen, Stefano Bonacina, Sabine Koch and Christian Lovis</i>	627
Gamification of Clinical Routine: The Dr. Fill Approach <i>Mark Bukowski, Martin Kühn, Xiaoping Zhao, Ralf Bettermann and Stephan Jonas</i>	629
Interactive Patient Engagement: System Design to Cross the Continuum of Care <i>K. Burke</i>	631
A Systematic Review of Omaha System Literature in Turkey <i>Selda Secginli, Nursen O. Nahcivan and Karen A. Monsen</i>	633
Student Documentation of Community Strengths Using Omaha System Terminology <i>Selda Secginli, Nursen O. Nahcivan and Madeleine J. Kerr</i>	635
Exploration of Risk Factors for Falls Using Electronic Nursing Records <i>Eunju Choi, Youngshin Lee, Eunjung Yang, Jihui Kim, Yeonhee Kim and Hyeoun-Ae Park</i>	637
Evaluation of Nursing Actions Documented in EHRs for Patients Falls Against Clinical Practice Guidelines in a Korean Tertiary Hospital <i>Youngshin Lee, Eunju Choi, Eunjung Yang, Jihui Kim, YeonHee Kim and Hyeoun-Ae Park</i>	639
Information Content Across Types of Nurse Cognitive Artifacts <i>Jacquelyn W. Blaz, Alexa K. Doig, Kristin G. Cloyes and Nancy Stagers</i>	641
Applications of Information Technology in Nursing During 2005–15: Evidence from Iran <i>Marziye Meraji, Nahid Ramazan Ghorbani, Sanaz Mahmoodian and Mahnaz Samadbeik</i>	643

Study of Learning by the Virtual Patient Case Created <i>Kayoko Hirano, Yukie Majima and Kiyoko Tokunaga</i>	645
<b>Student Contest</b>	
Adoption of Speech Recognition Technology in Community Healthcare Nursing <i>Dawood Al-Masslawi, Lori Block and Charlene Ronquillo</i>	649
Individual Nomad Clinical Assistant: Supporting Nurses at the Point of Care <i>Yvann Argentin, Florent Gluck, Christian Lovis and Frederic Ehrler</i>	654
Improving Drugs Administration Safety in Pediatric Resuscitation Using Mobile Technology <i>Hamdi Hagberg, Johan Siebert, Alain Gervais, Peter Daehne, Christian Lovis, Sergio Manzano and Frederic Ehrler</i>	656
The Hygiene Games <i>Frederic Klein, Cassandra Severijns, Daniela Albiez, Eugen Seljutin, Marko Jovanović and Milad Eyvazi Hesar</i>	658
Instrumented Shoes for Real-Time Activity Monitoring Applications <i>Christopher Moufawad el Achkar, Constanze Lenoble-Hoskovec, Kristof Major, Anisoara Paraschiv-Ionescu, Christophe Büla and Kamiar Aminian</i>	663
The Development and Evaluation of Delirium Assessment and Nursing Care Decision-Making Assistant Mobile Application for Intensive Care Unit <i>Fangyu Yang, Meihua Ji, Shu Ding, Ying Wu, Polun Chang, Chiawei Lin and Xin Yang</i>	668
<b>Pre-Conference Tutorials</b>	
Analytic Strategies of Streaming Data for eHealth <i>Sunmoo Yoon</i>	675
NI Continuing Education: Replicating a U.S. Model in Other Countries? <i>Carol J. Bickford</i>	678
Public Health Information Systems: Priorities and Practices for Successful Deployments <i>Martin Pearce</i>	680
The Need for a Global Language – SNOMED CT Introduction <i>Jane Millar</i>	683
Understanding New Types of Evidence Ready for Translation into Nursing Informatics <i>Kathleen McCormick</i>	686
Human Factors for Nursing: From In-Situ Testing to Mobile Usability Engineering <i>Andre W. Kushniruk, Elizabeth M. Borycki, Terje Solvoll and Carola Hullin</i>	689



User-Centred Design Using Gamestorming <i>Leanne Currie</i>	692
<b>Panels and Workshops</b>	
Accelerating the Global Workforce Demand for Nurse Informaticians: Advanced Health Informatics Certification (AHIC) <i>Cynthia Gadd, Connie W. Delaney, Heimar de Fátima Marin, Karen Greenwood and Jeffrey J. Williamson</i>	697
MonDossierMedical.ch – The Personal Health Record for Every Geneva Citizen <i>Aurélié Rosemberg, Adian Schmid and Olivier Plaut</i>	700
How to Prepare a Nursing Informatics Conference Submission <i>Kaija Saranto, Elizabeth M. Borycki and Indra Neil Sarkar</i>	703
Nursing and eHealth: Are We Preparing Our Future Nurses as Automatons or Informaticians? <i>Michelle Honey, Paula M. Procter, Marisa L. Wilson, Anne Moen and Grace T.M. Dal Sasso</i>	705
Patient Engagement: Opportunities and Challenges for Nursing and Health Care Professionals <i>Mervat Abdelhak</i>	707
Nursing Informatics Competencies: Psychometric Validation, Dissemination, and Maintenance of Self-Assessment Tool for Nurse Leaders <i>Sarah Collins</i>	710
Continuity of Care: Sharing the Medication Treatment Plan <i>Stéphane Spahni</i>	713
Advancing Nursing Informatics in the Next 5–10 Years: What Are the Next Steps? <i>Charlene Ronquillo</i>	715
Accessing Quality Online Health Information: What Is the Solution? <i>Célia Boyer</i>	718
Health Information Technologies for Geriatrics: The Big Picture <i>Vallaurie Crawford and Shabbir Syed-Abdul</i>	721
Information Challenges in Patient Transition <i>Ragnhild Hellesø</i>	724
Intelligent Re-Use of Nursing Routine Data: Opportunities and Challenges <i>Werner O. Hackl</i>	727
Nursing Informatics Education: Latino America & Caribe <i>Carol Hullin</i>	729
Integrating a Proposed Population Health Model with Nursing Informatics Research <i>Dawn Dowding, Adriana Arcia, Ragnhildur Ingibjargardottir Bjarnadottir, Sarah Iribarren and Sunmoo Yoon</i>	732

Strategies for Leveraging Interoperable Health Information Exchange Systems Among Healthcare Communities <i>Gregory L. Alexander, Joyce Sensmeier, Joe McDonald, William Goossen and Mary M. Alexander</i>	735
Twenty Years of Health On the Net: Committed to Reliable Information <i>Marion J. Ball</i>	738
Reducing Technology-Induced Errors: Organizational and Health Systems Approaches <i>Elizabeth M. Borycki, Yalini Senthriajah, Andre W. Kushniruk, Sari Palojoki, Kaija Saranto and Hiroshi Takeda</i>	741
Harmonising ICNP and SNOMED CT: A Model for Effective Collaboration <i>Nicholas Hardiker</i>	744
Update: NI Scope and Standards of Practice, Competencies, and Certification <i>Carol J. Bickford</i>	746
Milestones and Experiences of Standardized Documentation <i>Kaija Saranto, Virginia Saba, Patricia Dykes, Ulla-Mari Kinnunen and Minna Mykkänen</i>	748
Health Informatics Competencies, Workforce and the DNP: Why Connect These ‘Dots’? <i>Juliana J. Brixey</i>	750
Urgent Call for Nursing Big Data <i>Connie W. Delaney</i>	753
Documentation and Reporting of Nutrition – Interoperability, Standards, Practice and Procedures <i>Ann Kristin Rotegård</i>	756
Deep Dive: Evaluation Methods for Electronic Health Records <i>Sarah Collins</i>	759
Towards Implementing a Global Competency-Based Nursing and Clinical Informatics Curriculum: Applying the TIGER Initiative <i>Ursula Hübner, Marion Ball, Heimar de Fátima Marin, Polun Chang, Marisa Wilson and Christel Anderson</i>	762
Engaging Nurses in the Design and Adoption of mHealth Tools for Care Coordination <i>Judy Murphy</i>	765
Not Lost in Translation: Changing Intervention Delivery Mechanisms in e-Health <i>Karen L. Courtney</i>	768
Nursing Informatics Beyond 2020; An Interactive Workshop Exploring Our Futures <i>Peter J. Murray</i>	771
Nursing Informatics Competencies for Emerging Professionals: International Leaders Panel <i>Lisiane Pruinelli</i>	774

Facilitating eHealth for All Through Connecting Nurses and the Women Observatory for eHealth <i>Veronique Ines Thouvenot and Nicholas Hardiker</i>	777
The Future of Informatics in Aged Care: An International Perspective <i>Gregory L. Alexander, Patti Abbott, Mariann Fossum, Ryan J. Shaw, Ping Yu and Mary M. Alexander</i>	780
Developing a Framework for Teaching Nursing Informatics Internationally <i>Inge Madsen, Elizabeth Cummings, Elizabeth M. Borycki and Paulette Lacroix</i>	783
Healthcare Informatics Schemata: A Paradigm Shift over Time <i>W. Scott Erdley</i>	786
 <b>Demonstration</b>	
POLESAT an Innovative e-Geoplatform in Health Management <i>Anne Quesnel, Julien Soula, François Dufosseze and Régis Beuscart</i>	791
 <b>Posters</b>	
<i>Clinical IT</i>	
Understanding Nurses' Perceptions of Electronic Health Record Use in an Acute Care Hospital Setting <i>Gillian Strudwick, Linda McGillis Hall, Lynn Nagle and Patricia Trbovich</i>	795
Improving EMR Usability: Critical Elements When Designing Perioperative Emergencies Template <i>Mary Rachel Romero and Allison Staub</i>	796
User Experience-Take Multimedia Registration Panel as an Example <i>Pei-Fen Lee</i>	798
Evaluation of a Fall Risk Prediction Tool Using Large-Scale Data <i>Shinichiroh Yokota, Ai Tomotaki, Ohmi Mohri, Miyoko Endo and Kazuhiko Ohe</i>	800
Nurses' Experiences of an Initial and Re-Implemented Electronic Health Record Use <i>Ting-Ting Lee and Chi-Ping Chang</i>	802
A Customized Workflow-Driven Instant Messaging System Support Team Communication in the Hospital <i>Ying-Li Lee, Tsai-Feng Chien and Hsiu-Chin Chen</i>	804
The Austrian Nursing Minimum Data Set (NMDS-AT) <i>R. Ranegger, W.O. Hackl and E. Ammenwerth</i>	806
Evaluation of an Allergy Documentation System Adopted by Hong Kong's Private Hospitals – A Pilot Study <i>Wing-Yan Chan, Kup-Sze Thomas Choi, Chung-Lim Vico Chiang, Shek-Kei Clement Cheung, Lai-Han Ellen Tong and Ngai-Tseung Cheung</i>	808

A Standard for Nursing Process – Clinical Decision Support Systems (NP-CDSS) <i>Maria Müller-Staub and Wolter Paans</i>	810
Shifting Tasks from Nurses to Physicians: CDS Needed After Introduction of CPOE? <i>Emmanuel Eschmann, Sascha Karlen, Ludwig Perger, Markus Schneemann and Jürg Blaser</i>	812
Using a Text-Mining Approach to Evaluate the Quality of Nursing Records <i>Hsiu-Mei Chang, Shwu-Fen Chiou, Hsiu-Yun Liu and Hui-Chu Yu</i>	813
Electronic Health Record Messaging and Quality of Care for Type 2 Diabetes Patients in Primary Care <i>Marlon P. Mundt and Larissa I. Zakletskaia</i>	815
Nursing Informatics in Turkey <i>Sengul Akdeniz and Mustafa Ozkaynak</i>	817
Development Needs of Electronic Nursing Discharge Summaries in Finland <i>Anne Kuusisto, Paula Asikainen and Kaija Saranto</i>	819
Reporting Patient Safety Events: A Cross-Cultural Trial <i>Weiyang Shan, Weichao Shan, Na Yang, Heng Zhang, Qing Li, Rong Zhang, Chen Liang and Yang Gong</i>	820
Using Hospital Information System Data to Capture Nurse Workload <i>Shangping Zhao, Hong Chen and Ling Feng</i>	822
A Study on the Effect on Scheduling and Management of Surgeries with the Introduction of Excellent Medical Information <i>Tsai Ching Mei</i>	824
Emergency Information Systems for Performance Assessment Value Before and After the Child Abuse and Sexual Assault of Time After Medical Intervention <i>Siou-Jhen Tang, Shu-Jin Jhan, Siou-Ji Chen, Ai-Ru Lan, Huei-Jhu You, Huei-Lan Jhang and Fang-Shan Li</i>	826
Effect of Automatic Inpatient Fall Prediction Using Routinely Captured EMR Data: Preliminary Results <i>Insook Cho and Eunja Chung</i>	828
Design of an Electronic Reminder System for Supporting the Integrity of Nursing Records <i>Chien-Min Chen, I-Ching Hou, Hsiao-Ping Chen and Yung-Ching Weng</i>	830
Discussion on the Initial Use of Nursing Information Systems Related Factors of Satisfaction <i>Shu-Ting Peng, Shu-Jina Jhan and Siou-Jia Chen</i>	832
Classification of Patient Care Complexity: Cloud Technology <i>Caren de Oliveira Riboldi, Andrea Barcellos Teixeira Macedo, Thiane Mergen, Vera Lúcia Mendes Dias, Diovane Ghignatti da Costa, Maria Luiza Falsarella Malvezzi, Ana Maria Muller Magalhães and Denise Tolfo Silveira</i>	834

Nursing Activities Score: Cloud Computerized Structure <i>Kátia Bottega Moraes, Fabiana Zerbieri Martins, Maximiliano Dutra de Camargo, Débora Feijó Vieira, Ana Maria Muller Magalhães and Denise Tolfo Silveira</i>	836
Using a System Science Strategy to Measure Teamwork in an Urban Hospital <i>Haeyoung Lee and Sunmoo Yoon</i>	838
From a Suspect Victim to the Holmes: The Unexpected Value of a Home-Made Mobile Chemotherapy Medication Administration System <i>Ming-Chuan Kuo and Polun Chang</i>	840
Nursing Documentation: An Evaluation of an Action Research Project <i>Grete Vabo, Åshild Slettebø and Mariann Fossum</i>	842
Enhancing a Blood Transfusion Platform with Clinic Decision Support Component to Better Assure Patient Safety <i>Hsiang-Fen Lai, Hui-Tzu Yeh, Wen Ray Lee, Li-Chun Hsiao, Hsin-Tsung Ho and Polun Chang</i>	844
An Empirical Study on the Successful Implementation of Nursing Information System <i>Hui-Hua Tsai, Shwu-Fen Chiou, Tsi-Chi Wang, Meng-Ping Wu and Rung-Chuang Feng</i>	846
Leading the Development of Our New Nursing Information System with the TIGER-Based Taiwan Model <i>Zhenxian Shi, Lin Li, Ming-Chuan Kuo and Polun Chang</i>	848
Clinical Knowledgebase Integration of Nursing Terminology <i>Luann Whittenburg</i>	850
The Automated Alert System for the Hospital Infection Control and the Safety of Medical Staff Based on EMR Data <i>Eunmi Jo</i>	852
Development and Appraisal of Multiple Accounting Record System (Mars) <i>H.C. Yu and M.C. Chen</i>	854
Mining Clinicians' Electronic Documentation to Identify Heart Failure Patients with Ineffective Self-Management: A Pilot Text-Mining Study <i>Maxim Topaz, Kavita Radhakrishnan, Victor Lei and Li Zhou</i>	856
Nurses' Actual Usage of EMRs: An Access Log-Based Analysis <i>Ayako Kajimura, Tadamasu Takemura, Tomoko Hikita, Kenichiro Fujita, Waon Yoshihara, Akane Hashiya and Tomohiro Kuroda</i>	858
Outcomes of Medication Administration Information System for Nurses <i>Jen-Chun Lin and Ting-Ting Lee</i>	860
The Application of an Integrated IHCA Information System to Analysis the Related Indicators <i>Hui-Tzu Yeh, Wen Ray Lee, Suh-Meei Hsu and Hsiang-Fen Lai</i>	862

Decision-Making to Support Smooth Daily Unit Operation in Perioperative Settings	864
<i>Eriikka Siirala, Laura-Maria Peltonen, Heljä Lundgrén-Laine, Sanna Salanterä and Kristiina Junttila</i>	
Using a Call Centre for Data Mining and Data Capturing – Pilot Study Using Glasgow Coma Outcome Scale in Head Injured Patients	866
<i>Teemu Xavier, Metilda Robin and Deepak Agrawal</i>	
A Model for Risk Assessment in Health Care	868
<i>Vesna Prijatelj, Vladislav Rajkovič and Olga Šušteršič</i>	
Improving EHR Usability Using LEAN Methodology	870
<i>Corbin Bosse and Kandace Kelly</i>	
The Relationship Between Nursing Workload, Quality of Care and Nursing Payment in Intensive Care Units	871
<i>Li-Yin Chang and Hsiu-Hui Yu</i>	
Nursing Informatics Pioneers Continue to Influence the Profession: A Sustainable Impact	873
<i>Susan K. Newbold and Juliana J. Brixey</i>	
Impact of an Emergency Nurse Coordinator on Work Flow Optimization in an Emergency Department in Delhi, India	875
<i>Preethy S, Teemu Xavier, Reghunathan N, Metilda Robin and Deepak Agrawal</i>	
An Interview and an Observation Study of Nurses and Student Nurses' Electronic Clinical Documentation Behaviors in a OB/GYN Nursing Ward	877
<i>Yen-Chiao Angel Lu and Yen-Ju Lin</i>	
Design of a Recommendation System for Adding Support in the Treatment of Chronic Patients	879
<i>Simon Torkar, Peter Benedik, Uroš Rajkovič, Olga Šušteršič and Vladislav Rajkovič</i>	
The Impact of Nursing Students' Cultural Diversity on the Intention and Attitudes Towards the Use of Information Technology (IT)	881
<i>Ayala Gonen, Dganit Sharon, Lilac Lev-Ari, Ester Straus and Ronen Segev</i>	
The Effect of Tele-Consultation Between a Hospital-Based Nurse and a COPD Patient	883
<i>Anne Dichmann Sorknaes</i>	
Nurses' and Patients' Experiences of Tele-Consultations	885
<i>Anne Dichmann Sorknaes</i>	
Developing Evidence-Based Care Standards and a Decision-Making Support System for Pain Management	887
<i>Rung-Chuang Feng and Polun Chang</i>	
Chinese Nurses' Acceptance of PDA: A Cross-Sectional Survey Using a Technology Acceptance Model	889
<i>Yanling Wang, Qian Xiao, Liu Sun and Ying Wu</i>	

User's Satisfaction of Multiple Accounting Record System <i>M.C. Chen and H.C. Yu</i>	891
Early Assessment of Patient's Medical Condition in Ambulance Care Affects the Level of Care of Non Urgent Patients <i>Glenn Larsson, Anders Holmén and Kristina Ziegert</i>	893
Health Consumers eHealth Literacy to Decrease Disparities in Accessing eHealth Information <i>Hyejin Park, Eileen Cormier and Gordon Glenna</i>	895
<b>eHealth</b>	
User Expectations: Nurses' Perspective <i>Güney Gürsel</i>	897
eHealth Literacy Skills Among Undergraduate Nursing Students in the U.S. and South Korea <i>Hyejin Park and Hyunmi Park</i>	899
Telerehabilitation Services in Pakistan: A Rehabilitation Professional's Perspective <i>Zeshan Zahid and Suleman Atique</i>	901
Organizational Benefits of Computerized Physican Order Entry (CPOE) System in Pakistan <i>Suleman Atique, Chien-Yeh Hsu and Syed-Abdul Shabbir</i>	903
A Serious Game for Teaching Nursing Students Clinical Reasoning and Decision-Making Skills <i>Hege Mari Johnsen, Mariann Fossum, Pirashanthie Vivekananda-Schmidt, Ann Fruhling and Åshild Slettebø</i>	905
POLESAT an Innovative e-Geoplatform in Health Management <i>Anne Quesnel, Julien Soula, François Dufosse and Régis Beuscart</i>	907
Decision Support System in the Nursing Instruction Information System <i>Hui Ling Huang and Chun Jen Chen</i>	909
An Efficient User Interface Design for Nursing Information System Based on Integrated Patient Order Information <i>Chia-Hui Chu, Ming-Chuan Kuo, Shu-Hui Weng and Ting-Ting Lee</i>	911
Utilization of Communication Robot in Patient Education <i>Keitaro Ishiguro and Yukie Majima</i>	913
The Effectiveness of Peritoneal Dialysis System Implementation on Case Management <i>Ching-I Cheng and Shwu-Fen Chiou</i>	915
Study on Synchronization of the Heart in a Nursing Art <i>Soh Sakaki, Atsushi Ishigame and Yukie Majima</i>	917

CarerSupport – An Innovative Approach to Informal Carers’ Training and Collaboration <i>Lene Lunde and Anne Moen</i>	919
My Cancer Care Plan as a Web-Solution <i>Bodil Westman and Birgitta Cornelius</i>	921
What if It Was Like a Departure Lounge at an Airport? – eHealth for Healthcare Staff in a Swedish Healthcare Organization, a Participatory Design Study <i>Lina Nilsson and Malin Hofflander</i>	923
Network Visualization of Dementia Tweets <i>Sunmoo Yoon, Manuel C. Co Jr. and Suzanne Bakken</i>	925
Living with Chronic Obstructive Pulmonary Disease and Being Followed Up Through Telemedicine – A Phenomenological Approach <i>Tina Lien Barken, Elin Thygesen and Ulrika Söderhamn</i>	926
An eNursing Solution for Patients with Home-Ventilation – The eVent@home-Tool <i>Heike Dewenter, Daniel Zenz and Sylvia Thun</i>	928
Application of Text Mining in Cancer Symptom Management <i>Young Ji Lee and Heidi Donovan</i>	930
VIH-TAVIE™ Relational Model of Engagement: Creating Meaningful Connections to Empower People Living with HIV via a Virtual Nursing Intervention <i>Geneviève Rouleau, Lauralie Richard and José Côté</i>	932
How Do Information and Communication Technologies Influence Nursing Care? <i>Geneviève Rouleau, Marie-Pierre Gagnon, José Côté, Julie Payne-Gagnon, Emilie Hudson and Carl-Ardy Dubois</i>	934
Call for Increased Patient Support Focus: Review and Evaluation of Mobile Apps for Tuberculosis Prevention and Treatment <i>Sarah Iribarren and Rebecca Schnell</i>	936
Current Trends in Nursing Informatics: Results of an International Survey <i>Laura-Maria Peltonen, Dari Alhuwail, Samira Ali, Martha K. Badger, Gabrielle Jacklin Eler, Mattias Georgsson, Tasneem Islam, Eunjoo Jeon, Hyunggu Jung, Chiu-Hsiang Kuo, Adrienne Lewis, Lisiane Pruinelli, Charlene Ronquillo, Raymond Francis Sarmiento, Janine Sommer, Jude L. Tayaben and Maxim Topaz</i>	938
Using Rapid Prototyping to Design a Smoking Cessation Website with End-Users <i>Charlene Ronquillo, Leanne Currie, Derek Rowsell and J. Craig Phillips</i>	940
Developing Customer Oriented eHealth Services to High Schools in City of Espoo <i>Susanne Rosenqvist and Elina Rajalahti</i>	942
Use and Acceptance of Mobile Technology by Hospital Nurses in Germany <i>Regina Schmeer, Marianne Behrends, Thomas Kupka, Iris Meyenburg-Altward and Michael Marschollek</i>	944



What Facilitates the Use of Telehealth Applications Among Nurses? <i>Marita Koivunen and Kaija Saranto</i>	946
Textual Analysis and Data Mining: An Interpreting Research on Nursing <i>W. De Caro, L. Mitello, A.R. Marucci, L. Lancia and J. Sansoni</i>	948
eHealth Literacy Scale: An Nursing Analysis and Italian Validation <i>W. De Caro, E. Corvo, A.R. Marucci, L. Mitello, L. Lancia and J. Sansoni</i>	949
Co-Operation and Co-Funding Networks in eHealth Research <i>Peter Kokol, Helena Blažun Vošner and Kaija Saranto</i>	950
Improving Patient Safety with a Mobile Application for Patients with Peripherally Inserted Central Venous Catheters (PICC) <i>Stephan Nüssli, Florian Schnyder, Raphael Zenhäusern and Katharina Bosshart</i>	952
e-Health Interventions for Healthy Aging: A Systematic Review Protocol <i>Marie-Pierre Gagnon, Idrissa Beogo and Ronald Buyl</i>	954
The Research and Application of Information Platform About Community Support Intervention for Patients with Alcohol Dependence <i>Liqun Yang</i>	956
<b><i>Education in Health IT</i></b>	
Relationship Between Organizational Culture and Organizational Effectiveness – A Study of Nurses in Taiwan <i>Yu-Hua Yan</i>	957
An Assessment of the Application of Pharma Cloud System to the National Health Insurance Program of Taiwan and the Result in Hospitals <i>Yu-Hua Yan and Chen-Luan Lu</i>	959
Exploring the Flexibility of Challenge Based Learning in Health Promotion Training <i>Angie H.Y. Lam</i>	961
Co-Designing Mobile Apps to Assist in Clinical Nursing Education: A Study Protocol <i>Siobhan O'Connor and Tom Andrews</i>	963
Design of a Program to Learn the Nursing Process by Introducing Digital Stories – For the Promotion of Patient Understanding <i>Misako Teraoka, Yoko Muranaka, Yukie Saito, Tatsuya Sakuma, Mariko Kaizu and Saori Mitsuhashi</i>	965
Patients' Opinions on Display Methods to Protect Privacy <i>Yukari Niimi and Katsumasa Ota</i>	967
Using ADDIE Model to Develop a Nursing Information System Training Program for New Graduate Nurse <i>Sheng-Chieh Lu, Yu-Chen Cheng and Pi-Tuan Chan</i>	969

- Factors Affecting Participation in the eRedBook: A Personal Child Health Record 971  
*Siobhan O'Connor, Alison M. Devlin, Marilyn McGee-Lennon,  
 Matt-Mouley Bouamrane, Catherine A. O'Donnell and Frances S. Mair*
- Effects of Reflection Using the iPad on Students' Motivation to Learn Nursing  
 Techniques 973  
*Yukie Saito*
- Social Media and Population Health Virtual Exchange for Senior Nursing  
 Students: An International Collaboration 975  
*Paula M. Procter, Juliana J. Brixey, Michelle L.L. Honey  
 and Fern Todhunter*
- A 2-Year Study on the Use of NursingNAVI with the Partogram by Midwifery  
 Students 977  
*Yumiko Iwao and Satoko Tsuru*
- Development of an Open Source Educational Resource: "Clinical Procedures  
 for Safer Patient Care" 979  
*Glynda Doyle and Jodie McCutcheon*
- Diffusing Innovations in Nursing Education: From PDAs to OERs 981  
*Glynda Doyle and Bernice Budz*
- Geo-spatial Informatics in International Public Health Nursing Education 983  
*Madeleine J. Kerr, Michelle L.L. Honey and Brittany Krzyzanowski*
- Problems Faced by Nurses in Use of Electronic Health Records During Clinical  
 Practice 985  
*Medha Verma and Sandhya Gupta*
- Distance Education Programs: The Technical Support to Be Successful 987  
*Ryan E. McNew, Jeffry S. Gordon, Elizabeth E. Weiner  
 and Patricia Trangenstein*
- An Innovative Use of Telepresence Robots for Educating Healthcare Professional 989  
*Margie Molloy, Ryan J. Shaw, Jackie Vaughn and Remi Hueckel*
- Design and Development of Learning Objects for Health Professionals 991  
*Katia Cilene Ferreira Pacheco and Marcelo Schenk de Azambuja*
- Education Methods for Improving the Ability to Use Nursing Information,  
 with a Focus on Issues Related to the Role of the Head Nurse: A Post-Workshop  
 Evaluation 993  
*Takako Izumi and Yukie Majima*
- Design of a Hospital Simulation Software for Nursing Education 995  
*Gustavo Henrique Cervi, Cecilia Dias Flores, Rute Merlo Somensi  
 and Rita Catalina Aquino Caregnato*
- Evaluation of Knowledge, Attitude, Practise and Adoption Among Health Care  
 Professionals for Informatics/Computerised Technology Systems 997  
*Kavitha Karthik and Suresh Munuswamy*

Information Sharing and the Nursing Practice for the Certified Nurse in Radiation Therapy Nursing	999
<i>Manami Inoue and Satoko Tsuru</i>	
Designing an Internet-Based Intervention Tailored to Psychological Factors for CVD Risk Reduction: Role of Stress and Anger	1001
<i>Chun-Ja Kim, Na-Jin Park, JiYeon Choi and Dong-Soo Shin</i>	
Attitude Towards Health Information Privacy and Electronic Health Records Among Urban Sri Lankan Adults	1003
<i>Shaluni R. Tissera and S.N. Silva</i>	
Nursing Students' Satisfaction with Mobile Academic Electronic Medical Records for Undergraduate Clinical Practicum	1005
<i>Mona Choi, Joon Ho Park and Hyeong Suk Lee</i>	
Linking Nurses with Evidence-Based Information via Social Media Tools: An Analysis of the Literature	1007
<i>Heather Carter-Templeton, Mangala Krishnamurthy and Ramona Nelson</i>	
The Creation of Simulation for the Development of Competencies in Nurses	1009
<i>Ana Paula Noronha Zucatti, Cecilia Dias Flores and Luíza Maria Braga da Silveira</i>	
Iranian Novice Nursing Faculty Experiences on Their New Roles in Relation to IT Literacy	1011
<i>Seyed-Masoud Hosseini, Abbas Heydari and Hossein Karimi Moonaghi</i>	
<b><i>Standards and Mobile Health</i></b>	
Establishing Long-Term Nursing Informatics Capacity in Malawi, Africa	1013
<i>Siobhan O'Connor, Joe Gallagher, Nathalis Wamba, Chris Moyo, Grifpin Baxter Chirambo and John O'Donoghue</i>	
Personalised Multi-Criterial Online Decision Support for Siblings Considering Stem Cell Donation: An Interactive Aid	1015
<i>Mette Kjer Kaltoft, Glenn Salkeld and Jack Dowie</i>	
Cross-Mapping Diagnostic Nursing Concepts Between the ICNP and the ICF for Expressing Nursing in the Health Care Record	1016
<i>Jan Florin, Inger Jansson, Elisabeth Strandberg, Anna Ehrenberg and Catrin Björvell</i>	
Real-Time MFER Monitoring Using Interval-Saving of Health Signals	1018
<i>Yonghee Lee, Sunho Kim, Kangwoo Lee, Soonseok Kim and Dongho Kim</i>	
Exploring Community Planning Thinking as a Model for Use Case Development	1020
<i>Marisa L. Wilson and Paula M. Procter</i>	
Is the ISO Reference Terminology Model for Nursing Actions Enough to Describe Nursing Actions?	1022
<i>Joo Yun Lee and Hyeoun-Ae Park</i>	

Nursing Students' Opinion on the Use of Smartphone Applications (Apps) in Clinical Education and Training: A Study Protocol <i>Siobhan O'Connor and Tom Andrews</i>	1024
Perceptions of Older Adults with Heart Failure on Playing an Interactive Digital e-Health Game (IDEG) for Learning About Heart Failure (HF): Prototype Development and Usability Testing <i>Kavita Radhakrishnan, Paul Toprac, Matt O'Hair, Randolph Bias, Mike Mackert, Bo Xie, Miyong Kim and Paul Bradley</i>	1026
Barriers to Co-Designing Mobile Technology with Persons with Dementia and Their Carers <i>Siobhan O'Connor, Matt-Mouley Bouamrane, Catherine A. O'Donnell and Frances S. Mair</i>	1028
Current Status and Quality Assessment of Cardiovascular Diseases Related Smartphone Apps in China <i>Qian Xiao, Yanling Wang, Liu Sun, Sai Lu and Ying Wu</i>	1030
A Survey on the Willingness to Use Physical Activity Smartphone Applications (Apps) in Patients with Chronic Diseases <i>Liu Sun, Chen Jiao, Yanling Wang, Qian Xiao, Yiling Zhang and Ying Wu</i>	1032
Preliminary Findings of the Delivery of the National Diabetes Prevention Program via a Mobile Application <i>Victoria L. Tiase, Marissa Licata and Elaine M. Fleck</i>	1034
Quality of Chinese CVD Medication Apps <i>Yisi Liu, Polun Chang, Nan Li, Karen V. Lamb, Jiani Wang, Xiuxiu Huang, Yi Wang and Ying Wu</i>	1036
The Usefulness of the Electric Textbooks at Nursing Practicum by Analyzing the Usage Logs of the Terminal Tablet <i>Yumiko Nakamura, Yukie Majima and Kaori Fukayama</i>	1038
Could People Get Quality Apps They Intend to Get? Taking Finding Stroke Apps for Example <i>Yanyan Cui, Chen Fu, Hong Chang, Ying Wu and Polun Chang</i>	1040
Evaluation of Efficiency Improvement in Vital Documentation Using RFID Devices <i>Eizen Kimura, Miho Nakai and Ken Ishihara</i>	1042
Structural Equation Model of Health Promoting Behaviors for Health Information Seekers with Mobile <i>Hanna Choi, Jeongeun Kim and Ahjung Byun</i>	1043
The Educational and Supportive Mobile Application for Caregivers of Dementia People <i>Sumi Cho, Je Hyeok Lee, Il Kon Kim, Min Gyu Kim, Kim Young Sik and Eunjoon Lee</i>	1045
Modeling a Mobile Health Management Business Model for Chronic Kidney Disease <i>Ying-Li Lee and Polun Chang</i>	1047

Understanding the Learning Needs of New Graduate Nurses at a Surgical Ward to Develop a Smartphone/Table Based Training System <i>Yen-Chiao Angel Lu, Yen-Ju Lin and Lin-Yi Cyu</i>	1049
Specialty Task Force: A Strategic Component to Electronic Health Record (EHR) Optimization <i>Mary Rachel Romero and Allison Staub</i>	1051
Wearable Technology Surveillance Data for the Personal Health Record Using the Omaha System: Noise Exposure, Cardiovascular and Stress Biomarkers <i>Madeleine J. Kerr, Dal Lae Chin, Karen A. Monsen and OiSaeng Hong</i>	1053
Proposal of Comprehensive Model of Teaching Basic Nursing Skills Under Goal-Based Scenario Theory <i>Yuri Sannomiya, Yoko Muranaka, Misako Teraoka, Sayuri Suzuki, Yukie Saito, Hiromi Yamato and Mariko Ishii</i>	1055
Collaboration in the Hospital-Situations <i>Eiko Suzuki, Akiko Maruyama, Yuko Takayama, Yukiko Sato, Miyuki Saito and Shiho Sato</i>	1057
Development and Verification of a Clinical Process Chart for Nutritional/Dietary Management <i>Miho Omori, Satoko Tsuru, Yukihiro Michiwaki and Yumi Hasegawa</i>	1058
A Report on Nursing Information During Volunteer Activities Conducted by Nursing Faculty Members and Students After the Great East Japan Earthquake <i>Yayoi Tomizawa, Makino Ichinose, Hiroshi Onogi, Chiaki Suzuki, Reiko Nakamura and Sumi Misawa</i>	1060
Feasibility of Describing Wellbeing and Strengths at the Community Level Utilizing the Omaha System <i>Grace Gao, Madeleine J. Kerr and Karen A. Monsen</i>	1062
Using Model of Clinic Care Classification in Clinical Nursing Information System <i>Hui Ling Huang, Cheng Yuan Lee, Pei Lung Chuang, Chu Jung Hsu and Shu Chung Chen</i>	1064
The Experience of the ICNP Francophone Research and Development Centre of Canada with Validating the ICNP® French-Canadian Version <i>Sylvie Jetté, Andréanne Tanguay, Lise R. Talbot, Stéphanie Westover, Roxana Pavel, Éline Perreault and Geneviève Mercier</i>	1066
The Construction of a Subset of ICNP® for Patients with Dementia <i>Lene Baagøe Laukvik, Kathryn Mølstad and Mariann Fossum</i>	1068
Success Criteria for Implementing Standardized Care Plans in Community Health Care <i>Elisabeth Østensen and Ragnhild Hellese</i>	1070
Proposal for Inclusion of New Terms for Submission to the ICNP® <i>Rodrigo Guerra Leal, Deborah Ribeiro Carvalho, Bruna Silva Santos, Amanda de Souza and Marcia Regina Cubas</i>	1072

Analysis the Nursing Documentation of the Observation Plans and Practices of Breast Cancer Using Nursing NAVI® Contents <i>Manami Inoue, Satoko Tsuru, Miho Omori, Kumiko Sudo and Fumiko Wako</i>	1074
Development and Evaluation of a Low Fertility Ontology for Analyzing Social Data in Korea <i>Ji-Hyun Lee, Hyeoun-Ae Park and Tae-Min Song</i>	1076
Mapping Wound Assessment Data Elements in SNOMED CT <i>Lori Block and Shannon Handfield</i>	1078
Lightweight Expression of Granular Objects (LEGO) Content Modeling Using the SNOMED CT Observables Model to Represent Nursing Assessment Data <i>Christie Johnson</i>	1080
Implementation of Improvements in an Electronic Documentation Nursing Process System Structured on NANDA-I, NOC and NIC (NNN) Classification <i>Heloisa Peres, Diná Cruz, Michelle Tellez, Rita de Cássia Gengo e Silva, Diley Ortiz, Regina Diogo and Dóris R. Ortiz</i>	1082
Developing Standardized Physiologic Assessments <i>Susan A. Matney, Theresa (Tess) Settergren, Bonnie Westra and Lisiane Pruinelli</i>	1084
Subject Index	1087
Author Index	1099

# Full Papers

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# Determining Optimal Nursing Resources in Relation to Functions During the Oulu University Hospital Nurse Staffing Management Project

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**Abstract.** The Oulu University Hospital's staffing management project sought information on the number of nursing staff in relation to treatment days and visits, using existing indicators to describe the activities involved. The retrospective data obtained was compared to human resources and the personnel structure. On this basis an optimal number of staff was determined for the units, taking account of a range of explanatory indicator data. The project made use of the computational model for nurse staffing and the World Health Organisation's (WHO) Workload Indicators of Staffing Need (WISN) method. The project provided extensive information on human resources issues within the units. Its results indicated the differences between wards with respect to the number and structure of resources. In addition, the nurse administrators lacked skills in gathering and using data from administrative datasets. This information will provide support for the further development of nursing operations and nursing management decision-making.

**Keywords.** Nursing staff, personnel staffing and scheduling, workload, WISN-model, management information systems

## 1. Introduction

The ageing population, new technology and demand for higher quality of care, combined with shrinking budgets and nursing shortages are creating new challenges for health care. In Finland, as in other high-income countries, we have an ageing nursing workforce caring for increasing numbers of elderly [1]. On the other hand, higher staffing levels and a richer skills mix improve patient outcomes, for instance in relation to falls, medication errors, surgical wound infections, pressure injuries, pneumonia, upper gastrointestinal bleeding, sepsis and even deaths [2, 3, 4]. Such studies also argue that the staffing level and skills mix affect nurses' wellbeing [5] and intention to leave [6]. This makes it particularly important to find the optimal staffing level for promoting

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quality of care and nurse and patient satisfaction, and to prevent nurses from wishing to leave the profession.

The nurse staffing project in Oulu University Hospital (OUH) in Finland sought to provide information on the number of nursing staff in relation to treatment days and visits, using indicators from the management information system to describe the operations concerned. The information obtained was compared to human resources and the personnel structure, on the basis of which an optimal number of staff were determined for the units in question while taking account of various explanatory indicator data. Nurse staffing levels were also calculated for Kuopio University Hospital (KUH) in East Finland [7], but without evaluating all nursing units.

## 2. Methods

The project involved the use of the computational model for nurse staffing developed during the Nurse Staffing Management Development project as part of a broader project for designing a new building for the KUH [7, 8]. The WHO's WISN-tool [9] was also used to gather existing data from information systems in the organisation.

The data was collected retrospectively from all 111 independent or related units of the OUH in which nursing staff with a range of professional titles work. Nursing staff include registered nurses, midwives, assistant head nurses (if not wholly administrative), physiotherapists, occupational therapists, radiographers, dental hygienists and licensed practical nurses. The study covered all of the hospital's current specialties. The final sample consisted of information on 142,193 treated patients, 302,650 in-patient care days, 627,304 outpatient visits and 34,631 operations in 2013, and administrative information (workload, posts, divisions of tasks, absences) on 2,518 nurses. The WISN tool was used to compute the available working time of nurses; for one nurse it averaged 1,542.24 hours per year, excluding various types of absences (public holidays, annual leave, vacations, sick leave and other leave) in OUH. For both subjects, patients' care needs and nursing resources were converted into hours. The basic formula for the unit's computational nurse staffing need (CNN) was:

$$\text{CNN} = \frac{\text{Patients' care needs in hours} * \text{NP (nurse-to-patient)-ratio}}{\text{available working time of one nurse}}$$

Patients' care needs were based on registered data on the units' day-to-day functions and the time needed. On the hospital wards, the patient day lasts 24 hours, so the need for care calculation formula is: (*number of in-patient days (ipd) in one year \* 24 hours*). Outpatients' visits and time spent in the operating theatre can vary from a few minutes to several hours. Account should also be taken of other essential activities that require nursing resources.

The NP-ratio indicates the nurse-to-patient ratio [10] and is calculated as follows: [*1/ (average in-patient days in one week/nurse workload)*]. For example: in one surgical ward there are 158 in-patient days in one week and the nurse workload is 28 →  $158 / 28 = 5.6$  in-patient (=treatment) days per one nurse workload, i.e. 5.6 patients per one nurse per day. To obtain the NP-ratio, you need to calculate:  $1/5.6 = 0.18$ . This is the ratio for each nurse workload per day receivable per patient. The NP-ratio varied between in-patient units: from 2.0 for ICU patients (two nurses to one patient) to 0.08

for postpartum mothers with newborns (one nurse cared for an average of 12.5 mothers or newborns each day). In internal medicine and surgical units, the NP-ratio ranged between 0.18 and 0.22 (4.5–5.5 patients per nurse per day). We also used a higher value of 0.5 for the highest intensity in-patient days. Nursing intensity was measured using the Oulu Patient Classification (OPCq), part of the RAFALA patient classification system [11] which has been systematically used in OUH for over 15 years. For outpatient clinics and operational theatres the average nursing time was calculated for various patient functions and visits. Below is an example of a calculation for one surgical in-patient unit:

$$CNN = \frac{8000 \text{ ipd} * 24 \text{ hours} * 0,20(\text{NP-ratio}) + 100 \text{ high intensity ipd} * 0,5}{\text{available working time of one nurse}} = \frac{38\,400 \text{ h} + 50 \text{ h}}{1542,24 \text{ h}} = 24,9$$

The computational nurse staffing need (CNN = 24.9) was then proportioned to the unit’s number of nurse vacancies (N=30) and the resulting ratio (24.9/30 \*100 % = 83%) provided information on the usage level of nurse resources in care processes [7]. In addition to the units’ actual nurse staffing volume, much information had been published on work intensity and issues affecting staff workloads, such as the number of students, division of labour, transfer and cancellation of nursing time, the ratio between registered nurses and licensed practical nurses, and the percentage of emergency treatment periods.

### 3. Results

#### 3.1. Computational results

The ratio between the computational nurse staffing need and the posts in each unit was calculated. This ratio provided information on the usage level of nurse resources in care processes [8]. Within the units, the ratio of nurse staffing needs to vacancies varied between 55 and 129%. When the ratio was between 80 and 90 %, the unit’s nurse staffing was considered adequate, at optimal level, but at 90–100% it indicated a need for process development. If the ratio was over 100% and no other results were

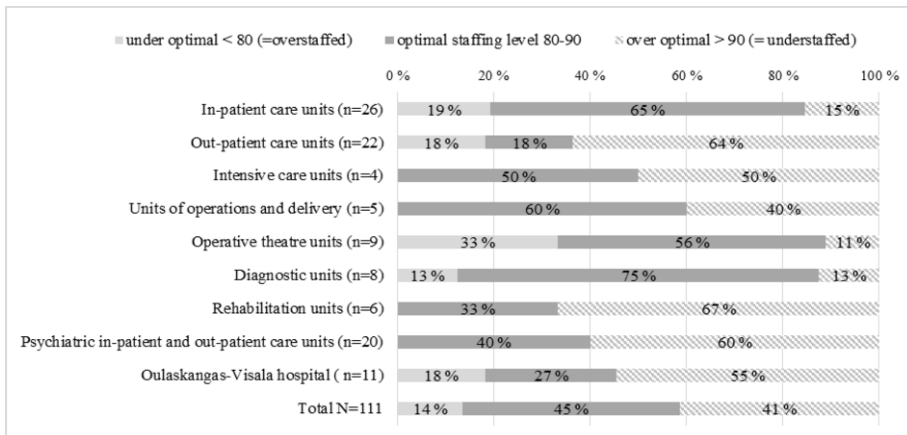


Figure 1. Nurse staffing situation in relation to functions in different sectors of OUH.

indicative of understaffing, there was an obvious need for additional resourcing. If it was under 80%, in terms of current nursing functions the resources available can be deemed excellent.

### *3.2. Results of explanatory factors*

The number of students varied greatly. In general, there were more students in wards than in outpatient clinics. Nurses had many non-nursing duties such as cleaning, clerical work and service provision (meal, logistics and transfer). Providing advice to others (mainly doctors and support workers) was very common in almost every unit. Much time was also spent transferring and cancelling outpatient visit times. During 2013, around 80,000 outpatient visits were transferred and cancelled, involving an annual workload equivalent to that of 12 nurses or clerical workers. The ratio between registered nurses and licensed practical nurses varied between 71% and 100% in wards and 45% and 100% in outpatient clinics.

## **4. Discussion**

The nurse staffing project provided the units with a tool for allocating the correct number of nurses to different teams. It also helped in directing development at the right issues and provided staff with information on the content of work and the time devoted to various tasks. In itself, the ratio between the computational nurse staffing need and vacancies changes nothing, but it does provide transparent and comparable information for the planning, follow-up and evaluation of nurse staffing [8]. An enormous range of data is produced within health care organisations, which could also be used for managerial purposes [9, 12]. The project revealed that nurse administrators lack the uniform competencies and information literacy required to use management information systems. This need for further education has been identified on previous occasions [12]. There is an essential need for nurse informaticists in healthcare to support and educate with different kind of information systems and data capturing [13].

Most of the data was collected by two researchers, but all phases of the study were analysed together with the units studied. A major reliability factor was the nurse-to-patient ratio, which decreased as the number of patient episodes increased in a situation with unchanging resources. Within certain limitations, the NP-ratio needed to be standardised for this reason.

The results indicated that the staff situation in in-patient care units is fairly good on the whole, but there are differences between wards with respect to the number and structure of resources. Account should be taken of the poorer nursing staff resource situation in outpatient clinics and other open care units when rectifying staff shortages and beginning new open-care operations. In the current economic situation, there is a great temptation to reduce staffing in units with optimal or better resources, but many other issues affecting staff workloads should be considered. On the basis of the results, the clearest staffing deficiencies were rectified immediately between hospital division areas, since increases in the workloads of nurses 'are associated with serious medical events' [2]. Less acute shortcomings could be addressed by developing the occupational division of labour, renewing operational processes and distributing staff evenly between the responsible units. Sensible resourcing could be supported by

introducing new technology and improving nursing practices. The development of new IT systems enabling patients to reserve and cancel visits online and provide pre-surgery information has begun. Staffing calculations within the units should be updated if operations change substantially or processes are developed in a manner that enables the release of staff resources. It will soon be necessary to assess the impacts of measures taken in relation to patient care outcomes.

## 5. Acknowledgments

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## References

- [1] J. Buchan, L. Aiken, Solving nursing shortages: a common priority, *J Clin Nurs* **17** (2008), 3262–3268.
- [2] L.H. Aiken, D.M. Sloane, L. Bruyneel, K. Van den Heede, P. Griffiths, R. Busse, M. Diomidous, J. Kinnunen, M. Kózka, E. Lesaffre, M.D. McHugh, M.T. Moreno-Casbas, A.M. Rafferty, R. Schwendimann, P.A. Scott, C. Tishelman, T. van Achterberg, W. Sermeus, Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study, *The Lancet* **383** (2014), 1824–1830.
- [3] S. Hinnö, P. Partanen, K. Vehviläinen-Julkunen, Nursing activities, nurse staffing and adverse patient outcomes as perceived by hospital nurses, *J Clin Nurs* **21** (2011), 1584–93.
- [4] D. Twigg, C. Duffield, A. Bremner, P. Rapley, J. Finn, The impact of the nursing hours per patient day (NHPPD) staffing method on patient outcomes: A retrospective analysis of patient and staffing data, *Int J Nurs Stud* **48** (2011), 540–548.
- [5] A.M. Rafferty, S.P. Clarke, J. Coles, J. Ball, P. James, M. McKee, L.H. Aiken, Outcomes of variation in hospital nurse staffing in English hospitals: Cross-sectional analysis of survey data and discharge records, *Int J Nurs Stud* **44** (2007), 175–182.
- [6] M. Flinkman, *Young registered nurses' intent to leave the profession on Finland – a mixed method study*, Department of Nursing Science, Faculty of Medicine, University of Turku, Finland. Annales Universitatis Turkuensis, Turku, 2014.
- [7] T. Pitkääho, *Hoitotyön henkilöstövoimavarojen hallinnan kehittäminen – projekti (The Nurse Staffing Management Development project)*, Pohjois-Savon julkaisu no 80/2013, Kuopio, 2013. In Finnish.
- [8] T. Pitkääho, K. Vehviläinen-Julkunen, M. Miettinen, P. Partanen, A Computation Model Quantifying Nurse Staffing to Care Needs, *24th International Nursing Research Congress*, 2013, available: <http://hdl.handle.net/10755/304122>.
- [9] WHO, *WISN Workload Indicators of Staffing Need, User's manual*, 2010, available: [http://apps.who.int/iris/bitstream/10665/44414/1/9789241500197\\_users\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/44414/1/9789241500197_users_eng.pdf).
- [10] R. Kane, T. Shamllyan, C. Mueller, S. Duval, T. Wilt, The Association of Registered Nurse Staffing Levels and Patient Outcomes, *Medical Care* **45** (2007), 1195–1204.
- [11] L. Fagerström, K. Lønning, M.H. Andersen, The RAFAELA system: a workforce planning tool for nurse staffing and human resource management, *Nurs Manage* **21** (2014), 30–36.
- [12] T. Kivinen, J. Lammintakanen, The success of a management information system in health care – A case study from Finland, *Int J Med Inform* **82** (2013), 90–97.
- [13] B.L. Westra, L. Pruinelli, C.W. Delaney, Nursing Knowledge: 2015 Big Data Science, *CIN* **33** (2015), 427–431.

# Making Patient Risk Visible: Implementation of a Nursing Document Information System to Improve Patient Safety

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**Abstract:** Objectives: The aims of this study were to develop a nursing information system (NIS), enhance the visibility of patient risk, and identify challenges and facilitators to adoption of the NIS risk assessment system for nurse leaders. Methods: This article describes the function of a nursing risk assessment information system, and the results of a survey on the risk assessment system. Results: The results suggested that quality of information processing in nursing significantly improved patient safety. Nurses surveyed demonstrated a high degree of satisfaction, with saving time and improving safety. Conclusions: The nursing document information system described was introduced to improve patient safety and decrease risk. The application of the system has greatly enhanced the efficiency of nursing work, and guides the nurses to make an accurate, comprehensive and objective assessment of patient information, contributing significantly to further improvement in care standards and care decisions.

**Key words:** Patient dynamic evaluation; Information system; Patient risk; Nursing assessment; Medical care.

## 1. Introduction

With continuing developments in information technology, health care institutions are constantly confronted with the need to adapt to new processes of information management and use. [1] Nursing information systems (NISs) are promoted as a technology-supporting collaboration, improving health care decision-making at the point of care and, ultimately, improving health care outcomes. [2] However, a lack of clinical decision support tools makes it difficult for nurses to document guideline implementation and to determine the effects of nursing care. To address this, we created an electronic NIS system for patient risk assessment. The study described in this article focused on a hospital-based NIS, describing its function and using a strong research design for evaluation.

The use of information technology has grown rapidly in health care to support improvement in patient care quality. Moreover, when users participate in system development at an early stage, content design to meet the needs of nurses is identified, and the adoption process is facilitated, [1] thus emphasizing the importance of including nurse practitioners in the design of an NIS. The success of health information technology implementation is often tied to the impact the technical system will have on

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the work of the clinicians using it.<sup>[3]</sup>A ‘user-centered’ design principle is considered a bedrock for creating usable systems and devices,<sup>[4]</sup> meaning that collaboration with and the opinions of users of the system are important to successful implementation

## **2. Methods**

### *2.1 Working team and site*

This study took place in an 1800-bed hospital at the highest level of care available in China and the information system used was for hospitalized patients.

There is no certificate program for nursing informatics as a specialty in China, so we selected a nurse with a master’s degree in nursing and with rich computer science knowledge. She was then employed as a site coordinator to facilitate the technology implementation process. The remainder of the research team was composed of an engineer from the information management center of the hospital, and an engineer who conducted the system.

### *2.2 Procedures*

Beginning in November 2012, the research team developed the system, focused on the users. The development workflow included planning for the system, designing and building the system frame, piloting usability and testing user acceptance of the system. Following this, the system was rolled out on two wards from the medicine and surgical departments. Finally nurses from all inpatient departments were trained to use the system, after the nurses began to use the system on patients, they around the wards to make improvement.

### *2.3 Survey research*

In order to investigate nurse satisfaction with the system, we set up a questionnaire survey. We selected 740 nurses from different departments within the hospital. The subjects were nurses currently engaged in clinical nursing work, with a nurse practitioner qualification and who were willing to complete the survey. A satisfaction survey questionnaire was designed by the research team. The contents of the questionnaire included demographic questions on age, gender, education and professional title. To measure nurse satisfaction with the system a Likert scale of five grades.

## **3. Results**

### *3.1 Nursing information system development and framework*

The assessments included in the system were as follows: three falls assessment charts, three pressure sore assessment charts, numerical rating scale (NRS), visual analogue

scale (VAS), brief pain inventory (BPI) pain assessment, Glasgow Coma Scale, Ramsay, Richmond Agitation-Sedation Scale, acute physiology and chronic health evaluation (APACHE II), nutritional risk screening (NRS) 2002, mini nutritional assessment (MNA), Wells, Geneva, and Essen assessment. In these assessment charts, the nurses could obtain general patient information from the EMR system.

Each risk assessment electronic sheet contained the following functions:

- Automatic calculation: nurse users were required only to click options on the computer according to the condition of the patient. Scores were automatically calculated and the degree of risk to the patient was visible to the nurse user and measurable.
- The system established a link between assessment and management, with clinical decision support tools making it easy for nurses to document and determine the effects of nursing care on patient risk. This linked the nursing care to nursing intervention and outcomes.
- The design of the system allowed for assessment results and intervention data to be collected for research, evaluation and nursing management.

### 3.2 Effects of use of the electronic assessment system

Visibility of risk. An evaluation table automatically displayed the level of risk of each patient; combined with the data collection function, it was easier for nurses and managers to view patient risk scores and compare patients across different wards.

Before the introduction of this electronic assessment system, only three assessment charts were in use: pressure sore assessment, fall risk assessment and pain assessment. The introduced information system enabled the use of 18 assessment charts. These charts were able to meet the particular needs of different departments. For example, to assess pressure sore risk, we provided three different charts, including Braden, Norton Scale and Waterlow Score. From the number of the assessment, we can know that the nurses give more assessment and they found more high risk patients. We selected records from August 2012 and August 2015, to contrast the different data.

**Table 1.** Number and positive risk of patients

Variable	2012	2015
Fall		
Assessment number	NA	3635
Positive number	NA	1584
Pressure sore		
Assessment number	2819	6132
Positive number	1462	2282
Pain		
Assessment number	NA	10704
Positive rate	NA	2474

The number of valid questionnaires returned was 667, giving a completion rate of 90.14%.



**Table 2.** Nurse satisfaction with the assessment system (n = 667)

Number	Item content	The score
1	Using the mobile cart, the nurse can assess the patients and record the document, thus can reduce the time of the record.	4.28±0.75
2	Early warning function of the electronic thermometer can improve patient safety.	4.26±0.82
3	The function of the statistics and analysis	4.24±0.72
4	The system can automatically record the name of the nurse and time, so as to regulate the behavior of nursing	4.16±0.75
5	The function of the doctors' order can get from the system directly, so it can shorten the time of the nurses and improve the work efficiency.	4.06±0.88
6	Using PDA the nurses scan a patients' wristbands Bar code, they can view real-time patient information, convenient nursing.	3.99±0.92
7	The template of nursing documents can meet the needs of different departments.	3.86±0.93
8	Using the PDA input the vital signs of patients, the nurses can reduce the error caused by handwriting.	3.55±1.09

## 4. Discussion

There is an increasing awareness of the importance of evaluating and measuring the impact of NISs in clinical practice.<sup>[5]</sup> We developed our electronic nursing assessment system in response to the importance of nursing staff assessing patient risk and provide appropriate nursing care.

### 4.1 Bridging the gap between clinical care and technology

System functions should not only facilitate accomplishment of daily clinical tasks, such as quickly obtaining information and accurate data, but also be portable and provide a user-friendly, easy-to-operate interface.<sup>[6]</sup> An NIS is appreciated for supplying unhampered access to complete, legible, structured patient data.<sup>[7]</sup> In response to this need, we selected a senior nurse with an advanced nursing qualification. As the bridge between clinical care and technology, she was able to communicate and coordinate across multiple disciplines, manage data for patient care, and support nursing practice by developing and maintaining information systems. Her tasks included the incorporation of technology into nursing practice, such as system design and development, data management, research and evaluation.

### 4.2 Increased user satisfaction

Implementing electronic health records without a focus on usability is the greatest barrier to their widespread adoption. Broadly defined, usability is viewed as the capacity of a system to allow users to carry out their tasks safely, effectively, efficiently and enjoyably.<sup>[8]</sup> For nurses, an NIS is a good substitute for paper records.<sup>[4]</sup>

The survey results gave a nurse satisfaction level of between  $3.55 \pm 1.09$  and  $4.28 \pm 0.75$ . The item that nurses were most satisfied with was "Using the mobile cart, the nurse can assess the patients and record the document, thus can reduce the time of the record" The item that nurses were least satisfied with was "Using PDA input to record the vital signs of patients, nurses can reduce errors caused by handwriting", which may be related to wireless network signal instability when using the PDA.

### 4.3 Improving work efficiency

A mobile nursing station innovatively integrates a wireless network, information technology devices and online charts.<sup>[8]</sup> We found that using a mobile nursing station can improve nursing activity distribution and that nurses hold generally positive attitudes toward mobile nursing station interface usability and usage effectiveness.<sup>[9]</sup>

Our system linked doctors' orders and patient information from the EMR, avoiding the need for nurses to write patient information repeatedly. The survey results suggested that nurses were satisfied with the efficiency of the system.

### 4.4 Improving patient safety

The goal of health care technology utilization is to promote a safer and more efficient system of care.<sup>[4]</sup> With patient assessment scores easily available, patient safety in the nursing process was improved. Nurses only needed to check the relevant option on the system; the level of patient risk would automatically appear and the nursing plan created, thus improving patient safety. The survey results suggested high acceptance of this aspect of the system.

## 5. Acknowledgments

Introducing the hospital-wide project which incorporate patient risk assessment module in NIS can affect nursing practice. The application of the system has greatly enhanced the efficiency of nursing work, and guides the nurses to make an accurate and comprehensive and objective assessment of patient information, which means a lot to further improvement of the care standard and care decisions. It appears that improving the visibility of risk assessment increased its use and promoted patient risk management procedures.

## References

- [1] C.H. Liu, T.T. Lee, M.E. Mills. The Experience of Informatics Nurses in Taiwan. *j. profnurs* **2** (2014), 158-164.
- [2] P.S. Sockolow, M.L. Rogers, K.H. Bowles, E. Kristin, J. George. Challenges and facilitators to nurse use of a guideline-based nursing information system: Recommendations for nurse executives. *Applied Nursing Research* **27**(2014), 25-32.
- [3] M.L. Rogers, P.S. Sockolow, K.H. Bowles, K.E. Hand, J. George. Use of a human factors approach to uncover informatics needs of nurses in documentation of care. *Int J Med Inform* **11**(2013), 1068-74.
- [4] C.A.Kennedy Page. A. Schadler: A Nursing Focus on EMR Usability Enhancing Documentation of Patient Outcomes. *Nurs Clin N Am* **49** (2014) ,81–90.
- [5] F. D'Agostino, M. Zega, G. Rocco, L. Luzzi, E. Vellone, R. Alvaro. Impact of a nursing information system in clinical practice: a longitudinal study project. *Annali Di Igiene: Medicina Preventiva E Di Comunita* **4**(2013),329-41.
- [6] T.C. Lin. Mobile nursing information system utilization: the task-technology fit perspective. *Comput Inform Nurs* **32**(2014), 129-37.
- [7] M.B. Michel-Verkerke. Nursing information system: a relevant substitute of the paper nursing record. *Stud Health Technol Inform* **169**(2011),339-43.
- [8] C. Deblieck, A.F. Laflamme, M. J. Rivard. Standardizing Documentation for Postoperative Nausea and Vomiting in the Electronic Health Record. *AORN Journal* **98** (2013),370-380.
- [9] F.M. Chang, T.T. Lee. Exploring nurse, usage effectiveness of mobile nursing station. *Hu li za zhi the journal of nursing* **2**(2013),32-40.

# Electronic Nursing Documentation: Patient Care Continuity Using the Clinical Care Classification System (CCC)

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**Abstract.** An innovative nursing documentation project conducted at Bumrungrad International Hospital in Bangkok, Thailand demonstrated patient care continuity between nursing patient assessments and nursing Plans of Care using the Clinical Care Classification System (CCC). The project developed a new generation of interactive nursing Plans of Care using the six steps of the American Nurses Association (ANA) Nursing process and the MEDCIN<sup>®</sup> clinical knowledgebase to present CCC coded concepts as a natural by-product of a nurse's documentation process. The MEDCIN<sup>®</sup> clinical knowledgebase is a standardized point-of-care terminology intended for use in electronic health record systems. The CCC is an ANA recognized nursing terminology

**Keywords.** Continuity Care, Nursing Informatics, Electronic Documentation, Clinical Care Classification System, CCC

## 1. Introduction

Nursing informaticians are increasing the visibility of professional nursing through the implementation of coded Nursing Plans of Care in the Electronic Health Record (EHR) [1]. A new generation of Nursing Plans of Care reuses patient data from the nurses' patient admission or shift assessments, deploys the professional framework of the American Nurses Association (ANA), the full six steps of the nursing process, to prompt individualized, customized, Nursing Plans of Care using structured, coded nursing concepts for enhanced continuity of care documentation. In most EHRs, nurses autonomously assess patients and their psychological, functional, physiological, and health behavioral needs that may be unrelated to a medical diagnosis. This nursing assessment is critical to achieving improved patient outcomes. Nursing Plans of Care frequently identify patient concerns that may not be identified when treating a patient's medical diagnosis alone. This patient assessment and 'needs analysis' is a function of the nursing diagnosis and provides the rationale for 'why' a Nursing Plan of Care is essential for patient care coordination. This new design of Nursing Plans of Care has

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been implemented at Bumrungrad International Hospital to promote continuity of care through the integration of nursing patient assessment data coded in MEDCIN<sup>®</sup> clinical concepts and nursing documentation for individualized, coded Nursing Plans of Care using the Clinical Care Classification System (CCC), the United States first national nursing terminology standard [2]. Bumrungrad International, one of the largest private medical facilities in Southeast Asia, is a 580-bed Joint Commission International accredited hospital that provides care for more than 1.1 million patients annually including over 520,000 patients from more than 190 countries. The project objective was to create the next generation of interactive and individualized Plans of Care to provide more personalized nursing care and enhance patient care continuity.

MEDCIN<sup>®</sup> is a renowned clinical knowledgebase which includes a hierarchy of nearly 400,000 clinical terms in six data domains: symptoms, history, physical exam, tests, diagnoses, and therapies [3]. In MEDCIN<sup>®</sup> the information structures and concepts of the CCC System use Hyper Text Markup Language (HTML) [4] and JavaScript [5], a scripting programming language that runs on a web browser. JavaScript allows web pages to function for specific purposes and is supported by a variety of web browsers such as Internet Explorer, Safari, Firefox, and others.

The CCC System [6] is the nursing terminology for MEDCIN<sup>®</sup> to achieve a sustainable approach for the documentation of patient care. The CCC System consists of a four level framework. The first level consists of 21 Care Components used to link the six standards of the Nursing Process as well as the two terminologies (CCC of Nursing Diagnoses and Outcomes) and (CCC of Nursing Interventions /Actions) to each other. The CCC framework is illustrated at: [www.clinicalcareclassification.com](http://www.clinicalcareclassification.com). The CCC System framework makes it possible to document nursing care based on the six standards of the Nursing Process: Assessments, Diagnoses, Outcome Identification, Planning, Implementation, and Evaluation (outcome of nursing care) for professional practice. The CCC has a five-character alpha-numeric structure to code the nursing concepts of the two CCC System terminologies making standardized, coded nursing documentation able to link and track the patient care process for an episode of illness. The CCC can also be used for linkages with its two interrelated terminologies as well as other EHR systems (interoperable), such as SNOMED CT or Logical Observation Identifiers Names and Codes (LOINC). The CCC System is indexed in MEDCIN<sup>®</sup> to CPT<sup>®</sup>, DSM, ICD, LOINC<sup>®</sup>, RxNorm, SNOMED CT<sup>®</sup> and others for the prompting of CCC concepts for virtually any clinical condition.

## 2. Methods

In this applied research, the data layout of existing nursing assessment documentation currently in use the Computerized Provider Order Entry (CPOE) system was replicated in HTML, codes in a file intended for display on a web browser page, and JavaScript, both content components of the World Wide Web Consortium (W3C) and was used to create structured, standardized, coded CCC Nursing Plans of Care based on existing nursing assessment which were a priori supporting the Bumrungrad nursing workflow and evidence-based practice. In using MEDCIN<sup>®</sup> within HTML layout, the patient's signs and symptoms documented in the assessment automatically presented relevant CCC concepts within the Nursing Process format [7]. This method, known as the Integrated Method<sup>™</sup> carries a CCC code to the Nursing Plan of Care based on a coded MEDCIN<sup>®</sup> term that allows data aggregation for future nursing care research and

analysis. The CCC System Information Model guided the integration of nursing data in the Nursing Plan of Care to optimized care continuity using the Nursing Process.

### 3. Results

MEDCIN<sup>®</sup> allowed Nursing Plans of Care for a single patient to be individualized based on nursing assessed signs and symptoms and for documentation to flow directly from point-of-care assessments to the Nursing Plan of Care [Figures 1, 2]. In 2014, 50 nursing assessment documentation layouts were in HTML. Of these, 18 were selected for Phase #1 use of the HTML layouts in the Integrated Method<sup>™</sup>. There were two phases of the Integrated Method<sup>™</sup>: Phase #1 was from Feb.-Mar. 2014 and involved 75 patients. Phase #2 from May to July 2014 and involved 82 patients. During each Phase, paper and electronic nursing assessment documentation was done concurrently (in parallel) for each patient to avoid any loss of data integrity or effect on patient care:

- Phase #1: February – March 2014: 75 patients
- Phase #2: May – July 2014: 82 patients

In the Integrated Method<sup>™</sup> CCC codes were carried from the nursing assessment documentation to the Nursing Plan of Care. A retrospective review of the first 24 hours of admission documentation found the completeness of nursing assessments was higher with the Integrated Method<sup>™</sup> than CPOE documentation (compared with average 2013 scores) [Figure 3]. In the Phase #2, Integrated Method<sup>™</sup> completeness was higher than Phase #1. Currently, the Integrated Method<sup>™</sup> has been used to prompt individualized Nursing Plans of Care for 1,755 new admissions. The Integrated Method<sup>™</sup> is now hospital-wide with MEDCIN<sup>®</sup> and the CCC used for 97% of new inpatient admission documentations.

The screenshot displays the 'Cognitive/Coping' assessment form in the MEDCIN system. The form includes sections for 'Speech', 'LOC', 'Disoriented to', 'Memory', 'Visual', 'Psychological', and 'Social'. The 'LOC' section has three options: 'Comatose', 'Confused', and 'Drowsy'. The 'Confused' option is selected with a checkmark and is highlighted by an orange rectangular box. To the right of the form, a text box with an orange border contains the text: 'Adult Inpatient Cognitive and Coping Nursing Assessment with Level of Consciousness (LOC) Nursing Assessment: Patient is Confused'. The bottom of the interface shows a 'Current Encounter' tab and a list of other assessment categories: Cardio/Resp, Nut/Met, Neuro/Skin, Gastro, Prenatal, Postpartum, Fall Risk, and Braden.

**Figure 1:** Nursing Assessment documentation [© 2014 Medicomp].

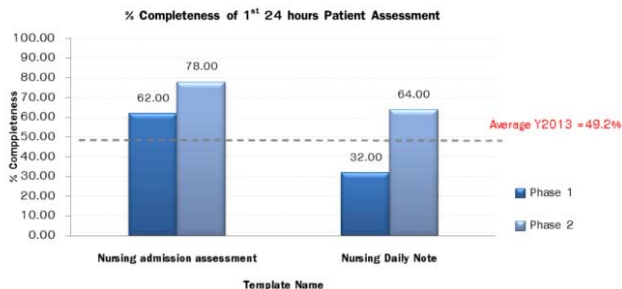
Nursing Daily Note	Name:	
	HN:	Date: 4/24/2014 11:07 AM
	Birth Date: 11/22/1988	Age: 25 Years
	Room:	Sex: Female
	Physicians:	
	Allergies:	

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<b>Cognitive/Coping</b> LOC: <input type="checkbox"/> Comatose <input checked="" type="checkbox"/> Confused <input type="checkbox"/> Drowsy <input type="checkbox"/> Semi comatose	<b>Nursing Diagnoses</b> <input checked="" type="checkbox"/> Confusion
	<b>Goals</b> <input checked="" type="checkbox"/> Oriented to time, person, place <input checked="" type="checkbox"/> Remains free of injury related to altered mentation
	<b>Interventions</b> <input checked="" type="checkbox"/> Reality Orientation
	<b>Actions</b> <input checked="" type="checkbox"/> Orient Patient Every 2 Hrs <input checked="" type="checkbox"/> Provide Calmness And A Restful Environment <input checked="" type="checkbox"/> Provide Assurance

**Figure 2:** Sample Nursing Plan of Care [© 2014 Medicomp].

The HTML layouts using MEDCIN<sup>®</sup> and CCC demonstrated data continuity between the nursing assessments of patient sign and symptoms and individualized Plans of Care. The new Nursing Plans of Care enabled the re-use patient data to offer new insight into the complexity of care performed by nurses. The Integrated Method<sup>™</sup> with HTML and CCC contributed to patient care continuity between the nursing assessment and documentation of patient sign and symptoms and Nursing Plans of Care.



**Figure 3:** Electronic Documentation Completeness

#### 4. Discussion

The benefit of applied research is validation that the partnership of nursing and technology is vital for designing nursing practice environments. A clear and robust nursing terminology standard identifying each of the six steps of the Nursing Process supports the documentation patient care continuity. The exchange of nursing data using the Nursing Process facilitates the provision of patient-centric care for the entire healthcare team. The research recommendation is to include standardized, coded, nursing terminology in EHR nursing documentation modules. The replication of this

study is feasible; the CCC System is available in the public domain and can be used in further research studies with copyright permission.

## 5. Acknowledgments

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## References

- [1] L. Whittenburg, V.K. Saba. Foundation of a nursing plan of care standard. In: Saba VK, McCormick KA, editors. *Essentials of nursing informatics, 6<sup>th</sup> edition*. New York, NY: McGraw-Hill Publishing; 2015 (cited 2015 Dec 31). Chapter 26.
- [2] R.M. Kolodner. *Secretarial recognition of certain Healthcare Information Technology Standards Panel (HITSP) interoperability specifications as interoperability standards for health information technology*. Washington, D.C: Department of Health and Human Services; 2008 Jan (cited 2015 Dec 31); 73(15): 3973-3977.
- [3] P.S. Goltra. *MEDCIN<sup>®</sup>: a new nomenclature for clinical medicine*. New York: Springer-Verlag Publishing; 1978.
- [4] World Wide Web Consortium. *HTML 4.0 specifications – W3C recommendations – conformance: requirements and recommendations*. (Internet). 2015 Sep (cited 31 Dec 2015). Available from: <https://en.wikipedia.org/wiki/HTML>.
- [5] ISO/IEC. *Information Technology – Programming languages, their environments and system software interfaces – ECMAScript language specifications: 16262:2011*. Geneva, Switzerland: IOS Press; 1997 (cited 2015 Dec 31).
- [6] V.K. Saba. *Clinical Care Classification (CCC) System, Version 2.5: User's Guide*. New York: Springer Publishing; 2012 (cited 2015 Dec 31).
- [7] American Nurses Association. *Nursing Process: A common thread amongst all nurses*. (Internet). 2015 Oct. (cited 2015 Dec 31). Available from: <http://www.nursingworld.org/EspeciallyForYou/StudentNurses/Thenursingprocess.aspx>

# Transforming Clinical Documentation in EHRs for 2020: Recommendations from University of Minnesota's Big Data Conference Working Group

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**Abstract:** In 2014, a group of diverse informatics leaders from practice, academia, and the software industry formed to address how best to transform electronic documentation to provide knowledge at the point of care and to deliver value to front line nurses and nurse leaders. This presentation reports the recommendations from this Working Group geared towards a 2020 framework. The recommendations propose redesign to optimize nurses' documentation efficiency while contributing to knowledge generation and attaining a balance that ensures the capture of nursing's impact on safety, quality, yet minimizes "death by data entry."

**Keywords:** clinical decision support, EHR, best practice, nursing documentation, nursing informatics

## 1. Introduction

The phenomenon of "data rich, information poor" electronic health record systems (EHRs) is all too often the reality for nurses working in acute-care settings in the United States today. Despite being the largest number of health information technology (HIT) users and the discipline that documents more than any other group of health professionals in acute- and post-acute care, nurses receive a negligible amount of knowledge back to help inform their practice. This paper reports the results of the Working Group 10 that emerged from the University of Minnesota, School of Nursing's 2<sup>nd</sup> annual conference on "Nursing Knowledge: Big Data Science<sup>1-2</sup> in 2014". Over twenty conference attendees representing informatics leaders from practice, academia, knowledge content providers and the major EHR software vendors volunteered to tackle the thorny problem of transforming EHR clinical documentation for nurses and other health professionals in acute care. This working group met monthly over a 12-month period to define the themes that made EHRs current state problematic for nursing and develop recommendations that could be implemented in the near term and address the most burdensome of these themes. Another deliverable was to report out to the 2014 Big Data Conference on our findings and recommendations. Two types of documents were to be used for this succinct summary and the power point slide is included here.

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## 2. Current State

Researchers looking at documentation practices and nursing satisfaction post-EHR implementations report that nurses spend 19% to 28% of their shift time documenting; and yet for reasons that range from its lack of use for reimbursement to lack of standardized terminology, this full set of nursing documentation is often not read by other disciplines, including nurses<sup>3,4</sup>. Data entry and nursing workflow has historically been designed as though it occurs on paper, with spreadsheet formats and content driven by regulatory and quality reporting requirements, rather than capturing the “patient’s story”. When data entry is not linked to real-time knowledge and context of how the data fit together within the patient’s story or a given problem, nurses’ struggle with value received from their documentation efforts that benefit other stakeholders rather than supporting their care delivery.

Optimal workflow design, clinical decision support and documentation templates call for highly skilled and clinically knowledgeable informaticists. Yet the practice used in designing, building and implementing an EHR in the United States is that each organization does this undertaking from scratch, tapping clinical personnel to do this important work who show an interest in technology but who often have no formal education or certification in informatics. Every health care organization designs and implements its own version of an EHR, purchasing a system using the software code current at time of purchase, and customized based on local perceived needs. Vendor-based clinical content is either purchased or built by the organization on the basis of best practices defined by internal end-users or from external content provider vendors. Organizations own the responsibility for maintaining their own content and/or purchasing upgrades from their vendor. Working Group 10’s members spoke with a united voice that instead of keeping this siloed approach, it would be so much more preferable to be able to leverage lessons learned from organizations that have gone before them. Ideally, a “best practice” repository would exist that holds examples of data sets complete with clinical terms mapped to standardized terminologies, such as LOINC (Logical Observation Identifiers Names and Codes) and SNOMED-CT (Systematized Nomenclature of Medicine – Clinical Terminology).

## 3. Recommendations

Also problematic with the documentation burden is the lack of automatic integration of data results from other medical monitoring devices that require the nurse to manually enter the results into the EHR. This lack of external systems and device integration is a problem that impacts all disciplines across care settings and is addressed in the American Medical Informatics Association’s recently published EHR 2020 Task Force’s report<sup>5</sup>. The report’s first recommendation is to simplify and speed documentation through a number of measures including building standards for device integration.

The following set of recommendations encompass multiple levels, including: new EHR functionality, new processes, standards adoption, practice changes, and boarder engagement by national nurse organizations. In developing these recommendations, Working Group 10 included the work of the HIMSS CNO/CNIO Vendor Roundtable, AMIA’s Nursing Informatics Scholarship Initiatives, and AMIA’s EHR 2020 Task Force Report<sup>5,6</sup>.

### *3.1. Data Standards*

Nurse leaders be knowledgeable of and to actively engage within their local provider organizations in support of adopting SNOMED-CT and Clinical LOINC as data standards for all nursing clinical data. These two terminology standards have been endorsed by nursing informatics leaders in HIMSS and AMIA and serve as the international standards across the Commonwealth countries and continental Europe as well<sup>7</sup>. Encoding of nursing data generated from care delivery could be available to nursing for reports on patient outcomes at the clinician level and roll up to the unit, department, and organization level. The Big Data opportunity comes with this clinical data being aggregated with other data from disparate sources, such as finance, staffing and human resources to answer questions related to costs, staffing levels and outcomes, as well as comparisons between organizations.

Coded data enable aggregation and querying to answer clinical questions and perform comparisons over time, recognize patterns, and make predictions. It enables new knowledge generation, knowledge-based learning and evidence-based practice. It is the basic building block of delivering power over its business and practice into the hands of nursing. For nursing leaders this recommendation includes investing and building an informatics team that has extensive knowledge in mapping nursing concepts to Clinical LOINC and SNOMED-CT.

### *3.2. Vendor Neutral Content Library*

A source is identified to serve as a central repository for best practice clinical forms embedded in workflow with clinical decision support to include standardized assessments and interventions, evidence-based bundles and CDS rules. The proposed library would be housed by a professional body like the National Library of Medicine or the American Nurses Association with sufficient resources and commitment to build, maintain and keep it available to all. This library of resources would be vendor-neutral and freely available to all health care organizations throughout the world.

### *3.3. Documentation is simple and fast, generated from care delivery*

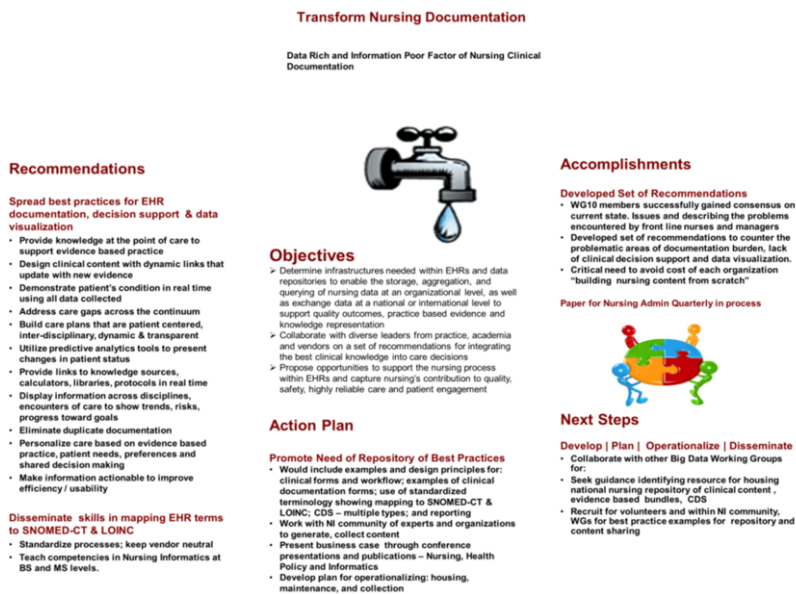
Refocus regulatory mandates for quality and safety measures so that they use data generated from actual care delivery and do not require additional work by health professionals to support. Policymakers should require fully standardized interfaces between IT systems so that biomedical devices and external systems like laboratory, radiology and anesthesiology automatically send results to the EHR without any manual interventions required. It is also essential to create mechanisms to ensure and validate the integrity of EHR data to avoid redundancy and for the ease and simplification of documentation. For nursing to move to predictive analytics using the full power of the data science requires data that are accurate, complete and timely. The business case and road map for these recommendations are defined in the JASON Report commissioned by the Office of the National Coordinator in which the task force stipulates that interoperability data standards are needed to efficiently extract data, support innovation with 21<sup>st</sup> century information technology tools and to interact across multiple EHR systems [www.healthit.gov/sites/default/files/ptp13-700hhs\\_white.pdf](http://www.healthit.gov/sites/default/files/ptp13-700hhs_white.pdf).

### 3.4. Clinical documentation supports patient participation and the capture and sharing of the “patient’s story

Templated document forms as they exist in today EHR systems do not allow for the voice of the patient and the full socio-economic picture of the individual patient in their home and community context to be captured nor incorporated in a plan of care that extends to health professionals in the community and home. In addition to designing more patient-centered documentation tools, enhanced patient portals that allow patients and family to be more fully engaged partners in the person’s care and care plan are key mechanisms for moving to patient-centered systems and care delivery systems.

## 4. Summary

One of the action commitments of our working group was to broadly disseminate our report recommendations and this paper submission is an effort to bring this body’s work to the attention of the international community for its critique, input and informing our next step efforts to bring these recommendations to a reality. We are heading into our second year of work with priority on publications, national presentations, and engagement with our national health policy entities, and nursing associations for sponsorship, funding and support. And importantly, since our working group members include leaders from provider organizations, software vendor companies, and academia, we will also focus on getting commitment from these sectors to embrace standards and to invest in developing mapping terminologies skills in our informatics workforce. We look forward to reporting the progress on our goal of setting up a library repository for best practices, content, and terminology mapping of data sets available to help all implement based on lessons learned and optimal system design. Next steps involve building the business case through a proof of concept pilot and to obtain funding. This 2015-2016 focus will be completed for report out for the NI2016 meetings.



**Figure 1.** Summary of Working Group 10’s findings and recommendations on transformation of clinical documentation

## References

- [1] A. O'Brien A, C.A. Weaver, T. Settergren, et.al, EHR documentation: The hype and the hope for improving nursing satisfaction and quality outcomes. *Nurs Admin Q* **39** (2015) 4:333-339.
- [2] B.L. Westra, T.R. Clancy, J. Sensmeier, et.al, Nursing knowledge: Big data science – implications for nurse leaders. *Nurs Admin Q* **39** (2015) 4:304-310.
- [3] A. Hendrich, M.P. Chow, B.A. Skierczynski, Z. Lu, A 36-hospital time and motion study: how do medical surgical nurses spend their time? *Permanente J* **12** (2008) 3:25-30.
- [4] T. Yee, J. Needleman, M. Pearson, et al, The influence of integrated electronic medical records and computerized nursing notes on nurses' time spent in documentation. *Compu Inform Nurs* **30** (2012) 6:287-292.
- [5] T.H. Payne, S. Corley, T.A. Cullen, et al, Report of the AMIA EHR 2020 Task Force on the status and future direction of EHRs. *JAMIA* **22** (2015) 5:1102-1110. DOI: <http://dx.doi.org/10.1093/jamia/ocv066> Published online: 29 May 2015, Accessed October 4, 2015
- [6] HIMSS. Guiding principles for big data in nursing: Using big data to improve the quality of care and outcomes. *HIMSS CNO-CNIO vendor roundtable*. Available at: <http://www.himss.org/big10>. Accessed October 4, 2015
- [7] K. Hannah, P.A. White, M.A. Kennedy, N. Hammell, C-HOBIC: standardized information to support clinical practice and quality patient care across Canada. International Congress of Nursing Informatics, NI 2012, Montreal, Canada. *Proceedings of the 11<sup>th</sup> International Congress on Nursing Informatics*, 2012.

# Nurses' Information Seeking Behavior for Clinical Practice: A Case Study in a Developing Country

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**Abstract.** We used a valid questionnaire to survey Iranian nurses' seeking information behavior and their confidence on different information sources. The frequently used sources were Internet" and "personal experiences"(54.8% and 48.2% respectively). English medical journals" (61.9%) and "English textbooks" (41.3%) were the least frequently used sources. Nurses felt high confidence in sources such as "International instructions/guidelines" (58.6%) and "English medical textbooks" (50.4%). The main reasons for selecting sources were easy accessibility, being up to date and reliability. Google, Pubmed and Up to Date were the most used electronic sources. In addition, there were differences in terms of using some of these resources and nurse' age and gender. In developing information sources for nurses, factors such as reliability level, availability, and updatedness of resources should be more emphasized.

**Keywords.** nurse, evidence based practice, information, information seeking

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## **1. Introduction**

Evidence-based medicine (EBM) helps nurses make the best decisions based on the valid evidence [1, 2]. Information seeking is a main stage in problem-solving process and EBM. Nurses consider quality of information very important [3]. The purpose of professional nursing is to increase the use of the best information for the best practice. Achieving this purpose requires identifying information resources [4, 5]; however identifying resources for making informed decisions is a difficult task. Doctors and nurses encounter some problems such as lack of access to related information [6]. Nurses use resources such as books, discussion with colleagues, as well as e-journals, e-books, and the Internet [7]. In this regard, there is not much information in Iran. The purpose of this study is to consider nurses' information seeking behavior in clinical practices. Determining nurses' information seeking behavior can be helpful in planning for nursing education, designing and accessing the required information resources, and ultimately approaching the objectives of evidence-based medicine.

## **2. Methods**

A cross-sectional study was conducted during August-October 2013 using a questionnaire in all of the five academic hospitals affiliated with Mashhad University of Medical Sciences, Iran. The nurses' participation was voluntary and uncompensated. The criteria for selecting nurses were willingness to participate, availability and having at least three years' work experience in hospitals. The questionnaire was offered to 164 nurses; however, 131 nurses (80%) completed the questionnaire. Two medical informatics specialists and three nurses were asked to provide feedback on format, clarity and meaning of questions and response options. Furthermore, a pilot test-retest study was conducted to test the questionnaire ( $r=85$  percent). The data were analyzed using the SPSS version 16.0 using Mann-Whitney and Pearson's correlation coefficient tests.

## **3. Results**

Most nurses (76%) were female, less than 30 years old (46.2%). The most frequently used sources were "Internet" (54.8%) and "personal experiences" (48.2%). The sources that nurses felt high confidence in were "International instructions/guidelines" (58.6%) and "English medical textbooks" (50.4%) (Table 1). The nurses counted easy accessibility, being up to date and reliability with the mean of 2.4, 2.9 and 3 (from 1-7 scores), respectively, as their primary reasons for the selection of their information sources. Also nurses reported that "English medical journals" (61.9%) and "English textbooks" (41.3%) were the least frequently used sources. There was a significant difference between using some information sources such as weekly seminar ( $p=0.03$ ), CME virtual courses ( $p=0.04$ ) and nurse's gender. Women used more of these information sources in comparison with men. There was a positive relationship between using some information sources ("English textbooks" ( $p<0.001$ ), "English medical journals" ( $p<0.001$ ), "Persian medical journals" ( $p=0.01$ ), "Seminar/Congress" ( $p=0.02$ ), "Discussion with colleagues" ( $p=0.001$ ), "Pharmaceutical companies

instructions”(p=0.04), “Media (TV and Radio)” (p=0.02), “Professional newsletters”(p=0.006) and nurse’s age.

Sixty nine percent of nurses did not have access to the Internet in consultation room, and the skill of using the Internet in 49.2 percent of them was at the average level. Most of the nurses (40.6 percent) used the Internet daily, and most of them (37.8%) used the Internet for obtaining medical information weekly. Most of the nurses used the Internet for seeking information for their own health (49.6%) or for their person of interest (47.2%). Most of the nurses (65.1%) mentioned the ease of access to information as the most important reason for using the Internet to seek health-related information. Most of the nurses used electronic resources of Google (80.2%) and Medline/PubMed (19.8%) for obtaining information (Table 2). Nurses considered slow internet connection speed (76%), unavailability of some medical resources due to untargeted filtering (53.6%) and language barriers (45.6%) respectively as the most important reasons of dissatisfaction with the Internet .

Table 1. Frequency of use and Confidence in use of information sources

Source of Information	Use of information sources N, (%)			Level of confidence N, (%)		
	Always	Some	Never	High	Some	None
English textbooks	6(5.8)	55(52.9)	43(41.3)	60(50.4)	53(44.5)	6(5)
Persian textbooks	50(43.5)	61(53)	4(3.75)	42(33.9)	79(63.7)	3(2.4)
English medical journals	6(6.2)	31(32)	60(61.9)	43(39.8)	50(46.3)	15(13.9)
Persian medical journals	10(10)	60(60)	30(30)	31(27.4)	76(67.3)	6(5.3)
Seminar / congress	11(9.7)	85(75.2)	17(15)	31(25.8)	81(67.5)	8(6.7)
Weekly conferences	27(23.9)	63(55.8)	23(20.4)	23(19.7)	86(73.5)	8(6.8)
CME (Courses)	40(35.4)	64(56.6)	9(8)	45(38.1)	65(55.1)	8(6.8)
CME (virtual courses)	26(23)	63(55.8)	24(21.2)	35(29.4)	73(61.3)	11(9.2)
Educational classes	51(42.5)	65(54.2)	4(3.3)	50(41.3)	65(53.7)	6(5)
Discussion with colleagues	40(33.9)	67(56.8)	11(9.3)	23(19.8)	83(70.7)	11(9.5)
Internal instructions	48(42.1)	57(50)	9(7.9)	40(34.2)	73(62.4)	4(3.4)
International instructions	16(15.4)	52(50)	36(34.6)	65(58.6)	33(29.7)	13(11.7)
Pharmaceutical companies instructions	16(14.3)	82(73.2)	14(12.5)	37(31.4)	70(59.3)	11(9.3)
Media (TV and Radio)	33(28.9)	69(60.5)	12(10.5)	29(25)	76(65.5)	11(9.5)
Professional newsletters	19(17.4)	58(53.2)	32(29.4)	19(17)	84(75)	9(8)
Web/internet	68(54.8)	53(42.7)	3(2.4)	43(35.5)	74(61.2)	4(3.31)
Electronic documents (Offline)	15(13.6)	80(72.7)	15(13.6)	18(16.1)	83(74.1)	11(9.8)
Personal experiences	54(48.2)	54(48.2)	4(3.6)	24(21.8)	80(72.7)	6(5.5)

#### 4. Discussion

Nurses should effectively face large volume of information so that they can make informed decisions about patients’ care. Without updating their knowledge, they cannot have high performance in their profession [5]. Access to valid information is a cost-effective strategy for constant improvement of health care [6, 8]. We found that the Internet and personal experience are the most widely used resources. The least reliable information resources were offline electronic documents and newsletters. Resources that had the least utilization by nurses were English journals and medical books respectively. Nurses’ most preferable reasons for choosing a resource were easy and quick access, updatedness and reliability.

Table 2. Use of electronic information resources

Electronic Sources	Use of electronic information sources		
	N, (%)		
	Always	Some	Never
Medline/ PubMed	20(19.8)	39(38.6)	42(41.6)
Web of knowledge	6(6.5)	31(33.3)	56(60.2)
Scopus	3(3.3)	20(22.2)	67(74.4)
Science Direct	9(9.9)	22(24.2)	60(65.9)
Cochrane	1(1.1)	20(22.5)	68(76.4)
MD Consult	8(8.8)	24(26.4)	59(64.8)
Embase	4(4.4)	20(22)	67(73.6)
EBSCO	5(5.9)	16(18.8)	64(75.3)
Up To Date	17(17.7)	28(29.2)	51(53.1)
Google	97(80.2)	18(14.9)	6(5)

In spite of our results, Bernard concluded that books and printed journals are the first preference of general practitioners [9]. Kapiriri mentioned books as the doctors' most used resource after discussion with colleagues and doctors' proclamations [8]. Research indicated that the third reason for choosing an information resource by nurses is its reliability level. Previous research shows that among different resources, nurses and doctors' most reliability belongs to English medical books. For example, Cullen's indicated that GPs were more relying on medical books and journals than other resources [10]. In our study, offline electronic resources and newsletters had the lowest reliability; however, less than 4 percent of nurses did not rely on the Internet. Despite positive and useful features of internal resources, such as having low cost and being written in native language, it seems that Persian journals failed to meet criteria such as reliability level and updatedness. Additionally, in Iranian universities students are trained based on international texts therefore, we think that this results in more confidence of nurses on international and English materials.

Nurses mentioned the use of web-based resources as their most widely used resource. Kitchin and Applegate's results confirm the present results. They showed that radiology residents have also selected the use of Internet as the most important information resource [11]. Another study about Canadian nurses showed that nurses consider the Internet as an obstacle for patient's contact [12].

In this study, most of the nurses used the Internet daily for obtaining information, even more than medical books and journals. Their most important reason was ease of access to information. Another reason for using the Internet was the access to much information from different resources. Schwartz states that information retrieval technology, compared to other information resources, improves access to updated medical knowledge [13]. Previous studies show that nurses' use of Internet for medical research and personal gain and for contacting with patients and colleagues is increasing [14]. In this study, regarding searching the Internet, most people were satisfied with the obtained information. Internet provides general information such as health education, enhancement, prevention, prognosis and disease treatment, which are helpful in making decisions about different patients. This information may include texts, images, audios and educating videos from databases as well as digital libraries, computerized clinical guidelines, electronic journals or text-books, and electronic medical websites [15, 16]. According to findings, although Internet is the favorable sources, the nurses did not



appropriate access to Internet in point of care probably due to the infrastructure issues or their work loads. In addition, we found that most nurses seek information for their own health or for their person of interest not for patients. We think that these two problems may lag EBM in nursing practices in Iran. Furthermore, there is also low-quality information resources in the Internet, nurses should be fully trained about evaluating the quality of the retrieved information for EBM.

In sum, in creating information resources that are going to be used by nurses, factors such as reliability level, availability, and updatedness of resources should be more emphasized. Further, increasing nurses' information literacy can be effective in better access to information.

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## References

- [1] R. Saitz, Evidence-based medicine: time for transition and translation (to practice). *Evidence Based Medicine* **15**(2010), 103-104.
- [2] M.Dawes, W. Summerskill, P. Glasziou, A. Cartabellotta, J. Martin, K. Hopayian K, et al, Sicily statement on evidence-based practice. *BMC Medical Education* **5**(2005),1.
- [3] K. Kimiafar, F. Sadoughi, A. Sheikhtaheri, M. Sarbaz, Prioritizing factors influencing nurses' satisfaction with hospital information systems: a fuzzy analytic hierarchy process approach, *Computer Informatics Nursing* **32**(2014), 174-181.
- [4] J. Roberts, Senior student nurses information seeking skills: a comparative study. *Nurse Education Today* **24**(2004), 211-218.
- [5] A.J. Ross, C.A.Estabrooks, Sources of information used by nurses to inform practice: an integrative review. *International Journal of Nursing Studies* **45**(2008), 954-970.
- [6] N.L. Bennett, L.L.Casebeer, R.Kristofco, B.C. Collins, Family physicians' information seeking behaviors: a survey comparison with other specialties. *BMC Medical Informatics and Decision Making* **5**(2005),9.
- [7] C.Dee, E.E Stanley, Information-seeking behavior of nursing students and clinical nurses: implications for health sciences librarians. *Journal of the Medical Library Association* **93**(2005), 213-222.
- [8] L.Kapiriri, S.J.Bondy, Health practitioners' and health planners' information needs and seeking behavior for decision making in Uganda. *International Journal of Medical Informatics* **75**(2006), 714-721.
- [9] E.Bernard, M.Arnoold, O.Saint-Lary, D.Duhot, G.Hebbrecht. Internet use for information seeking in clinical practice: a cross-sectional survey among French general practitioners. *International Journal of Medical Informatics* **81**(2012),493-499.
- [10] R.J.Cullen, In search of evidence: family practitioners' use of the Internet for clinical information. *Journal of the Medical Library Association*. **90**(2002), 370-379.
- [11] D.R.Kitchin, K.E.Applegate. Learning radiology: a survey investigating radiology resident use of textbooks, journals, and the internet. *Academic Radiology* **14**(2007), 1113-1120.
- [12] C.A.Estabruuks, M.Milner, *Measuring Knowledge Utilization in Health Care*. *International Journal of Policy Evaluation and Management* (2003).
- [13] K.Schwartz, J.Northrup, N.Israel, K.Crowell, N.Lauder, A.V.Neale. Use of on-line evidence-based resources at the point of care. *Family Medicine* **35**(2003), 251-256.
- [14] F.Lupiáñez-Villanueva, M.Harvey, J.Torrent, P.Ficapal, The integration of information and communication technology into nursing. *International Journal of Medical Informatics* **80**(2011), 133-140.
- [15] Y.Kagolovsky, J.R.Moehr. Terminological problems in information retrieval. *Journal of Medical Systems* **27**(2003), 399-408.
- [16] K.Masters. Access to and use of the Internet by South African general practitioners. *International Journal of Medical Informatics* **77**(2008), 778-786.

# Homecare Nurses' Decision-Making During Admission Care Planning

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**Abstract.** The re-hospitalization rate of homecare patients within 60 days of hospital discharge is 30%. Enhanced care planning based on better information may reduce this rate. However, very little is known about the homecare admission and care planning processes. The research team collected data during observations of three nursing visits to admit homecare patients in Camden NJ, and conducted thematic content analysis on these data. Human factors methods helped to identify nurse decision-making related to selection of the plan of care problems, non-nursing resources, and the nursing visit pattern. They identified how the electronic health record (EHR) assisted the nurse in visit pattern frequency decisions. Major themes that emerged included reduced efficiency due to use of redundant intra-team communication methods to augment EHR documentation, redundant documentation, and workarounds and reorganization of clinical workflow.

**Keywords.** Evaluation studies; technology evaluation; clinical information systems; patient care team; aged; homecare.

## 1. Introduction

Home care agencies face the challenge of assuring timely and accurate data collection during the homecare admission process. The re-hospitalization rate of homecare patients within 60 days of hospital discharge is 30%[1]; enhanced care planning and allocation of clinical care services based on better information may reduce this rate. However, very little is known about the homecare admission and care planning processes. The homecare admission nurse, who makes the admission visit, must balance information, cognitive tasks, and workflow processes as he or she makes health care decisions. Understanding and supporting information needs and enhancing clinical decision-making during the admission care-planning process may assist homecare nurses to overcome the challenges of timely and appropriate allocation of clinical resources during the admission process and to reduce adverse events and hospital readmissions from homecare. While health information technology (HIT) has the potential to support the admission process, thereby improving quality of care while

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minimizing risk and harm to patients, contextual factors (e.g., workflow integration, HIT usability) present challenges to HIT implementation and adoption. To better understand admitting nurses' information needs, we need to understand how clinical work is and could be accomplished. Human factors methods aid in such understanding including how context affects both work processes and information needs. The study objective was to examine plan of care (POC) decision-making during the homecare admission process using selected human factors methods. Accordingly, we focused on the supportive aspects and the insufficiency of one point-of-care home care EHR with rigidly structured data used in one community by one nurse managing 3 readmissions as observed by three researchers and an assistant.

## **2. Methods**

The research team collected data during observations of nursing visits to admit homecare patients and conducted thematic content analysis on these data. The team consisted of three researchers: a public health informatician (PS) with knowledge of homecare, a human factors engineer (EB) knowledgeable in health informatics, a nurse informatician (KB) with homecare expertise, and a research associate, a biomedical engineering student (CE). Drexel's IRB approved the study.

### *2.1. Setting, participants*

The research setting was a nonprofit urban homecare agency which is part of a larger health system. The agency serves a population that includes a low socio-economic status, minority population with complex care needs in Camden, NJ. The agency implemented the most widely used homecare EHR system, Homecare Homebase, in 2008. To support care planning at the patient bedside, the EHR is installed on a hand-held tablet running the Android operating system. The agency deploys two nurses to conduct the admissions for the annual patient population of 389 Camden Medicare beneficiaries. One nurse was available to be observed by the study team. This nurse provided written consent and the patients being admitted during the study period provided oral consent to participate in the study.

### *2.2. Observations*

We observed the first admission visits for three different patients. Team members (PS, EB, CE) conducted the following data collection methods: observation of the nurse admitting a patient, observation of the nurse completing the admission documentation, and a structured interview with the nurse. In the home, the types of data collected included: 1) nurse/patient conversations; 2) nurse access of paper artifacts; and 3) notes taken by the nurse. At the agency, the nurse was also audio-recorded when not calling other healthcare providers. We copied de-identified physical documentation and reviewed the nurse's electronic product. Following documentation completion, we audio-recorded a structured knowledge elicitation session with clarifying questions. In addition, we interviewed agency experts (i.e., two nurse administrators familiar with both the clinical operations and the EHR) to clarify issues related to HIT usage and nurse procedures.[2] The research associate transcribed the field notes and audio

recordings. Researchers (PS, EB) checked the transcripts of the field notes for accuracy and completeness; CE made corrections in the transcriptions as necessary.

### *2.3. Thematic content analysis*

Team members (PS, CE) conducted thematic content analysis of the transcribed documents to identify data related to nurse decision-making. We inductively analyzed data about (i.e., observations) and from (i.e., interview responses) the admission visit to identify themes. We used the Health Information Technology Reference-based Framework (HITREF) conceptual framework to sensitize the initial organization of the categories. The HITREF is an evidence-based HIT evaluation framework which encompasses six HIT dimensions that guide EHR assessment through outcomes measurement.[3] Data were then incorporated as interpretive units in the NVivo software program[4] for data management and analysis. Themes that appeared at least three times (saturation)[5] were identified.

## **3. Results**

### *3.1. Observations*

We focused on admission nurse decision-making regarding which patient problems to be addressed in the POC, the non-nursing resources to be consulted (i.e., the disciplines involved such as physical therapy, social work), and the nursing visit pattern. The visit pattern involved two decisions: frequency of subsequent visits and time of next visit.

Nurse selection of problems to be included in the POC was not assisted by the EHR. Instead, the nurse referred to the patient problems and other contributing conditions identified in the hospital discharge and/or the physician homecare referral documentation. The nurse identified specific criteria for inclusion: problems that concerned the nurse; keeping the patient safe; pain management; and fall risks if there were many steps in the home. The EHR assisted POC development related to identification of interventions for each problem. Following nurse documentation of the assessment, the EHR presented a standard set of patient problems. The nurse selected a POC problem which triggered the display of a pathway which had decision branches that the nurse traversed as she selected POC interventions.

Nurse identification of resources was not supported by the EHR. Resource decisions were prompted as the nurse reviewed the patient assessment, surveyed the patient's home environment, and as the patient raised concerns. When the nurse identified a patient challenge that could be addressed by a non-nursing resource, she explained to the patient the intended benefit and asked the patient if he/she would like the resource to visit him/her (i.e., shared decision-making).

Nurses made patient admission visits within the 24-48 hour timeframe as required by Medicare. They make two decisions related to frequency of visits: (1) the number of visits per week; and (2) the day for the first return visit. The EHR provided assistance to the nurse for the first decision, but not the second decision. To determine the number of weekly visits, the EHR calculated a numeric frailty measure based on the patient's current health status as documented by the nurse in the Outcome and Assessment Information Set. A frailty indicator above the specified cut-off point indicated the scheduling of three visits in the first week. For the patients not classified as frail, in

addition to the admission visit, the nurse scheduled two more visits for the first week for both patients and scheduled two visits for the second week for one patient. Agency experts stated that more visits are scheduled at the start of the home care episode compared to the end of the episode as per the best practice guidelines.[6]

Nurse selection of the visit pattern decision for scheduling the subsequent return visit was not assisted by the EHR. We observed different visit pattern decisions between the patients not categorized as frail. The nurse explained that scheduling the return visit the next day was based on the patient's needing assistance within 48 hours. Subsequently, agency experts explained additional reasons for scheduling the first follow-up visit for the next day: 1) if the nurse detected presence of symptoms; or 2) if the patient or caregiver required additional demonstration of a nursing procedure.

### 3.2. Thematic content analysis

Three themes related to EHR characteristics attained saturation. No themes were related to satisfactory EHR characteristics (e.g., facilitators to EHR use as intended). All themes were related to dissatisfactory characteristics (e.g., challenges to EHR use as intended) categorized in the HITREF component Efficiency. The first dissatisfactory theme was related to redundant communication to team members. The nurse, after having documented in EHR structured text the need for a clinical service, pursued that need via additional communication methods. For communication to the social worker, the *nurse* documented the need for services in the summary note, explaining, "When they read my note they'll see that's one of his issues, is that he's going to need help with transportation and food." *Researcher*: "Is reading your note the only way that they know?" *Nurse*: "No. I called her [social worker] too." *Researcher*: "You call and document in free text." Similarly, to communicate to the nurse who will make the next patient visit, the admission nurse relied on email and the telephone as an additional communication method. The *nurse* explained, "Right now I'm sending an email to the nurse and I'll have his [patient] name on here...And then I'll paste that [clinical data] on there and she can see it." To communicate clinical admission information that required review to her supervisor, the nurse stated that she also sent an email.

A second dissatisfactory Efficiency theme focused on redundant documentation of clinical data in the EHR. During three situations, involving different types of data, the nurse documented the same information in two different places. The nurse documented wound care in the nursing note as well as the wound care assessment. When asked about the duplicate documentation, the nurse explained, "What I did for her [patient] notes: I added, even though they have that wound assessment in there, that new one [recently added functionality]. We also put in the old nursing note where you can see, so the nurse can see, what that initial wound is. Even though it comes up on the new one, we still put it in the old one too." For other clinical information, the nurse wrote free text in the summary note template which previously entered structured data.

A third theme was related to workflow and system flow mismatch as evidenced by workarounds and workflow reorganization. For all three patients, the nurse handwrote generalized free form observations about diverse clinical information (e.g., weight loss, needed durable medical equipment) on a pre-printed blank document labeled "cheat sheet" instead of documenting in the EHR. Another workaround was recording memory jogs in a free text field as the EHR did not have a reminder field. The workflow reorganization was related to the nurse's inability to document (using touch) when she wore sterile gloves during the physical exam. Instead, she reorganized her

work to record in the EHR before she began the exam. During the exam, she documented on paper.

#### **4. Discussion**

We used human factors methods to examine homecare admission POC decision-making and to identify where the study's EHR assisted the nurse in selection of the POC problems, allocation of non-nursing resources, and determination of the nursing visit pattern. The EHR assisted the nurse in determining the frequency of patient visits by calculating patient frailty using already recorded information. However, the EHR introduced inefficiencies due to redundant documentation, redundant communication methods, workarounds, and reorganization of clinical workflow. The homecare EHR should benefit nurses by supporting efficiency and team communication[7] without creating new problems already identified to occur in hospitals, such as workarounds to circumvent poor system design.[8]

#### **5. Conclusion**

Human factors methods facilitate insights into homecare admission point of care decision-making and related EHR use. Our findings suggest that the EHR in this study was both a facilitator and a barrier in nurse POC admission decision-making, an understudied informatics area of investigation.

#### **6. Acknowledgments**

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#### **References**

- [1] Basic Statistics About Home Care. Washington, DC: The National Institution for Home Care and Hospice; 2010:1-21.
- [2] E.J. Bass, K.H. Bowles, C. Eberle, Homecare Nurses' Decision-Making Information Needs During Admission. Home Healthcare and Hospice Information Technology Conference. Nashville, TN;2015.
- [3] P.S. Sockolow, P.R. Crawford, H.P. Lehmann, Broadening a general framework for evaluating health information technology through health services research evaluation principles. *Meth Med Infor* 2012;51(2):122-30.
- [4] International QSR. NVivo. 2008; Volume 8.
- [5] N. Burns, S.K. Grove, *The Practice of Nursing Research*. Philadelphia: W. B. Saunders; 2013.
- [6] M. O'Connor, Hospitalization among medicare-reimbursed skilled home health recipients. *Home Health Care Manage Pract* 2012;24(1):27-37.
- [7] P.S. Sockolow, K.H. Bowles, M. Adelsberger, C. Liao, J.L. Chittams, Impact of home care electronic health record on clinician satisfaction, timeliness of clinical documentation and reimbursement, and patient outcomes. *Appl Clin Inform* 2014;5(2):445-462.
- [8] R. Koppel, T. Wetterneck, J.L. Telles, B.T. Karsh, Workarounds to barcode medication administration systems: their occurrences, causes, and threats to patient safety. *J Am Med Inform Assoc* 2008;15(4):408-23.

# Online Information Seeking Behaviour by Nurses and Physicians: A Cross-Sectional Study

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**Abstract.** Online bibliographic databases constitute the access to information supporting evidence-based practice. The purpose of the present survey is to evaluate the awareness, the use and the impact that online evidences have in clinical practice. An online survey was conducted using a 25 item questionnaire which was completed by 263 healthcare practitioners (nurses and doctors). Chi-square analysis and t-tests were used and comparisons between both groups were made. Multiple logistic regression to predict databases use was employed. Ninety-three percent (n=206) of participants had heard about the online bibliographic databases; 5.7% of participant sample have heard about online databases but they do not use them. 18.3% was the total sample of non-users(n=48). The main reason of using was filling a knowledge gap (50.7%), and the main reasons of not using were both that they use another information source and they don't need them to do their job. Both nurses and doctors believe that the use of online databases improves patient care it is a part of their legitimate clinical role. They need more training to improve their searching skills, enhancing them in everyday clinical place.

**Keywords.** Online evidence, online bibliographic databases, information retrieval, use of evidence.

## 1. Introduction

Estimating the potential need of information in health care community, current trends have been focused in the provision of evidence-based practice[1]. As Joint Commission (JCAHO) defined, knowledge-based information sources are the clinical, scientific and management literature that is readily available, current and authoritative[2]. Evidences to support practice come from many types of sources. One type of these is online bibliographic databases such as Medline and CINAHL. These online portals of information consolidate evidences that are readily available to clinicians. Online clinical databases have been shown that compromise the utilization of research in practice and provides the answers to clinicians' questions[3]. Online evidence systems have been adopted as the element to support evidence-based practice (EBP) at the point of care around the world. The last decade many studies have been shown the association and the effectiveness of online databases' use in patient care[4]. Such surveys have been focused to nurse practitioners and evaluate all the factors that

influence the use of online evidences in workplace settings and also measure the perceptions of retrieving information through online sources[5,6].

The primary aims of this study were to investigate healthcare practitioners' awareness of online evidence databases, the impact in their clinical practice and all the affecting factors that influence the exploit of online research. This is a unique survey conducted in Greek healthcare sector, examining the benefits of electronic knowledge, comparing with similar international surveys and filling the existing research gap about clinicians' evidence-based information retrieval.

## 2. Methods

A 25 item questionnaire were selected from a South New Wales survey accessing an online evidence portal called Clinical Information Access Program (CIAP)[7]. The instrument was tested about the validity and reliability. The reuse of this instrument was approved by its authors by an electronic message. The items of the instrument contains information about a) demographics of participants (e.g. age, sex, clinical position, time of experience) b) information technology skills c) awareness of online bibliographic databases d) usage of online bibliographic databases e) frequency of use f) rating the characteristics of databases g) the reasons of using h) the reasons of not using i) attitudes about the impact of patient care. The questionnaire contains closed-ended questions(yes/no), multiple response items and rating scale items. The study was approved by the University of Athens, Faculty of Nursing's Ethics Committee. The instrument were translated in Greek language by two independent translators using reverse translation method and designed online, using Google forms.

A group of 6 clinical experts evaluated the survey questionnaire to adjust it to the present research providing narrative comments and testing the adequacy and efficacy of question items. After the improved version, the questionnaire was pilot tested by a sample of 20 clinicians (18 nurses and 2 physicians). The instrument's Cronbachs' alpha coefficient ranged from 0.887 to 0.897 appearing high internal consistency and reliability between the questions[8].

### 2.1. Procedure

Convenience sampling was selected for the data collection. An online survey was designed and was conducted from June to September 2015. An announcement was published on the website of Greek Nurses Association and the online instrument was posed to this website. Also, an electronic mail was sent to the emailing list of 650 physicians of a Greek Medical Association, containing the electronic format of the questionnaire. In both organizations were notified information about the aim of the research and the ethical considerations that were ensured by the research procedure.

The data were entered into a SPSS database. Descriptive statistics were used to examine distributions of responses. Chi-square analysis and t-tests were used to evaluate the characteristics of the participants who were users of electronic databases and some were not, significance was set at  $p < 0.05$ . Bivariate analysis were used to specify the correlation between the outcome of bibliographic databases' use (dependent dichotomous variable) and the determinants (independent variables) setting statistical significance of 0.05. Variables were tested about Normal distribution; Spearman's rank correlation coefficient was used and simple logistic regression was used for ordinal



variables. Furthermore, a predictive regression model was constructed to estimate the likelihood of the outcome (use of databases), affecting by specific indicators, using stepwise logistic regression with backward variables elimination.

### 3. Results

The convenience sample of 263 health care professionals had a mean age of 37.6 years (SD= 9.1 years, range=22-66 years); 61.6 % were females and 38.4% were males. The high proportion of females reflects the gender composition of health care professionals. Respondents to survey by professional groups were nurses 46.4% (n=122), doctors 52.5% (n=138) and other 1.1% (n=3). Ninety-three percent (n=221) had heard about the online bibliographic databases. There were no significance differences in the level of awareness among the professional groups ( $\chi^2=1.559$ , d.f.=2, p-value>0.001). 7.2% (n=19) of doctors and 8.4% (n=22) nurses haven't heard about them. 5.7% of participant sample have heard about online databases but they do not use them. 18.3% (n=48) was the total sample of non-users, from this 58.3% (n=28) were nurses and 39.6% (n=19) were doctors. Non-users seem to disagree with the statement (31.3%) "*I don't need online bibliographic databases to do my job*" but they agreed (45.8%) with the statement "*I use other information source*", 45.8%, also admitted that they do not use them because of lack of time, 37.5% of them have difficulty using it and 43.8% doesn't use them because of lack of training.

Users of online bibliographic databases called to rate the reasons of using in a five-point-scale (1 = never to 5 = always). The reasons that ranked at the top of users' perceptions were: fill a knowledge gap (50.7%), develop and review policies (41.9%), access standard reference (41.9%), develop a scientific assignment (36.7%) and settle disputes (33%). Users, also, called to rate the properties of online databases. They were assessed as very easy to use by 16.7%, easy by 42.8%, neither easy nor difficult by 38.1%, difficult by 2.3%. About the speed of search time, 50.7% rated very good and 20.9% excellent search time, moreover 54% of the users admitted that have very good access to technical support. Online bibliographic databases, also, were assessed about their effectiveness in clinical practice. 74.9% (n=161) of respondents who use them replied that they have found most of the times the information needed and a percentage of 15.8% (n=34) have found always the needed information. Also, users called to answer the questions "Do you believe that online databases have the potential to improve patient care?" 93% (n=200) said yes, 4.7% (n=10) said don't know and "Do you have direct experience of online databases resulting in improved patient care?" 64.7% (n=139) of users responders replied yes, 35.3% said no. Users of databases called to mention their perceptions of support for use. 30.7% (n=66) agreed that '*stuff is encouraged to use them*', 15.3% (n=33) is strongly agreed with this statement. 40.5% (n=87) agreed and 19.5% (n=42) strongly agreed that '*people I am worked with use them*'. 47% (n=101) agreed and 22.8% (n=49) strongly agreed that '*the use of online bibliographic databases are a legitimate part of my clinical role*', 23.7% agreed and 17.2% strongly agreed with the statement that '*my supervisor thinks that using online bibliographic databases is a legitimate part of my clinical role*'.

Results from bivariate analysis (Table 1) were shown that people who use computers in general have 14.2 times more likelihood to use bibliographic databases and 4 times more likelihood if they are using computers in their workplace. There was no significance correlation between database use, education level and computer skills,

using the 95% confidence interval for adjusted odds ratio. Results from the multivariate analysis were concluded in the construction of a predictive logistic model of bibliographic database use (Nagelkerke R square= 0.280, Hosmer and Lemeshow Test= 0.475). The total predictive capacity was assumed of 84% which means that 213 participants of the survey use bibliographic databases after the effects of confounders (Table 2).

**Table 1.** Pearson's chi-square test with dependent variable the electronic database use and independent variables, the variables which appeared statistical significance 0,05 (Variables' Test distribution Normal) and Risk estimate

Variable	X <sup>2</sup>	df	P value	Value	95%CI for Exp(B)
Experience in computers' use in general	5.298	1	0.020	(Odds ratio, Yes/No) 14.200	1.444-139.65
Use of informatics in workplace	5.649	1	0.033	(Odds ratio, Yes/No) 4.031	1.177-13.810
Educational level <sup>a</sup>	529.852	1	0.001	Exp(B):Technological Education 0.031	0.004-0.244
				Exp(B):Higher Education 0.099	0.013-0.763
				Exp(B):MSc Education 0.267	0.032-2.252
Skills in using computers <sup>a</sup>	7.796		0.005	Exp(B):Poor 0.00	0.000-0.000
				Exp(B):Moderate 0.144	0.034-0.618
				Exp(B):Proper 0.396	0.107-1.461
				Exp(B):Great 0.322	0.091-1.145

<sup>a</sup> For Ordinal variables used Linear-by-Linear Association. Odds ratio and relative risk were estimated using Simple Logistic Regression for ordinal variables.

**Table 2.** Stepwise regression with backward variables elimination in a sample of 262 participants with dependent variable the use of electronic databases or not and independent variables the use of informatics in workplace, skills in computer use, educational level, experience in computer use in general.

Variable	Coefficient of Regression (b)	S.E	Exp(B)	95% CI for Exp(B)	P value
Use of informatics in workplace	1.524	0.748	4.589	1.060-19.863	0.042
Skills in using computers (moderate=2)	-1.571	0.802	0.208	0.043-1.002	0.050
Educational level (Technological=1)	-3.744	1.106	0.024	0.003-0.207	0.010
(Higher=2)	-2.311	1.079	0.099	0.012-0.822	0.032

#### 4. Discussion

The present survey adds critical knowledge about nurses' and physicians use of online evidences arising from online bibliographic databases and the use of them in clinical practice. Both groups, nurses and doctors, seem to have heard about them with a low percentage of nurses who have not. The users seem to have low frequency of use the last month, in both groups, and higher percentages in the intention of future use. Most of them have used them near the point of care and sparsely in home or in a library.

Non-users which consisted in the majority by nurses admitted that they prefer another source of information, they do not have enough time to use them and they have lack of training in retrieval information. On the other hand the majority of users utilize them to fill a knowledge gap and to review online policies and procedures to improve their clinical practice. Users agree that online bibliographic databases are a part of their legitimate role and they are encouraged by their work environment to use them. The

significant amount of 93% of participants who use them seems to believe that the use of online bibliographic databases improves the provided patient care and 67% of them have such an experience in the past. A predictive logistic model was developed to correlate the use of retrieval information systems with the independent confounding variables but further research in this field is needed to discover the confounders that are connected with the real clinical area.

Similar surveys are existed in published literature. The findings look similar with the present research. Clinicians[9] from New South Wales increase the web-logs of their online information retrieval system (CIAP) with the patients admissions, which means that the use of evidences is related to direct patient care. Some health care professionals[10] admitted that online evidences improve patient care and they have lack of access in databases at the point of care. Perceptions[11] about organizational and professional support for health care professionals to use of retrieval systems on their work play a primary role influencing the systems' use. Searching for valid, accurate, relevant clinical knowledge through online databases, nurses are expected to improve the strategy skills finding the best clinical inquiry to answer their clinical questions[12]. Although physicians are increasingly confident and successful in searching databases to answer questions associating with patient care, it is needed to encouraged them use online data based on patient encounter[13]. As a conclusion, further research must be continued to assess nurse practitioners' skills, identify the barriers in using resources and examine the role that online databases plays in facilitating reflective nursing practice.

## References

- [1] A. Anker et al, Health Information seeking: A review of measures and methods, *Patient Education and Counseling* **82** (2011), 346-354.
- [2] N. Tannery et al, Hospital nurses' use of knowledge-based information resources, *Nursing Outlook* **55** (2007), 15-19.
- [3] W. Hersh et. al, Factors associated with successful answering of clinical questions using an information retrieval system, *Bull Med Libr Assoc* **88** (2000), 323-331.
- [4] O. Waloush, Information literacy during entry to practice: Information-seeking behaviors in students, nurses and recent graduates, *Nurse Education Today* **34** (2014).
- [5] J. Squires, Individual determinants of research utilization by nurses: a systematic review update, *Implementation Science* **6**(2011), 1.
- [6] J. Ross, Information Literacy for Evidence-Based Practice in Perianesthesia Nurses: Readiness for Evidence-Based Practice, *Journal of PeriAnesthesia Nursing* **25**(2) (2010), 64-70.
- [7] A.S. Gosling, J. Westbrook, Nurses' use of online clinical evidence, *Journal of Advanced Nursing* **47** (2004), 201-211.
- [8] P. Lialiou, J. Mantas, Health Professionals' Use of Computer Databases to Utilize Research for Practice: A Pilot Study, *Studies in Health Technology Information* **213** (2015), 291-293.
- [9] J.I. Westbrook et al, Do clinicians use online evidence to support patient care? A study of 55,000 clinicians, *Journal of the American Medical Informatics Association* **11** (2004), 113-120.
- [10] J.I. Westbrook, Ambulance officers' use of online clinical evidence, *BMC Medical Informatics and Decision Making* **6** (2006), 1-8.
- [11] C.A. Estabrook et al, Profiling Canadian nurses' preferred knowledge sources for clinical practice, *Canadian Journal of Nursing Research* **37** (2005a).
- [12] L. Facchiano, C.H. Snyder, Evidence-based practice for the busy nurse practitioner: Part two: Searching for the best evidence to clinical inquiries, *American Academy of Nurse Practitioner* **24** (2012), 640-648.
- [13] N. Benett et al, Family physicians; information seeking behaviors: A survey comparison with other specialties, *BioMed Central* **5** (2005)(9), 1-5.

# Studying the HIT-Complexity Interchange

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**Abstract.** The design and implementation of health information technology (HIT) is challenging, particularly when it is being introduced into complex settings. While complex adaptive system (CASs) can be a valuable means of understanding relationships between users, HIT and tasks, much of the existing work using CASs is descriptive in nature. This paper addresses that issue by integrating a model for analyzing task complexity with approaches for HIT evaluation and systems analysis. The resulting framework classifies HIT-user tasks and issues as simple, complicated or complex, and provides insight on how to study them.

**Keywords.** Complexity, health information technology, usability testing, clinical simulation, naturalistic observations, technology-induced errors

## 1. Introduction

It is acknowledged that introducing health information technology (HIT) into clinical areas is complex, particularly when workflows are impacted [1]. There is a wide body of research on unintended consequences that describe HIT implementation issues including communication issues, workflow issues, and contribution to or the creation of medical errors [2-5]. Sometimes unintended consequences arise as a result of interventions to address other problems. For example, while HIT was advocated as a solution to prevent medical errors [6], it actually became the driver for a new category of errors called technology-induced errors [5]. HIT issues are particularly problematic for front line clinical staff such as nurses.

Despite our best attempts at automating a complex environment we still have trouble predicting how people and technology will interact, resulting in a variety of unintended consequences as described above. A complex adaptive system (CAS) is a system that displays properties such as emergent behaviors, non-linear processes, co-evolution, requisite variety, and simple rules [7]. As a system becomes more complex, the number of components and interactions between each component increase, both within the system itself, and between a system and its surrounding environment [8]. Automating healthcare delivery through HIT is also a complex endeavor and could be informed by principles of complexity theory for understanding workflow and other aspects that are critical for HIT implementation [1]. Articulating workflow complexities and how to evaluate and design HIT to manage the issues is particularly relevant to front line clinical staff such as nurses [9].

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While it has been acknowledged that CASs can help us study, analyze and propose solutions for reconciling workflow and HIT implementation, an acknowledged shortcoming with using CASs for studying healthcare delivery is that it may simply be the new fad, or the ‘emperors new clothes’ [8]. Much of the current research on CASs is descriptive in nature and lacks methodological rigor on how CASs should be used to understand HIT design and implementation [10].

Evaluation approaches from usability engineering such as usability testing and cognitive task analysis have greatly enhanced our ability to understand how HIT needs to be tailored to fit the clinical context where it will be used [11-12]. It has been suggested that multi-modal approaches to evaluation, for example combining think-aloud methodology with ‘near-live’ clinical simulation can enhance evaluation by providing an environment that replicates real world clinical settings [12]. While innovative usability approaches such as near-live evaluation have pushed the envelope of how we evaluate HIT, it works best if we can have an accurate model of the clinical environment. While the complexity of the clinical environment, and the impact it has on HIT implementation has been acknowledged, there are no studies that have combined elements of CASs and usability engineering to inform the design and evaluation of HIT.

This paper addresses the above shortcoming and integrates the Cynefin model of CASs with approaches for HIT evaluation and systems analysis. The results are an integrated framework that can be used to classify and study user-task interactions with HIT.

## 2. Methods

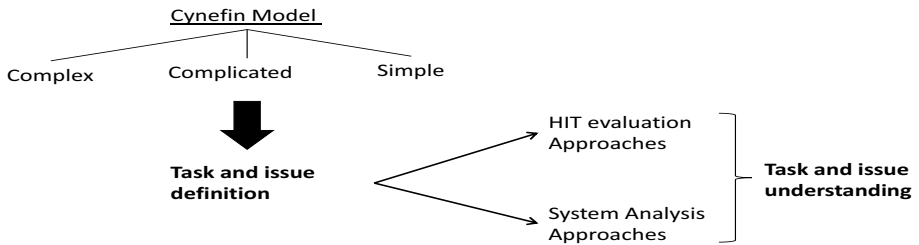
### 2.1. Case Studies and Conceptual Models

The authors draw upon several studies where they have looked at HIT implementation in a variety of contexts and settings including perioperative care, palliative care and handovers between units and facilities. Our conceptual framework integrates two models and a set of systems analysis approaches. First is a model for representing complex systems (the Cynefin Model) that represents complex systems as agent relationships, experience, and context from a systems perspective [13]. Second is a model that represents a continuum of system testing approaches ranging from usability testing through to naturalistic studies [14]. Third is the incorporation of methods for systems analysis of an environment where HIT is used.

### 2.2. Data Analysis

In each of our cases studies we first identified various tasks users do while interacting with HIT. We then identified issues that occur in the context of conducting the task and then categorized the issues as simple, complicated or complex as per three of the categories from the Cynefin model [13]. Simple issues are repeatable and predictable and they can be managed by developing best practices. Simple issues are managed by sensing, problem, categorizing and responding to a problem. Complicated issues are separated over time and space and may have multiple components and relations. While they can be modeled and replicated, they require systems thinking and analysis to articulate the issues so they can be managed. Complex issues are not predictable but

rather will evolve over time, unlike simple or complicated issues, which tend to be more stable. Complex issues require probing and sensing to understand the issues both initially and longitudinally over time. Fig.1 shows our conceptual framework and its two main aspects. On the left side, the Cynefin model is used for to define tasks and issues. On the right side, the tasks and issues are analyzed to enable understanding of them using HIT evaluation and systems analysis approaches, respectively.



**Fig. 1.** Conceptual framework for defining and understand tasks and issues

### 3. Results

In this section we provide empirical examples of using our framework. We describe simple, complicated and complex issues and how they would be studied.

#### 3.1. Simple

Simple refers to defined and repeatable tasks and situations involving minimal interactions. Examples of simple tasks are defined data entry such as a patient surgical history as part of pre-operative assessment. The task is a one-to-one interaction between the nurse and patient involving one system and no additional interactions. One way of analyzing simple problems involving technology in health care is to apply basic methods from usability engineering such as usability testing and usability inspection. Both of these methods involve analyzing user interactions on tasks that are well defined a repeatable and involve minimal interaction with other users. Examples of such studies come from the work of Kushniruk and colleagues who have refined low cost rapid analysis methods for analyzing simple clinical situations involving health information technology such electronic health records and decision support systems [15]. For example, one could conduct usability tests with a nurse using a peri-operative system as the nurse performs the task of entering patient information for pre-operative assessment.

#### 3.2. Complicated

Complicated tasks have components and relationships that are separated by time and space. The nature of the tasks is that cause and effect may be repeatable, and while the task has multiple interactions, they can all be proactively predicted. For example, collaborative care delivery involves teamwork in which clinicians work both

synchronously and asynchronously. The key is to understand the nature of the various interactions to ensure that HIT supports them appropriately while limiting unintended consequences. Clinical simulations can be used for systems analysis to understand how technology is used in complicated situations. Here, representative users can be asked to work with health information technology in realistic and repeatable scenarios in contexts. Data gathered using audio, video and computer screen recordings can be reviewed and analyzed to identify the unintended consequences. Video analysis can be further done to reveal the factors that contributed to the emergence of unintended consequences during the clinical simulations [14]. For example, a peri-operative nurse could be administering medication to a patient. In the process of administering the medications, s/he engages in several workarounds involving the system and the devices that are used to verify the patient's identity (i.e. bar code scanner, bar coded medication and the patients' bar coded identification bracelet). The nurse also needs to consult a perioperative information system to verify earlier information collected on the patient and to ensure there are no potential conflicts with the new medication. System understanding is brought to the situation as the nurse is interacting with several types of technology (including a medication administration system) and system components (e.g. team members or information from other perioperative areas).

### 3.3. *Complex*

Complex situations refer to instances where cause effect are not repeatable and will evolve and change over time. An examples is the handover process between units such as the operating room (OR) and post anesthesia care unit (PACU). Nurses described that in the previous paper based system the handover process had been mainly written with oral supplementation as needed. After implementing a perioperative HIT there was a large increase in the oral component of handovers. This change was attributed to two issues. One was the variation in surgery types where more complicated surgeries would lead to more complex handovers. The second issue was that some anesthetists described how the fast pace of handovers did not enable them time to accurately type a handover report, especially in complicated cases. Subsequently the handover process became more verbal with written supplementation as needed. Naturalistic observation can be used to better understand complex clinical situations such as the OR-PACU handover. Here, observations are directly made of the work environment where a nurse is performing patient care. Observations allow the researcher to identify the activities the nurse is performing and the interactions that she has with the technologies in her work environment to provide patient care. In these cases, there is a need to have trained observers note the interactions that take place. This work can also be done by video and audio recording of live interactions between a nurse and her colleagues in a given setting such as a patient care area or an operating room [16]. Given that complex tasks will evolve over time, observations must be done repeatedly to identify and understand the impact of such task evolution.

## 4. Discussion

This paper provides a framework that illustrates how CASs can be combined with HIT evaluation and systems analysis approaches for understanding the complex nature of HIT implementation. It addresses shortcomings in existing use of CASs in healthcare in

that we provide methodological details on how CASs can be used to study the tasks and issues. A key contribution from our framework is the distinction between the definition and understanding of tasks and issues. Definition helps categorize tasks & issues while understanding helps to understand them from both a HIT and complexity perspective. Some tasks are simple, others are more complicated and may span multiple agents or units, while others are complex and evolving and may not be apparent at first glance. It is essential that complex tasks are or probed in order to articulate the inner workings of the complexity as well as studying longitudinally given that complexity evolves over time. Limitations of our study are that the framework we developed is based on limited studies. Future work will evaluate our framework in other settings.

## References

- [1] P.A. Abbott, J. Foster, H.D.F. Marin, H.D.F., P.C. Dykes. Complexity and the science of implementation in health IT-knowledge gaps and future visions, *International Journal of Medical Informatics* **83** (7) (2014), e12-e22.
- [2] J.S. Ash, M. Berg, E. Coiera. Some unintended consequences of information technology in health care: the nature of patient care information system-related errors, *J Am Med Inform Assoc.* **11**(2004), 104-112.
- [3] M.I. Harrison, R. Koppel, S. Bar-Lev. Unintended consequences of information technologies in health care: an interactive sociotechnical analysis, *J Am Med Inform Assoc* **14**(2007) 542-549.
- [4] L. Novak, J. Brooks, C. Gadd, S. Anders, N. Lorenzi. Mediating the intersections of organizational routines during the introduction of a health IT system, *European Journal of Information Systems* **21** (5) (2012), 552-569
- [5] E.M. Borycki, Technology-Induced Errors: Where Do They Come From and What Can We Do About Them? *Studies in health technology and informatics* **194** (2013), 20-26.
- [6] D.W. Bates, A.A. Gawande. Improving safety with information technology. *N Engl J Med* **348**(25) (2003), 2526-34.
- [7] B. Ellis, S.I. Hebert. Complex adaptive systems (CAS): an overview of key elements, characteristics and application to management theory, *Informatics in Primary Care* **19** (2011), 33–37.
- [8] T. Kannampallil, G. Schauer, T. Cohen, V. Patel. Considering complexity in healthcare systems, *J Biomed Inform* **44**(6) (2011), 943-7
- [9] S.A. Collins, D. Alexander, J. Moss. Nursing domain of CI governance: Recommendations for health IT adoption and optimization, *Journal of the American Medical Informatics Association* **22** (3) (2015), 697-706.
- [10] I. Reid. Complexity science. Let them eat complexity: the emperor's new toolkit. *BMJ (Clinical research ed.)* **324** (7330) (2002):171.
- [11] L.W.P. Peute, N.F. de Keizer, M.W.M. Jaspers. The value of Retrospective and Concurrent Think Aloud in formative usability testing of a physician data query tool. *Journal of Biomedical Informatics*, **55** (2015), 1-10.
- [12] A.C. Li, J.L. Kannry, A. Kushniruk, D. Chrimes, T.G. McGinn, D. Edonyabo, et al., Integrating usability testing and think-aloud protocol analysis with “near-live” clinical simulations in evaluating clinical decision support, *Int. J. Med. Inform.* **81** (2012) 761–772.
- [13] D.J. Snowden, M.E. Boone ME. A leader’s framework for decision making. *Harv Bus Rev.* 2007;**85**(11):68-76, 149.
- [14] A. Kushniruk, C. Nohr, S.Jensen, E.M. Borycki. From Usability Testing to Clinical Simulations: Bringing Context into the Design and Evaluation of Usable and Safe Health Information Technologies. Contribution of the IMIA Human Factors Engineering for Healthcare Informatics Working Group. *Yearb Med Inform* (2013), 78-85
- [15] A. W. Kushniruk, E. M. Borycki. Low-cost rapid usability engineering: Designing and customizing usable healthcare information systems. *Healthcare quarterly (Toronto, Ont.)*, **9**(4) (2005), 98-100.
- [16] A.W. Kushniruk, E.M. Borycki, J. Kannry. Commercial versus in-situ usability testing of healthcare information systems: Towards “public” usability testing in healthcare organizations. *Stud Health Technol Inform* **183** (2013),157-61.



# Competency Skills Assessment: Successes and Areas for Improvement Identified During Collaboration Between Informaticists and a National Organization

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**Abstract.** The Association of periOperative Registered Nurses (AORN) approached the Nursing Informatics Research Team (NIRT) with a request to collaborate and conduct a competency assessment for their organization. An online tool was developed to determine current technology in perioperative settings. This presentation shares the process used to conduct research that led to a method for assessing perioperative nurses' competencies skills in their practice as well as identified gaps in curricula that faculty could address. Both successes and areas for improvement are detailed. The outcome of the process demonstrated a need to understand *what* skills are being assessed as AORN did not know *what* technology existed or *how* existing equipment was being used.

**Keywords:** Informatics, competencies, technology assessment, competency skills self-assessment

## 1. Introduction

National organizations call for nursing informatics skills in today's workforce. However, there is little understanding of what competencies are needed or how they should be applied. Chamberlain College of Nursing's Nursing Informatics Research Team (NIRT) developed tools to assess informatics competencies. The Association of periOperative Registered Nurses (AORN) sought to determine members' needs when using technology in perioperative areas.

### 1.1 History and Definition

Informatics competencies are crucial to clinical practice and patient safety. All healthcare providers must be able to guide nurses and other healthcare workers, as end-users of technology, in ways that advance their informatics competencies. Historically, the Institute of Medicine (IOM) *The future of nursing* report stated, "In the future,

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virtually every facet of nursing practice in each setting where it is rendered will have a significant digital dimension around a core EHR” [1]. This same report noted informatics competencies were critical for effective workforce planning and policy making, which require better data collection and information infrastructure [1]. The World Health Organization (WHO) has informatics initiatives in place to meet its work in eHealth [2]. Some competency examples are:

- At the entry level, basic computer literacy, ability to use information technology (IT) to support clinical and administrative processes, and the ability to process data and document via computers.
- Experienced nurses are proficient in the areas of nursing and IT needed to support practice, methods for evidence-based practice (EBP), use of EBP, and the promotion of innovation applications.
- The informatics nurse specialist (INS) possesses a higher level of understanding and application of information management/technology.

More recently, the American Nurses Association (ANA) updated the definition of nursing informatics (NI) as the “specialty that integrates nursing science with multiple information and analytical sciences to identify, define, manage, and communicate data, information, knowledge, and wisdom in nursing practice” [3]. Advances in informatics will benefit greatly those who use clinical IT once the first and basic step of education and competency development has been provided in ways that will empower them to acquire and apply needed competencies. As noted in the Technology Informatics Guiding Education Reform (TIGER) initiative, the need to understand and apply these skills is critical to assure that providers excel when delivering best practices that will enhance patient safety and improve clinical workflows, research and other outcomes [4]. The call for informatics competencies has been “hindered by a lack of procedures and assessments available for determining nurses’ informatics competencies – in other words - what they actually require in order to be competent in their job roles” [5]. According to McGonigle, Hunter, Sipes, and Hebda, the lack of understanding of what nursing informatics is, prerequisite skills, and how those skills can be applied to practice continues [6].

This paper shares the process and lessons learned through a collaboration. During the informatics skills assessment phase, inconsistencies were found in understanding what informatics skills were and how technology was used. For example, using radio-frequency identification (RFID) or bar-code scanning to control the flow of personnel in the operating room (OR) varied by institution, which led to inconsistent responses from the participants on the informatics self-assessment tool. At this point, the AORN tool was revised, leading to tool development for assessing perioperative technology, and how it was used by nurses. Some of the skills defined were informatics competencies such as data management and workflow assessment. Both the informatics-competency self-assessment and the new AORN tool helped to identify skills required for competent practice and gaps to be addressed through education.

### *1.2 Competency skills tool development*

Chamberlain College of Nursing (Chamberlain) Nursing Informatics Research Team (NIRT) has long recognized the challenges and needs for nurses to gain skills to support the move to eHealth and use of electronic medical records (EMRs) in a safe and effective manner. In 2013 and 2014, Chamberlain researchers designed and developed instruments that were reliable and valid for nurses to self-assess their

nursing informatics (NI) competencies at both the basic and advanced levels. Hunter, McGonigle, and Hebda developed TIGER-based Assessment of Nursing Informatics Competencies (TANIC), a measure of basic informatics competencies first referenced in 2001 by Staggers, Gassert and Curran [7, 8]. The basic competencies include Level 1, the beginning nurse, and Level 2, the experienced nurse. McGonigle, Hunter, Hebda, and Hill further developed Nursing Informatics Competency Assessment (NICA) L3/L4, a measure of advanced informatics competencies, which includes Level 3, the informatics specialist, and Level 4, the informatics innovator [9].

The resulting published research and instrument development led to the Association of periOperative Registered Nurses (AORN) approaching Chamberlain's NIRT with a request to collaborate and conduct an informatics competency skills assessment for the organization. They also requested collaboration to develop an online informatics skills competency tool they could use to determine utilization of current technology employed in perioperative settings as well as evaluate how that technology might affect surgical outcomes.

## 2. Methods

The initial plan was to assess AORN membership to determine their informatics skills level, then to address gaps in their skills levels with education. The process is described below.

### 2.1 Initial plans

AORN sought help from NIRT to develop an instrument based on NIRT's prior work. A research plan and timeline were created and a group of reviewers with perioperative expertise established. The literature review found no current or relevant information that addressed the question, "How does technology affect the nature of surgeries for perioperative nurses"? It was determined that progress required understanding what competencies were needed as supported by an article defining why one must understand nursing informatics [10]. A self-assessment of competencies, using TANIC, as a baseline to identify skill gaps was identified as the next step.

## 3. Results

While investigating AORN needs, NIRT found it necessary to define what informatics skills were, as opinions differed. Other areas were to understand how skills were used with perioperative technology, what technology was used - as it differed by region, and to identify skills needed and gaps that could be addressed through education.

### 3.1 Outcomes of initial assessment – Lessons learned

The initial informatics-competency self-assessment found AORN members did not understand what informatics was, beyond data collection, nor *what* technology was in current use, or *how* it was used, especially in different settings across the country. Through subsequent meetings with AORN and subject matter experts, the research

process and desired outcomes were revised from using the TANIC to assess informatics skills to gaining a better understating of the types of technology in use. Initially, the planned outcomes of this collaboration were to develop a reliable, valid instrument that could be used annually to assess competency levels, explore research questions, and develop additional peer-reviewed articles that could be published in the AORN journal.

The lessons learned demonstrated that before an informatics competency assessment can be completed, one must first understand *what* the goal of the assessment is, including defining all terms and determining what is actually being measured. After this, one can develop the next steps and plan for how the self-assessment and research will be done, who will be involved, and the anticipated outcome. It is also important to determine where and what gaps might be found in the assessment and develop a plan to address them. For example, if there is a gap in skills' education and training, it will be important to plan professional-development activities for perioperative nurses.

#### **4. Conclusions and Successes**

Based on the research and "discovery," it was evident that gaps existed in understanding informatics, existing competencies, skills needed based on the technology in use by AORN members, and how issues would be resolved. According to Sipes, it was evident that before any competency assessment could accurately be completed, there is a need to investigate and understand exactly who, what, where, why, and how skills are being assessed [12]. From this information, a plan can be developed for what the next steps should be. If this assessment is implemented before first trying to understand what skills are needed, any subsequent work will be invalid.

The success of this project with AORN demonstrated the need to conduct a needs assessment prior to developing a process to evaluate competencies and moving forward with a plan. There is now a documented process and a valid, reliable, online self-assessment tool that can be used in the future by AORN with success, based on the re-work of this project. The next steps for AORN and the collaborative project will be to determine further utilization of current perioperative technology and how that use affects surgical outcomes, which was the original intent of the collaboration. The knowledge acquired can be used to plan professional development activities.

#### **5. Recommendations: Areas for Improvement**

The original goal of assessing competencies and skills was underestimated. The TANIC tool did not meet the needs or goals of the project. There was a lack of methodology to determine what technology was used at various organizations and related competencies needed by nurses.

This project demonstrated a need to fully understand the problem and then develop and implement a plan to move forward. In retrospect, a pilot study to identify gaps in skill levels, existing technology use, and other issues would have been helpful. Some other problems and questions derived from the study were "the technology exists but the skills training does not"; If trained for x technology, how does that apply to z technology? Can standardized training meet the needs of all perioperative nurses?

In order to achieve the knowledge and wisdom needed in today's healthcare arena, information must be available. Educational programs, curricula development, publications, national meetings, and other venues must disseminate the information needed to assess skill requirements and educate the workforce [11]. National organizations such as American Nursing Informatics Association (ANIA), National League of Nursing (NLN) and the American Nurses Association (ANA) can drive opportunities for nurses to gain skills needed, after first completing the self-assessments.

## References

- [1] IOM: The Future of Nursing: Leading Change, Advancing Health *Committee on the Robert Wood Johnson Foundation initiative on the future of nursing, at the Institute of Medicine.* (2010). Retrieved from <http://www.thefutureofnursing.org>. p.140.
- [2] World Health Organization (WHO) eHealth Collaborations. (2015). Retrieved from <http://www.who.int/ehealth/about/ehealthcollaborations/en/>.
- [3] American Nurses Association (ANA) Health IT Initiatives. (2015). Retrieved from <http://nursingworld.org/MainMenuCaterforries/The Practice of Professional Nursing/Health-IT.org>, p.1-2; 190.
- [4] Technology Informatics Guiding Education Reform (n.d.) *Informatics competencies for every registered nurse: Recommendations from the TIGER collaborative.* Retrieved from [http://www.tigersummit.com/uploads/3.Tiger.Report\\_Competerencies\\_final.pdf](http://www.tigersummit.com/uploads/3.Tiger.Report_Competerencies_final.pdf).
- [5] T. Hill, D. McGonigle, K. Hunter, C. Sipes, & T. Hebda, An instrument for assessing advanced nursing informatics competencies. *Journal of Nursing Education and Practice* **4** (7), (2014) 104-112.
- [6] K. Hunter, D. McGonigle, T. Hill., T. Hebda., & C. Sipes Self-Reported Assessment of Basic and Informatics Specialist/Innovator Nursing Informatics Competencies: TANIC© and NICA L3/L4©. *Nursing Informatics Today* **29** (2) (2014). 4-6.
- [7] K. Hunter, D. McGonigle, & T. Hebda The integration of informatics content in baccalaureate and graduate nursing education: A status report. *Nurse Educator* **38** (3) (2013).110-113. doi: 10.1097/NNE.0b013e31828dc292.
- [8] N. Staggers, C. Gassert, & C. Curran, Informatics competencies for nurses at four levels of practice. *Journal of Nursing Education* **40** (7) (2001). 303-16
- [9] D. McGonigle, K. Hunter, T. Hebda, & T. Hill Self-Assessment of Level 3 and Level 4 NI Competencies Tool Development. (2014). Retrieved from <http://himss.files.cms-plus.com/FileDownloads/Self-Assessment.pdf>.
- [10] D. McGonigle, K. Hunter, C. Sipes, & T. Hebda Why nurses need to understand nursing informatics, *AORN Journal* **100** (3) (2014).
- [11] M.D. Hart Informatics competency and development within the US nursing population workforce: A systematic literature review. *Computers, Informatics, Nursing* **26** (6), (2008), 320-329. doi:10.1097/01.NCN.0000336462.94939.4e.
- [12] C. Sipes (2016) *Project Management for Advance Practice Nurses*, Springer, New York

# Promoting mHealth in Nursing Practice in China

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**Abstract.** The purpose of this project was to reveal the status quo of mHealth application in clinical settings in China, especially in reducing patient falls and pressure ulcers and discuss how patient safety could be enhanced in the context of global collaboration on patient safety. The literature search resulted in a total of 290 articles. A steady increase is witnessed in the field of mHealth, especially after the year 2010. Personal digital assistant and electronic cart are the two main devices used in mobile nursing workstation. mHealth was mainly focused on two clinical areas, nursing practice (60.69%) and nursing management (25.86%). mHealth has begun to change the way of nursing process in prevention of adverse nurse events with an encouraging results in reducing the rate of pressure ulcer and falls. Healthcare educators should fully recognize the characteristics of mHealth and enhance a clinical informatics component in the curricula.

**Keywords.** mHealth, Patient Safety, Fall, Pressure Ulcer, Nursing Informatics Education

## 1. Introduction

The prevalence of mHealth shows a growing impact in nursing practice and education. According to the World Health Organization (WHO), mHealth is regarding “medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices”[1]. mHealth has the potential to transform the way of healthcare delivery across the globe[2]. It facilitates real-time clinical information at the point of care, improves communication between healthcare professionals and provides evidence-based medical resources including drug references and patient education materials[3,4]. Especially, it helps in prevention of patient safety events, such as falls and pressure ulcers [5].

As smart phone becomes ubiquitous, there has been an increasing adoption of mobile health (mHealth) in China and other countries [3]. China owns the largest number of mobile devices and mHealth app users in the world[6]. The data from the Ministry of Industry and Information Technology of China showed that in 2014, the overall mobile phone users in China were over 1.29 billion[6]. Unfortunately, it remains unclear in terms of the status of mHealth in nursing practice in China. The

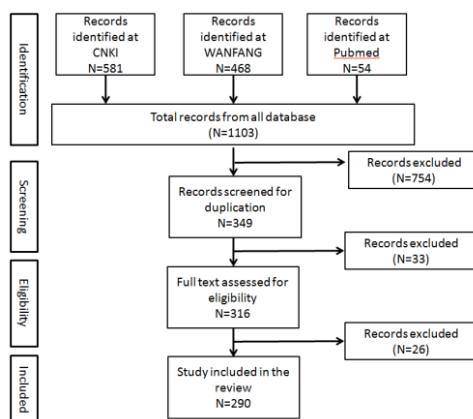
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main purpose of this project was to reveal the status quo of mHealth application in clinical settings in China. Besides, as patient fall and pressure ulcer are typical nursing adverse events, thus another purpose of this study was to explore the role of mhealth in reducing patient fall and pressure ulcer and discuss how mHealth has changed the way of nursing practice and patient safety could be enhanced in the context of global collaboration.

## 2. Methods

We defined our search strategy by using PICO framework (Population: “nursing” or “health care” or “care” or “pressure ulcer” or “fall”; Intervention: “mHealth” or “mobile Health” or “electronic health record” or “applications” or “Personal Digital Assistant” or “PDA” or “smartphone” or “hospital information system”; Comparison: none; Outcome:none). CNKI (1999-2015), and WanFang(1999–2015), two most popular Chinese literature databases, and Pubmed (1990-2015), were used to identify relevant references. The focus of the study was on mobile health in clinical settings, as a result, articles not related to health care was excluded based on an agreement of the authors. Articles in English or Chinese were included.

Following the PRISMA flow chart (Figure 1), we identified 290 articles for further analysis.



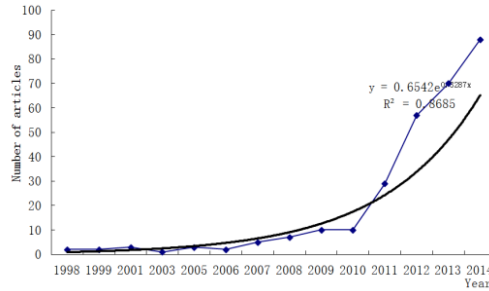
**Figure1.** PRISMA flow chart of the study

## 3. Result

### 3.1 Status Quo of mHealth Application in Clinical Settings in China

The first eligible article was a review about mobile hospital information system published in 1998[7]. A milestone of mHealth in China was dated in 2005 when Peking Union Medical College Hospital introduced the very first clinical mobile hospital information system in China[8]. Since then, a steady increase is witnessed in the field of mHealth (Figure 2). Noticeably, a dramatic increase is observed as of 2010, with 87.59% of the total articles were published between 2010 and 2015.

In China, Beijing, Shanghai and Guangdong province are the top three areas, from which the majority China’s mHealth articles (43.12%) were published.



**Figure 2.** Number of mHealth articles in China (1998-2014). Y means an exponential curve fitting equation with  $R^2$  representing degree of fitting

Personal digital assistant (PDA) and electronic cart (with PC mounted) were the two main devices used in mobile nursing working station. The mHealth related techniques were mainly focused on two clinical areas:

- Nursing practice: 176 articles (60.69%) described applying mHealth in nursing practice. Examples: electronic health record, nursing rounds assistance, patients health education, vital signs monitor and integration, and
- Nursing management: 75 articles (25.86%) discussed about using mHealth nursing management. Examples: workload management, performance appraisal, shift arrangement, and adverse nursing event reporting.

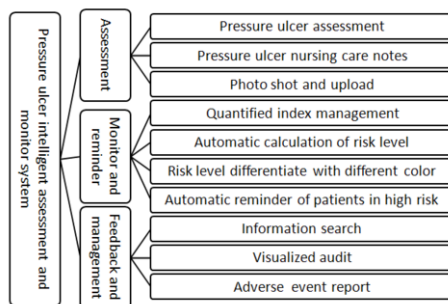
### 3.2 The Role of mHealth in Fall and Pressure Ulcer Prevention in Clinical Settings

Specifically, in the field of pressure ulcer and fall prevention, there are only four articles found among 290 papers, two on fall and two on pressure ulcer with encouraging results. Though the numbers appear small, they represent a trend of applying mHealth in patient safety. Traditionally, nurses use paper and pencil to assess and record the status of pressure ulcer. A nurse who takes over the shift needs to check the handwritten notes by the nurse of last shift to determine the patient's care plan. If the last shift nurse forgot to complete an assessment of pressure ulcer or the notes were in awful handwriting, it is possible that the nurse who takes over the shift might forget to carry out caring plan for pressure ulcer. To indicate the impact of mHealth, a comparison of before and after mHealth was conducted as shown in Table 1.

Recently, an intelligent assessment tool for pressure ulcer has been developed and integrated into a mobile nursing workstation [9]. Illustrated by Figure 3, the system consists of three main components, (1) *pressure ulcer continuous assessment*: the tool was developed based on Braden Scale[10]. Nurses could use PDA to conduct assessment, upload pictures, remark care notes, and record handover information at point of care, which saves their time in returning to nurse workstation and handwriting those information. (2) *reminder and monitor*: the application could automatically calculate risk levels of pressure ulcer and recommend the corresponding nursing plan, based on Braden score and other risk factors, including but not limited to patient age, weight, nutrition status and so on. It is noted that all the relevant information has already been made available in hospital information system and integrated into the app. Patients at different risk levels could be labeled with different colors on the home screen to remind nurse of conducting assessment. In addition, a voice alarm would show up if a nurse failed to follow any scheduled assessment or interventions (e.g. patient needs a turnover every two hours). (3) *feedback and management*: nurse manager could use the system to search for any information related to pressure ulcer



care process. By analyzing the data, nurses could find out the pitfalls and make improvement. With the aid of this apps, the rate of pressure ulcer has been significantly reduced (5.05% to 1.23%,  $P < 0.05$ ) [9].



**Figure 3.** mHealth Structure for Pressure Ulcer Assessment and Management

Mobile nursing workstation also plays a role in preventing falls[5]. Prior to mHealth, patients received fall risk assessment recorded on paper when admitted. If a patient identified with fall risk, an alarm card placed on headboard and proper use of bed rail would be the main preventive measures. However, studies demonstrated that lack of communication and lack of in time assessment are the main reasons of falls[5]. The advantages of using mHealth in prevention of falls are obvious as shown in Table 1. Moreover, mHealth provides nurses evidence-based medical resources, such as patient education materials, accompanied by vivid pictures and videos. This new method of mHealth application facilitates patient-nurse communication and holds promise in improving patient's adherence. An encouraging story from a hospital in Yantai, Shangdong Province indicated that, patients' awareness of fall risk was increased, and incidence of fall was significantly decreased after the application of mobile nursing workstation [5].

#### 4. Discussion

mHealth applications could improve the efficiency and quality of healthcare process. With the increasing adoption of mHealth in clinical settings, a pressing assessment of nursing (informatics) curriculum should be conducted in terms of how future nurses should be trained for using mHealth or even participating the design of mHealth. Based on the curriculum offered in the college of nursing at Capital Medical University, it appears falling behind and mHealth technology advancement. In China, most health science universities/colleges do not offer nursing informatics courses yet. Even for those pioneers who teach nursing informatics, the content is merely basic computer science in nature which are not directly associated with clinical content. Therefore, preparing competent courses in nursing informatics appears to be our top priority.

Functionalities of mHealth are growing rapidly and new functionalities are emerging with every major release[4], which implies that continuous assessment of mHealth is highly necessary. To ensure the accuracy of content and improve its functionality are fundamental for effective nursing practice. We envision that updating pictures of pressure ulcer through the apps could automatically differentiate the risk level of pressure ulcer and thus greatly facilitate clinical decision making.

**Table 1.** Task Differences Before and After mHealth for Pressure Ulcer and Fall Prevention

Tasks	Before mHealth-paper based	After mHealth-electronic based
Nursing assessment	<ul style="list-style-type: none"> <li>• Only use textual description;</li> <li>• Document at nursing station to write assessment notes</li> </ul>	<ul style="list-style-type: none"> <li>• Store both textual and pictorial description;</li> <li>• Remark assessment notes, record handover information at point of care</li> </ul>
Nursing diagnosis	<ul style="list-style-type: none"> <li>• Manually calculate risk levels;</li> <li>• Check patients information separately in patients chart to diagnose</li> </ul>	<ul style="list-style-type: none"> <li>• Calculate risk levels by system</li> <li>• Potential diagnosis offered based on the information stored in the system</li> </ul>
Nursing plan	<ul style="list-style-type: none"> <li>• Might refer to nursing pamphlet for making nursing plans.</li> </ul>	<ul style="list-style-type: none"> <li>• Offering potential nursing plans for nurse to choose</li> </ul>
Nursing intervention	<ul style="list-style-type: none"> <li>• Record on paper nursing notes</li> <li>• Require frequent nursing note check up to avoid being forgotten</li> </ul>	<ul style="list-style-type: none"> <li>• Voice alarm generated when a nurse failed to follow any scheduled assessment or interventions</li> <li>• Patients at different risk levels will be labeled with colors on the home screen to remind nurse of conducting assessment.</li> </ul>
Nursing evaluation	<ul style="list-style-type: none"> <li>• Handwritten notes</li> <li>• Review previous handwritten nursing notes</li> <li>• Need data input for analyzing rates and reasons.</li> </ul>	<ul style="list-style-type: none"> <li>• Use PDA and nurse manage workstation</li> <li>• Check electronic record</li> <li>• Adverse events rates summarized by the system and reported reasons offered by the system.</li> </ul>
Advantages	<ul style="list-style-type: none"> <li>• Nurse is used to it.</li> <li>• Write with paper and pencil is easy</li> </ul>	<ul style="list-style-type: none"> <li>• Saving time as all notes could be done at the point of care.</li> <li>• Easy for dynamic assessment</li> <li>• Reminder function could reduce adverse event rate due to forgetting</li> <li>• Make job easy as all information is in the pocket.</li> </ul>
Disadvantages	<ul style="list-style-type: none"> <li>• Illegible handwriting</li> <li>• Time consuming</li> <li>• Inconvenient in dynamic assessment and evaluation.</li> </ul>	<ul style="list-style-type: none"> <li>• Need to change nurse's habitual behavior.</li> <li>• Need a stable internet environment.</li> <li>• Might have issues such as slow data download, download failure, or system locked</li> </ul>

## References

- [1] World Health Organization, *mHealth: New horizons for health through mobile technologies*, Retrieved from [http://www.who.int/goe/publications/goe\\_mhealth\\_web.pdf](http://www.who.int/goe/publications/goe_mhealth_web.pdf) on September 21, 2015.
- [2] I. Holeman, J. Evans, D. Kane, L. Grant, C. Pagliari, D. Weller, Mobile health for cancer in low to middle income countries: priorities for research and development, *Eur J Cancer Care* **23**(2014), 750-756.
- [3] Y. Liu, Y. Wu, Literature metrology analysis on mHealth related articles in China: 2000 to 2014, *Chinese Journal of Practical Nursing* **31**(2015), 2344-2348.
- [4] A.S.M. Mosa, I. Yoo, L. Sheet, A Systematic Review of Healthcare Applications for Smartphones, *BMC Med Inform Decis Mak* **12** (2012), 67.
- [5] D.P. Meng, J. Ling, Mobile nursing workstation could effectively reduce the rate of fall, *Science and technology vision* **25** (2014), 323-324.
- [6] Ministry of industry and information technology of the People's Republic of China, *The overall mobilephone users in China was over 1.29 billion*, Retrieved from: <http://tech.sina.com.cn/t/4g/2015-03-17/doc-ichmifpy0605101.shtml> on September 23, 2015.
- [7] Y. Liu, L. Wang, Telemedicine in border area of China, *Telemed J* **4**(1998), 39-41.
- [8] X. Feng, B.L. Li, Add Flying Wings to the Modern Digital Ward-An exploration on modern nursing with mobile technology, *Chinese Hospitals* **9**(2005),27-29.
- [9] L.L. Fu, Q.H. Liu, C.Y. Wang, An Intelligent pressure ulcer assessment and monitor technique in orthopedics ward, *Chinese Journal of Practical Nursing* **29** (2013), 71-72.
- [10] Braden scale for predicating pressure sore risk. Retrieved from: <http://www.healthcare.uiowa.edu/igec/tools/pressureulcers/bradenscale.pdf> on September 23, 2015.

# A Quantitative Study Investigating the Effects of Computerised Clinical Decision Support in the Emergency Department

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**Abstract.** This paper describes the evaluation of a computerized clinical decision support system (CCDSS) for Emergency Department (ED) triage. The CCDSS for triage was developed as a means to improve ED quality and safety. Whilst there is significant research on the role of CCDSS in health care, their role in EDs remains under-investigated. In this study, a CCDSS for ED triage was developed and evaluated using a quasi-experimental interrupted time-series design. Data was collected at four time points before and after the introduction of the CCDSS to assess key aspects of quality and safety within the ED. The results demonstrated a statistically significant improvement in triage prioritization ( $p < 0.001$ ), pain scoring ( $p < 0.001$ ) and pain management ( $p < 0.001$ ). This study clearly identifies the positive clinical impact that a CCDSS can have on quality and safety for ED patients and provides a unique contribution to the current knowledge base.

**Keywords.** Emergency Department, triage, clinical decision-support, CCDSS, interrupted time-series

## 1. Introduction

The demand for emergency care has risen exponentially over the last decade, both in the UK NHS and internationally [1, 2]. Several authors cite the challenges of the ED environment, including multiple interruptions, complex patients and overcrowding, as the impetus for the development of CCDSSs [3-6]. Within UK EDs the challenges of increasing demand and the achievement of performance targets have become significant issues for patients, clinicians and politicians over the last decade [7]. The triage CCDSS in this research study was developed as a means of supporting the delivery of safe, effective emergency care against a backdrop of rising patient attendances and staff shortages.

The triage CCDSS was developed in-house by engineers and ED clinicians. The lead clinician ensured that the clinical and operational needs of the users within ED were met. CCDSSs developed with users are strongly associated with high levels of user acceptance [8]. During its three years of operation from 12/04/2010 to 17/06/2013 the system handled the ED attendances of 293,206 patients.

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The overall objective of the triage CCDSS was to improve ED quality and safety. It would achieve this by providing, at the point of face-to-face triage, decision-support for prioritization, pain assessment and pain management. It would also provide a direct accessible link to the departmental clinical guidelines relevant to the patient presentation.

## **2. Methods**

The triage CCDSS had been introduced as an intervention to support increased demand and to mitigate the threats to quality and safety that increased activity and clinician inexperience may produce. A quasi-experimental interrupted time-series (ITS) design was selected after careful consideration of alternative quantitative designs identified by Cochrane Effective Practice and Organisation of Care Group (EPOC) [9].

The statistical analysis compared the pre- and post- CCDSS groups. If large effects are demonstrated this can provide convincing evidence of the effect of an intervention [10]. However, to improve the quality of the study and reduce bias a time series design, with regression, was used to evaluate changes over time based on the methods used by Busing et al [11]. ITS design cannot determine cause and effect in the same way that a true experiment can [12]. However, it can establish whether an intervention is associated with a sustainable statistically significant change or not.

### *2.1. Research Question*

The research question was: Does the introduction of a triage CCDSS improve the quality of triage decisions and safety within the ED?

### *2.2. Aims and objectives of the research*

The aim of the research was to test the assumption that a CCDSS at the point of triage is an effective means of improving the quality and safety of clinical care in ED. The research objectives were

1. To compare the decision making of triage nurses before and after the introduction of the CCDSS
2. To compare the quality of pain assessment and management before and after the introduction of the CDSS
3. To investigate the ability of the CCDSS to improve the care of patients with potential neutropenic sepsis, a condition associated with significant morbidity and mortality

### *2.3. Setting and sample*

This research was undertaken in a busy district general hospital ED in the north of the UK with an annual attendance in 2012 of 90,081. A random sample of 100 triage records was taken every third month for a year prior to the launch of the CCDSS

(2009-2010). One year post implementation a further random sample of 100 triage records was taken every third month for another year (2011-2012). A gap of one year between the data collection points enabled staff to become accustomed to using the CCDSS and any technological problems to be resolved. This ensured that data was collected on a stable CCDSS with which staff were familiar.

#### *2.4. Data collection*

The total sample size was 800; 400 records taken prior to implementation and 400 records afterwards. The design of this study also ensured that the basic EPOC [9] criteria for ITS studies deemed suitable for inclusion in their reviews were met: 1) there is a clearly defined time point when the intervention started 2) there is the collection of data from at least three data points before and after the intervention.

To evaluate the ability of the triage CCDSS to improve the safety of patients presenting with possible neutropenic sepsis, the care of all patients that presented during the two 12 month study periods was reviewed (1/4/2009-31/3/2010 and 1/4/2011-31/3/2012). Patients with confirmed neutropenia (neutrophil count <1.0) who had attended the ED were identified from the hospital's haematology database.

Data was collected by retrospective case note review to assess the accuracy of triage decisions as outlined previously.

#### *2.5. Data analysis*

Data was analysed using SPSS (20.0). Descriptive statistics were used to characterize the samples. Inferential statistics were used to draw conclusions about the data and test differences between the pre- and post- triage CCDSS groups. Regression analysis was used to adjust for confounding variables and expose the underlying secular trend.

#### *2.6. Ethics and research governance*

Ethical approval for the study was obtained from the University of Salford Research Ethics panel in 2010. NHS ethical approval was not required as there was no risk to patients and the research constituted service evaluation.

### **3. Results**

The following results demonstrate the impact of the triage CCDSS on: triage prioritization, pain assessment, pain management and management of patients with potential neutropenic sepsis.

#### *3.1. Triage prioritization*

Correct triage prioritization pre CCDSS was 60.5% versus 85.2% post CCDSS;  $\chi^2 = 60.70$ ;  $p < 0.001$ .

### 3.2. Pain assessment and management

Pain assessment pre CCDSS was 35% versus 97.7% post CCDSS;  $\chi^2 = 350.04$ ;  $p < 0.001$ . Appropriate analgesic administration pre CCDSS was 26.6% versus 78.5% post CCDSS;  $\chi^2 = 216.80$ ;  $p < 0.001$

### 3.3. Management of patients with neutropenic sepsis

Administration of intra-venous antibiotics within 1 hour pre CCDSS was 11.5% versus 5.6% post CCDSS;  $\chi^2 = 4.55$ ;  $p < 0.47$

### 3.4. Regression analysis

The regression analysis demonstrates that in the pre CCDSS there was no evidence of any “correct priority” trend. Immediately post CCDSS there is a much greater “correct priority” percentage than expected for the extrapolation point at 24 months.

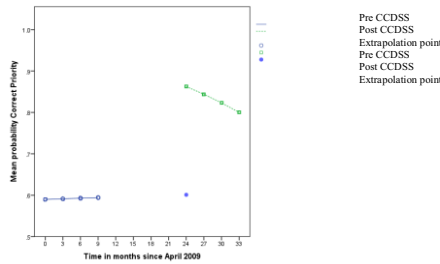


Figure 1. Fitted time trends of correct priority

## 4. Discussion

The potential for a triage CCDSS to remind triage nurses and assist them with critical decisions about patient management are evident from the results of this study. However the wider impact of the system beyond triage was not demonstrated by the results from the neutropenic sepsis cohort. Possible explanations are the design of the system, the small sample size, or both and further research is warranted.

This study adds to the limited body of published research on the impact of CCDSSs in emergency care. The results of this research support the initial assumption that the triage CCDSS would improve the quality and safety of triage decision-making. The use of an ITS design demonstrates that the improvements to patient management are above what would be expected if the CCDSS had not been introduced. The results of this research provide a unique and significant contribution to the existing CCDSS knowledge base.

It is well documented that the wholesale adoption of technology in health care is not always based on robust evidence [13, 14]. This research seeks to redress this balance for clinicians working in emergency care. The importance of rigorous evaluation of any system cannot be over-emphasized. This ensures that clinicians and managers are aware of how and when the system can improve upon existing quality

and safety strategies, and when they cannot. Those embarking upon CCDSS developments should ensure that their systems are based on functionality that has been shown to improve effectiveness [15, 16].

## 5. Acknowledgments

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## References

- [1] Kings Fund. *Are accident and emergency attendances increasing?* 2013 [cited 2013 22 October]. Available from: <http://www.kingsfund.org.uk/blog/2013/04/are-accident-and-emergency-attendances-increasing>.
- [2] U Hwang, B Harris, RS Morrison, LD Richardson. The Effect of Emergency Department Crowding Factors on Pain Management. *Annals of Emergency Medicine*. 2006;48(4, Supplement):117.
- [3] CM Bond, D Djogovic, C Villa-Roel, MJ Bullard, DP Meurer, BH Rowe. Pilot Study Comparing Sepsis Management with and without Electronic Clinical Practice Guidelines in an Academic Emergency Department. *The Journal Of Emergency Medicine*. 2013;44(3):698-708.
- [4] JW Dexheimer, TJ Abramo, DH Arnold, KB Johnson, Y Shyr, F Ye et al. An asthma management system in a pediatric emergency department. *International Journal of Medical Informatics*. 2013;82(4):230-8.
- [5] MA Gibbs, MR Baumann, J Lyden, TD Strout, D Knowles. Effect of the implementation of an electronic clinical decision support tool on adherence to joint commission pneumonia core measures in an academic emergency department. *Academic Emergency Medicine*. 2012;19:S198-S9.
- [6] J Nelson, BL Smith, JD Jared, JG Younger. Prospective Trial of Real-Time Electronic Surveillance to Expedite Early Care of Severe Sepsis. *Annals of Emergency Medicine*. 2011;57(5):500-4.
- [7] M Cooke, J Fisher, J Dale, E McLeod, A Szczepura, P Walley et al. Reducing Attendances and Waits in Emergency Departments. A systematic review of present innovations. *Report to the National Co-ordinating Centre for NHS Service Delivery and Organisation R & D (NCCSDO)2004* 18 July 2013. Available from: [http://wrap-test.warwick.ac.uk/134/1/WRAP\\_Szczepura\\_29-final-report.pdf](http://wrap-test.warwick.ac.uk/134/1/WRAP_Szczepura_29-final-report.pdf).
- [8] AX Garg, NKJ Adhikari, H McDonald, MP Rosas-Arellano, PJ Devereaux, J Sam et al. Effects of Computerised Clinical Decision Support Systems on Practitioner Performance and Patient Outcomes. *The Journal of the American Medical Association*. 2005;293(10):1223-38.
- [9] EPOC. *What study designs should be included in an EPOC review and what should they be called?* 2013 1 February 2014. Available from: [http://epoc.cochrane.org/sites/epoc.cochrane.org/files/uploads/05\\_What\\_study\\_designs\\_should\\_be\\_included\\_in\\_an\\_EPOC\\_review\\_2013\\_08\\_12.pdf](http://epoc.cochrane.org/sites/epoc.cochrane.org/files/uploads/05_What_study_designs_should_be_included_in_an_EPOC_review_2013_08_12.pdf).
- [10] C Brown & R Lilford. Evaluating service delivery interventions to enhance patient safety. *British Medical Journal*. 2008;337(dec17 1):a2764-a.
- [11] KL Buising, KA Thursky, JF Black, L MacGregor, AC Street, MP Kennedy et al. Improving antibiotic prescribing for adults with community acquired pneumonia: Does a computerised decision support system achieve more than academic detailing alone? - A time series analysis. *BMC Medical Informatics and Decision Making*. 2008;8:35.
- [12] T Sheldon, N Cullum, D Dawson, A Lankshear, K Lowson, I Watt et al. What's the evidence that NICE guidance has been implemented? Results from a national evaluation using time series analysis, audit of patients' notes, and interviews. *British Medical Journal*. 2004;329(7473):999.
- [13] AD Black, J Car, C Pagliari, C Anandan, K Cresswell, T Bokun et al. The Impact of eHealth on the Quality and Safety of Health Care: A Systematic Overview. *PLoS Medicine*. 2011;8(1):e1000387.
- [14] RB Haynes & NL Wilczynski. Effects of computerized clinical decision support systems on practitioner performance and patient outcomes: methods of a decision-maker-researcher partnership systematic review. *Implementation Science*. 2010;5:12.
- [15] D Lobach, G Sanders, T Bright, A Wong, R Dhurjati, E Bristow et al. Enabling Health Care Decisionmaking Through Clinical Decision Support and Knowledge Management. Evidence Report No 203 Rockville: *Agency for Healthcare Research and Quality*; 2012 [cited 2014 17 March]. Available from: <http://www.ahrq.gov/research/findings/evidence-based-reports/er203-abstract.html>.
- [16] P Roshanov, N Fernandes, J Wilczynski, B Hemens, J You, S Handler et al. Features of effective computerised clinical decision support systems: meta-regression of 162 randomised trials. *British Medical Journal*. 2013;346

# An Analysis of the Factor Model on the Workload of Nursing Staff Using a Hospital Management Tool

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**Abstract.** We developed a tool that allows a medical facility to offer efficient nursing care with limited human resources by optimizing the distribution of hospital ward nursing tasks. The use of information and communications technology to visualize daily workloads and make use of quantified workload data is important for identifying management elements that allow the efficient allocation of personnel and tasks. The goal of this study was to utilize data from the ward management tool that we developed to consider workflow processes for nursing staff and the relationships between the nursing competence of the nursing staff and the patients' conditions and how these impact on workloads. We found a correlation between workload and staff competence. With respect to the teamwork index and patient condition, structural equation modeling analysis using the intensity of nursing care needs and degree of independent daily living showed that patient condition had a meaningful effect on workload.

**Keywords:** Workload, staff assignment, nursing competence, ICT tool, structural equation modeling.

## Introduction

In order to continue to improve the quality of medical services into the future, it is important to plan for the establishment and cultivation of medical personnel resources through the improvement of the work environment in the medical field. To this end, medical policy recommends efforts to improve the "employment quality" of hospital staff.[1] In this way, the working environment of medical care facilities is changing, and nursing managers are now expected to provide safer and higher-quality nursing care. To achieve this, it is necessary to understand the working conditions of each member of staff and to undertake analyses to identify potential means of improvement. In this study, we used information and communications technology (ICT) to visualize the daily workloads of staff, to analyze the data in terms of identifying improvements, and to feed the results back into our business management model. Our goal was to

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create the ideal environment for implementing this plan-do-check-act cycle. With this in mind, and utilizing a hospital ward management tool, we developed the Nursing Care Assignment Management (NCAM) system to predict the daily workload of each member of the hospital nursing staff, and to make adjustments to tasks between individuals and teams, to distribute the tasks for completion by the end of the work period. By optimizing the distribution of all nursing tasks for each work period, this tool enables efficient nursing care to be offered using a limited number of human resources. However, various factors can cause statistical noise in the measurement of hospital staff workloads. It is important, therefore, to determine management elements to allow the efficient distribution and placement of tasks and personnel, and to offer an index as a valuation basis. To isolate the effects of each patient's condition, the overall workload and staff competence on the time required for the completion of each task – with these data gathered through the process of actually performing each task during the working day – and to offer a means of improving the allocation of tasks, we used data from the NCAM system to investigate the relationships between these factors, and structural equation modeling (SEM) to produce a factor model.

## 1. Methods

### 1.1. NCAM system

At Gifu University Hospital (hereafter, this hospital), one element of the management of nursing tasks is “task adjustment”. The goal of task adjustment is to strengthen habits concerning cooperation and work-time management within the nursing teams. As a practical tool for adjusting tasks, nursing staff are required to complete a sheet known as a “workload calculation sheet”. In our hospital, such data is manually entered onto a paper workload calculation sheet, and the nursing director for each ward enters this data into a separate Excel workbook to track their ward's daily workload time. We began with the efficient computerization and operation of the workload calculation sheets and incorporated display and aggregation capabilities to create a system to enable the best use of the data.

The time needed to complete all the items of work listed on the workload calculation sheets is entered into the NCAM system using a system tool. The system comprises four areas of functionality: input, display, aggregation, and management.

On a target ward, we conducted an evaluation experiment using the NCAM system. The target was a 54-bed surgical and circulatory organ medical ward, and the experiment lasted from Monday, May 18, to Sunday, May 24 2015. Survey methods: using the NCAM system, we allowed the target ward nursing staff to input the actual task end time at the time required, and also the planned end time.

### 1.2. Statistical analysis

We conducted multivariate analysis to analyze the relationships between the various factors relating to workload, staff competence, and individual tasks, based on 1 weeks' worth of data input as part of the system evaluation experiment. A descriptive statistical analysis was performed using the SPSS for Windows software (ver. 21.0) and SPSS Amos (ver. 23.0) (IBM Corp, Armonk, NY, USA). The definitions of each factor are as follows.

- Workload

We added up the workload at four time points: morning, afternoon, evening, and overtime. In the morning, the time required for that day's planned workload was counted. The time needed for completion of the remaining workload was included in the afternoon (13:00) and evening (16:00) periods. Overtime was counted as the time differential between the finishing time (17:15) and the time at which the work was actually completed.

- Staff competence

The clinical ladder is used for the assessment of fixed items on each step of the ladder as they apply to nursing competence, learning, education, research ability, management ability, and people skills. This hospital uses steps I-IV for general, and steps I-II for management. The clinical ladder was used to indicate staff competence, and was converted into points in the range of 1-7 are assigned. The teamwork is composition staff's staff competence point mean value.

- Item of work

Item of work lists the task within the study target ward and their corresponding seven categories: care, management, observation, education, examination/checking, surgery, and treatment.

The ward nursing staff workload includes not only individual task processes such as nursing care and medical aid, but may also be influenced by various factors such as the level of teamwork and the condition of the patient. To properly control the workload in light of this, we used SEM analysis of the measured amount of workload time to quantify the influence of unmeasured factors such as teamwork and patient condition. For the indicators of teamwork we used the clinical ladder, years of experience, and the number of team members, and for the patient condition indicators we utilized information regarding the intensity of nursing care needs and degree of independent daily living of the patients cared for by each nurse, as collated from the hospital information system.

- The intensity of nursing care needs

The intensity of nursing care needs shows the level of nursing that the inpatient should be offered. [2] The assessment table for the intensity of nursing care uses two separate indicators that are assessed separately: one indicator is a score (A) that denotes the intensity of nursing care being provided to the patient, and the other indicator is a score (B) giving the condition of the patient. The two assessment results are then combined to estimate the amount of nursing care that needs to be given to a particular patient. The A and B scores are added up to classify the severity of the nursing care and to assign points of 1-5, in reference the patient classification table for Kyoto University hospital version. [3]

- Degree of independent daily living

The degree of independent daily living indicates the level of independence a senior citizen has in daily life. The decision criteria for this factor were converted into points of 1-8, representing the range from highly-independent to completely bedridden, respectively.

## 2. Results

### 2.1. One-day Workload and Overtime

Table 1 shows the descriptive statistics of the workload measurement items for one nursing team, out of a total of 32 teams (68 deferred staff), within the target period of 1 day. The unevenness of the data according to each team can be seen according to the day.

**Table 1.** Descriptive statistics of the workload.

	MEAN	SD
Morning	782.66	176.05
Afternoon	399.84	81.88
Evening	171.56	61.65
Over time	119.06	54.79

N=68

MEAN,SD of Workload TIME min / team per day

### 2.2. Correlation between workload and teamwork

From the observed correlation between teamwork and the expected workload requirement in the morning, afternoon, and evening, the afternoon and evening workload took longer to complete, and thus the overtime hours were likely to be greater. Therefore, a tendency to provide higher estimates for the morning and afternoon workloads was observed to be correlated with lower levels of teamwork (table 2).

**Table 2.** The correlation coefficient between each workload and teamwork variable.

	Team point	Morning	Afternoon	Evening	Extra time	M	SD
Team point	-	-0.33*	-0.31*	-0.23	0.01	3.35	1.10
Morning		-	0.68**	0.37*	0.18	782.66	176.05
Afternoon			-	0.71**	0.48**	399.84	81.88
Evening				-	0.79**	171.56	61.65
Over time					-	119.06	54.79

\*p<0.05      \*\*p<0.01

### 2.3. Correlation between work categories and teamwork

Individual tasks were classified into work categories, and the correlation between teamwork and each work category showed that the stronger the team, the longer the surgery and examination/testing times. However, in contrast, there was a tendency towards shorter education, observation, and care times (table 3).

**Table 3.** Correlation coefficient between each variable of work categories and teamwork.

	Team point	Care	Management	Observation	Education	Examination	Operation	Treatment	M	SD
Team point	-	-0.35*	-0.16	-0.37*	-0.42*	0.45**	0.53**	-0.04	3.40	1.16
Care		-	0.76**	0.69**	0.31	0.15	0.27	0.06	378.22	155.85
Management			-	0.69**	0.10	0.48**	0.38	-0.10	134.11	62.62
Observation				-	0.05	-0.10	0.06	0.28	273.57	97.51
Education					-	0.17	0.06	0.00	27.22	16.95
Examination						-	0.72**	-0.27*	54.13	64.60
Operation							-	0.40**	74.74	43.93
Treatment								-	41.20	25.17

\*p<0.05      \*\*p<0.01

In other words, in relation to the workload and staff competence, we can observe a trend towards higher workloads for staff with lower nursing competence and less experience, while veteran staff with a high nursing competence were assigned work requiring greater experience, for example assisting during surgery.

From the results of the SEM analysis, our new model provided the best fit (goodness-of-fit index (GFI) = 0.96; adjusted GFI = 0.91) (Fig. 1). The correlation

coefficient relating the “condition of the patient” to the “workload” was 0.49, confirming that the more severe the patient’s condition, the more impact it had on the workload. In addition, it can be said that the “condition of the patient” strongly influenced the required level of nursing care. By contrast, “teamwork” had no strong influence on the “workload,” but a higher level of “teamwork” was found to be negatively correlated with a lower “workload”. In brief, the higher the level of staff competence the shorter the required time tended to be, and vice versa. This study hypothesized that “teamwork” and the “condition of the patient” were the main factors influencing the “workload.” It will be necessary to perform further analyses to confirm the hypothesis using a structure that also includes relationships with more detailed workflow processes.

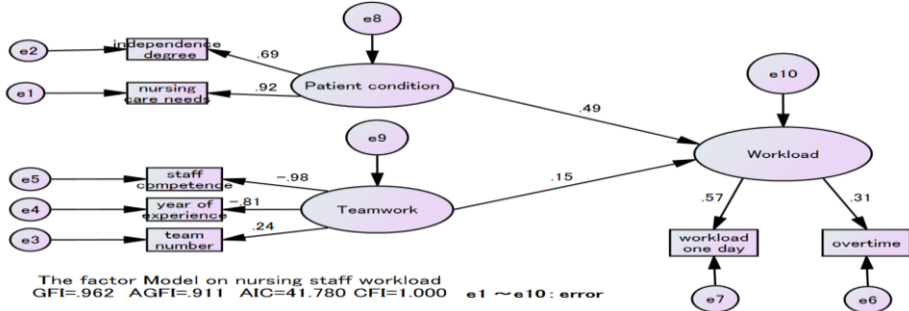


Figure 1. A Structural Equation Modeling of workload prediction.

### 3. Discussion and Conclusion

We developed a medical ward management tool to support the efficient management of ward-based nursing tasks using ICT, workload visualization, and the active utilization of data. Based on this, we developed a novel workload model. Workload trends showed a high degree of conformity to a model which accounted the influences of staff teamwork and patient condition. This suggested that the condition of the patient had a significant effect on the workload and, at the same time, the workload tended to decrease as the degree of teamwork increased. Using these results, we were able to identify management elements that had the potential to contribute towards the improvement of operations. A further increase in the number of variables that comprise the patient condition and degree of teamwork factors, as well as the inclusion of other elements such as the workflow process, should allow for a more detailed analysis of the relevant factors. The next goal is to present these results in a manner that allows for the optimum assignment of human resources based on the workload prediction model.

### References

- [1] Ministry of Health, Labour and Welfare, "Quality improvement of the employment" of the medical field. Project team report, 2013.5, <http://www.mhlw.go.jp/stf/houdou/2r9852000002uzu7-att/2r9852000002v08a.pdf>
- [2] K. Iwasawa, et al., kangohitsuyodo (the intensity of nursing care needs) version.5, Japanese Nursing Association Publication society, 2014.
- [3] M. Matsuzuki, et al., Utilization of nursing quality indicators in management, Japan Society for Healthcare Administration, 51(2) (2014), 127-140..

# Measuring Nursing Value From the Electronic Health Record

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**Abstract.** We report the findings of a big data nursing value expert group made up of 14 members of the nursing informatics, leadership, academic and research communities within the United States tasked with 1. Defining nursing value, 2. Developing a common data model and metrics for nursing care value, and 3. Developing nursing business intelligence tools using the nursing value data set. This work is a component of the Big Data and Nursing Knowledge Development conference series sponsored by the University Of Minnesota School Of Nursing. The panel met by conference calls for fourteen 1.5 hour sessions for a total of 21 total hours of interaction from August 2014 through May 2015. Primary deliverables from the bit data expert group were: development and publication of definitions and metrics for nursing value; construction of a common data model to extract key data from electronic health records; and measures of nursing costs and finance to provide a basis for developing nursing business intelligence and analysis systems.

**Keywords.** Common Data Model; Nursing Value; Nursing Business Intelligence and Analytics; Big Data

## 1. Introduction

The search for a method to measure nursing care value has been elusive. One main barrier is the lack of a comprehensive framework for defining value-based metrics and the lack of analytic approaches for measuring the economic, clinical, and operational outcomes of nursing care. Nursing care time (intensity) and cost measurement in the U.S. are typically averaged across many nurses and many patients and billed as a daily room charge [1]. Clinical data collected and used for patient care remains largely unused. With the emergence of electronic health records (EHR), there is an opportunity to consider and develop methods to extract relevant data to describe and analyze nursing care in ways that have not been possible to date.

### 1.1. Nursing Big Data Conference Series

In June, 2013 the first of a series of conferences to address big data in nursing was convened at the University of Minnesota School of Nursing [2]. The conference was an

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effort to address the exploding amount of data collected in healthcare and find ways to share and compare information and knowledge about nursing care within and across different settings. At the second conference in June 2014, several themes emerged from participants and ten big data expert groups were created to address core issues and concepts [3]. One focus area was the need to identify and measure the value of nursing care. An expert group was formed to address ways to extract key data from EHRs to measure nursing value and report findings back at the June 2015 conference.

## **2. Methods**

### *2.1. Expert Panel Process*

The big data expert group 7: measuring the value of nursing was formed at the 2014 Big Data in Nursing Conference as part of an overall action plan to investigate new methods to share and compare nursing and related healthcare data across differing settings, patient populations, and EHR systems [4].

The group consisted of 14 members from a diverse nursing background including clinical, informatics, leadership, academics, and professional organizations. Bi-monthly conference calls of 1.5 hours each were conducted from August 2014 through May 2015 for a total of 14 sessions and 21 hours of group interaction time with an average participation of 55.1% across the sessions. Guests from professional organizations participated in several calls to provide background to the group as needed.

### *2.2. Goals of the Big Data Expert Group: Measuring the Value of Nursing*

Goals for the expert panel were established on the first convening session in August 2014 and included the following:

1. Develop a national consensus data model to measure patient level nursing intensity, patient level outcomes, and costs per patient in multiple care settings to support the continuum of care and to produce objective measures of nursing value.
2. Develop new nursing business intelligence and analytic tools that will utilize the rich clinical, operational, financial, and quality/safety outcome data currently available to measure and compare nursing value.
3. Develop and test new nursing financial models to bring transparency to support the risk sharing within Accountable Care Organizations (ACO), Value Based Purchasing, and pay for performance models.

## **3. Results**

To meet the first goal of the expert panel, several sessions were needed to define nursing value. One key idea emerged and a consensus was formed that nursing care is provided by individual nurses who act as unique providers of care and the primary focus of measuring nursing care was the encounter between a single nurse and patient, family or community [5]. This drove the construction of the data model to define, within the data, a way to link each nurse with each patient (Figure 1). There are several

analysis possibilities using this approach, for example patient level nursing costs can be derived from an aggregate of individual nurse and patient encounters such as an inpatient assignment or home visit. Patient problems, nursing interventions, and care outcomes can be included and linked to patients, nurses, or setting specific variables. For example, the Nursing Outcomes Classification (NOC) [6] data can be collected sequentially throughout a hospitalization and linked to nurse staffing and assignment patterns to determine whether unit or nurse level factors such as high workload or low experience is associated with the clinical trajectory.

### 3.1. Common Data Model

The common data model in Figure 1 is designed to be vendor agnostic and setting neutral. The primary purpose is to provide a framework for data extraction from different EHRs to compare and benchmark nursing care across many settings. The components of the common data model allow collection of individual patient, nurse, and facility data with linkages by primary and secondary keys to facilitate abstraction. The intent is to build a robust data model that will allow development of new analytic methods and future business intelligence tools that can identify patient level nursing costs, quality, performance, productivity, efficiency, and effectiveness [7].

### 3.2. Big Data Analytics and Nursing Business Intelligence

Value-based metrics were discussed and chosen based on the goals of the group and suitability and fit with the common data model (Table 1). These core metrics form the basis for developing new analytic techniques that can provide near real-time feedback to clinicians and managers. The metrics can be used to develop new nursing business intelligence tools to provide aggregate and summary data on the clinical care as well as quality outcomes, operational workflow and cost of nursing care. The ability to identify unique nurses caring for individual patients provides a new capability to identify patterns and trends at the nurse-patient unit of analysis. Some potential analysis include measuring exact nursing care hours and costs for each patient summarized by a complete episode of care (hospitalization) or effects of difference levels of staffing, skill mix (such as unlicensed versus professional staff), and experience on outcomes of care.

**Table 1.** Nursing Care Value Metrics

<b>Metric</b>	<b>Traditional Model</b>	<b>Value-Based Model</b>
Staffing Levels	Unit level analysis of hours and costs by skill mix, e.g. %RN vs UAP	Patient level analysis of direct care hours by nursing skill mix, effects of individual nurse and nurse characteristics (e.g. experience level or AD vs BSN) on patient outcomes of care
Outcomes	Hospital and unit level outcomes, e.g. average length of stay	Patient level outcomes analysis e.g. unit and hospital length of stay adjusted by nursing acuity or tied to DRG/DX, change in shift level nursing outcomes.
Trending	Trend of unit average cost per patient day by month or quarter	Trend of patient level direct costs per patient day (direct) by month, day of stay, DRG, etc.

Nursing Costs	Average total nursing costs per patient day (many patients and many nurses)	Patient level nursing costs per day per patient; nursing wage variability by patient;
Nursing Acuity	Unit level average metrics by month or quarter	Patient level acuity by day of stay, aggregate metrics by shift, month, day/evening, quarter, etc. As well as patient level acuity trends (patient) or aggregate unit level trending analysis. Patient level acuity by discharge or DRG
Nurse Characteristics	Unit or department level average nurse experience and academic preparation by budget period (e.g. month, quarter)	Patient level measures of average experience level and academic preparation of nurses assigned to patient aggregated by day of stay, summary for hospitalization, trend by shift, etc. These can be rolled up into an episode of care, e.g. hospitalization, series of home visits, etc.
Workload	Nurse to patient ratios or average NHPPD	Acuity adjusted assignments and efficiency measures, e.g. relationship between actual patient level hours needed vs. delivered

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#### 4. Discussion

The findings of the big data nursing value expert group provide a basis for developing new business intelligence and analysis tools using existing and emerging real-time clinical and operational data. The primary purpose of this work is to disseminate a common way to extract these data from existing EHRs and develop new metrics that can identify nursing care system effects as well as individual nurse effects on patient outcomes. Future work will involve testing the model with live clinical and operational data as well as incorporating the common data model into existing EHRs.

#### 5. References

- [1] J.D. Thompson, D. Diers, *Nursing resources*, in: R.B. Fetter, D.F. Brand, D. Gamache (Eds.) DRGs. Their Design and Development, Health Administration Press, Ann Arbor, 1991, pp. 121-183.
- [2] C. Delaney, B.L. Westra, Capturing Nursing Information for Big Data Research and Improved Health Outcomes, Proceedings of the Conference: Nursing Knowledge: Big Data Research for Transforming Health Care. August 12-13, 2013, University of Minnesota School of Nursing Center for Nursing Informatics, Minneapolis, MN, August 12-13, 2013, 2013.
- [3] C. Delaney, B.L. Westra, Proceedings of the Conference: Nursing Knowledge: Big Data and Science for Transforming Health Care, University of Minnesota School of Nursing, Minneapolis, MN, 2014.
- [4] T.R. Clancy, K.H. Bowles, L. Gelinas, I. Androwich, C. Delaney, S. Matney, J. Sensmeier, J. Warren, J. Welton, B. Westra, A call to action: Engage in big data science, *Nursing Outlook*, **62** (2014) 64-65.
- [5] J.M. Welton, E.J. Harper, Nursing Care Value-Based Financial Models, *Nurs Econ*, **33** (2015) 14-20.
- [6] S.E. Birmingham, K. Nell, N. Abe, *Determining Staffing Needs Based on Patient Outcomes Versus Nursing Interventions*, in: P.S. Cowen, S. Moorhead (Eds.) Current Issues in Nursing, Mosby, St. Louis, MO, 2010, pp. 391-404.
- [7] J.M. Welton, Nursing and the Value Proposition: How information can help transform the healthcare system, in: B.L. Westra, C. Delaney (Eds.) Proceedings of the Conference: Nursing Knowledge: Big



Data Research for Transforming Health Care. August 12-13, 2013, University of Minnesota, School of Nursing, Center for Nursing Informatics, Minneapolis, MN, August 12-13, 2013.

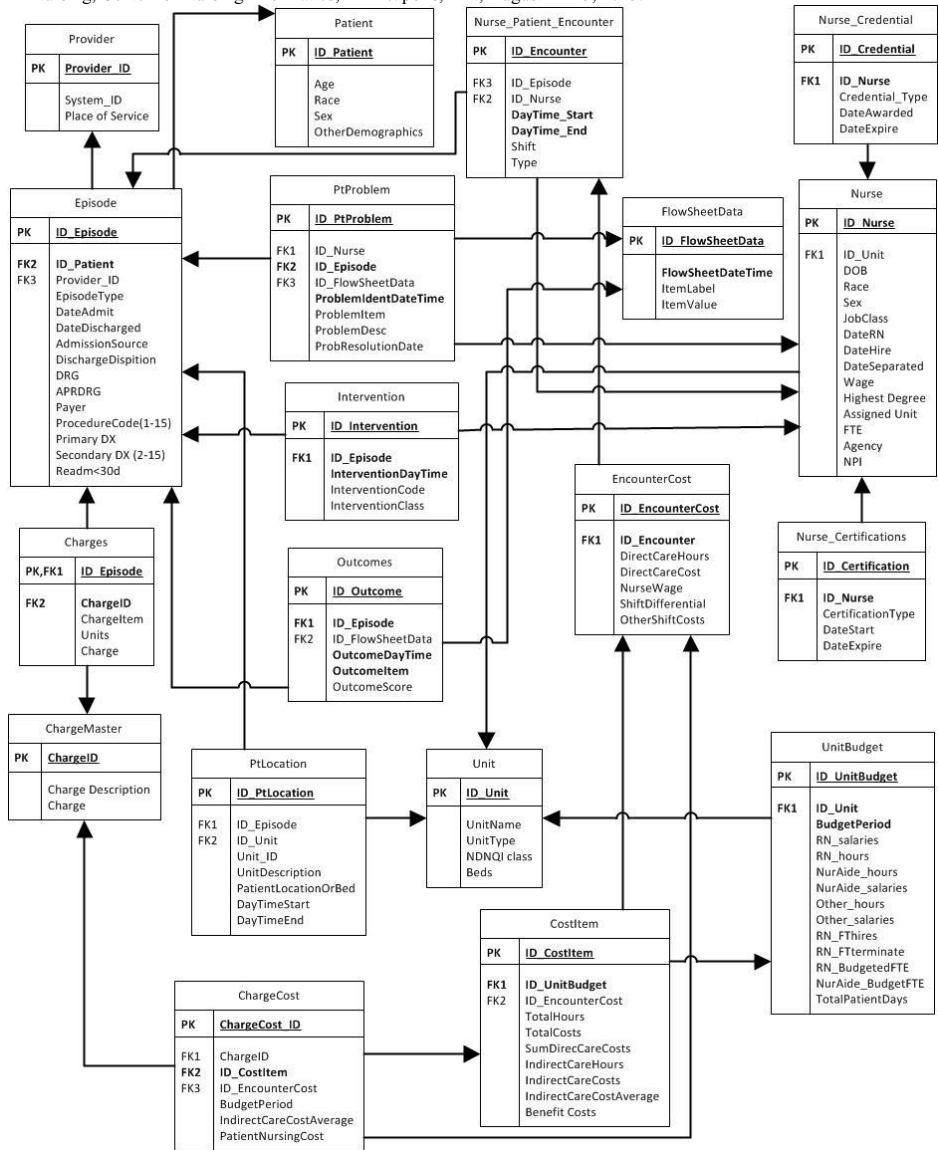


Figure 1. Nursing Value Common Data Model.

# Biometric Attendance and Big Data Analysis for Optimizing Work Processes

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**Abstract.** Although biometric attendance management is available, large healthcare organizations have difficulty in big data analysis for optimization of work processes. The aim of this project was to assess the implementation of a biometric attendance system and its utility following big data analysis. In this prospective study the implementation of biometric system was evaluated over 3 month period at our institution. Software integration with other existing systems for data analysis was also evaluated. Implementation of the biometric system could be successfully done over a two month period with enrollment of 10,000 employees into the system. However generating reports and taking action this large number of staff was a challenge. For this purpose software was made for capturing the duty roster of each employee and integrating it with the biometric system and adding an SMS gateway. This helped in automating the process of sending SMSs to each employee who had not signed in. Standalone biometric systems have limited functionality in large organizations unless it is meshed with employee duty roster.

**Keywords.** Biometric attendance, software, big data analysis

## 1. Introduction

With the advancement in information technology our society is getting more electronically connected. Daily transactions between individuals and between individual and organizations are increasingly taking place through electronic devices.<sup>1</sup> The capability of automatically establishing the identity of individuals is thus very essential in this technological era. Reporting late to work and leaving before the end of shift can have a negative impact on the functioning and productivity of organizations. Most organizations use manual registers to check punctuality and absenteeism. The main drawback of maintaining registers are that signatures can be forged and sign in or sign out by other colleagues. One solution to this problem is a biometric time management system.<sup>2</sup>

Biometric attendance can help in various contexts in the developing world. The development of an attendance management system using biometrics helps in efficiently managing the attendance and manpower of the institution. It can drastically decrease the use of stationary and can help in time management.

In a tertiary care hospital like AIIMS which has 2300 beds, the total number of staff exceeds 20,000 (permanent, adhoc, students) and it is very difficult to manage the attendance and leaves of the employees. An electronic database which deals with

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the attendance of the staff can reduce the burden on administration regarding the staff management and leave records.

We deployed this attendance system in AIIMS in August 2015 and logged over 10,000 staff (permanent employees) over a period of one month. Presently clinical faculties were excluded from the biometric attendance system. Therefore the purpose of this paper is to report on the assessment of the implementation of the biometric attendance system and its utility using big data analysis.

## 2. Methods

In this prospective study the implementation of biometric system was evaluated over 3 month period at our institution. Software integration with other existing systems for data analysis was also evaluated.

## 3. Observations

The biometric attendance system was deployed on August 1st 2015. A total of 50 machines were installed in the hospital premises. Secured Networking and cabling was done for the machines and staffs were enrolled within a period of 2 months. These biometric machines are fitted with cameras to avoid any malpractices. Recordings are periodically retrieved. The status of machines can be checked online in any system connected to intranet.

Figure 1 shows the workflow of the system:

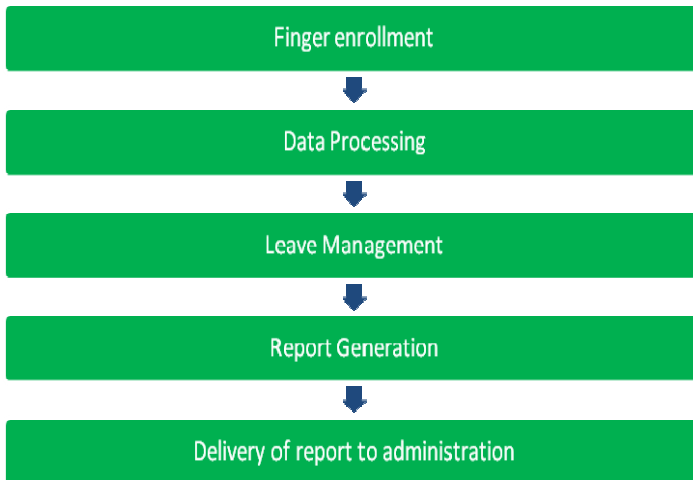


Figure 1. Workflow of biometric attendance system



This star link has unique username and password to avoid any misuse of the system. All leaves received manually are entered into the star link along with the scanned copies which is uploaded in the in house software for further references. A new option for employees were also introduced to send the approved leaves to the concerned authority for real time updating of leaves and the link is available on intranet access through smart phones. However generating reports and taking action this large number of staff was a challenge. For this purpose, software was made for capturing the duty roster of each employee and integrating it with the biometric system and adding an SMS gateway. This helped in automating the process of sending SMSs to each employee who has not punched in his/ her duty and also has not submitted leave application.

### *3.4. Report Generation*

Leave reports can be retrieved from the system for the individual employee or for the entire department. During report generation the reports are checked and if leaves are not updated then a notice is being sent to the concerned employee and officer in charge of that department manually and also an auto generated sms is sent to phone number linked with Biometric ID.

### *3.5. Delivery of report to administration*

Absent reports are send to the administrative department in case of not producing leave within the stipulated period. Hence they may be marked officially and salary may be deduced or leave may be deduced if available.

## **4. Discussion**

Biometric attendance system helps in time management and helps the administration in continuous scrutiny. The advantage of biometric attendance system are:

- **Accurate identification:** Unlike the traditional attendance registers biometric system provides unique identification of employees thus preventing any duplication in the attendance system.
- **There's the option of employee tracking:** Since biometrics systems are essentially automatic and therefore data tracking is simple to implement, they offer employers and managers great opportunities for oversight concerning daily activities and operations.
- **Systems are user friendly:** Once they've been installed and implemented, biometrics systems are able to identify people very rapidly, uniformly, and reliably. Typically, only minimum training is needed to get the system operational. In addition, high-quality systems don't tend to need a large amount of maintenance, further cutting costs.

- **Improves the transparency and efficiency of the system**

Future plans include the following:

1. Aadhar linked attendance system.
2. Biometric attendance for faculties.
3. Duty rota linked to the punching system.

In conclusion, a standalone biometric system has limited functionality in large organizations unless it is meshed with employee duty roster for automatic data analysis and corrective action.

## **5. Acknowledgement**

We would like to acknowledge the programmers and clerical staff who helped in enrolment.

## **References**

- [1] E.B.Hazem, N. Mastorakis. Personal identification through biometric technology. AIC'09 Proceedings of the 9th WSEAS international conference on Applied informatics and communications.2009; 325-340
- [2] A.S.Hamza, M.Tella. Design of time management system for sustainable productivity in organizations: a prototype development of a biometric system. Proceedings of the International Academic Conference on Sustainable Development Vol. 2 No. 1 November, 13-14 2014.

# Networking Hospital ePrescribing: A Systemic View of Digitalization of Medicines' Use in England

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**Abstract.** Medicine management is at the core of hospital care and digitalization of prescribing and administration of medicines is often the focus of attention of health IT programs. This may be conveyed to the public in terms of the elimination of paper-based drug charts and increased readability of doctors' prescriptions. Based on analysis of documents about hospital medicines supply and use (including systems' implementation) in the UK, in this conceptual paper electronic prescribing and administration are repositioned as only one aspect of an important wider transformation in medicine management in hospital settings, involving, for example, procurement, dispensing, auditing, waste management, research and safety vigilance. Approaching digitalization from a systemic perspective has the potential to uncover the wider implications of this transformation for patients, the organization and the wider health care system.

**Keywords.** ePrescribing, CPOE, innovation, transformational change, value

## 1. Introduction

Since May 2013 the Department of Health in the UK has made available a £260 million 'Safer Hospitals, Safer Wards' fund for hospitals in England to implement ePrescribing and electronic patient records. To this, a further funding of £250 million was later added (the 'Integrated Digital Care Technology' fund) [1]. In total, "over 40 e-prescribing projects were funded. Hospitals at the top of the list for funding included Leeds Teaching Hospital, getting £7.7 million for an integrated health record and e-prescribing project, and Guy's & St Thomas' £3.1 million for an e-prescribing project" [2]. A Nursing Technology Fund was also established "to support nurses, midwives and health visitors" use of technology with the overall aim of delivering "safer, more effective and more efficient care" [3], and included mobile technology to support ePrescribing, administration of medicines and bedside data collection (e.g. at Oxford University Hospitals NHS Trusts and The Whittington Hospital NHS Trust). These are just some of the recent examples of a series of large investments in the digitalization of hospitals' activity.

This short conceptual paper argues that electronic prescribing is only one aspect of an important wider transformation in the supply and use of medicines in hospital

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settings – a move we have referred to as the coming of ‘digital drugs’ [4]. This transformation involves connecting ePrescribing related activities into the wider networks of supply and use of medicines within (and beyond) the hospital; it involves a range of regulatory, technological and organizational innovations and has implications for the delivery and measurement of value both to patients and the organization.

## 2. Methods

This conceptual paper draws its data from documentary analysis. Documents were retrieved online about ePrescribing, hospital drug supply and pharmacy activity. In particular, information was retrieved about Leeds Teaching Hospital NHS Trust (LTHT) which is a local organization where one of the authors (VL) has conducted research in the past years. Among the other documents considered were articles in the trade press, hospital bids, business cases, and implementation documents.

Conceptually the analysis ‘followed the drug’ across a hospital system; mapping the movement of medicines (as material objects and as engaged in events/transactions) and associated information/digital representations. This mapping approach provided a structure for understanding of the wider system of supply and use of therapeutic drugs. The scope of the analysis presented here is limited to the boundaries of a hospital, but this overall approach can be applied on a larger health system/health economy scale.

## 3. Flows and stocks of medicines

Millions of drug items travel through a hospital each year, for millions of patients. In LTHT, for example, “there are over 1.3m patient attendances” each year and practically all patients require medication during their stay [5]. As a financial commitment drug budgets are generally the second largest running expense for a hospital after staffing costs.

Some medicines are obtained in ready-to-use form from manufacturers, and other medicines require preparation before administration. Medicines enter the hospital mainly through supply and procurement processes, which are a pharmacy services responsibility. Some organizations may allow or even encourage patients to bring in hospital their own drugs [6, 7]. A small number of drugs may also enter the hospital through research activity (clinical trials). Most medicines are stocked and handled in the pharmacy – though patients own drugs may be managed on the ward. Generally dedicated teams manage the different phases of procurement and distribution – for example, with a Distribution team, Returns and Recycling team, Stock Replenishment Unit, Procurement team, Store keepers, and Medical Gas Team [8].

Drugs may leave the hospital with in-patients at discharge or with out-patients supplied from the hospital pharmacy; or they may return to pharmacy as and when recycling is allowed in the hospital. Indeed, “the logistics of managing returned unused, unsold or damaged goods back into the supply chain and the associated activities of handling, consolidation and disposal of such products is becoming of increasing interest in reducing costs and maximising efficiencies” [9]. Drugs may have to be disposed of in special bins, and destroyed. The possibility of medicines being lost in the system, or possibly stolen needs to be minimised. Systems need to be put in place for the management of all these flows and the associated stocks.



#### **4. Digital representations and flows of data**

Data about medicine use in hospital may be accessible in individual and aggregate forms as needed by pharmacy staff, clinicians, managers and for investigators, for reviews, audits, and research. Data are also reported to the commissioners (the NHS), and (standard) national reporting requirements will have wider influence on how data is entered, aggregated, analyzed and reported. It should also be noted that data about clinical use (about use of drugs and combined with other patients data) are increasingly used for ‘Big Data’ research, aimed at identifying new therapies or making old therapies work better for certain patient profiles – an emerging practice known as personalised or precision medicine [10]. The influence that the movement to Big Data services will have on the wider digitalization of drugs in hospital settings is as yet unclear but many have identified the start of a shift of focus in health informatics towards the needs of stronger ‘data analytics’.

For any and all of these purposes, data about the clinical use of drugs captured through Electronic Prescribing and Medicine Administration systems (ePMA) operating on the wards will need to be integrated with hospital eProcurement systems, data from system(s) for stock control and dispensing, and safety reporting systems for the identification, reporting and investigation of drugs related errors. However, supply chain, pharmacy and clinical systems may not integrate easily, in part because of how drugs are represented in each type of system. For example in timed doses for clinical use, in pack form for dispensing, and in other aggregates for stock management use. In each case the ‘attributes’ associated to a drug record will be different – for example manufacturer may be important in dispensing (for pharmacovigilance), but less so in (generic) prescribing.

Standardization in these areas can help integration, but this may pull in different directions. The future implementation and use of GS1 standards for identification and tracking of medicinal products in the supply chain with Global Trader ID numbers may facilitate data integration for the hospital with the wider pharma industry and NHS supply networks, but may be less efficacious within the hospital and in clinical domains.

#### **5. Decision support for clinical use of therapeutic drugs and its wider implications**

The main benefits deriving from use of ePMA systems often lie with the embedded decision support functionalities – the benefits being mainly in terms of patient safety and prevention of errors. However, the inclusion of hospital formulary and guidance (decision support) in ePMA modules is also a factor in achieving organizational benefits, such as savings in the hospital drug budget, through increased control over what is used in the hospital at the time of prescribing, dispensing and/or administration and through increased transparency of the fungibility of drugs (generics vs branded medicines). It may also serve other objectives such as implementation of infection control (anti-microbials) and local antibiotic policies.

Benefits listed in hospitals’ business plans are often valued in monetary terms. In the case of LTHT, for example, up to £1.33 million a year including improvements to medicines management processes (eliminating waste and loss of inventory), real time information on use of antimicrobials (enabling targeted reduction in antimicrobial expenditure), fewer inappropriate prescriptions and greater consistency of prescribing

through prescribing to protocols [11]. A system supplier estimated that by improving antibiotic prescribing, an ePMA system (with decision support) can “help reduce the incidence of hospital acquired infection. [...] [and] could result in a 10 per cent reduction in the number of MRSA or C.difficile cases” [2].

Savings from the elimination of paper prescription charts (reduction in stationery costs) contributes about 3% of these total yearly savings (£41k).

## 6. Discussion and conclusion

The digitalization of the activities of prescribing and administration of medicines with ePrescribing systems are often the focus of attention of national implementation projects, and conveyed to the public in terms of the elimination of paper drug charts. For example, the large funds made available in England for the implementation of electronic prescribing in hospitals were justified in terms of the ‘modernization’ of ‘traditional’ paper based prescribing and eliminating the risks associated with handwritten prescriptions. The funds were to be used to “replace outdated paper-based systems for patient notes and prescriptions” [2] within a more general drive for the entire NHS to go paperless by 2018.

However, through an analysis of the movement of drugs within a hospital context, a more complex set of network(s) of supply and use of drugs becomes apparent, associated with a range of existing or emerging digital systems, covering a variety of activities: procurement, stock control, dispensing, auditing, ordering, prescribing, reviewing, disposal, recycling, administration, safety vigilance. Transformation is occurring across these areas, involving regulatory, technological and organizational innovations.

This digitalization of supply networks in hospitals is occurring against the background of two sets of initiatives proposed respectively by the Department of Health (DH) and the European Union. In the case of DH, attention has been given to new models of procurement, through its e-Procurement program, and initiatives to better understand activity through the tracking of patients, therapeutic drugs use, devices as well as the other products and substances that are part of the delivery of patient outcomes [12]. In this work it is proposed that coding of the artefacts and participants in the delivery of healthcare is based around global and not health specific GS1 communication standards, which define standards for the creation, use and sharing of machine-readable coding. This initiative is also associated with the EU Falsified Medicines Directive (FMD) for the implementation of which machine-readable coding and tracking of drugs are expected to become an integral part of service provision within the NHS over the next five years.

This complex sets of digitalization initiatives around the procurement, supply and use of drugs has implications for the delivery and measurement of value deriving from IT implementations, looking beyond efficiency savings in general or ‘going paperless’ in particular. For the patient, real time data, more/greater range of data and decision support should facilitate a more accurate tailoring of the therapy to the patient profile, needs and response. Digitalization can add value for the patient by shortening the time for the often empirical (trial and error) approach in drug therapies. But reduced time for a more effective therapy also has implications for value at the organisational level – e.g. reduce costs for a given tariff. Beyond the patient and the organization, better use of medicines has also an impact at health care system level, as evident in the case of

antibiotics and the problem of antibiotic resistance (effective use of antibiotics represent a “shared societal benefit” [13]). We argue that approaching digitalization from a systemic perspective can contribute to identifying the wider ramifications of the consequent transformations. In this we subscribe to the definition of medicines management provided by the Audit Commission:

*“Medicines management in hospitals encompasses the entire way that medicines are selected, procured, delivered, prescribed, administered and reviewed to optimise the contribution that medicines make to producing informed and desired outcomes of patient care” [14][p5].*

## 7. Acknowledgments

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## References

- [1] NHS England. Integrated Digital Care Technology Fund. 2015 Available from: <http://www.england.nhs.uk/digitaltechnology/info-revolution/idct-fund/>.
- [2] P3 Pharmacy, EPS making its mark in hospitals. 2015 Available from: <http://www.p3pharmacy.co.uk/eps-making-its-mark-in-hospitals>.
- [3] NHS England. Nursing Technology Fund. 2015 Available from: <http://www.england.nhs.uk/digitaltechnology/info-revolution/nursing-technology-fund/>.
- [4] T. Cornford, and V. Lichtner, Digital Drugs: An anatomy of new medicines, in Information Systems and Global Assemblages: (Re)configuring Actors, Artefacts, Organizations. IFIP Advances in Information and Communication Technology, B. Doolin, et al., Editors. 2014, Springer. p. 149-162.
- [5] LTHT, Pre-Qualification Questionnaire For the Provision of An Electronic Prescribing and Medicines Administration System (eMedicines), 2013, Leeds Teaching Hospitals NHS Trust: Leeds. Available from: <https://www.leedsth-tenders.co.uk>.
- [6] M. McLeod, et al., A national survey of inpatient medication systems in English NHS hospitals. BMC Health Services Research, 2014. 14(1):93.
- [7] R. Oishi, Current status of preparation and distribution of medicines. American Journal of Health-System Pharmacy, 2009. 66(5 Supplement 3): s35-s42.
- [8] CMFT. Pharmacy Supply Chain. 2015. Available from: <http://www.cmft.nhs.uk/royal-infirmary/our-services/pharmacy/pharmacy-supply-chain>.
- [9] L. Breen, and Y. Xie, Avoid waste, save money — recycling matters in hospital pharmacy practice. The Pharmaceutical Journal, 2012. 288: 321.
- [10] National Information Board, Personalised health and care 2020: using data and technology to transform outcomes for patients and citizens: a framework for action, 2014, HM Government.
- [11] LTHT, Business Case to Support an eMedicines System, 2013, Leeds Teaching Hospitals NHS Trust: Leeds. Available from: [www.eprescribingtoolkit.com](http://www.eprescribingtoolkit.com).
- [12] DH. Policy paper: NHS e-procurement strategy. 2014. Available from: <https://www.gov.uk/government/publications/nhs-e-procurement-strategy>.
- [13] IDSA, Combating Antimicrobial Resistance: Policy Recommendations to Save Lives. Clinical Infectious Diseases: An Official Publication of the Infectious Diseases Society of America, 2011. 52(Suppl 5):S397-S428.
- [14] Audit Commission, A spoonful of sugar - Medicines management in NHS hospitals. 2001, London: Audit Commission Publications.

# Evaluating Nurses Acceptance of Hospital Information Systems: A Case Study of a Tertiary Care Hospital

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**Abstract.** This study aims at evaluating hospital information systems (HIS) acceptance factors among nurses, in order to provide suggestions for successful HIS implementation. The study used mainly quantitative survey methods to collect data directly from nurses through a questionnaire. The availability of computers in the hospital was one of the most influential factors, with a special emphasis on the unavailability of laptop computers and computers on wheels to facilitate immediate data entry and retrieval when nurses are at the point of care. Nurses believed that HIS might frequently slow down the process of care delivery and increase the time spent by patients inside the hospital especially during slow performance and responsiveness phases. Recommendations were classified into three main areas; improving system performance and availability of computers in the hospital, increasing organizational support in the form of providing training and protected time for nurses' to learn and enhancing users' feedback by listening to their complaints and considering their suggestions.

**Keywords.** Hospital Information Systems, Acceptance, Satisfaction, Nurses.

## Introduction

Hospital information systems (HIS) are comprehensive, integrated and specialized information systems designed to manage both the administrative and clinical aspects of hospitals and healthcare facilities. They are considered one of the most important focal points on which the delivery of healthcare depends [1]. Despite the proved evidence that HIS have the potential to improve health of individuals and performance of healthcare providers, yielding improved quality, cost savings, and greater engagement by patients in their own healthcare, healthcare professionals and hospitals' adoption, acceptance and utilization of HIS is still low [2]. The response of healthcare professionals to the use of hospital information systems is an important research topic that can explain the success or failure of any HIS development and implementation project [3]. HIS research often focuses on IT design and implementation, but may be not enough on how end users react to already implemented HIS. The fit between HIS and clinical work will lead intended users to accept or reject the HIS, to use it or misuse it, to incorporate it into their routine or work around it. This is why many researchers have been trying to explain delayed or unsuccessful implementation of HIS by exploring the problem of acceptance or resistance of healthcare professionals'

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towards these systems [4]. The effect of information technology knowledge, experience and skills of healthcare professionals, current status of computerization and availability of computers in hospitals, and professionals' attitudes, in terms of their positive or negative beliefs about computerized systems and HIS in the healthcare environment are considered among the major barriers to the successful implementation and use of such systems. Training of healthcare professionals is needed to enhance positive attitudes about HIS and build confidence in the benefits of these systems [5]. Most research on HIS acceptance has focused on physicians and very less is known about nurses' acceptance of HIS technology and its different functionalities, despite nurses are usually the largest population among all healthcare professionals in hospitals [6]. Some challenges to acceptance and use may be temporary and visible only during the initial adoption and adjustment phase that immediately follows implementation. Other challenges to acceptance and use may arise only after extended use of the technology by users [7]. The implementation and utilization of the hospital information system at King Faisal Specialist Hospital and Research Center, Saudi Arabia have been facing many challenges. Among these were the resistance, acceptance and satisfaction of the HIS by end users; mainly nurses. The Health Information Technology Affairs (HITA) department decided to conduct a survey to explore and evaluate HIS acceptance by nurses and investigate the influential factors that might affect acceptance levels.

## **1. Methods**

The Health Information Technology Affairs developed a questionnaire to collect objective quantitative data from nurses about their acceptance of the currently operational HIS. The questionnaire contained five sections of questions; the first section included demographic information, such as age group and total healthcare experience. The second section included ten statements regarding general HIS assessment, the third section included four statements regarding accessibility and availability of computer terminals in the hospital, the fourth section included three statements regarding the HIS and the patient care and the fifth section included six statements regarding the nurses satisfaction with the HIS. The questionnaire sections from two to five used the classic five Likert scale format; strongly agree, agree, neutral (neither agree nor disagree), disagree and strongly disagree. One final open ended question was added to ask nurses about their suggestions to improve the HIS performance, acceptance and satisfaction among nurses.

## **2. Results**

The researcher used SPSS – statistical package for social sciences to perform statistical analyses including descriptive and inferential statistics. The total number of valid responses was 244 participant nurses. Regarding the age group distribution; 3 nurses were less than 25 years old (1.2%), 85 were 25 to 35 years (34.8%), 99 were 36 to 50 years 99 (40.6%) and 57 were over 50 years old (23.4%). Regarding the total work experience of the nurses in the hospital; 55 had less than 2 years of experience (22.5%), 56 had 2 to 5 years (23.0%), 76 had 6 to 10 years (31.1%), 43 had 11 to 15 years (17.6%), 7 had 16 to 20 years (2.9%) and 7 had over 20 years of experience (2.9%). Table 1 shows HIS acceptance factors sorted ascending by nurses' responses.

Looking into the inferential statistics of the results; the age group had a statistically significant effect on many of the acceptance and satisfaction factors evaluated, showing that older nurses accepted and were satisfied with the availability, performance and function of the HIS, in general, more than younger nurses. Younger nurses, 35 years or less, were specifically unsatisfied with the availability of computers, speed and responsiveness of the HIS performance and confirmed that using the HIS increased the time spent by patients in the hospital and slowed down the healthcare processes.

The total years of experience of nurses in the hospital had also a statistically significant effect on most of the acceptance and satisfaction factors evaluated, showing that nurses with longer experience, more than 10 years, accepted and were satisfied with the availability, performance and function of the HIS, in general, more than nurses with shorter experience, 10 years or less. Nurses with shorter experience were specifically unsatisfied with the HIS performance speed, user friendliness of the HIS and comprehensiveness of the downtime procedure and their preparedness for it. They also shared young nurses in their concerns regarding the unavailability of computers and the increased time spent by patients in the hospital due to using the HIS.

**Table 1.** HIS Nurses Acceptance Factors Sorted Ascending.

Nurses Acceptance & Satisfaction Statements	Score	Answer
HIS performance speed is acceptable	2.0	Disagree
HIS is user friendly and easy to use	2.8	Neutral
HIS screens layouts are appropriate	3.1	Neutral
HIS provides sufficient information	3.2	Neutral
HIS provides accurate information	3.3	Neutral
HIS provides updated information	3.4	Agree
HIS fonts and characters are easy to read	3.5	Agree
HIS provides clear information	3.5	Agree
HIS improves access to patient information	3.5	Agree
My practice needs are optimized by HIS provided	3.6	Agree
<b>HIS General Assessment Overall Score</b>	<b>3.2</b>	<b>Neutral</b>
Laptop Computers	1.4	Strongly Disagree
Computer on Wheels/Flo Computers	1.5	Strongly Disagree
Computers are always available when I need them for HIS	1.8	Disagree
Desktop Computers	2.3	Disagree
<b>Availability of Computers in the Hospital Overall Score</b>	<b>1.8</b>	<b>Strongly Disagree</b>
Use of HIS decreases time spent by patients in the hospital	2.4	Disagree
HIS improves the quality of patient care process	3.2	Neutral
HIS improves the quality of patient data entry and retrieval	3.2	Neutral
<b>Patient Care &amp; HIS Overall Score</b>	<b>2.9</b>	<b>Neutral</b>
I am prepared for HIS downtime	2.2	Disagree
HIS downtime procedure is clear and comprehensive	2.3	Disagree
Overall, I am satisfied with HIS	2.8	Neutral
Current HIS training materials are helpful	2.9	Neutral
I am satisfied with the support provided to HIS users	2.9	Neutral
I received enough training on HIS	3.0	Neutral
<b>Users' Satisfaction Overall Score</b>	<b>2.7</b>	<b>Neutral</b>

### **3. Discussion**

It is very clear from the results of the survey that the “Availability of Computers in the Hospital” had the least acceptance overall score among the four sections of factors, with a special emphasis on the unavailability of laptop computers and computers on wheels to facilitate immediate data entry and retrieval when nurses are at the point of care, especially from the perspective of younger nurses. Many studies discuss and highlight the influence of computers availability on the success or failure of hospital information systems adoption and implementation [8, 9]. Nurses were not satisfied with the downtime procedure and they highlighted that they are not prepared for it; to switch to an alternative manual system in case the electronic system failed, especially from the perspective of new nurses. They said that HIS downtime procedure is not clear and not comprehensive; where many studies highlighted that clearly understood downtime can spare a lot of the unintended consequences or HIS related medical errors, especially in the areas of medications and ICU [10, 11]. Younger nurses agreed that using the HIS might frequently slow down the process of care delivery and increase the time spent by patients inside hospital. This is typically reported; a form of decreased efficiency and increased patient waiting time, mainly in the outpatient settings and during the process of registration and admission especially at the beginning of the HIS implementation or at the transitional phases of updating or upgrading HIS [12-14]. Nurses agreed that the performance of the HIS is slow overall and that this slowness is not acceptable and might lead to more slowness in the process of care delivery and might increase the time spent by patients inside hospital even more. Research work shows that inadequate design of HIS, such as bad or inadequate user interface or poor HIS performance, such as slow response times, will reduce its chances of being accepted by users and implemented successfully [8]. Years of experience and age group both had significant influence on nurses’ acceptance of the HIS, where younger and less experienced nurses had lower satisfaction levels. Younger and less experienced nurses thought that the system is very slow, the system is not user friendly or easy to use, and the system provides insufficient information, inaccurate information and sometimes out-of-date information. Younger and less experienced nurses thought that there is a severe shortage in the number and availability of computers, especially laptop computers and computers on wheels. They believed that computers are not always available when they needed them. They also thought that using the HIS increases the time spent by patients inside hospital and does not improve the quality of patient care much. They also reported that they are not prepared for the HIS downtime, the downtime procedure is not clear or comprehensive and that the HIS training materials are not helpful.

### **4. Conclusions and Recommendations**

Using qualitative thematic analysis of the nurses feedback to the open ended question, about their suggestions to improve the HIS performance, acceptance and satisfaction among nurses, we could summarize the conclusions and recommendations into three main areas; improving system performance, increasing organizational support and enhancing feedback mechanisms. On the first area; it is very important to enhance the software speed, responsiveness and increase the availability of computers, laptops and computers on wheels. Screen designs need to be enhanced with more focus on the

sequence and logic of functions, tasks and buttons, some software features need to be more user friendly or user adjusted when possible, such as font size. The conventional methods of data entry, using keyboards, are labor intensive and time consuming, which can be alleviated by using new innovative technologies such as automated voice recognition. The second area includes increasing organizational support of nurses, through providing more training to nurses, more dedicated and protected time during working hours to learn and practice on the system after implementation or upgrade and providing better user manuals and materials for training and also as reference for nurses when they have problems. The third area is enhancing channels of communication and feedback, since many nurses reported that they have been suggesting ideas and sometimes finding solutions for problems but the low communication level and unavailability of reliable feedback mechanisms decreased their chance of successful contribution to HIS improvement. We recommend that this type of study should be expanded to include other hospitals, secondary and even primary health environments.

## References

- [1] A. Ismail, A. T. Jamil, A. Fareed, A. Rahman, J. Madihah, A. Bakar & H. Saadi, The implementation of Hospital Information System (HIS) in tertiary hospitals in malaysia: a qualitative study, (2012).
- [2] M. B. Buntin, M. F. Burke, M. C. Hoaglin & D. Blumenthal, The benefits of health information technology: a review of the recent literature shows predominantly positive results. *Health affairs*, 30(3) 2011, 464-471.
- [3] P. Ketikidis, T. Dimitrovski, L. Lazuras & P. A. Bath, Acceptance of health information technology in health professionals: an application of the revised technology acceptance model. *Health informatics journal*, 18(2) 2012, 124-134.
- [4] R. J. Holden & B. T. Karsh, The technology acceptance model: its past and its future in health care. *Journal of biomedical informatics*, 43(1) 2010, 159-172.
- [5] M. Khalifa, Barriers to health information systems and electronic medical records implementation. A field study of Saudi Arabian hospitals. *Procedia Computer Science*, 21, 2013, 335-342.
- [6] P. Carayon, R. Cartmill, M. A. Blosky, R. Brown, M. Hackenberg, P. Hoonakker & J. M. Walker, ICU nurses' acceptance of electronic health records. *Journal of the American Medical Informatics Association*, 18(6) 2011, 812-819.
- [7] C. D. Melas, L. A. Zampetakis, A. Dimopoulou & V. Moustakis, Modeling the acceptance of clinical information systems among hospital medical staff: An extended TAM model. *Journal of biomedical informatics*, 44(4) 2011, 553-564.
- [8] M. Berg, Implementing information systems in health care organizations: myths and challenges. *International journal of medical informatics*, 64(2) 2001, 143-156.
- [9] R. Heeks, Health information systems: Failure, success and improvisation. *International journal of medical informatics*, 75(2) 2006, 125-137.
- [10] J. S. Ash, M. Berg & E. Coiera, Some unintended consequences of information technology in health care: the nature of patient care information system-related errors. *Journal of the American Medical Informatics Association*, 11(2) 2004, 104-112.
- [11] R. Koppel, J. P. Metlay, A. Cohen, B. Abaluck, A. R. Localio, S. E. Kimmel & B. L. Strom, Role of computerized physician order entry systems in facilitating medication errors. *Jama*, 293(10) 2005, 1197-1203.
- [12] B. Chaudhry, J. Wang, S. Wu, M. Maglione, W. Mojica, E. Roth & P. G. Shekelle, Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. *Annals of internal medicine*, 144(10) 2006, 742-752.
- [13] A. X. Garg, N. K. Adhikari, H. McDonald, M. P. Rosas-Arellano, P. J. Devereaux, J. Beyene & R. B. Haynes, Effects of computerized clinical decision support systems on practitioner performance and patient outcomes: a systematic review. *Jama*, 293(10) 2005, 1223-1238.
- [14] R. Hillestad, J. Bigelow, A. Bower, F. Girosi, R. Meili, R. Scoville & R. Taylor, Can electronic medical record systems transform health care? Potential health benefits, savings, and costs. *Health Affairs*, 24(5) 2005, 1103-1117.



# Using Mixed Methods in Health Information Technology Evaluation

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**Abstract.** With the increasing adoption of interactive systems in healthcare, there is a need to ensure that the benefits of such systems are formally evaluated. Traditionally quantitative research approaches have been used to gather evidence on measurable outcomes of health technology. Qualitative approaches have also been used to analyze how or why particular interventions did or did not work in specific healthcare contexts. Mixed methods research provides a framework for carrying out both quantitative and qualitative approaches within a single research study. In this paper an international group of four informatics scholars illustrate some of the benefits and challenges of using mixed methods in evaluation. The diversity of the research experience provides a broad overview of approaches in combining robust analysis of outcome data with qualitative methods that provide an understanding of the processes through which, and the contexts in which, those outcomes are achieved. This paper discussed the benefits that mixed methods brought to each study.

**Keywords.** Mixed methods, evaluation studies, health information technology, interactive systems

## 1. Introduction

With the increasing adoption of health information technology (HIT), there is a need to ensure that the impact of such systems on outcomes of care and care processes are formally evaluated. Quantitative research methods have a strong tradition in informatics research, relying on the premise that HIT has measurable attributes, as do the people who use it and the processes it supports.[1] However, using quantitative research methods in informatics research involves significant challenges; by their nature most interactive systems are complex and are introduced into complex health care environments.[2] Qualitative methods are used to develop new understanding of the HIT environment or system implementation context.[3] This knowledge is important when studying HIT impact on delivery of care or human interactions, the importance of

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the practice setting on implementation success, and the politics of a system's implementation.[4] Mixed methods (MM) research provides a framework for carrying out both quantitative and qualitative approaches to research design, data collection, and data analysis within a single research study. In this paper, we briefly present four case studies to highlight the benefits and limitations of using MM to evaluate HIT. We suggest that through the use of MM evaluation, HIT can be improved.[5]

## 2. Case Studies

The characteristics of the research studies (Table 1) and diversity of data collection methods (Table 2) for each case study are summarized below.

**Table 1.** Research Study Characteristics

Characteristic	Case 1 [6]	Case 2 [7,8]	Case 3 [9]	Case 4 [10]
Country	USA	USA	UK	Mexico
Unit of analysis & number	Homecare agency: 1	Hospitals: 29	Hospitals: 4	Homecare agencies: 2
	Clinicians: 137 Patients:1,200/mo	Clinicians: 26	Operations:18 (ongoing)	
HIT	EHR	EHR	Robotic surgery	Occupational therapy tool
Year implemented	2007	2007-2010	Variable across settings	2011
Commercial	Yes	Yes	Yes	No
Study time period	2008-2011	2009-2010	2014-Present	2012-2013

**Table 2.** Research Study Data Collection Methods

Method	Case 1 [6]	Case 2 [7,8]	Case 3 [9]	Case 4 [10]
Qualitative data	Ethnographic observation; Interviews	Non-participant observation; Semi-structured interviews following observation	Structured observation using OTAS; Observation; Video recording; Brief semi-structured interviews following observation	Non-participant observation; Semi-structured interviews
Quantitative data	EHRNS survey; Documentation time-to-completion; Reimbursement; Patient outcomes	Pressure ulcer and fall risk assessments completed; Pressure Ulcer and Fall Rates	SURG-TLX survey; Speed of team response to surgeon instruction	Surveys: NPI-Q, AES, ZNI, RSCSE; Log of system use

### 2.1 Case Study 1: Barriers, facilitators to EHR use as intended in a home care agency

*Overview:* The study assessed a point-of-care electronic health record's (EHR) impact on clinical process in a home care agency including impact on workflow, reimbursement, patient outcomes, and clinician satisfaction[6] to identify challenges and opportunities to EHR use as intended. *Methods:* A concurrent nested design with the quantitative data as the prioritized data and the qualitative data as nested data. The quantitative aspect of the study used a pre-post study design with the point-of-care EHR deployment as the focusing event. Quantitative data was accessed from the EHR, the financial system, and survey responses and included workflow data (documentation time-to-completion), patient outcomes, reimbursement timeliness data, and clinician satisfaction data with the EHRNS survey[11]. Qualitative data was collected from ob-

observation and interviews to gain a richer description of clinician perspectives. Quantitative data were statistically analyzed. Qualitative data was analyzed using thematic content analysis. MM analysis entailed sorting results from each data source by theme, referring to the HIT Reference-based Evaluation Framework (HITREF)[11], and summarizing themes in a matrix. Key findings were: clinicians were satisfied with the point-of-care EHR impact on workflow and financial outcomes; and EHR implementation improved productivity in timeliness of clinical documentation completion and Medicare reimbursement timeliness. However, clinicians' perception of EHR impact on patient outcomes was neutral; EHR impact on patient outcomes was minimal, and not all clinicians used the EHR as intended.

### *2.2 Case Study 2: Impact of EHR introduction on nursing specific patient outcomes*

*Overview.* In this evaluation, we explored: 1) the impact of introducing a system-wide EHR on nursing sensitive patient outcomes using an interrupted time series design; [7] and 2) how nurses used the EHR in practice through use of a case site approach, collecting data using ethnographic non-participant observation, and interviews [8]. *Methods.* A concurrent MM design was used, both data sets were given equal status for both analysis and reporting of results. *Interrupted Time Series:* Data were collected from 29 hospitals from 2003 Quarter 1 to 2009 Quarter 4 for the following care process and outcome variables: proportion of patients with a completed fall risk or pressure ulcer risk assessment within 24 hours of admission; number of falls per 1,000 patient days; and percentage of patients on the day of data collection with a stage I, II, III, IV or unstageable pressure ulcer. Multivariate regression analysis was used to evaluate EHR implementation effect on outcomes. Key findings included EHR introduction as being significantly associated with an increase in pressure ulcer risk documentation and a decrease in pressure ulcer rates. There was considerable variance across individual hospital outcomes. *Qualitative data:* Observation of 14 nurses using the EHR and interviews with 26 nurses and their managers; data were analyzed thematically using codes derived inductively from data and deductively from literature. Key findings identified: how EHR introduction changed the way that nurses practiced; and the influence of organizational context on nurses' and managers' behavior.

### *2.3 Case Study 3: Impact of robotic surgery on communication, teamwork, and decision making in the operating theatre*

*Overview:* Use of robotic surgery (i.e., surgeon sits at a console and controls robotic arms which hold instruments inserted into the patient through small 'key-hole' incisions) has increased rapidly over the past decade.[12] Robotic surgery involves a significant change in the spatial configuration of the operating theatre (OT), with the surgeon separated from the patient and OT team, which has the potential to impact communication, teamwork, and decision making. *Methods:* A process evaluation alongside a clinical trial comparing robotic and laparoscopic surgery for the curative treatment of rectal cancer.[9] Realist evaluation uses Context-Mechanism-Outcome configurations (CMO) to explore the mechanisms (user reasoning and response to a technology) through which particular outcomes are achieved and contexts in which those mechanisms are triggered. A literature review and interviews with surgeons and OT teams were used to develop initial CMO configurations. A MM multi-site case study collecting quantitative and qualitative data concurrently is underway. *Data on outcomes:* Quantitative data includes ratings of teamwork in an operation using the OTAS (Observational Teamwork Assessment for Surgery)[13] and measures of surgeon and OT

team members' perceptions of the physical and mental task load associated with an operation using SURG-TLX questionnaire.[14] Brief semi-structured interviews following the operations explore staff perceptions of the outcomes. *Data on context:* Quantitative data concerning experience of robotic and keyhole surgery are collected through the SURG-TLX questionnaire. Ethnography is being used to capture those aspects of the context that cannot easily be measured, such as culture of an organization. *Data on mechanisms:* Video data, complemented by ethnographic observations is being used to explore how robotic surgery impacts communication, teamwork, and decision making. Brief semi-structured interviews will enable further exploration of mechanisms. *MM analysis:* Data is being analyzed iteratively with ongoing testing and refinement of theories and gathering of further data given refinements. Matrix displays are being used to integrate both qualitative and quantitative data.

#### 2.4 Case Study 4: A touch-based tool's impact on caregiver burden with family member

*Overview:* Persons with dementia (PwD) need a great deal of support and assistance, and this need increases as the disease progresses. Behavioral and psychological symptoms of dementia (BPSD), such as aggressive behavior and depression, impose a significant burden on informal caregivers. There is a growing agreement that personalized non-pharmacological interventions can be effective to ameliorate challenging behaviors. A cognitive assistance system was developed to support occupational therapy to address BPSD. It includes a personal computer with a touch-based display and two smartphones, one for the PwD and one for the caregiver, tailored to the needs of each informant.[10] The system was deployed during six months in two homes where one PwD and one family caregiver live. *Methods:* The MM study was concurrent. During the intervention, as the log on the use of the system was analyzed, it informed the design of the posterior semi-structured interviews with the aim of better understanding what motivated use of the system and its impact on the PwD's apathy and independence and on caregiver burden. The analysis of quantitative data at the study's end was also supported with qualitative results from both observations and interviews.[10] Quantitative data included: Apathy Evaluation Scale[15], to measure PwDs' apathy as perceived by caregivers; Zarit burden interview[16] to assess subjective burden on the caregiver; and Revised Scale for Caregiving self-efficacy[17] to measure the caregivers' perceptions about their ability to successfully care for their PwDs. In addition, a system usage log was kept. Interviews were conducted with caregivers before, during, and after deployment to assess the effect of the intervention, and PwDs were observed using the system in several sessions. Analysis included the use of techniques to derive grounded theory and affinity diagramming.

### 3. Discussion

These case studies demonstrate use of MM evaluations of both developing (i.e., Home Care Therapy) and mature (i.e., EHR, Hospital Operating Theater) technologies. MM research demonstrates that inclusion of both qualitative and quantitative data fosters a richer exploration of the data when using multiple methods. Use of MM provides complementarity; that is, qualitative results can provide greater insights into the reasons *why* a particular system may or may not be used effectively and provides greater insights into interpretation of quantitative results. However, MM studies are not without challenges, including the amount and disparate nature of data from multiple sources. It

is challenging to synthesize quantitative and qualitative data, and use of MM often entails the requirement for further data collection to explore divergence in results.

#### 4. Conclusion

The use of MM as a research design in HIT evaluation has the potential to strengthen the research design and enable researchers to better understand the complexity of the system being investigated. MM can be used in a variety of settings to examine diverse HIT, as exemplified in the four case studies discussed in this article.

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#### References

- [1] C.P. Friedman, J.C. Wyatt, Evaluation methods in medical informatics. New York, NY: Springer; 2006.
- [2] D.F. Sittig, H. Singh, A new sociotechnical model for studying health information technology in complex adaptive healthcare systems. *Qual Safety Health Care* 2010;19(3):68-74.
- [3] D.E. Forsythe, B.G. Buchanan, Broadening our approach to evaluating biomedical information systems. 1991. p 8-12.
- [4] B. Kaplan, D. Duchon, Combining qualitative and quantitative methods in information system research: a case study. *MIS Q* 1988;4:571-86.
- [5] P.J. Scott, J.S. Briggs, A pragmatist argument for mixed methodology in medical informatics. *J Mixed Meth Res* 2009;3(3):223-41.
- [6] P.S. Sockolow, K.H. Bowles, M. Adelsberger, C. Liao, J.L. Chittams, Impact of home care electronic health record on clinician satisfaction, timeliness of clinical documentation and reimbursement, and patient outcomes. *Appl Clin Inform* 2014;5(2):445-462.
- [7] D. Dowding, M. Turley, T. Garrido, The impact of electronic health record on nurse sensitive patient outcomes: an interrupted time series analysis. *J Am Med Inform Assoc* 2012;19:615-20.
- [8] D. Dowding, M. Turley, T. Garrido, Nurses' use of an integrated electronic health record: results of a case site analysis. *Inform Health Soc Care* 2014.
- [9] R. Randell, J. Greenhalgh, J. Hindmarsh, D. Dowding, D. Jayne, A. Pearman, P. Gardner, J. Croft, A. Kotze, Integration of robotic surgery into routine practice and impacts on communication, collaboration, and decision making: a realist process evaluation protocol. *Implement Sci* 2014;9(52).
- [10] R.F. Navarro, M.D. Rodriguez, J. Favela, Use and Adoption of a Touch-Based Occupational Therapy Tool for People Suffering from Dementia. IWINAC. Volume LNCS 9107. Spain 2015.
- [11] P.S. Sockolow, J.P. Weiner, K.H. Bowles, H.P. Lehmann, A new instrument for measuring clinician satisfaction with electronic health records. *Comp Inform Nurs* 2011;29(10):574-85.
- [12] P. Abrishami, A. Boer, K. Horstman, Understanding the adoption dynamics of medical innovations: affordances of the da Vinci robot in the Netherlands. *Soc Sci Med* 2014;117:125-33.
- [13] S. Undre, N. Sevdalis, A. Healey, A. Darzi, C. Vincent, Observational teamwork assessment for surgery (OTAS): refinement and application in urological surgery. *World J Surg* 2007;31(7):1373-81.
- [14] M. Wilson, J. Poolton, N. Malhotra, K. Ngo, E. Bright, R.W. Masters, Development and validation of a surgical workload measure: the surgery task load index (SURG-TLX). *World J Surg* 2011;35(9):1961-9.
- [15] D.E. Clarke, R. Reekum, M. Simard, D.L. Streiner, M. Freedman, D. Conn, Apathy in dementia: an examination of the psychometric properties of the apathy evaluation scale. *J Neuropsych Clin Neurosci* 2007;19(1):57-64.
- [16] S.H. Zarit, K.E. Reeve, J. Bach-Peterson, Relatives of the impaired elderly: correlated of feelings of burden. *Gerontologist* 1980;20(6):649-55.
- [17] A.M. Steffen, C. McKibbin, A.M. Zeiss, D. Gallagher-Thompson, A. Bandura, The revised scale for caregiving self-efficacy reliability and validity studies. *J Geront Ser B: Psychol Sci Soc Sci* 2002;57(1):74-86.

# The Evaluation Imperative

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**Abstract.** With the advent of wide scale adoption and use of clinical information systems and other technologies to support the delivery of healthcare services, the inclusion of iterative evaluation is an often overlooked but important component of project management. In this paper, it is proffered that the evaluation process should be an imperative and initiated at the outset of the design and implementation of clinical information systems including any single component of hardware or software. Ideally, methods of evaluation should be multi-faceted, include formative and summative evaluation approaches and include a range of metrics that will provide organizations with insight to process and technology efficiency and effectiveness as well as human and financial impacts.

**Keywords.** Evaluation, clinical information systems, benefits realization, implementation, adoption.

## 1. Introduction

In this paper, it is emphasized that the evaluation process should be initiated at the outset of the design and implementation of clinical information systems (CIS) or any related constituent functional components including hardware and software. While several authors have described different frameworks and approaches to systems evaluation, few healthcare organizations systematically employ techniques to comprehensively capture and demonstrate the clinical and operational returns for these costly acquisitions. Numerous authors have reported on some aspect of CIS evaluation (e.g., quality, cost, satisfaction, outcomes impact of organizational factors) [1, 2, 3, 4, 5], but comprehensive evaluation reports addressing the domains of people, process and technology impact are lacking. Others have identified some of the barriers and challenges associated with the evaluation of information technology in healthcare [6, 7, 8], but it remains unclear as to why a majority of healthcare organizations fail to incorporate evaluation as a core and critical component of any CIS project plan. To fail to measure the impacts of CIS implementations, is a failure to demonstrate the benefits to be derived from these investments and quite frankly, irresponsible given the costs.

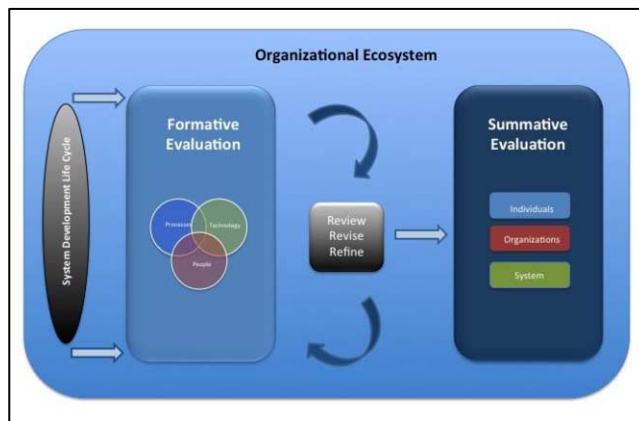
## 2. Types of Evaluation

Although frequently guided by the phases of the Systems Development Life Cycle (SLDC), an evaluation should be driven by the objectives of the CIS as established at the time of a solution acquisition. The intent of any evaluation should always be focused on whether an organization(s) has achieved the original goals driving the investment. For example: medication barcoding has been purchased to improve patient safety by reducing adverse events associated with medication errors hence evaluation

measures should include the capture of pre and post-implementation rates of error (e.g., medication errors). Furthermore, since most implementations begin with design and testing, not only is it important to conduct summative evaluations but iterative, formative evaluation will garner insights to design and process improvement opportunities. Specific issues

### 2.1 Formative and Summative Evaluation

Others have addressed the processes and timing of CIS evaluation [9, 10], but the evaluation of one or more functional components of a clinical information system will ideally encompass both *formative* and *summative measures* (see Figure 1). Formative evaluation occurs during the phases of CIS design, implementation and education such that the end state and processes may be modified on the basis of findings along the way. Following the SLDC, formative evaluation is iterative following the processes associated with CIS functional design, redesign, implementation, and education. Formative measures should incorporate those that inform the impact of the CIS on people (e.g., clinician users, patients) and processes (e.g., efficiency, error reduction, decreased duplication of effort), as well as performance of the technology itself (e.g., ease of use, responsiveness, access). Over the course of time, formative evaluation will inform the need for system revisions and refinements. Upon completion of these modifications, the CIS component(s) should be subject to a repeat evaluation focused on the relevant people, process and or technology changes.



**Figure 1.** Iterative model of formative and summative evaluation

Summative evaluation typically occurs upon completion of a CIS or subset of functional systems implementation. This evaluation focuses on whether the desired outcomes have been achieved (as per the objectives), unintended consequences, impacts, and possibly comparisons with other programs or baseline, pre-implementation metrics within the same program (e.g., changes in efficiency and effectiveness). Summative evaluations may incorporate measures of individual, organizational and or system outcomes. With the addition of integrated or interdependent CIS functionality, a summative evaluation may be repeated with

measures to determine the additive impact of same on pre-existing processes and technologies.

### 3. Evaluation Metrics

A determination of single indicators or the combination of indicators that will best demonstrate the dimensions intended objectives of the CIS functional components should ideally be identified at the outset of an CIS initiative. Many organizations find it helpful to develop a logic model that reflects the intended changes to system processes and outcomes. This model should be developed to align the SDLC, with formative and summative measures. Possible indicators and their constituent dimensions to be considered for evaluation are summarized in Table 1.

**Table 1.** CIS evaluation categories, indicators and constituent dimensions. Adapted from DeLone & MacLean [11,12] and Canada Health Infoway [13] benefits evaluation frameworks.

Category	Indicator	Dimensions
System Performance	<i>System quality</i>	<ul style="list-style-type: none"> <li>• Security</li> <li>• Functionality</li> <li>• Performance</li> </ul>
	<i>Information quality</i>	<ul style="list-style-type: none"> <li>• Availability</li> <li>• Completeness</li> <li>• Accuracy</li> <li>• Access</li> <li>• Content</li> </ul>
	<i>Service quality</i>	<ul style="list-style-type: none"> <li>• Performance</li> <li>• Responsiveness</li> <li>• Usability</li> </ul>
System Use	<i>Use and User Satisfaction</i>	<ul style="list-style-type: none"> <li>• Use</li> <li>• Self-reported use</li> <li>• Intention to use</li> <li>• Competency</li> <li>• Ease of use</li> <li>• Satisfaction</li> </ul>
Net Benefits	<i>Access</i>	<ul style="list-style-type: none"> <li>• Patient/care-giver participation</li> <li>• Access to services/clinicians</li> </ul>
	<i>Productivity</i>	<ul style="list-style-type: none"> <li>• Efficiency</li> <li>• Resource reduction/reallocation</li> <li>• Care co-ordination</li> <li>• Cost-savings</li> <li>• Cost-avoidance</li> </ul>
	<i>Quality</i>	<ul style="list-style-type: none"> <li>• Appropriateness of care</li> <li>• Clinical outcomes</li> <li>• Safety                             <ul style="list-style-type: none"> <li>○ Incidence of adverse events – drug &amp; device</li> <li>○ Surveillance</li> </ul> </li> <li>• Care transitions</li> </ul>
Organizational Support	<i>Environmental Context</i>	<ul style="list-style-type: none"> <li>• Organizational culture</li> <li>• Risk Tolerance</li> <li>• Leadership</li> <li>• Communications</li> <li>• System Design Processes                             <ul style="list-style-type: none"> <li>○ User engagement</li> </ul> </li> <li>• Implementation Processes                             <ul style="list-style-type: none"> <li>○ Training &amp; support</li> </ul> </li> </ul>
System Goals	<i>Achievement of CIS Goals</i>	<ul style="list-style-type: none"> <li>• Current (baseline) state</li> <li>• Desired (future) state</li> <li>• Actual (post-implementation) state</li> </ul>

\*Note: This list of indicators is not intended to be all inclusive.



Based upon the evaluation framework developed by DeLone & MacLean [11, 12], Canada Health Infoway's Benefits Evaluation Technical Report [13] provides a compendium of indicators associated with different CIS components. This reference document provides many examples of indicators with definitions and possible approaches and tools for measurement. Another good reference site is the Agency for Healthcare Research and Quality (AHRQ) website. They have developed a resource identifying an array of health care decision-making and research tools in the Quality Indicator Toolkit [14]. This toolkit is designed to provide organizations with tools to evaluate change, many of which can be downloaded at no cost.

## 5. Discussion

Although there are several different approaches to consider, Neville and colleagues [15] proposed the following practical steps to planning for the evaluation of a CIS:

- Step One: Identify WHO are the key stakeholders
- Step Two: Orient key stakeholders to the CIS initiative and reach agreement on WHY an evaluation is needed
- Step Three: Agree on WHEN to evaluate
- Step Four: Agree on WHAT to evaluate
- Step Five: Agree on HOW to evaluate
- Step Six: Analyze and report.
- Step Seven: Agree on recommendations and forward to key stakeholders.

Detailed recommendations regarding approaches to each step are provided within the complete publication. In conjunction with these proposed steps, before, during and following the evaluation phases, there are critical success factors to be addressed including the need for:

- Knowledge and understanding of evaluation metrics and approaches;
- Knowledge of the central constructs of evaluation;
- Experience in CIS evaluations, formative and summative;
- Knowledge and experience with all phases of the CIS SDLC;
- The active participation and involvement of key stakeholders in the formulation of the evaluation plan;
- Proven methodology in gathering and analyzing data;
- Good communication throughout the evaluation with management and the users, on the status of the evaluation process;
- Experience in identifying opportunities for measuring CIS benefits and outcomes;
- The development of an action plan to address the recommendations arising from the evaluation findings

Overall, an effective and useful evaluation will be only achieved with a clear vision for CIS deployment and use. But most importantly requires the guiding hand of a transformational leader who appreciates that evaluation is not just a 'nice to do' but an imperative in the face of a disruptive technology such as a CIS.

## References

- [1] W. Welch, D. Bazarko, K. Ritten, Y. Burgess, R. Harmon & L.Sandy. Electronic health records in four community physician practice: Impact on quality and cost of care. *Journal of the American Medical Informatics Association*, **14** (2003), 320-328.
- [2] C. Bossen, L. Jensen & F. Udsen, Evaluation of a comprehensive EHR based on the DeLone and McLean model for IS success: Approach, results, and success factors. *International Journal of Medical Informatics* **82** (2013), 940-953.
- [3] S. Kossman, S. Scheidenhelm, Nurses' perception of the impact of electronic health records on work and patient outcomes. *Computers Informatics Nursing* **26** (2008), 69-77.
- [4] D. Dowding, M. Turley, T. Garrido, The impact of an electronic health record on nurse sensitive patient outcomes: An interrupted time series analysis. *The Journal of the American Medical Informatics Association* **19** (2012), 615-620.
- [5] M. Studer, The effects of organizational factors on the effectiveness of EMR system implementation- What have we learned? *Electronic Healthcare*, **4** (2005), 92-98.
- [6] B. Kaplan, Addressing organizational issues into the evaluation of medical systems. *Journal of the American Medical Informatics Association* **4** (1997), 94-101
- [7] H. Heathfield, D. Pitty, R. Hanka, Evaluation information technology in health care: Barriers and challenges. *British Medical Journal* **316** (1998), 1959-1961.
- [8] J. Moehr, Evaluation: Salvation or nemesis of medical informatics? *Computers in Biology and Medicine* **32** (2002), 113-125.
- [9] J.J. McGowan, C.M. Cusack, E.G. Poon, Formative Evaluation: A critical component in EHR implementation. *Journal of the American Medical Informatics Association*, **15** (2008), 297-301.
- [10] J.C. Wyatt, J.C. & S.M. Wyatt, When and how to evaluate health information systems. *International Journal of Medical Informatics* **69** (2003), 251-259.
- [11] W. DeLone, & E. McLean, Information systems success: The quest for the dependent variable. *Information Systems Research* **3** (1992), 60-95.
- [12] W. DeLone & E. McLean, The DeLone and McLean Model of Information Systems success: A ten year update. *Journal of Management Information Systems* **19** (2003), 9-30.
- [13] Canada Health Infoway. Benefits Evaluation Indicators: Technical Report 2.0. (2012) Available at: <https://www.infoway-inforoute.ca/.../544-benefits-evaluation-indicators-technical-report-version-2-0>
- [14] Agency for Healthcare Research and Quality. AHRQ Quality Indicators Toolkit: Specific tools to support change (2014). Available at: <http://www.ahrq.gov/professionals/systems/hospital/qitoolkit/g2-specifictoolstosupportchange.pdf>
- [15] D. Neville, K. Gates, D. MacDonald, et al.. Toward an evaluation framework for electronic health records initiatives: A proposal for an evaluation framework (2004). Available at: [http://www.nlchi.nl.ca/images/PDFs/final\\_framework.pdf](http://www.nlchi.nl.ca/images/PDFs/final_framework.pdf)

# User-Centered Design Practices to Redesign a Nursing e-Chart in Line with the Nursing Process

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**Abstract.** Regarding the user-centered design (UCD) practices carried out at Hospital Italiano of Buenos Aires, nursing e-chart user interface was redesigned in order to improve records' quality of nursing process based on an adapted Virginia Henderson theoretical model and patient safety standards to fulfil Joint Commission accreditation requirements. UCD practices were applied as standardized and recommended for electronic medical records usability evaluation. Implementation of these practices yielded a series of prototypes in 5 iterative cycles of incremental improvements to achieve goals of usability which were used and perceived as satisfactory by general care nurses. Nurses' involvement allowed balance between their needs and institution requirements.

**Keywords:** nursing record, nurse e-chart, user-centered design, user interface design, nursing process

## 1. Introduction

As health care organizations evolved from record paper based to electronic clinical record systems, representation of nursing data in formats that can be shared preserving its complexity, context, and richness of patient's care has become one major challenge [1]. Multiple nursing vocabularies are required to represent the variation which exists through practice domains and levels of care, in addition to formal coordination rules that support the representation of more complex concepts [2-3]. The UCD considers user's requirements in all phases of the design process of a product, generating more 'usable' tools [4]. Health Informatics Department of Hospital Italiano de Buenos Aires (HIBA) has implemented a process of UCD, establishing new rules and procedures for information systems design and evaluation, as recommended by Eric Schaffer [5] and the National Institute of Standards and Technology (NIST) to standardize the usability evaluation protocol of electronic health records [6]. To improve the quality of nursing records a redesign of the user interface was decided following the nursing process and Virginia Henderson model adapted to our hospital and the standards for patient safety aligned to Joint Commission International (JCI) accreditation process.

The aim of this study is to describe the participatory redesign of the nursing e-chart user interface at Hospital Italiano de Buenos Aires.

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## 2. Methods

This study was conducted at HIBA from March to July of 2014. The hospital was founded in 1853 and it belongs to a nonprofit health care network that includes a second hospital, 25 outpatient centers and 150 private offices distributed in the city of Buenos Aires. It has its own electronic health record (EHR). For inpatient, emergency room and home care areas a nurse e-chart is visible and accessible. At the moment of this study the nursing record was organized in 4 sections: Assessment, Planning, Implementation and Evaluation. Where each section is independent of each other, so nurses can record following the logic of nursing process or directly access any section without going through the others.

With regard to UCD framework, design of new nurse e-chart user interface was addressed with the following work plan outlined in table 1:

**Table 1:** Work plan for the design of new nurse e-chart user interface

Work plan	Actions
Nursing record assessment	Content evaluation Nurse-system interaction Usability defects Navigation
Contextual interview	Observation of EHR Nurses' interviews
Focus group	10 nurses Experiences related with care process documentation
Participatory design	Design sessions Informaticians and usability experts participation
Usability testing	5 iterative cycles Usability objectives: <ol style="list-style-type: none"> <li>1. Select pain and risks assessments according to needs.</li> <li>2. Choose a nursing diagnosis, or add a new one, relevant with assessed findings.</li> <li>3. Plan actions aimed to resolve the diagnostic cause.</li> <li>4. Register planned actions execution.</li> <li>5. Conduct an evaluation selecting one or more diagnoses.</li> <li>6. Expressing satisfaction with the new interface.</li> </ol>
Sample	Inclusion: General care nurses, Inpatient areas, both gender, no age limit Exclusion: Administrators and auxiliary nurses
Tests	Acoustically isolated room. Notebook DELL Latitude E5510 Balsamiq® mockups , Morae 3.2 (TechSmith Corporation) Paper prototypes with Carolyn Snyder methodology <sup>(9)</sup> Clinical case as trigger Final Interviews: nurses' tool perception and feasibility of application

We carried out, in several team meetings, brainstorming sessions, tasks analysis and nursing workflow, review of the literature [7-8], and analysis of Nurses Department requirements. Looking for usability and navigation defects we observed several nurses at their work environments in interaction with EHR, interviewing five of them. A focus group session was held with 10 nurses with a bachelor's degree or studies in progress.

In the first phase we developed the interface prototype, then the nutrition needs, pain and risks assessments considering the nursing process (NP) five stages. Using a

clinical case, paper-based tests were conducted with 13 nurses, aged 26 - 52 years, and more than half of them have been using the EHR for more than 5 years. After each test, a survey was conducted to each participant and iterative improvements were implemented in prototypes for new testing.

### 3. Results

The most important changes and modification to prior nursing record is given in sections of assessment, diagnoses and planning (in the same interface); the introduction of nursing diagnoses according to NANDA-I taxonomy II, Nursing Outcomes Classification (NOC) and Nursing Interventions Classification (NIC), and the evaluation according to nursing diagnoses. In the final version the NOC were removed (Figure 1).

Figure 1: Assessment and Planification screen prototype [9]

#### 3.1. User evaluation

The focus group and nurses' interviews showed that nurse-patient ratio (1:7 - 1:10 in general care areas), workflow, workload and number of computers available, impact on the quantity and quality of documentation. The nurses who participated in the tests described their relationship with technology as 'good enough'. We observed that nurses were inclined to write data in the evaluation section that should be written in others sections (assessment or execution), duplicating information. Once they have chosen the nursing diagnosis they were disoriented about etiology and outcomes. Also we observed they decided not to perform the ulcer pressure assessment risk based on assumptions and not on scales application. Repeatedly they were looking for free-text entry spaces to record even if not engage with the required information, and most reported using paper notes as memory aid. Sections that resulted in major questions

were those of diagnosis and assessment. During testing, the nurses preferred to record in the evaluation section that allows free-text because 'it is easier and faster'. They also expressed that would be useful to locate pain in a human figure and have reminders of reassessment for those patients who in initial assessments have been classified as 'low risk'.

The perception regarding the new interface, information, navigation and content organization was satisfactory. Some mentions were that: would register more complete and accurate the nursing process avoiding the omission of data; that it would be simple to use with brief training, and the frequencies of planification for the NIC were not congruent with nurse-patient ratio and the availability of time, being this the most worrying aspect.

#### **4. Discussion**

We describe UCD practices to redesign the nurse e-chart user interface in order to improve the quality of the NP documentation. The impact of changing from a model that allows documentation ignoring the logic of the NP to a sequential model that implies choosing diagnoses and structure record requires a mental abstraction process and decision making that nurses identify in their mental process but fail to express in the documentation, generating tensions. But most acknowledged that 'they had studied it (NP) at undergraduate school'. Also that the new system was 'understandable' and with proper training would not have difficulties to use it. Considering the potential organizational impact caused by the new record, including all changes set to meet JCI accreditation process, we decided to remove the NOC because of lack of experience on using it and the complexity in the use.

One of the problems associated with electronic nursing records related to little involvement of nurses in the development of systems [10], aspect that we consider has been mitigated in this experience by applying the philosophy of the UCD and usability, considering represents one of the ways to address the use of a new system to increase adoption and determine the needs and preferences of end users [11].

Other experiences agreed with our findings, as long as a system is designed from the nurses' perspective, who consider the characteristics of their practice and project them on the content and functionality of the user interfaces, and is consistent with the sequence of evaluations of the patients that nurses perform, accompanying the mental process, planning of care and clinical judgment it is more likely to support the nursing work [12-13]. We must consider that this experience was performed with general inpatient care nurses. Future phases contemplate to replicate these practices with nurses in critical areas, neonatology, pediatrics and other special populations (mental health).

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## References

- [1] P.C. Dykes, H. Kim, D.M. Goldsmith, J. Choi, K. Esumi, H.S. Goldberg, The adequacy of ICNP version 1.0 as a representational model for electronic nursing assessment documentation. *J Am Med Inform Assoc JAMIA*. 2009 Apr;16(2):238–46.
- [2] P.C. Dykes, L.M. Currie, J.J. Cimino, Adequacy of evolving national standardized terminologies for interdisciplinary coded concepts in an automated clinical pathway. *J Biomed Inform*. 2003 Oct;36(4-5):313–25.
- [3] R.D. Zielstorff, C. Tronni, J. Basque, L.R. Griffin, E.M. Welebob, Mapping nursing diagnosis nomenclatures for coordinated care. *Image-- J Nurs Scholarsh*. 1998;30(4):369–73.
- [4] K. Pavelin, J.A. Cham, P. De Matos, C. Brooksbank, G. Cameron, C. Steinbeck, Bioinformatics meets user-centred design: a perspective. *PLoS Comput Biol*. 2012;8(7):e1002554.
- [5] E. Schaffer, *Institutionalization of usability a step-by-step guide*, Addison-Wesley, Boston, Mass., 2004.
- [6] US Department of Commerce NIST Manuscript Publication Search [Internet]. [Cited 2015 Oct 4]. Available from: [http://www.nist.gov/manuscript-publication-search.cfm?pub\\_id=907313](http://www.nist.gov/manuscript-publication-search.cfm?pub_id=907313)
- [7] NANDA international. *DIAGNÓSTICOS ENFERMEROS. Definiciones y clasificación 2012-2014*. 1a ed, Elsevier, Barcelona, 2012
- [8] G.M. Bulechek, M. Johnson, M. L. Maas, J.M. Dochterman. *Interrelaciones NANDA, NOC y NIC: diagnósticos enfermeros, resultados e intervenciones*, 2da edición, Elsevier; Madrid, 2007.
- [9] C. Snyder, *Paper Prototyping: The Fast and Easy Way to Design and Refine User Interfaces*. Morgan Kaufmann, San Francisco, 2003.
- [10] W.T. Goossen, P.J. Epping, T. Dassen. Criteria for nursing information systems as a component of the electronic patient record. An international Delphi study. *Comput Nurs*. 1997 Dec;15(6):307–15.
- [11] M.C. Beuscart-Zéphir, J. Brender, R. Beuscart, I. Ménager-Depriester. Cognitive evaluation: how to assess the usability of information technology in healthcare. *Comput Methods Programs Biomed*. 1997 Sep;54(1-2):19–28.
- [12] S. Hyun, S.B. Johnson, P.D. Stetson, S. Bakken. Development and evaluation of nursing user interface screens using multiple methods. *J Biomed Inform*. 2009 Dec;42(6):1004–12.
- [13] N.R. Hardiker, S. Bakken. Requirements of tools and techniques to support the entry of structured nursing data. *Stud Health Technol Inform*. 2004;107(Pt 1):621–5.

# Using Clinical Decision Support and Dashboard Technology to Improve Heart Team Efficiency and Accuracy in a Transcatheter Aortic Valve Implantation (TAVI) Program

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**Abstract.** Heart Team meetings are becoming the model of care for patients undergoing transcatheter aortic valve implantations (TAVI) worldwide. While Heart Teams have potential to improve the quality of patient care, the volume of patient data processed during the meeting is large, variable, and comes from different sources. Thus, consolidation is difficult. Also, meetings impose substantial time constraints on the members and financial pressure on the institution. We describe a clinical decision support system (CDSS) designed to assist the experts in treatment selection decisions in the Heart Team. Development of the algorithms and visualization strategy required a multifaceted approach and end-user involvement. An innovative feature is its ability to utilize algorithms to consolidate data and provide clinically useful information to inform the treatment decision. The data are integrated using algorithms and rule-based alert systems to improve efficiency, accuracy, and usability. Future research should focus on determining if this CDSS improves patient selection and patient outcomes.

**Keywords.** Computerized Decision Support; Heart Team; Medical Informatics; TAVI; user-computer interface

## 1. Introduction

Currently, patients with critical aortic stenosis have a variety of treatment alternatives. Historically, the only treatment option, once the narrowing had progressed in severity, was open sternotomy with surgical replacement. In 2005, clinical trials began in the United States to determine if minimally invasive therapies were at least as good as the

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standard of care. Smith et al. [1] and Adams et al. [2] have shown that for patients at high risk for open-heart surgery, transcatheter aortic valve implantation (TAVI) is at least as good, if not superior to open heart surgery. In addition, patients who are deemed inoperable have a minimally invasive option that was shown to decrease mortality by at least 25% [3].

Due to the promising data, the Centers for Medicare & Medicaid Services (CMS) approved reimbursement for TAVI in 2012 with the condition that, perioperatively, the patient is under the care of a heart team. This team is defined by CMS as being ‘a cohesive, multi-disciplinary, team of medical professionals. The heart team concept embodies collaboration and dedication across medical specialties to offer optimal patient-centered care’ [4]. Regulatory agencies are not the only institutions recommending the collaboration of a heart team. In 2012, the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS) established that TAVI was only recommended in hospitals with a heart team available to assess patient risks [5]. This cohesive approach is imperative in elderly patients with critical aortic stenosis and multiple comorbidities.

The importance of interdisciplinary communication and collaboration is described throughout the literature. As early as 1999, the Institute of Medicine described the importance of developing a culture at the institution in which communication flows without constraint in order to increase patient safety [6]. This is increasingly important in patients with aortic stenosis. Often, the patients are octogenarians or nonagenarians and do not have a great deal of reserve. At Scripps Clinic and Green Hospital the heart team has been in existence since 2008 and consists of interventional cardiologists, cardiothoracic surgeons, a congestive heart failure specialist, imaging specialists, anesthesia, a nurse practitioner, research coordinators, and administration. With the success of the program and transcatheter technologies our volume has expanded and the team evaluates an average of seven patients per week. The possible treatment plans include not only a multitude of research protocols, but also commercially available transcatheter protocols all that require complex analysis of patient information.

The initial review and discussion of patient data occur at the weekly valve conference. Each patient is discussed in depth and a treatment plan is synthesized. The plan of care is exceptionally comprehensive.

Patient outcomes, quality, and cost-effectiveness impact the success of a new program or technology. Challenges exist in determining the methodologies for communicating outcomes and depend on resources and the culture of the practice environment. Patients with aortic stenosis who are not considered for surgical aortic valve replacement (SAVR) are now being regularly referred for and treated with transcatheter aortic valve implantation (TAVI). Evidence on patient selection and outcomes is rapidly evolving as a result of clinical trials and registry data. Determining which patients will benefit from the TAVI remains a key responsibility for the heart team. In order to improve outcomes for these patients, efforts are being made to define and implement best practice interventions.

## 2. Methods

### 2.1 System Description

In 2012, an Access database was created to streamline the screening process for TAVI patients at Scripps Clinic and Green Hospital. Creating the database was a grass roots effort on the part of an interdisciplinary group led by a Nurse Practitioner. This team created, modified, and improved the database capabilities and reports based on evidence based practice initiatives and end-user feedback. The database contained multiple free-text fields and required manual data-entry. A summary sheet was utilized during the weekly TAVI meeting to provide the team with clinical data. The potential for error was great because this data was neither synthesized nor displayed effectively.

### 2.2 System Development

Developing the dashboard involved an initial interview with the Heart Team to identify pertinent information required to facilitate the patient-provider interaction and determine the treatment plan. Subsequently clinician needs were incorporated through iterative feedback and evaluation activities. Involving intended users in a timely fashion ensured that the clinical decision support system (CDSS) met the expectations of the end user and the users developed a sense of ownership and pride in the process and end product. In addition, a rapid-cycle evaluation process allowed for a rather swift progression. Clinical and information technology (IT) experts collaborated to develop the algorithms, alert systems, and interfaces.

The first phase was to convert free text to standardized discrete data fields, as these were necessary for improved accuracy. In addition, the data were the inputs for algorithms that were developed in a subsequent phase. As there were over 600 patients in the database, a student volunteer was utilized for conversion with systematic audits for accuracy. Other inputs necessary for algorithm development were staging and classifying of diseases. Clinical experts in pulmonary, heart failure and nephrology were interviewed to confirm the literature-based classifications. The providers are confident that the machine decision-tree is based on science. Systematic audits were performed throughout the development process and feedback provided for necessary changes.

Algorithms were also developed to determine valve sizing, vascular access, and eligibility for participation in a clinical research trial. These algorithms were based on published trial and registry data, valve instructions for use, trial inclusion/exclusion criteria and expert opinion. Processes were built in for systematic audits for accuracy. Alerts were created using traditional red-yellow-green visualization strategies. Audits to ensure that alerts were accurate, pertinent, and useful were conducted and end-user feedback was provided for changes to prevent alert fatigue.

### 2.3 System Workflow

CDSS that do not support its users, the work environment, can create inefficiencies and prevent goal attainment. We implemented a CDSS so it would integrate into existing clinical workflows on the TAVI Heart Team. Clinicians are accustomed to having most, if not all of the data obtained for the screening process (i.e. comorbidities, risk assessment, and annulus and vascular access assessment) prepared at the weekly Heart

Team meeting. Thus, the data are available for review before the clinical encounter. Because we do not have an integrated electronic health record or tablet use for patient care, the raw data supporting the treatment recommendations and alert system was displayed for the provider. In addition, copies of the CDSS was printed for all providers during the Heart Team weekly meetings.

### 3. Results

#### 3.1 Study Design

A waiver of informed consent was obtained from the institution. Participants were informed that their participation was voluntary and all demographic and testing information would be de-identified. For data governance, all testing material were kept in a locked drawer, in a locked office. Computerized data, such as video files, excel spreadsheets and SPSS files are kept on a password protected computer. To allow for comparisons between the traditional TAVI summary sheet and the TAVI CDSS we tested the same clinicians, in the same setting using mock patient data. Participants were asked to identify possible treatment plans and priorities for the patient. Forty questions were assessed using 15 different ‘mock patients’. The pilot will be evaluated using a pre–post quasi-experimental design involving mixed methods. During a videotaped session, each clinician was provided with scripted instructions. These instructions included:

- Instructions for the testing session and ‘think aloud technique’ for qualitative data collection
- Demographic data collection tool
- Sample of the CDSS and traditional TAVI summary sheet
- 15 test scenarios (same exact patient data using the displayed on the CDSS and TAVI summary sheet)
- System Usability Scale for each tool. This is a valid and reliable likert scale testing CDSS

Late 2015, we started collecting both quantitative and qualitative data on usability of the CDSS. We examined accuracy and efficiency of the Heart Team in identifying pertinent components in the patient’s plan of care. Brooke’s Standardized Usability Tool [7] was utilized to assess usability. This instrument has been deemed valid and reliable in prior studies [8]. In addition, two independent appraisers reviewed the think-aloud sessions for usability themes (qualitative). Disagreements were reconciled via discussion. In addition, demographic information was collected about the providers to enable comparison across different specialties, age groups, and gender. A complete analysis of these data is expected early 2016.

#### 4. Discussion

Inefficiencies, practice variation and imprecise decisions in Heart Teams are inevitable, because clinicians have to make critical decisions regarding complex patients with multiple comorbid conditions with very limited support [9]. Computer algorithms and rule-based alerts can provide CDS to clinicians, and this prototype is aimed to improve team efficiencies, accurate assessment of the clinical information to ultimately promote improved decision-making. For clinical decision support to be adopted in daily clinical practice, engaging end-users in the design of the tool, ensuring seamless integration with the workflow of the clinicians is of paramount importance.

#### 5. Acknowledgments

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#### References

- [1] C. R. Smith, M. B. Leon, M. J. Mack, D. C. Miller, J. W. Moses, L. G. Svensson, . . . S. J. Pocock (2011). Transcatheter versus surgical aortic-valve replacement in high-risk patients. *N Engl J Med*, 364(23), 2187-2198. doi:10.1056/NEJMoa1103510
- [2] D. H. Adams, J. J. Popma, M. J. Reardon, S. J. Yakubov, J. S. Coselli, G. M. Deeb, . . . J. K. Oh (2014). Transcatheter aortic-valve replacement with
- [3] M. B. Leon, C. R. Smith, M. Mack, D. C. Miller, J. W. Moses, L. G. Svensson, . . . S. Pocock (2010). Transcatheter aortic-valve implantation for aortic stenosis in patients who cannot undergo surgery. *N Engl J Med*, 363(17), 1597-1607. doi:10.1056/NEJMoa1008232
- [4] Centers for Medicare and Medicaid Services (2012). Decision Memo for Transcatheter Aortic Valve Replacement (TAVR) (CAG-00430N).
- [5] The Joint Task Force on the Management of Valvular Heart Disease, of the European Society of Cardiology and European Society of Cardio-Thoracic Surgery. Guidelines on the management of valvular heart disease. *European Heart Journal*. (2012). doi:10.1093/eurheartj/ehs109
- [6] Institute of Medicine. To err is human: Building a safer health system. Retrieved from [http://books.nap.edu/openbook.php?record\\_id=9728](http://books.nap.edu/openbook.php?record_id=9728). 1999 (pp. 180-182)
- [7] J. Brooke SUS: a 'quick and dirty' usability scale. In: Jordan PW, Thomas B, Weerdmeester BA, McClelland IL (eds) Usability evaluation in industry. 1996. Taylor & Francis, London, pp 189-194
- [8] A Bangor, P Kortum, J Miller. An empirical evaluation of the System Usability Scale. *International Journal Of Human-Computer Interaction* [serial online]. August 2008;24(6):574-594.
- [9] DM. Eddy 1990 The challenge. *J. Am. Med. Assoc.* 263, 287-290. (doi:10.1001/jama.1990.03440020121046)

# Enhancing Patient Safety Using Clinical Nursing Data: A Pilot Study

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**Abstract.** To enhance patient safety from falls, many hospital information systems have been implemented to collect clinical data from the bedside and have used the information to improve fall prevention care. However, most of them use administrative data not clinical nursing data. This necessitated the development of a web-based Nursing Practice and Research Information Management System (NPRIMS) that processes clinical nursing data to measure nurses' delivery of fall prevention care and its impact on patient outcomes. This pilot study developed computer algorithms based on a falls prevention protocol and programmed the prototype NPRIMS. It successfully measured the performance of nursing care delivered and its impact on patient outcomes using clinical nursing data from the study site. Results of the study revealed that NPRIMS has the potential to pinpoint components of nursing processes that are in need of improvement for preventing patient from falls.

**Keywords.** Quality improvement, nursing care, health information systems, delivery of nursing care

## 1. Introduction

Falls are a common adverse event in health care settings and are associated with unintentional injuries such as fractures, head and soft tissue trauma, which may lead to impaired rehabilitation, decreased independence and premature death [1-3]. According to the U.S. Public Health Service, two-thirds of deaths due to falls are potentially preventable. The Joint Commission<sup>2</sup> recognized patient falls as a patient safety concern and has mandated nursing staffs to prevent patient falls by assessing and documenting fall risk levels regularly. Patient falls are a nursing sensitive indicator and falls data are useful sources of reflecting quality nursing care information [4-6]. In order to prevent or reduce patient falls and improve quality of nursing care, many hospitals have implemented fall prevention information systems, which typically involve fall risk assessment targeting specific interventions, patient and family education, low beds, alert signs and notes in patient records etc. [7].

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<sup>2</sup> <http://ww1.jointcommision.org>

Despite the wide implementation of various fall prevention systems in healthcare practice, there is a lack of studies that examined the performance of nursing care activities delivered in response to the recommendations of fall prevention systems and its impact on patients' health outcomes. The purpose of this pilot study was to develop a prototype computerized information system, Nursing Practice and Research Information Management System (NPRIMS) which captures and processes clinical nursing data to measure the performance of falls prevention nursing care and its impact on patient outcomes.

## **2. Methods**

### *2.1. Sample and Setting*

A nursing care protocol, the Fall and Fall-related Injury Prevention Protocol (FFIPP) for Veterans Admitted to Adult Day Health Care (ADHC) at Veterans Affairs (VA) Medical Center in Milwaukee, Wisconsin, was selected for this study because patients here are often older and are at a higher risk for falls. The ADHC at the VA Medical Center offers a program that the veterans can participate in during the day for social activities, peer support, companionship, and recreation. During program days, health care interventions from nurses, therapists, social workers, and others are provided.

### *2.2. Study Phases*

#### *2.2.1. Phase I: Expert nursing panel*

Two expert nurses were recruited for this study. One was a Master's prepared nurse with 19 years of work experience who participated in developing the FFIPP. The other nurse has 15 years of work experience in the quality improvement department of the study site. They validated data items identified from the FFIPP and logics of computer algorithms throughout the study.

#### *2.2.2. Phase II: Construction of computer algorithms*

Data items related to clinical assessments, patient problems, interventions, and patient outcomes from the FFIPP were identified by the investigators. These data items were presented to an expert nursing panel to determine whether data items were accurate and to elicit suggestions for modification. Then, computer algorithms using validated data items were constructed and depicted in an activity diagram to visualize logics of computer algorithms using Unified Modeling Language (Figure 1) [8]. An activity diagram and tabulated data items were presented to two expert nurses for validation of logics of the computer algorithm. This process was iterated until no more modifications and suggestions were made by the two expert nurses.

#### *2.2.3. Phase III: Programming a prototype NPRIMS*

A web-based system was programmed based on computer algorithms developed in phase II and installed on a Windows 7 platform. A web developmental tool, Ruby on Rails, was used to develop the system: 1) Sqlite as a database; 2) WEBrick as a simple

web server; and 3) Internet Explore/Firefox/Chrome as a client (<http://rubyonrails.org/>). The installed prototype was tested and debugged iteratively with 30 synthetic patient data sets.

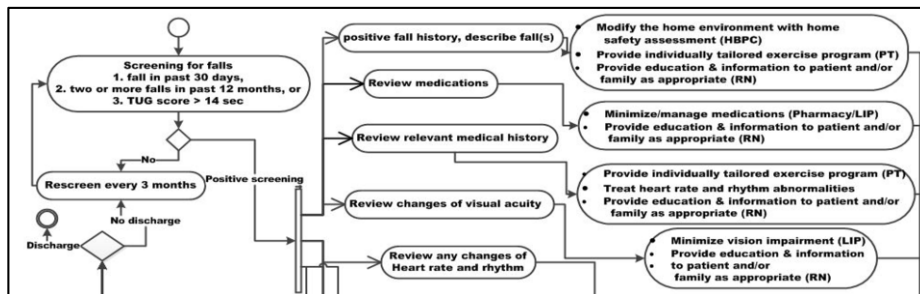


Figure 1. A partial view of an activity diagram

### 2.2.4. Phase IV: Evaluation of NPRIMS

Approval of the VA Medical Center Institutional Review Board was granted for the project. Non identifiable patient data associated with the FFIPP (i.e. assessment done, problem identified, intervention provided and outcome measured) were collected from electronic medical records at the Adult Day Health Care at VA Medical Center from January 1, 2014 through March 31, 2014 and entered into the NPRIMS for analysis. Fall data analyzed by the NPRIMS were compared to the existing QI report prepared by a data analyst at the VA Medical Center to evaluate performance of the NPRIMS.

## 3. Results

### 3.1. Characteristics of Patients

Among a total of 52 patients, there were 51 male patients (98%) and one female patient (2%). The average age was 80.8 with a range of 61 to 99 years.

### 3.2. Identified Data Items and Computer Algorithms

A total of forty-four data items were identified and validated by an expert nursing panel. The validation process was conducted twice and one issue emerged: “gait unbalanced or difficulty walking” screened as a risk for fall factor, but it had no associated nursing intervention. A suggested modification was associating following nursing interventions: 1) modify the home environment with home safety assessment; 2) provide individually tailored exercise programs; 3) improve fit and safety of footwear; and 4) provide education and information to patient and/or family with that risk factor.

Table 1 shows eight examples from forty-four data items validated by an expert nursing panel.

**Table 1.** Examples of data items identified from FFIPP

Assessment	Patient Problem	Intervention(s)	Outcome
Review feet & footwear	Feet & footwear cause difficulty walking	<ul style="list-style-type: none"> <li>• Improve fit and safety of footwear</li> <li>• Consult for foot care</li> <li>• Provide education and information to patient and/or family as appropriate</li> </ul>	(no fall) or (fall but no injuries)
Gait unbalanced or difficulty walking	(*TUG score > 14 seconds) or (difficult with walking or balance) *Timed Up and Go (TUG) Test	<ul style="list-style-type: none"> <li>• Modify the home environment with home safety assessment</li> <li>• Provide individually tailored exercise program</li> <li>• Improve fit and safety of footwear</li> <li>• Provide education and information to patient and/or family as appropriate</li> </ul>	(no fall) or (fall but no injuries)

### 3.3. Accuracy of the NPRIMS

The data from the first quarter QI report were: 1) average daily census in ADHC (26 patients/day); 2) program days (61 days); 3) number of falls (2 patients); and 4) 0.12 falls per 100 program days ( $0.12 = 2 / (61 * 26) * 100$ ). These QI data were compared with outputs analyzed by the NPRIMS (Table 2).

**Table 2.** Comparison of types of fall data

	NPRIMS	QI report at VA
% of patients received fall Prevention care	69%	N/A
# of patients screened for fall	36 patients	N/A
% of completed Fall prevention assessment	100%	N/A
% of completed Fall prevention patient problem	100%	N/A
% of completed Fall prevention intervention	100%	N/A
# of patients who fell	2 patients	2 patients
% of falls	6%	N/A
Falls per 100 program days	N/A	0.12
Falls with injuries	N/A	N/A

N/A = data is not available

## 4. Discussion

A prototype web-based NPRIMS successfully calculated basic statistics of falls prevention care provided (i.e. fall rates, percentages of screened patients, census of the unit, etc.) and displayed meaningful information such as percentage of completed fall risk assessments, identified patient problems, interventions provided, and patient outcomes (e.g., fall rates) in the format of histograms (Figure 2). This information is useful because it enables stakeholders to effectively pinpoint the nursing care components requiring improvement to prevent patient falls. In addition, NPRIMS provided much more detailed and useful falls data compared to the current QI report.

Evaluating its effectiveness by comparing outputs analyzed by the NPRIMS with falls data from a QI report was challenging because there was only one common data item, the number of falls. A QI report provided the number of falls and falls per 100 program days, while the NPRIMS provided different types of falls data. Instead of comparing data item by data item, a comparison of available types of data was conducted and summarized in Table 2. Neither NPRIMS nor a QI report provided falls with injuries data. Although the NPRIMS clearly provided more detailed and useful falls data than a QI report, adding a function to calculate falls per 100 program days to the NPRIMS is recommended for benchmarking.



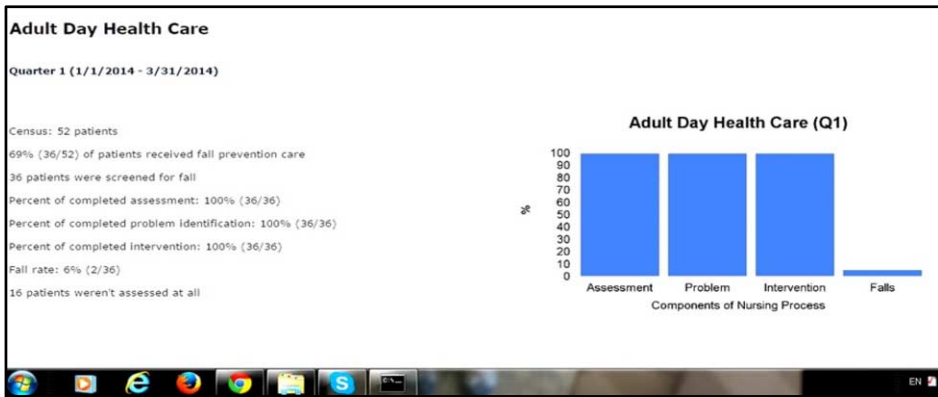


Figure 2. A partial view of NPRIMS

## 5. Limitations

The prototype web-based NPRIMS was tested with small data set (n=52) in one hospital. Impact on patient safety such as decreased fall rate is not generalizable until it is validated with large data sets and in multiple health care settings.

## 6. Conclusion

The NPRIMS successfully supports capturing clinical nursing data and measurement of the relationship between fall prevention nursing care provided and patient outcomes. Although visualization of analyzed data was attempted without any formal usability testing, it helps stakeholders to identify gaps between practice and actual outcomes to enhance patient safety. The NPRIMS provides falls data at the point of care, thereby reducing patient falls.

## References

- [1] J. Fabre, et al., Falls Risk Factors and a Compendium of Falls Risk Screening Instruments. *Journal of Geriatric Physical Therapy* 2010. **33**: p. 184-197.
- [2] D. Oliver, et al., Risk factors and risk assessment tools for falls in hospital in-patients: a systematic review. *Age and Ageing*, 2004. **33**(2): p. 122-30.
- [3] L. Rubenstein, Falls in older people: epidemiology, risk factors and strategies for prevention. *Age and Ageing*, 2006. **35**(S2): p. ii37-ii41.
- [4] S.H. Bae, et al., Analysis of nurse staffing and patient outcomes using comprehensive nurse staffing characteristics in acute care nursing units. *J Nurs Care Qual*, 2014. **29**(4): p. 318-26.
- [5] D. Doran and N. Lefebvre, The Relationship Among Evidence-Based Practice and Client Dyspnea, Pain, Falls, and Pressure Ulcer Outcomes in the Community Setting. *Worldviews on Evidence-Based Nursing*, 2014. **11**(5): p. 274-283.
- [6] L. Heslop, Outcome detection using hospital activity data: implications for development of nursing-sensitive quality monitoring and reporting in Australia (commentary on Schreuders et al., *Int. J. Nurs. Stud.* 51 (3) (2014) 470-478). *Int J Nurs Stud*, 2015. **52**(1): p. 487-90.
- [7] S. Hempel, et al., Hospital fall prevention: a systematic review of implementation, components, adherence, and effectiveness. *Journal of the American Geriatric Society*, 2013. **61**: p. 483-494.
- [8] OMG. *Introduction to OMG's Unified Modeling Language™ (UML)*. 2013 [cited 2013 September]; Available from: [http://www.omg.org/gettingstarted/what\\_is\\_uml.htm](http://www.omg.org/gettingstarted/what_is_uml.htm).

# The Integrated Patient's Self-Care Process Model

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**Abstract.** Long-term care is more efficient and effective when it involves the active participation of the empowered patient and informal caregivers. To achieve this, it is necessary to guide the patient and informal caregivers through the systematic process of self-care. Well-documented observations and assessments are fundamental to plan further interventions of the interdisciplinary team.

A systematic literature review revealed that the self-care process and the support of information technology are focused on just one chronic disease. Defined self-care process has a positive impact on the functionality and satisfaction of patients with comorbidity and on their caregivers. The model of the patient's self-care process should be an integral part of the long-term care.

**Keywords:** long-term care, self-care, process, model, patient, chronic disease

## 1. Introduction

The aging population is one of the most pressing challenges facing modern society and individuals alike. Aging alone is not a problem; rather, the consequences that come with it are the problem [1]. More than 18.2% of all Europeans are currently aged 65 years or older [2].

Long-term care (LTC) is defined as a range of different services: which people need due to reduced functional ability (various physical and/or cognitive status or pathological processes). Because of their reduced functional ability they are dependent on help from others in activities of daily living (ADL) or instrumental activities of daily living (IADL) [3][4].

With the increasing average length of the human life span, it could be expected that patients suffering from more than one chronic disease will experience adverse effects in their functionality. Thirty-seven to 90% of elderly people have more than one chronic disease [5] and thus supporting them requires a holistic approach.

Rapid technological development brings changes to the area care of patients care. Professionals are encouraged to reflect on the achievements of the integration of modern information and communication technologies (ICT) in their work. In order to effectively and efficiently integrate new services and models of care with the support of ICT, it is necessary to upgrade the organization and implementation of LTC services [3][6].

Fieldwork conducted by community health nurses is essential for the health of the whole population. In addition to participating in diagnostic and therapeutic procedures,

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their essential work includes preventive activities [7] and coordination services for patients, families and communities [8][9]. Due to demographic and social changes in developed countries, they have to modify the scope and content of their activities and provide more flexible and upgraded services that address patients' needs [10].

Social care is intended for persons who have suitable housing and other living conditions at home. The providers offer help to support patients' IADL [4].

Elderly people at home need and expect consistency and continuity in care that is affordable for them. The objective of an effective and efficient interdisciplinary team is to implement services that empower the patient and his/her family to achieve optimal use of his/her own potential for self-care (SC). Adequate professional support and guidance provided to informal caregivers are based on identified needs.

Informal care is usually defined as unpaid home care. This includes personal care, household tasks and help with paperwork [11]. The role of informal caregivers has become increasingly important, especially the role of family members. Within the European Union, over 80% of all care is provided by family members [12][13]. Their important role is to influence the patients' quality of life (QoL).

Elderly people nowadays usually live in single-person households. Women related to a patient (e.g. a wife, daughter or daughter-in-law) are often informal caregivers [14][15]. Existing informal caregivers are usually old or busy with schooling, professional work and taking care of their own family. Providing care can have a negative impact on the caregivers' physical and/or mental health, resulting in high blood pressure, cardiovascular disease, stress and depression [14][16]. Professional support for the patient and informal caregivers is important because such support enables them to function as a caregiver for a longer period.

The decline of patients' SC ability affects their inner satisfaction and QoL. That is why it is important to develop a true insight into the process of SC and understand the factors that affect it [17]. Professional support for the patient's SC is certainly one of the cornerstones which can contribute to reducing the demand for formal care. Such support represents a reserve which thus far has not been sufficiently recognized and exploited.

## **2. Self-care process**

Taking care of yourself, trying to improve your health and seeking advice regarding how to help yourself when you are sick are as old as humankind. SC is thus not a new idea. Since its inception, human societies have formed systems of measures to promote health and forms of help in the event of illness [18].

Knowing the elements of the patient's SC process, the healthcare professionals provide a framework within which we can identify areas where their professional activities may affect the patient's health [19]. An effective SC process for patients with chronic disease has a significant impact on reducing the frequency and length of hospitalizations, health cost and mortality [20].

Levin was one of the first researchers to define SC. He defined it as a process in which a lay person takes action in the field of health promotion, disease detection,

prevention and treatment on his/her own behalf. He also defines it as an integral part of the healthcare system [21].

SC monitoring is a process of routine, vigilant body monitoring or surveillance. It is normal human behaviour. With respect to the occurrence of chronic disease, systematic and routine monitoring produces the best results [20].

To achieve an active role in LTC, it is necessary to support nonprofessional caregivers and the patient to focus on systematic observation and evaluation of the patient's condition and independence. Precisely documented results of observations and assessments are the basis for planning further activities and measures to prevent the exacerbation of disease, preserve health and/or assure the timely action of professionals.

By defining the patient's SC process, the patient and informal caregivers feel more competent and secure. All of this could have a positive impact on their health and requires fewer professional interventions.

### **3. Methods**

A systematic search of the literature was conducted from December 2014 to January 2015 in the online bibliographic databases Web of Science and ProQuest Central. The keywords used were as follows: 'long-term care' AND 'self-care process' OR 'self-management process' AND 'chronic disease' AND 'patient' AND 'home' AND 'information system' OR 'information communication technology'. In addition to searching the databases, the references of relevant publications were checked. Articles that met the following criteria were included in the review: they focused on the SC process patient at home and ICT support and were written in English. Articles were excluded if they were focused on the SC process for a specific disease; if they were not related to the care of the patient at home; and/or if the role of ICT in the SC process was not clearly specified. The remaining articles that fulfilled the inclusion criteria were assessed, extracted and analysed using the full text of the study.

### **4. Results**

A multidisciplinary bibliographic database was searched and the researcher found 13 publications published up until January 2015. After conducting the exclusion process, only two dissertations remained which are partially related to LTC and the SC process of the patient at home and ICT support. These two papers were published during the period from 2006 to 2012.

One paper reported that patients benefit from learning from others and that their participation in the online community helps them to improve their health and better engage in their disease self-management process. Furthermore, accurate and sufficient informational and emotional support plays a significant role in enabling the patient to improve their health. Supported by ICT, the patient can make proper decisions regarding his/her health issues which, in turn, can lead to better health [22].

Use of electronic personal health record systems (PHRs) in the self-management process remains low. However, PHRs have the potential to increase patient autonomy and reduce disability and the resulting negative health consequences. Additional research findings indicate that while patients are seeking options to manage their health

and they are motivated to use Internet-based PHRs, they may need assistance to gain access to PHRs [23].

## 5. Discussion

The current demographic changes represent a major challenge for society and experts to ensure appropriate care for elderly patients in their own homes when they are in need. Patients' LTC at home is more efficient and effective when the patient is empowered to actively participate in his/her own care. SC is a more complex task in the case of comorbidity. There are questions regarding the extent to which care from the family replaces market or public services and in terms of identifying the perfect mix of family, market, public [15] or volunteer services. The SC process should add value to professional healthcare and should thus be supported by professionals.

By defining the SC process, the patient and informal caregivers feel more competent and safe. The SC process has a wider range and usually includes more preventive measures; in contrast, self-management is more focused: on the patient's ability to manage symptoms of disease. The model of the SC process will have to include different aspects of health and would be useful for all kinds of patients and their caregivers irrespective of the type of chronic health condition.

A critical analysis of the literature revealed that there is a lack of ICT support for patients with comorbidity, which is a common health status among elderly patients. There is a need to develop a model which is based on the intersection of existing models for specific chronic diseases and each patient's unique set of health problems.

Community health nurses have an important role to play in the coordination and organization of different types of help and services for the patient at home [8][9]. They are key professionals to provide interventions that support the patient in his/her SC process. Their role is also to provide information and proper educational support to the patient and his/her family. They already have a well-defined nursing process and developed ICT support for their work. The SC process could be part of nursing process.

The developing model is based on different theoretical approaches to assessing the patient's needs. Data sets are designed for the most chronic conditions and adapt to each patient regarding to his/her health status and the importance for the patient or professionals. Data sets are relevant for the patient's decision making regarding further interventions needed according to his/her health status.

The aim of our work is based on a scientific method to develop a practical model which will be useful for patients. The advantages of the new model are that it is personalized to each patient regarding their needs and is also simple to incorporate into their daily routine. With complex health problems and a lot of data related to the health issues, the data model should be scalable. Our work is focused on developing a data model which is related to PHRs.

In order to address the challenges related to providing suitable and cost-effective LTC interventions for people at home [13], experts and decision-makers have to develop comprehensive and sustainable solutions that will not lead to social or sexual discrimination in society. Defined patients' self-care process model Defined model of patients' SC process would be an important contribution to the successful implementation of LTC. The SC process supported by ICT would enable the patient and his/her informal and professional caregivers to be connected while also providing

high-quality and cost-effective care. By integrating the SC process with other healthcare processes, professionals can also ensure the continuity of care.

Our future work will be focused on the development of ICT support. We plan to test such ICT support with an experimental method in order to research its advantages and benefits for patients, informal caregivers and healthcare professionals.

## References

- [1] M Toth, Dolgotrajna oskrba – nova veja socialne varnosti, *Delo in varnost*, **54** (2009) 9-21.
- [2] European Commission, *Eurostat Regional Yearbook 2014*, European Union, Belgium, 2014.
- [3] F. Colombo, A. Llana-Nozal, J. Mercier, F. Tjadens, *Help Wanted?: Providing and Paying for Long Term Care*, OECD Publishing, Paris, 2011.
- [4] OECD, EU, WHO, *A System of Health Accounts*, OECD Publishing, Paris, 2011.
- [5] M. Petek Šter, I. Švab, Bolniki s sočasnimi boleznimi v družinski medicine, *Medicinski razgledi*, **47** (2008) 205–211.
- [6] C. Kofahl, (ed), *Services for Supporting Family Carers of Elderly People on Europe: Characteristics, Coverage and Usage*, EUROFAMCARE, European Union, 2005.
- [7] O. Šušteršič, *Večparameterski hierarhični model evalvacije organizacijsko-informacijskega sistema patronažne zdravstvene nege*, Univerza v Mariboru, Fakulteta za organizacijske vede, Kranj, 1999.
- [8] O. Šušteršič, M. Horvat, D.Cibic, A. Petermelj, M. Brložnik, Patronažno varstvo in patronažna zdravstvena nega – nadgradnja in prilagajanje novim izzivom. *Obzornik zdravstvene nege*, **40** (2006) 247-252.
- [9] V. Rajkovič, O. Šušteršič, *Informacijski sistem patronažne zdravstvene nege*, Moderna organizacija, Kranj, 2000.
- [10] IVZ, *Gibanje obiskov in zaposlenih v patronažnem varstvu Slovenije od leta 2007 do leta 2011*, Inštitut za varovanje zdravja, Ljubljana, 2012.
- [11] A.Kalwij, G. Pasini, M. Wu, *Home Care for the Elderly: Family, Friends, and the State*, Discussion Paper, Netspar, Utrecht, 2009.
- [12] E. Mestheneos, J. Triantafyllou, *Supporting Family Carers of Older People in Europe - The Pan-European Background Report. Empirical Evidence, Policy Trends and Future Perspectives*, Munster, LIT-Verlag; 2005.
- [13] S. Kehusmaa, I. Autti-Rämö, H. Helenius, P. Rissanen, [Does Informal Care Reduce Public Care Expenditure on Elderly Care? Estimates Based on Finland's Age Study](#). *BMC Health Services Research*, **13** (2013) 317.
- [14] R. Rodrigues, M. Huber, G. Lamura, *Facts and Figures on Healthy Ageing and Long-term Care*, European Centre for Social Welfare Policy and Research, Wien, 2012.
- [15] F. Bettio, A. Verashchagina, *Long-term care for the elderly. Provisions and providers in 33 European countries*, Publications Office of the European Union, Luxembourg, 2012.
- [16] C. L. Wu, H. Y. Hu, N. Huang, Y. T. Fang, Y. J. Chou, C. P. Li, Determinants of Long-Term Care Services among the Elderly: A Population-Based Study in Taiwan, *PLoS ONE*, **9** (2014) e89213.
- [17] B. Dale, U. Söderhamn, O. Söderhamn, Self-care Ability among Home-Dwelling Older People in Rural Areas in Southern Norway, *Scandinavian Journal of Caring Sciences*, **26** (2012) 113-122.
- [18] D. McCormack, An Examination of the Self-Care Concept Uncovers a New Direction for Healthcare Reform, *Nursing Leadership*, **16** (2003) 48-65.
- [19] B. Høy, L. Wagner, E. O. C. Hall, Self-care as a Health Resource Of Elders: An Integrative Review of the Concept, *Scandinavian Journal of Caring Sciences*, **21** (2007) 456-466.
- [20] B. Riegel, T. Jaarsma, A. Stömberg, A Middle-Range Theory of Self-Care of Chronic Illness, *Advances in Nursing Science*, **35** (2012) 194-204.
- [21] L. S. Levin, The Layperson as the Primary Health Care Practitioner, *Public Health Report*, **91** (1976) 206-210.
- [22] L. Yan, Y. Tan, Feeling Blue? Go Online: An Empirical Study of Social Support among Patients, *Information Systems Research* **25** (2014) 690-709.
- [23] M. D. Logue, Validating And Testing A Model To Predict Adoption of Electronic Personal Health Record Systems in the Self-Management of Chronic Illness in The Older Adult, *Informatics in Primary Care*, **20** (2012) 151–69.

# Use of Nurses in Tele-Consultation for Patients in Remote Areas

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**Abstract** : There is poor penetration of trauma healthcare delivery in rural areas. On the other hand, mobile penetration in India is now averaging 80% with most families having access to mobile phone. Aims and Objectives: The aim of this study was to evaluate the effectiveness of tele-consultation by nurses using an integrated call centre Materials and Methods: This was a prospective observational study carried out over a 6-month period at a level I trauma Center in New Delhi, India. Patients called the call centre and the specially trained call centre staff answered the calls who handled their simple queries, if they were unable to respond, the call was directed to the nurse informatics specialist on duty responded to their queries with the help of senior residents who were posted in emergency department. The nurse informatics specialist documents a tele-consult note in CPRS(Computerized Patient Record System). Results: Of the total 150 calls , 64 calls were diverted to the nurse informatics specialist(NIS). Of the 64 calls received by the NIS 55 (85%) were rectified by the nurses at their level and 9 calls (14%) were further discussed with the concerned doctors. Conclusions: As shown by our case study, call centers can be used for tele consultation with the help of nurse informatics specialist.

**Keywords** Call center, head Injury, healthcare delivery, rural, tele –consultation, nurse informatics specialist

## 1. Introduction

It is well known that there is poor penetration of trauma healthcare delivery in rural areas in developing countries like India. Evidently, there is an acute scarcity of super-specialists like neurosurgeons in these areas. The problem is compounded by the fact that head and spinal-injured patients are usually bedridden or wheelchair bound and it extremely difficult for these patients to access specialized services like neurosurgical follow-up on continuing basis. It is not uncommon for these patients to miss the follow-ups leading to break in continuity of care. So tele consultation plays a vital role in improving the patient care.

Tremendous growth has occurred in mobile phone use over the last decade with most families having access to mobile phone. <sup>[1]</sup> In another first for India and possibly the world, an integrated call center started operations for our hospital on 2 January 2010 (call-center number: +91 11-40401010). Although call centers are common in

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commercial industries like telecommunications, the concept has been alien to hospitals. [\[2\],\[3\],\[4\]](#) Hospitals usually have reception desks which manage general enquiries and appointments. An integrated call center on the other hand manages extensive backend administrative chores and services besides providing a host of patient related activities on a common platform.

In a public-funded hospital like ours, an integrated call center can provide immense cost savings besides revolutionizing healthcare management and delivery. Due to the presence of a mature electronic medical record system (EMR) at our hospital, we were in a unique position to leverage the advantages of a traditional outsourced call center and innovatively wrap a multitude of healthcare services around this model to provide unparalleled benefits in patient care.

The aim of this study was to evaluate the effectiveness of tele-consultation by nurses using an integrated call centre.

## 2. Methods

Our center is a 152 bedded level I trauma Center (JPN Apex Trauma Centre, All India Institute of Medical Sciences) in New Delhi, India. A nine-seater call-center was outsourced to a private company in January 2010. The actual call center was located in a different state of India (Noida, Uttar Pradesh). The hospital's electronic medical records were integrated with the call-center operations so that all patient data was accessible by the call-center staff with necessary privileges. As per guidelines in India, healthcare professionals and personnel who are involved in the management of the patient have access to the patient's data. Accordingly a 'nondisclosure agreement' was put in place between the hospital and the call center so as to ensure confidentiality of patient data. The call-center was given responsibility of maintaining appointments and scheduling clinics for the whole hospital as well as ensuring follow-up visits. It is for the first time that this was implemented in healthcare industry in India & the unique features/objectives of the call center are:

### *Patient services*

With the main thrust on improving the quality of patient care, the call center can manage all appointments and follow-up of patients for the whole hospital. The call center can also answer queries on all admitted patients and will provide information on all diagnostic and therapeutic services available, the workflow and pricing of getting a specific service or test done and the approximate wait times.

### *Professional operations*

The call center can provide best-in-class service to clients with quality control at every stage and 100% call recording for auditing and quality purposes.

### *Research*

Research is one of the key mandates of academic medical institutions and a call center can facilitate research by ensuring follow-up of patients, administering surveys and ensuring authenticity of data.



### *Centralized help desk and support*

The call center can also take over the responsibility of logging and initial troubleshooting software and hardware problems all over a hospital and thus help in providing professional 24 × 7 support services.

### *Inventory management and support*

It is envisaged that the call center will act as the single window for all civil, mechanical, and equipment-related issues for the hospital. The call center can provide complete audit trail for any breakdown or even and follow-up with the vendor and end user to ensure optimal utilization of resources.

### *Timeline*

The project from conceptualization to full implementation took less than a year. Integration of various patient, administrative and biometric attendance databases was achieved within a period of 3 months. Interestingly, call volume has currently increased to about 500 calls per day .

This prospective observational study was carried out over a 6-month period. Patients called the call centre and the specially trained call centre staff answered the calls who handled their simple queries, if they were unable to respond, the call was directed to the nurse informatics specialist on duty. The call centre staff was given special training regarding triaging of calls. Calls regarding queries related to appointment and minor queries were addressed by the call centre staff and call related to medical queries were directed to nurse informatics specialist.

Patients were also enquired about their overall experience of the visits. The questions asked were:

Were your queries answered –yes, /partially answered/ no

How was your overall experience with the call centre –good/fair/ bad

### *2.1 Role of Nursing Informatics Specialist:*

Nursing Informatics Specialist receives the call from call centre .The Medical query is being analyzed and cross verified from the Electronic Health records of the patients. If its related to home based care like Tracheostomy care ,colostomy care,fever management,plaster care etc the NIS provides health teaching telephonically.If it is a query to be consulted with doctor, NIS consults with the senior resident doctor of concerned department posted on duty and clarifies it.

The NIS documents a tele-consultation note in CPRS and an email alert was also send to the concerned consultant doctor regarding the call.

## **3. Results**

Out of the total 150 incoming calls received during the study period , 64 calls were medical related queries which were diverted to the nurse informatics specialist. Of the 64 calls received by the NIS 55 (85%) were rectified by the nurses at their level and 9 calls (14%) were further discussed with the concerned doctors. 26 (41%) cases were related to orthopedics, 20 (31%) were related to neuro surgery department, 14 (22%) calls were related to surgery and 4 (6%) of other departments.(table 1)

Table 1. Characteristics of questions

Characteristics of questions	Frequency (percentage)
Orthopaedics	41%
Neurosurgery	31%
Surgery	22%
Other departments	6%

Out of 26 orthopaedics cases majority of the queries i.e. 65% cases were related to plaster of paris related issues like itching, swelling etc. Of the 20 cases related to neurosurgery department 70% of cases were related to tracheostomy issues .60 % of surgery cases were related to colostomy issues and other queries were fever (10%), pus formation (30%) .

Out of the 64 patients 97% (62) of the patients answered that their queries were answered and 3% informed that their queries were partially answered. 97% of the subjects rated that their overall experience with the call centre was good and 3 % rated as fair.

#### 4. Discussion

Worldwide, head injury is the single largest cause of death and disability following injury. The burden of head injury is greatest in low- and middle income countries (LAMIC), where 85% of the world's population live. <sup>[5]</sup>

Delhi with a population of around 15 million has the dubious distinction of having the largest number of road traffic accidents of any city in India. <sup>[6]</sup> The main reasons this project was done were twofold: firstly, there is no support structure in place to provide information and continuity of care for trauma patients even in cities like Delhi. Also, patients with trauma usually come from far distances to the hospital for specialized treatment and it is a major socioeconomic burden to come for follow-up visits. Secondly, there is a general lack of accountability in public-funded healthcare delivery systems (including hospitals) in developing countries like India. This has a cascading effect on quality of healthcare delivered to people living in rural areas. The only way to bridge this gap in resources is to use innovate IT solutions and one of them is the use of call centre with active participation of nurse informatics specialist for teleconsultation. This study shows that call center can be used for tele consultation with the help of nurses for improving the rural health care delivery and has the potential to revolutionize delivery of trauma health care in an extremely cost effective manner which can improve patient satisfaction.

#### 5. Challenges

##### *Acceptability of the concept*

Acceptability of the concept of a call center for hospitals was low, especially in its present scope. A major challenge was to convince all stakeholders about the feasibility and potential of the project.

### *Changing the work culture*

In the present form, there was lack of accountability in the system and change management wherein every process step was documented was not easily accepted by people.

### *Integration of various databases*

As our hospitals had various disparate databases such as EMR database, biometric attendance database, registry database, administrative database, etc, integrating them in to a common front-end (for the call center agents) was a major challenge and one which was successfully overcome.

As our study shows, in public-funded hospitals like ours, an integrated call center can provide immense tangible and intangible benefits. This model can be replicated in all public or private hospitals and can revolutionize healthcare management and delivery. Importantly, this model is completely scalable right up to the national level. One central call center can provide all patient-related and back-end activities to a group of hospitals providing huge economies of scale as well-transforming healthcare delivery.

As shown by our case study, call center has the potential to revolutionize delivery of trauma healthcare in an extremely cost-effective manner can facilitate tele – consultation with the help of nurses for patients in remote areas.

## **6. Acknowledgments**

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## **References**

- [1] A.Shet , A. de Costa . India calling: Harnessing the promise of mobile phones for HIV healthcare. Trop Med Int Health 2011; 16:214-6.
- [2] Batt, L. Moynihan. The viability of alternative call centre production models. Hum Resour Manage J 2002; 12:14-34.
- [3] P. Bain, A. Watson, G. Mulvey , P.Taylor . Taylorism, targets and the pursuit of quantity and quality by call centre management. New Technology, Work and Employment 2002; 17:170-85.
- [4] D. Knights, D.McCabe. Governing through Teamwork: Reconstituting Subjectivity in a call centre. J Manag Stud 2003; 40:1587- 619.
- [5] M.J.De Silva , I.Roberts , P.Perel , P. Edwards , M.G.Kenward , et al. Patient outcome after traumatic brain injury in high-, middle- and low-income countries: Analysis of data on 8927 patients in 46 countries. Int J Epidemiol 2009;38:452-8
- [6] R. Dandona, G.A.Kumar, M.A. Ameer, G.M. Ahmed, L. Dandona. Incidence and burden of road traffic injuries in urban India. Inj Prev 2008; 14:354-9.

# Evaluation of Acceptance of Nursing Information System in a German and American Hospital

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**Abstract.** Nursing Information Systems (NIS) are not well-adopted and accepted in Germany. The evaluation of a NIS deployment in a German University Hospital supports this assumption. A second side study in the US should point out the differences regarding the technical and organizational differences. We use a questionnaire including standardized instruments like the Unified Theory of Acceptance (UTAUT). Results indicated that nurses in Germany compared to in the US do not use nursing process documentation to the same extent. The main reasons behind the low usage in comparison with the US are deficits in ease-of-use, system performance and the high expenditure of time and paper work for charting nursing plans.

**Keywords.** Evaluation study, Acceptance model, Clinical information systems, Technology Acceptance

## 1. Introduction

The University Hospital Erlangen UKER started the implementation of a Nursing Information System (NIS) in March 2013 on five pilot wards. The purchased NIS is an integrated module of the commercial EHR system and provides assessment tools based on standardized classifications like NANDA diagnosis and a workflow engine to assist the documentation of care plans. The implementation was evaluated during the system deployment. The results showed a low acceptance of software functionalities and software ergonomics. The system usage decreased in one year. Nurses report a time-consuming and tedious use of the NIS and in performing nursing process documentation. The authors of previous studies have proposed that missing acceptance of NIS implementations is common in Germany. Previous surveys from 2002 [1], 2007 [2] and 2014 [3] which were distributed to more than 2,000 health care institutions (2007 return rate 270 = 12.4%) showed, that although the installations of NIS in Germany increased from 7% in 2002 to (58 institutions) in 2007, often only documentation of procedures and interventions was covered. Nursing diagnoses documentation, for example, was only established in 70% and mostly restricted to few wards of the responding institution. Research studies and case studies stress the fact that the nursing process is often not well-accepted by practitioners [4–7] and there are a number of technical and organizational problems regarding the implementation of NIS.

## 2. Study goals and objectives

These results at the UKER render a comparison with another major hospital site, where NIS and care plans are well-accepted, preferably outside Germany. We choose the

Intermountain Medical Center (IHC) in Salt Lake City with more than 15 years' experience in computerized nursing documentation and care planning as second side. Through empirical examination we hope to produce a more complete understanding of the necessary conditions of NIS adaption for the German context. The study hypotheses are presented in table 1.

**Table 1.** Hypotheses

Hypotheses
The NIS in the US is more useful to attain gains in job performance.
The NIS in the US is easier to use.
The technical and organizational infrastructure to support use is better in the US.
The nurses in the US perceived more social support to use the system.
The nurses' attitude toward the nursing process is more positive in the US.

### 3. Methods

#### 3.1 Study context

The evaluation in Germany was conducted at the University Hospital located Erlangen, Bavaria, which provides more than 1,300 beds, with 42 different departments employing more than 7,400 employees. The five NIS-pilot wards are situated in the departments of otorhinolaryngology (23 beds), internal medicine (24 beds), neurology (28 beds), surgery (27 beds) and palliative medicine (8 beds). The IHC in Salt Lake City is the largest hospital in Utah with 454 beds. Intermountain Medical Center contains five interconnected centers, including women's/newborn care, heart/lung care, emergency/trauma care, outpatient care, and cancer care. The study at IHC was undertaken in the oncology (32 beds), surgery (32 beds) and medical units (32 beds).

#### 3.2 Study design

A paper-based questionnaire was distributed to all nurses on the five pilot wards at the University Hospital in Erlangen and on four wards of the IMH Medical Center. Participation was voluntarily and anonymous. The questionnaire contains four parts:

**Part A** concerned basic demographic data such as age, position, working experience; computer skills and time spent at the computer.

**Part B** examined the use of the different NIS functionalities. Users were asked to rate their usage of different functionalities with "yes" and "no". The different functionalities of the local NIS were examined in a pre-analysis.

**Part C** contains the NACT scale to survey the attitude toward the nursing process documentation [8]. Users were asked to rate their level of agreement to the statements using a four-point Likert scale, where "1" corresponded to "disagree strongly" and "4" corresponded to "agree strongly".

**Part D** was based on the Unified Theory of User Acceptance (UTAUT) research model and comprised questions about the nurse's acceptance of the local NIS [9]. The UTAUT research model includes four core determinants: *performance expectancy* (PE), *effort expectancy* (EE), *social influence* (SI) and *facilitating conditions* (FC) to explain user's acceptance and usage. Users were asked to rate their level of agreement to the statements using a five-point Likert scale, where "1" corresponded to "disagree strongly" and "5" corresponded to "agree strongly".

Data analysis of the questionnaire comprises the calculation of the frequencies of the responses for questions using SPSS 20.0. All continuous variables will be summarized using the following descriptive statistics: n (non-missing sample size), mean, standard deviation, maximum and minimum. The reliability of the different scales is assessed using Cronbachs alpha ( $\alpha$ ). Differences between groups (IMH/UK ER) will be determined by Mann-Whitney-U-Test for continuous data and by chi-square ( $\chi^2$ ) test for categorical data.

## 4. Results

### 4.1 Socio-demographic data and reliability

A total of 225 questionnaires were collected; 122 in Germany and 103 in the US. This resulted in a net response rate of 28% in Germany and 15% in the US. No confounding effect of work experience (Mann-Whitney-U-Test;  $p = 0,116$ ) was found, but regarding age ( $p = 0,05$ ) and gender ( $\chi^2$ test;  $p = 0,032$ ). See Table 1.

**Table 2.** Sociodemographic data.

Setting	N	Age	Gender		Work experience
		In years	Female	Male	In years
UK ER	122	38,78	86	29	3.73
IMH	103	34,28	59	8	6.69

The reliability (expressed as Cronbach alpha) of the scales is displayed in table 2. Most alphas meet the minimal requirements of Nunnally ( $>.70$ ) [10]. The scale of the construct *Facilitating Conditions* does not meet the minimal requirements ( $\alpha = 0.381$ ). A closer inspection of the latter scale showed that one item did not correlate with all other items. After removal of this item, the reliability increased significantly ( $\alpha = 0.677$ ).

**Table 3.** Reliability of the Scales (<sup>1</sup>Internal consistency reliability: Cronbach's Alpha; <sup>2</sup>recoded: they were negatively phrased)

Model	Construct	Abbr.	Items	ICR <sup>1</sup>
UTAUT	Performance Expectancy	PE	U6, RA1, RA5	0.861
UTAUT	Effort Expectancy	EE	EOU3, EOU5, EOU6	0.871
UTAUT	Facilitating conditions	FC	PBC2, PBC3, (PBC5*), FC3	0.677
UTAUT	Social Influence	SI	SN1, SN2, SF2	0.639
NACT [8]	Nursing process documentation	NA	1, 2*, 3*, 4, 5*, 9, 10, 11, 19	0.711

### 4.2 Acceptance of the Nursing Information System and the nursing process

Table 3 presents the average rating of the different constructs per group. Overall the results showed a moderate acceptance of the various measures.

**Table 4.** Descriptive statistics (<sup>2</sup>Standard derivation; <sup>3</sup>Mann-Whitney-U-Test for hypothesized significant differences)

	UK ER			IMH			p-value <sup>3</sup>
	range	mean	s.d. <sup>2</sup>	range	mean	s.d. <sup>2</sup>	
PE	1-5	2.4350	0.99751	1-5	3.7451	0.78199	$p = 0.000$
EE	1-5	2.7479	0.85481	1-5	3.7516	0.71132	$p = 0.000$
FC	2-5	3.8174	0.56372	1-5	3.8176	0.62895	$p = 0.933$
SI	1.33-5	3.1871	0.90637	1-5	2.9462	0.96646	$p = 0.303$
NA	1.88-3.63	2.7996	0.41155	1.25-3.63	2.7699	0.49116	$p = 0.959$

Differences were found in rating of *performance expectancy* (PE) and *effort expectancy* (EE). In the German group the mean scale rating was significant lower, so they see less ease associating with the system and also do not believe that using the system will help to attain greater job performance. For example only 11.6% in the German group agree that “*Using the system enables accomplishing tasks more quickly*”; instead, in the US group, 65.4% agree. Other findings that stand out are the high ratings on the *social influence* and *facilitating condition* scale on both sides. The hypotheses about more social support and better organizational and technical infrastructure were rejected: German and American nurses seemed to have equally good support to use the system. The German nurses confirm a high support from senior management using the system (mean = 4.12). The mean scale rating of the nursing process (NACT scale) also indicates a similar attitude of both groups. When analyzing each statement we found the following points of interest. Nurses in Germany rate the time exposure (“*care plans are too time-consuming*”) and the effort of care plans (“*care plans are too much paperwork*”) significantly higher than in the US, even if they are also convinced that nursing plans have a high effect on the quality of care.

**Table 5.** Result summary

Hypotheses	Result
The NIS in the US is more useful to attain gains in job performance.	Supported.
The NIS in the US is easier to use.	Supported.
The technical and organizational infrastructure to support use is better in the US.	Not supported.
The nurses in the US perceived more social support to use the system.	Not supported.
The nurses' attitude toward the nursing process is more positive in the US.	Not supported.

### 4.3 Use of NIS functionalities

Figure 1 illustrates the usage of different NIS functionalities. The NIS in both countries offers the possibility to chart nursing diagnosis, goals, interventions and a nursing assessment. We also ask for the use of the NIS for the shift handover. The results show a significant differences in the usage of the nursing diagnosis ( $\chi^2$ test,  $p = 0.001$ ) and nursing goals ( $\chi^2$ test,  $p = 0.000$ ). In Germany more than 60% of the nurses do not use the diagnosis and goals. Nearly all nurses chart the assessment and the interventions, so there are no differences between German and US usage. The data also suggest the great difference in the use of the NIS to support communication. According to the statistics only 5% of the German nurses have the NIS in use at the handover.

**Table 6.** Self-reported use of functionalities

Usage of NIS functionalities	UK ER	IMH
Nursing diagnosis.	38,65 %	71,7%
Nursing goals	45,6%	80,4%
Nursing interventions	86,0%	81,8%
Nursing assessment	96,0%	81,8%
Using the NIS for handover situations	5,3%	66,7%

## 5. Discussion

The objectives of this study were to analyze the necessary conditions for a well-adapted system. We could illustrate that the nurses in the US have a higher acceptance of the NIS, leading to higher ratings on the performance expectancy and effort expectancy.

The reason behind the greater performance can be seen in the NIS design. The NIS in the US does not have strict workflows, free text input is allowed and the catalogue for nursing diagnosis is well selected. The German NIS is an integrated module of the commercial EHR system and offers internationally standardized classifications like NANDA and a workflow engine to assist the planning and the documentation of care, which restricts the freedom of individual care plans. With further regression analysis we will get a better insight which UTAUT constructs are the best predictors of the acceptance and use of NIS. UTAUT is considered state-of-the-art in technology evaluation [11], but some previous studies in the medical field using UTAUT suggest that the model can only explain around 30% of the variance in behavioral intention [12–14] this is lot less than the 70% Venkatesh et al. found when they developed the model. We also see the need for a deeper analysis of the different constructs by using qualitative data. The organizational structure in both countries is quite different. For example the specialization into RNs and CNAs does not exist in Germany. The comparison of the work organization using observations or interviews could be the right way to gain a better understanding of the factors influencing the adoption.

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## References

- [1] N.T. Shaw, 'CHEATS': a generic information communication technology (ICT) evaluation framework. *Computers in Biology and Medicine* 2002;32:209–20.
- [2] U. Hübner, B. Sellemann, D. Flemming, M. Genz, A. Frey, IT-Report Gesundheitswesen: Schwerpunkt eBusiness Schwerpunkt Pflegeinformationssysteme; 2007. Available from: URL:www.mw.niedersachsen.de/download/10632.
- [3] U. Hübner, J. Liebe, M. Straede, J. Thye, IT-Report Gesundheitswesen: Schwerpunkt IT-Unterstützung klinischer Prozesse. Hannover: Schriftenreihe des Niedersächsischen Ministeriums für Wirtschaft, Arbeit und Verkehr; 2014.
- [4] M. Habermann, LR. Uys, *The nursing process: A global concept*. Edinburgh and New York: Elsevier/Churchill Livingstone; 2006.
- [5] M.J. Ball, *Nursing informatics: Where caring and technology meet*. 3rd ed. New York: Springer Verlag; 2000. (Health informatics series).
- [6] S.K.Y. Chow, W. Chin, H. Lee, H. Leung, F. Tang. Nurses' perceptions and attitudes towards computerisation in a private hospital. *Journal of Clinical Nursing* 2011
- [7] E. Ammenwerth, *EDV in der Pflegedokumentation*. Hannover: Schlütersche; 2003.
- [8] G.S. Bowman, D.R. Thompson, T.W. Sutton, Nurses' attitudes towards the nursing process. *Journal of Advanced Nursing* 1983;8:125–9.
- [9] V. Venkatesh, M.G. Morris, B.D. Gordon, F.D. Davis, User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly* 2003;27:425–78.
- [10] K. Saranto, C.A. Weaver, P. Chang, editors, *Nursing Informatics 2014: East Meets West eSMART : Proceedings of the 12th International Congress on Nursing Informatics Taipei Taiwan 2014.06.21-25*. Amsterdam: IOS Press; 2014. (Studies in health technology and informatics; vol 201).
- [11] E. Ostensen, I. Svargard, A.B. Fosberg, A., Moen Evaluation of Ambient Assisted Living Interventions - Which Tool to choose? In: Saranto K, Weaver CA, Chang P, editors. *Nursing Informatics 2014: East Meets West eSMART : Proceedings of the 12th International Congress on Nursing Informatics Taipei Taiwan 2014.06.21-25*. Amsterdam: IOS Press; 2014. p. 160–6
- [12] B. Pynoo, P. Devolder, W. Duyck, van Braak J, Sijnave B, Duyck P. Do hospital physicians' attitudes change during PACS implementation? A cross-sectional acceptance study. *International Journal of Medical Informatics* 2012;81:88–97.
- [13] É. Maillet, L. Mathieu, C. Sicotte, Modeling factors explaining the acceptance, actual use and satisfaction of nurses using an Electronic Patient Record in acute care settings: an extension of the UTAUT. *International Journal of Medical Informatics* 2015;84:36–47.
- [14] B. Kijnsanayotin, S. Pannarunothai, S.M. Speedie, Factors influencing health information technology adoption in Thailand's community health centers: Applying the UTAUT model. *International Journal of Medical Informatics* 2009;78:404–16.



# Advancing Nursing Informatics in the Next Decade: Recommendations from an International Survey

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**Abstract.** In the summer of 2015, the International Medical Informatics Association Nursing Informatics Special Interest Group (IMIA NISIG) Student Working Group developed and distributed an international survey of current and future trends in nursing informatics. The survey was developed based on current literature on nursing informatics trends and translated into six languages. Respondents were from 31 different countries in Asia, Africa, North and Central America, South America, Europe, and Australia. This paper presents the results of responses to the survey question: “What should be done (at a country or organizational level) to advance nursing informatics in the next 5-10 years?” (n responders=272). Using thematic qualitative analysis, responses were grouped into five key themes: 1) Education and training; 2) Research; 3) Practice; 4) Visibility; and 5) Collaboration and integration. We also provide actionable recommendations for advancing nursing informatics in the next decade.

**Keywords.** Nursing informatics, future trends, big data science, standard terminologies, informatics competencies

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## 1. Introduction

Nursing Informatics (NI) integrates nursing, informatics and computer sciences to promote human health. To date, some significant achievements by NI pioneers include development of several standard terminologies [1] and implementation of effective interventions to improve patient outcomes [2]. However, there are many areas for future development, for example, creating and integrating NI education into nursing curricula; a challenge remaining in many countries [3]. There are also several significant barriers that hinder the implementation and meaningful use of nursing information systems, such as clinical decision support systems [4].

Recurring questions around NI priorities for the future have been raised by in recent discussions within the International Medical Informatics Association – Nursing Informatics (IMIA-NI) Student Working Group. To address these questions, our student group created and distributed an international survey of current and future NI trends in the summer of 2015. This paper presents the thematic analysis of recommendations on the advancement of NI as reflected by responses of 272 international NI researchers and practitioners.

## 2. Methods

**Survey creation and distribution:** This cross-sectional survey explored current and future trends in NI. The survey was disseminated electronically and responses were collected using Google Forms. Questionnaire development was iterative and informed by current NI literature [5-6]. The final questionnaire was translated into six languages (Arabic, English, Korean, Portuguese, Spanish and Swedish). Each translation was conducted by a nurse with a background in informatics and who spoke the native language. Translations were validated by at least two other native speaking NI professionals and revised until a final version was generated. Qualitative responses from the various translated versions of the survey were translated to English. Translations of survey responses were conducted by the same nurses who translated the original survey questions; each translated response was validated for accuracy by one or two additional native language speakers who were also fluent in English. The study received a supportive ethical statement from the University of Turku, where it was coordinated. Data were collected between August and September 2015. Any nurse (or other allied health professional) with experience in NI (clinical or academic) was eligible to participate. We used snowball sampling to reach as many international respondents as possible. The questionnaire consisted of twenty-four questions and both structured and open-ended response options. There were eight demographic questions (professional background; highest degree received; clinical or academic role; years of NI experience; country and city) and sixteen questions on the current state of nursing informatics. This paper focuses on qualitative responses to the question: “*What should be done (at a country or organizational level) to advance NI in the next 5-10 years?*”

**Qualitative thematic analysis:** Narrative responses were independently analyzed by two authors experienced with qualitative data analysis (CR, MT). To analyze the responses, we used thematic analysis: a qualitative descriptive approach for identifying, analyzing and reporting themes within data [7]. Each response was first independently examined by two authors and one or more themes for each response were suggested in a spreadsheet. After an initial categorization of all responses, the authors discussed the

themes that emerged and consolidated a list of five major themes. Each author went back and examined each of the responses in relation to the broader themes identified. The themes for each response were merged and the two authors achieved consensus on the themes for each response [7]. The results were shared with two other members of the student group for validation.

### 3. Results

Out of 402 total survey participants, 272 (67.7%) responded to the question regarding recommendations on the advancement of NI. Responders were from 31 different countries in Asia, Africa, North and Central America, South America, Europe, and Australia. The majority of respondents were nurses (87.8%) with Bachelors (28.25%), Masters (39.75%), and PhD (28.75%) degrees. Clinical roles ranged from staff (33%), middle management (25.8%), upper management (16.4%), or other (24.8%). Those identifying with academic roles included students (22.9%), teachers/instructors (16.9%), and professors (36.4%). The 57.8% of respondents did not receive formal education in NI, 32.9% received formal NI education, and 9.3% were current students or received education in another informatics field.

### 4. Discussion

Five key themes were identified among the narrative responses: 1) Education and training; 2) Research; 3) Practice; 4) Visibility; and 5) Collaboration and Integration.

**1) Education and Training:** Specific details of respondent recommendations centered on training and specialized NI education. For instance, a prevalent sub-theme related to the need to develop and deliver specialized informatics education across various nursing roles (e.g., from students to leadership), and making available advanced NI education for those who wish to pursue NI specialization. Incorporating NI as a mandatory component of nursing education and training was another salient sub-theme. Specifically, aiming for the inclusion of informatics as required learning in undergraduate nursing curriculums, for staff nurses, and for nurses in leadership and administrative roles, were noted as important goals to target in the near future. This theme aligns with recent literature reports identifying the critical need in integration of NI education into nursing curricula and practice internationally [8].

**2) Research:** In general, several respondents explained the rationale for more research in NI, e.g., “Continue conducting research showing the impact of NI on improving patient care via improved decision making by nurses.” Additionally, even in countries where NI funding seemed to be more available, participants felt that NI specific funding opportunities should be increased (for instance by the National Institute of Nursing Research in the U.S.).

**3) Practice:** Interestingly, participants from countries with either low or high health information systems adoption rates indicated that better and more prevalent nursing systems are critically needed. Several participants suggested making those systems obligatory for nursing documentation and reporting, similar to what was done for physicians in the U.S. under the Meaningful Use regulations [9]. Another practice sub-theme was a recommendation on an increased support for professional roles such as Chief Nursing Information Officers (CNIO) or other types of field informatics

specialists: “Every organization should include the position of CNIO”. Another frequent theme was the creation of more nursing specific information systems. Finally, several participants recommended improving systems’ usability, for example, “Enhancing nursing information systems usability and better understanding of the use of structured vs. unstructured documentation by demonstrating the impact on patient outcomes.”

**4) Visibility:** Responses highlighted the need for increased awareness of what NI is, its relevance in health systems and the representation of NI at leadership, organizational, and policy levels. The suggestion to “Demand a seat at the table when decisions are being made related to health information technology at all levels”, reflected a common sentiment across responses. To improve the visibility of NI and its representation, respondents mentioned the need to demystify NI within nursing and across other disciplines. Clearly linking nursing specific data in electronic health records to health outcomes and improved decision-making was identified as another key strategy for improving the visibility of NI and establishing its centrality as part of nursing work.

**5) Collaboration and Integration:** The need for integration of NI as part of the larger informatics and health fields included two key sub-themes: i) the need for integration of all health disciplines as key components of information systems; and ii) multi-disciplinary collaboration in the strategic planning, development, implementation, and evolution of the various health informatics disciplines. Respondents suggested maximizing impact of health informatics as a whole by establishing a common voice: e.g., “Develop...informatics initiatives that demonstrate a united front across a broad range of nursing and non-nursing organizations.” Finally, combining resources at the international level, among various nursing organizations, between research and practice, and integrating this collaborative and multidisciplinary approach into nursing education, was identified as key strategy.

**Table 1.** Summary of recommendations based on thematically grouped survey responses.

Topic	Recommendations
Education and training	Integrate NI contents into all levels of nursing curricula.
	Provide continuous, practice-relevant NI education opportunities to practicing nurses and other interdisciplinary stakeholders.
	Prepare more nurses with NI background to enrich the current teaching workforce.
Research	Create more funding opportunities for NI research (at a government and other levels). Existing research funding institutions (e.g., the National Institute of Nursing Research-NINR- in the U.S.) should allocate NI specific funds.
Practice	Make nursing information systems a requirement for all the nurses to improve patient outcomes.
	Increase support for roles such as Chief Nursing Information Officers or other types of field informatics specialists at organizational/country levels.
	Create better, more nursing specific and usable information systems.
Nursing informatics visibility	Increase awareness of NI relevance in health systems, and the representation of NI at leadership, organizational, and policy levels.
	Create clear linkages between nursing data and health outcomes and improved decision-making by nurses in the current information systems.
Collaboration and integration	Create tangible strategies for integration of all health disciplines as key components of health information systems.
	Increase multi-disciplinary collaboration to advance development, implementation, and evolution of the various health informatics disciplines.
	Combine resources at the international level, among various nursing organizations, between research and practice, and integrate collaborative and multidisciplinary approaches as foundations in NI education.

**Limitations:** Our study has several limitations. First, the generalizability of our survey results is limited due to small numbers of participants from certain geographic regions (e.g. from African countries). The snowball sampling approach was also limited by the reach of our respective networks and only reached certain organizations and practitioners while others were not included.

## 5. Conclusions

This study describes one of the largest international surveys on the future trends in NI with respondents from 31 countries. Other previous studies have surveyed nursing informatics at an international level [10-11]. However, previous studies have focused on solely research priorities; this survey includes inquiry about NI practice. Our qualitative analysis revealed five central areas of recommendation for advancing NI research and practice in the next 5-10 years: 1) Education and training; 2) Research; 3) Practice; 4) Visibility; and 5) Collaboration and integration. The recommendations identified in this study point to actionable steps needed to move NI forward in practice and address the NI research priorities identified in other recent studies [10]. More insights from the survey can be found here [12] and other upcoming publications.

## References

- [1] M. Rutherford, "Standardized Nursing Language: What Does It Mean for Nursing Practice?" *OJIN: The Online Journal of Issues in Nursing*. 2008 Vol. 13 No. 1.
- [2] K.H. Bowles, J. Chittams, E. Heil, M. Topaz, K. Rickard, et al. Successful electronic implementation of discharge referral decision support has a positive impact on 30- and 60-day readmissions. *Res Nurs Health*. 2015 Apr;38(2):102-14.
- [3] E.M. Borycki, N. Frisch, J. Moreau, A.W. Kushniruk, Integration of Electronic Health Records into Nursing Education: Issues, Challenges and Limitations. In KL Courtney, et al. (Eds.), *Driving Quality in Informatics: Fulfilling the Promise*. IOS Press, 2016.
- [4] S. Lee, Features of computerized clinical decision support systems supportive of nursing practice: a literature review. *Comput Inform Nurs*. 2013 Oct;31(10):477-95; quiz 496-7.
- [5] M. Topaz, C. Ronquillo, L. Pruinelli, R. Ramos, L.M. Peltonen, et al. Central trends in nursing informatics: students' reflections from International Congress on Nursing Informatics 2014 (Taipei, Taiwan). *Comput Inform Nurs*. 2015 Mar;33(3):85-9.
- [6] V.K. Saba, K. McCormick K, *Essentials of Nursing Informatics*, 6<sup>th</sup> Ed, McGraw-Hill Education, USA, 2015.
- [7] M. Vaismoradi, M. H.Turunen, T. Bondas, Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nurs Health Sci*. 2013 Sep;15(3):398-405.
- [8] K. Hunter, D. McGonigle, T. Hebda, The integration of informatics content in baccalaureate and graduate nursing education: a status report. *Nurse Educ*. 2013 May-Jun;38(3):110-3.
- [9] HealthIT.gov. Meaningful Use Definition and Meaningful Use Objectives of EHRs. <http://www.healthit.gov/providers-professionals/meaningful-use-definition-objectives>.
- [10] D.W. Dowding, L.M. Currie, E. Borycki, S. Clamp, J. Favela, International priorities for research in nursing informatics for patient care. *Studies in Health Technology and Informatics*. 2013 192, 372.
- [11] S. Bakken, P.W. Stone, E.L. Larson, A nursing informatics research agenda for 2008-18: Contextual influences and key components. *Nurs Outlook*. 2008;56:206-14.
- [12] L. Peltonen, M. Topaz, C. Ronquillo, L. Pruinelli, R. Sarmiento, Nursing informatics research priorities for the future: recommendations from an international survey. *Studies in Health Technology and Informatics: The Bi-annual Congress in Nursing Informatics 2016*, (NI 2016).

# Functionality of Triggers for Epilepsy Patients Assessed by Text and Data Mining of Medical and Nursing Records

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**Abstract.** A trigger is a powerful tool for identifying adverse events to measure the level of any kind of harm caused in patient care. Studies with epilepsy patients have illustrated that using triggers as a methodology with data mining may increase patient well-being. The purpose of this study is to test the functionality and validity of the previously defined triggers to describe the status of epilepsy patient's well-being. In both medical and nursing data, the triggers described patients' well-being comprehensively. The narratives showed that there was overlapping in triggers. The preliminary results of triggers encourage us to develop some reminders to the documentation of epilepsy patient well-being. These provide healthcare professionals with further and more detailed information when necessary.

**Keywords.** Trigger, data mining, text mining, medical records, nursing documentation

## 1. Introduction

A trigger is a powerful tool for identifying adverse events in order to measure the level of any kind of harm caused in patient care [1,2]. There are also triggering factors (TFs), which refer to chemical or physiological stimuli that may precipitate a seizure [3]. The Global Trigger Tool (GTT) methodology, developed by the Institute for Healthcare Improvement (IHI) in 2003, is a retrospective review of a random sample of inpatient hospital records using 'triggers' to identify possible adverse events or adverse drug events [2]. The use of triggers as a methodology enables achieving improvements that affect patient outcomes and safety in different healthcare processes and settings. Published studies in which trigger tool methods have been used have identified a wide range of adverse events in randomly selected adult patients [3–5].

Studies with epilepsy patients have illustrated that using triggers as a methodology with data mining may increase their well-being [6-7]. Epilepsy is a varied group of neurological diseases with respect to its etiology, symptoms and prognosis [8]. Despite all advances, approximately 30% of patients have a drug-refractory condition with the significant associated comorbidities of depression and cognitive impairment, which is

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multi-factorial: AEDs (antiepileptic drugs), genetic factors, seizures and interictal epileptiform discharges (IEDs) all contribute to the patient's status [9-10].

## 2. Aims and objectives

The purpose of this study is to test the functionality and validity of the previously defined triggers in order to describe the status of epilepsy patients' well-being. The triggers will function as patient-specific indicators highlighting changes in patient well-being. The following objectives were defined.

- How valid are the triggers in medical data?
- How valid are the triggers in nursing data?
- What kind of overlapping can be found in the clinical data?

The future aim is to develop reminders to be used by nurses and physicians in the documentation of epilepsy patients' well-being.

## 3. Methods

### 3.1. Text Mining and Data Mining

Text mining is defined as the process of discovering knowledge and structure from unstructured data [11]. Text mining is concerned with looking for patterns in text, while data mining can be loosely described as looking for patterns in data [12]. The similarity between text mining and data mining conceals real differences [12]. Data mining can be more fully characterized as the extraction of implicit, previously unknown, and potentially useful information from data. The information is implicit in the input data: it is hidden, unknown, and could hardly be extracted without recourse to the automatic techniques of data mining. With text mining, the information to be extracted is clearly and explicitly stated in the text. It is not hidden at all, and from a human point of view, the only sense in which it is "previously unknown" is that human resource restrictions make it infeasible for people to read the text themselves. [11-12] Text mining strives to bring information out of the text in a form that is directly suitable for processing by computers, with no need for a human intermediary [12].

In this study, SAS Enterprise Miner® has been used to identify highly related phrases [13]. SAS is a set of interactive data preparation tools and enables addressing filtered outliers and develops segmentation rules. It produces high quality data mining results tailored and optimally suited to specific triggers.

### 3.2 Materials and procedures

The electronic data was received from a Finnish tertiary hospital (2009–2013). All medical and nursing records of randomly selected adult epilepsy patients (N=100) were reviewed using triggers [14]. The 13 triggers and their synonyms were used as keywords. With keywords and their combinations SAS program extracted phrases from the research data which all were manually, individually and independently interpreted by each researcher.

#### 4. Results

One hundred patients' medical and nursing records were reviewed using the triggers. Based on the findings, the triggers described patients' well-being comprehensively. There were little differences in the frequencies of triggers between physicians and nurses (Table 1) in the mining. Cognitive symptoms, socioeconomic problems, sleep and insomnia, and quality of social life seemed to be triggers commonly found both in medical and nursing documentation with text mining.

**Table 1.** Epilepsy Patient Triggers and Triggers' Frequency of Occurrence.

Trigger	Medical Records (f)	Nursing Records (f)
Headaches	89	87
Dizziness	94	75
Visual symptoms	98	63
Cognitive symptoms	100	98
Mental symptoms	95	83
Vitality	95	93
Sleep and insomnia	100	96
Bowel symptoms	81	69
Hormonal imbalance	83	53
Skin problems	80	63
Weight fluctuation	94	70
Quality of social life	100	96
Socioeconomic problems	100	98

Triggers, seldom found in both medical and nursing documentation, were; bowel symptoms, hormonal imbalance, and skin problems. In addition, in nursing documentation, there were fewer instances of the triggers of dizziness, visual symptoms, and weight fluctuation. Overlaps and inexactitudes were frequent in first mining.

Data mining brought to light a different emphasis in medical and nursing documentation (Figure 1). The narratives suggested that there were parallel triggers.

<b>Trigger:</b>	Headaches
<b>Description:</b>	Different symptoms of headaches; ophthalmic, migraine.
<b>Narrative:</b>	<p>"Period headaches. Now with headaches also sensation of hummed in his head." (Medical)</p> <p>"Patient has been very tired a couple of weeks, he has headaches nearly constantly and he felt as "walking through the walls" because of tiredness. His mood was low because of tiredness." (Nursing)</p>
<b>Trigger:</b>	Dizziness
<b>Description:</b>	Dizziness, vertigo, spell of dizziness, faint, fainting, syncope.
<b>Narrative:</b>	<p>"In anamnesis, occasionally the sensation of dizziness and uncertain walking" (Medical)</p> <p>"Patient's position adjusted often from right side to on his back. Feels easily dizzy when bedhead raised a little." (Nursing)</p>

**Figure 1.** Sample Headaches and Dizziness Triggers in Medical and Nursing Documentation.



## 5. Discussion

The results of the previously defined triggers encouraged us to continue and test their functionality with clinical data. SAS Miner allowed us to focus on the core during several sequences and screen out well-being of patient. In both medical and nursing data, the triggers described patients' well-being comprehensively. There was a different emphasis in medical and nursing documentation, which underlines a multi-professional collaboration. The preliminary results of triggers encourage us to develop some reminders to the documentation of well-being in epilepsy patients. A reminder provides healthcare professionals with more specific information when necessary. Reminders could be designed to reflect best practice and notify healthcare professionals to take or avoid a certain action [15]. The reminder could be e.g., a sticker on medical and nursing notes and enable quick access to patient-specific best practice. This study was limited by the fact that it was conducted in a single hospital. The strength of the study was that the review team was experienced. Clinical computer systems already have features that can alert users about patients who need to be called for medical treatment and remind the users of actions that need to be taken [7]. If used properly, these are important safety features.

Future research will particularly need to address the issue of replication of evaluations, the suitability of the technologies, and the usability and acceptability of using these technologies in medical and nursing documentation. The results offer healthcare personnel an opportunity to develop epilepsy patients' care documentation. Electronic documentation will improve the quality and safety of care provided by standardizing both structures and content of health records.

## 6. Acknowledgments

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## References

- [1] F.A. Griffin, R.K. Resar. IHI Global Trigger Tool for Measuring Adverse Events (Second Edition). IHI Innovation Series white paper. Cambridge, Massachusetts: Institute for Healthcare Improvement, 2009. Available from: [www.IHI.org](http://www.IHI.org) Access: 15.12.2014.
- [2] Institute for Healthcare Improvement (IHI). Introduction to Trigger Tools for Identifying Adverse Events. Cambridge, Massachusetts, USA, 2014. Available from: <http://www.ihl.org/resources/Pages/Tools/IntrotoTriggerToolsforIdentifyingAEs.aspx>
- [3] B.D. Franklin, S. Birch, M. Schachter, N. Barber. Testing a trigger tool as a methods of detecting harm from medication errors in a UK hospitals: a pilot study. *The International Journal of Pharmacy Practice* **18** (2010), 305-11.
- [4] C.P. Landrings, G.J. Parry, C.G. Bones, A.D. Hackbarth., D.A. Goldman, P.J. Sharek. Temporal trends in rates of patient harm resulting from medical care. *The New England Journal of Medicine* **363** (2010), 2124-34.
- [5] M. Härkänen, M. Kervinen, J. Ahonen, A. Voutilainen, H. Turunen, K. Vehviläinen-Julkunen. Patient-specific risk factors of adverse drug events in adult inpatients - evidence detected using the Global Trigger Tool method. *Journal of Clinical Nursing* 2014; 13Dec.
- [6] E. Balamurugan, M. Aggarwal, A. Lamba, N. Dang, M. Tripathi. Perceived trigger factors of seizures in persons with epilepsy. *Seizure* **22** (2013) 743-747.

- [7] S.S. Sahoo, S.D. Lhatoo, D.K. Gupta et al. Epilepsy and seizure ontology: towards an epilepsy informatics infrastructure for clinical research and patient care. *J Am Med Inform Assoc* **21** (2014), 82–89.
- [8] The Finnish Medical Society Duodecim, *Epilepsies (adult), Current Care Guidelines*, 2014.
- [9] A.T. Berg, S.F. Berkovic, M.J. Brodie et al. Revised terminology and concepts for organization of seizures and epilepsies: report of the ILAE Commission on Classification and Terminology, 2005-2009. *Epilepsia* **51** (2010), 676-685.
- [10] L. Forsgren, E. Beghi, A. Öun, M Sillanpää. The epidemiology of epilepsy in Europe – a systematic review. *Eur J Neurol* **12** (2005), 245-253.
- [11] M. Timonen. Term Weighting in Short Documents for Document Categorization, Keyword Extraction and Query Expansion. University of Helsinki, Faculty of Science, Department of Computer Science Report A-2013-1, <http://urn.fi/URN:ISBN:978-952-10-8567-3>
- [12] I.H. Witten and D. Bainbridge. Text Mining in book *How to build a digital library*. Morgan Kaufmann. San Francisco, CA. 2003.
- [13] SAS Enterprise Miner® [http://www.sas.com/content/dam/SAS/en\\_us/doc/factsheet/sas-enterprise-miner-101369.pdf](http://www.sas.com/content/dam/SAS/en_us/doc/factsheet/sas-enterprise-miner-101369.pdf) Access: 7.9.2015.
- [14] E. Kivekäs, U-M. Kinnunen, K. Haatainen, R. Kälviäinen, K. Saranto. Trigger Development for the Improvement of Neurological Patient Care. I.N. Sarkar et al. (Eds.) *MEDINFO 2015; eHealth-enabled Health*, doi: 10.3233/978-1-61499-564-7-1116.
- [15] Varonen H., Jousimaa J., Helin-Salmivaara A., Kunnamo I. Electronic primary care guidelines with links to Cochrane reviews – EBM Guidelines. *Family Practice* **22** (2005), 465-469.

# Computerization of a Nursing Chart According to the Nursing Process

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**Abstract.** The benefits associated with the computerization of clinical records are known since a long time ago. Documentation evolution from paper to electronic format aims to always improve communication, reduce errors and facilitate continuity of care. Ideally when improvements to nursing records are contemplated, they should consider the nurses needs, new functionality workflow impacts and correspondence with representation models of standardized data that are specific to their domains practices. The aim of this study was to describe the development and implementation of computerized nursing record at Hospital Italiano de Buenos Aires.

**Keywords:** Electronic nursing record, Nursing process, Nursing taxonomy, Electronic health records

## 1. Introduction

Paper has been the format to support most of health records generating difficulties with the content, storage, availability, accessibility of information and resulting in losses, confusion and illegibility [1-2]. These issues and the increase in volume, complexity and diversity of healthcare information have determined the need to distribute it in information systems in an effective and efficient way [3]. Electronic health records (EHR) are implemented in order to reduce medical errors associated with medication; make more effective communication and facilitate the availability of information for educational purposes and research as well as ensuring the continuous health care [4-5]. Nursing records are important part of clinical documentation being registration of nursing process a very important section. However, when evaluating nursing record integration of nursing process (NP) and nurse documentation is not always evidenced [6-7]. Electronic nursing records have been developed in different organizations to increase the quality of the records but need to understand in depth the impact on the nursing process documentation [8]. Several studies have reported that due to the use of computerized records has increased the completeness of routine nursing assessments and care plans [9], quality and quantity of documentation and how often parts of NP are registered [6].

The aim of this study is describe the development and implementation of the computerized nursing record at Hospital Italiano de Buenos Aires (HIBA).

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## 2. Methods

Hospital Italiano de Buenos Aires (HIBA) is a teaching hospital that serves 3 million consultations and 45,000 surgical procedures a year providing an infrastructure of 750 inpatient beds. Staff is composed of 2800 doctors, 1500 nurses and 1900 employees spread among administrative and support staff.

The EHR is home-developed by the Department of Health Informatics (DHI), problem-oriented and patient-centered. It started out in 1998 generalized to different levels of care and specialty care groups including nursing. The nursing record was developed in stages beginning with a digital literacy process in conjunction with the development and integration of administrative applications, followed by a redesign of the paper records with subsequent digitization and computerization in stages culminating in a substantial modification of architecture and data model.

In recent years the Joint Commission International (JCI) accreditation process taking place at HIBA promotes changes in the information system. Over the same period the DHI standardized and implemented a process of user-centered design (UCD) practices establishing procedures of design and evaluation of information systems. We describe the evolution of the electronic nursing record (ENR) with emphasis on the major periods of time.

## 3. Results

The most important milestones achieved during computerization of the nursing record at every stage are outlined in Figure 1.

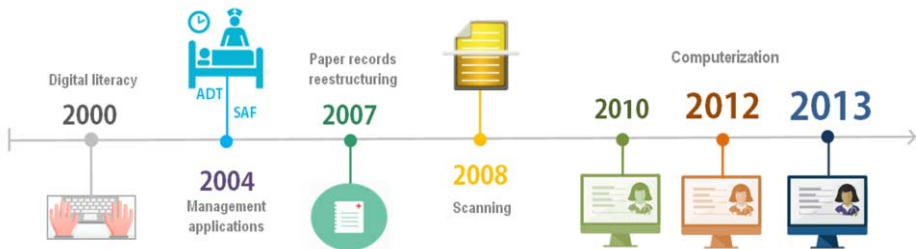


Figure 1: HIBA electronic nursing record evolution

- **Digital literacy:** in 2000 nurses achieve access to hospital internal network (intranet) and institutional e-mail. Also received training in management software for invoicing of supplies and drugs.
- **Development and integration of administrative applications:** in 2004 an admission, discharge and transfer (ADT) system were implemented to keep the hospital census and an application to nursing resources distribution and management (both online).

- **Redesign of paper records:** In 2007 HIBA had 64 models of different papers records. Information was restructured by modifying the medical prescriptions. NR it was also modified in sections of initial assessment - notes; vital signs control, fluid balance and pain assessment.
- **Digitization-Scanning:** in 2008 format of record sheets changed for digitization. In parallel, clinical pharmacists 'transcribed' on a daily basis to an online pharmacy management (SAF) medical prescriptions. Outside the scheduled hours, nurses did.
- **Computerization:** In 2010 paper record was computerized including sections of medication administration, hydric balance, vital signs control and free-text notes area. Census management remained and assessment of pain was not included. In 2012, ENR was organized according to NP stages in sections of initial assessment, care planning, implementation and evaluation. Each section could be used in sequence or not. By 2013 evaluation and audit of nursing records showed high variability because of free-text format and the 'dissociated' sections threatened nursing process clinical documentation. The information recorded remained 'static' affecting communication and continuity of care. Considering the nurses Department requirements to have a nursing record **based on** a)Virginia Henderson conceptual model, b)NANDA-NIC-NOC (NNN) classifications, c) patient safety international goals , and d) JCI accreditation process, an interdisciplinary team worked in a new version of the ENR with the strategies outlined in table 1. Due to the legacy system constraints, the architecture and data model changed and precluded the gradual implementation. Therefore a process of training and support pre and post system implementation was required.

**Table 1:** Development strategies for the redesign of HIBA electronic nursing record in 2013

Domains	Actions
<b>Conceptual framework -NNN taxonomy</b>	Virginia Henderson model adaptation NANDA-NIC-NOC taxonomy selection and adaptation Hierarchy of information: risk assessments and detection screenings (patient safety)
<b>Usability - GUI</b>	User centered design: Analysis of content, usability and navigation. Observations and interviews with nurses in interaction with EHR Nursing process prototypes Tests: improvement iterative cycles
<b>Software engineering - data model</b>	Relational database integrated with legacy system Modeling terminology (SNOMED CT) Linked model: Needs > Concepts > Diagnostic > Interventions
<b>Training - Induction</b>	Daily meetings for 3 weeks 900 nurses Demonstration of functionality in test environment Audiovisual material
<b>Implementation</b>	Big Bang methodology On-site support post implementation Telephone Support

#### **4. Discussion**

We described the process of development and implementation of the electronic nursing record at HIBA. To reach the last deployed version it took more than 10 years of development and change of organizational paradigm to progress from a record model with a vision of the nurse 'executing' planned by other professional care to a model based on nursing conceptual framework grounded in the scientific method. All innovation involves an adjustment period to the new features that will vary according to adopter's characteristics and stages of behavior that is going through [10] but, 2013 ENR introduced not only new capabilities but the requirement to document according to nursing process logic using NNN standardized taxonomies under terminological control. Recommended practice when records are computerized if you want to share and reuse information, representing variability, complexity and richness of the different nursing domains [11-12].

Different determinants joined together: nurses' digital literacy at the beginning; followed by adaptations to technological changes, expansion of computer equipment, connectivity and PCs availability per nurse, as well as changes in the registration tool that intensified in recent years or even latest version implementation modality (Big Bang). Incorporating UCD techniques for the redesign of the ENR interface followed workflow and clinical trial performed by professionals, increasing the chances of being truly support nursing work [13]. Considering that nurses have expressed to feel excluded from discussions in decision-making about EHR [14], this strategy led to mitigate unintended consequences of implementing an EHR [15].

In pre-deployment training instances, emerged as concern the possible increase of time associated with the new ENR, so different lines of research were initiated by stages aimed at determining the expectations and perceptions of nurses regarding registration [16] as well as the study of the time needed to perform nursing activities including documentation relating to pre EHR implementation [17]. Post implementation measurements and evaluation are currently in preliminary stage of preparation.

Finally, the new record turned out to be a documentation tool but would be a training instrument and conceptual reinforcement, requiring a strong support post implementation. Because the reasoning associated to NP logic involves cognitive processes and knowledge that Argentine's nurses education provides extremely heterogeneous [18, 19].

#### **5. Acknowledgments**

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## References

- [1] Sociedad Española de Informática de la Salud (SEIS) y Comisión Económica para América Latina y el Caribe. Manual de salud electrónica para directivos de servicios y sistemas de salud [Internet]. 2014 [cited 2015 Oct 4]. Available from: <http://www.cepal.org/es/publicaciones/3023-manual-de-salud-electronica-para-directivos-de-servicios-y-sistemas-de-salud>
- [2] S. Ajami, T. Bagheri-Tadi, Barriers for Adopting Electronic Health Records (EHRs) by Physicians. *Acta Inform Medica AIM J Soc Med Inform Bosnia Herzeg Časopis Druš Za Med Inform BiH*. 2013;21(2):129–34.
- [3] Pan American Health Organization. Building Standard-Based Nursing Information Systems, PAHO, Washington, 2000.
- [4] K. Häyriinen, J. Lammintakanen, K. Saranto, Evaluation of electronic nursing documentation--nursing process model and standardized terminologies as keys to visible and transparent nursing. *Int J Med Inf*. 2010 Aug;79(8):554–64.
- [5] H. Ayatollahi, N. Mirani, H. Haghani, Electronic health records: what are the most important barriers? *Perspect Health Inf Manag AHIMA Am Health Inf Manag Assoc*. 2014;11:1c.
- [6] C. Mahler, E. Ammenwerth, A. Wagner, A. Tautz, T. Happek, B. Hoppe, et al. Effects of a computer-based nursing documentation system on the quality of nursing documentation. *J Med Syst*. 2007 Aug;31(4):274–82.
- [7] B.D. Davis, J.R. Billings, R.K. Ryland, Evaluation of nursing process documentation. *J Adv Nurs*. 1994 May;19(5):960–8.
- [8] N. Wang, P. Yu, D. Hailey, The quality of paper-based versus electronic nursing care plan in Australian aged care homes: A documentation audit study. *Int J Med Inf*. 2015 Aug;84(8):561–9.
- [9] T.A. Pryor, Computerized nurse charting. *Int J Clin Monit Comput*. 1989 Jul;6(3):173–9.
- [10] E.M. Rogers, *Difusion of innovations*. Third edition, Free Press, New York, 1983.
- [11] R.D. Zielstorff, C. Tronni, J. Basque, L.R. Griffin, E.M. Welebob, Mapping nursing diagnosis nomenclatures for coordinated care. *J Nurs Scholarsh*. 1998;30(4):369–73.
- [12] C.G. Chute, S.P. Cohn, J.R. Campbell, A framework for comprehensive health terminology systems in the United States: development guidelines, criteria for selection, and public policy implications. ANSI Healthcare Informatics Standards Board Vocabulary Working Group and the Computer-Based Patient Records Institute Working Group on Codes and Structures. *J Am Med Inform Assoc JAMIA*. 1998 Dec;5(6):503–10.
- [13] S. Hyun, S.B. Johnson, P.D. Stetson, S. Bakken, Development and evaluation of nursing user interface screens using multiple methods. *J Biomed Inform*. 2009 Dec;42(6):1004–12.
- [14] W.T. Goossen, P.J. Epping, T. Dassen, Criteria for nursing information systems as a component of the electronic patient record. An international Delphi study. *Comput Nurs*. 1997 Dec;15(6):307–15.
- [15] S. Gephart, J.M. Carrington, B.A. Finley, Systematic Review of Nurses' Experiences With Unintended Consequences When Using the Electronic Health Record. *Nurs Adm Q*. 2015 Dec;39(4):345–56.
- [16] Z.A. Gonzalez, F.J. Recondo, J.A. Sommer, M.B. Schachner, G. Garcia, D.R. Luna, et al, Nurses' expectations and perceptions of a redesigned Electronic Health Record. *Stud Health Technol Inform*. 2015;210:374–8.
- [17] M.B. Schachner, F.J. Recondo, J.A. Sommer, Z.A. González, G.M. García, D.R. Luna, et al. Pre-Implementation Study of a Nursing e-Chart: How Nurses Use Their Time. *Stud Health Technol Inform*. 2015;216:255–8.
- [18] R.E. Dinardo, A.L. Mezquida, El impacto del nivel de formación del recurso humano de enfermería en la calidad del cuidado. *Rev Cifra* [Internet]. 2010; (N°5). Available from: <http://fhu.unse.edu.ar/carreras/rcifra/c5/mesquida-dinardo.pdf>
- [19] A. González, Situación de la formación en las escuelas de enfermería terciarias no universitarias de la República Argentina, 2007. *Rev Argent Salud Pública*, 2010; 1(5):28-32.

The access to the images of developments described can be done from the following link:  
<http://goo.gl/NWUU1c>

# Utilizing Health Analytics in Improving Emergency Room Performance

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**Abstract.** Emergency room performance improvement has been a major concern for healthcare professionals and researchers. ER patients' length of stay and percentage of patients leaving without treatment are two of the most important indicators for performance monitoring and improvement. The main objective of this study is to utilize health analytics methods in identifying areas of deficiency, potential improvements and recommending effective solutions to enhance ER performance. ER data of 2014 were retrospectively retrieved in January 2015 and analyzed for significant variables affecting inpatient admission rates. Patient Acuity Level was the significant variable on which the recommendations were based. A Fast-Track area was redesigned and dedicated for managing lower acuity level patients; CTAS levels 4 and 5. The performance of the ER has been monitored for the first six months of 2015 and compared to 2014. 29% improvement was achieved on shortening the total ER LOS and 30% improvement was achieved on the percentage of patients leaving ER without treatment.

**Keywords.** Health Analytics, Emergency Room, Improving Performance, ER Length of Stay, Patients Left Without Treatment.

## Introduction

Crowding in Emergency Room (ER) and impaired performance has become a major concern for healthcare professionals and researchers. ER impaired performance is a major barrier to receiving effective and efficient emergency care. Patients who present to ER face long waiting times to be treated and those under treatment face longer treatment time till they are admitted to the hospital or discharged home [1]. Some researchers analyzed the ER crowding and classified its related factors into three interdependent components: input, throughput and output [2]. Other researchers studying emergency room length of stay divided this key performance indicator into three intervals; waiting time, treatment time and boarding time; for patients to be admitted from ER to the hospital [3]. Using these conceptual models we can work on developing strategies and solutions to decrease the crowding of the ER and improve its performance. The problem of inadequate staffing, due to lack of physicians or nurses, low ER physicians and nurses' productivity, low efficiency of ER staff and shortages of treatment areas are commonly studied throughput factors that may cause ER crowding and prolonged LOS [4]. Lower staffing levels or productivity of physicians and triage nurses predisposed patients to wait longer for care [5]. Competency of attending physicians in ER, in terms of skills and efficiency, and lack of, or slow,

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responsiveness of ER nurses has been associated, in many studies, with patients leaving without being seen or leaving before complete treatment. The use and/or delays of the ancillary services, including lab, radiology and other procedures, usually prolong the ED length of stay [6]. This article describes in details the processes implemented in ER performance improvement at King Faisal Specialist Hospital and Research Center, Jeddah, Saudi Arabia. The executive management of the medical and clinical affairs of the hospital decided to utilize health analytics methods to identify areas of deficiency and suggest potential improvements then implement solutions and finally monitor ER using two main key performance indicators; the total ER length of stay for ER patients, reflecting the efficiency of performance [7], and the percentage of patients leaving the ER without treatment, including both patients who left without being seen and those who left before complete treatment, reflecting the effectiveness of ER performance [8].

## **1. Methods**

This study was planned on two phases. The first was to perform a retrospective analysis of ER data; early January 2015. The study data was retrieved from the data warehouse system including all data of all emergency encounters of the last year; 2014. A total of 26,948 encounters with valid data were retrieved. Descriptive analytics techniques were used in the form of calculating different variables and testing for any relationships between those variables and the admission status probability of the patient to determine which variables could be used to support executive management decisions regarding suggesting changes or recommending process redesign in order to improve the ER performance. The second phase of the study started in mid-January 2015, immediately after getting the full results of the analysis of the ER data. This phase included implementing a Fast-Track for lower acuity level ER patients; dedicating 20% of the ER bed capacity in addition to an added internal waiting area for those patients who can stay vertical instead of occupying an ER bed. Two consultant family medicine physicians were assigned to manage those patients with acuity level 4 and 5. The main objective was to assign ER physicians only to cases with higher acuity levels, 1 to 3, and in the same time to reduce the demand for other resources by less acute patients. The ER performance was monitored for any potential improvement using two indicators; ER length of stay and percentage of patients leaving ER without treatment.

## **2. Results**

ER data was cleaned and validated then processed and analyzed exploring different variables that could predict any significance, deficiency or room for potential improvement. Eight main variables could be identified for evaluation using health analytics; these were: Patient Gender, Age Group, Nationality, Patient Acuity Level, Patient Mode of Arrival, Patient Discharge Destination, Day of Encounter and Session of Encounter. Three variables only had statistically significant influence on the admission rates of emergency patients to the hospital inpatient departments and services; those were Patient Acuity Level, Patient Mode of Arrival and Patient Age Group. Other variables did not have any significant effect on the rate of admission, where the most influential variable among these three variables was the Acuity Level of the patient which is following the CTAS – The Canadian Triage and Acuity Scale.

The Acuity Level of all ER patients during 2014 were analyzed and categorized, counting total patients visiting the ER in each acuity category and number of patients admitted from ER to inpatient departments and services in each category and the percentage of admission. The results are summarized in table 1. As the acuity level goes down; become less severe, the percentage of admission becomes less, which is very logic. About third of the cases, 32.8%, were of the acuity levels 4 and 5 where less than 0.5% of those patients were eventually admitted to the hospital.

**Table 1.** Patients admitted through ER compared to Total ER Patients sorted by Acuity Level during 2014.

Code	Acuity Level	Admitted Patients	%	All ER Patients	%	% of Admitted to All
1	1-Resuscitation	95	2.6%	145	0.5%	65.5%
2	2-Emergent	913	24.8%	2,470	9.2%	37.0%
3	3-Urgent	2,636	71.5%	15,489	57.5%	17.0%
4	4-Less Urgent	38	1.0%	7,575	28.1%	0.5%
5	5-Nonurgent	5	0.1%	1,269	4.7%	0.4%
<b>Total</b>		<b>3,687</b>	<b>100%</b>	<b>26,948</b>	<b>100%</b>	<b>13.7%</b>

The explanation of this, after investigation, was that many eligible patients might have problems accessing their primary care or long waiting for an outpatient appointment, so they come to the ER instead when they feel sick. The decision of the executive management of the hospital was to redesign part of the ER into a Fast-Track area that contained 20% of the ER bed capacity and to dedicate this area to receiving only patients of the least two acuity levels; 4-Less Urgent and 5-Nonurgent and in the same time to dedicate two consultant family physicians, who worked primarily in the ER, to manage only patients of these two acuity levels on a 24 hours basis and then to monitor the performance of the ER for a few months after this change. Starting from January 2015 the ER performance was monitored for both ER length of stay and percentage of patients leaving ER without treatment. The average ER LOS was consistently decreased from around 22 hours in January 2015 to less than 10 hours in June 2015. The ER LOS was also less comparing each month in 2015 with respective months of 2014, except for January, which included the implementation of the new Fast-Track workflow change. The numbers of patients visiting the ER over 2015 months and respective 2014 months were insignificantly different and nearly the same and the numbers of working physicians and nurses were also the same, this indicates that the achieved improvement was mainly due to the change made in the workflow.

**Table 2.** Total ER LOS in Hours Comparing First 6 Months of 2014 to First 6 Months of 2015.

ER LOS (Hrs)	2014	2015	Improvement %
January	22.4	22.7	+1.3%
February	18.9	17.5	-7.4%
March	20.7	14.8	-28.5%
April	25.1	15.1	-39.8%
May	18.5	11.3	-38.9%
June	23.2	9.8	-57.8%
<b>Average 6 Months</b>	<b>21.4</b>	<b>15.2</b>	<b>-29.0%</b>

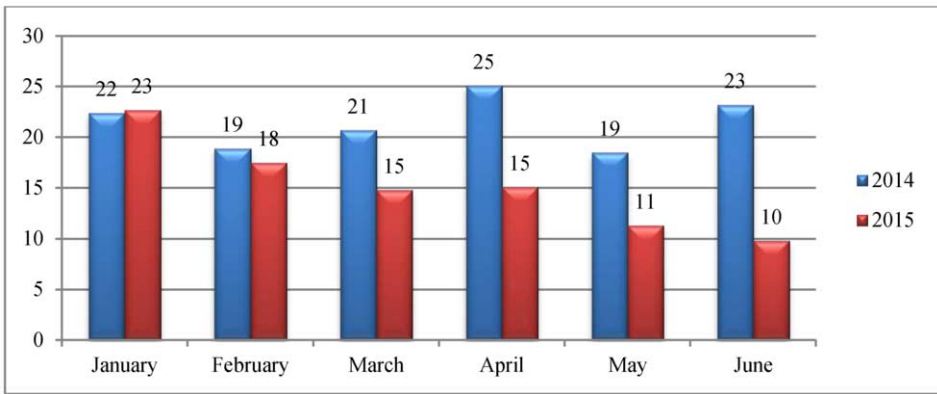


Figure 1. Comparing Total ER LOS during the first 6 months of 2014 and 2015.

The percentage of ER patients who left without treatment was also consistently decreased from around 19% in January 2015 to 7% in June 2015. The percentage of ER patients who left without treatment was also less comparing each month in 2015 with respective months of 2014, except for January, which included the implementation of the new Fast-Track workflow change. Since the numbers of patients visiting the ER and the number of working staff over 2015 months and respective 2014 months were the same, this indicates that the achieved improvement in the percentage of ER patients who left without treatment was mainly due to the change made in the workflow.

Table 3. Percentage of ER Patients Left Without Treatment; comparing 2014 & 2015.

ER Patients Left Without Treatment	2014	2015	Improvement %
January	15.6%	19.4%	24.4%
February	14.6%	14.8%	1.6%
March	17.1%	10.9%	-36.0%
April	19.6%	9.9%	-49.4%
May	13.9%	7.3%	-47.8%
June	17.2%	7.4%	-57.2%
<b>Average 6 Months</b>	<b>16.4%</b>	<b>11.5%</b>	<b>-29.9%</b>

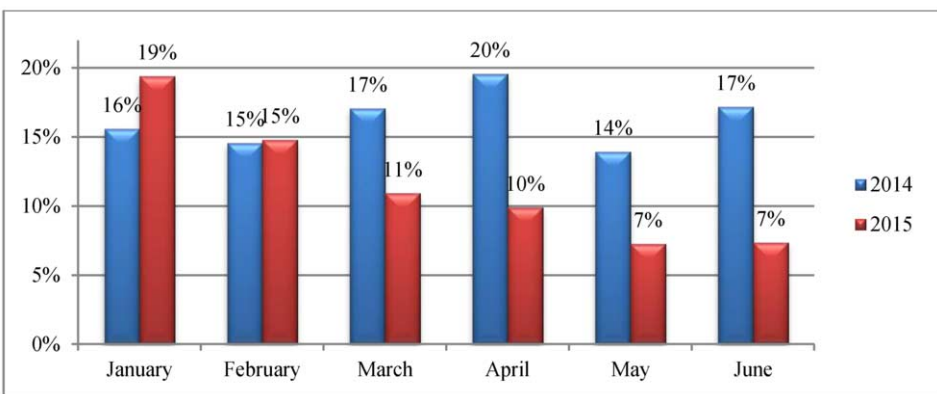


Figure 2. Percentage of ER patients Left Without Treatment during the first 6 months of 2014 and 2015.

### 3. Discussion

Timeliness is considered an essential quality indicator for many healthcare services, especially for emergency conditions [9]. The Institute of Medicine defines six domains of quality of care: safety, patient-centeredness, timeliness, efficiency, effectiveness, and equity. ED crowding is associated with increased mortality or complications and morbidity in patients with time sensitive conditions or those who leave without treatment. At least two domains of quality of care, safety and timeliness, are compromised by ED crowding [10]. Many studies investigated the association between increased hospital occupancy rates and the increased ER crowding and prolonged ER length of stay or increased percentage of patients leaving without treatment [11-13]. Our study examined utilizing health analytics methods in identifying areas of deficiency, potential improvements and recommending effective solutions to positively enhance ER performance. Data and analysis can be used for process improvement through identifying variables, conducting measurements and exploring areas and methods of potential improvement. This study had two main limitations; 1) it examines the effect of one solution, implementing a Fast-Track area for low acuity ER patients, on the performance of the ER. 2) It examines the improvement in the ER performance along only two indicators. More solutions should also be examined for their effects on improving ER performance and more indicators should also be monitored.

### References

- [1] I. Higginson, Emergency department crowding, *Emergency Medicine Journal*, 29(6) 2012, 437-443.
- [2] B. R. Asplin, D. J. Magid, K. V. Rhodes, L. I. Solberg, N. Lurie & C. A. Camargo, A conceptual model of emergency department crowding, *Annals of emergency medicine*, 42(2) 2003, 173-180.
- [3] R. Ding, M. L. McCarthy, J. S. Desmond, J. S. Lee, D. Aronsky, & S. L. Zeger, Characterizing waiting room time, treatment time, and boarding time in the emergency department using quantile regression, *Academic Emergency Medicine*, 17(8) 2010, 813-823.
- [4] J. L. Wiler, C. Gentle, J. M. Halfpenny, A. Heins, A. Mehrotra, M. G. Mikhail, & D. Fite, Optimizing emergency department front-end operations, *Annals of emergency medicine*, 55(2) 2010, 142-160.
- [5] S. M. Schneider, M. E. Gallery, R. Schafermeyer & F. L. Zwemer, Emergency department crowding: a point in time, *Annals of Emergency Medicine*, 42(2) 2003, 167-172.
- [6] S. K. Polevoi, J. V. Quinn, & N. R. Kramer, Factors associated with patients who leave without being seen, *Academic Emergency Medicine*, 12(3) 2005, 232-236.
- [7] M. L. McCarthy, S. L. Zeger, R. Ding, S. R. Levin, J. S. Desmond, J. Lee & D. Aronsky, Crowding delays treatment and lengthens emergency department length of stay, even among high-acuity patients. *Annals of emergency medicine*, 54(4) 2009, 492-503.
- [8] B. H. Rowe, P. Channan, M. Bullard, S. Blitz, L. D. Saunders, R. J. Rosychuk & B. R. Holroyd, Characteristics of patients who leave emergency departments without being seen. *Academic Emergency Medicine*, 13(8) 2006, 848-852.
- [9] R. M. Mayberry, D. A. Nicewander, H. Qin & D. J. Ballard, Improving quality and reducing inequities: a challenge in achieving best care, *Proceedings (Baylor University. Medical Center)*, 19(2) 2006, 103.
- [10] S. L. Bernstein, D. Aronsky, R. Duseja, S. Epstein, D. Handel, U. Hwang & B. R. Asplin, The effect of emergency department crowding on clinically oriented outcomes, *Academic Emergency Medicine*, 16(1) 2009, 1-10.
- [11] A. J. Forster, I. Stiell, G. Wells, A. J. Lee & C. Van Walraven, The effect of hospital occupancy on emergency department length of stay and patient disposition, *Academic Emergency Medicine*, 10(2) 2003, 127-133.
- [12] Hoot, N. R., & Aronsky, D. (2008). Systematic review of emergency department crowding: causes, effects, and solutions. *Annals of emergency medicine*, 52(2), 126-136.
- [13] J. C. Moskop, D. P. Sklar, J. M. Geiderman, R. M. Schears & K. J. Bookman, Emergency department crowding, part 1—concept, causes, and moral consequences, *Annals of emergency medicine*, 53(5) 2009, 605-611.

# Analyzing 30-Day Readmission Rate for Heart Failure Using Different Predictive Models

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**Abstract.** The Center for Medicare and Medical Services in the United States compares hospital's readmission performance to the facilities across the nation using a 30-day window from the hospital discharge. Heart Failure (HF) is one of the conditions included in the comparison, as it is the most frequent and the most expensive diagnosis for hospitalization. If risk stratification for readmission of HF patients could be carried out at the time of discharge from the index hospitalization, corresponding appropriate post-discharge interventions could be arranged. We, therefore, sought to compare two different risk prediction models using 48 clinical predictors from electronic health records data of 1037 HF patients from one hospital. We used logistic regression and random forest as methods of analyses and found that logistic regression with bagging approach produced better predictive results (C-Statistics: 0.65) when compared to random forest (C-Statistics: 0.61).

**Keywords.** Predictive models, readmission, heart failure, Electronic Health Records, Logistic Regression, Random Forest

## 1. Introduction

A vast amount of literature over the past 20 years as well as projections into the future indicate that heart failure incidence and prevalence will continue to rise in the United States [1][2]. This situation has quality and cost implications for both patients and health care organizations. Hospitals concerned with disease burden, cost containment, and worries about penalty for high readmission rates are critically looking at 30-day readmissions after initial hospitalization for heart failure (HF). We intend to examine predictivity of the risk factors for such readmissions.

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A systematic review of the previous models indicates that researchers have suggested various administrative, clinical, and psychosocial predictors of HF readmissions [3][4]. Recently, there is some work done to dynamically select a predictor set for various diseases during modeling [5]. However, there does not appear to be a comparison of various modeling techniques applied to the same dataset. Hence, we intend to apply the same set of clinical predictors to two different predictive models—Logistic Regression with Bagging and Random Forest—to understand the effort involved in constructing and running them and to see which model is better at predicting readmission risk in our dataset. Clinical predictors are measures of physiologic change and typically consist of vital signs such as heart rate, blood pressure, some HF specific laboratory values, and comorbidities. We also intend to understand the role of tuning parameters, if any, for the models and review predictor importance suggested by the models.

## 2. Methods

We employed observational retrospective cohort study design using health care data from Electronic Health Records (EHR) at Veterans Affairs Palo Alto Health Care System, Palo Alto, CA, USA to derive and validate the models. This system represents one of the oldest electronic data sources of patient information in the United States. Institutional Review Board of the hospital approved this project and protocols to protect patient-specific identifiable information were followed.

### 2.1. Definitions and Data Set

The patient cohort consisted of outcome variable with two classes of patients: Class 1 representing the patients who were readmitted for any cause within 30 days of their last hospitalization and the other, Class 0, representing the patients who were either not readmitted within 30 days of their last hospitalization or readmitted after the 30-day window. The 30-day window was chosen based on the prior empirical studies that indicated that the probability of readmission of patients with heart failure is highest during the first 30-day period from the earlier hospitalization [6] and also on the Center for Medicare Services (CMS) guidance based on the Affordable Care Act of 2010 [7].

We extracted six years worth of clinical data using International Classification of Diseases version 9 – Clinical Modification (ICD-9-CM) codes for heart failure. If patients had multiple episodes of 30-day readmissions, only the last readmission was considered. In addition, if the patient was readmitted more than once during the 30-day period from his/her last discharge, the last episode within the 30-day range was considered. We also made sure that the same patients were not repeated in the non-30-day set if, in case, they had had other episodes of admission that were not 30-day readmissions. These rules made sure that (i) we did not repeat any patient within the 30-day readmission set, and (ii) we did not repeat any patient across 30-day and non-30-day readmission sets. We, thus, had a statistically independent and mutually exclusive sample of patients across the two classes of the cohort.

The raw dataset extractions were carried out from database system running on Linux servers to Windows server running R language environment. In all, about 25 million records and 10 GB of data were manipulated to arrive at the dataset

representing 48 predictors with 1037 patient readmissions; 180 of which were within 30 days and 857 represented the non-30-day class. This indicated  $180/1037 = 17.36\%$  of 30-day readmission rate. If the repeated readmissions for the same patient were counted, we found the readmission rate of  $260/1037 = 23.96\%$ . This rate coincided with the industry reported rate of 24% by the other hospitals including United States government's Medicare website. Table 1 represents the predictor set for the classification models.

**Table 1.** Predictor set used for full classification models for N = 1037 patients.

Predictor Subset	Predictor Name	Not	Readmitted
		Readmitted	
Vitals	Heart Rate (beats/m)	80 ± 18	81 ± 18
	Respiratory Rate (breaths/m)	19 ± 3	19 ± 2
	Systolic Blood Pressure (mm Hg)	128 ± 24	120 ± 21
Laboratories	Glucose (mg/dL)	111 ± 39	119 ± 50
	Urea Nitrogen (mg/dL)	31 ± 18	30 ± 16
	Creatinine (mg/dL)	1.9 ± 0.7	1.9 ± 0.6
	Sodium (mEq/L)	138 ± 4	137 ± 4
	Potassium (mEq/L)	4.0 ± 0.4	4.0 ± 0.3
	Albumin (g/dL)	3.1 ± 0.3	3.1 ± 0.3
	Hemoglobin (g/dL)	9.3 ± 2.8	9.0 ± 2.5
	Hematocrit (%)	34.4 ± 3.5	34.4 ± 3.0
	B-Natriuretic Peptide (pg/mL)	519 ± 356	550 ± 351
	Comorbidities (Only Disease Groups reported here)	Diabetes Mellitus (n (%))	368 (78.8)
Coronary Artery Disease (n (%))		442 (77.7)	127 (22.3)
Ischemic Heart Disease (n (%))		75 (77.3)	22 (22.7)
MI (n (%))		117 (72.2)	45 (27.8)
Rheumatic Aortic Disease (n (%))		2 (100)	0 (0)
Valvular Heart Disease/Stenosis (n (%))		201 (75.3)	66 (24.7)
Vascular/Circulatory Disease (n (%))		604 (75.2)	199 (24.8)
Arrhythmias (n (%))		424 (75.7)	136 (24.3)
Idiopathic Cardiomyopathy (n (%))		191 (71.8)	75 (28.2)
Renal Disease or ESRD or Dialysis (n (%))		517 (71.4)	207 (28.6)
Chronic Lung Disease/COPD/Asthma (n (%))		215 (71.7)	85 (28.3)
Cerebrovascular Accident /TIA (n (%))		42 (65.6)	22 (34.4)
Metastatic Cancer/Acute Leukemia/severe hematological disorder (n (%))		166 (71.6)	66 (28.4)
Liver Disease (n (%))		52 (75.4)	17 (24.6)

## 2.2. Logistic Regression

Logistic regression is a method of modeling a binary categorical response variable. It uses a generalized linear model with a logit link function, estimating its beta parameters via Weighted Least Squares regression. Given observations of the predictors, Logistic Regression estimates the probability that the response falls into a particular category. When used in classification as a binomial response, a probability greater than 0.5 indicates classification in one category, and that less than or equal to 0.5 indicates classification in the other category (Readmission or No-readmission).

The Logistic Regression implemented via **glm()** and **step()** methods in stats package in R was wrapped with bagging layer in this project [8]. We examined final model selection using both Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) for the dataset.

### 2.3. Random Forest

Random Forest method stems from general decision tree methods of Classification and Regression Tree (CART) family. These methods involve segmentation of the predictor space into a number of simple regions with recursive binary splitting and then use of the mean or the mode of the observations in the region for making a prediction. The basic Classification Tree method results are sensitive to predictor measurements and thus introduce high variance in the prediction decision and hence bootstrap aggregation or bagging procedure was suggested [9]. Further improvements of random selection of certain number of predictors were suggested to reduce the influence of highly correlated predictors to create the resulting method of Random Forest [10].

There are 3 main parameters that control the behavior of the Random Forest algorithm implemented in `randomForest` package using `randomForest()` call [11]: (i) *n*tree parameter decides the number of trees to grow in a bootstrapped sample. (ii) *m*try parameter determines the number of predictors to select randomly at each tree split. There are two methods (`tuneRF()` and `rfcv()`) to estimate this parameter. We tried both methods to select optimal value of *m*try parameter. (iii) *nodesize* parameter decides the depth of each tree that is grown during bagging. It indicates the minimum number of terminal nodes in the tree. The resultant Random Forest model was finally run with all the tuned parameters.

## 3. Results

We ran Logistic Regression with bagging for 100 iterations for both AIC and BIC based stepwise selections. The prediction error and Class 0 error performance with the AIC based predictor selection was slightly better than that of the BIC selection. However, the Class 1 error for the AIC criterion was 18.7% lower than that of the BIC criterion. The AIC criterion, by its definition, selected many more predictors (in the range of 20-24 out of 48) as compared to the BIC case (8-12 out of 48). The optimal model using this method provided C-Statistics of 0.65 and 0.62 for the AIC and BIC criteria respectively.

For the Random Forest method, the Out Of Bag (OOB) errors in each class varied significantly with the tree size. The Class 1 produced bigger errors, as its class size was considerably smaller than Class 0 and *n*tree = 300 parameter was used for the final run. Our simulations for *m*try parameter showed that *m*try = 24 setting had the lowest Cross Validation (CV) error whereas 3, 6, 12 predictors produced about the same CV error. Our simulations with various values for *nodesize* parameter showed *nodesize* = 10 provided minimum class errors. The optimal model using this method provided C-Statistics of 0.61.

## 4. Discussion

We compared parametric model approach using Logistic Regression with bagging to a non-parametric model of Random Forest as a statistical technique applied to the same dataset. With Logistic Regression approach, the predictors related to comorbidities had positive coefficients and indicated increased probability of 30-day readmission with their presence. The other significant predictors with negative coefficients were blood



pressure and hemoglobin indicating that as their values go down, patient's chance of 30-day readmission went up. These findings coincided with the empirical observations in our patient cohort. For the Random Forest approach, Gini Index based method seemed to favor continuous variables whereas the classification error based prediction favored categorical variables representing comorbidities. One lab test (BNP) and vital signs appeared to be important predictors of 30-day readmission according to Random Forest method.

The direct comparison of the methods indicated that Stepwise AIC Logistic Regression model provided the highest predictivity as measured by C-Statistics. Tuning of Random Forest algorithm became incrementally time consuming and resource intensive as the number of simulations that had to be run to find optimal values for all the parameters increased exponentially with the grid of trial values for each parameter.

This work used dataset derived from the EHR system of one hospital and hence it requires additional validation studies. On the other hand, it demonstrated the feasibility of using incrementally better methods of risk prediction in the HF patient cohort. It also provided a baseline for exploring use of additional predictor domains and more advanced algorithmic techniques.

## 5. Acknowledgments

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## References

- [1] M.W. Rich, Quality improvement in heart failure: A simple solution to the beta-blocker problem, *Journal of Cardiac Failure* **10(3)** (2004), 225-227.
- [2] N. Fida & I.L. Pina, Trends in heart failure hospitalizations, *Curr Heart Fail Rep* **9(4)** (2012), 346-353.
- [3] J.S. Ross, G.K. Mulvey, B. Stauffer, V. Patlolla, S.M. Bernheim, P.S. Keenan, & H.M. Krumholz, Statistical models and patient predictors of readmission for heart failure: A systematic review, *Arch Intern Med*. **168(13)** (2008), 1371-1386.
- [4] A.M. Hersh, F.A. Masoudi, & L.A. Allen, Postdischarge environment following heart failure hospitalization: expanding the view of hospital readmission, *J Am Heart Assoc* **2(2)** (2013), e000116.
- [5] T. Tran, W. Luo, D. Phung, S. Gupta, S. Rana, R.L. Kennedy, A. Larkins, S. Venkatesh, A framework for feature extraction from hospital medical data with applications in risk prediction, *BMC Bioinformatics* **15(425)** (2014), 1-9.
- [6] H.M. Krumholz, L. Horwitz, C. Partovian, Z. Lin, J. Herrin, J. Grady, . . . E. Drye, *Hospital-Wide (All-Condition) 30-Day Risk-Standardized Readmission Measure*, New Haven, CT: Yale New Haven Health Services Corporation/Center, 2008.
- [7] Center for Medicare and Medicaid Services. (2013). *Readmissions Reduction Program*. Bethesda, Maryland. Retrieved from <http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html>.
- [8] R Core Team. (2015). *R: A language and environment for statistical computing [Computer software manual]*. Vienna, Austria. Retrieved from <http://www.R-project.org>.
- [9] L. Breiman, Bagging predictors, *Machine Learning* **24** (1996), 123-140.
- [10] L. Breiman, Random forests, *Machine Learning* **45** (2001), 5-32.
- [11] A. Liaw & M. Wiener, Classification and Regression by randomForest, *R News* **2(3)** (2002), 18-22.

# Quality Evaluation of Nursing Observation Based on a Survey of Nursing Documents Using NursingNAVI<sup>®</sup> Contents in JAPAN

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**Abstract.** We have identified three foci of the nursing observation and nursing action respectively. Using these frameworks, we have developed the structured knowledge model for a number of diseases and medical interventions. We developed this structure based NursingNAVI<sup>®</sup> contents collaborated with some quality centred hospitals. Authors analysed the nursing care documentations of post-gastrectomy patients in light of the standardized nursing care plan in the “NursingNAVI<sup>®</sup>” developed by ourselves and revealed the “failure to observe” and “failure to document”, which led to the volatility of the patients’ data, conditions and some situation. This phenomenon should have been avoided if nurses had employed a standardized nursing care plan. So, we developed thinking process support system for planning, delivering, recording and evaluating in daily nursing using NursingNAVI<sup>®</sup> contents. It is important to identify the problem of the volatility of the patients’ data, conditions and some situation. We developed a survey tool of nursing documents using NursingNAVI<sup>®</sup> Content for quality evaluation of nursing observation. We recommended some hospitals to use this survey tool. Fifteen hospitals participated the survey using this tool. It is estimated that the volatilizing situation. A hospital which don’t participate this survey, knew the result. So the hospital decided to use NursingNAVI<sup>®</sup> contents in HIS. It was suggested that the system has availability for nursing OJT and time reduction of planning and recording without volatilizing situation.

**Keywords.** Volatility of situation, quality assurance, nursing informatics, structured knowledge, thinking process, professional judgment

## Introduction

Nursing’s target is the patients’ conditions and their situation which surrounds them (e.g. healthcare providers, hospital facilities and administration, and healthcare system as a whole). Nursing process complies fully with the PDCA cycle for quality assurance: nurses develop patient care plans, implement them, evaluate the outcome and proceed to next planning and implementation. In this process, nursing observation and nursing action are two major factors, which should be implemented and then documented duly for quality nursing. However, our previous study [1][2] showed that nurses often failed in observing the patients’ conditions and their situations (observation failure), in

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implementing nursing action as planned (implementation failure), or in documenting what they observed or implemented (documentation failure). These failures lead to the significant information loss, causing the nursing process less satisfying. We name this phenomenon “volatilizing situation”. It volatilize though there was a patient status or conditions.

The purpose of this study is developing of a survey tool to identify such volatilizing situation focusing on the nurses’ observation failure using NursingNAVI® contents.

## 1. Methods

We have developed a tool named the “NursingNAVI®”, including the items for nursing observation and nursing action, together with a number of standardized nursing care plans such as one for post-gastrectomy conditions (Table 1).

“NursingNAVI®” is a set of standardized nursing care plans, which is made up of the standardized terminology for nursing . The standardized terminology, the Master File of Standardized Nursing Practice Terminology has been also developed by a team of nurses including authors and contains 3,610 terms for nursing observation and 4,587 terms for nursing action [3].

Each plan has been built up and refined by the first line practicing nurses, the nurse managers, the peer review teams and the nursing informatics specialists. It consists of three parts: “diagnostic testing and medical procedure”, “nursing observation” and “nursing action”. In “diagnostic testing and medical procedure”, we describe the medical procedures, prescriptions and medical orders made by the physicians for the patient. In “nursing observation” and “nursing action”, we describe what nurses should observe and implement for the patient [4] [5].

**Table 1** The “NursingNAVI” for the post-gastrectomy patients (partial view)

Diagnostic testing and therapy						
(1 <sup>st</sup> day) WBC, Blood biochemistry						
Oxygen therapy, Intermittent pneumatic compression, Prophylactic antibiotics, Infusion therapy, Epidural catheter (PCA).						
Nursing observation						
Major category	S	C	A	Code	Observation item	Unit
Vital signs	✓	✓	✓	31001848	BP: systolic	mmHg
	✓	✓	✓	31001849	BP: diastolic	mmHg
	✓	✓	✓	31001390	Pulse rate	rate/ min.
	✓	✓	✓	31001368	Body temperature	C
	✓	✓	✓	31001369	Respiratory rate	rate/ min
	✓	✓	✓	31000001	SpO2	%
Intake & output		✓	✓	31000014	Infusion volume	ml
		✓	✓	31000018	Total intake	ml
		✓	✓	31000021	Urine volume	ml
		✓	✓	31000029	Bowel movement	rate/ day
		✓	✓	31000027	Urination	rate/ day
		✓		31000294	Bleeding	ml
		✓		31000072	Drainage: NG tube	ml
		✓		31000257	Drainage: anastomosis site	ml
		✓		31002499	Drainage: subphrenic	ml
		✓	✓	31000041	Vomiting	rate/ day
		✓	✓	31000040	Amount of vomit	ml
Signs & symptoms, Systematic assessment		✓	✓	31001657	Consciousness(JCS)	
		✓	✓	31001620	Consciousness(GCS-E)	
		✓	✓	31001621	Consciousness(GCS-M)	
		✓	✓	31001622	Consciousness(GCS-V)	
		✓	✓	31001627	Unbalanced chest movement	
		✓	✓	31001946	dyspnea	
		✓	✓	31000541	Weakened breath sound	
		✓	✓	31000533	Abnormal breath sound	
		✓	✓	31000535	Abnormal breath rhythm	

S: Signs and symptoms caused by the disease, C: Complications caused by invasive medical procedures, A: Adverse effects of the drugs



		Table 2. result of the survey														
Hospital code		A	B	C	D	E	F	G	H	I	J	L	M	N	O	P
病床数		614	300	609	281	590	903	250	575	270	199	91	395	128	281	452
acute date		1	3	2	4	4	5	3	3	5	3	1	3	2	2	1
Age		68	—	64	74	73	35	79	64	75	85	80代	—	76	60代	46
male/female		male	male	male	male	female	female	male	female	female	male	male	male	male	male	male
risk assesment		high	low	uncertainty	low	low	low	low	—	uncertain	low	uncertainty	—	uncertainty	uncertainty	low
Type of Ope.		total	partial	total	partial	total	—	partial	partial	total	total	—	partial	total	partial	partial
post complication		—	—	—	—	non	—	non	non	—	—	—	—	—	cholecystoduodenal	non
ECG		○	○	○	○	○	non	○	○	○	○	—	non	○	○	○
O2		○	○	○	○	○	○	○	○	○	○	—	○	○	○	○
IPC		○	○	non	—	○	○	non	○	○	non	—	○	non	○	non
others									narcotic							Compression stockings
T u b e	Magen	○	○	non	○	non	non	○	○	○	non	—	non	○	—	○
	anastomotic	—	—	—	○	—	—	○	non	○	—	—	—	○	—	○
	subdiaphragmatic	○left	—	○left	—	○left	—	—	non	○left	—	—	—	—	—	—
	others	Window hole	Window hole	arteries user	liver under	liver under			non		Window hole					
infusion	peripheral	○	○	○	○	○	○	○	○	○	○	—	○	○	○	○
	central	—	○	○	—	○	non	non	non	non	○	—	non	non	non	non
peridural catheter		○	—	non	○	○	non	○	non	○	○	—	○	○	○	○
urethral catheter		○	○	○	○	○	○	○	○	○	○	—	○	○	○	○
others																
vital signs (6 items)	documented rate	6	6	6	6	6	5	6	5	6	6	6	5	6	6	6
	documented rate	100%	100%	100%	100%	100%	83%	100%	83%	100%	100%	100%	83%	100%	100%	100%
intake and output (6 items)	number of items	5	6	5	6	5	1	5	2	6	4	3	3	5	5	6
	documented rate	83%	100%	83%	100%	83%	17%	83%	33%	100%	67%	50%	50%	83%	83%	100%
signs and symptoms (42 items)	number of items	21	10	14	17	14	4	11	12	5	10	12	8	11	10	27
	documented rate	50%	24%	33%	40%	33%	10%	26%	29%	12%	24%	29%	19%	26%	24%	64%

Based on our findings, an acute hospital having 1,116 beds introduced this system using NursingNAVI® contents to prevent volatility in 2014. After six months, nurses could make nursing care plan and documentation more easily, efficiently and reasonably. One of their achievements was that the rate of nurses who took 30 minutes or more for gathering data and information was decreased from 45.8% to 4%.

### 3. Discussion

Not all the observation items in the standardized care plan were actually observed in their clinical practice. The typical pattern in this case was the “failure to observe”. When it occurs, the data and information concerning the patients’ conditions and their situation gets lost. When such loss occurs, quality of nursing care becomes compromised because nursing is art and science that is built upon the effort to capture the comprehensive picture of patients and their situations. Data and information is essential element when nurses try to capture such a comprehensive picture of patients’ situation. Thus, when any element is missing, the volatility will be caused in some part of the whole picture.

Although nurses developed individual nursing care plan for each patient in their own manner, they did not have any structured or systematic method to construct a care plan

which reflects the comprehensive picture of the patient situation. This might be one cause of the missing items of nursing observations, which in turn leads to volatility. In addition, some nurses do not seem fully aware of the significance of documentation, which in turn leads to the lack of recording. These elements, namely, insufficient planning and insufficient documentation are the serious causers of volatility of the patients' situations.

As there were only weak relation among the planning, implementation and documentation, we cannot but think documentation alone is not enough to evaluate the nursing process. This is to say, we need much better documentation system that supports PDCA cycle in nursing to go on. In the current clinical settings, it seems difficult to relate the standardized care plans, the individual care plans, implementation, documentation and the evaluation one another as such effort is too costly.

Volatility of the patients' data, conditions and some situation may be prevented by using the structured and standardized nursing care plans and efficient documentation systems.

Standardized care plan such as the "NursingNAVI<sup>®</sup>" is one of the effective and efficient tools to assure the comprehensiveness of the picture. First, it describes what nurses should observe in a systematic and structured manner, thus enabling them to collect data and information to construct a comprehensive picture of the patients' situations more easily. Secondly, the "NursingNAVI<sup>®</sup>" may function as a tool for documentation as well, when it is installed into the hospitals' EHR systems. Thus, the nursing observation part of the "NursingNAVI<sup>®</sup>" shows nurses what they should observe and provides them with a platform for documentation at the same time.

Healthcare including nursing is a service that is provided in response to, thus adaptive to, the patients' conditions and situations. Healthcare providers including nurses are facing the demand of responding the changing patients' needs. In order to assist them responding such needs in a timely manner, tools to support them such as IT systems are of vital importance.

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## References

- [1] Satoko Tsuru, Mutsuko Nakanishi, Katsumasa Ohta, et al.: The problem of nursing common language for the information sharing in clinical practice: The fact-finding in regard to the correspondence between name and contents of nursing action. *Japan J Med Informatics*. 2002; 22 (1): 59-70.
- [2] Satoko Tsuru, Chitose Watanabe, Mutsuko Nakanishi, et al.: Developing the nursing care contents for navigating the thinking process in practice. *Japan J Med Informatics*. 2011; 27 (Suppl.): 434-437.
- [3] Satoko Tsuru, Fumiko Wako, Manami Inoue, et al.: Issues in terminology for describing nursing practice in Japan: Development of standardized terminology for nursing observation and action. *Proc. of the IMIA 2012 11th International Congress on Nursing Informatics (2012)*, 665
- [4] Satoko Tsuru, Chitose Watanabe: The navigator for thinking process in nursing. (eds.). *Japan Standard Association, Tokyo*. [in Japanese], 2011
- [5] Satoko TSURU, Fumiko WAKO, Miho OMORI, et al.: Developing the Structured Knowledge Model to Navigate the Nurses' Thinking Process in their Professional Judgment and Action, *Proc. of the 12th International Congress on Nursing Informatics (Taipei)*, Scientific paper CD-ROM (7pages), 2014.

# The Role of Nurses in E-Health: the MobiGuide Project Experience

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**Abstract.** Leveraging the experience of the European project MobiGuide, this paper elaborates on the nurses' role in developing, delivering and evaluating e-health based services. We focus on the home monitoring of atrial fibrillation. Patients enrolled in our study are provided with a smartphone and an ECG sensor, and receive recommendations, reminders and alerts concerning medications and measurements that they should perform through a mobile decision support system that is constantly updated by a backend system. Patients' data are sent to health care personnel that may visualize them, and act accordingly. Nurses play a central role in such setting. After being involved in the design of the caregiver interface, they are responsible for the patients' enrollment phase (which includes patients' training), for the daily checking of incoming data, for the triage of patients' complaints, and for the final phase of the study where patients are interviewed about their experience with the system.

**Keywords.** nursing informatics, telemedicine, atrial fibrillation

## 1. Introduction

The MobiGuide project ([www.mobiguide-project.eu](http://www.mobiguide-project.eu)) develops a ubiquitous, distributed and personalized decision-support system (DSS) for patients and their care providers. It is based on computer-interpretable representation of clinical practice guidelines (CIG, [1]), which allows executing the guideline knowledge with a patient's data to produce patient-specific recommendations. While previous CIG-based DSSs were aimed only at clinicians, MobiGuide targets patients as well. Motivated by the fact that chronic patients, such as atrial fibrillation (AF) patients, want to lead a clinically-controlled safe life while maintaining their individual freedom outside clinically-controlled environments, patients are provided with mobile monitoring devices (e.g., ECG sensor) connected with their smartphones, upon which the DSS system operates. Once a CIG is selected for a patient, the patient's relevant hospital electronic health record (EHR) data is imported into a personal health record (PHR) that is maintained by the system and records all data collected from the sensors, from patient self-reporting and also includes DSS recommendations delivered to the patient and his care providers.

Doctors use the DSS system to set guideline-based therapy prescriptions for their patients. At the enrollment, nurses, together with patients, define regular times for

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reminders for taking medications, and for performing and recording measurements (e.g., weight, blood pressure), mobile ECG monitoring sessions, and exercise sessions. These directions are saved in the PHR and allow the system to advice the patient when he is in his normal environment. Based on the patient interview, the nurse can further customize the CIG by defining different contexts (e.g., irregular routine due to travel), which can be dynamically set and influence the recommendations for therapy.

To increase compliance, the system generates reminders at the times set by the patient or his care provider. To maintain patient safety, the DSS analyses the sensor data in real time and identifies clinically-relevant patterns, such as AF episodes or non-compliance to therapy. Once identified, recommendations are provided to the patients, via the smartphone interfaces as well as to their care providers, via web interfaces.

Nurses have important tasks when following the patients: assuring that they understand therapy instructions, find out how well they manage to comply with therapy recommendations, and follow up their health states. They are the ones who alert the doctors if they feel that a therapy change should be considered. When introducing a patient telemonitoring system such as MobiGuide, the nurse's workflow changes. She has access to valuable data that are collected daily from the patient and include summaries of ECG monitoring sessions and exercise sessions, daily and weekly measurements, and patient-reported symptoms, and medications consumption. She also has a new role in assisting patients in using the MobiGuide technology. To assess the feasibility of using the MobiGuide telemonitoring system with patients, we have conducted a pilot study with ten patients, one nurse and one doctor. We report our experiences from this study, focusing on the nurse's role.

## 2. Methods

A pilot feasibility study has been carried out in the cardiology ward of the Fondazione Salvatore Maugeri research hospital in Pavia, from April to October 2015. The study involved the monitoring of 10 patients using the system over a period of 3 months. The pilot preparation included 3 training sessions for nurses regarding system usage. Patients were recruited on a voluntary basis, and met the following enrollment criteria: (i) a diagnosis of paroxysmal, persistent or permanent AF, (ii) NYHA<sup>2</sup> < III, (iii) ejection fraction > 35%, (iv) stable clinical conditions since at least 3 months. Additional enrollment criteria like motivation, technological skills and clear understanding of the project goals were also included, in the effort to minimize drop-out rate. Exclusion criteria only consisted of severe comorbidities (e.g. cancer, neurological disorders) that could prevent continuous use of the system for the planned 3 months of the study.

In agreement with previous literature [2], nurse's workflow was affected by the presence of the system. In our study, one part-time research nurse was specifically dedicated to manage patients using MobiGuide. She was responsible for the patients' enrollment phase (including patients' training), for the daily checking of incoming data, triage of patients' complaints, and for the final encounter where patients are interviewed about their experience. Figure 1 summarizes the main activities the nurse is responsible for in each phase.

Interviews were used to collect the nurse's feedback on system usability and perceived usefulness. Patients' data was extracted from the PHR and from paper-based

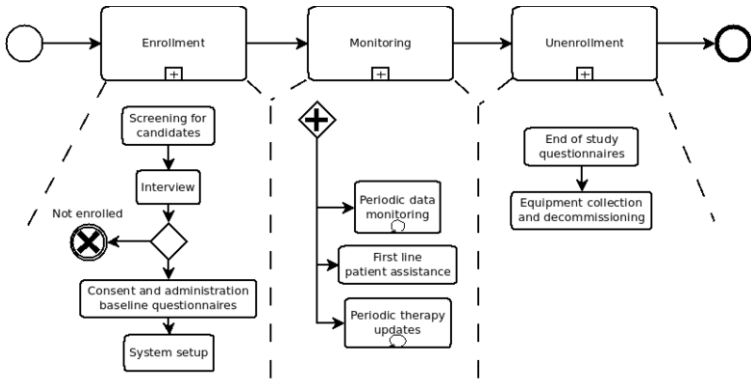
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<sup>2</sup> New York Heart Association class



questionnaires filled out by patients during the study. Finally, analysis of the logs of the care-provider’s interface provided data about monitoring sessions duration, their frequency, and other statistics about system usage.

At enrollment/un-enrollment, a checklist helps the nurse to remember all the documents to be filled-in and/or provided to patients. They are: (1) the Informed Consent; (2) a form to collect any additional data not included in the PHR; (3) “Ten motivations for using MobiGuide” to be scored by the patient, aimed at capturing patients’ expectations before and after the system usage; (4) EuroQOL; (5) AFEQT, measuring how much AF affects the patient’s Quality of life; (6) receipt of the delivered devices; (7) A folder containing the user guide and a notebook for the patient



**Figure 1.** A business process (BPMN) diagram of the workflow for the nurses involved in MobiGuide.

**3. Results**

Evaluating the requirements in terms of effort spent by nurses in telemedicine initiatives is an essential step to understand the impact of their widespread adoption. In this section we report our estimate of this effort in the various phases of the study.

*3.1. Enrollment phase*

The nurse spent significant time searching for patients to be enrolled. During 4 months, 10 individuals were enrolled, out of 35 patients screened and invited for a meeting. Among these only 5 did not meet the formal enrollment criteria defined in the protocol while others were excluded for other reasons. In particular, people who were still employed felt that they would have to dedicate much of their time to the study; the length of the study was considered a barrier to participation. Similarly, patients who lived far from the clinic were concerned that using a system like MobiGuide would imply the need of managing some technical issue, leading to more frequent interactions with the hospital and thus an increased need for travel or phone calls.

As most telemedicine interventions, MobiGuide implies operating devices and using interfaces for patients. Given the significant amount of technology involved and the fact that AF patients are usually older than 65 (mean age of the 10 enrolled patients is 66.3±9.2 years) some patients refused to enroll because they did not feel skilled enough to operate the system on their own at home. The presence of a caregiver able to

help the patient with the smartphone might mitigate this perceived barrier and indeed allowed the enrollment of one of the patients who was being assisted by her daughter.

Devices and hardware can also impose some limitations on the possibility to enroll certain patients. One example comes from the technical specifications of the BioHarness ECG sensor used in the MobiGuide project, which did not guarantee that the sensor would not interact with cardiac implantable devices like pacemakers [3].

Enrollment of eligible and interested patients is also a labour-intensive process. Usually, the cardiologist is present for a limited amount of time needed for the clinical assessment of the patient, which is usually followed by a data-entry phase carried out by the nurse alone. In the MobiGuide pilot, enrollment visits lasted 150 minutes on average (90 minutes for completing paperwork and filling out enrollment questionnaires, and 60 minutes for system setup and training of the patient for system use). Another 30 minutes were spent by the nurse alone for data entry tasks like input of therapy prescriptions or completing patients' clinical history.

### 3.2. Remote monitoring and patient support phase

During the main phase of the study, nurses' tasks revolved around two main areas: remote monitoring of the patients and patients support, both technical and clinical. Patients enrolled in our study are supposed to record a 30min ECG session once or twice a day. Even more data is available on a daily basis if a patient spontaneously starts an ECG monitoring when feeling a symptom. Other parameters like blood pressure and weight complete the collected data. Thus, the nurse checked patients' data on a daily basis. The time spent on this activity depended on the specific diagnosis and varied between a minimum of 5min for patients in permanent AF (where checking for AF occurrence is not needed) to a maximum of 20min for paroxysmal AF. A set of patients that need further attentions from the nurses are those taking oral Vitamin K antagonists to prevent risk of stroke. These patients have their blood tested every two weeks and report back their INR value and possible dose adjustments to the nurse, who then inputs the new therapy plan to enable the system to send the appropriate therapy reminders. This activity takes about 10 minutes of the nurse's time for each patient.

The activities regarding patients' support also cause an increased interaction between patients and nurses. Nurses are the first contact point for both patients' clinical needs and, with the introduction of MobiGuide, also for technical support. Table 1 summarizes this effort for the 10 patients during the first 6 months of the study. Note that patients were enrolled at different times and, according to the protocol, they used the system for 3 months, so that the maximum number of contemporary patients was 6.

**Table 1.** Number of patient-nurse interactions. The number of technical problems that the nurse was able to solve alone is reported in brackets. For the other ones second level technical support was needed.

	Clinical	Technical	Other
Calls	5	13 (6)	37
Visits	8	10 (3)	14

Obviously, the nurse had to allocate time for solving each of these interactions. However it is important to point out that the same data also highlight a positive effect on patient participation and accountability. In fact, most of the calls in the "other" category were spontaneous calls made by patients that wanted feedback about an ECG recording they just made or to notify the nurse that they have just used the system to report new symptoms (interestingly, this could mean that patients do not fully *trust* the

communication capability of the system). Also, the 14 visits reported in the “other” category represent patients interviews to check how they were doing and ask about the overall results of the project. Another benefit of the increased interactions between patient and nurse is the improved quality of data available for the clinical visits, which ultimately leads to time saving. Nurses reported that when not using MobiGuide, 2 out of 10 visits in the cardiology ward at FSM were affected by missing data that could only be solved by re-scheduling. The use of MobiGuide increases compliance to monitoring prescriptions and allows to collect measurements in the PHR as soon as they are taken. This, together with the daily monitoring of data performed by the nurse, positively affects data completeness and eases data preparation for doctor appointments.

### 3.3. End-of-study phase

The un-enrollment phase also involves the nurse in an end-of-study visit that consists in the administration of end-of-study questionnaires and the collection of all the devices previously assigned to patients. The final visit duration was about 30 minutes.

## 4. Discussion

The adoption of a telemedicine system such as MobiGuide has important implications on nurses’ workflow and needs to be carefully considered for proper allocation of time resources. Some findings of the pilot trial experience pointed out that additional tasks have to be performed by nurses, which ultimately lead to increased effort. However, previous studies about a similar domain (heart-failure) point out that, in a setting where proper facilitators are present, benefits like an improved sense of security for both patients and nurses, and timely information about the patient status, are also expected [4]. Some facilities are however necessary to ensure longer-term sustainability of telemedicine initiatives. The addition of more selective patient enrollment criteria (applied by nurses) has proven to be successful in our experiment, in which all enrolled patients have completed the study. This is in agreement with recent research findings [5], which also pointed out that the availability of appropriate technical support is required “to ensure the success of telehealth” [5]. This was also the case in our experience where a significant number of interactions between nurse and patients needed second level technical support. Limitations of our study include the number of patients involved in the pilot trial (10 in total, with a maximum of 7 actively managed at the same time) and the presence of only one nurse. Higher numbers would be needed to confirm statistical significance of the results in a follow-up study.

## References

- [1] M. Peleg, Computer-interpretable clinical guidelines: A methodological review *JBI*, 46 (2013):744-63.
- [2] K. L. Courtney, G. Demiris, G. L. Alexander, Information technology: changing nursing processes at the point-of-care *Nurs Adm Q*, 29:4 (2005):315-322.
- [3] Zephyr BioHarness 3 data sheet. Available from: <http://www.zephyranywhere.com>
- [4] K. Radhakrishnan, C. Jacelon, J. Roche, Perceptions on the use of telehealth by homecare nurses and patients with heart failure: a mixed method study, *Home Health Care Manag Pract*, 2012.
- [5] B. Odeh, R. Kayyali, S. Nabhani-Gebara, N. Philip, Implementing a telehealth service: nurses’ perceptions and experiences, *Br J Nurs*, 23:21 (2014):1133-1137.

# Tripartite Governance: Enabling Successful Implementations with Vulnerable Populations

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**Abstract.** Vulnerable populations are often at a distinct disadvantage when it comes to the implementation of health information systems in an equitable, appropriate, and timely manner. The disadvantages experienced by vulnerable populations are innumerable and include lack of representation, lack of appropriate levels of funding, lack of resources and capacity, and lack of representation. Increasingly, models of representation for complex implementations involve a tripartite project governance model. This tripartite partnership distributes accountability across all partners, and ensures that vulnerable populations have an equitable contribution to the direction of implementation according to their needs. This article shares lessons learned and best practices from complex tripartite partnerships supporting implementations with vulnerable populations in Canada.

**Keywords.** Tripartite partnerships, vulnerable populations, health information system implementation, project governance, lessons learned

## 1. Introduction

Implementation of a health information system is a challenging initiative in any context, and is dependent on a high degree of planning and detailed identification of specific tasks, strategic stakeholder engagement, effective project management, and proactive change management. Numerous context-specific challenges may be encountered in the journey to successful implementation. Project management approaches such as the Project Management Institute's Project Management Body of Knowledge® (PMBOK) or the PRINCE2 Project Management® methodology are essential in managing challenges, issues, and risks encountered in any project. Additionally, a discrete change management methodology is equally essential in achieving successful outcomes and supporting end users in adopting the new system.

For vulnerable populations, the process of implementation can be even more complex. Vulnerable populations, such as indigenous populations, face numerous challenges in large-scale jurisdictional implementations and often face limited resources, and under-representation or invisibility in terms of project governance and inclusion in culturally appropriate implementation practices. Deliberate effort is required to establish inclusive project governance models where all partners have a

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voice in the overall implementation and are active participants in their specific implementation. In the Canadian context, a tripartite model of project governance has been used successfully to ensure that vulnerable populations have an equal voice in implementation projects.

## 2. Background

### 2.1. Vulnerable Populations in Canada

First Nation people in Canada face a myriad of concerns related to health and as such, represent a major sector of the vulnerable population in Canada. According to Health Canada [1], First Nations living on reserves face disproportionate health issues compared to the typical Canadian as presented in Table 1.

**Table 1.** Health Canada statistics on First Nations health indicators [1]

<b>Health Indicator</b>	<b>Relationship to Canadian average</b>
Heart disease	1.5 times higher
Type 2 diabetes	3-5 times higher
Cerebral vascular accidents (CVA)	2 times higher
Acute myocardial infarction (AMI)	20% higher
Tuberculosis (TB)	8-10 times higher
Sexually transmitted infections (chlamydia)	6 times higher
Life expectancy	5-8 years shorter

Results are equally concerning for preventive care among those living on First Nation reserves. Only half of women aged 18-69 reported having a Pap test in the last year, while less than a quarter of women reported having a mammogram [2]. Rates for vaccine-specific childhood immunization vary in Canada from a low of 73% to a high of 91% [2]. Likewise, rates vary widely among First Nation communities with some regions reporting stable immunization rates [3] and others reporting declining coverage rates hovering in the 50-60% range [4]. Additionally, rates may vary widely between communities within the same province, and contributing factors require close scrutiny.

Health services for First Nations are funded through Health Canada. Across Canada, transfer payments are made directly to First Nation communities who are self-governing and provide health services to community members through Health Centers with health care professionals employed directly by the community. Health Canada retains responsibility for some First Nation communities due to small population size, remote location, and limited ability to recruit resources.

## 3. Methods

This article reflects a composite of critical literature reviews, environmental scans, government documents, and direct experience gained through work in multiple

jurisdictions across Canada on health information system implementations with vulnerable populations, specifically First Nations. Search terms for literature reviews included project governance, tripartite governance, participatory project management, collaborative project management, capacity development, and engagement. Sources included CINAHL, ProQuest, Medline, PubMed, government reports, and gray literature.

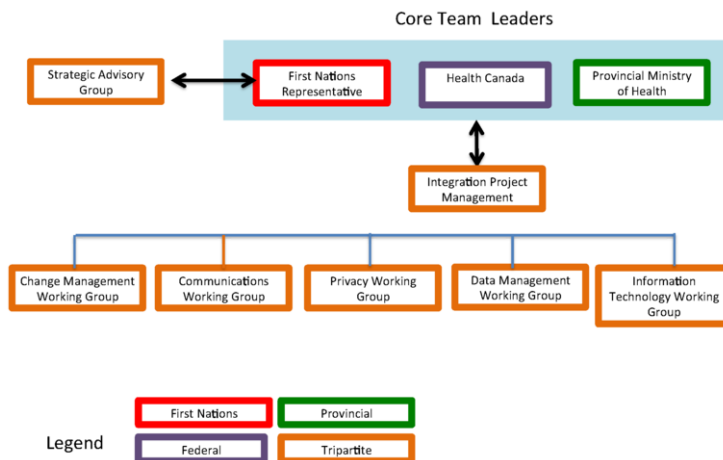
#### **4. Results**

Abundant literature is available on participatory action research and collaborative research methodologies across a plethora of sectors, yet a dearth of comparable literature is available to guide project management approaches or applied informatics initiatives. To a considerable extent, best practices from research and public administration sectors have been applied to develop project management processes and refined through negotiation with key project partners including First Nations.

##### *4.1. Tripartite Project Governance*

Historically, projects deploying information systems to jurisdictions have not necessarily included representatives from vulnerable populations in planning or project decision-making [5]. Populations such as First Nations were included in mainstream implementations without specific attention to their unique needs, or were considered well after the primary implementation had been initiated. This “helicopter approach” is noted as demonstrating a lack of cultural respect and exacerbating distrust by aboriginal peoples [6,7]. Similarly, past project management approaches utilized a “deploying to” rather than “deploying with” philosophy, and employed standardized deployment approaches that did not meet cultural sensitivity needs, often leading to further alienation, project delays, low adoption rates, or even project failure.

Current practices for broad jurisdictional implementations are evolving to establish more inclusive project governance and engaged partnership among stakeholders [7-11]. Tripartite partnerships involving Health Canada as the funding source and governance partner, the provincial Ministry of Health and First Nations are increasingly common, and are achieving successful outcomes as evidenced by the First Nations Health Authority in British Columbia [12]. In the case of First Nations, representation is often provided through a provincial First Nations advocacy body or regional Tribal Council. In the case of British Columbia, a First Nations Health Authority is in place and is supported by a multilevel governance structure to strengthen planning, development, and delivery of health services to all First Nation people in the province [11-12]. Figure 1 presents a sample tripartite governance structure that was successful in achieving project objectives.



**Figure 1.** Sample tripartite project governance structure

#### 4.2. *Implementation Best Practices & Lessons Learned*

Key lessons about supporting vulnerable populations have been learned over multiple implementations across Canada and the literature. The complexity of large-scale implementation projects is significantly expanded when collaborating with vulnerable populations, and communications are critical to the success of the tripartite governance model [6-12]. The following are included among key lessons learned:

- Priorities must include establishing common goals and building trusting relationships based on recognition and respect for cultural values [5-11];
- Intentionality is required across the project structure to support the complexity of a tripartite governance model and ensure effective operations;
- Project governance structures must be formalized with equitable representation in advisory, lead, and team roles [6-12];
- Community engagement through formalized internal governance structures and processes is critical to gaining support and meaningful participation in change management [5-11];
- Communications must be deliberately and consistently inclusive of vulnerable populations or alternatively, be developed using a stream of customized communications [5-12];
- A customized change management assessment is recommended to determine unique implementation needs for vulnerable populations [5-9];
- A dedicated implementation team is recommended to support trusting relationships and consistent, culturally sensitive implementation activities;
- Timelines for implementation phases may require adjustment for vulnerable populations to accommodate barriers and challenges, build momentum, and enable successful adoption [6-8];

- Project leaders should plan for additional time to negotiate data sharing agreements and commence negotiation well in advance of implementation to avoid delays.

## 5. Discussion

The complexity of large-scale health information system implementations is magnified by the addition of working with vulnerable populations. The challenges facing vulnerable populations are often barriers to gaining a voice and participating in complex implementation projects. It is imperative however, that such populations have adequate representation across project governance structures to ensure culturally sensitive, appropriate and timely implementation approaches that respect cultural practices, recognize challenges, and build both capacity and sustainability. A tripartite project governance structure is an effective and inclusive approach in which to cultivate greater decision making equity, cultural sensitivity, shared ownership, and project success.

## References

- [1] Health Canada, First Nations and Inuit Health (2015) Diseases and health conditions. Available: <http://www.hc-sc.gc.ca/fnihah-spnia/diseases-maladies/index-eng.php>
- [2] Health Canada, Vaccine coverage in Canadian children: Highlights from the 2013 Childhood National Immunization Coverage Survey (cNICS) (2015) Available: <http://healthycanadians.gc.ca/publications/healthy-living-vie-saine/immunization-coverage-children-2013-couverture-vaccinale-enfants/index-eng.php>
- [3] Health Canada, First Nations health status report: Alberta Region 2011-12 (2014) Available: [http://publications.gc.ca/collections/collection\\_2013/sc-hc/H26-4-2012-eng.pdf](http://publications.gc.ca/collections/collection_2013/sc-hc/H26-4-2012-eng.pdf)
- [4] Health Canada, Manitoba First Nations Community Childhood Immunization Coverage Report 2008-2012 (2014) Available: [http://publications.gc.ca/collections/collection\\_2014/sc-hc/H33-1-18-2012-eng.pdf](http://publications.gc.ca/collections/collection_2014/sc-hc/H33-1-18-2012-eng.pdf)
- [5] J.G. Lavoie, J. Kaufert, A. J. Browne, S. Mah, J. O'Neil, S. Sinclair, & K. Bluesky, Negotiating barriers, navigating the maze: First Nation peoples' experience of medical relocation, *Canadian Public Administration*, **58**:2 (2015), 295-314.
- [6] T.D. Campbell, A clash of paradigms? Western and indigenous views of health research on involving aboriginal peoples, *Nurse Researcher*, **21**, 39-43.
- [7] J.G. Oetzel, M. Villegas, H. Zenone, E. White Hat, N. Wallerstein, & B. Duran, Enhancing stewardship of community-engaged research through governance, *American Journal of Public Health*, **105**:6 (2015), 1161-1167.
- [8] Tripartite Governance Committee, Implementing the vision: Governance of First Nations' health services in British Columbia (2012). Available: <http://www.hc-sc.gc.ca/fnihah-spnia/pubs/services/tripartite/vision-eng.php>
- [9] M. A. Riopelle, & J. Brown, From theory to practice: An illustrative case for selecting evidence-based practices and building implementation capacity in three Canadian health jurisdictions, *Evidence & Policy*, **10**:4 (2014), 565-577.
- [10] C. Morton, T.I. Guntun, J.C. Day, Engaging Aboriginal populations in collaborative planning: An evaluation of a two-tired collaborative planning model for land and resource planning, *Journal of Environmental Planning and Management*, **55**:4 (2012), 507-523.
- [11] J. Kurpa, L. Galbraith, & S. Burch, Participatory and multi-level governance: Applications to Aboriginal renewable energy projects, *Local Environment*, **20**:1 (2015), 81-101.
- [12] Health Canada, Community-Driven, Nation-Based - New Investments in BC First Nations Health (2015) Available: [http://www.hc-sc.gc.ca/fnihah-spnia/services/2011-09\\_tripartite\\_plan/2015-new\\_investments-nouveau-investissements-eng.php](http://www.hc-sc.gc.ca/fnihah-spnia/services/2011-09_tripartite_plan/2015-new_investments-nouveau-investissements-eng.php)



# Nurses' Contribution to Health Information Technology of Iran's 2025 Health Map: A Review of the Document

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**Abstract.** Implementation of eHealth strategy in Iran has a history less than 17 years. Iran's eHealth strategy is developed in 2011 and is called "Iran' 2025 Health Map: Health Information Technology". Considering the important role of nurses in providing healthcare services as well as in future long term plans such as sustainable development, it is of high value to pay attention to nurses' contribution in developing eHealth strategies. Thus the purpose of this study was to investigate nurses' contribution to health information technology of Iran's 2025 health map. This study was a qualitative study conducted in 2015 through reviewing the "Iran' 2025 Health Map: Health Information Technology" official report. The strategy published in three volumes and in Persian language was downloaded through the official website of the office of Statistics and Information Technology of Iranian Ministry of Health and Medical Education (MOHME). Two main themes were identified in the report indicating areas which nurses' roles were clearly stated. The findings revealed that nurses' contribution is not clearly stated in the strategy. However, there are a few areas highlighting nurses' involvement such as "determining beneficiary groups" and "information dissemination". It is suggested that more attention needs to be paid in contribution of nurses in further actions to revise the Iran's eHealth strategy.

**Keywords.** Nurses, Contribution, Iran's 2025 Health Map, Health Information Technology, eHealth Strategy, Document Review

## 1. Introduction

It is less than 17 years which eHealth has emerged in Iran. Implementation of Hospital Information Systems (HISs) was started in 1998 by regulation of Iranian Ministry of Health and Medical Education (MOHME). Research Deputy of MOHME was then the center in charge of doing research for eHealth. Primary studies were also conducted

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during 2002- 2003. It was in 2006 when the Office of Statistics and Information Technology of MOHME was established to continue the research and to develop strategies on eHealth in Iran (1).

Office of Statistics and Information Technology carried out several eHealth projects including “Developing Electronic Health Record Architecture”, “Iranian Application Software for EHR”, “Designing Information System Architecture of Health Centers” and “Feasibility Study of Developing Iranian Health Smart Cards” (1).

One of the major activities of this office was to develop a high level strategy called “Iran’ 2025 Health Map: Health Information Technology” in 2011. To develop this strategy, high level references such as “Iran’s 20 year Vision Plan”, “Iran’s Fifth Development Plan”, “Iran’s Forth Development Plan”, “Iran’s National Strategy for Development of Health and Treatment”, “Iran’s Comprehensive Strategy for Information Technology in a 20 Year Vision” and “Main eHealth Development Strategies of Iranian Ministry of Health and Medical Education” published by the Iran’s government were reviewed.

Moreover, information technology model in health section provided by WHO was adopted as a universal framework to be implemented in “Iran’ 2025 Health Map: Health Information Technology”. In this model, to achieve macro level health objectives, foundation policies are used as the basis for developing “enabling policies” and enabling policies are in turn applied to provide eHealth applications. This concept is illustrated in figure 1.



**Figure 1.** WHO Information Technology Model in Health Section

One major feature in developing the “Iran’ 2025 Health Map: Health Information Technology” is the influencing participation of experts belonging to different healthcare professions. Although a variety of healthcare professionals were involved in designing, developing and implementing different projects of Iran’s eHealth strategy, it seems that contribution of nurses as well as other healthcare providers is not well defined in the final report of the strategy. Thus, the purpose of this study was to investigate nurses’ contribution to health information technology of Iran’s 2025 health map through reviewing the official report of the strategy.

According to declarations of international organizations such as WHO, and considering the fact that nurses are among the most important human resources of healthcare industry, they play an important role in future long term plans such as sustainable development. So their effective and well clarified contribution in national and international strategy development along with other healthcare providers is of high significance.

## 2. Methods

This study was a qualitative study conducted in 2015 through reviewing the “Iran’ 2025 Health Map: Health Information Technology” report.

The strategy published in three volumes and in Persian language was downloaded through the official website of the office of Statistics and Information Technology of Iranian Ministry of Health and Medical Education (MOHME) available via <http://it.behdasht.gov.ir/> (5) and studied carefully. Keywords related to nurses’ contribution were extracted and categorized as the main themes.

In this section, two main themes were identified including “determining beneficiary groups” and “information dissemination”. These two themes indicated the areas which nurses’ roles were clearly stated in the report of “Iran’ 2025 Health Map: Health Information Technology”.

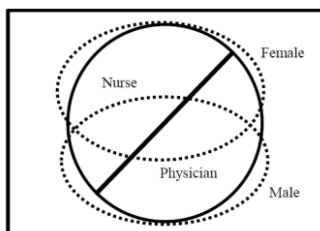
## 3. Results

The first National Strategy concerning eHealth in Iran was released in 2011 and included six areas of actions as follows (2):

1. Developing standard and security architecture
2. Providing information sources of integrated health information systems
3. Knowledge management development
4. Health information architecture development
5. Public access to health information
6. Developing integrated health information systems

Although nurses along with other healthcare providers contribute in the above mentioned areas practically in healthcare settings, their significant role and contribution is not clearly stated in the strategy. However, there are a few areas highlighting nurses’ involvement in healthcare technology strategy.

One of these areas includes identifying health information beneficiary groups. These groups are information consumers and use information or create it. Beneficiary groups directly interact with health systems and include citizens, health professionals and health assistances among which health professionals are categorized as nurses and physicians providing healthcare services to all citizens. This concept is demonstrated in figure 2.



**Figure 2.** Health Professionals in Health Information Technology Report

Other areas emphasizing on the nurses’ contribution is the information dissemination section. In this section, some websites such as khp.ir and ino.ir

dependent to the government are presented as initiatives administered by nurses to provide information related to latest news on nursing profession as well as health issues.

#### 4. Discussion

Although it is very clear that nurses have an effective participation in applying eHealth strategies in healthcare environments, their role and their contribution is not very well defined in "Iran' 2025 Health Map: Health Information Technology".

A similar study by Törnvall about nurses' contribution to Swedish eHealth Strategy indicated different results. She demonstrated that six areas of actions exist in Swedish eHealth Strategy and nurses have an active role in all six areas. These areas include providing accessible electronic services and information, knowledge management, providing technical infrastructure and information structure and enactment of regulations regarding the use of Information and Communication Technologies (ICT). However she indicated some areas for further improvement as follows: "patients' possibility to take part of the information and adding information in their own patient health record", "nurses' education" and "safe IT support in medication" (4).

The results of the Törnvall study is in little agreement with the results of the present study however it could be because of different local needs and different economic, social and cultural levels in both countries.

Similar for any other country, Iran has its own special economic, cultural, social and political contexts as well as priorities which make it to have different needs and policies in healthcare and health information technology industry. In addition, the speed of information technology growth and adaptation, the infrastructure and the readiness of public to accept new forms of healthcare services are various among countries. However, the point is to acquire the best practices from the lessons-to-be-learnt each country share.

Since the role of nurses as one of the beneficiary groups in healthcare industry has not been stated clearly in Iran's eHealth strategy, it seems that there is the need of benchmarking nurses' role against the successful experiences of other countries in order to revise and develop Iran's eHealth strategy. Besides the Swedish eHealth strategy, another good example is the NHS Scotland eHealth Strategy.

In comparison with the NHS Scotland eHealth Strategy, there are four areas for nurses' contribution which Iran can benefit in this regard (6):

- To improve leadership of nurses in eHealth services
- To educate nurses' eHealth capabilities and to develop their skills
- To provide an appropriate infrastructure and practical solutions for nurses engagement in the "multidisciplinary, multiagency, patient focused" environment
- To enhance health information management using health information systems for nurses

Although some aspects of eHealth such as HIS and EHR are implemented in Iran, there is demand for further enhancement and nurses could play an important role in this area considering the fact that they are among the most important human resources of healthcare industry who play an important role in future long term plans such as sustainable development. Thus, their effective and well clarified contribution in

national and international strategy development along with other healthcare providers is of high significance.

Finally, it is suggested that more attention needs to be paid in contribution of each healthcare professionals especially nurses in future actions to revise the "Iran' 2025 Health Map: Health Information Technology".

## References

- [1] H. Riazi, S. Aubedian, Islamic republic of Iran 2025 health map- health information technology. Tehran: Office of Statistics and Information Technology of Ministry of Health and Medical Education; 2011. V. 1, p. 1-64. 2015 [Cited 2015 Oct. 1]. Available from: [http://it.behdasht.gov.ir/uploads/101\\_1754\\_Health\\_Map-IT\\_1st\\_Report\\_v.1.8.pdf](http://it.behdasht.gov.ir/uploads/101_1754_Health_Map-IT_1st_Report_v.1.8.pdf)
- [2] H. Riazi, E. Bitafar, S. Aubedian, Islamic republic of Iran 2025 health map- health information technology. Tehran: Office of Statistics and Information Technology of Ministry of Health and Medical Education; 2011. V. 3, p. 1-41. 2015 [Cited 2015 Oct. 1]. Available from: [http://it.behdasht.gov.ir/uploads/101\\_1754\\_Health%20Map-IT%20Final%20Report%20v.1.4.pdf](http://it.behdasht.gov.ir/uploads/101_1754_Health%20Map-IT%20Final%20Report%20v.1.4.pdf)
- [3] WHO. Moving the nursing agenda forward: World Health Organization; 2015 [cited 2015 Oct. 1]. Available from: [http://www.who.int/hrh/news/2015/global\\_nurse\\_conf\\_kor/en](http://www.who.int/hrh/news/2015/global_nurse_conf_kor/en)
- [4] E. Törnvall. Nurses contribution to Swedish eHealth strategy. NI 2012: Proceedings of the 11th International Congress on Nursing Informatics. **2012** (2012), 411. [Cited 2015 Oct. 1]. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3799127>
- [5] Statistics and Information Technology Office. Documents. Iranian Ministry of Health and Medical Education, Statistics And Information Technology Office; 2014 [Cited 2015 Jan. 15]; Available from: <http://it.behdasht.gov.ir/>
- [6] H. Strachan NMAHP eHealth Lead. National eHealth Programme, NHS Scotland eHealth Strategy, The Nursing, Midwifery and Allied Health Professions contribution to realising benefits of the national eHealth Programme. Scotland: The Scottish Government; 2007. p. 26.

# National eHealth Implementation: Country Experience

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**Abstract.** A national eHealth strategy is presumed to empower health professionals, patients and citizens to increase patient safety and quality of health care delivery. A national eHealth infrastructure encompassing a secure HealthNet, interconnected electronic health records, e-prescriptions, a national medication database and a patient portal has been implemented in Iceland. The timely and secure access to patient information by health professionals through a single portal, independent of where the patient received care, is expected to increase continuity of care, decrease duplication of data and tests, increase efficiency, increase cost effectiveness and benefit citizens in several ways. The eHealth strategy needs to be evaluated using comparable indicators.

**Keywords.** eHealth, electronic health record, information sharing, national strategy, patient portal, patient safety, quality of care

## 1. Introduction

The concept of eHealth encompasses the use of information and communication technologies within health care to meet the needs of patients, health care professionals, citizens and policy makers towards better health of the citizens [1]. The Icelandic Government has long recognized the need to utilize information technology within health care to improve patient safety and the quality of health care delivery. The *Act on Health Records* [2] in 2009 provided the first legal framework for access and sharing of electronic patient information across different health care institutions. Furthermore, it addressed the patient's right to access own health record, and the right to be informed on who has accessed the health record, when and why.

A report in 2011 by the Boston Consulting Group [3] on the performance of the Icelandic health care system identified substantial improvements needed in planning and performance management. The report underlined the need to increase the use of information technology to improve data collection, retrieval and analyzes of health care data on all levels of service delivery.

Several policies have been published by the Government toward the aims for Iceland to become a leading nation in the utilization of information technology to improve the quality of life for all Icelanders. The current policy of the Information Society in Iceland, *ePower Expansion* [4] highlights increased use of information

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technology to improve public services and efficiency. It prioritizes access to public domain information and databases using a single portal for accessing data. Furthermore, emphasis is on knowledge building, privacy and safety, effectiveness and quality of services.

Current national eHealth policy in Iceland states that all health professionals shall have secure and timely access to all necessary patient data at point of care to support increased safety and quality of care for healthier populations [5]. It also supports patient empowerment, and thus all citizens shall have secure access to their own health record when needed. Furthermore, strategies involve implementation of a personal health record on a national level. This is in line with the *Act on Patients' rights* [6]. The patient has the right to the best available health services at any point in time. Furthermore, the patient has the right to continuity of health services and cooperation between health professionals.

Health care in Iceland is nationalized and mainly financed by the Government through taxes. The country is divided into seven health care districts. Each district has one or more hospitals and primary health care clinics. The National Hospital in Reykjavik is the biggest hospital providing highly specialized health care to all citizens.

The purpose of this paper is to give insight into how national eHealth strategies can empower health professionals, patients and citizens to increase patient safety and quality of health care delivery.

## 2. Methods

The Directorate of Health in Iceland is responsible for the development and implementation of an electronic health record (EHR) as well as a patient portal on a national level. The aims are seamless and secure access for all health professionals to relevant and timely patient information at point of care. Furthermore, secure electronic access for citizens to their own health record [5]. The Directorate works in close relationship with users, including nurses, at the University Hospital, the Primary Health care of the capital, other health care organizations and a vendor. Currently, all primary health care institutions and hospitals in Iceland use the same EHR, the Saga system. Moreover, Saga is being used by many private practitioners and most nursing homes. Saga is locally developed and was first implemented in 1997. In 2011 a fully integrated nursing documentation component was added to the Saga system.

In line with the goals of the European Commission to improve citizens' health by using eHealth tools, increase healthcare quality and access, and to make eHealth tools more effective, user-friendly and widely accepted [1] the Icelandic government has developed a national plan and strategy to reach these goals.

### 2.1. Implementation of a national plan and strategy

- The Icelandic HealthNet, Hekla.

All health care institutions in Iceland shall be connected via the secure HealthNet Hekla for health data exchange. Patient information, such as, on nursing and medical diagnoses and interventions, medications, allergies, visits, hospital admissions and discharges, various certificates, clinical notes, test results, vital signs, children's growth

charts, maternal care, labor and delivery shall be shared between health professionals and across different health care institutions and geographical boundaries. The HealthNet is owned and maintained by the Directorate of Health.

- Seamless Access and Sharing of Patient Information

According to the *Health Records Act* [2] all health care professionals shall have access to relevant health information about their patient in order to deliver best available health care services. The national eHealth strategy involves connecting and integrating health information systems for secure and seamless sharing of patient information via the HealthNet Hekla.

- e-Prescriptions and National Medication Database

E-prescriptions of medications are a prerequisite for building a national medication database. In 2012 the law on the national medication database was changed to give all physicians up to date access to medication prescriptions and dispensed medications [7]. All physicians shall preferably use e-prescriptions but nurses in Iceland, however, are not permitted to prescribe any medications. Furthermore, citizens shall have access to their own medication data.

- Vera - patient portal

All Icelandic citizens shall have secure electronic access to their health information and allowing for secure messages to be sent between citizens and health care providers.

### 3. Results

- The Icelandic HealthNet, Hekla.

The HealthNet is used to connect health information between different health care institutions and across the seven health districts within the country. A master patient index is used to identify the location of individual patient data located in the EHR databases of each health care institution, but all Icelanders are issued a unique ID at birth.

Health care institutions need to have implemented an active privacy and security standard, issued by the Directorate of Health, before they can connect to the HealthNet. All data are encrypted while being transferred and all access of health professionals is logged on an individual level. The logs for the national health information services are available to health authorities.

Currently, all hospitals and primary health care institutions in the country are connected to the HealthNet. Moreover, many privately run clinics have also been connected to the HealthNet. Eventually all privately run clinics are expected to be on board in adherence to the national eHealth policy.

- Seamless Access and Sharing of Patient Information

Currently nursing and medical diagnoses and interventions, medications, allergies, visits, hospital admissions and discharges, various certificates, clinical notes, nursing and physicians summaries, test results, vital signs in primary health care are accessible and shared across health care services and institutions. Examples of pending projects



include sharing of information on vital signs in hospitals, some nursing data, other than nursing summaries, from hospitals and nursing homes, children's growth charts, labor and delivery charting. Information sharing of maternal care is in a pilot phase.

The patient information is on a read only basis, except for allergies, where the information can be downloaded to own EHR system. To avoid information overload the health data can be searched and viewed depending on the need for information. For example, one can choose to view all diagnoses of a patient, only view data associated with one diagnose and sort by age of information. Patient privacy and security are highlighted and every health care institution has to have a security and disaster plan implemented to connect to the HealthNet.

- e-Prescriptions and National Medication Database

Every physician in Iceland has secure access to e-prescriptions. Furthermore, all pharmacies in the country are connected to the HealthNet. Currently e-prescriptions are approximately 70% of all prescribed medications in the country. Physicians' lookups or viewings are logged via the HealthNet as are logs for citizens' lookups. E-prescriptions are integrated within the EHR. Moreover, physicians and dentists can prescribe medications electronically through a secure website located at the Directorate of Health with official individual e-identity.

- Vera - patient portal

Vera is a national patient portal developed to be a platform from where citizens can access their own health information in a secure way. At present Vera contains for example "My immunizations", "My prescriptions", "My e-Prescription renewal", "My GP", "e-Booking", "Secure e-Mail with health professionals" and information on the individual's perspective on being an organ donor.

#### 4. Discussion

Health services that use information and communication technologies are expected to improve prevention, diagnosis, treatment, monitoring and management. The national policy on eHealth supported by Icelandic law and regulations has proven to be of high importance for building an eHealth infrastructure. Furthermore, eHealth projects have been governed by one authority, the Directorate of Health. By building an infrastructure such as the HealthNet Hekla important health information is shared on a national level to support increased patient safety and quality of care. The HealthNet minimizes geographical hindrances. The timely and secure access to patient information by health professionals through a single portal, independent of where the patient received care, is expected to increase continuity of patient care, decrease duplication of data and tests and increase cost effectiveness.

The benefits of the implementation of the eHealth strategies for citizens and health professionals can be summarized with a few scenarios: 1. A patient visits the primary health care centre for monitoring of his health status and tells the nurse or general practitioner that he recently saw a cardiologist. With data accessible and at point of care the health professional can see the results of that visit and medication changes that may have been done. The quality of the care the patient receives increases, becomes more efficient and safer; 2. The elderly patient who is discharged from the hospital may

have an updated nursing care plan which can be accessed by the nursing home where he will be admitted and save the nurses in the nursing home valuable time; 3. Still another patient is admitted unconscious to the emergency room. He has an identification card which makes access to his health data possible. The quality of the care the patient receives is likely to increase, become more efficient and safer; 4. With deployment of the national medication database misuse of medications can be minimized. Patients 'shopping around' for medication prescriptions can be identified and misuse diminished. All prescriptions that are electronically prescribed or have been dispensed will show up in the database; 5. A patient needs a medication renewal and logs on to Vera. Within minutes the request has reached the physician who can then renew the medication and notify the patient through Vera. Patient and health professional time is saved and the service more effective.

Communication between health professionals and the citizens through Vera is possible but currently limited mainly due to physicians' resistance to this innovation. Moreover, nurses have not executed their leadership skills enough in adopting information technology advocating benefits for citizens. Nurses in Iceland need to make better use of information technology for empowering patients.

Information and data sharing between patients and health professionals is an important step towards the goals of eHealth. Studies to evaluate the outcomes of eHealth implementation in Iceland are needed, for example by surveying health professionals, patients, and citizens. The implementation of eHealth is an ongoing project which needs to be evaluated using comparable indicators at local, national and international levels.

## References

- [1] European Commission. *Public Health, e-Health*. [http://ec.europa.eu/health/ehealth/policy/index\\_en.htm](http://ec.europa.eu/health/ehealth/policy/index_en.htm). 2008.
- [2] *Health Records Act, No. 55/2009*. <http://eng.vefjerdarraduneyti.is/acts-of-Parliament/nr/20194>
- [3] The Boston Consulting Group, *Health care system reform and short term savings opportunities. Iceland health care system project*. Author, Boston, MA. 2011.
- [4] Ministry of the Interior. *E-power expansion, create, connect, participate. Icelandic State and Municipal Policy on the Information Society 2013-2016*. 2008
- [5] Directorate of Health. *e-Health Strategy 2015-2020*. <http://www.landlaeknir.is/>
- [6] *Patients' Rights Act, No. 74/1997*. <http://eng.vefjerdarraduneyti.is/acts-of-Parliament/nr/20100>
- [7] *Medicinal Products Act, No.45/2012*. <http://eng.vefjerdarraduneyti.is/acts-of-Parliament/nr/20128>

# Health@Home Moves All About the House!

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**Abstract.** It is now well recognized that patients play an important and active role in self-care and disease management, and many of these activities happen in their homes. Information technologies to support such care might be better used if they were designed taking into account the physical context of the home and the health information management needs of the residents. We conducted home-based interviews of 20 adults including an extensive analysis of their personal health information management (PHIM) tasks. Here we present these task descriptions, locations of their performance, and distribution across space and time. Implications for the informatics community include accommodating the distributed nature of tasks in the design of consumer technologies.

**Keywords.** personal health information management, self-care, information technologies, home context

## 1. Introduction

The ‘home as a site for care’ has emerged as an important target for consumer health informatics tools, and there is a rush of smart appliances<sup>1</sup>, interactive health technologies<sup>2</sup>, home care apps and connected self-monitoring devices. Yet innovations intended for “home care” or “self-monitoring” are often designed with little attention to the physical characteristics of the place where such devices are used, resulting in little guidance on strategies to address and accommodate physical characteristics of the home including its spatial orientation, furnishings, and personal objects. The purpose of this paper is to explore personal health information management (PHIM) in the home, with attention to the extent to which the tasks are distributed over time and space. We believe such findings provide new insights to the design and the deployment of consumer health informatics innovations for self-care.

The need to explicate the impact of the physical context of the home on PHIM arises from three trends: 1) evidence that physical contexts shape health outcomes<sup>3</sup>; 2) the rise of home monitoring, health apps, and other technologies to support PHIM, and 3) the relative lack of guidance on the design of consumer health informatics innovations<sup>4</sup>. This paper, and the larger project from which it emanates (HS 22548, *vizHOME*), addresses trends 2 and 3: to accelerate the design and deployment of context-appropriate consumer health informatics tools to support PHIM.

PHIM encompasses a broad range of behaviors from seeking diagnostic information on the web to self-tracking. To define the field of exploration for this study, we adopted the three areas in which PHIM is being investigated as identified by MacGregor and

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Walthen<sup>5</sup> 1) *storage and organization of health information in electronic or paper form*; 2) *tracking or recording observations such as symptoms or calorie intake*; 3) *seeking health-related knowledge or information*.

In Project HealthDesign<sup>6</sup> we observed that not all PHIM tasks involved use of a physical artifact; thus we include as PHIM tasks the cognitive and decision making tasks used for self-monitoring (e.g. selecting an insulin dose based on a glucometer reading). Thus PHIM comprises a suite of behaviors and cognitive strategies used by an individual to record, organize, act on, store, retrieve, or coordinate information related to health and health care.

The growing literature on PHIM tasks in the home has focused on either self-report by patients or laboratory observations of prompted task performance<sup>2,7</sup>. These approaches attend to the psychomotor aspects of PHIM but they provide minimal description of the physical space of the home where tasks occur. However, we know that aspects of the home such as privacy, lighting, or storage access influence PHIM and the usefulness of devices to support it<sup>8</sup>.

In earlier work exploring PHIM in the home, participants were asked to “show me how you do ...” without specific attention to context<sup>2</sup>. Our group employed a modified contextual inquiry to explore the spatial dimensions and natural trajectory of PHIM tasks from the perspective of the person in his or her home. Participants identified tasks that were most important to them; then described or demonstrated the steps of each task and where they performed them in a typical day. In addition, we believe this approach better illuminated cognitive aspects of PHIM, such as triggers and recall, as well as how visual cues in the home prompt PHIM tasks.

## 2. Methods

*Parent Project.* The data we report represent the first phase of the parent vizHOME project: exploring PHIM task performance in homes. We had approval from the Institutional Review Board for this phase of the study. Participants were compensated for their time.

*Setting and sample.* The target population was community-dwelling adults who reported having diabetes and lived in homes in urban, suburban or rural regions of a mid-western state. Four types of homes were targeted (detached, semi-detached, multi-unit and mobile) to represent a range of households. Adults with diabetes were selected as informants because they must regularly engage in a number of self-care activities involving PHIM tasks, and the disease affects many aspects of daily life, such as food selection and exercise needs.

*Data Collection and Data Analysis Procedures.* Similar to Dabbs and colleagues<sup>2</sup>, we employed a modified contextual inquiry process involving three home visits to each participant, each visit lasting 2-3 hours. Contextual inquiry is an unstructured but purposeful interactive process situated in the person’s natural environment. We employed a work systems approach to characterize the PHIM tasks and a consolidation strategy for data analysis.

Interviews were audio-recorded and were conducted by two study team members, an interviewer and a notetaker. Participants responded to questions about their health concerns, self-monitoring and self-management practices. A schematic map of the home was created to highlight layout and focal areas for PHIM. Participants identified

specific PHIM tasks in the locations where they performed them when possible. All instruments and forms are available from the authors.

Additional data collected included general location of the home, global health rating, perceptual or mobility limitations, others living in the home, presence of pets and a home clutter rating. We also obtained full-scale 3D scans of the interior of each home. Data consolidation processes applied the Health@Home model<sup>9</sup> to characterize information management. Finally, we reviewed home maps to facilitate reconstruction of task activities across space and time.

### 3. Results

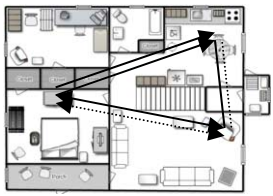
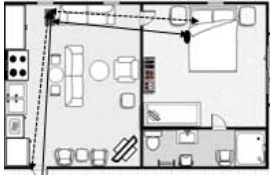
We interviewed 20 people in their households during 2014-2015. The mean age of participants was 59 (sd=12), 65% were white, 70% were females, and 25% lived alone. All participants had a cell phone, a land line or both; all but one household had a laptop or a personal computer. We identified over 100 different tasks, and explored 60 in depth (3 per participant). Table 1 provides examples of PHIM tasks reported by the participants.

**Table 1:** Personal Health Information Management Task Examples

<u>Medication Management</u>	<u>Self-Monitoring</u>	<u>Information Management</u>
Manage & execute med schedule Restock 7-day pill organizer Prepare & take daily meds	Monitor & track blood sugar levels Monitor blood pressure & cardiac status Assess, treat & monitor headaches	Plan clinical appointments Search for, use, & store info Journal about health conditions or emotional state

We now provide three detailed examples of PHIM tasks, locations and time sequences reported by participants to illustrate this point. The schematic maps of the homes highlight distribution of tasks in the home as well as over time by solid vs broken arrows. See Table 2.

**Table 2:** Vignettes and Home Layouts

<p><i>Each day at 9:30am, Participant A retrieves her glucometer and log book from the dresser in the spare bedroom. She brings it to the kitchen table where she checks and records the reading. If she wants help interpreting the reading or advice on what to do, she goes to telephone in the living room to call a friend who has diabetes. When done, she returns the glucometer to her bedroom. She repeats this procedure before her evening meal. She relies on memory and routine to perform these tasks.</i></p>	
<p><i>Participant J has four to five appointments with different health care providers each week at varying times of the day. She uses both a traveling planner and a main planner to record all her appointments. As she leaves an appointment she records upcoming appointments in the travel planner, which she stores in her backpack. When she returns home, she transfers the appointment information into her main planner which she keeps under her bedside table. She refers to this main planner on a daily basis.</i></p>	

*Every morning before breakfast, Participant L counts out his morning and evening pills from their individual bottles that he stores on his bedroom dresser. He leaves his evening pills on the dresser and takes his morning pills with him to the kitchen where he obtains an aspirin from a cabinet; he then ingests all pills at the dining table. He has another pill that he takes with dinner; he keeps this medicine bottle on the dining table as a reminder to take it. Around 9pm, when his wife goes to bed, he retrieves his evening pills from the bedroom dresser and brings them to the kitchen counter. He takes them around 11pm. He primarily uses environmental cues and diurnal events to perform these tasks.*



Findings demonstrated that people perform PHIM tasks in multiple areas of the home. This suggests a distributed nature of even apparently simple tasks, such as taking a medication. These vignettes illustrate the distribution of the location and of the timing of PHIM task performance within individuals and across households. By consolidating data from the interviews and the maps, we discovered that PHIM task steps occur throughout the day and the home; most commonly in the kitchen, living room and bedroom.

We examined the extent to which PHIM task performance was distributed in space and time across all participants. We analyzed a total of 60 tasks, 20 medication management tasks, self-monitoring tasks and information management tasks. With only one exception, tasks related to medication management occurred not at a single point in time, but as a discrete set of steps unfolding over long intervals (95%) and in several different spaces in the home (90%). Similar variability in space and time was observed with information management tasks (75-80%) and self-monitoring tasks (80-55%).

#### 4. Discussion

There is no one place or time of day that PHIM tasks occur in the home. We explored a total of 60 different PHIM tasks identified in the course of three home visits with 20 people recruited for a larger study of how the home context influences PHIM. We expected that PHIM tasks, such as medication management, would happen in a specific place at a given, well-circumscribed time. This is evident in the case of Participant A, who has a specific time of day and specific space where she does her blood glucose monitoring. Even in this single act, however, there are interruptions and additional activities in additional spaces. Conversely, Participant L, who takes many medications during the day, starts planning and sorting actual pills early in the morning. He does not use a chart or record, but relies on memory. He distributes small containers of these pills throughout the house to intersect in the place he anticipates being at that time. We characterize PHIM tasks that unfold over space and time as “distributed”.

Participant L used strategically placed objects, like a pill bottle, to serve as a visual cue to action. Palen and Aaløke’s<sup>7</sup> description of the structures of ‘pill boxes and piano benches’ was echoed in the self-made solutions we uncovered in this study. From TV shows serving as cues to take a medication, or the color-coding on a kitchen calendar to signify types and timing of appointments, to having a refrigerator in the bedroom to enable taking medication after retiring - the individualization of routines customized to the home, even specific areas within the home, was apparent. This finding underscores the importance of design informed by understanding how and where patients actually

perform tasks in their homes – not how they tell us they would perform them or even how they show us when in a hospital or clinic.

Even when people had access to technology, there was less reliance on computer and communications technologies, such as cell phones, laptops and/or desk top computers for PHIM. Participant J employed an extensive, redundant set of paper diaries to keep track of clinic visits, a very common type of PHIM. Here the artifact is not displayed and does not provide any visual cues to action, but rather serves as an archive. It is notable that the various diaries are stored in different places in the home, some being more accessible, others affording more privacy. Our findings suggest that PHIM is supported by three interrelated resources: 1) cognitive functions (memory and recall), 2) health-related objects (pill bottles and organizers) and 3) artifacts (diaries).

*Limitations.* The work presented here relies on descriptions of behaviors, actions and visual cues to infer motivation and intention. In addition, although participants reported that a part or all of some tasks occurred outside of the home, we did not capture how they occurred or were distributed over spaces outside of the house.

*Conclusions.* Our work complements emerging work in distributed cognition suggesting a rich environment for novel health information technologies. We have transformed consumer health informatics through a patient work framework: connecting patients to context.

## 5. Acknowledgments

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## References

- [1] I. Mizukura, T. Tamura, Y. Kimura, W. Yu. New application of IEEE 11073 to Home Health Care. *Open Med Inform J* **3** (2009), 4–53.
- [2] A.D.V. Dabbs, B.A. Myers, K.R. McCurry, J. Dunbar-Jacob, A. Begey, M.A. Dew. User centered design and interactive health technologies for patients *CIN* **27** (2009), 175–183.
- [3] R.A. Payne, G.A. Abel, B. Buthrie, S.W. Mercer. The effect of physical multimorbidity, mental health conditions and socioeconomic deprivation on unplanned admissions to hospital: a retrospective cohort study. *CMAJ*. **185** (2013), 221-228.
- [4] US AHRQ. Designing Consumer Health IT: A Guide for Developers and Systems Designers. Rockville, MD, (2012). AHRQ Publication No. 12-0066-EF.
- [5] J. MacGregor, C.N. Walthan. ‘My health is not a job’: a qualitative exploration of personal health management and imperatives of the ‘new public health’. *BMC Pub Health* **14** (2014), 726.
- [6] P.F. Brennan, G.R. Casper. Observing health in everyday living: ODLs and the care-between-the-care. *Pers Ubiqu Comp* **19** (2015) 3-8.
- [7] L. Palen, S. Aaløkke. Of pill boxes and piano benches: “Home-made” method for managing medication. CSCW 2006 Banff, Alberta Canada.
- [8] H. Demirkan, N. Olguntürk. A priority-based “design for all” approach to guide home designers for independent living. *Archit Sci Rev* **57**(2014), 90-104.
- [9] A. Moen, P.F. Brennan. Health@Home: The work of health information management in the household: Implications for consumer health informatics innovations. *JAMIA* **12**(2005), 648-656.

# Older Consumers' Readiness for e-Health in New Zealand

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**Abstract.** The increase in numbers of older people in the population and their incidence of long term conditions means their readiness for e-health is imperative. This cross sectional survey set in primary health care in New Zealand sought to understand how older people are accessing health information. A convenience sample (n=263) found one third had been on-line and this was more likely to be those with poorer health. Free telephone services and receiving health information in person were preferred, with little use of email or text messaging found. Information found on-line was considered useful to understand their health conditions, treatment options and for decision-making.

**Keywords.** Elderly, seniors, ICT, internet use, older people, information literacy

## 1. Introduction

In New Zealand (NZ), similar to global patterns, the number and the proportion of older people is growing due to the increase in life expectancy and falling fertility rate[1]. However, older people are more likely to have long term conditions and multiple morbidities[2]. To successfully prevent and manage these long term conditions they need reliable health information[3]. Accessibility to trustworthy health information sits at the core of prevention, early detection and prompt treatment of long term conditions[4]. Promoting self-management and shared decision making for long term care among older consumers is recommended by the World Health Organisation (WHO)[5]. To be able to encourage self-management and to better understand NZ older consumer's use of information and communication technology (ICT) and health information seeking behaviour a survey was undertaken with those  $\geq 65$  years in primary health care (PHC) settings.

## 2. Older consumers and their information and communication technology use

In the era of e-health there is increasing use of ICT by consumers. Where previously consumers mainly sought health information from health care professionals and traditional media sources such as magazines and television, there is now a wide range of health information available on the internet, through social media, and applications

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(apps) for mobile phones[6]. ICT can promote physical and mental health, and social well-being in older people contributing to an increased sense of control[6,7]. Older people adopt technology later compared to their younger counterparts, however, acceptance of ICT has risen considerably among older people in recent years[8]. In 2014 59% of older Americans went on-line and 77% owned mobile phones[9]. Nevertheless, they lag behind younger people in their use of ICT as 86% of those over 18 years go on-line. Similarly, in NZ 61% of older people use the internet[10]. However, despite the rising trend in internet usage among older people, there is still a digital divide between different demographic groups and older people, notably those younger, more educated and having a higher socioeconomic status facing fewer barriers to using ICT[11]. In NZ there is increasing use of ICT and the Government is committed to increasing the effective and sustainable use of ICT to maximize the accessibility, affordability and equity of health care delivery[12,13]. Knowing that access to health information is important for healthy ageing, and that ICT use is increasing, it is important to understand how older consumers are using ICT for health information.

### 3. Methods

This cross sectional study used a survey, with an anonymous self-administered questionnaire distributed to patients within primary healthcare settings over one week in a large urban area of NZ in late 2010. Ethics approval was obtained (NTY/09/110/EXP). Over 1800 questionnaires were received, resulting in a final sample of 1783 once partially completed questionnaires were excluded (at least 75% of questions needed to be answered for inclusion). This paper reports on those  $\geq 65$  years, giving a sample of 263 participants, which is 14.75% of the total study population. Data from the surveys were entered into Statistical Package for Social Sciences (SPSS Inc.) for statistical analysis.

### 4. Results

The majority of participants were NZ European, with 6% being Maori, who are the indigenous people of NZ. Nearly 40% had NZ secondary school qualifications. Table 1 summarises the demographic characteristics of participants. Of the total, 87% reported being in either 'excellent', 'very good' or 'good' health, with only 1% reporting 'poor' health (Table 2). However, 85% of participants reported having at least one long term condition, with many having more than one (Table 3).

Around one third (36%) of participants had used a computer to find health related information in the last 12 months. This was usually to find information for themselves (74%), for someone else (32%), or for general interest (30%). No one had participated in an on-line support group. In terms of the participant's information seeking behavior and their gender, ethnicity, education or health status, there was no statistically significant difference noted. The use of on-line health information was more than double (67%) among those with 'poor' compared to those with 'good' (31%) self-reported health status; although not significant due to the small numbers of those with 'poor' health.

Those participants who used the internet perceived that on-line health information was 'useful' (49%) or 'very useful' (25%). In terms of trustworthiness 79% of participants reported that they trusted on-line health information 'somewhat', 'quite a lot' or 'very much'. In addition the majority of participants 'agreed' that the health information they found was useful for finding out more about their health conditions, different treatment options and to make health related decisions.

**Table 1.** Demographic characteristics of participants (N=263)

Characteristics	n (%)
<b>Gender</b>	
Male	128 (50%)
Female	128 (50%)
<b>Ethnicity</b>	
NZ European	225 (87%)
Maori	15 (6%)
Pacific	3 (1%)
Asian	2 (1%)
Other	13 (5%)
<b>Education</b>	
No formal qualification	52 (22%)
NZ secondary school qualification	93 (40%)
Overseas secondary school qualification	33 (14%)
University degree or diploma	18 (8%)
Polytechnic degree or trade or technical certificate	18 (8%)
Professional qualification	18 (8%)
Other	3 (1%)

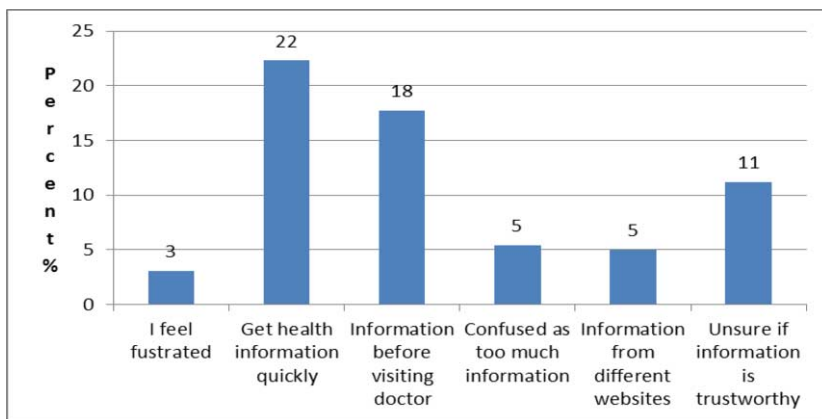
**Table 2.** Health status of participants

Health status	n (%)
Excellent	16 (6%)
Very good	84 (32%)
Good	128 (49%)
Not so good	31 (12%)
Poor	3 (1%)

**Table 3.** Long term conditions of participants

Condition	n (%)
Arthritis	107 (41%)
Heart disease	66 (25%)
Respiratory	50 (19%)
Diabetes	45 (17%)
Chronic pain	39 (15%)
Cancer	24 (9%)
Mental health	8 (3%)
Other	111 (42%)

In response to the question 'How do you feel about looking for on-line health information?' 22% reported they liked being able to find information quickly; 18% looked on-line for health information before visiting their doctor; and 5% liked searching many websites. However, 11% did not like using on-line health information because they did not know which information they could trust. Figure 1 shows these results, including that only 3% reported feeling frustrated by not being able to find what they are looking for or feeling confused by finding too much information (5%).



**Figure 1.** Participants responses to using the internet for locating health information

Most of participants (90%) preferred to receive health information from their doctor or other health professional, 13% preferred obtaining information from the

internet, while only 10% considered email or text messaging (0.4%) preferable. Free telephone services were more popular than free on-line health websites with 21% of participants having used HealthLine (national free phone health service) and 14% QuitLine (national free smoking cessation phone service). However, HealthPoint (1%) and Health Navigator (2%), both government supported websites, were not often accessed.

## 5. Discussion

This is the first study exploring health information seeking behavior targeting ICT use among older consumers in NZ. Most participants were NZ European reflecting the ethnic profile of older New Zealanders (88%) [14]. However, Asian (5%) and Pacific peoples (2%) were under-represented within the  $\geq 65$  population, although this also reflects a disparity in life expectancy [14]. Previous studies identified education as a strong determinant for older people's use of health ICT [7,15] and this study showed older consumers with a university degree more likely to seek health information than others, although the difference was not statistically significant. Having an existing health condition has been found to strongly predict use of on-line health information [15], but this finding was not borne out in this study.

The internet has become a popular health information source for older people; and while this study found almost 30% of participants went on-line to search health information, this proportion is lower than the 64.7% of those  $\geq 65$  who have access to the internet [1]. Since about two thirds of NZ older consumers seek health information offline there is a continued need to ensure health information is distributed through traditional media sources also, and there is scope to increase awareness of existing health-related websites. In this study older consumers mainly sought health information about their health conditions, prescribed medicines, and healthy living, which supports the findings of US studies [3,16]. Additionally, most of the older consumers sought information for themselves rather than for someone else, which is similar to the findings of Tian and Robinson [17].

Participants in this study perceived the health information they found to be both useful and trustworthy. This finding may be explained by the result from a study that perceived usefulness and trust are correlated [8]. Previous studies have found on-line health information has been useful [18], as it keeps older people informed [19-21]; and this can help them make health related decisions [20], changes to lifestyle [18], and improve access to healthcare [8]. In terms of trust, older people trust information from nurses and doctors more than that from inanimate sources, such as the internet [22]. However, not knowing which information they could trust was also a common problem [8]. Few participants in this study encountered negative experiences when seeking on-line health information. However, frustration of being unable to find what is wanted is a known problem [23]; as is confusion from information overload [18].

Limitations include the small sample size, sampling method and lack of age bands for sub-group analyses. Low participation of Maori and other ethnicities are also a limitation. Lastly, by the nature of a quantitative study, there is no in-depth understanding of reasons behind the use and nonuse of e-Health and a further qualitative study, is needed. While NZ needs to continue providing free telephone health services there is a need for further study to explore how to increase awareness

and use of free, non-commercial, government supported on-line health information websites. Despite these limitations this study adds new knowledge of how NZ older people use ICT.

## References

- [1] Statistics New Zealand, *New Zealand in profile*, Statistics New Zealand, Wellington, New Zealand, 2015.
- [2] R. Suzman, J.R. Beard, T. Boerma, S. Chatterji, Health in an ageing world—what do we know?, *The Lancet* **385**, (2015), 484–486.
- [3] M.K. Cresci, P.A. Jarosz, T.N. Templin, Are health answers online for older adults?, *Educational Gerontology* **38**, (2012), 10-19.
- [4] T.L.S. Visscher, Public health crisis in China is about to accelerate the public health crisis in our world's population, *European Heart Journal* **33**, (2012), 157-159.
- [5] World Health Organisation, *Assessing national capacity for the prevention and control of NCDs: Report of the 2010 global survey*, WHO, Geneva, Switzerland, 2012.
- [6] B. Tennant, M. Stelfox, V. Dodd, et al., eHealth literacy and web 2.0 health information seeking behaviours among baby boomers and older adults, *Journal of Medical Internet Research* **17**, (2015), e70.
- [7] M.K. Cresci, J.M. Novak, Information technologies as health management tools: Urban elders' interest and ability in using the internet, *Educational Gerontology* **38**, (2012), 491-506.
- [8] D.M. Zulman, M. Kirch, K. Zheng, L.C. An, Trust in the internet as a health resource among older adults: Analysis of data from a nationally representative survey, *Journal of Medical Internet Research* **13**, (2011), e19.
- [9] A. Smith, *Older adults and technology use*, Pew Internet: Pew Research Center, Washington D.C., 2014.
- [10] Statistics New Zealand, *Household use of information and communication technology*, Wellington, 2012.
- [11] A.K. Hall, J.M. Bernhardt, V. Dodd, M.W. Vollrath, The digital health divide: Evaluating online health information access and use among older adults, *Health Education and Behavior* **42**, (2015), 202-209.
- [12] N. Mays, *Reorienting the New Zealand health care system to meet the challenge of long-term conditions in a fiscally constrained environment*, New Zealand Treasury, Wellington, New Zealand, 2013.
- [13] Ministry of Health, *Health Information Strategy for New Zealand 2005*, Author, Wellington, New Zealand, 2005, <http://www.health.govt.nz/publication/health-information-strategy-new-zealand-2005>
- [14] Statistics New Zealand, *2013 Census QuickStats about people aged 65 and over*, Statistics NZ Wellington, New Zealand, 2015.
- [15] K.E. Flynn, M.A. Smith, J. Freese, When do older adults turn to the internet for health information? Findings from the Wisconsin Longitudinal Study, *J Gen Intern Med* **21**, (2006), 1295-1301.
- [16] R.M. Crabb, S. Rafie, K.R. Weingardt, Health-related internet use in older primary care patients, *Gerontology* **58**, (2012), 164-170.
- [17] Y. Tian, J.D. Robinson, Incidental health information use and media complementarity: A comparison of senior and non-senior cancer patients, *Patient Education and Counseling* **71**, (2008), 340-344.
- [18] J. Chung, C.A. Gassert, H.S. Kim, Online health information use by participants in selected senior centres in Korea: Current status of internet access and health information use by Korean older adults, *International Journal of Older People Nursing* **6**, (2011), 261-271.
- [19] S. Medlock, S. Eslami, M. Askari, D. Sent, S.E. de Rooij, A. Abu-Hanna, The consequences of seniors seeking health information using the internet and other sources, *Studies in Health Technology & Informatics* **192**, (2013), 457-460.
- [20] V.J. Rideout, T. Neuman, M. Kitchman, M. Brodie, E-health and the elderly: How seniors use the internet for health information: Key findings from a national survey of older Americans, Henry J. Kaiser Family Foundation, 2005, <https://kaiserfamilyfoundation.files.wordpress.com/2013/01/e-health-and-the-elderly-how-seniors-use-the-internet-for-health-information-key-findings-from-a-national-survey-of-older-americans-survey-report.pdf>
- [21] B. Xie, Older adults' health information wants in the internet age: implications for patient-provider relationships, *Journal of Health Communication* **14**, (2009), 510-524.
- [22] S. Chaudhuri, T. Le, C. White, H. Thompson, G. Demiris, Examining health information-seeking behaviors of older adults, *CIN: Computers, Informatics, Nursing* **31**, (2013), 547-553.
- [23] M. Ybarra, M. Suman, Reasons, assessments and actions taken: Sex and age differences in uses of internet health information, *Health Education Research* **23**, (2008), 512-521.

# Evolving National Strategy Driving Nursing Informatics in New Zealand

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**Abstract.** An update to the New Zealand Health Strategy identifying direction and priorities for health services is underway. Three specific areas have implications for nursing informatics and link to education and practice: best use of technology and information, fostering and spreading innovation and quality improvements, and building leaders and capability for the future. An emphasis on prevention and wellness means nursing needs to focus on health promotion and the role of consumers is changing with access to their on-line information a major focus. As the modes of delivery for services such as telehealth and telenursing changes, nurses are increasingly working independently and utilizing information and communication technologies to collaborate with the health team. New Zealand, and other countries, need strong nursing leadership to sustain the nursing voice in policy and planning and ensure nurses develop the required informatics skills.

**Keywords.** public policy; health strategy, nursing informatics, consumer engagement, nursing education

## 1. Introduction

The New Zealand Health Strategy provides the direction for the government's action on health by identifying the priority areas and aims to ensure that health services produce the largest benefits for the population [1]. The current strategy was released in 2000: however, since then financial constraints have increased, technologies have advanced, there is an increasing aging population, more focus on the impacts of health on the social sector, and these factors are drivers for the health sector demands for a clearer sense of direction and priorities. It is timely that a review and update of the national health strategy for New Zealand is taking place in order to set the vision and road map for the health sector for the future.

The Strategy development has been influenced by two external reviews. The first a "health system funding" review to promote a high quality sustainable funding model across social sectors. The second a "health system capability and capacity" review to ensure the health and disability sector can be adaptable and responsive [2]. These together aim to 'future-proof' the updated Health Strategy. It is encouraging to see a refocus of the Strategy which provides an impetus for further development and

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emphasis on the role nursing informatics plays in supporting healthcare in New Zealand.

## **2. New Zealand as context**

New Zealand is a small long country made up of three main islands. With a population of nearly 4.6 million and a publically funded health service, there is the constant issue of obtaining enough funding through taxation to meet individual's health needs [3]. New Zealand spends 10% of its gross domestic product (GDP) on health, compared to the United States 16.9%, Netherlands 11.8%, France 11.6% and Germany 11.3% [4].

Public health services are provided by twenty District Health Boards (DHB). Each DHB receives funding from Government, through the Ministry of Health, according to the nature of the district, considering size, rural/urban mix, and their specific population. A limited number of the DHBs also provide tertiary/quaternary services. Each DHB has responsibility to plan, manage, provide and purchase health services for their district. This includes primary care, secondary/tertiary hospital services, public health services, aged care services, and community services provided by other non-government health providers [5].

## **3. Developing a Health Strategy**

The process of developing the new Health Strategy involved many stakeholders and wide consultation identifying issues that an updated Health Strategy could ideally address. Feedback from stakeholders suggested that the New Zealand health system should aim to improve its performance by addressing health outcomes, rather than focus on activity performance measurements. Additionally, the division of the country into DHBs was thought to hinder collaboration and changes to service delivery, with arbitrary splits between districts being a barrier to change. Rather, a long-term view of a consumer-centred service with minimal fragmentation and duplication was desired. The working vision for the new Health Strategy proposed “a 21st century health and disability system that operates as one, focuses of wellbeing and prevention, and is people centered” aiming to support all New Zealanders to “live well, stay well and get well” [2].

The challenges identified to be addressed to develop this contemporary Health Strategy included:

- Changing demographics – people are living longer.
- Burden of disease – some people living longer are in poor health and with multiple long-term conditions/co-morbidities.
- Changing technology and drugs - with potentially huge benefits, but also with significant costs.
- Consumer expectations - more is expected from health services.
- Continuing fiscal constraint – not just in New Zealand but around the world.
- Continuing disparities - persistent differences in access and health outcomes for minority populations.
- A push for a new way of working and delivering health services.

Underpinning the above were the key priorities of prevention and wellness, strengthened integration of services, support for innovation, better collaboration, improved ways services are delivered especially to reach our most vulnerable, giving every child a healthy start, and ensuring information and services are more accessible. This requires strong leadership, capability for change and enhanced quality and performance.

#### **4. The Health Strategy**

The Health Strategy is nearing publication now, and three specific areas are emerging impacting nursing informatics: best use of technology and information, fostering and spreading innovation and quality improvements, and building leaders and capability for the future. Best use of technology and information provides a focus on the new eHealth and information technology (IT) solutions that are being implemented to support improvements in the health of the New Zealand population. The National Health IT Board is responsible for ensuring that the health information and communications technology aspects of the Health Strategy are implemented. The New Zealand IT and eHealth environment is evolving from a fragmented environment which creates infrastructure platforms to enabling sharing of information from disparate systems, to a focus now on having a stable, standardized information and decision support platform to allow integration across the sector. Strong clinical leadership and consumer input into systems design is supporting the enhancements in the quality and timeliness of information and delivering sustainable productivity improvements. The focus is now on co-design by clinicians and consumers to drive clinical productivity, and extending consumers' access to digital services online.

#### **5. Implications for nursing**

The above changes that are signaled by the review of the national Health Strategy for New Zealand have important implications for nursing, specifically for education and practice.

##### *5.1 Prevention and wellness*

The emphasis on prevention and wellness promotes a move towards decreasing the reliance on secondary care services and increasing health promotion, therefore reducing the disease burden on the health care system. This shift will need to be reflected in undergraduate and postgraduate nursing education with emphasize on nursing practice that utilizes health promotion and education to support healthy lifestyles at every opportunity for individuals, families, and communities.

Accessibility to information and software to support consumers in illness prevention and to promote healthy lifestyles is increasing. For example, there are many health and fitness related smart phone applications (apps) and with 64% of New Zealanders aged between 15 and 65 owning a smartphone, health promotional support is easily accessible [6]. A more recent emerging trend in New Zealand, is the use of wearable activity tracking devices (e.g. Fitbit). These wearable devices can be used

alone, on-line or via a phone app. The challenge for nurses will be how to work in partnership with consumers for realistic goal setting, biometric monitoring and encouraging ongoing progress towards healthy living.

### *5.2 Changing role of consumers*

Further participation of consumers is being encouraged through on-line access to their health information. In New Zealand this is being led through primary health settings, where general practice is being encouraged to share part of the Electronic Health Record (EHR) through a 'patient portal', so consumers can see their medications, laboratory results and the plan for their care [7]. With 77% of households already having internet access in 2013, and this predicted to rise, the use of patient portals will increase [3].

A further example is the transfer to an on-line cloud based record for the well child health record used by Plunket, which was traditionally a paper-based record in a book format given to parents. Plunket is the predominant national well-child health provider in New Zealand seeing 90% of newborns, approximately 60,000 new babies every year [8]. Plunket is in the process of rolling out their cloud-based EHR application which will allow nurses using tablets to access consumer's notes, and families also having access to their children's health information. As Plunket provide well-child care from when a baby is two weeks old and lasting until they are four, this provides a longitudinal health record. These changes mean nurses will need to have the skills to use different technologies, and also incorporate the use of ICT into their care, both in clinics (such as general practice), and in the home (Plunket).

### *5.3 Alternative modes of service delivery*

Integration of services and improved and alternative modes of service delivery will bring new roles for nurses. In New Zealand that is likely to include a requirement for more Nurse Practitioners and advanced nursing practice roles [9]. Nurses are increasingly working more independently and using ICT to collaborate with other members of the health team for care provision [10,11].

Telehealth, as a mode of service delivery will increase as a means of improving access to health care across the country, especially in remote and rural areas [12] as well as large urban centers, where traffic issues impede movement [13]. Nurses in New Zealand are already well-placed and have proven themselves capable of taking key roles in telehealth and this is likely to increase [11].

### *5.4 Leadership*

A key requirement that has been identified both within the profession and at the Government level is the need for strong nursing leadership. Within nursing informatics in New Zealand there are nurses involved in a number of important national committees [14], but this is an area that needs further attention to ensure succession planning and therefore a sustained nursing voice at the level of policy and planning. Leadership skills can be developed through experience, postgraduate education, and also through opportunity, by promoting a culture of supporting up and coming young leaders [15]. Future nursing leaders are needed to lead and promote the use of ICT [16].



## 6. Conclusion

It is relevant for all nurses to consider their national health strategies and the implications for nursing informatics. With limited funding and an ageing population NZ needs to have a 21st century health and disability system that operates as one, with a focus on wellbeing and illness prevention that is consumer centered and the publication of the new NZ Health Strategy, in 2016, will guide this. The skills and resources of the nursing profession, and nursing informaticians in particular, are a powerful toolset to leverage to support all New Zealanders to “live well, stay well, get well”.

## References

- [1] Ministry of Health, *The New Zealand Health Strategy*, Ministry of Health, Wellington, New Zealand, 2000.
- [2] Ministry of Health, *New Zealand Health Strategy update*, 2015, <http://www.health.govt.nz/about-ministry/what-we-do/new-zealand-health-strategy-update-and-associated-reviews/new-zealand-health-strategy-update>. Accessed September 22, 2015.
- [3] Statistics New Zealand, *New Zealand in profile*, Statistics New Zealand, Wellington, New Zealand, 2015.
- [4] Organisation for Economic Co-operation and Development (OECD), *OECD health statistics 2014: How does New Zealand compare?*, 2014, <http://www.oecd.org/els/health-systems/Briefing-Note-NEW-ZEALAND-2014.pdf>. Accessed September 22, 2015.
- [5] Ministry of Health, *Overview of the health system*, 2011, <http://www.health.govt.nz/new-zealand-health-system/overview-health-system>.
- [6] Frost and Sullivan, *By 2018 New Zealand will have 90% smartphone and 78% tablet ownership levels*, 2013, <http://www.frost.com/prod/servlet/press-release.pag?docid=288249825>. Accessed September 25, 2015.
- [7] K. McDonald, Patient portals: Start simple, start small, *Pulse+IT* **September 12** (2014), <http://www.pulseitmagazine.com.au/news/new-zealand-ehealth/2070-patient-portals-start-simple-start-small?highlight=WyJwYXRpZW50IiwicGF0aWVudCdzliwiJ3BhdGllbnQnLiIsIidwYXRpZW50JyIsIidwYXRpZW50IiwicGF0aWVudCciLCJwb3J0YWwiciLCJwb3J0YWwncyIsInBhdGllbnQgcG9ydGFsIl0=>
- [8] K. McDonald, Plunket delivers baby book in the cloud through ePHR, *Pulse+IT* **September 11** (2015), <http://www.pulseitmagazine.com.au/new-zealand-ehealth/2657-plunket-delivers-baby-book-in-the-cloud-through-ephr?highlight=WyJwbHVua2V0IiwicGF0aWVudCdzliwiJ3BhdGllbnQnLiIsIidwYXRpZW50IiwicGF0aWVudCciLCJwb3J0YWwiciLCJwb3J0YWwncyIsInBhdGllbnQgcG9ydGFsIl0=>
- [9] District Health Boards New Zealand (DHBNZ), *Future Workforce: Nurse Practitioner - A healthy future*, (2010), [http://www.dhbnz.org.nz/Site/Future\\_Workforce/Nursing-Midwifery/Nursing-Projects/Nurse-Practitioner/Default.aspx](http://www.dhbnz.org.nz/Site/Future_Workforce/Nursing-Midwifery/Nursing-Projects/Nurse-Practitioner/Default.aspx)
- [10] New Zealand Telehealth Forum, *New Zealand Telehealth Stocktake: District Health Boards*, The University of Auckland National Institute for Health Innovation and the Ministry of Health IT Health Board, Wellington, 2014.
- [11] J. Wright, M. Honey, Nurses providing teleconsultation and caring at a distance. *Poster presented at 14th Annual HiNZ Conference: Collaborate* Christchurch, New Zealand, 2015.
- [12] J. Lucas, M. Honey, K. Day. Clinicians’ perceptions of telemedicine opportunities and barriers: Interim findings of a descriptive study. 11th National Health Informatics Conference: Health Informatics into Clinical Practice; November 7-9, 2015, 2012; Rotorua, New Zealand.
- [13] C. Pye, L.A. Westbrooke. TeleDOT: Directly observed therapy for tuberculosis using telehealth. *Med-e-Tel 2015, The international eHealth, Telemedicine and Health ICT Forum for Educational, Networking and Business*; April 22-24, 2015, 2015; Luxembourg.
- [14] E.J.S. Hovenga, M.L.L. Honey, L.A. Westbrooke, Pacific rim perspectives, In: Saba VK, McCormick KA, eds. *Essentials of Nursing Informatics*. 6th ed, McGraw-Hill Education, New York, NY, 2015, 777-800.
- [15] S.C. Grossman, T.M. Valiga, *The new leadership challenge: Creating the future of nursing*, F.A. Davis Company, Philadelphia, PA, 2013.
- [16] B.L. Westra, C.W. Delaney. Informatics competencies for nursing and healthcare leaders. *AMIA 2008 Symposium*; 2008.

# Nursing Telehealth, Caring from a Distance

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**Abstract.** Tele-technology in the health care system is prognosed to be able to produce better health, better care at lower cost (Triple aim). This paper will discuss the validity of this prognosis, which in many ways is considered as some sort of diagnosis of the conditions concerning triple aim in relation to Tele-technology. Tele-technology in the health care system covers three different types of technological settings: telecare, telehealth and telemedicine. This paper will disclose the different meanings of telecare, telehealth and telemedicine and discusses how nursing informatics can accomplish and gain from this disclosure. Theoretically and methodologically the paper is based on post-phenomenological readings and reflections, where use, practice, users, participants, values and knowledge systems are addressed on an equal level in order to understand technology and how we act appropriately through and with technology.

**Keywords.** Telehealth, triple aim, 7 E's, values, post-phenomenology

## 1. Background

During the last decade we have witnessed the launch of myriads of tele-medicine or tele-care projects. In Denmark alone a recent mapping revealed the existence of 372 projects [1]. Few of them have been properly evaluated, and for those who have there seem to be a limited impact on the triple aims: better care, better health and lower cost [2][3]. In order to improve impact and also increase sustainability we draw attention to some fundamental preconditions for designing and implementing tele-technologies in health care, and discuss these issues in relation to fundamental thoughts in a Danish telecare project – the Epital.

## 2. Introduction and theoretical anchor

The Dutch researcher on socio-technical understanding of health informatics Jeanette Pols writes in “Care at a Distance” [4] that hands are not necessarily warm and technology is not necessarily cold. We do fully concur on this polyvalent statement where is in-built a request for critique and reflection in relation to use, practice, participants, values and knowledge systems, and furthermore how technology affects all of this. This means that we are not going to fall into the pit of romanticism on how we should always strive towards direct physical and psychological contact in between caregivers, caretakers, citizens and patients. On certain occasions and in certain contexts technolo-

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gy provides better care than humans, for a variety of reasons. Telecare, Telehealth and Telemedicine have different roles, qualities and potentials in relation to care and comfort of the citizen/patient and furthermore in relation to how professional staff experience their everyday life work practice. When we think of the development and implementation of tele-technology in the health care system it is paramount that it is not only the citizen/patient who experience better care, better health at lower cost, but also the professional staff should through and with technology have the possibility of perceiving what we have coined as empowerment, enhancement and emancipation [5][6][7]. In order to reach that we have to apply engagement, embodiment, empathy and enactment, which are ways of moving on the path as healthcare professionals in order to achieve the multiple aims of empowering, enhancing and emancipating both for oneself and for the receiver of the healthcare service, e.g. the citizen/patient.

The American philosopher Don Ihde first introduced post-phenomenology as a philosophical position on technology in 1993 [8]. Ihde tells us that technology is multi-stable, which means that our relations to technology changes according to use, context and understanding. There is no essence in technological artefacts. They constantly and dynamically co-constitute together with humans in new configurations. Therefore technology is not per definition something in itself, which we should consider the moment we construct and design technology. Humans are in this same perspective neither something in itself. We change and become something new through our interaction with technology. This is why we cannot from the outset classify technology as cold and human hands as warm, and the same thing goes for the hybrids that are created in the conjoinment of humans and technology.

Lars Botin introduced to the methodological framework in [5] where he writes about the 7 E's: engagement, embodiment, empathy, enactment, empowerment, emancipation and enhancement. Engagement, embodiment, empathy and enactment are means, whereas empowerment, emancipation and enhancement are aims. Four of the concepts are already familiar to the profession of nursing and nursing informatics, i.e. engagement, embodiment, empathy and empowerment, whereas enactment, emancipation and enhancement seldom occur in research or actual practices. It is important to notice that as if the methodology is co-constitutional then professional staff, e.g. nurses should experience empowerment, emancipation and enhancement through the use of tele-technology, as should the care receiver, e.g. citizen, patient, relatives and/or informal caretakers.

We have dealt with this in [9], where we indicate that all of this should happen on an individual and personal level, because engagement, embodiment, empathy and enactment is an individual experience and manifest as a sensation in the singular individual. In philosophy of technology this enterprise is called scaffolding, where we build scaffolds in order to construct structures that protects, support, maintain and renew fragile and vulnerable bodies and identities of humans [10][11]. The scaffold is a fairly mechanical and instrumental thing made out of standardized components, which fit neatly together, and the foremost quality of the scaffold is that can be assembled in an infinity of ways in order to scaffold what is to be scaffolded. It is not a one size fits all construction, but exactly co-constitutional where scaffolds transform and change in relation to the scaffolded and the scaffolded is equally affected and influenced by the scaffold as work/practices are performed.

Empowerment and enhancement are aims that can be reached by procedures and decisions made by others in relation to the individual. The citizen/patient can be empowered and enhanced by technology without actually doing something on her own. It

is different when it comes to emancipation, because we can set up possibilities for emancipation, but this does not necessarily mean that the individual will become emancipated. In order for that to happen it requires an act of will and furthermore knowledge on what it actually means to become emancipated, which of course means that citizens/patients are expected to reflect on their actions and practices and furthermore to seek knowledge about the impact and consequences of their actions and practices.

### 3. Methods and material

Technical reports and magazine news articles delivered input for a summary description of the Epital initiative. This description has been elaborated through an interview with one of the Epital key persons. The description has been approved for correctness by the Epital organization.

The Danish telecare project – the Epital is an attempt to redesign the structure of the health system to achieve a more accessible, coherent and efficient service by means of virtualizations of selected functionalities regarding the chronically ill person. It is described as a shift in paradigm from the profession dominated health care system where the citizens turn to the health care institutions when they decide they need it, or in special cases where they are so miserable that others decide they need acute attention by health professionals; to a new citizen centred paradigm where the citizens monitor themselves on vital parameters and share the measurements and information with health care professionals. To make this work the citizens must go through an inclusion process to join the Epital network. On a conceptual level the inclusion naturally require the citizen to be able to monitor his or her own health state in a way that also appear meaningful to health professionals who eventually can be involved to act. On an operational level, which for the time being only includes citizens with COPD, the citizens monitor four quantitative measures (FEV1, Heart Rate, O2 saturation, and temperature), and three qualitative parameters (breathing difficulties, cough, and secretion). On the basis of the self-monitoring the health professionals can triage the patients from the Response Coordination Centre (RCC). The RCC is staffed with a trained e-nurse who proactively can initiate treatments rather than allowing the conditions to exacerbate to a level, which requires more severe intervention. The e-nurse can ask the citizen to adjust their medication or refer to an e-physician who can initiate new medication from the medication toolkit located at the citizens home, or pay a visit to the citizen's home in severe cases.

The Epital care model consists of 6 steps:

*Independent living:* A citizen included as a member of the Epital who has COPD, are monitoring his/her conditions, but are functioning well, and in daily activities are not utilizing any health care services, but the Epital service keep an eye on their measurements and can intervene if necessary. These members are equipped with a medication box with a selection of drugs they are not taking, but could potentially need if symptoms exacerbate.

*RCC activated:* If the citizens experience an exacerbation that demands a professional response they call the RCC where an e-nurse can advice or refer to an e-physician who can e.g. tell the patient to take some Amoxicillin from their medication box. In this stage the citizen are fully mobile, and could in principle be located anywhere provided

they have their Epital hardware (Tablet computer, and devices to measure FEV1, Heart Rate, O2 saturation, and temperature) with them, and they have an Internet connection.

*Acute e-nurse visit to citizen's home:* In cases where symptoms gets worse or there is an aggravating anxiety the e-nurse from the call center can pay a visit to the citizen's home to initiate further diagnostic procedures. In this case the citizens will naturally have to be in their home.

*e-physician "outmit" the citizen:* When the nurses pay a visit to the citizen's home they also bring further medication that they can give to the citizens after consulting the e-physician. In this case the citizens are "outmitted" to treatment in their own home and in many cases a rather advanced treatment is performed in the citizen's home.

*Decentralized admission to a sub-acute bed:* In the case of further exacerbations the e-physician can admit the citizen to a sub-acute bed in a municipal institution, which is staffed 24 hours. Here it is possible to give oxygen and give more advanced treatment. This is the last decentralized step.

*Admission to a specialized hospital department:* Citizens who are demanding even more advanced treatment are admitted to a specialized respiratory department at a larger hospital.

#### 4. Results and discussion

The Epital is, as the concept refers to, an alternative or virtual hospital, wherein is present humans and technologies that appears in normal hospitals as well. There are doctors, nurses, patients and toolkits for measurement and treatment. However, the differences are the notion of distance in between humans and the proximity of technology, both for the caretaker and the care receiver. This means that the technology of monitoring and eventual treatment mediate trust, comfort and care. The proximity of technology also mediates the possibility of humans to get close very quickly, because the e-nurse from the RCC can reach the individual patient in very short time and produce professional care in situ. The e-nurse can also decide to activate the classical hospital by eventually hospitalizing the citizen.

In order for all of this to succeed certain preconditions are required, which has to do with the concept of inclusion. Inclusion is a classical virtue that we ask for in order to promote justice, equity and democracy. In order to be and feel like a citizen these frameworks are needed. Inclusion, in the Epital requires certain physical and technological capacities from the citizen (and the nurse). Empowerment, emancipation and enhancement through and with technology is hence dependent on these capacities, which of course create some issues concerning justice, equity and democracy, because it means that the weak and incapable is left exactly weak and incapable. At the same time the majority of citizens with COPD will experience empowerment, emancipation and enhancement through technological interaction, because she will feel in control and capable of managing her health in an interdependency with technology.

We are of the opinion that the life of COPD citizens are not independent, because in order to remain citizens with normal everyday lives they are intertwined with technology – they are *interdependent*. Empowerment, emancipation and enhancement are the results of this interdependency, wherein the e-nurse is also part and profit.

Inclusion should be broadened to widest extent possible in order to support and change the condition of the weak and incapable. In order for this to happen we have to consider how to engage the weak, how the weak can embody technology in different

ways than the stronger, how we with empathy can embrace and help the weak and finally how we enact the set up in order to create technological change. In other words how do we construct a scaffold that fits the weak in order to make way for inclusion?

We think that Ihde's notion on multistability could be of use. The citizen reads and understands the results of monitoring and reacts accordingly. This human-technology relationship is classified as a hermeneutic one, where the citizen reads the world (her-self) through technology. The weak and incapable could experience empowerment, and enhancement in relation to her condition through technology if we applied one of the other relations that Ihde has classified. In the alterity relation, humans change through technology. A man becomes a gunman through interaction with the gun. The COPD patient becomes a COPD citizen through interaction with the embodied tele-technology. This means that the role of the e-nurse also changes and there is a shift from the paradigm of telehealth to telecare, where the e-nurse is monitoring the citizen and through engagement and empathy (classical virtues of the nursing profession) is responsive to empowerment and enhancement of the citizen. Unfortunately, emancipation is not at stake in this case, because the citizen is dependent on the e-nurse, hence she is in control and managing the life of the COPD citizen.

The triple aim of better health, better care at lower cost is within reach by focusing on the values of empowerment, emancipation and enhancement, where tele-technology plays a crucial role because interdependent with humans hence enhancing the possibility of warm and meaningful relations between humans through and with technology.

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## References

- [1] C. Nøhr, S. Villumsen, S. Bernth Ahrenkiel, L. Hulbæk. Monitoring Telemedicine Implementation in Denmark. *Stud Health Technol Inform* 2015;216:497—500.
- [2] A. Davies, S. Newman. Evaluating telecare and telehealth interventions. WSDAN Brief Pap Kings Fund, London 2011.
- [3] D.M. Berwick, T.W. Nolan, J. Whittington. The triple aim: care, health, and cost. *Health Aff* 2008;27:759–69.
- [4] J. Pols. *Care at a distance: on the closeness of technology*. Amsterdam: Amsterdam University Press; 2012.
- [5] L. Botin. *The Technological Construction of the Self: Techno-Anthropological Readings and Reflections*. *Techne Res Philos Technol* 2015.
- [6] L. Botin, P. Bertelsen, C. Nøhr. *Techno-Anthropology in health Informatics. Methodologies for Improving Human-Technology Relations*. Amsterdam, Berlin, Tokyo, Washington DC: IOS Press; 2015.
- [7] L. Botin. The Question Concerning Narration of Self in Health Informatics. *Stud Health Technol Inform* 2015;218:153–8. doi:10.3233/978-1-61499-574-6-153.
- [8] D. Ihde. *Postphenomenology Essays in the Postmodern Context*. Chicago: Northwestern University Press; 1995.
- [9] L. Botin, P. Bertelsen, C. Nøhr. Challenges in Improving Health Care by Use of Health Informatics Technology. *Stud Health Technol Inform* 2015;215:3–13. doi:10.3233/978-1-61499-560-9-3.
- [10] B. Latour. *The Promises of Constructivism* Bruno Latour. Chas Technoscience Matrix Mater Indiana Univ Press Bloom 2003:26–7.
- [11] M. Heidegger. The question concerning technology. *Techno Values Essent Readings* 1954:99–113.

# Using Education Technology as a Proactive Approach to Healthy Ageing

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**Abstract.** Bone Health in the Park was created in Ireland and is an online health promotion education resource focussing on bone health, healthy ageing and falls prevention. The programme was designed by an Advanced Nurse Practitioner in collaboration with an Education Technologist and primarily uses storytelling to promote education specifically on bone health and falls risk prevention for health care professionals, clients, families and informal carers. This paper reports on core deliverables from this programme from 2010 to 2015, and provides insight into their development, in addition to details on its clinical effectiveness by using technology enhanced learning to underpin health promotion initiatives.

**Keywords.** older person, healthy ageing, technology enhanced learning, eHealth, advanced nurse practitioner, health promotion, falls, bone health

## 1. Introduction

Global trends indicate that the population is ageing, the fastest growing age group are those over 60 years and it is estimated that the figure of 688 million in 2006 is projected to grow to 2 billion by 2030 [1]. There is a need therefore to engage with the public and patient involvement agenda requiring health care professionals to become proactively involved in the direct delivery of health promotion. Evidence highlights that older people often have multiple medical problems, different disease patterns, slower response to treatment, increased requirements for social supports and need for specialist medical skills [2].

Falls and falls related injuries are a growing problem affecting quality of life of older people globally and are a leading cause of morbidity and mortality [3]. Recent studies have demonstrated that 30-40% of people over 65 years and 50-60% of people over 80 years fall each year [4]. According to the World Health Organisation up to 75% of injuries sustained by older people are attributed to falls [5]. The impact of these injuries can be devastating for the older adult who falls resulting in pain, distress, loss of confidence, loss of independence and mortality [6].

Early detection and early intervention has historically been found to improve healthcare outcomes and reduce dependency levels. With the establishment of Advanced Nurse Practitioner (ANP) roles in Ireland emphasis has been placed on

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providing focused health care interventions, relating to specific health and social care policy agendas, including health promotion and healthy ageing activities such as bone health and falls prevention awareness [7].

In Ireland falls contribute directly to the death of more than 250 older people each year. Financially the cost of falls on the economy is substantial and in Ireland projected to be over €2billion by 2030 with our ageing population [8]. However, the cost of loss of independence, acquired disability and loss of life is immeasurable.

ANP's through their professional role as clinical leaders, are ideally placed to engage with translational research relating to health promotion activity [7]. Delivery of such information to a wide audience was a challenge which was overcome through the use of technology – predominantly through on line learning and supportive information resources. This paper provides a summary overview of one ANP's journey which culminated in the development of the Forever Autumn Community of Practice (FACOP) - a core focus of which was to engage with translational research on bone health and fall risk prevention [9]. The FACOP naturally evolved from interest generated in the falls prevention programme developed and is made up of interdisciplinary healthcare professionals across many healthcare organisations with a shared passion in falls prevention and management. It provides an online platform underpinned by the eAuthoring software Articulate Presenter to share information, good practice stories and identify gaps in practice providing scope for new development [9]. FACOP provides examples of best evidence based practice using online learning technologies to illustrate and advance patient empowerment across different settings.

## 2. Methods

Using an action research approach the following activities were completed over a five year time frame. Key milestones in this translational work are included here and will be discussed in the presentation.

### Action Step One An Audit of Out Patient Service Users

An audit of an out patients service in North Dublin, Ireland to establish a base line for osteoporosis was completed in 2010. This audit completed on 1600 service users included a comprehensive bone health assessment, focused educational material for participants and a DXA scan. The audit indicated that two thirds of those screened had reduced bone density. Concurrently the Irish Osteoporosis Society indicated that there are over 300,000 people with osteoporosis [10]. A requirements analysis with key stakeholders suggested that content of an education resource should present information on bone health using a story telling approach and the material should use cases to demonstrate bone health throughout the life spectrum from childhood to old age.

### Action Step Two Development of Bone Health Promotion Resource

The ANP initiated the development of an education resource through engagement with an Educational Technologist. Using Articulate Presenter demonstration cases were devised and presented to the stakeholders for formative evaluation and editing to optimize impact and sustainability of the programme across different settings. Using differing elearning comic life a suite of resources to raise awareness of the importance



and relevance of bone health were created, and in 2011 Bone Health in the Park – I am not falling for you! was launched. This resource was revised in 2015 bringing the technologies up to date and rebranded eBonehealth and is available to view from [www.bonehealth.co](http://www.bonehealth.co) [11]

#### Action Step Three An Audit of Inpatient Residential Unit

In 2012 an audit of falls from a large Community Hospital in North Dublin, Ireland identified the number of falls that occurred in 2011 across the campus. 350 participants were included in this audit. The facility cares for adults over 65 years of age and has short stay beds and a residential unit. Data captured included - the location of falls, age of the person who fell, injuries from falls, time fall occurred, number of falls per person – single or recurrent and whether the fall was witnessed or unwitnessed. Key findings noted were that 75% of the falls occurred by the bedside, 98% were unwitnessed and 82% of those who fell were aged over 80 years.

#### Action Step Four Development of falls Prevention Programme

A falls prevention and management programme was developed and implemented in late 2012. An interdisciplinary collaborative approach was taken inclusive of staff members both clinical and non-clinical. The programme – Forever Autumn – incorporates a suite of core data elements as outlined in action step three above. Key falls reduction measures included surveillance of residents at risk through use of symbols, post fall reviews and comfort checks. Development of an online education resource to raise awareness of the risk of falls in an ageing population which also supported the implementation of the programme ensued [11].

#### Action Step Five Focus Group Discussion on Bone Health and Falls Risk

Based on the interest generated from the development of Forever Autumn Falls Programme by healthcare professionals working with older people, the programme has been rolled out in 16 sites across Ireland and focus groups were held with key stakeholders. Findings from discussions indicated that an online platform for supporting older person services on bone health and falls prevention in Ireland was required. A Community of Practice (COP) advocated by WHO as a strategic platform for communication was considered the most appropriate vehicle to provide support to advance the clinical effectiveness of the programme [12]. In January 2014, a Community of Practice entitled Forever Autumn Community of Practice (FACOP) was established and is hosted online through a web site ([www.foreverautumn.co](http://www.foreverautumn.co)). FACOP currently has 64 members from across Ireland from differing healthcare backgrounds incorporating medical, nursing, physiotherapy, occupational therapy, dietetics, pharmacy and radiography with a common interest in bone health and falls prevention across the spectrum of care of older adults [9]. Together the FACOP has identified areas that require development and education opportunities particularly in the area of intellectual disabilities.

### **3. Results**

By taking a pragmatic approach to the design and delivery of online resources using differing Web 2.0 tools made it easily accessible with open access for all – staff,

residents, patients, families and the general population. This was achieved by providing a suite of tailor made small learning resources for use on various platforms. For enhanced ease of access the resources could also be used with mobile devices.

Bone health education resource are in use on a daily basis to inform inpatients and outpatients of the importance of bone health throughout life at the point of contact with healthcare staff. The online resource has been adopted for use by many agencies – schools, colleges, day centres and community groups. It has been endorsed by the Irish Osteoporosis Society and is accessible from their website [10]. A revision of the resource with more up to date technologies was launched in September 2015 at a National Falls Prevention and Bone Health Conference hosted by the FACOP. The programme was developed using the e-authoring tools (Articulate Presenter) supportive material was created using iBooks Author and a Facebook page eBoneHealth complements the programme, YouTube is used to host accompanying videos. All resources are free to access from the web site [www.bonehealth.co](http://www.bonehealth.co) [11] and [www.happybones.ie](http://www.happybones.ie) [13] (this site hosts the educational resources for service users with an intellectual disability, their families and carers and healthcare professionals).

A comparison of falls data in the facility from 2011 and 2013 was undertaken. The results whilst not generalisable demonstrate a reduction in falls by 33% since the implementation of the programme. Key features of the programme such as the introduction of symbols to identify residents/patients at increased risk of falling provide a new intervention in raising awareness among all clinical and non clinical staff. An intervention in relation to fall risk identification was devised and implemented. Data reports on the interventions are now available and impacting on the incidence of falls with residents in the organisation. This data identifies the number of interventions carried out on each older resident who are at increased risk of having a fall by looking in on them as a result of the symbol outside their door. The collection of this data is evidence of the work that staff engage in to reduce the risk of potential falls on a day to day basis.

From the development of the online FACOP in 2014 there is now a structure providing support, guidance and continued education in bone health, falls prevention and management across the care spectrum for older adults – acute hospital, community, intellectual disabilities, palliative care and residential care [9]. Through the FACOP it was established that there were no education resources for Intellectual Disability (ID) population around falls prevention and bone health thus using a translational action research approach an opportunity was seized to collaborate with an ID community and service users to develop Happy Bones [www.happybones.ie](http://www.happybones.ie) in 2015 [13].

To date over 43,000 people have visited [www.bonehealth.co](http://www.bonehealth.co) in the last 3 years with over 50% of these returning to the site on subsequent occasions, 12,000 visits to the FACOP web site ([www.foreverautumn.co](http://www.foreverautumn.co)) have been recorded and 8,000 to [www.happybones.ie](http://www.happybones.ie). The audience is international with the majority of coming from Ireland, UK, USA, Canada, Australia and Europe.

#### **4. Discussion**

Healthcare of a global ageing population is very diverse and in ever changing societies' access to information is paramount for the primary prevention of illness and promotion of wellbeing. Embracing emerging technologies provides scope for education to the general population, healthcare staff, patients and residents that are easily accessible on key areas of health. This has the potential to impact on population health in areas such

as osteoporosis, falls and fractures and also to reduce dependency and illness in later life. Translational research such as the Forever Autumn COP demonstrates initial evidence of clinical effectiveness from one area in North Dublin, Ireland. The focus of this paper has been to demonstrate the effectiveness of an online education resource and platform developed for bone health and falls risk reduction. This approach has also been replicated in another online education resource - implementing and supporting holistic continence awareness (ISHCA) [www.ishca.net](http://www.ishca.net) [14].

As future healthcare provision shifts from a hospital focus to a community/primary care focus and a model that promotes disease prevention, health promotion and healthy ageing there is scope for similar online programmes to be developed. With the evolving nature of nursing practice and development of new roles – ANP, to facilitate that move, education resources such as those presented will become essential tools and resources for the empowerment of people to take ownership and responsibility for their health and wellbeing. Technology is evolving too and as demonstrated has the potential through differing platforms to facilitate learning in a variety of settings providing key information at the chosen point of care.

## References

- [1] World Health Organisation (WHO) Ageing and Life Course 2014
- [2] P. Srinivas, Giants of Geriatrics - Current Issues and Challenges. 1<sup>st</sup> world congress on healthy ageing, Malaysia 2012 Online Access [http://www.healthyageingcongress.com/slides/19/S5\\_PSrinivas.pdf](http://www.healthyageingcongress.com/slides/19/S5_PSrinivas.pdf) Accessed 15th September 2015
- [3] B. Stubbs, S. Brefka and M.D. Denkinger. What works to prevent falls in older adults dwelling in long term care facilities and hospitals? An umbrella review of meta-analyses of randomized controlled trials. *Physical Therapy* 95 8 (2015) 1-21 <http://ptjournal.apta.org/> Online Accessed 14<sup>th</sup> May 2105
- [4] S. Robinovitch, F. Feldman, Y. Yang, R. Schonnop, P. Ming Lueng,, T. Sarraf, J. Sims-Gould, M. Loughin, Video capture of the circumstances of falls in elderly people residing in long-term care: an observational study. 2012 <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3540102/> Accessed 14<sup>th</sup> May 2105
- [5] World Health Organisation. WHO Global Report on Falls Prevention in Older Age. 2007 Accessed April 2015
- [6] National Institute of Clinical Effectiveness Clinical Guideline [CG161] Falls: assessment and prevention of falls in older people. 2013 online <https://www.nice.org.uk/guidance/cg161>
- [7] Nursing and Midwifery Board of Ireland Framework for Development of Advanced Nurse Practitioner. 2008
- [8] Health Services Executive , Department of Health and Children and National Council of Aging and Older People Strategy to Prevent Falls and Fractures in Irelands Ageing population , Ireland, 2008.
- [9] D. Rodger and A. Spencer. Forever Autumn Community of Practice 2014 Online [www.foreverautumn.co](http://www.foreverautumn.co)
- [10] Irish Osteoporosis Society 2011 Online [www.irishosteoporosis.ie](http://www.irishosteoporosis.ie)
- [11] D. Rodger and A. Spencer Bone Health in the Park 2011 Online [www.bonehealth.co](http://www.bonehealth.co)
- [12] World Health Organisation Nursing and Midwifery Services Strategic Direction 2011-2015 Report 2011 Online [http://www.who.int/hrh/nursing\\_midwifery/en/](http://www.who.int/hrh/nursing_midwifery/en/)
- [13] D. Rodger and A. Spencer. Happy Bones 2015 Online [www.happybones.ie](http://www.happybones.ie)
- [14] F. Dunne, B. Thomas, W. Chukwureh, J. Celi Jose and A. Spencer. Implementing and Supporting Holistic Continence Awareness 2014 Online [www.ishca.net](http://www.ishca.net)

# Using the Virtual Reality World of Second Life to Promote Patient Engagement

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**Abstract.** Patients have typically been passive participants in their own healthcare. However, with a change in philosophy towards outcomes driven care, it has become necessary to make sure that patients mutually set their healthcare goals with their providers. Both eHealth and mobile health applications have required patient participation in ways never before valued. The virtual reality world of Second Life offers one eHealth solution that requires computer literate patients to participate via avatars in synchronous healthcare visits and support groups, as well as explore online resources asynchronously. This paper describes the development of a Second Life environment that served as a platform for nurse practitioner driven care supplemented by a patient portal as well as the institutional electronic health record. In addition, the use of Second Life is described as an active exercise to expose students in a Consumer Health course to support groups and resources available to actively engage patients.

**Keywords.** Patient participation, telemedicine, continuity of patient care, virtual systems, consumer participation

## 1. Introduction

Patient engagement is a necessary component in today's healthcare where patient centered care is the expectation. In an era of shortened length of stay, and an emphasis on evidence and outcomes, the participation of patients in the provision of their own care has become essential. Spruce argues that the inclusion of patients and their families in the planning and execution of their care is one way to help contribute to increased patient safety [1]. Furthermore, if there are issues of miscommunication, clinicians have the opportunity to engage patients in the conversation and invite them into the process improvement cycle.

The virtual reality world of Second Life (SL, secondlife.com) provides an environment that allows users from around the world to "log on" to this web-based platform. Second Life is a 3D virtual world, created by its residents. The world is driven by the interactions of real-world individuals and their avatars. Thus, for every avatar one encounters in SL, there is a live person somewhere in the world who is dictating that avatar's actions, emotions, words, dress, etc. SL provides the place for interactions with people, businesses, and organizations in a 3D environment that requires only an Internet connection and working computer rather than extensive travel

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arrangements. This environment thus has the capability of expanding global telehealth possibilities.

## 2. Background

The Second Life environment was built as part of prior funded grants from the U.S. Department of Health and Human Services Administration (Grants #D80HP11271 and #U1KHP1296). The purposes of these grants were to provide nursing faculty the opportunity to manage clinical simulations while advancing in their own competency and proficiency levels of simulation management while in the Second Life virtual world. Synchronous sessions were provided by master teachers, after an orientation to SL had been completed by the users. These grant activities have been reported in prior international informatics conferences [2,3].

Second Life is organized in such a way that developers lease island space, but have to develop the buildings and/or content to be placed on their islands. The developed space noted above consisted of a conference center, an outpatient facility (replicated from the Vanderbilt Eskin Diabetes Center), an acute care facility (replicated from the Vanderbilt Acute Care Tower), a nursing home environment, and several homes. The island was named “NurSim4U.”

Most faculty required orientation activities to the SL platform. One of the negative implications of using the SL platform is that most users start their experience on “Orientation Island.” Many times there are other avatars on the Orientation Island who are predators and are there only to harass new users either verbally or through the use of nudity or sexual innuendos. It was possible to bypass this island by providing participants with the specific island location for the intended education session via a SLURL (Second Life Universal Resource Locator). In doing so, however, participants did not learn how to manipulate their avatars. As a result, orientation activities specific to this project were required. Video sessions and one-on-one orientation sessions ensured that all participants reached pre-determined competency levels in SL. An orientation course was developed that was elevated from the island itself so that no additional geographic space would be required. Figures 1 and 2 illustrate both the conference center (initial entrance to the NurSim4U island) and the orientation course.



Figure 1. Conference Center.

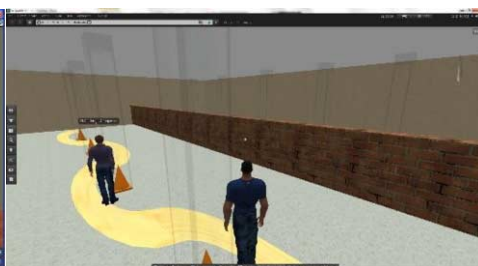


Figure 2. Orientation Course

The developed property on the leased island in Second Life can be considered as a backdrop for a play. Nothing is taking place there until avatars appear and interact,

whether spontaneously or in a scripted fashion. For grant activities, there were scripted simulations that took place after the users were oriented.

It was soon determined that this developed environment could be used for a multitude of purposes. One was for the provision of patient care in the outpatient environment. Another was for the involvement of informatics students.

### **3. Patient Engagement Examples**

Results of extending nurse practitioner care using the virtual reality world of Second Life was presented during NI 2012 [4]. However, the aspect of patient engagement was not fully explored during that presentation. In addition, the interaction in Second Life opened up the possibilities of how Second Life could be used for consumer health. As a result, one of the faculty members on the original grant, Dr. Trangenstein, incorporated aspects of Second Life involvement in order to demonstrate its potential engagement use with patients.

#### *3.1 Nurse Practitioner Example*

Long term management of adult patients with diabetes requires maintenance of glycemic control. One of the barriers to acceptable control is access to healthcare providers. While much has been written about the educational applications in SL, few attempts have been made to deliver actual patient care. Watson et. al. present a framework that demonstrates how applications within SL can be constructed to meet the needs of patients with diabetes, allowing them to attend group visits, learn more about lifestyle changes, and foster a sense of support and emotional well-being [5]. Furthermore, they describe the importance of dealing with concerns related to privacy and liability as pre-requisites before engaging patients and providers into using this new approach.

When this pilot project took place with nurse practitioners and patients, the best way to ensure privacy was to replicate the patient care room, have the NP press the privacy button, and then suspend the room around 200 meters above the ground. This was well out of audio eavesdropping range from the ground, as well as far enough away from the orientation course so that users there could not hear the private conversation. Once the visit was completed, the privacy "off" button teleported the patient and clinician back down to the original building in order to complete any post visit activities and exit the facility. Admittance to the island was restricted by accounts to care givers, identified patients, and technical support personnel. The general public were not able to access the island.

Patients were authenticated by logging into their patient portal and registering using a virtual screen in the SL lobby of the Eskin Diabetes Center. Patients were then met by his/her healthcare provider and were accompanied back to her office. The main purpose of the visit was for mutual goal setting to improve glycemic control. A questionnaire was completed by the patient prior to the visit, so this data could be used during the conversation. For example, one patient wanted to work on improving her exercise routine and diet; another was concerned about the high cost of medications; while another just wanted to decrease his A1c. Using this self-assessment questionnaire provided structure to the visit in such a way that the nurse practitioners were able to

capitalize on that time to meet the needs of the patient. Figure 3 illustrates the office environment, which included an ocean view not typically seen by the participants.



**Figure 3.** Office Environment for Clinical Visit.

### *3.2 Consumer Healthcare Informatics Example*

The Vanderbilt University School of Nursing (VUSN) has an informatics specialty that is part of the Master's in Nursing Science program. One of the unique features of this program since its inception is the inclusion of a two credit hour course in Consumer Healthcare Informatics. Taught by the Specialty Director, Dr. Patricia Trangenstein, this course is also a popular choice for the Doctorate in Nursing Practice (DNP) students to take as an elective, regardless of their focus area.

One aspect of the course is to expose the students to technology applications that empower and inform consumers. After orienting the students to SL (using the Orientation Course described above), one of the assignments required students to explore a number of patient engagement possibilities in SL. Those virtual activities were followed by an actual synchronous class session held in SL. The sites listed below represent a range of immersion from merely providing education via text bulletin boards to experiencing the sights and sounds of a combat event in a village. Students were directed to choose the following islands in SL:

- Avatar Fitness Club (Research indicated that exercising your avatar regularly may help you to improve your own physical fitness. Join the club and try the cycles, treadmills, yoga, climbing wall, swimming pool, aerobics, lounge with ping pong.)

- National Health Service (The UK's publicly-funded healthcare system, known as the National Health Service, also has a home in SL. This region offers visitors a tour that represents the future of medical care throughout the nation.)
- Virtual PTSD Experience (This is an immersive, interactive learning experience designed to educate visitors about combat-related post-traumatic stress disorder (PTSD).)
- Reality Check Café (This 3D learning environment illustrates the relationship between calorie intake and physical activity, and the importance of making smart choices while dining out.)
- Tox Town at Virtual NLM (environmental health information from the National Library of Medicine)
- Virtual Hallucinations (UC Davis sponsored schizophrenia education experience that allows users to see what those with paranoid schizophrenia might see in order to better understand the symptoms of this disease.)

#### 4. Discussion and Conclusions

Feedback results from both examples provide evidence that the SL environment can be an alternative to face-to-face patient engagement activities. Both the patients and the nurse practitioners involved in the care scenario thought that this was a viable alternative to driving in for appointments, and appreciated the pre-visit questionnaire that helped to focus in on their healthcare needs for the visit. They did, however, acknowledge that this type of visit required technology literacy to be possible, and thought the orientation activities were excellent. While the second example included students, they provided positive course evaluation statements in support of being able to experience patient focused SL activities that expanded their ideas about how to better engage patients. Both examples describe the potential of the virtual reality world of SL in providing viable alternatives to our patients to become better involved in their own care regimens.

#### References

- [1] L. Spruce. Back to basics: patient and family engagement. *AORN J.* 2015; 102(1):34-37.
- [2] E. Weiner, R. McNew, P. Trangenstein, J. Gordon. Using the virtual reality world of Second Life to teach nursing faculty simulation management. In Safran C, Marin H, Reti, S (Eds.). *Proceedings from MEDINFO 2010: Partnerships for Effective eHealth Solutions, 13<sup>th</sup> World Congress on Medical and Health Informatics.* 2010: 615-619. doi:10.3233/978-1-60750-588-4-615
- [3] E. Weiner, D. Abshire, C. Beals, C. Benson, C. Catlett, J. Gordon, R. McNew, S. Miller, S. Prevost, G. Tipton, P. Trangenstein. Faculty simulation management using Second Life. *Proceedings of NI2012: 11<sup>th</sup> International Congress on Nursing Informatics, Montreal.* 2012:768.
- [4] E. Weiner, T. Elasy, N. Lorenzi, R. McNew, L. Shackleford, K. Wolff, S. Martin, C. Benson. Extending nurse practitioner care using the virtual reality world of Second Life. *Proceedings of NI2012: 11<sup>th</sup> International Congress on Nursing Informatics, Montreal.* 2012:437-441.
- [5] A. J. Watson, R. W. Grant, H. Bellow, D. B. Hoch. Brave new worlds: How virtual environments can augment traditional care in the management of diabetes. *J Diabetes Sci Technol* 2008; 2(4):697-702.



# The Development Process of eHealth Strategy for Nurses in Finland

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**Abstract** Growing use of information and communication technology (ICT) demands have caused a need for nursing to strengthen the knowledge, skills and competences related to ICT in health (eHealth) and define its versatile roles. The Finnish Nurses Association (FNA) named a group of eHealth experts from various professional fields that are closely connected to nursing e.g. nursing practice, higher education, nursing research and administration. The main purpose was to describe nurses' contribution to the national strategy concerning eHealth development and implementation in health and social care. The group searched for answers, discussed strategic issues, wrote drafts, and sent texts for open commentary circles. The chosen themes of the eHealth strategies deal with the role of the client, nursing practice, ethical aspects education and eHealth competences, nursing leadership, knowledge management and research and development. The article describes the strategic work and the structure of eHealth strategy of nurses in Finland.

**Keywords.** eHealth, strategy, nursing, competencies, education, health informatics

## 1. Introduction

The development of the concept and content for the ubiquitous term eHealth was launched in the early 2000's in Europe by the European Commission in order to guide various countries to build up roadmaps and strategies to adopt and implement eHealth through action plans. [1, 2, 3] Parallel to EU actions the World Health Organization stressed the importance to focus on eHealth initiatives across the world. [4] Both these coalitions highlighted the importance of goals to increase the quality of care and efficiency, reduce cost, and enable new modes of care and to empower citizens and communities with the implementation of eHealth internationally. In this article client refers to patients also.

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eHealth as a concept emerged in literature at the beginning of 2000 when Eysenbach published his argumentative paper: What is eHealth? This paper stressed the significance of understanding “e” not only as an abbreviation of electronic. eHealth refers also to efficiency, enhancing quality of care, evidence based, empowerment, education, enabling, extending, ethics and equity [5]. All these elements are common and well known in nursing.

The International Council of Nurses’ (ICN) has adopted the definition by the WHO to be used in nursing: eHealth is the use of information and communication technologies (ICT) for health. This has implications to treating patients, conducting research, educating the health workforce, tracking diseases and monitoring public health. [6.] The ICN has established the eHealth Programme to support eHealth adoption among its members. The goals are to support eHealth practice, to be recognized as an authority on eHealth, and to be positioned centrally in the eHealth Community. With policies and strategies applicable throughout the ICN pillars and programmes, eHealth Programme seeks to advance nurses’ knowledge of and involvement in eHealth worldwide. All this is empowered by global collaboration through various networks as Telenursing Network, Connecting Nurses and advancing the use of International Classification for Nursing Practice (ICNP). The eHealth Programme especially aims to provide tools and techniques to meet future healthcare needs, to promote best eHealth practices and policies, to collaborate with stakeholders, and to represent the voice of nurses. [7.] Following international and national initiatives many nursing associations have prepared national eHealth strategies focusing on the topic from a nurses’ point of view (E.g. Iceland, Norway, Sweden) [8, 9, 10]. This paper describes the process of strategy work and the chosen structure of the national eHealth strategy for nurses in Finland. Furthermore the paper aims to start discussion about the importance of international co-operation in strategic eHealth work.

## 2. Methods

This development project can be seen as a multiprofessional triangulation. Ten experts representing eHealth and health informatics from different parts of Finland and from various nursing contexts, universities (n=3), universities of applied sciences (UAS) (n=2), university hospitals (n=2), central hospital (n=1) and health care centres (n=2) were asked to join the strategy development.

**In the first phase** the expert group had group discussions about the need of strategy for nurses to be able to develop and use eHealth services, what kind of participation citizens and professionals will share in now and in future in health and welfare services. The larger group was divided into sub-groups based on experts’ interests and the work was time-scheduled. Qualitative analysis was used in the first part of knowledge creating. **In the second phase** an integrative review was accomplished in order to clarify the research based from both national and international norms and declarations. **In the third phase** the expert group had joint virtual writing hours. The collaboration with the FNA and joint writing as a group method helped the experts to do abductive thinking of what kind of strategy is best for the nursing association. The experts used various information sources and formed a future-oriented and realistic base of the strategy. **The fourth phase** of knowledge creation was an open web based questionnaire to all members of the FNA and other specialists, such as association’s professionals and Board of Directors, to comment on the strategy

electronically (n =13). The e-questionnaire had qualitative questions covering every part of the strategy. **The final strategy** was revised based on the feedback. The process of creating the eHealth strategy for nurses has taken one year. After intense group working the content of the strategy is presented with the mission and vision statements as well as a short description of the strategy themes.

### 3. Results

eHealth strategy for nurses includes six themes 1) client participation, 2) nurse's daily work, 3) ethical aspects, 4) eHealth competency requirements, 5) nursing management and 6) knowledge management, research and development. In publishing on the web every theme has three goals and five actions to achieve the objectives of the theme in question.

- **The mission:** Nurses develop and use e-Health in client' nursing care, rehabilitation, alleviating suffering, promoting health and increasing well-being of citizens.
- **The vision:** Nurses are courageous reformers of health care practices, who have the expertise to use and develop e-health utilities with multidisciplinary cooperation with the client and other stakeholders.

**Client participation.** Electronic services are an integral part of everyday life. Citizens' participation is strengthened by means of national archives of health data and different assessment tools of well-being. Citizens are increasingly using email and social media, and they also have access to comprehensive self-analysis tools that will make them more active partners during treatment. Data networks allow the nurse to be actively present in citizen's lives 24 hours a day, 7 days per week. The nurse supports and guides citizens to take responsibilities in their own functional capacity, both in care units and outside them.

**Nurses' daily work.** eHealth services are increasingly a part of every nurse's daily work. The nurse's role is to search for information and understand the importance of health information both for a patient's self-care and in nursing care. The nurse acts as the clients' partner, offers them appropriate eHealth services and encourages and supports the use of eHealth services. Nurses exploit in nursing the data that citizens and their families produce themselves and which is available in different information systems and also in national archiving services. Using social media and other communication technology tools in nursing requires that the nurse understands the differences between private and professional roles.

**Ethical aspects.** In social and health care, technology is used to support the citizens' quality of life, dignity, autonomy, and participation in human care. As the eHealth services become more common, it is important to recognize and ensure that every citizen has an equal right to utilize them. However, the quality of services, social interaction, or human aspects of care should not be compromised. It cannot be expected that every citizen is computer-literate, thus the diverse services need to be ensured. Citizens need to have information about the benefits, possibilities and risks in eHealth services and use of technology. In all situations nurses who provide in eHealth services, follow general ethical guidelines.

**Nursing management.** Nursing leaders are in a key position in developing eHealth services on an organisational and national level. Strong leadership and vision are needed to develop client-centred eHealth processes that take the individual needs

into account and to enhance the citizens' participation together with flexible working methods for the professionals. Nursing leaders need to ensure that the professionals have enough resources and the required competence so that their knowledge, skills or attitudes do not hinder the citizens' eHealth services. Knowledge-based management and active utilisation of data warehouses need to be at the core of leadership skills with the aim to ensure quality and safe care. Availability and visibility of nursing-sensitive outcomes strengthen the nurses' commitment and satisfaction.

**eHealth competency requirements.** There are three dimensions in the European Qualifications Framework EQF description of learning outcomes: knowledge, skills and competence [11]. Nursing education includes five descriptions of learning areas: learning, ethicalness, working skills, innovations, and internationalism. Generation of eHealth services is connected to all those areas. Nurses need to responsibly use ICT in their daily work effectively. They must have basic skills for technology use, information literacy, and knowledge management. Depending on the level of education, work assignments, and length and experience of work, they work in health and social care with different levels of expertise. Nurses need to have resources and a willingness to use eHealth services and the tools to support good clients care and citizens' health and welfare.

**Research and development.** The health care sector is knowledge intensive. Today eHealth is regarded as a possibility to make health care more visible, more accessible and equal for citizens. The 'Big Data' concept is connected to describe an increasing amount of data that is gathered in health care [12]. More and more data is being generated by citizens and processed by computers e.g. using wearable wireless sensors and smartphones to collect person's own health data. Using data elements reliably will allow for information to be gathered one time and reused for multiple purposes e.g. development of both nursing practice improvements and population health issues. There is a need for developing reliable and fast methodology and how to utilise large amounts of data for purposes mentioned earlier.

#### 4. Discussion

A strategy should describe and define the mission and vision of the nurse association as well as objectives and means of how to achieve them. In this strategy development our far-reaching vision is, healthier citizens and a better and more effective care to patients through ethically and technically sound modern nursing care. The development process among our expert group was rewarding with various discussions and arguments. The strategical papers from the Ministry of Social Affairs and Health as well as all EU publications guided us right from the beginning. Every theme has its own perspective to nurses' work and citizen's participation in eHealth services. The collaboration with the FNA was essential and the change of opinions enhanced strategy building. Furthermore the layout of the strategy should serve as a virtual publishing style. We decided that each group should only define three objectives and five actions for each theme of the strategy. This may have led to trivial and restricted expressions on the reality of nursing care. However our aim is also to raise international discussion related to eHealth strategies in the nursing field. The Finnish Nursing Association represents most of the nurses and has effective ways to implement this strategy via its regional and local networks, many-sided publications and via launching eHealth projects.

In Finland there is an agreement on the minimum requirements of nursing excellence. All nurse educators need to offer students the possibility to learn eHealth and health informatics knowledge, skills and competence. However, the level of education varies in practice. It is therefore important to pay attention to the educators' skills, to enable students to achieve the desired level of competence. Nurses also have the possibility to show their expertise and apply for a Nursing Informatics Certificate from the FNA. The strategy also challenges nurses to be more active in multidisciplinary teams. Especially there is a need to participate in information system development and implementation projects. Nurses have a lot of knowledge and skills to share for the development of better tools and applications in nursing practice.

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## References

- [1] eEurope 2002. Available: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:l24226a>
- [2] Commission of the European Communities. 2004. e-Health – making healthcare better for European citizens: An action plan for a European e-Health Area. {SEC(2004)539} Available: <http://eur-lex.europa.eu/legal-content/FI/TXT/PDF/?uri=CELEX:52004DC0356&from=EN>
- [3] Richardson R. 2002. eHealth for Europe. *eurohealth*. 2002 Spring; 8(2) Available: <http://www.lse.ac.uk/LSEHealthAndSocialCare/pdf/eurohealth/vol8no2.pdf>
- [4] eHealth. World Health Organization. Available: <http://www.who.int/topics/ehealth/en/>
- [5] Eysenbach G. What is e-health? *J Med Internet Res*. 2001 Apr-Jun; 3(2): e20. Published online 2001 Jun 18. doi: 10.2196/jmir.3.2.e20 Available: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1761894>
- [6] ICN. International Council of Nurses. eHealth. Available: <http://www.icn.ch/what-we-do/ehealth>
- [7] ICN. International Council of Nurses. eHealth Bulletin. June 2011. Available: [http://www.icn.ch/images/stories/documents/news/bulletins/eHealth/ehealth\\_bulletin\\_june\\_2011.pdf](http://www.icn.ch/images/stories/documents/news/bulletins/eHealth/ehealth_bulletin_june_2011.pdf)
- [8] Nursing Knowledge for Your Benefit. Policy of the Icelandic Nurses' Association on Nursing and Health Care 2011-2020. Available: <http://www.hjukrun.is/library/Skrar/Fagsvid/NursingPolicy2011%20loka.pdf>
- [9] NNO's (Norwegian Nurses Organisation) Strategy -the nursing profession in development through ehealth. 2013-2016. DM 312105. Available: <http://www.acendio.net/join-acendio/ehealth-strategy-documents/>
- [10] Swedish Society of Nursing. eHealth a Strategy for Nurses. 2012. Available: <http://www.swenurse.se/in-english/publications-in-english/e-health-a-strategy-for-nurses>
- [11] Descriptors defining levels in the European Qualifications Framework (EQF). 2015. Available: <https://ec.europa.eu/ploteus/en/content/descriptors-page>
- [12] J. Sensmeier. Big data and the future of nursing knowledge. *Nursing Management* 46 4 (2015), 22 – 27 Available: <http://nursingcenter.com/cearticle?an=00006247-201504000-00005>

# A Study on the Effectiveness of XMOOC Teaching in Improving Practical Nursing Teaching

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**Abstract.** This article studies the effectiveness of xMOOC teaching in the area of nursing education, by making a comparison between two study groups. Through observation, academic tests and interview, this study finds out that the application of xMOOC to teaching scheme practice could effectively increase teaching ability of teachers, learning ability of students and their test scores which had positive significance in improving clinical nursing teaching quality..

**Keywords.** xMOOC, flipped classroom, traditional teaching mode, ability training, teaching quality

Teaching quality control is the important content to strengthen the construction of clinical nursing teachers, and to standardize the clinical nursing teaching management. Base on past experience with clinical nursing in TCM and western medicine, this research is done with XMOOC mode. It aims to find a solution to improve clinical nursing teaching. It will help students to study more efficiently and have a "studying in teaching, teaching in studying" phenomenon[1].

## 1. Target group and method

### 1.1 target group

Choosing 100 in house second stage nursing students who have passed in house TCM surgery theory training by convenient sampling method. Experiment group and control group were chosen randomly. Each group consists of 50 people. There are 1 male and 49 female students in experiment group. There are 3 male and 47 female students in control group. From educational leve, there are 4 bachelor diploma and 46 with Junior College in experiment group while in control group there are 2 bachelor diploma and 8 Junior College. The average age in experiment group is  $21.3 \pm 0.9$  years old and  $21 \pm 1.2$

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years old in control group. The grade in TCM surgery theory is  $67.1 \pm 5.3$  in experiment group and  $65.8 \pm 4.2$  in control group. According to statistical analysis both groups haven't any significant difference in age, gender, education level and TCM basic knowledge, so all these elements are included as a whole.

## 1.2 Method

### 1.2.1 Preparation:

Firstly, research progress is checked and approved by our ethics committee. Secondly, in terms of teachers' preparation: Draw up 'teacher training hand book'. Produce 10-minute-videos on each topic with lecture content, key notes and questions, and encourage discussion; while Control group will receive traditional teaching. Thirdly, in terms of student preparation: Familiarize with research background, and cooperation method. Guarantee a proactive attitude and remain honesty in tests. At last, Develop information platforms: establishing online discussion group such as QQ and Wechat.

### 1.2.2 Implementation method.

Experiment group: using XMOOC teaching mode. It's divided into four parts. Part one: students are asked to study 'study guide' and task list, download videos, research on the content that is difficult to master through the Internet. Problems will be collected and noted. Part two: joining face to face group discussion. Choosing students who are good at study and organizing as group leader to summarize the opinions and solutions coming up from all the group members. Teachers are able to expand students' view and lead them achieving ultimate goal. Part three: everyone is to have exams to test learning effectiveness. Part four: completing review table and ability test table. Students and teachers will make conclusions together.

Control group: preview the lessons by self-learning, and have traditional study in classrooms. Both groups will study for 8 weeks with 2 lessons per week.

Curriculum: While prevention is the key to Vascular disease[2], it is not the primary content of nursing studies. As a result students usually have insufficient knowledge about this particular disease. The designed curriculum in our experiment is divided into 8 parts. mTeacher demonstration and presentation are blended into nursing instructions.

### 1.2.3 Test criteria.

#### (1) Teaching and study appraisal table.

Using teaching and study appraisal table prepared by Wang Aiping et[3] from the first hospital attached to China medical university. Every student will complete one form after finishing the whole course to reflect their own achievement.

#### (2) Theory exam.

After the course, both experiment group and control group will have theory tests. Multiple choice questions and short answer questions are more difficult than blank filling questions and single choice questions. They work better to reflect level of understanding.

1.3 Statistical treatment

Measurement data expresses as  $\bar{x} \pm S$ , comparison between two groups by using t to test, comparison between couples of groups by using single factor to analysis, classify data by using square to test, applying SPSS18.0 statistic software to analysis, statistically significant with  $P < 0.05$  or  $P < 0.01$  for difference.

2. Results

2.1 Two groups of nursing students' evaluation of teaching

This scale is completed by students and reflects the evaluation of their own gains after teaching. Table 1 shows the result.

Table 1. Comparison of teaching evaluation scale(n=50, student)

	Recognize area				Emotional area				Spirit area			
	Absolutely agree	agree	No idea	Don't agree	Absolutely agree	agree	No idea	Don't agree	Absolutely agree	agree	No idea	Don't agree
Controlgroup	29(58.0)	6(12.0)	14(28.0)	1(2.0)	31(62.0)	11(22.0)	5(10.0)	3(6.0)	26(52.0)	10(20.0)	13(26.0)	1(2.0)
Experiment group	41(82.0)	7(14.0)	2(4.0)	0	45(90.0)	1(2.0)	4(8.0)	0	39(78.0)	9(18.0)	2(4.0)	0
<i>n</i>	6.857				10.746				7.429			

2.2 Evaluation of two groups of nursing students in the theory examination

Compared to the test results before teaching, the experimental group and the control group can significantly improve the students' theoretical test of multiple-choice questions, short answer questions and total score ( $P < 0.01$ ), and the experimental group and control group of multiple-choice questions, short answer questions and total score differences with statistical significance ( $P < 0.01$ ). See Table 2

Table 2. Compare the performance of student course score( $\bar{X} \pm S$ , n=50, score)

		Fill in the blank	Single choice	Multiple choice	Short answer	Titalscore
Control group	before	26.0±3.3	25.4±4.0	6.1±3.3	8.4±2.2	67.1±5.3
	after	24.6±2.9	27.1±2.1	11.2±4.0	12.0±1.3	75.6±4.9
	t	-9.783	-8.045	-10.359	-9.750	-11.471
Experiment group	before	24.9±3.4	25.1±2.9	9.1±5.8	7.0±3.7	65.8±4.2
	after	25.8±1.9a	24.7±3.6a	18.2±1.7b	17.9±4.9b	86.9±7.4b
	t	-8.650	-8.153	-11.870	-12.365	-11.694

P<0.01; a:p<0.05, compared with control group; b:p<0.01,compared with control group  
Changes may occur in the table

3. Discussion

3.1 Design teaching programs according to the teaching requirement and students' situation.

As Dong Huijuan[4] has pointed out in her papers on TCM nursing pedagogics, on the one hand, there lies a big difference in nursing theories while a lack of qualified teachers is becoming a common phenomenon. On the other hand, in order to facilitate



the understanding of Chinese medical science, teacher can only “westernization” teaching content[5], which also affected the essence of Chinese medical science and the enthusiasm of learning Chinese medical by nurse. Rao Xiaoming[6]and Jia Zhenzhen[7] have concluded that the teaching methods of TCM nursing should be diversified.

Through investigation, Using modern information technologies can not only provides a communication between teachers and students, but also helps teachers to monitor students’ learning according to the feedback data, in the discussion conference class, teachers can provide help, guidance, which has played a positive role.

MOOC itself is not the guarantee for effective teaching, as a teacher, after ensuring the quality and retaining compulsory content of the class, one must have the courage to try different teaching modes, actively looking for suitable ideas for course, for different students’ teaching mode, the quality of clinical nursing teaching can continue to be improved.

### *3.2 Influence of individual teaching program on students' ability*

Nursing is a practical study[8]. As the leading teacher in the teaching and learning, whether the teacher can effectively carry out the cultivation of the clinical nursing directly affects the working ability of the nursing students after the work[9]. The xMOOC method puts emphasis on students’ proactive participation, while teachers mainly become providers of micro videos, organizers of supplementary flipped discussions[10], mediators in classroom communications, and sources of students’ inspirations. In such a process, the courses are more likely to be completed with higher quality of understanding.

The attempt through video courseware query makes students actively participate in the learning process of reflection and helps them to understand more knowledge of medical care and clinical practice. By flipping the classroom discussion, communication can also make students realize their advantages and disadvantages, encourage students to use their own knowledge to discover and solve problems, and improve the ability of judging and analyzing problems. XMOOC teaching mode for clinical nursing teaching[11]has a certain positive meaning for cultivating ability of students.

### *3.3 The effect of individualized teaching program on students' academic performance*

The important index of the test teaching effect is the student's study result, also is the teaching mode reform's ultimate goal. And compared with traditional teaching mode, xMOOC teaching mode has a certain function to knowledge combine, better understanding to use knowledge and enhance students’ memory.

### *3.4 The influence of individual teaching scheme to the teaching ability of teachers*

xMOOC mode focus on preview in advance, plan arrangement, which guarantees the teaching quality of the courses they teach. Recorded video can be broadcasted repeatedly, if new content requires modification, it can be recreated, which allows teachers to have more energy to attend to class discussion. Clinical nursing teachers often take several roles, not only as teachers but also as nurses, processor in clinic area, some of them also served as a quality control management, time and energy exist

difficulty.

#### **4. Conclusion**

Through the practice experience to feel the exploit of course source, teacher's effective guidance is a basic condition for the successful implementation of the course; must many kinds of models coexistence, which is committed to creating reflective, independent cooperatively explore students' learning context and problem situations; the field of information technology is an important research content of the course, and usage of multimedia technology in teaching also need to be continue improved.

#### **References**

- [1] Y.Guan, The application of dual role play teaching mode of nursing students academic emotional impact, *International Journal of Nursing* 32 (2013), 1121-1123.
- [2] Y.Cao. Development status, problems and Countermeasures of Chinese and Western medicine in the diagnosis and treatment of diabetic foot, *Journal of Beijing University of Traditional Chinese Medicine(Clinical Medicine)* 20 (2013), 12-15.
- [3] A.Wang, X.Zhang, Reliability and validity of the questionnaire on the evaluation of PBL teaching in medical undergraduate students, *China Journal of Modern Medicine* 11 (2008), 1625-1627.
- [4] H.Dong, L.Chen, X.Qi etc. Regarding existing problems n TCM nursing clinical teaching in western medical colleges and universities from nursing teaching practice and its countermeasures, *Chinese Nursing Research* 25 (2011), 3095-3096.
- [5] L.Chen, X.Chen. Probe into the reform of clinical teaching of traditional Chinese medicine under the new situation, *Journal of Qilu Nursing* 13 (2007), 84-85.
- [6] X.Rao, M.Hu, S.Zhang, Exploration of clinical teaching methods of traditional Chinese medicine nursing, *Chinese Journal of Nursing Education* 4 (2007), 204-205.
- [7] Z.Jia, H.Ying, Analysis on the problems existing in the teaching of traditional Chinese medicine nursing, *Chinese Medicine Modern Distance Education of China* 10 (2012), 83-84.
- [8] H.Jin, Q.Xing, Q.Lu, Research Progress on the theory and method of surgical nursing teaching in China, *Chinese Journal of Nursing Education* 12 (2015), 230-234.
- [9] Y.Wang, S.Gao, B.Shi, Clinical teaching of teacher training clinical ability of nursing students, *China Practical Medicine* 26 (2011), 256-257.
- [10] J.Zhang, Y.Wang, B.Zhang, Flip the classroom teaching model research, *Journal of Distance Education* (2012), 46-51.
- [11] S.Ma, Combine traditional Chinese and western medicine nursing teacher's professional development, *World Journal of Integrated Traditional and Western Medicine* 8 (2013), 1170-1172.

# The «Intelligent Wardrobe»

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**Abstract.** In an ageing society technical systems that support the residents at home are becoming increasingly important. Many of the technologies available today focus on detecting falls or monitoring the health of residents. There are a few projects that focus the «smart home for the elderly» and offer support for the daily activities. The Institute of Medical Informatics of the Bern University of Applied Sciences has developed a prototype of an intelligent wardrobe. Based on sensor data from the apartment like inside temperature, weather forecast and today's events suggestions for appropriate clothes are generated and shown on a display. To facilitate the search, the garments are marked in the closet with colored LEDs

**Keywords.** Medical Informatics; ambient assisted living; housing and daily activities; gerontechnology;

## 1. Introduction

Ambient Assisted Living (AAL) is an emerging multidisciplinary field aiming at exploiting information and communication technologies for countering the effects of a growing elderly population [1]. A recent survey [1] identified current AAL systems, platforms, architectures and technologies. In Switzerland, the life expectancy has reached the record levels of 81 years in men and 85.2 years in women [2]. Many elder people wish to live independently in their own home as long as possible.

While the use of technological means is an attempt to assist the elderly in an independent life, it is important that the technologies do not interfere with normal daily activities and are not intrusive or dissuasive [1,3,4,5].

Many current AAL systems primarily monitor the residents [3,5,6] and trigger e.g. an alarm in case of an accident or danger. Sensor technology is used in three fields:

- Sensors for monitoring physiological values such as movement during sleep, ecg-measurement, toilets with built-in chemical analysis and many more [3,4].
- Sensors monitoring the behaviour of the residents: Sensors at different points of the household analyse the daily rhythm (e. g. use of toilet).
- Sensors placed directly on the body, such as fall detection sensors.

Our focus was different and aims towards an assistive device for people with mild dementia. A set of applications have been devised for people with dementia in the Gloucester Smart House project, the ENABLE project, Telecare and other projects

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described in [7]. Many of those again use sensor technology e.g. to monitor cooking activities, falls, medication dispensing or lost keys.

Our focus was somewhat different and aims at assisting the resident in typical daily activities. In mild dementia a living in the own home is still possible, potentially together with a partner or with the involvement of external assistance. For many people with mild dementia however dressing correctly is a real challenge [8,9] and a major stressor for caregivers [8,10]. Therefore a smart «dressing-aid» could be a real support und a relief for the caregivers [10].

Thus the goal of this report was the development of an assistive wardrobe, which uses of the shelf components to assist a person with mild dementia in daily dressing.

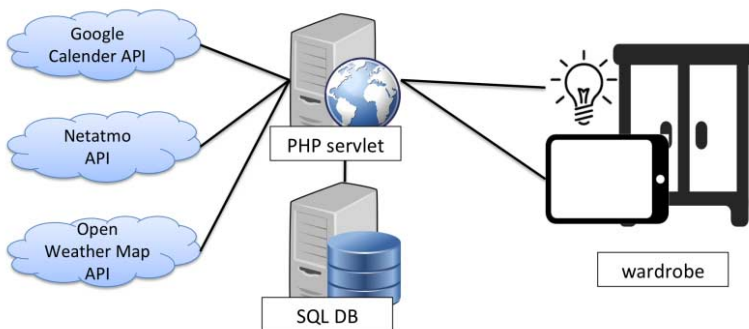
## 2. Methods

The Institute for Medical Informatics I4MI of the Bern University of Applied Sciences BFH maintains a so called living-lab for medical informatics, which comprises all the important stages of the Swiss healthcare system such as hospital, laboratory, intensive care unit, surgical theatre, pharmacy, physician's practice. Part of the living-lab is a complete one-bedroom apartment on the top floor of the building, which is gradually equipped with the latest sensor technologies and systems in support of its residents.

### 2.1. The construction of the intelligent wardrobe

The first prototype of the intelligent wardrobe was designed in a student's project. Its design was developed following an interview with a gerontologist based on user stories described in a storyboard. Sensor technology of a weather station was employed.

A modular software design based on PHP and the phpMyAdmin database [11] has been implemented (figure 1). It is centered around a PHP Servlet that reads the data of available garments and processes the rules for the choice of clothing. A Netatmo [12] weather station is used as sensor for inside and outside temperature and rainfall. The system integrates the weather forecast from OpenWeatherMap [13]. The scheduling tool Google Calendar is used [14]. The system has been implemented on an tablet PC with an HTML5 user interface. A physical wardrobe has been installed and "LED Strip Bricklet" (TinkerForge) [15] has been used for the illumination of compartments.



**Figure 1.** System architecture overview.

The data model is centered around two main tables «clothes» and «calendar events» to cater for the appropriate clothing for different events. The clothes table supports various attributes for garments, such as color, age, availability and supported outside temperature. Clothes can be associated to different types of events e.g. sport (e.g. playing with grandchildren), leisure (playing cards with friends) or formal (e.g. visit the doctor). The calendar entries are described with different categories; here the respective functionality of Google Calendar is used. Proposals and the choice of dresses will be logged and used to improve future proposals. On the administrative side a dialogue permits to add new clothes and to remove old ones from the database.

### 3. Results

At the heart of the work is the wardrobe in the bedroom. The tablet PC on the front door displays a summary of the appointments for the day, the inside temperature, the current weather conditions and the forecast. If a calendar entry is tapped, an appropriate clothing proposal is generated using the following data (figure 2): The current temperature in the apartment, the actual outside temperature, the weather forecast and the nature and duration of the event. The user receives a suggestion for clothes that are suitable for the chosen occasion and conditions. For appointments outside the apartment, the outerwear is calculated accordingly. If the user doesn't like the proposal, he/she can browse through more clothing suggestions. The system remembers in a learning algorithm whether certain garments are chosen more often and recommends their use more frequently.



**Figure 2.** Display with the clothing suggestion and the current weather condition.

The user receives additional support for finding the garments in the wardrobe: if a garment is selected on the tablet PC, this garment is highlighted on the display and its compartment in the closet is illuminated in the same color. If various garments are chosen (for example a sweater and trousers), then two different colors are used to point to the location (figure 3).



**Figure 3.** On the display the sweater is marked in green as well in the wardrobe.

#### 4. Discussion

The present prototype of the intelligent wardrobe is straightforward and therefore still requires some interaction with the user. Within the design phase we emphasized an easy to use screen design, which involves only two different screens with intuitive GUI. Evaluative tests with potential users are planned but have not yet been performed.

One weak point of the current implementation is the need of interaction between resident and system. The user has to activate the display and chose the event. Meanwhile we have integrated a full-surface capacitive sensor floor in our apartment, which is able to analyze pattern and direction of movement of the inhabitants. Thus we plan to use the floor and additional ultrasonic sensors (to measure the height of the person) to distinguish the inhabitants and further automate the interaction with the system. It is our goal to make interaction with the system almost superfluous.

We are fully aware not only of these shortcomings of the first assistive prototype, but also of the narrow window of potential users for this application who must still be able not only to operate the user interface but also to lay on the appropriate garments without help. There has been an interesting study of Mahoney et al. trying to assist demented persons with dressing called DRESS [7], which uses a padPC and camera recognition to assist the process of correctly dressing. They could demonstrate in a study with 25 families that an increase of correctness of the dressing process. Such applications could be joined with our approach to support as well the selection of garments and the dressing process itself. Thus some of our future efforts may center on the development of a 3D avatar, so the user can simply imitate the process of dressing.

##### 4.1. Extensions

The existing system has a simple and easily expandable design. As next expansion step we will equip the clothes with washable RFID tags so that the cabinet can determine autonomously which garments are in the closet. A laundry basket with RFID reader permits the application to know which garments require cleaning and can no longer be proposed. The same technology could be used to detect which clothes a user is wearing.

The RFID technology offers additional interesting logistic prospects. The process of cleaning the clothes and refilling the wardrobe could be completely remodeled. In Switzerland, many older people are cared for by the SPITEX [16], which visits and supports the patient several times a week. Thus there is the option to improve the existing SPITEX washing services. Using RFID a «just in time cycle» may be realized

which could prevent unnecessary visits of SPITEX when supply is sufficient. Thanks to the smart technical support, interaction with the system will be limited to a minimum.

With the conversion of the platform on MQTT [17] additional sensors can be connected to the existing system very easy. MQTT is a machine-to-machine (M2M)/«Internet of Things» connectivity protocol. Our goal is to get the most accurate picture of health of the residents and to offer a maximum of (unobtrusive) support through the integration of more sensor technologies into the platform.

Our primary goal is the support of an independent way of life for elderly persons using information technology. In Switzerland we face not only an increasing gap between available versus needed nursing staff but also an increasing cost pressure. The more we can facilitate daily life in old age and potentially prevent harmful events the more we may be able to prevent inpatient episodes and decreasing quality of life. But to achieve such goals, technology must be safe, cheap and unobtrusive. Studies with real users in cooperation with SPITEX are planned for early 2016 to demonstrate this.

#### 4.2. Conclusion

We demonstrated a first prototype of a decision support system to assist the demented user in the choice of garments. Currently extensions are being made to include RFID technology and improve supply routes for cleaning and delivery of clothes. Further promising research is required to assist the clothing process itself and to deploy the technology in the real world environment.

#### References

- [1] M. Memon, S. Wagner, C. Pedersen, F. Beevi, F. Hansen, Ambient Assisted Living Healthcare Frameworks, Platforms, Standards and Quality Attributes, *Sensors* **14** (2014), 4312-4341
- [2] Swiss Federal Statistical Office. Available from <http://www.bfs.admin.ch/> last visited Oct 3, 2015
- [3] T. Tamura, Home geriatric physiological measurements, Topical Review, *Physiological Measurements*, **33** (2012), R47-R65
- [4] R. Haux et al, Information an communication technologies for promoting and sustaining quality of life, health and self-sufficiency in aging societies—outcomes of the Lower Saxony Research Network Design of Environments of Ageing (GAL), *Informatics for Health and Social Care* **39** (2014):3-4, 166-187
- [5] M. Eichelberg et al, A technical platform for environments for ageing – lessons learned from three field studies. *Informatics for Health and Social Care*, **39** (2014):3-4, 272-293
- [6] G.L. Alexander, A. Wilbik, J.M. Keller, K. Musterman., Generating sensor data summaries to communicate change in elders' health status. *Appl Clin Inform.* **29** (2014);5(1):73-84.
- [7] M. Cash, Assistive technology and people with dementia. *Clinical Gerontology* **13** (2003); 313-319
- [8] D.F. Mahoney et al, Family caregivers' perspectives on dementia-related dressing difficulties at home: The preservation of self model. *Dementia* **14** (2015): 494-512, first published on Sept 11, 2013
- [9] D.F. Mahoney, W. Burseson, C. Lozano, V. Ravishankar, E.L. Mahoney. Prototype Development of a Responsive Emotive Sensing System (DRESS) to aid older persons with dementia to dress independently. *Gerontechnology*. **13**(3) (2015):345-358.
- [10] E.B. Fauth, E.E. Femia, S.H. Zarit, Resistiveness to care during assistance with activities of daily living in non-institutionalized persons with dementia: associations with informal caregivers' stress and well-being. *Aging Ment Health*. **11** (2015):1-11.
- [11] phpMyAdmin from <https://www.phpmyadmin.net/> last visited Oct 3, 2015
- [12] Netatmo weather station and rain gauge from <https://dev.netatmo.com/> last visited Oct 3, 2015
- [13] Open weather map, from <http://openweathermap.org/api> last visited Oct 3, 2015.
- [14] Google Calendar API, from <https://developers.google.com/google-apps/calendar/> last visit Oct 3, 2015
- [15] Tinkerforge LED Strip Bricklet from <http://www.tinkerforge.com>
- [16] SPITEX Switzerland, available from <http://www.spitex.ch/> last visited Oct 3, 2015
- [17] MQTT is a «Internet of Things» connectivity protocol, from <http://mqtt.org/> last visited Oct 3, 2015

# Implementing Innovation: The Creation of an iUnit and the Role of Nursing

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**Abstract.** NewYork-Presbyterian Hospital took on the challenge of thinking about innovation differently with the implementation of an innovation unit or iUnit to create the patient care unit of the future. Goals were to understand more about the innovation process and to test new service models, technology platforms, devices, and deployment models. Key findings from the focus groups included the need for additional training and technical support. In general, the initiative was felt to improve overall communication and represents a starting point for further innovation programs.

**Keywords.** Innovation, Focus Group Interviews, Implementation, Nursing Informatics, Hospital

## 1. Introduction

Finding ways to innovate in healthcare in the United States is more important today than ever. With a highly fragmented system accompanied by rising costs and serving more patients than ever, the strain is apparent and new approaches to delivering care are needed. Although ARRA created monetary incentives and funded The Center for Medicare & Medicaid Innovation<sup>1</sup> in 2009, there is still a slow adaptation of healthcare technology and barriers continue to exist around cost, resources and implementation of new practices.

Innovation is not just about novel technologies, but more importantly how they are used, when they are used, who uses them and with what process changes. This can be challenging to test, measure and evaluate in a busy academic medical center environment. Since 2009, hospitals are establishing innovation centers of their own or in collaboration with universities with copious staff and resources to perform the implementation tasks. According to a Commonwealth Fund survey, these centers typically have six employees, an annual budget of \$1.95 million and tests 12 or 13 ideas at a time.<sup>2</sup> In most cases, a new organizational culture is required to drive innovation in healthcare utilizing iterative adjustments to current care practices and involving busy front line clinicians. As described by Dr. Kenagy in his theory of adaptive design, innovation calls for an environment where ‘everyone is accountable for patient-centered innovation as part of their everyday work’<sup>3</sup>.

NewYork-Presbyterian Hospital (NYP), a large academic medical center in New York City, NY, took on the challenge of thinking about innovation differently with the



implementation of an innovation unit or iUnit to create the patient care unit of the future.

## 2. Methods

The innovation journey at NYP began in early 2014 with the launch of the NewYork-Presbyterian Innovation Center. Initially the main focus was partnering with healthcare startups and new technologies. Technologies were trialed in various areas but the projects lacked a coordinated effort with dedicated clinician involvement. It soon became clear that in order to be both agile and nimble with a focused need to think differently, a paradigm change was needed.

In July 2014, staff from across NYP were invited to submit applications to partner with the Department of Information Services (IS) to create the “patient care unit” of the future, where innovative technologies would achieve four goals: 1) Enhance the patient experience 2) Increase collaboration among the care team 3) Streamline workflow and 4) Engage with front line staff and patients. There was great interest throughout the Hospital resulting in 29 applications. Applications were evaluated on the ability to meet the four goals along with their passion for innovation, tech savviness and interdisciplinary collaboration. Finalists were interviewed by a team of IS staff members and one unit was selected as the iUnit.

To kick off the innovation activities, in September 2014, the iUnit staff, nursing informaticists and the IT team participated in several educational and listening sessions geared towards navigating the innovation process and the new technologies available. Session topics included change management, communication, innovative thinking, location tracking, internet of things, and others. In addition, the iUnit staff educated the rest of the team on their unit culture, types of patients and how it functions. To further galvanize the culture change, foster continuous learning and deliver success, NYP collaborated with an innovation consulting firm. Through their framework, the IS team, nursing informaticists and iUnit staff gained a common language around innovation and a social conduct on behavior during the initiative, including expanding the mind, nurturing ideas, keeping momentum, and having fun.

Once brainstorming sessions were completed, the mutually agreed upon scope of the iUnit initiative included four functionalities of technology: mobility, patient engagement, collaboration, and quality. NYP used the iUnit initiative to test new service models, technology platforms, devices, and deployment models. To address mobility, in October 2014, the iUnit staff received their first piece of technology - iPhones. Staff explored the phone’s capabilities and how to leverage the device in their day-to-day activities. A communication platform was loaded onto the iPhones so that staff could securely text message, voice & video call each other to assist with patient care.

To address patient engagement, patient bedside tablets were deployed next. The tablets provide access to the Internet, health records and information through the NYP patient portal ([myNYP.org](http://myNYP.org)), and entertainment options for both patients and their visitors. To facilitate a culture of transparent, consistent, and real-time communication, NYP developed an internal mobile application that provides detailed updates about the iUnit initiative. A component of the application is also interactive, where iUnit staff can enter in feedback and share their ideas for improvement. The IS team and iUnit

staff have collected user insight and feedback on each new technology to inform future innovations.

At the conclusion of first year of the iUnit program, 4 focus groups were conducted by the nursing informaticists with 30 nurses (RN). We asked specific questions regarding the use of the hardware, software and general satisfaction with the iUnit process. A total of 11 questions were used and responses were coded and categorized.

**Table 1.** Results of RN Focus Groups (30 RNs)

Themes	Examples
Communication	Convenience and increase in productivity associated with mobile phones.
Reliability of Hardware	Frequent updates were challenging to manage. Concern for when technology didn't work.
Change Management	Opportunity to make changes. New understanding of tech development.
Use of New Technology	Anxiety and fear regarding new devices. Idea of iUnit was overwhelming.
Training	Felt that more training was needed. Mostly learned from each other.
Technical Support	Had difficulties contacting support staff for acute issues.

### 3. Results

Four focus groups were conducted on the iUnit to hear from staff on various shifts. A total of 30 nurses attended the focus group. Improved communication was the most prevalent theme seen in over 50% of all responses. The ability to text, call and look up information from anywhere on the unit was seen as a great convenience and satisfier. The nurses felt that it was easier to find staff members and they could easily find out information to avoid mistakes. It was also felt that with more calling and texting with less overhead paging was a big satisfier for patients. One nurse noted that workflows were improved and that the phone 'is a lifesaver'.

On the other hand, there were themes regarding the reliability of the hardware and the ability to access technical support staff when needed. Almost half of the nurses cited issues regarding updates with either the phone or the iUnit applications. There were concerns with not having an updated directory and the passwords needed for the tablets. The nurses had difficulty with locating technical support staff when needed especially on the night shift. Problems with charging, freezing, and getting service in all areas of the unit were highlighted. The nurses suggested changing the phone service and obtaining extra chargers for the unit.

Another focus group theme related to the initial perceptions of being selected as the iUnit. Some nurses felt that it would be a good opportunity to make changes but others felt that having the time to create new ideas was difficult. Other nurses felt that the idea of the iUnit was overwhelming and a few noted anxiety and fear regarding the use of new devices. It was common for nurses to learn how to use the innovation features from each other and they felt that more training was needed. There were high expectations initially but the nurses felt they learned a great deal about technology development and the work that goes into designing an application.

#### 4. Discussion

After a year of innovation in the iUnit, our focus group results suggest that the nurses felt the program to be successful. The majority of the nurses were happy to have their unit selected as the iUnit and all were eager to learn about new devices and software. It was reported that nursing leadership initiated group texting to the nursing staff and were very supportive of the pilot. We feel these factors contributed to the nurses' satisfaction of the iUnit program and their enthusiastic acceptance of the iPhones.

The implementation of the iUnit was seen as helpful with communication however there were some minor improvements noted that could assist with future programs. In some cases the nurses felt they were not aware of iUnit projects and were not trained on the use of new technologies although weekly emails and meetings were scheduled. Future innovations could benefit from an assessment of the technical abilities of the nurses and tailor training according to ability.

Since issues were reported with new technologies not working, as often happens with innovation, it may be beneficial to have a clear support plan with an easy way for staff to reach technical support at a moment's notice. As new technologies emerge, nursing staff may become reliant on the technology and need immediate support while at the bedside. Lack of support when needed has the potential to inhibit acceptance of future innovations.

This evaluation is limited in scope and had several limitations. As noted above, some nurses needed additional training. In the future, it would be helpful to survey the nursing staff prior to the start of innovation projects in order to understand the nurses' comfort level with technology and to assess the amount of training needed. We did not assess the experience level of the nurses or amount of time on the unit. These data points would be helpful in understanding if the nursing experience or familiarity with the unit would impact the nurse's comfort level with technologies on the unit. We did not use a pre and post satisfaction tool which would have been helpful to gauge the impact of the iUnit activities.

In summary, we implemented an innovation unit in a hospital setting and assessed the general nursing satisfaction with the process. Our focus group findings suggest that nurses were pleased with the increased level of collaboration among staff using novel communication technologies. These data suggest that nurses are eager to use technologies that improve communication and are receptive to new innovations. Future studies to explore the scaling of innovation from unit to unit may yield new discoveries. In an effort to support care coordination and new models for health care reform, we expect the use of innovation to only increase. Therefore, the implementations of new and innovative technologies by nursing staff are an important area to further study and develop. Our innovative approach and technology development efforts anticipate this future.

#### References

- [1] Centers for Medicare & Medicaid Services. (2013). *About the CMS Innovation Center*.
- [2] S. Klein, M. Hostetter, D. McCarthy, & S. Hayes, (2015). *Findings from a Survey of Health Care Delivery Innovation Centers*.
- [3] J. Kenagy, (2011). *Adaptive Design*

# Nursing Informatics Research Priorities for the Future: Recommendations from an International Survey

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**Abstract.** We present one part of the results of an international survey exploring current and future nursing informatics (NI) research trends. The study was conducted by the International Medical Informatics Association Nursing Informatics Special Interest Group (IMIA-NISIG) Student Working Group. Based on findings from this cross-sectional study, we identified future NI research priorities. We used snowball sampling technique to reach respondents from academia and practice. Data were collected between August and September 2015. Altogether, 373 responses from 44 countries were analyzed. The identified top ten NI trends were big data science, standardized terminologies (clinical evaluation/implementation), education and competencies, clinical decision support, mobile health, usability, patient safety, data exchange and interoperability, patient engagement, and clinical quality measures. Acknowledging these research priorities can enhance successful future development of NI to better support clinicians and promote health internationally.

**Keywords.** nursing informatics, future trends, big data, standard terminologies, informatics competencies

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## 1. Introduction

The discipline of nursing informatics (NI) has evolved significantly over the past several decades. NI is often defined as a specialty that integrates nursing, informatics, and computer science to promote health [1]. NI has contributed to a number of achievements and is considered a well-developed practice and research discipline aligned under the broad umbrella term of health informatics. Nevertheless, despite NI advancements associated with care provision, patient engagement, decision support and patient safety, for example, research funding may be hard to acquire [2-3]. For instance, a recent literature review found that 63% (n=17) of the studies included in the review were based on unfunded research or did not report any funding sources for research [3]. An exploration of research needs from both academia and practice are needed to support efficient use of available resources to better support clinicians and promote health.

Exploring important research areas identified by professionals may help in directing future research efforts. We recently conducted an international survey aimed to describe current and future research trends of NI. The study was conducted by the International Medical Informatics Association Nursing Informatics Special Interest Group (IMIA-NISIG) Student Working Group. In this paper we present a subset of the study results: an overview of future NI trends as reflected by the responses of 373 international NI researchers and practitioners.

## 2. Methods

This study had a cross-sectional survey design with online data collection using Google forms. The questionnaire was developed based on current NI literature [4-5] to explore current and future trends in NI. The questionnaire was iteratively developed, revised and edited by members of the student group. We sought feedback from international NI experts, which included those identified through the IMIA-NISIG leadership or individuals with multiple publications examining informatics trends. Based on the expert recommendations and feedback, we revised the questionnaire until a final version was developed. The online survey version was pilot-tested to assure its adequate functionality before the international distribution.

The IMIA-NISIG Student Working Group members were invited to collaborate in the study. Collaboration involved distributing an invitation letter and link to the survey. Seventeen students from thirteen countries actively participated in distributing the survey through their professional networks. An ethical review was applied from the ethics committee of the University of Turku (Finland) as the study was coordinated from this university. The committee considered the research plan ethically approvable.

The questionnaire was translated into six different languages (Arabic, English, Korean, Portuguese, Spanish and Swedish) by native speaking student working group members with a background in informatics. These translations were then validated by at least two other native speaking NI professionals.

The following inclusion criterion to participate was communicated in the survey invite: any nurse (or other allied health professional) with experience in NI either in practice or academia. We targeted professionals from both academia and practice in order to get a comprehensive picture of current NI research trends and to also explore

research needs identified by clinicians. We used snowball sampling technique to reach as many international respondents as possible.

The questionnaire consisted of twenty-four questions with structured and open-ended response options. Eight of these were demographic questions including: 1) professional background, 2) highest degree received, 3) clinical position, 4) academic position, 5) years of NI experience, 6) NI education, 7) country, and 8) city. The remaining sixteen questions covered the current state and future trends of NI.

This paper focuses on the following question covering future trends of NI: “In your point of view, what should the research focus in NI be over the next 5 to 10 years?”. Participants were asked to choose up to 5 options from a checklist of 31 research priorities. The 31 topic priorities in the checklist were informed by current NI literature [4-5] and consultation with various nursing informatics experts. An ‘Other’ option with narrative text was also available. The full list of priority areas is available upon request. Data were collected between August and September 2015.

### 3. Results

From a total of 402 respondents, 373 (92.7%) answered the question focusing on identifying NI research priorities over the next 5 to 10 years. These responses were submitted from 44 different countries in Asia, Africa, Australia, Europe, North and Central America, and South America. The vast majority of the respondents were nurses (90.3%) with educational degrees, including Bachelors (28.8%), Masters (39%), PhDs (29.3%) and other (2.9%). The respondents’ in clinical positions were divided into staff (31.9%), middle management (25.8%), upper management (16.8%) and other (25.5%), and the respondents in academic positions were students (22.4%), teachers or instructors (16.6%), professors (38.2%) and other (22.8%). About one third of the respondents (34.5%) had received formal education in NI but more than half of the respondents (57%) had not, a further 8.5% of the respondents were identified as current students of NI, professionals with other NI education (e.g. taken NI courses) or education in another informatics field (e.g. medical informatics). Figure 1 presents the distribution of the top 10 research priority areas identified by the respondents.

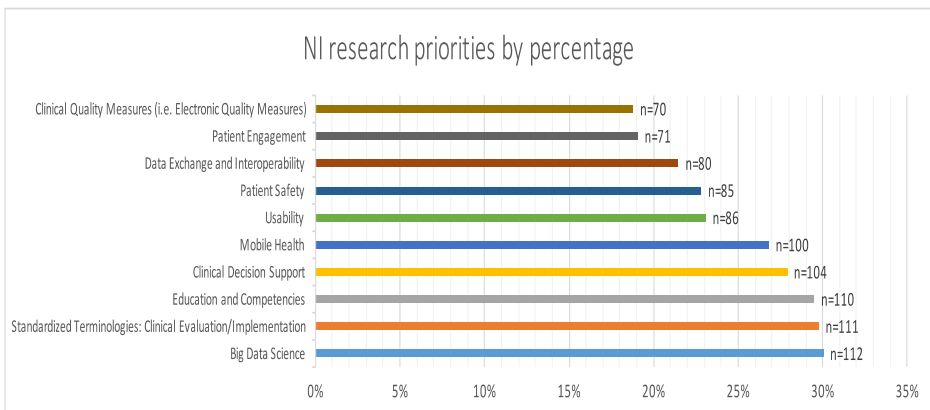


Figure 1. NI research priorities as identified by 373 respondents.

#### 4. Discussion

About one third of the survey responders (30%) indicated ‘big data science’ as one of the top research priorities for NI in the future. The term ‘big data’ refers to large, multi-dimensional, often interdisciplinary data sets that may be analyzed using diverse computational techniques to reveal patterns, trends, and associations related to promoting health [6-8]. Big data analytics can enable better comparative effectiveness research, personalized medicine, predictive modeling, and health risk stratification, among other areas [6]. Further development of nursing big data science is therefore critically important. Several key research directions might be considered based on recent literature [6, 8]. First, there is a need to further develop methods to extract and standardize nursing data, such as wide scale use of standard nursing terminologies. Advanced analytic techniques, such as natural language processing that enables automated data capture from free text clinical narratives [9] or data mining techniques that enable pattern recognition [10], should be adapted for nursing data analysis. In addition, comprehensive ways of data harmonization between nursing and other interdisciplinary health data [11] should be developed. The overall vision of this collaboration is to support sharable and comparable nursing data across settings.

Our survey offered two options of priority areas concerning standard terminologies: ‘standard terminology content analysis and development’ or ‘standard terminology clinical evaluation and implementation’. Participants chose the second option (29.8%) almost twice as often as the first option (15.5%), suggesting that significantly more applied terminology research is needed. This might be explained by a well described gap in nursing standard terminology: numerous nursing terminologies exist on national and international levels, but only a few are integrated into real world electronic health record systems [12-13]. Even when integrated, each terminology uses a unique code, and it is not possible to compare data across different terminologies. As a result, the ability of nursing professionals to generate and communicate standard nursing data is limited. Our results underscore the need to focus on making nursing terminologies more relevant in clinical practice and research into making nursing data exchangeable and interoperable. This is consistent with recent reports calling for a critical need in data harmonization and standardization [14].

Another important research priority identified in this survey was developing nursing informatics education and competencies (29.5%). This priority was also one of the central themes discussed by the survey participants in the open-ended question on advancing the discipline. Several other research priority areas identified in this survey were related to patient centeredness issues, such as patient safety (22.8%) or engagement (19%). This might be related to the general health policy trends in many countries supportive of a more personalized and safe healthcare by encouraging the adoption of health information technology, for example the Meaningful Use regulations in the U.S. aimed at improving patient engagement and safety [15].

Some research priorities identified by our study are already reported by current literature. For example, a recent review identified the following emerging themes in NI: decision support tools, interdisciplinary communication, medication administration, nursing terminology, nursing workflow efficiencies, patient engagement, and technology interventions [16]. The generalizability of our results is limited by our sampling technique that only reached certain organizations and a small numbers of participants from certain countries and geographic regions (e.g. we had a high number of responses from the USA but a low number of responses from African countries).

#### 4.1. Conclusions

In this paper we present an overview of future NI trends as reflected by the responses of 373 international NI researchers and practitioners from 44 countries. This study was conducted by the members of IMIA-NISIG Students Working Group. We identified a top ten central priorities list for future NI research, including: big data science, standardized terminologies (clinical evaluation/implementation), education and competencies, clinical decision support, mobile health, usability, patient safety, data exchange and interoperability, patient engagement, and clinical quality measures. Acknowledging these research priorities can enhance successful future development of NI to better support clinicians and promote health internationally.

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#### References

- [1] L. Thede, Informatics: Where Is It?, *OJIN: The Online Journal of Issues in Nursing* **17** (2012), 10.
- [2] J.M. Carrington, V.L. Tiase, N. Estrada, K.D. Shea, Research in nursing informatics 2014, *Nurs Adm Q* **39** (2015), E9–E16.
- [3] J.M. Carrington, V.L. Tiase, Nursing informatics year in review, *Nurs Adm Q* **37** (2013), 136–143.
- [4] M. Topaz, C. Ronquillo, L. Pruinelli, R. Ramos, L.-M. Peltonen, et al. Central trends in nursing informatics: students' reflections from International Congress on Nursing Informatics 2014 (Taipei, Taiwan), *Comput Inform Nurs* **33** (2015), 85–89.
- [5] V.K. Saba, K. McCormick. *Essentials of Nursing Informatics*, 6th Edition, McGraw-Hill Education, USA, 2015.
- [6] G. Keenan, Big Data in Health Care: An Urgent Mandate to CHANGE Nursing EHRs!, *OJIN: The Online Journal of Issues in Nursing* **18** (2014), 18.
- [7] B.L. Westra, T.R. Clancy, J. Sensmeier, J.J. Warren, C. Weaver, C.W. Delaney, Nursing Knowledge: Big Data Science-Implications for Nurse Leaders, *Nurs Adm Q* **39** (2015), 304–310.
- [8] F. Provost, T. Fawcett, Data Science and its Relationship to Big Data and Data-Driven Decision Making, *Big Data* **1** (2013), 51–59.
- [9] L. Zhou, A.W. Baughman, V.J. Lei, K.H. Lai, A.S. Navathe, et al., Identifying Patients with Depression Using Free-text Clinical Documents, *Stud Health Technol Inform* **216** (2015), 629–633.
- [10] W.O. Hackl, F. Rauchegger, E.A. Ammenwerth, Nursing Intelligence System to Support Secondary Use of Nursing Routine Data, *Appl Clin Inform* **6** (2015), 418–428.
- [11] T.Y. Kim, Automating lexical cross-mapping of ICNP to SNOMED CT, *Inform Health Soc Care* **19** (2015), 1–14.
- [12] B.L. Westra, C.W. Delaney, D. Konicek, G. Keenan, Nursing standards to support the electronic health record, *Nurs Outlook* **56** (2008), 258–266.
- [13] A. Thoroddsen, K. Saranto, A. Ehrenberg, W. Sermeus, Models, standards and structures of nursing documentation in European countries, *Stud Health Technol Inform* **146** (2009), 327–331.
- [14] University of Minnesota, 2014 Nursing Knowledge: Big Data & Science for Transforming Health Care Conference Proceedings, [http://www.nursing.umn.edu/prod/groups/nurs/@pub/@nurs/documents/content/nurs\\_content\\_482402.pdf](http://www.nursing.umn.edu/prod/groups/nurs/@pub/@nurs/documents/content/nurs_content_482402.pdf) (Last accessed 4 October 2015).
- [15] J HealthIT.gov, Meaningful Use Definition and Meaningful Use Objectives of EHRs, <http://www.healthit.gov/providers-professionals/meaningful-use-definition-objectives> (Last accessed 4 October 2015).
- [16] J.M. Carrington, V.L. Tiase, Nursing informatics year in review, *Nurs Adm Q* **37** (2013), 136–143.



# Ten Demands of Improved Usability in eHealth and Some Progress – Co-creation by Health and Social Care Professionals

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**Abstract.** Current healthcare organizations often do not accomplish the intended effects of their eHealth systems due to inadequate usability. Commissioned by the Swedish Ministry of Health and Social Affairs, the usability of current eHealth systems in Swedish health and social care has been analysed from the perspective of their professionals. The objective of the study was to report on current problems, potential solutions as well as to relate these to research in relevant areas. Using a participatory approach, nine workshops were held where health informatics researchers guided staff from different care organizations, representatives of the national associations of health and social care professionals and the national eHealth system vendor organization. This paper presents ten demands that Swedish health and social care professionals find imperative to prioritize. The study emphasizes that development of eHealth systems must be integrated into the care practice improvement process and iteratively evaluated regarding usability.

**Keywords.** eHealth systems, User participation, Participatory design, Healthcare and welfare development, Validation, Usability, Patient-centricity.

## Introduction

eHealth systems, i.e. information technology (IT) applied in the health and social care sector, has great potential to enhance efficiency, improve quality of life and strengthen innovativeness in health and social care [1]. Extensive resources are currently being invested in eHealth development at local, regional and national levels of society. To achieve the maximum benefits from these investments, eHealth systems that really *support* health and social care professionals in their work, focusing on health as an effect of the care and treatment given, are required [1,2]. However, technology in health and social care often regarded as a barrier to providing good healthcare in an efficient way [3]. Specifically, insufficient usability of the systems is identified as a major obstacle [3,4,5]. Unfortunately, little effort is put into health information system development according to usability requirements and methodology, leading to bottlenecks in eHealth systems when implemented into daily practice [2,5,6].

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## 1. Background

The Swedish National Strategy for eHealth in Health and Social Care [7] identifies useful and accessible information, as well as decision-making support for staff as important priority areas. In a review, the Swedish National Audit Office concluded that the national eHealth strategy had not been able to secure the benefits from the efforts made. Current IT-systems do still not give health and social care professionals access to “the right information at the right time” [8]. Likewise, a Gartner report [3], commissioned by the Swedish Ministry of Health and Social Affairs, indicated that professionals primarily identified a need for improvement of the usability of eHealth systems to increase their utilization. Based on the mentioned evaluations, the Swedish Ministry of Health and Social Affairs acknowledged the need to address usability issues in eHealth from a national perspective [6]. This was the starting point in early 2013 for the project presented in this paper. Working together, nurses and other health and social care professionals highlighted current obstacles, the most important solutions and necessary changes to get well-functioning information and communications technology (ICT) that contribute to good and secure care when meeting with patients and relatives, and that facilitates collaboration between different care actors.

## 2. Method

The aim of the project was to collect and highlight lessons learned and examples of best practice as a basis for improved integration of health and social care providers and their ICT support, as well as answering the following questions:

- Which problems do care professionals experience as users of eHealth systems?
- Which solutions do they regard as being most important?
- How do these findings relate to existing research regarding usability in eHealth?

The concept of usability, according to the international standard for usability 9241-11, focuses on *a specific user in a specific context performing a specific task* [9]. It was therefore challenging to address usability issues on an overall national level with the aim to create a basis for improved national strategies. The authors firmly believe that such an initiative needs a bottom-up approach and involvement of real end-users [10]. Hence, a participatory approach was adopted, inspired by the ‘Scandinavian tradition’ emphasizing participation in design [11,12]. The five major Swedish national associations of health and social care professionals were the driving force and members (actual end-users) from each organization were involved throughout the project. In order to collect data, representatives of health and social care staff, researchers in the area of usability in health informatics, as well as representatives of vendors of eHealth systems participated in nine workshops (n~70) [10]. Firstly, representatives from the national care organizations, researchers and the ministry of health and social affairs set the focus and aim for the following workshops. In workshop 2 and 3 end-users worked together with researchers to identify problems, and to propose potential solutions and future work scenarios. The fourth workshop involved vendors, while workshop 5-7 focused on discussing the results with other researchers and user representatives throughout Sweden. Finally, in workshop 8 the results were prioritized into an action list, and workshop 9 was an open workshop at a national eHealth conference where more feedback and comments were gathered from various stakeholders [1].

### **3. Results - Ten Demands of Improved Usability in eHealth Systems**

Focus in this project was not on describing the problems, but rather to emphasize what needs to be done in order to improve the situation. Important actions to perform locally, in each healthcare organization, were formulated, as well as suggestions for how to operationalize usability improvement work from a national perspective.

The development of eHealth systems is always a matter of organizational and process development and must be integrated into the improvement process of the care practices. To stress this, the study highlights the following ten demands for improving usability in order to capitalize on the potential of eHealth systems.

1. eHealth systems must be managed, evaluated, supervised and continuously optimized in relation to the usability needs of the organization that it is intended to support. There is a need for more collaborative efforts to integrate work processes and eHealth systems into a coherent and meaningful whole.
2. Care professionals must be involved in managing each eHealth project. Increased participation of usability experts, health informatics specialists and users is required in the development, implementation and evaluation of eHealth systems.
3. All health and social care professionals must have a basic understanding of the opportunities offered by eHealth systems, as well as adequate knowledge of how the eHealth systems should be used and how work processes relate to eHealth systems. Training and enhancement of informatics skills must be prioritized in the education and then continue in employment. Education in health informatics must be substantially expanded and take into account sector-independent knowledge in the area of informatics as well.
4. The technical prerequisites to document and access information must be met at the point of care. The need is particularly great in the social care sector where access to technical support is low and mobile work is common.
5. The technical infrastructure must be sufficiently powerful and reliable enough for users to be able to trust it. Security solutions must be implemented so that users can perform their work without unnecessary interruptions. The systems must be developed in order to ensure that response times are kept to a minimum. The IT environment is becoming increasingly complex, partly as a consequence of increasing requirements for exchange of information between health and social care providers. To manage this, care providers must coordinate their organizations for the operation and administration of eHealth systems more efficiently.
6. Health and social care staff must be able to move between different eHealth systems and still be able to find vital information quickly in time-critical situations. This requires the presentation of certain types of health and social care information to be structured and standardized graphically, while at the same time supporting personalization, based on e.g. role, activity and work situation.
7. Multiple recording of the same data must be eliminated. A set of information should be recorded only once and communicated automatically in its existing or aggregated form to other systems. Work regarding the National Interdisciplinary Terminology and the National Information Structure as well as the implementation of automated transfer of data must be accelerated.
8. Important information must follow the care recipient across health and social care provider boundaries to facilitate person-centered health and social care. Unnecessary legal obstacles must be eliminated. At the same time, eHealth systems

- must be developed to support the enforcement of legal and ethical requirements when data flows across health and social care provider boundaries.
9. Research on the usability of eHealth systems must be strengthened and the knowledge applied in practice. More usable systems lead to improved capture and recording of data, which in turn can provide improved feedback to the care staff and valid data for research.
  10. eHealth skills are a strategic development resource that must be present at all levels of management in health and social care. Understanding of usability is the key to achieve benefits of eHealth systems, and essential for good and reliable health and social care.

#### **4. Discussion about progress, further work and conclusion**

This work was sponsored by the presidents of the national associations of health and social care professionals. Their commitment was captured in the end of the project [13] showing statements in line with the participants from the “floor”. The presidents supported this project stressing it will provide a foundation for further development of eHealth and they firmly believed that usability of eHealth systems can be enhanced by e.g. improving the cooperation between responsible authorities to achieve efficient development, governance and implementation of eHealth as well as supervising eHealth systems with increased stringency and pro-activeness and in collaboration with relevant authorities (c.f. #1); ensuring that there is expertise and commitment regarding eHealth at all levels of management (#10); initiating nationally coordinated efforts in the development, governance and use of the National Information Structure and the National Interdisciplinary Terminology to eliminate documentation of repeating content in the electronic health record (#7); standardising and regulating vital sets of information, e.g. medical alert information (#6); ensuring resources for development of a robust and reliable IT infrastructure (#5); and actively involving health and social care enterprise and professionals in the development of eHealth (#2) [13].

Apart from local/regional eHealth development where the demands are kept alive by the professionals, three investigations on a national level were initiated following up the work of the professionals made in 2013: regarding correct information in health and social care (#4; #8) [14]; ongoing work regarding a national coordinator for more efficient resource utilization in healthcare (#5) [15] and better and safer coordination of IT services in health and social services [16]. Within the Swedish Association of Local Authorities and Regions (SALAR) the commitment regards e.g. quality registers, including the national program of data collection to reduce duplication (#7) [17].

Although Sweden often is considered a prominent country regarding the development and use of eHealth, the relationship between poor usability and stress factors does not seem to be well known in the actual organizations, even less how usability work should be conducted. Currently, the demands expressed in #3 and #9 regarding the need to deepen and disseminate knowledge about the usability aspect of eHealth still need action plans on a national and regional level. Apart from health informatics courses and alike at universities, the suggestions of #3 have to our knowledge only been initiated in three educational settings; the basics for nurses’ participation in the implementation of eHealth systems in the nursing education at one university [18], a master-class of basic eHealth during a Nordic eHealth conference

[19] and a 50 minutes web education for social care staff, released in late 2015 [20]. Furthermore, continuous monitoring of the usability of eHealth systems at the national level, which could serve as a basis for collaboration and supervision in developing and adopting eHealth systems, is currently missing (c.f. #9). To solve this, issue an initial measurement of the usability maturity [21] within the organizations is a suggestion, combined with joint evaluations. In conclusion, some evaluations have been made [1], but a long-term follow-up on how usability evolves over time is still missing.

## References

- [1] I. Scandurra, M. Hägglund, A Persson, R-M. Åhlfeldt. *Disturbing or Facilitating? On the Usability of Swedish eHealth Systems* Stud Health Technol Inform. 2014;205:221-5.
- [2] NISTIR 7804 (2012). *Technical Evaluation, Testing and Validation of the Usability of Electronic Health Records* [http://www.nist.gov/manuscript-publication-search.cfm?pub\\_id=909701](http://www.nist.gov/manuscript-publication-search.cfm?pub_id=909701), Retrieved 5 Jan 2016.
- [3] *Users Award, Vård IT-rapporten 2010* In Swedish. <http://www.usersaward.com/> Retrieved 25 Sept 2015.
- [4] Gartner, *eHälsa i Sverige – nuläge och framtida mål: Rapport för Socialdepartementet 2012*: 330006695.
- [5] J. Viitanen, H Hyppönen, T. Lääveri, J. Vänskä, J. Reponen, I. Winblad. *National questionnaire study on clinical ICT systems proofs: Physicians suffer from poor usability*. Int J Med Inf, 80 (2011), 708-725
- [6] I. Scandurra, *Disturbing or Facilitating?* (Report in Swedish) / [www.storandeellerstodjande.se](http://www.storandeellerstodjande.se)
- [7] *Ministry of Health and Social Affairs, National eHealth - the strategy for available and secure information in health and social care*, S2011.023 (2011).
- [8] *National Audit Office. Rätt information vid rätt tillfälle inom vård och omsorg – samverkan utan verkan? RiR 2011:19*. In Swedish. <http://www.riksrevisionen.se/sv/rapporter/Rapporter/EFF/2011/> 25 Sept 2015.
- [9] *International Organization for Standardization, ISO 9241-11:1998, Part 11: Guidance on usability* [http://www.iso.org/iso/home/store/catalogue\\_tc/catalogue\\_detail.htm?csnumber=16883](http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=16883)
- [10] I. Scandurra, R-M. Åhlfeldt, A. Persson, M. Hägglund, *Building Usability into National eHealth Strategies, an Action Research Approach*. The 4th Infrastructure workshop on Infrastructures for Healthcare: Action Research, Interventions, and Participatory Design. Tromsø, Norway, June 2013
- [11] S. Bødker, P. Ehn, D. Sjögren & Y. Sundblad, *Cooperative design perspectives on 20 years with "the Scandinavian IT Design Model"*. Proceedings of the first Nordic conference on Human-computer interaction. Association for Computing Machinery, 2000.
- [12] J. Stirna, A. Persson, K. Sandkuhl, *Participative enterprise modelling: experiences and recommendations*, in J. Krogstie, A.L. Opdahl, G. Sindre, (Eds.): 19th Int Conf on Advanced Information Systems Engineering (CAISE 2007), LNCS 4495, 2007, Springer Verlag
- [13] Presidents of: Swedish Municipal Workers' Union (Annelie Nordström); Swedish Society of Nursing (Ania Willman); Swedish Association of Health Professionals (Sineva Ribeiro), Swedish Society of Medicine (Peter Friberg); Swedish Medical Association (Marie Wedin) Summary from October 2013.
- [14] L. Lundgren, M. Jacobsson, E. Karlsson Helghe & P. Sundström. *Rätt information på rätt plats i rätt tid SOU 2014:23*. In Swedish. <http://www.regeringen.se/contentassets/909ca5e5ee2a48609b25824e228d6486/ratt-information-pa-ratt-plats-i-ratt-tid-sou-201423-bilaga-4> Retrieved 25 Sept 2015.
- [15] G. Stjernstedt. *En nationell samordnare för effektivare resursutnyttjande inom hälso- och sjukvården*. Swedish. <http://www.regeringen.se/contentassets/e9a983e2026e43929ad0da43392bcc4b/en-nationell-samordnare-for-effektivare-resursutnyttjande-inom-halso-och-sjukvarden-dir.-2013104> Dir. 2013:104.
- [16] S. Olofsson, R Broddvall, Å. Elffors & M. Jacobsson. *Nästa fas i eHälsoarbetet, SOU 2015:32*, in Swedish. March 2015. [http://www.sou.gov.se/wp-content/uploads/2015/03/SOU-2015\\_32](http://www.sou.gov.se/wp-content/uploads/2015/03/SOU-2015_32) 25 Sept 2015.
- [17] *SKL/SALAR. Nationella programmet för datainsamling*. In Swedish. *National program of data collection*. <http://www.kvalitetsregister.se/projekt/nationellaprogrammetfordatainsamlingnppi.387.html>
- [18] B. Östlund, S. Frennert I. Scandurra, *Lessons learnt to promote nurses participation in implementation of home healthcare systems*, Accepted for Nursing Informatics 2016, December 2015.
- [19] [http://www.vitalis.nu/PageFiles/118047/Masterclass\\_Vitalis2016.pdf](http://www.vitalis.nu/PageFiles/118047/Masterclass_Vitalis2016.pdf). Retrieved 5 Jan 2016
- [20] *Ministry of Health and Social Affairs. Kunskapsguiden.se*, In Swedish Retrieved 25 Sept 2015. <http://www.kunskapsguiden.se/utbildning/E-halsa-och-valfardsteknologi-i-socialtjansten/Sidor/>.
- [21] N. Stagers, M. Rodney, P. Alafaireet, C. Backman, J. Bochinski, B. Schumacher & Y. Xiao *Promoting Usability in Health Organizations: Initial Steps and Progress Toward a Healthcare Usability Maturity Model*. ed. Boone E Healthcare Information and Management Systems Society (HIMSS) Usability Task Force. [http://www.himss.org/files/HIMSSorg/content/files/HIMSS\\_Promoting\\_Usability\\_in\\_Health\\_Org.pdf](http://www.himss.org/files/HIMSSorg/content/files/HIMSS_Promoting_Usability_in_Health_Org.pdf) (2011) Retrieved 25 Sept 2015.

# A Personal Health Network for Chemotherapy Care Coordination: Evaluation of Usability Among Patients

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**Abstract.** Cancer is a top concern globally. Cancer care suffers from lack of coordination, silos of information, and high cost. Interest is emerging in person-centered technology to assist with coordination to address these challenges. This study evaluates the usability of the “personal health network” (PHN), a novel solution leveraging social networking and mobile technologies, among individuals undergoing chemotherapy and receiving care coordination. Early results from interviews of 12 participants in a randomized pragmatic trial suggest that they feel more connected to the healthcare team using the PHN, find value in access to the patient education library, and are better equipped to organize the many activities that occur during chemotherapy. Improvements are needed in navigation, connectivity, and integration with electronic health records. Findings contribute to improvements in the PHN and informs a roadmap for potentially greater impact in technology-enabled cancer care coordination.

**Keywords.** Care coordination, oncology, chemotherapy, person-centered, mobile technology, social network

## 1. Introduction

Care coordination is a critical need across the world to address fragmented and efficient care of individuals with complex care needs such as cancer.[1,2] Cancer patients can benefit from active engagement with their healthcare teams and active participation in improved care coordination.[3,4] Some have argued that this type of complex coordination is made possible and improved with technology.[5,6] Yet, there are few examples or evaluations of information technology (IT)-enabled care coordination beyond telephone follow-up.[7]

The “personal health network” (PHN) was developed to address this gap. The PHN is a personalized social network built around a patient for collaboration with clinicians, care team members, carers, and others designated by a patient, to enable patient-centered health and healthcare activities across a relevant community.[8] It was designed based on published frameworks for care coordination and the expertise of an interprofessional clinical and research team, and applied to a use case of patient

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initiating chemotherapy with PHN members including family members, oncologists, primary care physicians, nurse care coordinators, dietary, social work, and community services such as transportation and meal programs. The development of the PHN is reported in detail elsewhere.[8] The objective of this study was to assess the initial usability of the PHN among patients.

## 2. Methods

The PHN was implemented in a small (n=60) two-arm, randomized, pragmatic trial with the control group receiving standard nurse care coordination, and the intervention group receiving nurse care coordination and the PHN. Participants were adult, English-speaking patients of the University of California Davis, Comprehensive Cancer Center, with a primary diagnosis of cancer (any site), initiating chemotherapy, with an expected survival period of six months or longer. Participants were followed for six months even if chemotherapy was completed in less than six months. Participants received an 8.4 inch, Samsung Galaxy tablet with Wifi and 4G data plan and an individual orientation to the tablet and the PHN on enrollment. Technical assistance was offered via a help button in the PHN application and telephone helpline.

Interviews were conducted based on think-aloud methodology.[9] Interviews of the intervention group were conducted by one of two trained interviewers using an interview guide approximately three to four weeks after starting the trial in order to assess initial usability of the PHN. Participants were asked to show how they used each major function in the application with their own tablet and PHN account. The functions included: login, view members of the PHN, send/view a secure text message, start a video chat, use patient education library, complete symptom assessment survey, access plan of care, add or check appointments in calendar. The interviewer made notes on points at which the participant hesitated, seemed unsure how to proceed, or expressed frustration with the PHN so that she could prompt the participant to think aloud about the experience at those points. Interviewers also asked questions: How do you typically use this feature, what is easy or challenging, what would make this easier to use or more useful, has use of the PHN changed anything you do in your daily life? Interviews were recorded and transcribed verbatim. Transcripts were coded inductively by one investigator following principles of grounded theory.[10,11] Findings were used to develop version 2 of the PHN. The study was approved by UC Davis IRB.

## 3. Results

23 participants were enrolled in the RCT at the time of this qualitative study (78% recruitment rate). The mean age was 60 (range 46 to 81). They were 74% female, 91% white. They had on average a college degree and \$70 – \$79k annual income. The control group (n = 8) was slightly younger (mean age 59 vs. 64) and lower income (\$60 – 69k vs. \$70 - 79k). Interviews were completed on 12 of 15 intervention group participants and lasted 30-45 minutes each. Table 1 lists the commonly mentioned impacts of the PHN on daily life and challenges to use/areas of improvement for the application. Version 2 of the PHN is shown in Figure 1.

**Table 1.** Themes

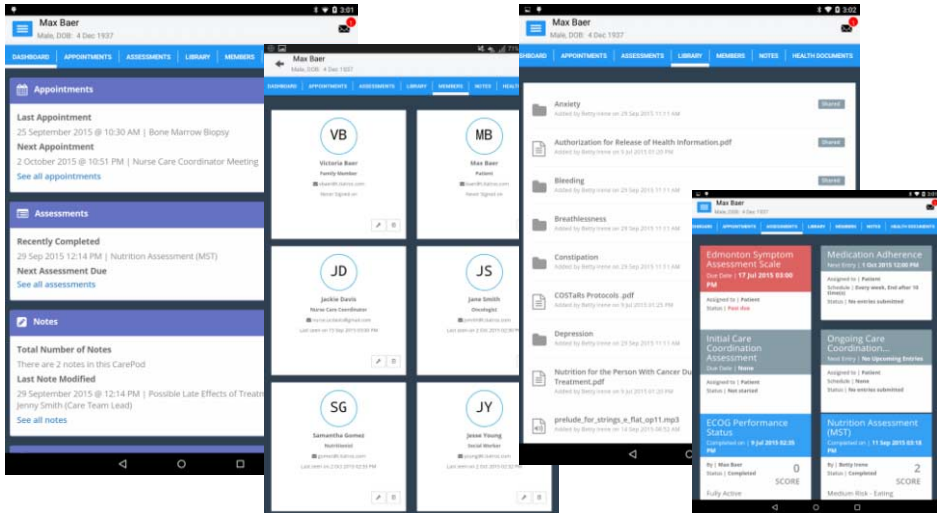
<b>Impacts on daily life</b>	<b>Representative Quotes</b>
Connectedness to healthcare team	<p>“...then it [messaging] kind of feels like you’re an email friend of mine rather than you’re a medical provider...And it makes it feel, our connection feels more personal...like, hey, I can build a relationship with these women and see how that goes. And that’s just going to be better for me in the long run with my whole care.”</p>
Coordination of activities	<p>“It helps keep me engagement in what’s going on. It kind of gives me something to do. If I think about every day I just have to check in and see if there’s anything, any messages that I’ve gotten. I’ve used it to keep notes when I have something going on so when I go to my doctor’s appointment I can remember to talk to my doctor about it, which came in very useful because I had an appointment on Monday and I think I had five things that I had already written down.”</p>
<b>Positive aspects of PHN</b>	
Ease of communication	<p>“...if I had my email I’d have to sort through all my emails...what’s nice about this is that it’s controlled, it’s contained. I have like five people on there so it’s really easy to see whom I’m giving my record. Yeah, so it’s faster to access things that way rather than having to scroll through. And it’s really easy to use” “I guess you know I’m saying like feedback on this one, like for me coming in and let us say it’s not—I have additional questions to this, maybe I can forward it to my care team.” “I don’t think there was anything really challenging about it. I just go along and press the buttons and figure out what I need to do.”</p>
Access to patient education	<p>“I guess it’s easy in term of because it’s all in category, then you know if I’m looking for certain things. Like for example, this is the one that I was reading a lot, the transportation and travel, and then the common concerns.” “It gives you a place to go. I mean you don’t have to bother the staff or contact the med center directly. This will be a good beginning and if there’s something on here that you know doesn’t answer your questions then you could very often just call.”</p> <p>“Perhaps there was a few things there about some of the issues I talked to her about. She listened to me and offered to send over documents to help me...So it’s not just a document, it’s actually a link to like guided imagery, like audio things that you can like listen to. So, I do like this feature a lot.”</p>
Attention to symptoms	<p>“And then using it to let people know if I’m having any health issues. Like I think when I have the heartburn, I let [care coordinator] know that I had pretty bad heartburn and then she was able to send me some suggestions.” “You know like if they are doing a survey about my pain, about my emotional state, is it useful to share it with my medical oncologist or my surgical oncologist or something, or my primary doctor.” “So it reminded me to pay more attention to things on a daily basis andlie, oh year, that’s right, I am having these little tingles on my tongue. Oh, that is part of sensory changes. So it kind of educated me like, I’m not going crazy. Like, oh yeah, the medication can.”</p>
Family/caregiver access	<p>“And then [spouse] is on it but he hasn’t gone on and played with it. I just let him get on it...If he is concerned about it and I’m say no, I’m fine, it’s fine. Then he can always check in with [care coordinator] and say, she’s saying this is fine but I don’t know. And I think that would give him some peace of mind. Because I don’t want to be sick. I don’t want to seem sick.”</p>
<b>Suggested improvements in PHN</b>	
Similar functions in EHR	<p>“The other thing is that since a lot of appointments are on MyChart [EHR] and some are on this and it would be nice to have them all in one place.” “I think the biggest challenge is whether some of these responded or not...because I don’t know if they’re on vacation or you know something like that...because usually I do get a response whether it’s from the doctor or nurse [in MyChart EHR]” “It’s much more focused or targeted because ...I know this is going straight to [care coordinator]...With MyChart I know I’m going to send it to the doctor, but then there is going to be an intermediary that’s going to come into the picture.”</p>
Confusing navigation	<p>“Well yeah, and then it would be a lot easier. And I still say that the tabs for me going to this and find those buttons, why isn’t it topic A and the three buttons there and topic B and the two buttons there and everything written out in some menu or something so there’s no confusion.”</p> <p>“No, here we go. Doggone it, I don’t know, I think it’s one of these. Nope, not that one. It’s behind door number two.”</p>
Connectivity/ Tablet	<p>“So the one issue that I have has is that my home internet is very slow...” “It’s been a little rough. Yes, because I’ve had trouble getting connections.”</p> <p>“And it kept saying, oh SIM card, activate SIM card. The SIM card needs to be installed, you know and I thought, isn’t this a SIM card I pulled off? Isn’t the SIM card a tiny card about</p>



Appointments

*that big with a corner cut off?"*

*"Because I could have sworn I put one in but I was also having a little bit of problems, tech problems. And so I don't know whether it actually went in...I'd like it if I pulled up a calendar and it showed the whole month and be able to click on the date of the month."*



**Figure 1.** The Personal Health Network Mobile Application v2.0: Patient Dashboard (Overall Care Plan), Members, Library, Symptom Assessments and Patient-reported Outcomes

#### 4. Discussion

Refinements to the user interface focused on the major challenges and usability issues identified by participants: simplifying the navigation, offering a dashboard as an alternative organization for information, and creating utilities for synchronizing appointments with Google and Outlook. Two of the key challenges identified will require additional investigation. First, the PHN is a rich application requiring substantial bandwidth for adequate performance. Connectivity is an ongoing challenge both on the medical center's wireless network, and in the home environments even using 4G. Strategies for optimizing performance must be investigated. Second, interoperability of the PHN with the EHR, particularly with respect to appointments, is critical for adoption. Synchronizing clinical and care coordination appointments and activities so that an individual and the healthcare team can have a comprehensive view of her schedule is a prerequisite for effective coordination. Interoperability in consumer and workplace scheduling systems is a well-documented user preference for which Internet standards have been promulgated since the 1990s.[12] Yet, these standards have not been adopted by EHRs for healthcare, perhaps due to privacy concerns.

Participants indicated the PHN supported communication with the healthcare team as well as engagement of family members in care particularly with symptom management. Enabling one-on-one and group communication among the healthcare team members, individuals, and family and caregivers offered a feeling of

connectedness that was important to participants. These findings align with previous work that suggests well-designed IT can preserve trust and sense of relationship.[5]

This study had several limitations. First, data was not collected on prior use of tablets or mobile applications limiting interpretation of potential usability challenges due to lack of experience. Second, since the study is in progress data on actual use of the technology was not available to allow for triangulation of interview findings with objective use of technology.

Early evaluation of the usability of the PHN has allowed for refinements in the mobile application to be implemented and rolled out to the same participants. Summative evaluation will be conducted to understand whether we have improved usability as well as gauge effectiveness of the. As one of the first examples of a technology-enabled care coordination intervention in oncology, this study contributes an early view into the possibilities for healthcare improvement that a person-centered model such as this may enable.

## 5. Acknowledgments

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## References

- [1] C. Schoen, R. Osborn, D. Squires, M. Doty, R. Pierson, S. Applebaum. New 2011 survey of patients with complex care needs in eleven countries finds that care is often poorly coordinated. *Health Aff (Millwood)*. 2011;30(12):2437-48.
- [2] T.J. Smith, B.E. Hillner. Bending the cost curve in cancer care. *New England Journal of Medicine*. 2011;364(21):2060-5.
- [3] A.D. Vandyk, M.B. Harrison, G. Macartney, A.Ross-White, D. Stacey. Emergency department visits for symptoms experienced by oncology patients: a systematic review. *Supportive Care in Cancer*. 2012;20(8):1589-99.
- [4] D. Peikes, P.D.R. Brown, P.D.G. Peterson, M.J. Schore. *The Promise of Care Coordination: Models That Decrease Hospitalizations and Improve Outcomes for Medicare Beneficiaries with Chronic Illnesses*. Mathematica Policy Research, 2009.
- [5] B.W. Hesse, C. Hanna, H.A. Massett, N.K. Hesse. Outside the Box: Will Information Technology Be a Viable Intervention to Improve the Quality of Cancer Care? *JNCI Monographs*. 2010;2010(40):81-9.
- [6] Oncology Care Model [cited 2015 March 8th]. Available from: <http://innovation.cms.gov/initiatives/Oncology-Care/>.
- [7] R. Dickinson, S. Hall, J.E. Sinclair, C. Bond, P. Murchie. Using technology to deliver cancer follow-up: a systematic review. *BMC Cancer*. 2014;14:311.
- [8] K.K. Kim, J.F. Bell, S.C. Reed, J.G. Joseph, R. Bold, K.L. Cerrone, et al. A novel personal health network for patient-centered chemotherapy care coordination. *Collaboration Technologies and Systems (CTS), 2014 International Conference on*; 2014: IEEE.
- [9] M.W. Jaspers, T. Steen, C.V.D. Bos, M. Geenen. The think aloud method: a guide to user interface design. *International Journal of Medical Informatics*. 2004;73(11):781-95.
- [10] J. Corbin, A. Strauss. *Basics of qualitative research: Techniques and procedures for developing grounded theory*: Sage publications; 2014.
- [11] K. Charmaz. *Constructing grounded theory: A practical guide through qualitative analysis (Introducing Qualitative Methods Series)*. 2006.
- [12] F. Dawson. (1997). Emerging calendaring and scheduling standards. *Computer*, 30(12), 126-128. doi:10.1109/2.642819.

# The Nursing Informatician's Role in Mediating Technology Related Health Literacies

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**Abstract.** The advent of computer based technology and the internet have not changed nurses' responsibility for patient education; but they are rapidly changing what we teach and how we teach. The challenge for nursing informaticians is to create innovative patient education models and applications with the goal of achieving literate, engaged, empowered and informed patients as well as preparing health professionals to maximize the advantages offered by digital media and other new technology based tools. This paper explores the interrelationship of basic literacy, health literacy and technology related literacies that provide the foundation for achieving these goals.

**Keywords.** Digital Health Literacy; Patient Education; ePatients, eHealth literacy

## 1. Introduction

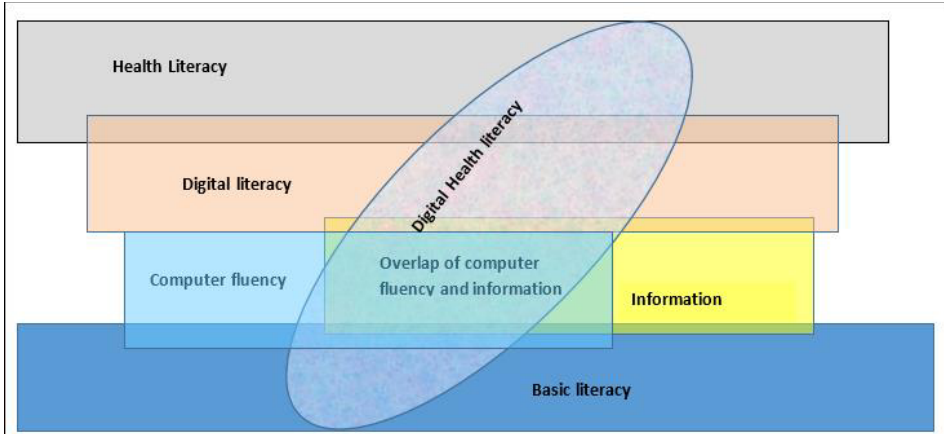
Patient and professional education has been a long standing responsibility of nursing the world over for centuries. The advent of the internet did not change that responsibility; but it is rapidly changing what we teach and how we teach. Key principles underlying the education process have also remained constant. For example, the education process begins by assessing the learner's knowledge, attitudes and skills as a basis for providing learner specific education. The internet and related technologies are now providing us with new models and tools for assessing patients, students, families, and communities and creating the opportunity for innovative interventions to meet the educational needs of the ePatient and eStudent. The challenge for the nursing informatician is to create innovative education models and applications for achieving the goals of (1) engaging, empowering and informing patients and (2) preparing health professionals to maximize the advantages offered by these new tools.

Meeting these challenges requires an understanding of digital health literacy and the literacies that are foundational to the concept of digital health literacy. In describing literacy levels a variety of literacy types have been identified. This paper explores basic literacy, health literacy and the technology related literacies that relate directly to the

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education of patients and healthcare providers in today's interactive networked world. Successful use of communication related technology tools in healthcare depends on a synthesis of basic literacy, computer literacy, information literacy, digital literacy and health literacy. These specific literacies are both overlapping and interrelated as illustrated in Figure 1.



**Figure 1.** Overlapping Relationships of Technology Related Literacies and Basic Literacy.

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## 2. Definition of Basic Literacy

In 2003, UNESCO proposed an operational definition that encompasses several different dimensions of literacy. “Literacy is the ability to identify, understand, interpret, create, communicate and compute, using printed and written materials associated with varying contexts. Literacy involves a continuum of learning in enabling individuals to achieve their goals, to develop their knowledge and potential, and to participate fully in their community and wider society.”<sup>[1]</sup>

This definition focuses on the ability to absorb and understand information in printed or written format. However, using this ability when the format moves from paper to a computer is not intuitive. Computer literacy involves much more than the ability to read or interpret information using a computer. Even the term computer literacy with its limited focus is becoming outdated.

## 3. Definition of Computer Literacy/Fluency

The National Academy of Science (NAS) coined the term “FIT Persons” to describe people who are fluent with information technology.<sup>[2]</sup> FIT Persons possess three types of knowledge:

- Contemporary Skills which include the ability to navigate and use current computer applications such as an internet search engine.
- Foundational Concepts which include understanding the how and why of information technology. This knowledge gives the person insight into the

opportunities and limitations of social media and other information technologies.

- Intellectual Capabilities which include the ability to apply information technology to actual problems and challenges of everyday life.

By 2006, the NAS, reflecting the ever growing types of computer based and digital technologies, was using the term *technologically literate person*, but the framework of contemporary skills, foundational concepts and the ability to apply these to everyday life remained. [3] As nursing informaticians continue to identify content and structure learning opportunities for healthcare providers and patients/consumers/clients this framework provides an overall organizing structure for that work.

#### 4. Definition of Information Literacy

The American Library Association (ALA) has supported the development of information literacy standards since the 1980s. The ALA defines information literacy as “a set of abilities requiring individuals to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information.”<sup>[4]</sup> The United Nations Educational, Scientific and Cultural Organization (UNESCO) defines information literacy as “the ability to recognize when information is needed and to locate, evaluate, effectively use and communicate information in its various formats.”<sup>[5]</sup>

The concept of information literacy acknowledges that different types of knowledge and skills are needed to evaluate health information posted on Facebook, versus Wikipedia, versus an on-line peer-reviewed pre-published article versus a peer-reviewed published article. The concept of information literacy also acknowledges professional students need different writing skills when participating in an online dialog as opposed to preparing a term paper. Developing appropriate learning experiences and educational standards to master these skills are the challenges facing informaticians in the world of social media and engaged patients/consumers.

#### 5. Definition of Digital Literacy

The term digital literacy first appears in the literature in the 1990s. However, to date there is no generally accepted definition. While the definition is currently evolving a review of those published reflect many of the same concepts. One of the earliest definitions was provided by the Aspen Institute Communications and Society Program and the John S. and James L. Knight Foundation. “Digital and media literacy are defined as life skills that are necessary for participation in our media-saturated, information-rich society.”<sup>[6]</sup> Nelson and Joos defined digital literacy as including:

- Competency with digital devices of all types including cameras, eReaders, smartphones, computers, tablets, video games boards, etc. This does not mean that one can pick up a new device and use that device without an orientation. Rather, one can use trial and error as well as a manufacturer's manual to determine how to effectively use a device.
- The technical skills to operate these devices as well as the conceptual knowledge to understand their functionality.

- The ability to creatively and critically use these devices to access, manipulate, evaluate and apply data, information, knowledge and wisdom in activities of daily living.
- The ability to apply basic emotional intelligence in collaborating and communicating with others.
- The ethical values and sense of community responsibility to use digital devices for the enjoyment and benefit of society.<sup>[7]</sup>

Digital literacy is a more comprehensive concept than computer or information literacy. Digital literacy does not just mean that one knows how to use digital tools; it is also about understanding the implications of digital technology and the impact it is having, and will have, on every aspect of our lives. While there is not a generally accepted definition, there are a number of books published about digital literacy. A search of Amazon in October 2015 returned 174 books with the term “digital literacy” in the title, the first published with a copyright date of 2010. However, if the search is limited to the Amazon categories of medicine or health no results are returned. Using the key term of health returned eight books, two of which included a chapter on digital literacy and health. Informaticians are challenged to close this gap in the literature.

## **6. Definition of Health Literacy**

While health literacy is concerned with the ability to access, evaluate and apply information to health related decisions, there is not a consistent generally accepted agreement on the definition of this term. In 2011, a published systematic review of the literature in Medline, PubMed and Web of Science identified 17 definitions of health literacy and 12 conceptual models. The most frequently cited definitions were from the American Medical Association, the Institute of Medicine, and WHO<sup>[8]</sup>. Current definitions from these organizations include:

- American Medical Association defines health literacy as “the ability to obtain, process and understand basic health information and services needed to make appropriate health decisions and follow instructions for treatment.”
- The Institution of Medicine uses the definition of health literacy developed by Ratzan and Parker and cited in *Healthy People 2010*. Health Literacy is “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions.”
- The World Health Organization (WHO) defined health as “the degree to which people are able to access, understand, appraise and communicate information to engage with the demands of different health contexts in order to promote and maintain good health across the life-course.”

The focus in each of these definitions is on an individual’s skill in obtaining, processing and understanding the health information and services necessary to make appropriate health decisions. While these definitions are congruent with the Web 1.0 model of information access, where health information is posted on websites for access by patients/consumers/clients they do not address the interactive world of Web 2.0 or the evolving Web 3.0 or the “internet of things.” In recognition of this deficiency, Norman and Skinner introduced the concept of eHealth as “the ability to seek, find,

understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem.”<sup>[9]</sup> This definition acknowledges the need for computer fluency and the use of information skills to obtain an effective level of health literacy; however it is not sensitive to the impact of social media. Creating a comprehensive definition and model for assessing health literacy levels that include social media literacy skills are needed for today’s communication processes and remains a challenge for informaticians.

## 7. Conclusion

While each of the technology related communication literacies focuses on a different aspect of literacy and has a different definition, they overlap and are interrelated. Figure 1 demonstrates those interrelationships. In this Figure, basic literacy is depicted as foundational to all other literacies. Digital literacy builds on computer and information literacy as well as other social media related knowledge and skills not currently included in the definitions of computer and information literacy. Health literacy requires both digital literacy and a basic knowledge of health.

The concept of digital health literacy incorporates each of these literacies. It includes contemporary skills, foundational concepts and the ability to apply these to everyday life. While each of the different literacies create unique challenges, mastering these challenges requires a synergistic approach. Such an approach makes it possible to develop effective digital health educational programs for patients and providers. Such programs make it possible to develop engaged, empowered and informed patients as well as prepare health professionals to maximize the advantages of working with such patients/consumers/clients.

## References

- [1] UNESCO, *The Plurality of Literacy and its Implications for Policies and Programmes*: UNESCO Education Sector Position. UNESCO. 2004. Page-13. Located at <http://bit.ly/1So9eSo>
- [2] Committee on Information Technology Literacy: National Research Council, *Being Fluent with Information Technology*. Washington, D.C.: National Academy Press 1999
- [3] E. Gamire and G. Pearson, Editors; Committee on Assessing Technological Literacy; National Academy of Engineering; National Research Council, *Tech Tally: Approaches to Assessing Technological Literacy*. National Academies Press Washington, D.C. 2006. Located at <http://bit.ly/1MIvY8w>
- [4] American Library Association, *Information Literacy Competency Standards for Higher Education*. Chicago, IL: American Library Association. 2000. Page 2.
- [5] C. Wilson, Al. Grizzle, R. Tuazon, K. Akyempong, and C. Cheung, *Media and Information Literacy Curriculum for Teachers*. UNESCO. Paris. 2011. Located at <http://bit.ly/1UvHZ7K>
- [6] R. Hobbs, *Digital and Media Literacy: A Plan of Action*. Aspen Institute Communications and Society Program and the John S and James L Knight Foundation. 2010. Located at <http://kng.ht/1JLjGMQ>
- [7] R. Nelson, and I. Joos, *An introduction to social media and the transforming roles and relationships in health care*. Chapter 1 in R. Nelson, I. Joos, D. Wolf, *Social Media for Nurses*. New York: Springer Publishing Company. 2013.
- [8] K. Sørensen, S. VandenBroucke, J. Fullam, G. Doyle, J. Pelikan, Z. Slonska, and H. Brand for (HLS-EU) Consortium Health Literacy Project European, *Health literacy and public health: A systematic review and integration of definitions and models*. *BMC Public Health* (2012). 12:80 Located at <http://bit.ly/1So9G3e>
- [9] C.D. Norman and H.A. Skinner, *eHealth literacy: Essential skills for consumer health in a networked world*. *Journal of Medical Internet Research*. (2006) 8(2), e9. Located at <http://www.jmir.org/2006/2/e9/>

# Discovering eHealth Technology: An Innovative Interprofessional Graduate Student Learning Experience

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**Abstract.** The use of eHealth has grown in recent years and is projected to continue to increase exponentially. In order to empower and prepare advanced practice providers to integrate eHealth into their clinical practice, curricular changes need to occur. The iTEAM grant provides a unique opportunity to prepare advanced practice disciplines to provide collaborative care using eHealth. Through the integration of a simulated telehealth using a standardized patient, Doctor of Pharmacy and Advanced Practice Registered Nursing students learned how to apply health information technology and coordinate care in an interprofessional manner. Opportunities and challenges to guide future efforts to integrate eHealth-learning experiences into the curriculum are identified.

**Keywords.** eHealth, telehealth, curriculum, interprofessional, simulation

## 1. Introduction

The adoption of health information technology (HIT) in the health care industry increased in the United States following the enactment of the Health Information Technology for Economic and Clinical Health (HITECH) Act in 2009. At the time of its ratification, the HITECH legislation mainly focused on the implementation and meaningful use of electronic health records (EHR). With the increased adoption of HIT, the focus has expanded to telehealth, which has become an essential component of the health care delivery system[1]. The terms *Telehealth* and *eHealth* have been used interchangeably to describe the use of technology in a healthcare manner[2]. Telehealth can be integrated into eHealth as it encompasses e-commerce and e-business practices in health systems management[3].

With the increasing use of telehealth technology, a reevaluation of curricula in health care disciplines is needed to prepare this workforce. The Institute of Medicine's *Health Professions Education: A Bridge to Quality* report [4] includes HIT in their list of five core student competencies. In nursing education, there is limited data about incorporating telehealth technology into graduate curricula. Erickson, Fauchald and Ideker described the inclusion of telehealth in nursing education through classroom and clinical experiences. Results revealed that the experience strengthened the Advanced

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Practice Registered Nurse (APRN) students' knowledge in telehealth and increased their interests to work in rural settings[5]. Additionally, integration of telehealth technology into pharmacy practice has been found to enhance patient monitoring and medication adherence[6,7].

The value of incorporating telehealth technology into practice is reflected in the accreditation standards for training nurse practitioners and pharmacists through graduate level education in the United States. These organizations call for optimization of medical service delivery through training of nursing and pharmacy students, respectively, in the competencies of technology utilization[8,9]. This shared value provides further opportunities to foster interprofessional (IP) HIT education for nursing and pharmacy students. In 2012, the Health Resources and Services Administration (HRSA) awarded the University of Colorado College of Nursing (CON) a \$1.2 million grant. The Interprofessional Technology Enhanced Advanced Practice Model (iTEAM) was formed to focus on the preparation of advanced practice disciplines in nursing and pharmacy to provide IP care through the use of HIT.

## 2. Methods

CON and School of Pharmacy (SOP) faculty collaborated to design and implement an educational experience that introduced students to telehealth technology in a simulated IP clinical environment. This elective simulation was offered to both second-year Doctor of Pharmacy students enrolled in an experiential education course and APRN students enrolled in an advanced physical assessment course during the 2015 spring semester. One student from each program was paired to form an IP team tasked to conduct a telehealth patient visit with a standardized patient (SP) integrating videoconferencing, telehealth monitoring tools, and a simulated academic EHR. A SP is an actor trained to portray a patient in a medical scenario in order to provide a consistent learning environment for all student participants.

After the telehealth encounter, the SP and faculty evaluated students based on the learning objectives (Table 1). Students completed an open-ended questionnaire evaluating their simulation experience and beliefs regarding telehealth. A qualitative content analysis[10] of all responses was undertaken to describe the learning experienced and evaluate effectiveness of the simulation in achieving outcomes.

**Table 1.** Student Learning Objectives and Telehealth Outcomes

Student Learning Objectives		Telehealth Outcomes
Shared Objectives	Profession-Specific Objectives	
1. Communicate in an IP manner during a simulated telehealth visit in order to positively influence patient outcomes.	1. Perform a problem focused patient history pertaining to the chief complaint while drawing upon the knowledge strengths of the pharmacy student ( <i>CON students only</i> ).	1. Telehealth technology is reported to be valuable for providing patient care.
2. Analyze patient telehealth data and correlate it to patient use of basic telehealth tools.	2. Identify a pharmacy-related patient care need and communicate it to the patient, to the APRN student, and in a written clinical note ( <i>SOP students only</i> ).	2. Telehealth is a tool that empowers and connects the provider and patient.
		3. Students identify ways in which telehealth technology may improve patient care if applied to the clinical practice setting.

### *2.1 IP Telehealth Visit Simulation Design*

All students were introduced to the telehealth tools and learning objectives during an initial meeting with the iTEAM project coordinator and faculty. Each student pair had the opportunity to demonstrate use of telehealth monitoring tools (blood pressure, weight scale, SpO<sub>2</sub>, and pulse monitors) and discuss logistics of the visit. A detailed outline of the activity, objectives and expectations were provided. Students were encouraged to become familiar with details of the clinical case uploaded into an academic EHR and to test the videoconferencing prior to the SP visit.

During an assigned time and from three remote locations, the students and SP accessed a videoconference meeting and conducted a simulated IP telehealth visit. The SP case involved a 69-year-old male with a history of heart failure, obstructive sleep apnea, and hypertension. Students were provided a brief patient history including the initial indication and instructions for the use of the telehealth tools. As described in the case, the patient was instructed to gather vital sign data daily and forward results to the office care coordinator weekly. During the simulation, the SP reports, "I am following up regarding my telehealth readings after I was given the heart failure kit to use at home". The patient's case data revealed sporadic adherence to this new program and the SP demonstrated confusion and misunderstanding of his current medication plan.

### *2.2. Qualitative Evaluation*

Students received an anonymous electronic survey designed to obtain demographic data and narrative responses to the following questions:

1. Which program were you enrolled in when you participated in the exercise?
2. How do you feel about the patient interview exercise using telehealth tools?
3. Regarding the IP patient visit and use of telehealth tools, what worked well?
4. Where do you think you could have improved in this exercise?
5. After participating in this experience, what is your definition of telehealth?
6. Please provide any additional comments you wish to share related to your IP experience utilizing videoconferencing, the academic EHR, or telehealth tools.

A trained research assistant reviewed the text data and a content analysis was conducted to identify similarities and differences using ATLAS.ti software. Two faculty members reviewed unique elements and statements to determine if they provide evidence of meeting the pre-determined telehealth outcomes. Consensus was achieved through discussion and context review and three distinct themes were identified.

## **3. Results**

Fifteen students participated in the simulation. Six teams consisted of one CON and one SOP student; one team that was assigned one CON student and two SOP students. Students submitted 158 lines of text in the questionnaire. The CON students were enrolled in the adult gerontology Clinical Nurse Specialty program (n=1) or the adult gerontology, family or pediatric Nurse Practitioner programs (n=6). The SOP students were in their second of a four-year program. Most students were female (12), Caucasian (12) and 20-29 years of age (n=10) with a range of 20-59 years.

### *3.1 Theme One: Telehealth Technology is Valuable*

Twenty-three unique statements described the value of using telehealth technology in patient care (telehealth outcome #1). Connectivity between providers and patient (telehealth outcome #2) was the most predominate sub-theme expressed. Students identified opportunities for patients to access providers despite distance. One student described telehealth visits as “ a modern day way of conducting a house/office visit.” Another student stated the technology “can benefit those who are living in rural areas or who are mobility limited”. An additional benefit identified was the increased ability to recognize verbal and non-verbal communication. One student stated that telehealth made it possible for the provider to “visualize the patient directly using the tools.” Other responses reflected that real-time patient observation was a more accurate reflection of the patient’s actual practice, “the provider can offer detailed instructions as well as [determine] whether the patient is on the right track.”

A concern for patients who may not know “how to use a computer properly or lack Internet connectivity” was noted as a limitation. Another student mentioned that geriatric and socioeconomically underserved patient populations might find integrating telehealth technology more challenging compared to other patient populations.

### *3.2 Theme Two: Telehealth Technology May Provide Efficient Care*

Several students described the technology as working well, “the academic EHR was fantastic in providing patient information” and there was “very minimal, if any, video lag.” Video and voice quality were described as reliable, offering easily discernable communication. Four students offered differing opinions about the videoconferencing and EHR tools. Most issues described were minor, such as “the interview was very loud... if one of the computers has some un-fixable interference, the conversation becomes very hard to hear.” One student noted a limitation of the academic EHR stating it “can be slow at times and requires a specific operating system.”

### *3.3 Theme Three: Telehealth Technology Promotes IP Collaboration*

Students clearly valued the simulation experience when describing the enhanced opportunities to practice as an IP team. One student stated, “Since we worked in an interdisciplinary team, we could spontaneously support each other.” Another student stated, “I think telehealth can help improve the gap within interprofessional communication. Each professional has their own set of knowledge and experience and bringing those together makes for optimal plan of care and treatment.”

## **4. Discussion**

With the increased utilization of teleconferencing and HIT in health care[2], nursing education now and in the future needs to focus on adequately preparing students[4,5,8]. In this educational experience, infusing telehealth technology into the curriculum through the use of an IP simulated telehealth visit was described as valuable. Students recognized the ability to increase connectivity and communication between the patient and the provider in an IP manner despite distance. A challenge included the cost of

hiring and training a SP as well as purchasing telehealth tools and use of an academic EHR. The SP and telehealth tools were purchased through the grant. Use of videoconferencing services was offered through the University for all students and faculty. If a SP cannot be purchased, a faculty member could play the role.

The SOP and CON students who participated in this pilot were volunteers, which may affect the transferability of the results. These students may have had a stronger curiosity or interest in telehealth. We did not determine what motivated these students to participate. This will be investigated further with future iterations of the simulation.

In conclusion, incorporating telehealth-learning experiences into academic curriculum has the potential to teach students the value of HIT as well as how it can connect different disciplines and be applied to the clinical setting. The next step will be the proposal of an academic module that can be implemented into the curriculum for all students. By acknowledging the direction of healthcare and continually guiding curriculum to stay up-to-date with HIT, students have an opportunity to be better prepared to practice in the ever-evolving health care environment.

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## References

- [1] American Hospital Association. Realizing the Promise of Telehealth: Understanding the Legal and Regulatory Challenges [Internet]. 2015 May [updated 2015 May; cited 2015 Sep 28]. Available from: <http://www.aha.org/research/policy/2015.shtml>
- [2] F. Fatehi, R. Wootton. Telemedicine, telehealth or e-health? A bibliometric analysis of the trends in the use of these terms. *Journal of telemedicine and telecare*. 2012;18(8):460-4.
- [3] The World Health Organization. E-Health [Internet]. 2015 [cited 2015 Sep 15]. Available from: <http://www.who.int/trade/glossary/story021/en/>
- [4] E. Knebel, A.C. Greiner. *Health Professions Education: A Bridge to Quality*: National Academies Press; 2003.
- [5] C.E. Erickson, S. Fauchald, M. Ideker. Integrating Telehealth Into the Graduate Nursing Curriculum. *The Journal for Nurse Practitioners*. 2015;11(1):e1-e5.
- [6] K.A. Clauson, S. Elrod, B.I. Fox, Z. Hajar, J.H. Dzenowagis. Opportunities for pharmacists in mobile health. *American journal of health-system pharmacy: AJHP: official journal of the American Society of Health-System Pharmacists*. 2013;70(15):1348-52.
- [7] K.L. Margolis, S.E. Asche A.R. Bergdall, S.P. Dehmer, S.E. Groen, H.M. Kadrmaz, et al. Effect of home blood pressure telemonitoring and pharmacist management on blood pressure control: a cluster randomized clinical trial. *Jama*. 2013;310(1):46-56.
- [8] A.C. Thomas, M.A. Dumas, R. Kleinpell, M.C. Logsdon, J.D. Marfell, D.G. Nativio. Nurse practitioner core competencies [Internet]. 2012 [updated 2012; cited 2015 Aug 10]. Available from: <http://c.ymcdn.com/sites/www.nonpf.org/resource/resmgr/competencies/npcorecompetenciesfinal2012.pdf>
- [9] M.S. Medina, C.M. Plaza, C.D. Stowe, E.T. Robinson, G. DeLander, D.E. Beck, et al. Center for the advancement of pharmacy education 2013 educational outcomes. *American journal of pharmaceutical education*. 2013;77(8):162. doi:10.5688/ajpe778162.
- [10] H.F. Hsieh, S.E. Shannon. Three Approaches to Qualitative Content Analysis. *Qualitative health research*. 2005;15(9):1277-88.

# Clinical Simulation in the Development of eHealth: In-Situ and Laboratory Simulation

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**Abstract.** Health information technology (IT) may improve patient safety and quality, but the application of new technology in health care may also increase patient safety hazards. The complexity of organizations, work practices and physical environments within the healthcare sector impacts the development and application of health IT. Clinical simulation can be used to evaluate technology in differing clinical contexts, throughout the software development life cycle in nursing informatics. Clinical simulation may be conducted in a range of settings varying from simulation laboratories to simulation in real settings. Clinical simulation supports involvement of context in pre-implementation design and evaluation of health IT involving real end-users as they use technology in realistic environments performing realistic tasks. The inclusion of clinical context is a powerful element of clinical simulation and enables visualization of technology in connection with clinical context without endangering patients.

**Keywords.** Clinical simulation, ergonomics, evaluation, patient safety, quality, technology-induced error, workflow, in situ, laboratory

## 1. Introduction

There is increasing demand for health care services to be efficient, highly productive and provided at a lower cost. Inadequate workflows may result in low efficiency and poor patient safety. Implementation of information technology (IT) is one method used to optimize workflow and patient safety. However, patient safety in relation to health IT presents a paradox [1]. Even though health IT may improve patient safety and quality [2], the application of new technology in health care may also increase patient safety hazards [3]. Errors persist in clinical practice even after new health IT has been introduced partly because manual processes co-exist with automated processes and the interfaces between the two are seldom perfect [4].

The substantial complexity of organizations, work practices and physical environments within the healthcare sector impacts development as well as the implementation and use of health IT [5, 6]. Healthcare environments are profoundly collaborative and rely on coordination between various health professionals [7] and are characterized by delegated decision-making, multiple viewpoints, inconsistent and evolving knowledge bases [8]. Multiple groups with potentially divergent values and objectives work together and face many contingencies, which cannot be fully anticipated [9, 10]. When there are differing types of health professionals, patient care

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can also be provided in varying ways, challenging the wisdom of standardizing health care work [8]. Clinical simulation can be used to proactively evaluate: (a) new technology in differing clinical contexts, (b) throughout the software development life cycle [11, 12], and (c) the interaction between users and technology as well as their potential effects on clinical workflow and organizational issues [13, 14]. In this paper we outline the two main approaches to clinical simulation from a methodological perspective and describe their value from a clinical simulation perspective.

## 2. Methods

Clinical simulation may be conducted in a range of settings varying from simulation laboratories to in-situ in real settings [15]. These settings include simulation laboratories and real-world health care facilities such as hospitals and clinics.

### 2.1. Simulation Laboratories

The IT Experimentarium (ITX) is a Danish simulation lab that was established in 2007 in the Capital Region of Denmark with the purpose of improving the quality and optimization of clinical information systems. Since 2011 it has been mandatory to conduct clinical simulation evaluations before new systems that affect clinical work practice are implemented. More than 40 clinical simulation studies have been conducted in the ITX-lab to improve the development and evaluation of clinical information systems [16]. Simulation labs are dedicated facilities with two rooms linked by a one-way mirror (see Figure 1 below for an example).



Figure 1 Left: Overview of the simulation set-up. Right: View from observation room

To the left of Figure 1, there is a diagram that is an overview of the simulation set-up. To the right of Figure 1, the view is from the observation room through a one-way mirror into the simulation room. The simulation room represents a hospital room for two patients with bedside tables and a portable computer for the health professional. An observation room is located in the right corner. Simulation of handover from hospital to community care by messaging technologies can also be carried out in a simulation laboratory. In such situations another simulation room replicates the nursing office in the community.

## 2.2. *In-situ*

In situations, where access to a simulation laboratory is not possible or it is difficult to fully replicate the organizational setting (including the technology that is present in that setting) in-situ simulations may be conducted. For example, a researcher might need to conduct a simulation involving a large x-ray scanner or a customized electronic health record that cannot be re-implemented elsewhere. In-situ clinical simulations have been conducted in empty patient exam rooms, health care team conference rooms and in operating rooms to give an example of a few in-situ simulation settings. The researchers identify a room or area that is representative of the organization where the health IT software or hardware will be used. Following this, representative users of the technology are asked to perform representative tasks in the context of scenarios that are the type of interactions they would have with the software and hardware. The approach allows one to see both usability and workflow problems in context with individuals who work in that setting. The approach has been used to evaluate telehealth, prescribing, electronic health record and operating room systems [12,15].

## 2.3. *Representative Users*

Clinical simulation can involve actors and real end-users [15]. During a simulation, actors may play the part of ‘patients’, while real life users engage with the technology while performing patient care. User colleagues’ (such as nurses, therapists) may also be invited to participate in the simulation to strengthen its realism.

## 2.3. *Audio and Video Recording to Data*

Representative users participate in the simulation and depending on the purpose of the simulation. Participants are asked to “*think aloud*” and are audio recorded to understand what they are thinking, and video recorded to better understand what they are doing. The impacts of the new technology on clinical workflow are recorded. Computer screens are also recorded to create an integrated view of technology, clinical and cognitive impacts of the new technology. Both technology professionals and clinicians are also able to observe their colleagues, when not participating in the simulation themselves [16]. After the simulation, the proposed information system is evaluated. Participants are asked to complete questionnaires and participate in a debriefing interview. Further to interview guides, observations made by the observers during the simulations are used as background for the interviews [16]. This may also include reviewing the video and audio data for clarification with the representative users. It must be clarified in advance as to whom the results are to be presented and how the results and recommendations should be implemented.

## 2.2. *Analysis of Clinical Simulation Data*

Data analysis involves reviewing audio, video and computer screen data in parallel. There is a need to integrate these three data views to fully understand the impacts of the technology on clinician cognition and workflow. Audio data is transcribed and the transcriptions are annotated with information about clinician activities from the video and computer screen recording data. Data can be coded for cognitive, usability, workflow and/or safety issues. The findings are used to improve health IT [12-14].

### 3. Results

Clinical simulation supports involvement of context as well as end-users in pre-implementation design and evaluation of health IT. Clinical simulations involve real end-users as they use technology in environments performing realistic tasks [15]. As shown in Figure 2, clinical simulation can be used in varying phases in the software development life cycle. Clinical simulation can be used to: analyse work practices, gather user requirements, conduct work practice analyses, provide application assessments, assess training programs, evaluate initial specifications, test early design solutions, and eliminate potential and actual patient safety issues (e.g. technology-induced errors). In the first phases of the lifecycle of health IT, simulation may be used for specification and evaluation of user requirements [12], as well as for obtaining knowledge and to evaluate work practice [14].

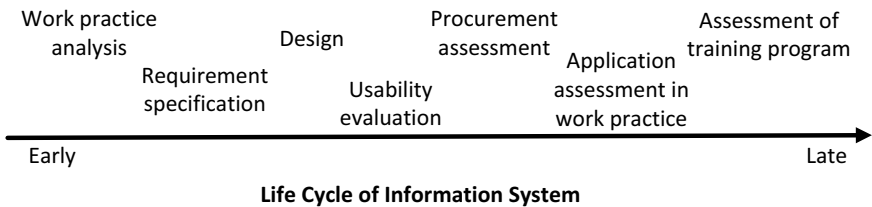


Figure 2 Activities in life cycle of an information system using clinical simulation

In the design phase, simulation is well suited for user involvement and makes it possible to test prototypical software in realistic scenarios and environments [15]. Simulation studies aim to evaluate design proposals for a new technology and combine elements of the laboratory test and field study [17]. Patient safety issues may be explored in all phases of the lifecycle as simulations allow for observation and analysis of medical errors, workflow and technology-induced errors in a close to a real-life environment [16]. Simulation studies can be designed to gain practical experience in health IT quality improvement, evaluation and safety of a new technology without introducing any kind of ethical issues or putting patients at risk [18]. Simulations do not reflect social-technical issues that may emerge over time and to a great extent the purpose and choice of scenarios determines the outcome of the simulations.

### 4. Conclusions and Discussion

Both laboratory based and in-situ simulations help nursing informatics professionals to improve the quality, fit and safety of health IT. Clinical simulation affords organizations a number of opportunities to improve software quality across the software development lifecycle. Simulations can be used to gather requirements for software development, evaluation of initial designs through to procurement and evaluation of pre- and post-software implementation activities (e.g. health professional training). As an evaluation methodology, clinical simulation can be employed by any healthcare organization. Formal simulation labs can be used by organizations to evaluate health IT. In-situ simulations can be conducted, if there is no access to a



formal lab or there is a need to ensure equipment and software that is specific to the organization is part of the simulation. Clinical simulations, a type of formative evaluation can be used to facilitate system adoption and utilization [16] and, improve systems during their development or implementation [17]. Clinical simulations can also identify potential problems, such as patient safety issues throughout the software development life cycle and can thus provide opportunities to improve a system as it develops. The purpose of the simulation must be very clear as it determines the outcome. Simulations allow for visualization of the correlation between human, technology and organization. By including all three aspects, patient safety simulation reveals both organizational and technical challenges associated with health IT. Observing the interaction between the user and the interface of the technology in a clinical context demonstrates the significant power of clinical simulation as an evaluation methodology for nursing informaticians. The inclusion of clinical context is one of the most powerful elements in clinical simulation and enables visualization of technology in connection with clinical context without endangering patients [18].

## References

- [1] E Coiera, J Aarts, C Kulikowski: The dangerous decade. *J Am Med Inform Assoc* 2012, 19:2-5.
- [2] DW Bates, M Cohen, LL Leape, JM Overhage, MM Shabot, T Sheridan: Reducing the frequency of errors in medicine using information technology. *J Am Med Inform Assoc* 2001, 8:299-308.
- [3] R Koppel, T Wetterneck, et al: Workarounds to barcode medication administration systems: their occurrences, causes, and threats to patient safety. *J Am Med Inform Assoc* 2008, 15:408-423.
- [4] CG Godriguez-Gonzalez, A Herranz-Alonso et al: Prevalence of medication administration errors in two medical units with automated prescription and dispensing. *J Am Med Inform Ass* 2012, 19:72-78.
- [5] YY Han, JA Carcillo, ST Venkataraman, RS Clark, RS Watson, TC Nguyen, H Bayir, RA Orr: Unexpected increased mortality after implementation of a commercially sold computerized physician order entry system. *Pediatrics* 2005, 116:1506-1512.
- [6] M Berg: *Health information management: Integrating information and communication technology in health care work*: Routledge; 2003.
- [7] P Carayon: Human factors of complex sociotechnical systems. *Appl Ergon* 2006, 37:525-535.
- [8] M Berg: Patient care information systems and health care work: a sociotechnical approach. *International journal of medical informatics* 1999, 55:87-101.
- [9] P Carayon, EJ Bass, T Bellandi, AP Gurses, MS Hallbeck, V Mollo: Sociotechnical systems analysis in health care: a research agenda. *IIE transactions on healthcare systems engineering* 2011, 1:145-160.
- [10] TG Kannampallil, GF Schauer, T Cohen, VL Patel: Considering complexity in healthcare systems. *Journal of biomedical informatics* 2011, 44:943-947.
- [11] EM Borycki, M Househ, AW Kushniruk, C Kuziemyky: Use of qualitative methods across the software development lifecycle in health informatics. *Stud Health Technol Inform* 2011, 164:293-297.
- [12] AW Kushniruk, VL Patel: Cognitive and usability engineering methods for the evaluation of clinical information systems. *J Biomed Inform* 2004, 37:56-76.
- [13] E Borycki, A Kushniruk: Identifying and preventing technology-induced error using simulations: application of usability engineering techniques. *Healthc Q* 2005, 8 Spec No:99-105.
- [14] EM Borycki, AW Kushniruk, S Kuwata, J Kannry: Use of Simulation Approaches in the Study of Clinician Workflow. *AMIA Annu Symp Proc* 2006:61-65.
- [15] A Kushniruk, C Nohr, S Jensen, EM Borycki: From Usability Testing to Clinical Simulations: Bringing Context into the Design and Evaluation of Usable and Safe Health Information Technologies. *Yearb Med Inform* 2013, 8:78-85.
- [16] S Jensen, AW Kushniruk, C Nøhr: Clinical simulation: A method for development and evaluation of clinical information systems. *Journal of biomedical informatics* 2015, 54:65-76.
- [17] S Jensen: Clinical Simulation: For what and how can it be used in design and evaluation of health IT. *Techno-Anthropology in Health Informatics: Methodologies for Improving Human-Technology Relations* 2015, 215:217.
- [18] S Jensen: Patient safety and quality of care: How may clinical simulation contribute? *Knowledge Management & E-Learning: An International Journal (KM&EL)* 2015, 7:412-424.

# Project Management: Essential Skill of Nurse Informaticists

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**Abstract:** With the evolution of nursing informatics (NI), the list of skills has advanced from the original definition that included 21 competencies to 168 basic competencies identified in the TIGER-based Assessment of Nursing Informatics Competencies (TANIC) and 178 advanced skills in the Nursing Informatics Competency Assessment (NICA) L3/L4 developed by Chamberlain College of Nursing, Nursing Informatics Research Team (NIRT). Of these competencies, project management is one of the most important essentials identified since it impacts all areas of NI skills and provides an organizing framework for processes and projects including skills such as design, planning, implementation, follow-up and evaluation. Examples of job roles that specifically require project management skills as an essential part of the NI functions include management, administration, leadership, faculty, graduate level master's and doctorate practicum courses. But first, better understanding of the NI essential skills is vital before adequate education and training programs can be developed.

**Keywords:** nursing informatics, project management, education, essentials, TANIC, TIGER, NICA-L3/L4

## 1. Introduction: History and Definitions

In today's high-tech world, expectations of the healthcare industry is that nurses will have informatics competencies including project management skills which are critical for improved quality outcomes and safety for patients. This is not only true for nurses in graduate courses, clinical practice management roles but administrative and other leadership roles as well. The expectation is that all of these roles as well as others described below will bring well-developed skills to the job.

Nursing Informatics (NI) has evolved beyond the definition of data management defined early on by Staggers, Gassert, and Curran [1] but is still considered by many as the primary and only skill of a nursing informaticist. Today, the American Nurses Association's (ANA) expanded definition of NI suggests that, "Nursing Informatics (NI) is the specialty that integrates nursing science with information and analytical sciences to identify, define, manage and communicate data, information, knowledge and wisdom in nursing practice. NI supports nurses, consumers, patients, the interprofessional healthcare team, and other stakeholders in their decision-making in all roles and settings to achieve desired outcomes." (p. 1-2) [2].

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In order to meet the Institute of Medicine (IOM) mandate of developing the nursing workforce of 2020, we must provide a mechanism to first assess and understand competencies/skills needed by the workforce [3]. While project management as NI skills are more the expectation of healthcare providers and nursing leadership, there remains a lack of understanding of what these are and how they are an essential competency of NI. McGonigle, Hunter, Sipes, and Hebda, suggest that even today “there is a lack of understanding of exactly what nursing informatics is in the way of skills needed or how they can and should be applied to practice” [4].

Presently, NI has a much broader definition, evolved from the 21 essential competencies defined by Staggers, et al., to 167 basic skills defined in the TIGER-based Nursing Informatics Competencies (TANIC) developed by Hunter, McGonigle, and Hebda, and the 178 advanced items in the Nursing Informatics Competency Assessment (NICA) - L3/L4 self-assessment tools developed by McGonigle, Hunter,, Hebda, and Hill [1,6,7,10]. Chamberlain College of Nursing, Nursing Informatics Research Team (NIRT) (Hunter, et.al, 2014) developed expertise designing competency skill-assessment instruments as well as conducting research studies on competency utilization, and as such, has implemented the tools for students to self-assess skills in the NI courses [7].

The ANA (2015) *Nursing Informatics Scope and Standards* outlined above clearly defines specialty of NI as the skill to integrate sciences into nursing practice using skills to “identify, define, manage and communicate data, information, knowledge ... (p.1-2).” The standards further suggest that NI supports judgments in all positions, functions and settings; the support is achieved through the use of information constructs and information methods and practices – attributes of a NI. [2] Although the skills are now attributed to NI, historically these were originally defined as concepts of project management defined by the engineering community in the 1950s.

Sipes references the history of project management through an article by Cleland and Gareis, who relate that “...in the 1950s, project management was formally recognized as a distinct contribution arising from the management discipline” (pp. 1–4) [8, 9]. Sipes further discusses how engineering, at the forefront of project management, has become a “key management strategy in large corporations, such as IBM, and more recently, in healthcare, where there is a need to put formalized structure and management to organizational tasks” (p.12). Sipes adds that nurses “...use a structured approach when providing care to patients such as the nursing process. Patient care management requires an organizational framework—processes similar to those used in project management are used to manage patient care” (p.12) [8].

The three larger categories, defined in the tools, TANIC and NICA-L3/L4, discussed above, are computer, informatics knowledge, and informatics skills. The skill sets have been extended to include major subcategories as systems integration, selection and maintenance, quality improvement, data terminologies, impact analysis, privacy/security, systems input/output, usability, data mining and structures and project management.

Project management is one of the largest but least understood essentials of the NI knowledge and skill set. It includes five major steps: Design/Initiation, Plan, Implementation, Monitor/Control and Evaluation/Lessons Learned

In the discussion below, methods of how the tools, TANIC and NICA – L3/L4, are applied in Chamberlain’s graduate courses to self-assess the NI students current skills on four levels including the project management skills. As more information is shared, such as in American Association of Colleges of Nursing (AACN) webinars presented by Chamberlain NIRT, the competency self-assessment tools are being requested by

healthcare leadership to integrate into job roles and requirements. More detail of project management attributes applicable in job roles and requirements is presented below. Many of the same project management attributes are also required for graduate students as they develop and implement practicum projects as the master's and doctoral levels.

## **2. Method**

The methods to self-assess NI skills were implemented by Chamberlain in the graduate NI specialty track in order for the faculty to better understand student skill needs. As faculty analyze students' results, they can determine gaps/needs in skill sets. Then based on analysis of the information, curricula are developed to mitigate gaps in skill levels needed by students and most importantly, as they enter the 2020 workforce. The model used in graduate courses is discussed below. Employing this process further enhances the practicum experiences as it provides an organizational framework in which to work.

### *2.1 Utilization of information from analysis*

The NI competency self-assessment tools add clarity and specificity to better understand exactly what skills are required as awareness of project management (PM) skills become more evident. To determine NI skill levels in graduate student population at Chamberlain, the TANIC and NICA – L3/L4 tools are integrated into master's level core courses. Students self-assess skills beginning the program and then again at the end of their master's graduate practicums. The application of project management skills are fully implemented in the two Chamberlain graduate NI specialty practicums – I and II. Students are required to apply skills as they develop and plan a project in Practicum I, then implement and evaluate projects at a clinical site in Practicum II, thus utilizing PM skills developed during practicums. These same skills are required in most job roles in healthcare. They learn to apply skills which are needed to be successful in both the practicums and their “real-world” projects.

## **3. Results**

Feedback from students at the end of their practicums emphasizes the success of this model as students realize the value of the skills they just implemented at a healthcare site on an actual project. Now, they say they would not only use these skills in their job roles but see how they can use them when managing everyday tasks. Today, project management skills are more recognized as a need. The organizing framework of project management is applicable in graduate level practicums, clinical practice, healthcare administration and leadership. Below are examples of some of the roles that require project management skills today.

### *3.1 Project Management as an essential skill of NI*

National organizations discussed above deliberate how nursing leaders must have computer and informatics knowledge and skills in order to be effective in their roles.

The skills discussed are project management competencies as well as others in informatics. Yet, according to McGonigle, Hill, Hunter, Sipes, and Hebda, “trying to reach the goals set forth by these organizations has been hindered by a lack of procedures and assessments available for determining nurses’ informatics competencies- what they actually require in order to be competent in their job roles” [4, pp. 104-112]. The project management skills of NI can be applied universally in many settings and job roles. Students developing projects for their practicums or research studies and everyday tasks would benefit from a more formalized structure and organization.

According to Sipes the partial list of project management skills and competencies includes such tasks as: development/implementation of work plans, design/development of systems, function as lead/project manager in all phases of the systems life cycle, and development and implementation of all organizational documents required as a project manager to successfully manage a project [8, pp.143-158]. Examples of specific project management skills listed above are seen in advertised job descriptions as well as graduate level courses, including those for the role of nurse administrators, such as nurse executives (NE), nurse managers, nurse practitioners (NP), clinical nurse specialists (CNS), informatics nurse specialist (INS), chief nurse informatics officer (CNIO), chief nursing officer (CNO), and doctor of nursing practice (DNP) student in the final practicum before graduation.

The project management skills needed by the NP and CNS are important in order to set up and manage clinics and for a DNP graduate project. An INS would need the skills above to support an electronic medical record (EMR) implementation and informatics skills to perform system/workflow analysis for a new computer system.

#### **4. Discussion**

National organizations such as those previously discussed – the IOM, ANA and others - identified a need to develop knowledge and skills including more advanced education of the nursing workforce of 2020. Yet skill sets needed to provide better, safer patient care and outcomes are sorely lacking. For example, some think that having the skill to develop a slide presentation is the only “real” skill needed that qualifies as both an informatics and PM skill. Or that data collection and analysis fulfills the job descriptions for project management and informatics.

We must assess and understand current competencies/skills, then address gaps in education by developing more relevant curricula that will meet needs of the workforce for 2020. To that point, McGonigle, Hunter, Sipes, and Hebda, suggest that even today “there is a lack of understanding of exactly what nursing informatics is in the way of skills needed or how they can and should be applied to practice” [4].

#### 4.1 Need to inform and empower

Today, to be a NI no longer requires just the skills to manage data and databases as previously discussed. It requires much more and has evolved to nearly 200 advanced skills – now more than ever expected by healthcare provider and organizational leadership as well as masters and doctoral level students and faculty. One of the most essential skills is project management. Education programs must be established that meet the needs of nurses to develop these skills, as well as empower them to enhance their practices.

### 5. Acknowledgements

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### References

- [1] N. Stagers, C. Gassert, & C. Curran, Informatics competencies for nurses at four levels of practice. *Journal of Nursing Education*, **40** (7) (2001) 303-16.
- [2] American Nurses Association Nursing informatics: Scope and standards of practice; p.1-2 (2nd Ed.). (2015). Silver Spring, MD: Author.
- [3] Institute of Medicine (IOM): The Future of Nursing: Leading Change, Advancing Health. Committee on the Robert Wood Johnson Foundation initiative on the future of nursing, at the institute of medicine. (2010), Retrieved from <http://www.thefutureofnursing.org>. p.140.
- [4] D. McGonigle, K. Hunter, C. Sipes, & T. Hebda, Why nurses need to understand nursing informatics, *AORN Journal*, September, (2014).100 (3).
- [5] K. Hunter, D. McGonigle, & T. Hebda The integration of informatics content in baccalaureate and graduate nursing education: A status report. *Nurse Educator*, 38(3):(2013).110-113.doi: 10.1097/NNE.0b013e31828dc292
- [6] D. McGonigle, K. Hunter, T. Hebda, & T. Hill, Self-Assessment of Level 3 and Level 4 NI Competencies Tool Development. (2014) Retrieved from <http://himss.files.cms-plus.com/FileDownloads/Self-Assessment.pdf>.
- [7] Hunter, K., McGonigle, D., T. Hill, T. Hebda, & C. Sipes Self-Reported Assessment of Basic and Informatics Specialist/Innovator Nursing Informatics Competencies: TANIC© and NICA L3/L4©. *Nursing Informatics Today*, 29 (2), (2014). 4-6.
- [8] C. Sipes, *Project Management for the Advance Practice Nurse*, Springer, New, York, September; (2016) (p.12, 113).
- [9] D. Cleland & R. Gareis, R. *Global project management handbook*; (2006) (pp.1-4). New York, NY; McGraw- Hill Professional.
- [10] T. Hill, D. McGonigle, K. Hunter, C. Sipes, & T. Hebda An instrument for assessing advanced nursing informatics competencies. *Journal of Nursing Education and Practice*, 4 (7), (2014) 104.

# Elements of Scenario-Based Learning on Suicidal Patient Care Using Real-Time Video

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**Abstract.** This study aims understanding of students' learning experiences when receiving scenario-based learning combined with real-time video. Videos that recorded student nurses intervention with a suicidal standardized patient (SP) were replayed immediately as teaching materials. Videos clips and field notes from ten classes were analysed. Investigators and method triangulation were used to boost the robustness of the study. Three key elements, emotional involvement, concretizing of the teaching material and substitute learning were identified. Emotions were evoked among the SP, the student performer and the students who were observing, thus facilitating a learning effect. Concretizing of the teaching material refers to students were able to focus on the discussions using visual and verbal information. Substitute learning occurred when the students watching the videos, both the strengths and weaknesses represented were similar to those that would be likely to occur. These key elements explicate their learning experience and suggested a strategic teaching method.

**Keywords:** nursing education, video analysis, scenario based learning, suicide

## 1. Introduction

Following South Korea and Japan, Taiwan has the third highest suicide rate among the west pacific countries [1]. Due to the efforts made by the Taiwan Ministry of Health and Welfare, suicide has not been one of the top ten leading causes of death since 2010 [2]. However, suicide has a great impact on the youth population. In 2014, suicide was the second leading cause of death among Taiwanese youths aged 15-24. For the last five years, over 90% of the total suicide cases have been reported by hospitals and clinics, indicating that nurses are situated at the frontline of suicide management. However, nurses have found barriers related to caring for suicidal patients [3].

It has been suggested that in didactic teaching, context is often extracted in order to purify knowledge or theories, causing difficulties for learners to obtaining situational understanding [4]. Scenario teaching can bridge the gap between knowledge and practical reality by simulating real world situations that include behavior and attitudes [5]. Due to cultural sensitivity and the complexity of the issue of suicide [6], scenario-based learning is suitable to apply for education on suicidal patient care. However, studies on the effectiveness of scenario-based learning are mainly focused more on quantitative measurements [7]. With the increased emphasis on the use of

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digital technologies, the timing is right to engage in more in-depth discussions about the role of video data in education research [8].

This study is aimed at gaining an understanding of students' learning experiences by using real time videos as teaching materials in line with scenario-based learning.

## 2. Methods

As the major manpower in health profession in Taiwan is two-year degree programme nursing students they are recruited as study participants [9]. The study was approved by the IRB of Chang-Gung hospital. Information of the study was revealed to them as well as the right of rejection. Inform consents were signed with their agreement.

Video analysis was chosen as the research method because video is a powerful way to collect, share, study, represent, and document detailed practice cases to support the intensive study of such practice [10]. Jacobs' [11] cycle model was adopted for data analysis, and repeated watching/discussion, hypotheses generation, code development and application, as well as analysis/ interpretation were applied.

In each class, two sections of eight minute videos that captured students' nursing intervention with a suicidal standardized patient (SP) were recorded and replayed immediately as the teaching materials. Then, debriefing between the students and teachers over the materials were recorded and integrated as the research data for this study. Consequently, the videos from ten classes were collected and divided into two major parts, intervention and debriefing. Each investigator wrote a narrative summary in each section individually, and then they met together to watch the same video for discussion. A table used by the researchers was designed to capture the important issues related to learning experiences. This table contained the video ID, time, critical events (what happened?), meaning or hypotheses, reflection (why choose the clip?) and overall opinions about the video section. Simultaneously, field notes were analyzed to enhance the robustness of the study.

## 3. Results

Students from ten classes aged 21-23 (SD 1.04) were mainly female (96%), unmarried (99.5%) and licensed (98%). Three key elements, emotional involvement, concretizing of the teaching material and substitute learning, were identified.

1) Emotion involvement refers to the emotion that was evoked by SP and it was pervade among students of performance and students of observation. Emotional connection facilitated learning by raising their attention and deep self reflection.

*"When assessing suicidal history, the SP burst out crying. I was stunned and then tried to stop her crying and wanted to comfort her with all my heart. At the beginning, I did not expect the SP to be so real because I knew that we were in a classroom doing a scenario. It is high fidelity but not REAL actually."* Concurrently, in the field notes, it was noted: The classroom went into silence; all small noises ceased. All students sat on the edge of their chairs staring at the scenario. A few students who were observing leaned over to pass their tissues to the flustered student actor, creating a



weird situation. This is because they broke the invisible boundary that existed between the scenario stage and the student audience. All of the students' attention was thoroughly captured. Some students were moved by the performance of the SP, and they talked to the SP to express their appreciation.

Emotional involved became deeper and personal. *"In the surgical nursing scenario, we were trained to do the procedure correctly and to not become involved emotionally as deeply as was the case with the SP with mental illness"; "When the SP talked about her daughter and sobbed while describing how close they were, I started to reflect on the relationship I had with my mom."* Facing a real person (SP) and challenged by her mood, the scenario demanded not only that the students interact instantly but also forced them to reflect on personal experiences. This reflection was able to deepen their understanding of mother's role and enabled them to express their empathy better.

2) Concretizing of the teaching material refers to when students can focus their questions on detailed visual and verbal information that has just occurred in the classroom. Videos produced by familiar classmates bridge and confine issues so that they can be clearly identified rather than viewed as abstract nursing principles.

One of the performing students reported: *"I was still concerned that I might provoke the patient's suicidal action although I was taught that it is OK and necessary to ask about a suicidal plan with an appropriate attitude. But what is the appropriate attitude? It was just so hard to initiate the topic with the right timing and right words."* The video allowed second thoughts to develop. *"Watching myself on the big screen, with a time and space distance from what I just practiced, it seems easier for me to find the right timing."* In the field notes, several students reflected they learned a couple of ways to start the tough questions using appropriate wording"

The other performing students reported: *"Theoretically, we should support the patient but did not really understand how to do it. When the SP cried, I wondered if I should hug her, stroke her shoulder or pat on her hand...I finally held her hand, but then I didn't know when I could let go of her hand."* In the field notes recorded: the teacher first invited all students to answer the question by recalling their experience of crying. A wide range of responses were collected. A male student brought out a gender issue related to body contact and expressions of empathy. Secondly, the SP was invited to give feedback about how she felt about being supported and was encouraged to say what else the nurse could do for her. These discussions concretized the knowledge.

Using real time video allows educators to make debriefing precise and concrete. Both students and teachers can focus on the event or concepts in the here and now. Abstract ideas in theory can be practically performed and closely examined via the characteristics of visualization and verbalization related to the video.

3) Substitute learning refers to when students observe their classmates practicing nursing care. Both the strengths and weaknesses of nursing performance shown in the scenario (and later on the video) were similar to how the student observers are likely to behave. By closely observing the performance of their classmates, students can imagine or project themselves as if they are on the stage as well. With the assistance of video clips and a teacher leading the discussion, learning from the experience of their peer's performance or mirroring it themselves are both possible.

In the debriefing section, one student observer gave feedback to the performing student. *"She interviewed almost all aspects to assess suicidal risk, especially the possibility of a suicide attempt. Although she was not very complete in every detail, I do not think I could do better than she did."* Watching classmates practice nursing care

seems to enable them to learn from their peers because they are similar in terms of nursing training background. They learned to imitate the strengths and also to avoid the drawbacks discussed. *Another student reported, "While watching two classmates providing nursing care to the patient with the same suicidal situation, we could compare the different ways of addressing the key questions."*

The teachers challenged the student observers to make improvements to parts of the clips, and a couple of students in many of the classes reported, *"I feel uneasy when someone cries in front of me. I saw the classmate performer trying hard to stop the SP by giving too much insignificant advice as I did before."*; *"I would be speechless, similar to the classmate performer when the SP expressed her sadness and indicated that she wished to die. I would agree with the patient's ideas and fall into a dilemma. I am inadequate at persuading people."* Student observers learned from the student performers as if they mirrored themselves, especially the difficult parts.

#### 4. Discussion

Few papers have discussed how real time video can benefit learning when it is accompanied with scenario-based learning since video footage is an innovation in the area of classroom research [8]. Our study answered a research question about what the key elements of students' learning experiences are when real-time video is used.

Theory and principles of nursing care for suicidal patients have been stated, but there are gaps between knowledge and practice [12]. Through providing interactive and role play elements, scenario-based learning is a powerful teaching strategy to enhance student confidence, satisfaction and evoke active learning [5][6][13]. Correspondingly, the students in our study showed more interest and participated more in activities when the SP showing intense emotion. Emotion involvement is an element to boost learning [14].

Used as teaching materials, real-time video contains rich, detailed, here and now information, and it also helps to confine the discussion to concrete nursing behavior, such as silence, distance and atmosphere. Teachers can pause punctually at a suitable point to facilitate discussion [8]. Overbaugh [15] pointed out that students of visual learning styles benefit from video-generated, graphic representations, especially in the case of those who have imagery skill difficulties. Videos embody abstract ideas into seeable and auditable information.

In this study, the nursing practice videos were freshly produced by the students themselves rather than being standard courseware. By closely inspecting their classmates' performance on the videos and discussing with the lecturer, they were able to advance their knowledge and skill through observation of the student performer. Similar to peer learning, which provides a positive learning environment that may benefit the students [16], substitute learning involves more role play features.

To conclude, using scenario-based learning assisted by real-time video brings a sense of clinical reality into classrooms for novices. The three key elements, emotional involvement, concretization of the teaching material and substitute learning, expanded their learning experience and suggested a strategic teaching method.

## 5. Acknowledgments

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## References

- [1] P.S.Yip, Towards evidence-based suicide prevention programs. *The Journal of Crisis Intervention and Suicide Prevention* **32** (2011), 117-120.
- [2] Taiwan ministry of health and welfare: Top ten leading cause of death in Taiwan in 2014. Retrieved on 2015.06.17 [http://www.mohw.gov.tw/cht/DOS/Statistic.aspx?f\\_list\\_no=312&fod\\_list\\_no=5488](http://www.mohw.gov.tw/cht/DOS/Statistic.aspx?f_list_no=312&fod_list_no=5488)
- [3] S.W. Chan, W. Chien, S. Tso, Evaluating nurses' knowledge, attitude and competency after an education programme on suicide prevention. *Nurse Education Today* **29(7)** (2009), 763-769.
- [4] G. Dall'Alba, R. Barnacle, Embodied Knowing in Online Environments. *Educational Philosophy and Theory* **37(5)** (2005), 719-744.
- [5] N. McNaughton, P. Ravitz, A. Wadell, B.D. Hodges, Psychiatric Education and Simulation: A Review of the Literature. *The Canadian Journal of Psychiatry* **53(2)** (2008), 85-93.
- [6] R. Luebbert, A. Popkess, The Influence of Teaching Method on Performance of Suicide Assessment in Baccalaureate Nursing Students. *Journal of the American Psychiatric Nurses Association* **21(2)** (2015), 126-133.
- [7] J. Norman, Systematic review of the literature on simulation in nursing education. *The ABNF Journal*. (2012), 24-28.
- [8] A. Fitzgerald, M. Hackling, V. Dawson, Through the Viewfinder: Reflecting on the Collection and Analysis of Classroom Video Data. *International Journal of Qualitative Methods* **12(1)** (2013), 52-64.
- [9] S.M. Chou, Response of Taiwan Nursing Education to Today's Nursing Shortage. *The Journal of nursing* **59(5)** (In Chinese, 2012), 24-29.
- [10] S.J. Derry, R.D. Pea, B. Barron, et al., Conducting video research in the learning sciences: guidance on selection, analysis, technology, and Ethics. *Journal of the learning sciences* **19(1)** (2010), 3-53.
- [11] J.K. Jacobs, T. Kawanaka, J.W. Stigler, Integrating qualitative and quantitative approaches to the analysis of video data on classroom teaching. *Journal of Educational Research* **31** (1999), 717-724.
- [12] G.E Miller, The assessment of clinical skills/competence/performance. *Academic Medicine* **65(9)** (1990), S63-67.
- [13] I.E. Purba, Nursing and midwifery students: A study about learning preferences. *International Journal of Pharmtech Research* **8(4)** (2015), 737-740.
- [14] K. Fraser, I. Ma, E. Teteris H. Baxter, B. Wright, K. McLaughlin, Emotion, cognitive load and learning outcomes during simulation training. *Medical Education* **46(11)** (2012), 1055-1062.
- [15] R.C Overbaugh, The Efficacy of Interactive Video for Teaching Basic Classroom Management Skills to Pre-Service Teachers. *Computers In Human Behavior* **11(3-4)** (1995), 511-527.
- [16] J.A. Secom, Systematic review of peer teaching and learning in clinical education. *Journal of Clinical Nursing* **17(6)** (2008), 703-716.

# Gamification of Clinical Routine: The Dr. Fill Approach

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**Abstract.** Gamification is used in clinical context in the health care education. Furthermore, it has shown great promises to improve the performance of the health care staff in their daily routine. In this work we focus on the medication sorting task, which is performed manually in hospitals. This task is very error prone and needs to be performed daily. Nevertheless, errors in the medication are crucial and lead to serious complications. In this work we present a real world gamification approach of the medication sorting task in a patient's daily pill organizer. The player of the game needs to sort the correct medication into the correct dispenser slots and is rewarded or punished in real time. At the end of the game, a score is given and the user can register in a leaderboard.

**Keywords.** Gamification, health care, patient safety, medication plan, pill sorting

## 1. Introduction

Nowadays, patient safety is the worldwide priority for health systems. A main objective is the elimination of risks and threats to patient health [1]. One of the most common health risks directly affecting patient health are medication errors [2], which are defined as “any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer” [3]. Medication errors can occur within the entire medication delivery process [4]. They are to blame for 10-18% of all reported hospital injuries [5], and lead to increasing mortality rates as well as duration of hospital stays. Thereby, they are a major economical factor [6].

One reasonable approach is it to focus on human factors, particularly the nursing staff, which is highly involved in the entire medication process [7]. Continuing education and training of the nursing staff can reduce medication errors [2] and improve patient safety in general [8]. Additionally, many advances in healthcare education have already been made through serious games [9], which along with gamification use game design elements and mechanisms (e.g., points and leaderboards) to create motivation for non-game situations [10]. This leads to a significantly increased performance in general and specifically in an educational context [11]. For example, A. Higgins and M.M. Hannan show that by using gaming technology in a hand hygiene program, an enhancement takes place in hand hygiene compliance and

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technique as well as motivation of staff participation in learning [12]. Another example for positive learning effects is the web-based collaborative serious game eMedOffice used in the medical education to teach organizational aspects in medical practice [13]. Based on the already successfully applied serious games in health [8], it is reasonable to use serious games with gamification elements to deal with medication errors and especially to provide the possibility of training nursing staff in a motivational, risk-free, and cost-effective environment [8, 9].

Here, we present an interactive serious game called Dr. Fill, which provides a real world gaming environment. The player acts as a nurse, filling a patient's daily pill organizer according to its requirements. During the game, the placed pills are recognized and immediate feedback on success and errors is provided. In the end, the results of the entire dispensing procedure are presented on a final game report as well as on a leaderboard. In this work the structure, the current results, and future work of Dr. Fill are discussed.

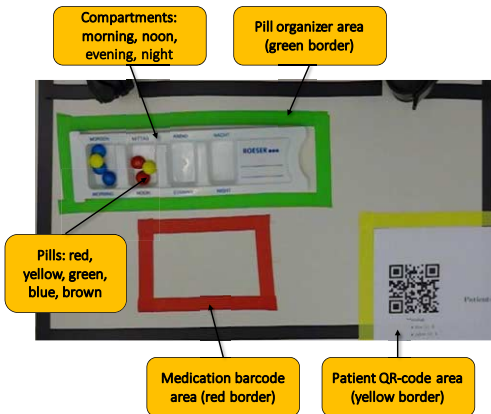


Figure 1. Game board with color-coded areas.

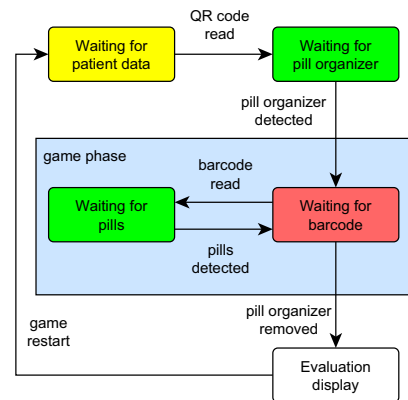


Figure 2. Gameflow with game phase, colors indicate board areas.

## 2. Methods

### 2.1. General Game Principle

The game Dr. Fill observes and scores a person who is filling a pill organizer. The game is played on a game board with different color-coded areas (Fig. 1) and structured as follows (Fig. 2):

1. Game start: The player places the patient information and an empty pill organizer on the game board. The game phase starts and the time is recorded.
2. Game phase: The player fills the container with pills according to the medication plan into compartments. First, the medication is indicated by placing the barcode of the medication box on the game board and then putting the pills into the organizer. This step is repeated until the user ends the game.

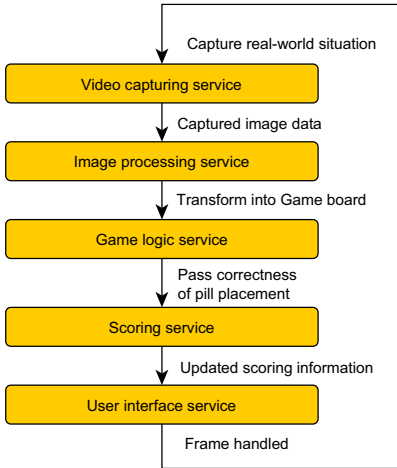


Figure 3. Services and interactions.



Figure 4. Game report.

3. Evaluation phase: The player ends the game by removing the pill organizer. The time counter then stops and the evaluation of the player's performance in terms of correct/wrong pills and time are displayed.

## 2.2. Implementation

The serious game Dr. Fill is a Java application. The software architecture is composed of two parts: Part one consists of several interconnected services that provide inputs and outputs and communicate with each other using a common data structure - the *Game board* (Fig. 3). The services represent different tasks that have to be performed in the game: (i) image acquisition, (ii) image recognition and processing, (iii) game logic, (iv) scoring, and (v) the rendering of the UI. Part two is a classical game loop, in which each service is called subsequently to perform its task in each frame, providing its output to the following services. In every frame, the current game situation of the real world is mapped into a corresponding *Game board* data structure, which the services access to perform their tasks and share messages/data. For the image recognition, the external computer vision library *OpenCV* (OpenCV.org) is used. The GUI is realized using the UI library *SWT* (eclipse.org/swt).

## 2.3. Services

The services orient themselves along the different tasks in the game and are called for each frame.

- *Video capturing*: retrieves and preprocesses images from the camera.
- *Image processing*: converts each image into a *Game board* structure. The Quick-Response (QR) code is scanned and the expected patient's medication determined. The placed pills are recognized in number, color, and the locations of the pills.

- *Game logic*: determines differences between the current and last *Game board* structures and checks for inserted or removed pills. Each changed pill can be either a wrong or a correct pill that has been placed or removed.
- *Scoring*: calculates the point change depending on the reported change, i.e., by rewarding correctly placed pills or penalizing wrongly placed pills.
- *User interface*: updates the recognized game situation and point score.

#### 2.4. Evaluation of Player's Performance

After a game is finished the player is shown the performance in the form of a timeline (Fig. 4). Placement and removal of all pills, the breakdown of the attributed points, and a table explaining the calculation of bonuses are shown. Bonus points can be gained by minimizing the time needed to complete the task and by placing only correct pills or placing a number of correct pills in a row. The difficulty of the medication plan based on pill arrangement and number of pills is also taken into account.

After that, the user is also displayed a high score board to illustrate how he or she performed in comparison to other players.

### 3. Results

The latest version of the interactive serious game Dr. Fill is fully applicable. It supports live and recorded video-stream data and detects a pill organizer with four compartments, a 2D barcode for the medication container, a QR barcode for the patient assignment and the related medication requirements, the placed and removed pills, and occurring obstructions.

As a first evaluation, 25 games were performed and recorded in order to calculate the pill recognition rate of the final game state of the placed pills: each of the five test subjects played five gaming rounds. Three gaming rounds were aborted because the game board and the QR code were not recognized. The recognized pills of the final game state were compared to the actually placed pills. Out of 314 placed pills in total, 307 were recognized correctly for a recognition rate of 97.77%.

### 4. Discussion

The game Dr. Fill provides a training game for healthcare professionals to evaluate their own performance on the common task of pill sorting. The initial quantitative evaluation of the game shows a good pill recognition result but it can be further improved. So far, the pill detection is limited to colored chocolate lentils (M&Ms). While using chocolate is valid for a training exercise, and might even increase compliance, more realistic versions of the training tool might be needed. This could be achieved by either marking pills with fluorescent dye or computer-readable codes, or using real medication and advanced image processing, for example, spectrographic imaging and shape detection.

The current game aims at motivating the user by showing shortcomings and error-proneness of the given task. However, a more thorough evaluation of the designed system needs to be performed through future studies:

- Short-/mid-term effect study: participants use the game as training device once per week for a short period of time. The study will measure the short-term benefit of the game regarding improvement of speed and/or accuracy. Alongside, usability of the system and improvements in motivation will be measured.
- Long-term effect study: the study will evaluate the long-term effects of a permanent serious game by measuring the impact of gamification on motivation, alert fatigue [14], and technology dependency.
- Scoring system study: the study will determine how points should be awarded or penalized to increase motivation in a real-world scenario.

A user acceptance testing is planned for July 2016. Further developments of the game will focus on the integration of badges and levels to foster long-term motivation.

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## References

- [1] H Hamishehkar, S Valizadeh, M Rasekhi, H Hamishehkar, M Asadollahi, Medication errors in oral dosage form preparation for neonates: the importance of preparation technique, *J Res Pharm Pract* 4 (2015), 147-152.
- [2] C Hayes, D Jackson, PM Davidson, T Power, Medication errors in hospitals: a literature review of disruptions to nursing practice during medication administration, *J Clin Nurs* (2015), 1-14.
- [3] National Coordinating Council for Medication Error Reporting and Prevention, About medication errors (2015), <http://www.nccmerp.org/aboutMedErrors.html>.
- [4] B Durham, The nurse's role in medication safety, *Nursing* 45 (2015), 1-4.
- [5] F Cebeci, E Karazeybek, G Sucu, R Kahveci, Nursing students' medication errors and their opinions on the reasons of errors: a cross-sectional survey, *J Pak Med Assoc* 65 (2015), 457-462.
- [6] MA Cheragi, H Manoocheri, E Mohammadnejad, SR Ehsani, Types and causes of medication errors from nurse's viewpoint, *Iran J Nurs Midwifery Res* 18 (2013), 228-231.
- [7] I Choi, SM Lee, L Flynn, C Kim, S Lee, NK Kim, DC Suh, Incidence and treatment costs attributable to medication errors in hospitalized patients, *Res Soc Adm Pharm* (2015), online first.
- [8] F Ricciardi, LT De Paolis, A comprehensive review of serious games in health professions, *Int J Comp Game Tech* 2014 (2014), 1-11.
- [9] S de Ribaupierre, B Kapralos, F Haji, E Stroulia, A Dubrowski and R Eagleson, Healthcare training enhancement through virtual reality and serious games, In MA Minhua, LC Jain, P Anderson (Eds.), *Virtual, augmented reality and serious games for healthcare I* (9-27), Springer Berlin Heidelberg, 2014.
- [10] A Domínguez, J Saenz-de-Navarrete, L de-Marcos, L Fernández-Sanz, C Pagés, JJ Martínez-Herráiz, Gamifying learning experiences: practical implications and outcomes, *Comp Edu* 63 (2013), 380-392.
- [11] ED Mekler, F Brühlmann, K Opwis, AN Tuch, Do points, levels and leaderboards harm intrinsic motivation: an empirical analysis of common gamification elements, *Proceedings ICGDRA - Gamification '13*, ACM (2013), 66-73.
- [12] A Higgins, MM Hannan, Improved hand hygiene technique and compliance in healthcare workers using gaming technology, *J Hosp Infect* 84 (2013), 32-37.
- [13] A Hannig, N Kuth, M Özman; S Jonas; C Spreckelsen, eMedOffice: a web-based collaborative serious game for teaching optimal design of a medical practice, *BMC Med Edu* 12 (2012), 104-118.
- [14] AS Kesselheim, K Cresswell, S Phansalkar, DW Bates, A Sheikh, Clinical decision support systems could be modified to reduce "alert fatigue" while still minimizing the risk of litigation, *Health Affairs* 30 (2011), 2310-2317.



# Evaluation of a Statewide HIV-HCV-STD Online Clinical Education Program by Healthcare Providers – A Comparison of Nursing and Other Disciplines

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**Abstract.** The New York State HIV-HCV-STD Clinical Education Initiative (CEI) has developed a large repository of online resources and disseminated them to a wide range of healthcare providers. To evaluate the CEI online education program and in particular to compare the self-reported measures by clinicians from different disciplines, we analyzed the data from 1,558 course completions in a study period of three months. The results have shown that the overall evaluations by the clinicians were very positive. Meanwhile, there were significant differences across the clinical disciplines. In particular, physicians and nurse practitioners were the most satisfied. In contrast, pharmacists and case/care managers recorded lower than average responses. Nurses and counselors had mixed results. Nurse practitioners' responses were very similar to physicians on most measures, but significantly different from nurses in many aspects. For more effective knowledge dissemination, online education programs should consider the unique needs by clinicians from specific disciplines.

**Keywords.** Online education, continuing professional development, HIV, HCV, STD, healthcare providers, nursing

## 1. Introduction

In the United States, the annual numbers of newly infected with HIV, HCV, and other STDs are estimated at 47,500 [1], 29,700 [2], and 20 million [3] respectively. The total infections are estimated at 1.2 million [1], 2.7 million [2], and 110 million [3]. Medical costs associated with diagnosis, treatment, and prevention could be as high as \$16 billion a year [3]. With the many ongoing clinical trials on treatments, vaccines, and behavioral interventions and the frequent updates on practice guidelines based on the findings from research, effective dissemination of the latest clinical evidence to the community healthcare providers, who are working on the frontline to fight HIV, HCV, and other STDs, has become an essential requirement.

Comparing to the traditional classroom or clinic-based approaches to providing continuing professional education, online training is advocated as an efficient platform for rapid dissemination of knowledge to healthcare providers [4-5]. Built on a history

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of success for two decades to provide in-person training, the New York State (NYS) HIV-HCV-STD Clinical Education Initiative (CEI) [6] started its online education program in 2008. Over a period of seven years, CEI has developed 290 multimedia learning modules, 111 online CME/CNE courses, 14 interactive case simulation tools, and various other online resources [7]. These resources have been disseminated to tens of thousands healthcare providers from 170+ countries through web, mobile apps, email newsletters, and online social networks [8].

In previous publications, we reported the development of CEI online resources [7], effective dissemination of these resources [8], their actual usage by clinicians [9], and initial assessment on effectiveness and impact of the CEI online education program [10]. Here we report an evaluation study to further analyze the feedback from healthcare providers who have completed CEI online courses, focusing on a comparison of nursing and other clinical disciplines. The results from this analysis will provide important information to guide the future development of online education programs that can be custom-tailored to specific clinical disciplines to better serve their information needs.

## 2. Methods

We included the clinicians who successfully completed a CEI online course between April 1, 2015 and June 30, 2015 in this study. As a part of the process for course completion, each clinician was required to provide evaluations on the training. The evaluation measures included usefulness/relevance of information, easy comprehension, trainer's knowledge, appropriateness of format, knowledge increase, intention to use the learned knowledge, and intention to change practice [10]. The entire process of course enrollment, completion, and evaluation by a clinician was through the CEI's student portal. Within the student portal, a clinician's personal information (for example, contact and demographics) and professional background (for example, discipline, employment setting, practice years, and patient case load) were collected and stored in the student profile [10]. Partial screenshots of the evaluation questionnaire and clinicians' background from the CEI student portal are shown in Figure 1.

For data collection, we queried the CEI database to obtain the student background, course completions, and evaluations. For the Likert-scale measures, we reformulated the evaluation responses as binary variables (positive vs. non-positive). For the measure on knowledge increase, we first calculated the difference of a clinician's self-reported knowledge levels (*novice*, *not very knowledgeable*, *knowledgeable*, *very knowledgeable*, or *expert*) before and after the training, and then formulated those with  $\geq 1$  level of increase as positive responses. For data analyses, we compared the proportions of the positive evaluation responses across the disciplines. We used the chi-square test to examine the statistical significance of the differences.

## 3. Results

We recorded a total of 1,558 completions of 76 online courses during the study period. The clinical disciplines that logged the most course completions were: physician (301, 19.32%), nurse practitioner (292, 18.74%), nurse (182, 11.68%), pharmacist (117,

7.51%), case/care manager (101, 6.48%), and counselor (84, 5.39%). For the remaining fifteen disciplines, each with course completions less than 5% of the total number, we grouped them into a single category (481, 30.87%) for analyses.

Course Evaluation		Gender:*	
L-a. The information and/or skills provided in this event were useful and relevant	<input type="radio"/> [1] Strongly Agree <input type="radio"/> [2] Agree <input type="radio"/> [3] Neutral <input type="radio"/> [4] Disagree <input type="radio"/> [5] Strongly Disagree <input type="radio"/> [6] Not Applicable	<input checked="" type="radio"/> Male <input type="radio"/> Female <input type="radio"/> Transgender: Male to Female <input type="radio"/> Transgender: Female to Male	
L-b. The information and/or skills taught in this event were easy to comprehend	<input type="radio"/> [1] Strongly Agree <input type="radio"/> [2] Agree <input type="radio"/> [3] Neutral <input type="radio"/> [4] Disagree <input type="radio"/> [5] Strongly Disagree <input type="radio"/> [6] Not Applicable		
L-c. The trainer was knowledgeable about the topic	<input type="radio"/> [1] Strongly Agree <input type="radio"/> [2] Agree <input type="radio"/> [3] Neutral <input type="radio"/> [4] Disagree <input type="radio"/> [5] Strongly Disagree <input type="radio"/> [6] Not Applicable		
L-d. As a result of this event I intend to use the knowledge/skills I have learned today in my clinical practice	<input type="radio"/> [1] Strongly Agree <input type="radio"/> [2] Agree <input type="radio"/> [3] Neutral <input type="radio"/> [4] Disagree <input type="radio"/> [5] Strongly Disagree <input type="radio"/> [6] Not Applicable		
M. How might the format of this activity be changed in order to be most appropriate for the content presented?	<input type="radio"/> [1] Format was appropriate; no change needed <input type="radio"/> [2] I would like the following format: <input type="checkbox"/> [3] Include more case-based presentations <input type="checkbox"/> [4] Add breakout for subtopics		
		Racial/ethnic background:*	
			Race <input type="radio"/> American Indian or Alaska Native <input checked="" type="radio"/> Asian <input type="radio"/> Black or African American <input type="radio"/> Native Hawaiian or Pacific Islander <input type="radio"/> White <input type="radio"/> Other <input type="text"/>
		Highest level of education:*	
			<input checked="" type="radio"/> Doctoral Degree <input type="radio"/> Master Degree <input type="radio"/> Bachelor Degree <input type="radio"/> College Coursework <input type="radio"/> High School Diploma <input type="radio"/> Other <input type="text"/>
		Primary professional discipline/occupation:*	
			<input type="radio"/> Physician <input type="radio"/> Physician Assistant <input type="radio"/> Nurse Practitioner <input type="radio"/> Nurse <input type="radio"/> Dentist <input type="radio"/> Dental Hygienist <input type="radio"/> Pharmacist <input type="radio"/> Psychiatrist <input type="radio"/> Psychologist <input type="radio"/> Nutritionist/Dietician <input type="radio"/> Counselor <input type="radio"/> Case/Care Manager <input type="radio"/> Social Worker

Figure 1. Partial screenshots of evaluation questionnaire and clinicians’ background from the student portal.

Similar to our previous findings [10], the overall evaluations by the clinicians were very positive (usefulness and relevance 92.17%, easy comprehension 91.21%, knowledgeable trainer 92.49%, appropriate format 86.07%), and the clinicians’ self-reported impacts of training were significant (knowledge increase 41.21%, intention to use the learned knowledge 86.78%, intention to change practice 37.67%).

When analyzing the responses by disciplines, we found statistically significant differences ( $p < 0.001$ ) for all measures. In particular, physicians had the most positive evaluations in all but one (appropriate format) aspects when compared with the other disciplines. Similar to physicians, nurse practitioners had more positive feedback on all but one (knowledge increase) measures when compared with the average responses from all disciplines. In contrast, pharmacists and case/care managers had lower than average responses, while nurses and counselors had mixed results.

Comparing nurses with nurse practitioners, significant differences were found on the measures of easy comprehension (86.81% vs. 93.49%,  $p = 0.014$ ), knowledgeable trainer (90.11% vs. 94.86%,  $p = 0.048$ ), intention to use knowledge (77.47% vs. 94.52%,  $p < 0.001$ ), and intention to change practice (28.57% vs. 43.56%,  $p = 0.030$ ). No obvious differences were found between these two groups on the measures of usefulness and relevance (90.66% vs. 94.18%,  $p = 0.149$ ) and appropriate format, (92.86% vs. 88.10%  $p = 0.089$ ). Nurses had more positive responses than nurse practitioners on the measure of knowledge increase (45.60% vs. 33.90%,  $p = 0.011$ ).

The detailed evaluation data by measures and disciplines are shown in Table 1.

**Table 1.** Number and percentage of positive evaluations by measures and disciplines.

Measures	Nurse	NP*	Physician	Pharm.*	CM*	Counselor	Other	All
usefulness and relevance	165 (90.66%)	275 (94.18%)	293 (97.34%)	102 (87.18%)	87 (86.14%)	66 (78.57%)	448 (93.14%)	1436 (92.17%)
easy comprehension	158 (86.81%)	273 (93.49%)	288 (95.68%)	104 (88.89%)	87 (86.14%)	67 (79.76%)	444 (92.31)	1421 (91.21%)
knowledgeable trainer	164 (90.11%)	277 (94.86%)	296 (98.34%)	103 (88.03%)	90 (89.11%)	65 (77.38%)	446 (92.72%)	1441 (92.49%)
appropriate format	169 (92.86%)	257 (88.01%)	270 (89.70%)	96 (82.05%)	80 (79.21%)	74 (88.10%)	395 (82.12%)	1341 (86.07%)
knowledge increase	83 (45.60%)	99 (33.90%)	151 (50.17%)	22 (18.80%)	39 (38.61%)	40 (47.62%)	208 (43.24%)	642 (41.21%)
intention to use knowledge	141 (77.47%)	276 (94.52%)	285 (94.68%)	99 (84.62%)	86 (85.15%)	64 (76.19%)	401 (83.37%)	1352 (86.78%)
intention to change practice	18 (28.57%)	115 (43.56%)	122 (46.56%)	14 (15.38%)	15 (28.85%)	7 (29.17%)	68 (34.52%)	359 (37.67%)
Total	182 (100.00%)	292 (100.00%)	301 (100.00%)	117 (100.00%)	101 (100.00%)	84 (100.00%)	481 (100.00%)	1558 (100.00%)

\*NP: nurse practitioner; Pharm.: pharmacist; CM: case/care manager

#### 4. Discussion

Comparing to our previously reported preliminary results [10], the overall course evaluations by clinicians remained to be very positive (in fact, slightly better than the preliminary results on most measures). Nevertheless, the responses from the different clinical disciplines were not uniform. The analyses clearly indicated that physicians and nurse practitioners were the two groups most satisfied with the online program, followed by nurses. Meanwhile, pharmacists and case/care managers recorded lower than average responses (though need to note that they still had >80% positive feedback on most measures). One potential explanation is that the current curriculum development of the CEI online program focused more on physicians and nurses (the two largest groups of our audience). Our future program development, thus, should be strengthened to address the needs of pharmacists, case/care managers, and other members of HIV-HCV-STD care team.

Interestingly, we noted that nurse practitioners' responses were very similar to physicians on most measures, but significantly different from nurses in many aspects. A potential explanation is that physicians and nurse practitioners had similar information needs, which were well satisfied by the significant number of our online courses addressing complex issues in patient management. Others had similar findings or assumptions in their evaluations of clinical education programs [11-12]. To our knowledge, this study is the first to report such findings on an online education program and with a focus in the clinical domains of HIV, HCV, and other STDs.

There are a few limitations in this study. First, we didn't include the training courses as a variable in the analyses. The specific courses or topics are likely an important factor to influence clinicians' evaluations. Given the significant number of the available CEI online courses, conducting such analyses will require a large sample of clinicians and course completions. This is a direction we would like to explore in the future. In addition to clinical discipline, other factors, such as employment setting, practice years, and patient case load, are also likely to influence a clinician's evaluation.

We have already collected clinicians' professional background in the CEI student portal. We plan to include these variables in analyses for the next steps.

In conclusion, our evaluation of the CEI online education program has shown very positive overall feedback from the clinicians. Meanwhile, we have found significant differences across the clinical disciplines. For more effective knowledge dissemination, online education programs should consider the unique needs by healthcare providers from specific disciplines for more effectively learning.

## 5. Acknowledgments

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## References

- [1] Centers for Disease Control and Prevention, HIV/AIDS Basic Statistics. Available at: <http://www.cdc.gov/hiv/statistics/basics.html>. Accessed on September 23, 2015.
- [2] Centers for Disease Control and Prevention, Viral Hepatitis – Hepatitis C Information. Available at: <http://www.cdc.gov/hepatitis/hcv/hcvfaq.htm>. Accessed on September 23, 2015.
- [3] Centers for Disease Control and Prevention, CDC Fact Sheet – Incidence, Prevalence, and Cost of Sexually Transmitted Infections in the United States. Available at: <http://www.cdc.gov/std/stats/STI-Estimates-Fact-Sheet-Feb-2013.pdf>. Accessed on September 23, 2015.
- [4] C. Fitzgerald, I. Kantrowitz-Gordon, J. Katz, A. Hirsch. Advanced practice nursing education: challenges and strategies. *Nurs Res Pract* (2012), 2012:854918.
- [5] T.E. Belda, O. Gajic, J.T. Rabatin, B.A. Harrison. Practice variability in management of acute respiratory distress syndrome: bringing evidence and clinician education to the bedside using a web-based teaching tool. *Respir Care* 49(9) (2004), 1015-1021.
- [6] New York State HIV-HCV-STD Clinical Education Initiative. Available at: <http://www.ceitraining.org>. Accessed on September 23, 2015.
- [7] D. Wang, X.H. Le, A. Luque. Development of digital repositories of multimedia learning modules and interactive case simulation tools for a statewide clinical education program. *Proc 6<sup>th</sup> International Workshop on Knowledge Representation for Health-Care* (2014), 145-151.
- [8] D. Wang, X.H. Le, A.E. Luque. Identifying effective approaches for dissemination of clinical evidence – correlation analyses on promotional activities and usage of a guideline-driven interactive case simulation tool in a statewide HIV-HCV-STD clinical education program. *Stud Health Technol Inform* 216 (2015), 515-519.
- [9] X.H. Le, A. Luque, D. Wang. Assessing the usage of a guideline-driven interactive case simulation tool for insomnia screening and treatment in an HIV clinical education program. *Stud Health Technol Inform* 192 (2013), 323-327.
- [10] D. Wang, A. Luque. An assessment of New York State (NYS) Department of Health HIV-HCV-STD Clinical Education Initiative (CEI) online training program by healthcare providers. *Proc 8<sup>th</sup> IAS Conference on HIV Pathogenesis, Treatment and Prevention* (2015), WEPED897.
- [11] C. Enweronu-Laryea, C. Engmann, A. Osafo, C. Bose. Evaluating the effectiveness of a strategy for teaching neonatal resuscitation in West Africa. *Resuscitation* 80(11) (2009), 1308-1311.
- [12] S.L. Toback, M. Fiedor, B. Kilpela, E.C. Reis. Impact of a pediatric primary care office-based mock code program on physician and staff confidence to perform life-saving skills. *Pediatr Emerg Care* 22(6) (2006), 415-422.

# Persuasive Technology in Nursing Education About Pain

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**Abstract.** Mobile devices, as persuasive technologies, represent an important platform to promote changes in attitudes and behaviors. They are not only understood as tools, but as a learning process that provides different opportunities to learn how to learn. The objectives of the study were to measure the quality of a virtual mobile learning object, to measure the mental workload of the educational intervention, and to evaluate the learning results. This is a technological production study with a mixed method, quasi-experimental approach. Three simulated clinical scenarios comprise the m-OVADor<sup>®</sup>, allowing for a simulated evaluation of acute pain through interactive tools. The technology met the quality criteria for educational software, with low mental workload, demonstrating a significant strategy for learning about pain among nursing students.

**Keywords.** persuasive technology, mobile learning, nursing education, nursing informatics, pain

## 1. Introduction

Pain is considered a public health problem worldwide, and gaps in professional learning contribute to this situation [1]. Therefore, development of innovative strategies for teaching and learning about pain is necessary, in order to promote improvements in patient care. In this context, the popularity of mobile devices is able to expand learning opportunities in a flexible, innovative and dynamic way [2].

As persuasive technologies, mobile devices are an important platform to promote changes in attitudes and behaviors. They are not only understood as tools, but as a learning process that provides different opportunities to learn how to learn, in a flexible and interactive way [3-4].

The inclusion of educational technologies has the potential to promote a link between theory and practice, encouraging students to make different connections between previous concepts and new knowledge, thereby facilitating reflection on their practices [5].

Therefore, based on the development of a Virtual Learning Object (VLO) for learning the nursing assessment of acute pain, the aim of the study was to evaluate the

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quality of the technology with the Learning Object Review Instrument - version 2.0 (LORI 2.0) [6]; to measure the mental workload of the educational intervention using the NASA Task Load Index Index (NASA TLX) [7]; and, to evaluate the learning results of undergraduate nursing students.

## 2. Methods

This is a technological production study with a mixed method, quasi-experimental approach, approved by the Research Ethics Committee of the Federal University of Santa Catarina (UFSC) - certificate number 2456/2012.

The study was performed from Nov/2013 to Feb/2014, with the participation of 75 undergraduate nursing students and five nurse experts. All received instructions on participation by e-mail and in a closed group on the social network, Facebook®.

m-OVADor® was based on the concept of the VLO [8]. The technology was accessed by means of the participants' own mobile devices, and the content was made available in three languages (Portuguese, English, Spanish), comprising three simulated clinical scenarios (adult surgery clinic, adult intensive care, and pediatrics) (Figure 1).

Its structure enables the simulated assessment of acute pain using interactive tools that address the different variables involved in pain assessment (talking with the patient, applying pain scales, assessing behavioral and physiological aspects of acute pain, determining nursing diagnoses and interventions) (Figure 2). All student actions are recorded in the system, and can be found in patient charts.

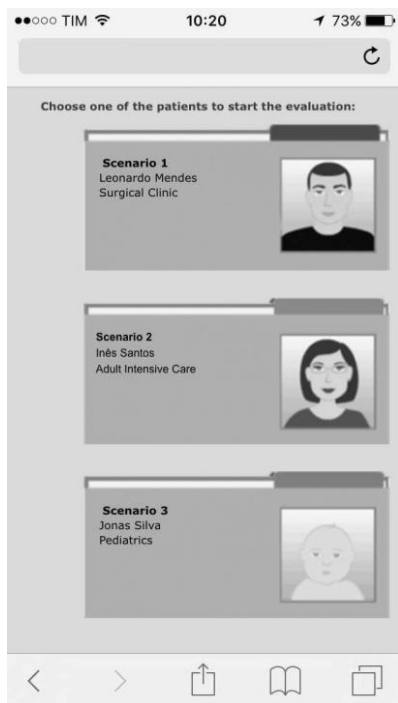


Figure 1 – Clinical scenarios of m-OVADor®

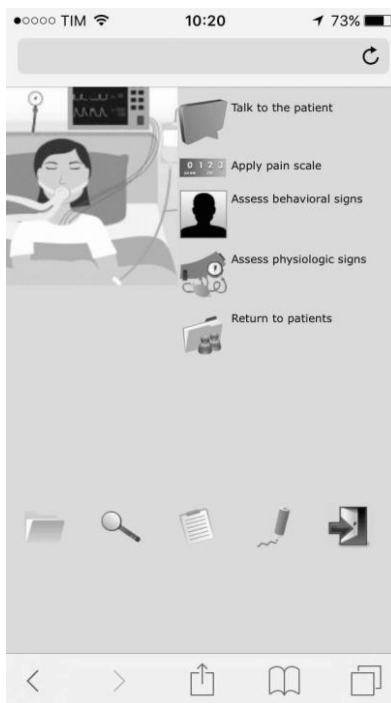


Figure 2 – Interactive tools for pain assessment.

The evaluation of the quality of the technology was based on the variables of LORI 2.0 (Content quality, Learning goal alignment, Feedback and Adaptation, Motivation, Presentation design, Interaction usability, Accessibility, Reusability and Standards compliance) [6], using a 5-point Likert scale (5-Excellent to 1-Bad), with the target mean being 3-Good.

The mental workload between students and experts was measured with the NASA TLX, which assesses the following dimensions: Mental demand, Physical demand, Temporal demand, Performance, Effort and Frustration level [7]. The mental workload index was established by multiplying the rate attributed to each dimension by the weight assigned to each dimension, followed by the sum of these values, the total value divided by 15. The results were analyzed based on a scale of 0 to 100 points.

Data were analyzed using the SPSS software, version 21.0, considering a level of significance of  $p < 0.05$  for a 95% confidence interval.

### 3. Results

The evaluation of the quality, according to students and specialists, averaged 4.27 and 4.31 respectively, on a 5-point Likert scale. Among the students, the variables "Standards compliance" (4.47) and "Presentation design" (4.55) stood out with the highest evaluation, whereas among the experts the following variables stood out "Content quality" (4.80) and "Reusability" (4.80).

The mental workload index was higher in experts than in students (50.20 vs. 47.87). The dimension "Mental demand", defined as the amount of mental and perceptual activity that the educational intervention demands, stood out as a major contributing factor to mental workload in experts and students ( $57.20 \pm 22.27$  vs.  $51.00 \pm 29.45$ ).

Also, experts and students recognized high levels of "Performance" ( $73.00 \pm 28.80$  vs.  $58.47 \pm 24.19$ ), defined as the point where the level of satisfaction with their own income during activity (Figure 3).

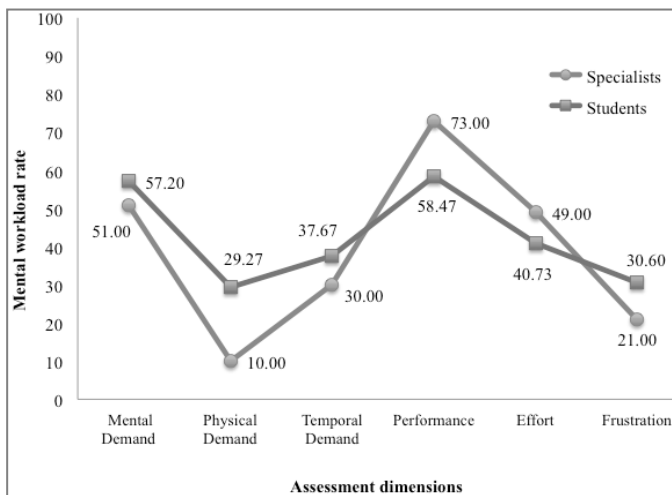


Figure 3. Mean rates of students (n=75) and experts (n=5) for the dimensions of NASA TLX.



The dimension "Physical demand" ( $29.2 \pm 27.91$  vs.  $10.00 \pm 8.66$ ), defined as the amount of physical activity that online educational intervention demands from the subject, was indicated by students and experts as the dimension of lowest contribution to mental workload.

The learning evaluation in students showed significantly higher results ( $p < .001$ ) in the post-test (7.51) compared to the pre-test (5.23).

In further evaluation, students gave their opinions about the online mobile device-based learning experience. The content analysis [9] showed that students recognize the subject's contribution to learning and its relevance; that technology motivated them to learn how to learn; the recognition of gaps in pain assessment in their nursing education; and the need to introduce VLOs in higher education. The possibility of mobility and ubiquity, the degree of interactivity and the layout also stood out.

#### 4. Discussion

The evaluation of technology quality exceeded the target mean (3-Good) in students and experts (4.27 vs. 4.31), considering a 5-point Likert scale. The results indicate the suitability of the technology produced for online educational interventions. The highlight attributed by students for the variable, "Standards compliance", ( $4.47 \pm 0.88$ ) represents the recognition of the appropriateness of the technology from a technical point of view, whereas the variable, "Presentation Design", ( $4.55 \pm 0.74$ ) demonstrates the suitability of the VLO regarding its layout, an element that influences user satisfaction [10].

For the experts, the variables of "Content quality" ( $4.80 \pm 0.45$ ) and "Reusability" ( $4.80 \pm 0.45$ ) stood out in the evaluation, which can be related to a pedagogical vision of the VLO, as well as the recognition of the possibility of its use in different learning contexts.

The results from NASA TLX indicated that the educational intervention demanded a greater "Mental demand" to complete the proposed activity (think, decide, remember, look, research), probably related to the need for greater attention to the different types of information available in m-OVADor<sup>®</sup> and the need to answer questions throughout the simulation.

Noteworthy are the low levels of mental workload, positively contributing to the mobile device-based approach for learning, as a viable process for use in the teaching-learning process in nursing, which is comparable to results of other studies [11-14].

The low "Physical demand" required for the activity can be justified by the familiarity of participants with mobile devices, as well as in other studies [11,15]. Also, the learning results of this group of students were significant ( $p < .001$ ), confirming the potential for the introduction of technology in higher education.

#### 5. Conclusion

The technology is considered to be appropriate quality for use in online educational interventions, low mental workload, satisfaction among students regarding mobile-device based approach for learning, and it also promoted meaningful learning.

Access through persuasive technologies can collaborate to fill the gap in new strategies for teaching of pain assessment among nursing professionals, establishing a new way of learning how to learn.

As future challenges, we highlight the need to develop new VLOs, planning strategies for inclusion of these technologies in higher nursing education, and training of faculty for its use. Thus, we conclude that m-OVADor<sup>®</sup> stimulated students' learning by means of a flexible, interactive and innovative process.

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## Endnote

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## References

- [1] G. Keefe, H.J. Wharrad. Using e-learning to enhance nursing students' pain management education, *Nurse Education Today* **32** (2012), 66–72.
- [2] R. Luanrattana et al. Mobile technology use in medical education, *J Med Syst* **36** (2012), 113-122.
- [3] B.J. Fogg, D. Eckles (Eds.) *Mobile Persuasion: 20 perspectives on the future of behavior change*. Stanford: Ed. Stanford Captology Media, 2007.
- [4] B.J. Fogg. *Persuasive Technology: using computers to change what we think and do*. San Francisco: Morgan Kaufmann Publishers, 2003.
- [5] C.Y. Lai, C.C. Wu. Supporting nursing students' critical thinking with a mobile web learning environment, *Nurse Educ* **37** (2012), 235-236.
- [6] J. Nesbit, K. Belfer, T. Leacock. *Learning Object Instrument Review – user manual version 2.0*, 2009.
- [7] S.G. Hart, L.E. Staveland. Development of NASA-TLX (Task Load Index): results of empirical and theoretical research. In: Hancock P.A., Meshkati N. (Eds.). *Human mental workload*. Amsterdam: North-Holland, 1988.
- [8] R. Schibeci et al. Evaluating the use of learning objects in Australian and New Zealand schools, *Computers & Education* **50** (2008), 271-283.
- [9] L. Bardin. *Análise de conteúdo*. Lisboa: Edições 70, 1977.
- [10] S.J. Smith, C.J. Roehrs. High-fidelity simulation: factors correlated with nursing student satisfaction and self-confidence, *Nurs Educ Perspect* **30** (2009), 74-78.
- [11] S. Iyengar, J.F. Florez-Arango. Decreasing workload among community health workers using interactive, structured, rich media guidelines on smartphones, *Technol Health Care* **21** (2013), 113-123.
- [12] F.P. Corrêa. *Carga mental e ergonomia* [dissertation]. Florianópolis: Federal University of Santa Catarina, 2003.
- [13] M.S. Young, N.A. Staton. Mental Workload. In: Staton NA. et al. (Eds.). *Handbook of Human Factors and Ergonomics Methods*. Taylor and Francis Group: London, 2004.
- [14] C.M. Perry et al. Effects of physical workload on cognitive task performance and situation awareness, *Theoretical Issues in Ergonomics Science* **9** (2008), 95-113.
- [15] G.T.M. Sasso. Mobile learning object in CPR – Advanced cardiac life support: an application of the persuasive technology in nursing. In: *Congresso Nacional de Hipermidias na Aprendizagem*. Florianópolis: CONAHPA, 2009.

# Issues for Deployment of Mobile Learning by Nurses in Australian Healthcare Settings

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**Abstract.** Undergraduate nursing curricula are being redesigned to include strategies for deployment of mobile learning as a legitimate nursing function. A recent online survey exploring the use of mobile learning by undergraduate student nurses revealed barriers, challenges, risks, and benefits to using mobile learning at the workplace. Inability to access mobile learning at both individual and organisational levels impacted on student learning and teaching opportunities. Students also indicated that educational preparation for ensuring appropriate use of mobile learning is necessary to guide learning and teaching *in situ* at point of care. This highlights the need for the development of policy to guide best practice that will enable this new pedagogy to be fully utilised for learning and teaching in healthcare settings. Until governance of mobile learning in educational and healthcare settings in Australia is addressed, harnessing the indubitable benefit of mobile learning and teaching will be unachievable.

**Keywords.** Mobile learning, undergraduate nurses; learning and teaching; governance; deployment

## 1. Introduction

Recent studies exploring the use of mobile technology and mobile learning (mlearning) indicate improved efficiencies can contribute to improved health care of patients by health professionals. However, risks and challenges have also been reported by end-users [1, 2]. As undergraduate nurses are the next generation of health professionals they must be provided with guidance and support in the use of mlearning in the clinical setting. This research explored current nursing students' (students) perception of the opportunities and barriers of using mlearning at point of care. The findings provided direction for developing contemporary and congruent undergraduate nursing curricula.

The Australian competency standards for nursing and midwifery are currently under review [3]. Previous standards have included no specific requirement for nurses' to be competent in health technology and informatics. However, since 2012 the inclusion of health technology and informatics has been a mandatory requirement for accreditation of undergraduate nursing courses in Australia [4]. An ANMAC [5] additional note outlined that health technology and informatics needed to be embedded at a technical, contextual and emancipatory level. This clearly articulates that all stakeholders need to understand the requirements and integrate health technology and

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informatics to prepare beginning level nurses in information literacy, knowledge, skills, attitudes and behaviour to ensure work-readiness.

In response to requirements of accreditation [5] sequencing of new nursing curricula is necessary to reflect the complexity of using health technology and informatics in the workplace [6]. Proficiency in using eportfolios, understanding electronic health records, and digital communication must be achieved [5]. Academics, educators, and supervisors will have to develop the proficiency required for using health technology and informatics during professional practice within healthcare settings [5]. The complexity of health technology and informatics use, level of knowledge and skills needed requires scaffolding throughout curricula to ensure critical thinking occurs with regard to the legal and ethical use of emerging technology, including social media [5].

Students need to understand the complexity of socio-political and technical points relating to appropriate use of mlearning. Currently there are a number of issues that reduce student's ability to access mlearning in educational or healthcare settings. Students need to understand the implications of inappropriate use. New nursing curricula must include knowledge of operational requirements of using mobile devices in education and healthcare environments [7].

Studies on the use of mobile technology have indicated there are a range of barriers, challenges and risks that need to be overcome before mlearning can become a legitimate nursing function at point of care [8]. Access to digital devices as an educational tool in healthcare environments in Australia is limited due to a range of individual, organisational, and systems level impediments [9]. Unless these impediments are ameliorated, the deployment of mlearning will continue to be slow. Currently a range of *workarounds* are used that can impact upon mlearning becoming a legitimate nursing function [10]. Non-compliance with organisational policies perpetuates poor role modelling and hinders appropriate social referencing that occurs when students observe and mimic their nurse educators' behaviour [1]. Utilising mobile devices covertly for learning and teaching in healthcare settings creates tension for end-users and perpetuates the mlearning paradox [10]. Harnessing the opportunity of mlearning in educational and workplace settings will remain problematic if governance regarding using mobile devices by nurses is not addressed [11].

## 2. Methods

This study comprised an online survey of undergraduate nurses administered while they were undertaking work integrated learning at a range of healthcare settings in two Australian states. This cross-sectional study captured student's self-reported access to Internet or device-based resources, using a mobile device, at the workplace. Participants were recruited by email. The survey contained 22 items relating to use of mobile devices to access information. There were three free text-questions seeking their opinions regarding perceived opportunities and barriers relating to using mobile devices during work integrated learning (or PEP as it is known at this university). Responses were coded by two researchers independently and then cross-checked to ensure validity. Human research ethics was approved (H0013729) prior to commencement of the study. Consent was implied by completion of the questionnaire.

### 3. Results

Of the students who indicated that they owned a mobile device (N=47) over three-quarters (n=40, 34 and 35) provided responses to each of the free text questions. Respondents were asked to 1) describe any opportunities they believe could impact on the use of mobile devices during PEP; 2) list their perceptions of barriers to using mobile devices; and 3) comment about access or the use of mobile devices during PEP. From the guided questions, two key themes emerged: 1) enabling access to resources for clinical or educational purposes; and 2) professionalism issues.

#### 3.1. Enabling access to resources for clinical or educational purposes

Students indicated use of mobile devices enabled easier access to evidence-based resources on the Internet, agency Intranet or loaded on the device. One student stated “The laptop is time and space-consuming to set up. Internet access on mobile phones are small and more efficient” or “their ability to be transported from one place to another” and “allowed me to jot down something I was not familiar with and in my break use my smartphone to look it up.” Respondents also indicated that access to a mobile device was useful for communication. Comments included “fast access to communicate with other services/multidisciplinary team” and “quick reference tool... alarm, clock, calculator, stopwatch, reminder.” Students indicated access to ‘best-evidence practice’ information was valuable to them. For example: “very good for intranet usage for evidence based protocols and guidelines” and “mobile technology can be very fruitful because it can be used for clearing up any confusion created.” Respondents listed resources they access using a mobile device including: medication management resources, e-textbooks for “looking up diseases and understanding pathophysiology”, and university learning management systems or information.

#### 3.2. Professionalism issues

Benefits related to “patient perceptions/engagement” or others of nurses using mobile technology. One student stated “I think a tablet device would look more professional than pulling out a mobile”. They indicated that access to mobile devices enabled learning and teaching opportunities that facilitated efficient and effective time management that could positively impact on patient care and learning and teaching opportunities. Comments included “increased access to resources = decreased risk of error eg meds” and “having a device capable of quick reference and look up for terms / drugs/references/pathophysiology etc. may be beneficial while on placement. Physical location of the appropriate resources, can at times, be difficult and time consuming.”

There was enthusiasm for enabling the use of mlearning. “My facilitator carries a mobile phone which we used because they could not answer my question. So we went to the tearoom, Googled the topic and we both discussed the answer. This assisted in my learning which allowed me to reflect with my preceptor”. One student stated “It is a really great resource to ponder and verify when we are in doubt” and “I think when they are used appropriately they can be an invaluable tool to aid learning and coordinating effective and efficient patient care”. One student commented “using the portable or mobile technology, provided that it is affordable, will have a very positive outcome during PEP such as clarifying doubts and revising the subject related activities etc”. “The technology has grown in such a way that it should be useful to everyone”.

Comments about proficiency of ICT use pertained to both clinical supervisors and students. One student commented “encourage IT illiterate preceptors to accept that times have changed and IT is a really useful tool to support clinical practice”.

Responses indicated there were barriers including lack of presence, disapproval, distraction and inappropriate use, including resistance by users. Presence included “people looking at the device too much instead of listening/eye contact” and “a barrier would be the social etiquette involved with students using such devices within the PEP setting.” Students indicated “patient perception of their use in healthcare settings may be negative, thus impacting on the therapeutic relationships held between them and their healthcare professional”. One respondent stated “other health professionals might believe I was neglecting my patients and patients might believe I was neglecting them!” Comments about distraction included “maybe distracting for both staff and patients” and “major distraction with access to social media.”

They indicated that organisational and university policy “clearly instructs students NOT to use our mobile phones during PEP so as not to create the impression we are texting or on Facebook” and the “hospital would not allow it and will reprimand you” or “facility policy often prevents use”. They were cognizant of the “dangers of privacy with patient information and care” and the “risk of breach of patient confidentiality”.

Student comments focused on “battery life, screen size”, “availability of charging ports”, “speed of the Internet” or devices loaded with resources “may not be regularly updated”. Students indicated that theft or loss of the device were a concern. Other comments related to professionalism and included “I noticed most of the doctors had a device in order to access information/patient results/or clarification of pharmacology” and “patients and families could think we are busy talking to our friends or doing something that is not related to caring patients.” Respondents also indicated “it may look unprofessional to be seen using mobile technology as it may not be assumed it is being used for educational purposes”. Concerns about inappropriate use of mobile devices such as using it as a torch for examining patients were also raised.

#### 4. Discussion

Implications for implementing new nursing curricula must be addressed in practice to ensure the next generation of nurses are equipped to optimally utilise health technology and informatics at graduation. Embedding health technology and informatics and appropriate sequencing of knowledge, skills, attitudes, and behaviour development of students requires leadership from the nursing profession to change current governance towards the use of mobile devices in both educational and healthcare environments [9]. Decision making at an organisational level about use of technology for educational purposes will require innovation in planning and implementation, taking heed of lessons of the past such as inadequate consultation; lead-time; training; inappropriate formats; and enabling access to the technology for practice [1]. Minimising resistance at individual and organisation levels will be required for mlearning to be effectively deployed. Facilitation of a change in culture and perception, to enhance understanding of the value of accessing information in real-time, will be integral to success. The use of mlearning as an adjunct to traditional learning methods can assist with ameliorating the theory-practice gap by enabling access to information at the point of need.

Students are aware of, and understand the potential barriers, challenges, risks, and benefits associated with mlearning *in situ*, at point of care. They clearly articulated an

understanding of the need to ensure positive behaviour was employed when using mobile devices in the presence of colleagues and patients. Authors report that the majority of patients believed the use of mobile devices by health professionals was work-related [12]. Clearly, students believed that learning in real-time could improve their understanding and clarify queries they have while caring for patients. Now is the time for Australian nurse leaders to engage in promoting changes in governance in education and healthcare settings that can enable mlearning *in situ*, at point of care while ensuring patient safety is maintained.

## 5. Conclusion

Nursing students demonstrated an understanding of the impact of enabling the use of mobile devices for mlearning in healthcare environments. They recognised there is a need for educational preparation for mlearning within the workplace. Most students were enthusiastic about being able to use mlearning, but understood professional behaviour needs to be modelled when mlearning is deployed. They also have an expectation their educators and supervisors will be competent in its use. Deployment of mlearning as legitimate nursing function requires embedding the use of health technology and informatics in the undergraduate curriculum and nursing leadership to support its use in educational and healthcare environments. Only when there is a change in organisational governance that enables mobile devices to be used for learning and teaching, will the Accreditation Council achieve its aim of promoting and supporting competency, in health technology and informatics in nursing in Australia.

## References

- [1] E Mann, J Medeves, E Vandenkerkhof, Accessing best practice resources using mobile technology in an undergraduate nursing program. A feasibility study. CIN. 2015;33(3):122-8.
- [2] D McBride, SA Le Vasseur, L Dongmei, Nursing Performance and Mobile Phone Use: Are Nurses Aware of Their Performance Decrements? JMIR Human Factors. 2015;2(1):e6.
- [3] NMBA 2nd draft registered nurse standards for practice Southern Cross University; 2015. [https://scuau.qualtrics.com/CP/File.php?F=F\\_4GCDJXTkfr48Ydv](https://scuau.qualtrics.com/CP/File.php?F=F_4GCDJXTkfr48Ydv) retrieved 3 August.
- [4] ANMAC. Registered Nurse Accreditation Standards 2012. ANMAC, editor. Canberra: Australian Nursing and Midwifery Accreditation Council; 2012. 1-30 p.
- [5] ANMAC. ANMAC Health informatics and health technology - an explanatory note 2014. 2014. [http://www.anmac.org.au/sites/default/files/documents/20150130\\_Health\\_Informatics\\_Technology\\_Explanatory\\_Note.pdf](http://www.anmac.org.au/sites/default/files/documents/20150130_Health_Informatics_Technology_Explanatory_Note.pdf) retrieved 3 August.
- [6] G O'Neill, R Donnelly, M Fitzmaurice, Supporting programme teams to develop sequencing in higher education curricula. International Journal for Academic Development. 2014;19(4):268-80.
- [7] J Moyer, Managing mobile devices in hospitals: A literature review of BYOD policies and usage. Journal of Hospital Librarianship. 2013;13(3):197-208.
- [8] J Ramen, Mobile technology in nursing education: where do we go from here? A review of the literature. Nurse Education Today. 2015;35(5):663-72.
- [9] C Mather, E Cummings, Mobile learning: A workforce development strategy for nurse supervisors. Studies in Health Technology and Informatics. 2014;204:98-103.
- [10] C Mather, E Cummings, Unveiling the mobile learning paradox Studies in Health Technology and Informatics. 2015;218:126-31.
- [11] A Garba, J Armarego, DA Murray, A policy-based framework for managing information security and privacy risks in BYOD environments. International Journal of Emerging Trends & Technology in Computer Science. 2015;4(2):189-98.
- [12] O Blocker, L Hayden, A Bullock, Doctors and the etiquette of mobile device use in trauma and orthopaedics. JMIR mHealth and Uhealth. 2015;3(2):e71.

# Interprofessional Student Perspectives of Online Social Networks in Health and Business Education

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**Abstract.** The education sector is experiencing unprecedented change with the increasing use by students of mobile devices, social networks and e-portfolios as they prepare for future positions in the workforce. The purpose of this study was to examine student's preferences around these technologies. A mixed methods research strategy was used with an initial online survey using 29 Likert scale style questions to students from the School of Health Sciences and the School of Business at the British Columbia Institute of Technology (BCIT). Descriptive statistics and ANOVAs were performed to examine if there were any differences between groups regarding their overall responses to the survey questions. Content analysis was used for qualitative focus group data. Overall, students (n=260) were enthusiastic about technology but wary of cost, lack of choice, increased workload and faculty involvement in their online social networks. Of note, students see significant value in face-to-face classroom time.

**Keywords.** Social networks, Connectivism, nursing education, business education,

## 1. Introduction

Today's educator is faced with challenges that include defining learning, defining the process of learning in a digital age, aligning teaching and curriculum with learning, and determining the role that technology plays as a strategy to enhance learning, thinking and being<sup>[1]</sup>. Schools of learning are looking for ways to accommodate these challenges. Technological advances such as the use of mobile devices, online social networks, and e-portfolios may potentially be used to enhance ways of teaching and learning so as to strengthen and deepen interactions between instructors and students leading to more meaningful education experiences.

Traditional academic institutions have resisted the increasing integration of online social networks into the lives of their students, but recently these same institutions have needed to look anew at the consequences and characteristics of the latest modes of technological socialization that are pervading the younger generations who are the majority of students<sup>[2]</sup>. A growing number of educators are advocating that undergraduate schools should incorporate technology to the highest levels possible, so as to not only take advantage of the student's desire for stimulation and instantaneous access to information as integral to their learning<sup>[3]</sup>, but also as part of their responsibility to stay current with educational advances<sup>[4,5]</sup>.

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Siemens<sup>[1]</sup> suggests that knowledge and learning in this digital age are defined by connections and that learning is primarily a process of network formation. He describes the theory of *Connectivism* pertaining to student’s desire for interaction with others online through social networking to improve their learning. Connectivism was chosen as the theoretical framework for this study to help understand the learning that occurs through connection with others in social networks in an age of technological advances.

The overall intent of this study was to determine how students are using various technologies in their learning, and if they see value in online social networks. This paper will specifically discuss findings with regard to student’s impressions and use of social networks in nursing and business education.

## 2. Methods

A mixed methods research strategy was used with an initial online survey using 29 Likert scale style questions, followed by focus groups to students and faculty from the School of Health Sciences and the School of Business at the British Columbia Institute of Technology (BCIT). Ethics approval was obtained for the study through BCIT’s Research Ethics Board.

The research team designed the survey questions after drawing on previous surveys conducted internally at BCIT in the School of Business and reviewing the literature. Subsequent focus groups with students and faculty from the School of Health Sciences and the School of Business were conducted to provide further insight into the data collected from the surveys. Questions for the focus groups were based on survey results and student and faculty responses were requested to clarify some of these results.

Eight of the 29 survey questions were related to student use of social networks (see Table 2). Following the online survey, focus groups were held with students from the School of Health Sciences and the School of Business, with questions asked specifically pertaining to social networks. Survey results were shared with students and their responses were discussed in the focus groups.

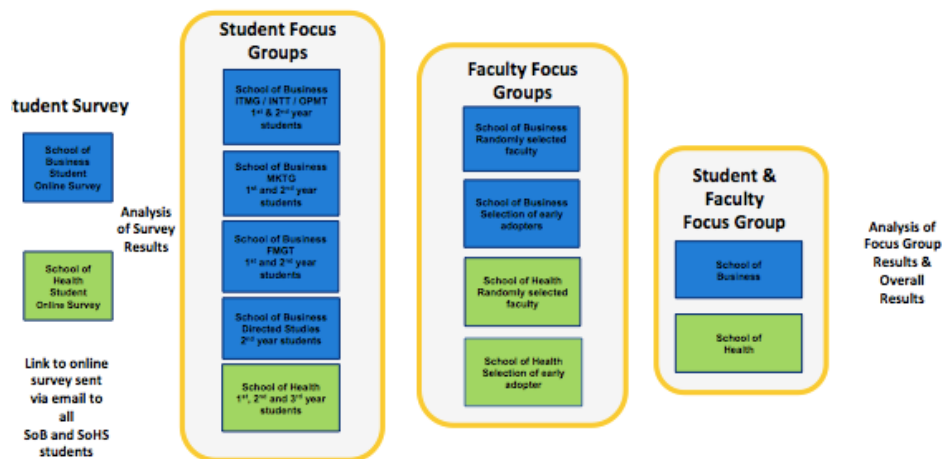


Figure 1. Data Collection Process

Descriptive statistics and ANOVAs were performed to examine if there were any differences between groups regarding their overall responses to the survey questions. Content analysis was used for qualitative focus group data.

### 3. Results

Two-hundred and sixty students responded to the online survey. Most students were in the School of Health Sciences Nursing Program compared to the School of Business programs, and most students were in the younger age group (20-25 years). The questions and the mean scores by schools and overall are shown in Table 2. Of note, the students preferred choice in their use of social network, and they favored internal school-based networks over public social networks pertaining to their learning. There was no significant difference between the students in the schools for the overall mean scores for the aggregate 8 questions ( $F= 1.63$ ;  $p = 0.197$ )

**Table 1.** Participant Demographics

Variable	Nursing (n=155)	Business (n=80)	Other (n=25)	All (n=260)
<b>Age Group</b>				
20 - 25	85 (54.8)	54 (67.5)	13 (52.0)	152 (58.0)
26 - 30	48 (30.9)	15 (18.8)	7 (28.0)	71 (27.1)
31 - 40	14 (9.0)	8 (10.0)	5 (20.0)	27 (10.3)
Over 40	8 (5.1)	3 (3.8)	0	11 (4.2)
<b>Device</b>				
Flip Phone	0	0	1 (4.0)	1 (4)
iPhone	74 (50.0)	48 (64.0)	17 (68.0)	139 (53.1)
Android	67 (45.3)	25 (33.3)	5 (20.0)	98 (37.4)
Windows	1 (0.7)	1 (1.3)	1 (4.0)	3 (1.1)
Blackberry	6 (4.0)	1 (1.3)	0	7 (2.7)

During the focus groups, students indicated that they would value educational sessions where they learn to use social networks not only in a professional manner but also to enhance their professional online presence. An interesting paradox of wanting an internal social network but preference in not having teacher involvement was apparent. Students did however see value in networking opportunities with external stakeholders and alumni. Students stated that they prefer the use of public social networks, such as, Facebook, to include students but exclude faculty. Student's valued time spent with faculty in face-to-face sessions despite appreciating the flexibility of online learning, and blended learning was voiced as the preferred educational delivery method.

Overall, students reported an appreciation for choice in technologies at school. Students did not report that access to devices is a method to better enabling their learning, but they do see value in educational technologies provided they are used thoughtfully. Students prefer to not have any additional workload related to use of technology (e.g. e-portfolios). Free online learning resources are seen by students to be less valuable than face to face programs at BCIT.

**Table 2.** Social Networking Questions and Mean Scores by School

Question	All Mean (SD)	Nursing Mean (SD)	Business Mean (SD)	Other Mean (SD)
I think BCIT should provide students with collaboration tools to help students work on team projects rather than have students pick their own external collaboration tools.	3.3 (1.0)	3.3 (1.0)	3.4 (0.9)	3.5 (1.0)
I think students should pick and use their own external collaboration tools instead of having to use tools provided by BCIT.	3.3 (0.9)	3.4 (0.8)	3.2 (0.9)	2.8 (0.9)
I think BCIT should provide collaboration tools but it should also let students pick their own external tools if they prefer.	4.2 (0.8)	4.1 (0.7)	4.2 (0.7)	4.2 (0.8)
I think BCIT should require all students in my program to use a social network based, collaboration tool for working on team projects and getting more frequent feedback from instructors.	3.1 (1.2)	3.0 (1.2)	3.3 (1.2)	3.1 (1.3)
If my instructors were on a school-based social network and collaboration system and willing to provide me with feedback outside of regularly scheduled class time, I would use the BCIT tool instead of external tools like Facebook for project collaboration.	3.5 (1.0)	3.5 (1.0)	3.5 (1.1)	3.6 (1.2)
I think my project work at BCIT would be improved if I had faculty more connected with my teams via social network tools.	3.3 (1.0)	3.2 (1.0)	3.4 (1.0)	3.2 (1.1)
I think my project work at BCIT would be improved if I had external industry people able to connect with my teams via social networks.	3.5 (1.0)	3.3 (1.0)	3.7 (1.0)	3.6 (0.9)
I think my project work at BCIT would be improved if I had alumni able to connect with my teams via social networks.	3.6 (0.9)	3.6 (0.9)	3.6 (1.0)	3.6 (0.9)
Overall means	3.5 (0.5)	3.4 (0.5)	3.6 (0.5)	3.5 (0.6)

#### 4. Discussion

This study indicates that although students see value in technology they do not want it to come with increased workload, faculty involvement in their social networks, or a loss in face-to-face time with their instructors. In conclusion, we determined that providing students with the choice to use their own technologies is appreciated, but post-secondary schools should offer students education around the professional and thoughtful use of technologies such as social networking sites.

There is a dearth of original research on the impact of social networks in education, but there are a number of reports of unprofessional conduct among healthcare students is increasing with the increased use of social media<sup>[6,7]</sup>. There is little evidence available in the literature about student's use of social networks, especially related to Health Sciences students<sup>[8]</sup>, but in support of this research study there is evidence that when social networks are used in a thoughtful structured pedagogically sound manner, they have the potential to enhance the quality of education<sup>[9]</sup>, increase student's sense of self-efficacy and to develop their learning to a deeper level<sup>[10]</sup>.

Further research studies should explore the impact of innovative educational technologies on student's learning and professional development, specific to the use of social networks.

## 5. Acknowledgments

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## References

- [1] G. Siemens. *Connectivism: A learning theory for a digital age*. Retrieved from Elearning Space: <http://www.elearnspace.org/Articles/connectivism.htm>. 2004
- [2] L. DeRossi. Online Social Networking And Education: Study Reports On New Generations Social And Creative Interconnected Lifestyles. *Robin Hood. – The National School Boards Association*. 2007.
- [3] S. Revell and M. McCurry. Engaging millennial learners: effectiveness of personal response system technology with nursing students in small and large classrooms. *Journal of Nursing Education*, **49** (2010), 272-275.
- [4] A. O. Arhin and E. Cormier. Using deconstruction to educate Generation Y nursing students. *Journal of Nursing Education*, **46** (2007), 562-567.
- [5] D.J. Skiba and A.J. Barton. Adapting your teaching to accommodate the Net Generation of learners. *Online Journal of Issues in Nursing*, **11** (2006), 15-25.
- [6] K.C. Chretien, E.F. Goldman, L. Beckman and T. Kind. It's your own risk: medical students' perspectives on online professionalism. *Acad Med*. **85**(2010):S68-S71.
- [7] J. Cain, D.R. Scott, P. Akers. Pharmacy students' Facebook activity and opinions regarding accountability and e-professionalism. *Am J Pharm Educ*. **73**(2009):1-5.
- [8] N. Mahapatra, and M.S. Schatz. Social Networking Among Health Sciences University Students: Examining Social Network Usage, Social Support, and General Well-Being. *Journal Of Human Behavior In The Social Environment*, **25**(2015), 618-629.
- [9] A.L. Pittenger. The use of social networking to improve the quality of interprofessional education. *American Journal Of Pharmaceutical Education*, **77**(2010), 174.
- [10] M. Tower, S. Latimer and J. Hewitt. Social networking as a learning tool: nursing students' perception of efficacy. *Nurse Education Today*, **34**(2014), 1012-1017.

# Knowledge Transfer in Health Care Through Digitally Collecting Learning Experiences – Results of *Witra Care*<sup>1</sup>

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**Abstract.** *Introduction:* The goal of the project *Witra Care* was to investigate how far the use of mobile technology is suitable to collect experience-based knowledge of nurses. *Methods:* Nine new employees and seven experienced nurses received for six weeks a mobile phone or a tablet pc with a mobile application that allowed them to collect learning object as pictures, videos, audio files or notes. *Results:* In *Witra Care* the nurses created 303 learning objects. They have found the collecting of learning experiences was helpful for their learning processes. The learning objects demonstrate various aspects of daily routines in nursing *Discussion:* The results of *Witra Care* show that the documentation of learning experiences with mobile devices helps to gather information about the practical knowledge in the daily work of nurses, identifies individual learning needs of the employees and supports them in their personal learning processes.

**Keywords:** Inpatient care, learning, knowledge transfer, mobile devices

## 1. Introduction

Learning processes in nursing are strongly influenced by personal exchange [1]. For nurses learning through cooperative exchanges is essential to gain professional expertise. To promote the transfer of knowledge in nursing and assure its quality, it would be useful to collect and share the knowledge and the personal learning experiences that nurses have acquired in their daily work. At this point the project *Witra Care* started. The main research question of the project was, whether a documentation of the everyday knowledge transfer in care could be administered by means of mobile devices.

In Hannover Medical School (MHH), new employees are supported by an experienced nurse for several weeks. In this time the experienced nurse shares her personal professional knowledge with the new employees. In *Witra Care* nine new employees and seven experienced nurses were asked to record their learning experiences using a mobile device. With a mobile application developed specifically for the project, the

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<sup>1</sup> *Witra Care* is an acronym that stands in German for knowledge transfer in health care.

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nurses were able to create images and texts or record video and audio files and to comment this data with keywords [2]. By analyzing these collected learning objects, it should be investigated in how far the use of mobile technology is suitable to collect experience-based knowledge of nurses.

This paper describes which content and knowledge were collected by the nurses in *Witra Care* and how they evaluated the application. This involves the question, whether the digital learning objects can be used for further learning situations and whether the approach of collecting learning experiences is suitable for the use in daily routines.

## 2. Methods

In *Witra Care* the nurses received a mobile phone or a tablet pc to document their learning experiences and to collect learning objects for six weeks. The collected learning objects were inserted into the Content Management System (CMS) *Medical Schoolbook*. The *Medical Schoolbook* is a web based learning platform that has been developed in the Peter L. Reichertz Institute of Medical Informatics and which is used in medical education and training [3]. In *Medical Schoolbook*, every learning object was realized as a single website in the CMS. Thereby, a learning object consists of a title and a media resource and possibly of an additional description. Media resources could be a note, a picture, a video or an audio file. In addition to the websites with the learning objects there are sites which describe a specific category. By linking the learning objects site with the category site a nursing scientist could categorize the material in *Medical Schoolbook*. In this process, attributes of eight major categories were assigned to the learning objects. Three categories described aspects of professional care, five other categories included formal aspects such as data type of the object, time of creation, used device and the person who collected the object. The categories of professional care were “daily care activities”, “quality management” and “general quality” (Table 1). In the category “daily care activities” a distinction was introduced between “specific care activities”, “additional care activities” and “information for new employees”. In the category “quality management“, the learning objects have been assigned to the in-house categories for certification according to DIN ISO 9001. The subcategories were “core processes” (which means all care activities involving direct patient contact), “reporting processes”, “management processes”, “support processes” and “processes for continuous improvement”. In the category “general quality” learning objects which contain images or data from patients were labeled as “critical in terms of data privacy”. Also learning objects with a vague meaning were marked. The categories are no disjoint sets so that one object can be assigned to more than one category.

**Table 1.** Categories and subcategories described aspects of professional care

daily care activities	quality management	general quality
specific care activities	core processes, reporting processes	critical in terms of
additional care activities	management processes	data privacy
information for new employees	support processes, processes for continuous improvement	unclear

After using the application for six weeks, the nurses were asked to evaluate *Witra Care* with a questionnaire and in a face-to-face interview.

### 3. Results

From July 2014 to May 2015 the nurses in *Witra Care* created 303 learning objects at 57 different days. The learning objects incorporate various aspects of daily routines in nursing. For example, one image shows what material is needed for a peripheral venous access (Figure 1). Another image shows the standard form to order drugs. In one video, a nurse explains how to operate the pneumatic tube and another video shows a dressing of a plastic cannula, to name just a few examples.

Overall, 162 learning objects are pictures, 106 notes, 22 audio files and 13 videos. 29 of these learning objects are critical in terms of data privacy. Thereby, about one third of these learning objects are instructions for operating the documentation program where patient names and details were seen. Furthermore, 30 learning objects were labeled as “vague“ as the meaning of the content was not self-explanatory.

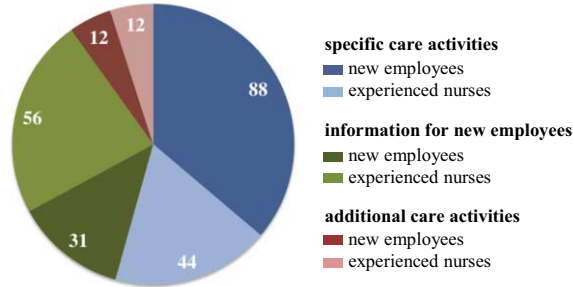
The screenshot displays a web-based learning object interface. On the left is a yellow sidebar with the 'Witra Pflege' logo and navigation options like 'Lernobjekte' and '27.01.2015'. The main content area has a grey header with icons for search, materials, chapters, and editing, alongside an HTML5 logo. Below the header, a metadata box for '27.01.2015' lists details such as 'Pflegearbeitsalltag: Pflegeleistungen', 'Station: Station64B', and 'Zeit: morgens(6.00-11.59)'. A 'PVK' (Pflegetätigkeiten) section is also visible. The central part of the image shows a photograph of various medical supplies: a metal tray, a blue t-shirt, white gloves, a green pad, a bottle of disinfectant, and other small items. Below the photo, there are two bullet points: '- Vorbereitung Verbandswechsel' and '- Auf folgende Zeichen achten: Schmerz, Rötung, Schwellung, Venenverlauf und Funktion'.

**Figure 1:** Presentation of a learning object about material needed for a peripheral venous access in *Medical Schoolbook*

Thematically, 243 learning objects were allocated to the category “daily care activities”. Inside this category 132 learning objects describe “specific care activities”, 87 learning objects include “information for new employees” and 24 learning objects are information on “additional care activities” (Figure 2).

The learning objects of patient-centered “specific care activities” encompass wound care, documentation, diagnoses or patient admission. The subcategory “information for new employees” contains for example images from colleagues or descriptions where to find the meeting room. The “additional care activities” include information on daily operations concerning the use of the pneumatic tube, patient transport, food and drug order etc.. The learning objects regarding “specific care

activities” were mostly created by new employees, the learning objects of "information for new employees" were primarily created by experienced nurses.



**Figure 2:** Learning objects in the category “daily care activities” (n=243)

In the category “quality management“, 120 learning objects belong to the “core processes”, 44 learning objects to “reporting processes”, 38 to “management processes”, 33 to “support processes” and just two to “processes for continuous improvement”. The core processes include all learning objects which also belong to the daily care activities. Management processes include many objects in which the experienced nurses document the incorporation process. The learning objects of the core processes were mostly created by new employees, the learning objects regarding the management processes were primarily created by experienced nurses.

At the end of the project eight nurses evaluated the usability of the mobile application and the utility of *Witra Care*. All aspects were positively rated by the nurses.<sup>3</sup> The nurses have found that the collecting of learning experiences was helpful for a better structuring of the familiarization phase. In addition, they have found that digitally collecting learning objects help them to save time.

#### 4. Discussion

The impact of using mobile devices in the daily work of care was shown in different studies [6,7,8]. E.g. Pimmer et al. demonstrated that mobile phones can help nurses to solve problems by sharing knowledge [9]. As well the nurses in *Witra Care* evaluated the use of mobile application as helpful for their learning processes. Beyond that, in *Witra Care* we have investigated whether the documentation of learning experiences by digitally collecting learning objects can be used to transfer knowledge in the daily work of care.

The collected learning objects represent a wide range of different data types and content and they indicate the individual learning needs of new employees. Trainers and practical instructors can use the information about learning needs to create special courses for new employees. For example, the use of documentation software was one of the central themes of the collected learning objects. Subsequently, short educational films about the use of patient documentation software have been produced and introduced in Hannover Medical School.

<sup>3</sup> The questionnaire was based on the Technology acceptance model [4] and the User experience questionnaire [5].



Moreover, the analysis showed that the collected learning objects represent practical knowledge embedded in daily care activities. Thus, some of the learning objects are of very good quality. In order to facilitate interpersonal knowledge transfer it could be helpful to make them available for other nurses, particularly for new employees. However, there are two limitations regarding the general use of the collected learning objects. On the one hand, the meaning of some of the learning objects has remained vague because of a lack of additional contextual knowledge. But this contextual information is indispensable for the knowledge transfer.

On the other hand, learning objects sometimes show images or data from patients that are critical for data protection reasons. Thus, data protection needs to be addressed before the approach of *Witra Care* can be introduced as an educational tool in health care.

The results of *Witra Care* show that the documentation of learning experiences with mobile devices helps to gather information about the practical knowledge in the daily work of care, identifies individual learning needs of the employees and supports them in their personal learning processes. In addition, the results could be helpful for other domains and it is planned to use *Witra Care* to support non-professional caregivers.

## 5. Acknowledgment

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## References

- [1] A. Kamin, *Beruflich Pflegende als Akteure in digital unterstützten Lernwelten*, 1st ed. Wiesbaden: Springer VS Fachmedien, 2013.
- [2] M.B. Becker, M. Behrends, C. Barthel, T. Kupka, R. Schmeer, I. Meyenburg-Altward, M. Marscholke, Developing a mobile application for recording learning experiences in nursing practice. *Stud Health Technol Inform* **210** (2015), 899-903.
- [3] T. Kupka, M. Behrends, R. Schmeer, M. Becker, C. Barthel, M. Marscholke, Inhaltsanalyse mit Hilfe semantischer Webtechnologien, Gms | GMDS 2015: 60 Jahrestagung Der Deutschen Gesellschaft für Medizinische Informatik, Biometrie und Epidemiologie e V (GMDS) 2015; 2015(8/28/2015).
- [4] V. Venkatesh, H. Bala, Technology acceptance model 3 and a research agenda on interventions, *Decision Sciences* **39**(2) (2008), 273-315.
- [5] A. Hinderks, User experience questionnaire. <<http://www.ueq-online.org/?lang=de>>. Accessed 2014 October, 17.
- [6] C.A. Clay, Exploring the use of mobile technologies for the acquisition of clinical skills, *Nurse Educ Today* **31**(6) (2011), 582-586.
- [7] Y.L. Chiu, C.C. Tsai, The roles of social factor and internet self-efficacy in nurses' web-based continuing learning, *Nurse Educ Today* **34**(3) (2014), 446-450.
- [8] T.T. Wu, Using smart mobile devices in social-network-based health education practice: A learning behavior analysis, *Nurse Educ Today* **34**(6) (2014), 958-963.
- [9] C. Pimmer, P. Brysiewicz, S. Linxen, F. Walters, J. Chipps, U. Grohbiel, Informal mobile learning in nurse education and practice in remote areas - A case study from rural south Africa, *Nurse Educ Today* **34**(11) (2014), 1398-1404.

# Operationalizing the TANIC and NICA-L3/L4 Tools to Improve Informatics Competencies

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**Abstract:** Two tools were developed for nurses to self-assess different levels of informatics competencies. The TANIC is used for all nurses to self-assess; the NICA – L3/L4 is a tool for the informatics nurse specialist (INS) to self-assess skill levels. There are 167 informatics items in the TANIC and 178 advanced informatics items in the NICA – L3/L4. These tools were piloted; the results presented here. Based on the evaluation, the tools have been integrated into informatics courses at the BSN and MSN programs at Chamberlain College of Nursing, and presented in two AACN webinars and other national conferences. Numerous requests have been honored to provide the tools for other schools of nursing to use in their courses, including DNP programs. Other requests include those from CNIOs and managers to include in their job descriptions for informatics nurses.

**Keywords.** Informatics, competencies, TANIC, TIGER, NICA-L3/L4, self-assessment

## 1. Introduction and History

Informatics competencies are critical in the technology-rich healthcare delivery system. Nurse educators and leaders experienced in informatics need to be prepared to consistently mentor nurses to use health-information technology (HIT) in ways that foster continual growth in nursing informatics competencies. One problem in reaching this goal is a lack of methods for determining nurses' informatics competencies.

Researchers from Chamberlain College of Nursing (Chamberlain) developed reliable, valid instruments for nurses to self-assess nursing informatics (NI) competencies at the basic and advanced levels. The first competency levels were established by Stagers et al. [1]. Hunter, McGonigle, and Hebda then developed TIGER-based Assessment of Nursing Informatics Competencies (TANIC), a measure of basic informatics competencies [2].

The basic competencies include Level 1, beginning nurse and Level 2, the experienced nurse. McGonigle, Hunter, Hebda, and Hill developed Nursing Informatics

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Competency Assessment (NICA) L3/L4, a measure of advanced informatics competencies, which includes Level 3, informatics specialist and Level 4, the informatics innovator [3]. This presentation addresses the implementation of TANIC and NICA L3/L4 self-assessment tools.

The ANA defined Nursing informatics (NI) as the specialty that “integrates nursing science with information and analytical sciences to identify, define, manage, and communicate data, information, knowledge, and wisdom in nursing practice”[4]. Some partial examples of competencies/skills are:

- *Entry level core competencies*: basic computer literacy.
- *Experienced skills*: proficiency in the area of nursing and IT needed to support the area of practice, knowledge of methodologies for evidence based practice (EBP).
- *Informatics Nurse Specialist (INS)*: understand and apply information management computer technology which requires high level management/leadership, research, education and clinical practice in new advances.
- *Informatics Innovator*: Support research efforts through use of specific types of software; analyze impact of information management, monitor effectiveness of NI practice; define and develop new computer competencies.

Evaluation of informatics competencies is a priority needed for patient safety. The Institute of Medicine (IOM) report stated, “...nursing practice in each setting where it is rendered will have a significant digital dimension around a core EHR” [5]. This same report noted other areas where NI competencies are important including effective workforce planning and policy making [5]. The World Health Organization (WHO) has a number of informatics initiatives to help meet the mandate including collaborating centers and eHealth Technical Advisory Group formed in 2013 to support WHO’s work [6]. The move to support eHealth represents another reason why nurses need to have informatics competencies assessed. The TANIC and NICA L3/L4 tools are one method to evaluate competencies and skill levels in NI.

## 2. Methods

Tools were developed and a definition of informatics competencies was adopted as, “NI competency is adequate knowledge, skills, and ability to perform specific informatics tasks”. The competencies identified by the TIGER Initiative were the base for TANIC [7]. The TANIC instrument has three subsets: basic computer skills, information literacy, and clinical information management. For NICA L3/L4, four competencies from the work of Staggers, Gassert, and Curran were used [1].

### 2.1 Tool Development

For each tool, the competencies were re-worded as behavioral items. Content validity index (CVI) was established based on responses from the expert-panel review; items had four possible responses: Expert, proficient, comfortable, and beginner/not applicable (NA).

The TANIC pilot study had 184 respondents. In their self-assessments, respondents chose classification of expert for most of the competencies. The NICA L3/L4 pilot study consisted of 178 items and 88 participants. Only 10.7% felt proficient

in using pattern-recognition technologies for analysis. The informatics-knowledge section had 56 items with 12.6% proficient in integrating nursing taxonomies. In the informatics-skills section, there were 109 items, 2.9% felt expert differentiating between machine and high-level programming languages.

### **3. Results**

Results from applying the TANIC and NICA L3/L4 indicated a need to enhance NI education at all competency levels. As the healthcare system continues to rely on electronic means of gathering, storing, and retrieving/ transforming data to information that supports decision making, self-assessment of competencies is a key approach to benchmarking informatics skills that require further development.

#### *3.1 Need for NI education*

An intentional integration of NI education is needed throughout healthcare, beginning with pre-licensure educational preparation. Nurse educators must revise curricula, enhancing the content to prepare beginning nurses with necessary NI competencies. Knowledge acquired in class should be applied in simulation laboratories, clinical settings, and individual assessments [8, 9, 10, 11]. Nursing leaders must support evolution of the NI competencies at all levels within their organizations. One way to accomplish this has been through individual self-assessment and targeted educational for individuals and groups.

### **4. Discussion**

In order to operationalize NI into the curricula and clinical practice, nurse educators, both nationally and internationally, must revise their curricula enhancing the NI content to prepare nurses with the necessary NI competencies. Knowledge acquired in class should be applied in simulation laboratories, clinical settings, and individual assessments, as well as management of electronic medical records (EHRs) [8, 9, 10, 11].

#### *4.1 Operationalizing the TANIC and NICA-L3/L4*

Chamberlain – NI Research Team (NIRT) has published multiple articles and presented at national and international conferences related to informatics skills competencies. Assessment and identification of current skill levels then training toward higher levels of competency will help enable organizations increase employee's knowledge and utilization of evidence-based practice. According to Hart, it would also allow for diversification across multiple settings [12]. To date, job specific competency tools have not yet been developed. For this reason, training and self- assessment is extremely important. Based on the work of Staggers, et al., the TANIC assessment tool was developed and used today to identify basic level competencies. In 2014, Hill, McGonigle, Hunter, Sipes, and Hebda developed a higher level assessment tool that is now incorporated into competency self-assessment [9]. Sipes, et al. discuss the process

of how partnering with national organizations to develop specific competencies will be essential in the future, as was done with a collaborative project with Chamberlain and the Association of perioperative Nurses (AORN) [13].

The ANA *Nursing Informatics: Scope and Standards of Practice*, deals with professional practice evaluation. Further, the informatics nurse engages in self-evaluation, obtains informal feedback, participates in systematic peer review, achieves goals, and provides rationale for practice beliefs, decisions, and actions as part of the process and reviews/ revises applicability to tool competencies practice [4].

The Chamberlain NIRT have operationalization competency self-assessment tools over the past two years in order to determine what basic computer skills exist, evaluated against suggested criteria from a variety of national groups such as ANA and Technology Informatics Guiding Education Reform (TIGER) [1, 8]. Then developed curricula at both the bachelor's and master's levels to meet the needs and address gaps.

Students at Chamberlain complete the self-assessment in the undergraduate courses, again after completing courses at the graduate level. Skills are self-assessment on one of four levels discussed above by using the TANIC. The same process is used for the advanced level - NICA L3/L4. Personal observations of self-assessment, many times, finds that when tools are employed in the classroom for the first time, students typically self-assess their skill levels higher before completing a series of informatics courses, than just before graduation.

In addition, Chamberlain NIRT has presented/disseminated new knowledge and information in a number of venues, including other schools and provided the tools for others to use such as job descriptions and evaluations by leadership and at the Doctorate of Nursing Practice (DNP) level to evaluate students and faculty. Other areas where tools have been presented are at the national informatics organizations, American Nursing Informatics Association (ANIA), ANCC webinars, educational summits with hospital partners and students conducting research in graduate courses and at international conferences.

Many questions arise regarding skills needed to identify and develop skills required industry-wide, critical to the success of technology-rich healthcare systems today. But is also raises questions regarding global indications. What are the indications today for national and international standardized, educational practices? What are the educational differences when it comes to informatics skills? How are EHRs implemented and used in other countries? If they are implemented what are the skill needs?

Obstacles to operationalizing skills assessment include, lack of a clear understanding of nursing informatics, potentially outdated competencies, and/or competencies that do not include unit specific competencies. Additionally, there is a lack of study of informatics competencies across organizations. While two competency tools, the TANIC and the L3/L4 NICA have been developed, they are currently being incorporated into assessments for nursing informaticists. Additional issues that remain need to be focused on the job specific competency assessment and length of tool.

With regard to tool use, it is interesting to note that when the TANIC and NICA L3/L4 tools were employed in the classroom for the first time, students typically self-assessed their skill levels much higher than after completing a series of informatics courses. This is consistent with Elder and Koehn's findings that performed competency levels were lower than self-reported levels among baccalaureate nursing students [12].

## 5. Recommendations for future

Recommendations for the future include revising the self-assessment tool to decrease the length of the tool to improve completion of the tool. Revisiting the initial competencies is imperative to identify if revisions are needed based on the new science. With this investigation, researchers and nurse informaticists can meet the recommendation by ANA for Standard 9 of the scope and standards: *The informatics nurse systematically enhances the quality and effectiveness of nursing and nursing informatics process*. Another important reason to update the tools periodically is due to new and innovative research that is developed. Standard 13 of the ANA scope and standards of practice for nursing informatics relates to research; therefore, it is important that more research be completed and implemented into practice to advance the NI profession [4]

## References

- [1] N. Stagers, C. Gassert, & C. Curran (2001) Informatics competencies for nurses at four levels of practice. *Journal of Nursing Education*, **40**(7) 303-16.
- [2] K. Hunter, D. McGonigle, & T. Hebda (2013). TIGER-based measurement of Nursing Informatics Competencies: The development and implementation of an online tool for self-assessment. *Journal of Nursing Education and Practice (JNEP)*, **3**(12), 70-80. doi: 10.5430/jnep.v3n12p70.
- [3] D. McGonigle, K. Hunter, T. Hebda, & T. Hill (2014). *Self-Assessment of Level 3 and Level 4 NI Competencies Tool Development*. Retrieved from <http://himss.files.cms-plus.com/FileDownloads/Self-Assessment.pdf>.
- [4] ANA (2015). *Health IT Initiatives*. Retrieved from <http://nursingworld.org/MainMenuCaterfories/ThePracticeofProfessionalNursing/Health-IT.org>, p.1-2; 190.
- [5] IOM: The Future of Nursing: Leading Change, Advancing Health (2010). *Committee on the Robert Wood Johnson Foundation initiative on the future of nursing, at the institute of medicine*. Retrieved from <http://www.thefutureofnursing.org>. p.140.
- [6] World Health Organization (WHO) (2015). eHealth Collaborations. Retrieved from <http://www.who.int/ehealth>.
- [7] Technology Informatics Guiding Education Reform (n.d.) *Informatics competencies for every registered nurse: Recommendations from the TIGER collaborative*. Retrieved from [http://www.tigersummit.com/uploads/3.Tiger.Report\\_Compentencies\\_final.pdf](http://www.tigersummit.com/uploads/3.Tiger.Report_Compentencies_final.pdf).
- [8] K. Hunter, D. McGonigle, T. Hill, T. Hebda, & C. Sipes (2014). Self-Reported Assessment of Basic and Informatics Specialist/Innovator Nursing Informatics Competencies: TANIC© and NICA L3/L4©. *Nursing Informatics Today*, **29** (2), 4-6.
- [9] T. Hill, D. McGonigle, K. Hunter, C. Sipes, & T. Hebda (2014). An instrument for assessing advanced nursing informatics competencies. *Journal of Nursing Education and Practice*, **4** (7), 104-112.
- [10] K. Hunter, D. McGonigle, & T. Hebda (2013). The integration of informatics content in baccalaureate and graduate nursing education: A status report. *Nurse Educator*, **38**(3): 110-113. doi: 10.1097/NNE.0b013e31828dc292.
- [11] D. McGonigle, K. Hunter, C. Sipes, & T. Hebda (2014). Why nurses need to understand nursing informatics, *AORN Journal*, September, Vol. **100**, No. 3.
- [12] B. Elder & ML Koehn (2009) Assessment tool for nursing student computer competencies. *Nursing Education Perspectives* **30**, 148–152
- [13] C. Sipes, K. Hunter, D. McGonigle, T. Hebda, T. Hill, & J. Lamblin (2016) Competency Skill Assessment: Success and Areas for Improvement Identified during Collaboration between Informaticists and a National Organization, World Nursing Informatics Congress, Geneva, Full paper presentation, June.

# Information Literacy in a Digital Era: Understanding the Impact of Mobile Information for Undergraduate Nursing Students

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**Abstract.** Recent entry-to-practice nursing informatics competencies for Registered Nurses in Canada mean nurse educators need educational strategies to promote student competency within the rapidly evolving informatics field. A collaborative research team from three Canadian nursing programs completed a mixed method survey to describe how nursing students used mobile nursing information support and the extent of this support for learning. The Mobile Information Support Evaluation Tool (MISSET) assessed Usefulness/Helpfulness, Information Literacy Support, and Use of Evidence-Based Sources. The quantitative and qualitative data were analyzed to describe students' perspectives and the ways they used mobile resources in learning situations. Findings suggest nursing students mainly accessed mobile resources to support clinical learning, and specifically for task-oriented information such as drug medication or patient conditions/diagnoses. Researchers recommend a paradigm shift whereby educators emphasize information literacy in a way that supports evidence-based quality care.

**Keywords.** Information literacy, nursing education, mobile information, research evaluation, undergraduate nursing students

## 1. Introduction

Entry-level requirements for registered nurses in Canada include both computer and informatics competencies<sup>[1]</sup> - skill sets that support evidence-based and safe patient care. Incorporation of mobile devices as tools to access relevant healthcare resources and support evidence-based care is a growing trend in nursing practice despite a relative lack of strong research evidence to support this education approach<sup>[2]</sup>. Professional education bodies are requiring nursing schools and nurse educators to integrate mobile devices within nursing curricula as a means to promote information literacy. Educators have few guidelines on how to maximize students' use of these devices and how to role-model professional use within nursing<sup>[3]</sup>. While the literature contains a wealth of information on the history of mobile devices and their use in

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nursing practice and nursing education<sup>[4]</sup>, there are minimal guidelines on how educators should best integrate mobile devices to support information literacy and evidence-based practice. In fact, most available literature is anecdotal with few research-based studies<sup>[5]</sup>. Another knowledge gap in the literature is whether the use of mobile devices is aligned with the Canadian Association of Schools of Nursing (CASN) entry-to-practice competencies in nursing informatics<sup>[1]</sup>. For example, does the use of mobile information resources improve information literacy in a way that promotes evidence-based practice?

Researchers have reported benefits from mobile devices that include improved currency of information for practicing and student nurses, self-efficacy, and access to electronic clinical information, workflow, and drug dosage calculation safety<sup>[6,7]</sup>. Students have reported mobile devices as useful sources of quick information for clinical practice<sup>[6]</sup>, and noted lower stress with preparation for clinical practice<sup>[8]</sup>.

This paper reports findings from a survey study aimed to fill gaps in the literature related to how nursing students use and evaluate mobile resources in their learning.

## 2. Methods

This mixed method, descriptive design study explored nursing students' use and satisfaction using a mobile information resource. Ethical approval for the project was received from the three Canadian programs where nursing students were recruited.

### 2.1 Procedure

A study explanation/invitation was emailed describing voluntary participation, which contained a url link to a secure online survey (<http://www.qualtrics.com/>) open for a three-week period during May, 2014.

The mobile software, Nursing Central (NC) <sup>TM</sup> (<http://nursing.unboundmedicine.com/nursingcentral>), can be downloaded to mobile devices (iPad, Android, iPhone) and the digital resources can be accessed at any location. Five standard nursing quick guides were available (Taber's Medical Dictionary, Davis's Drug Guide, Davis Lab & Diagnostic Tests, Diseases and Disorders) along with Medline Journals and various clinical calculators. The Medline Journal option allows students to access current journal table of contents and, in a wireless environment, complete articles. Small differences across the nursing programs included: (1) use of different add-on information sources, (2) student versus grant funding, and (3) length of time integrated within the nursing curriculum.

### 2.2. Measures

The online survey collected demographic data including gender, age group, nursing program, year in nursing program, and computer competence level (beginner, intermediate, or expert). Qualitative student perspectives were gathered with text boxes that asked students to provide examples of how the mobile information resources influenced their learning. Students completed the Mobile Information Software Evaluation Tool (MISSET) which contains 15 Likert rated items and has three subscales that assess extent of *Information Literacy Support*, *Helpfulness/Usefulness*, and *Use of Evidence Based Sources*. Validity and reliability parameters for the MISSET were evaluated with the study data. Internal consistency reliabilities were above the accepted standard of .70 <sup>[9,10]</sup>, ranging from .87 to .94. MISSET means were calculated with the



student data where all MISET scale items were completed (N = 141-202) rather than use missing values to impute means which means samples sizes vary across statistical tests.

### 2.3 Data Analysis

At the end of the recruitment period quantitative survey data were downloaded and converted to SPSS version 21 for analysis. Qualitative text box responses were uploaded to Nvivo and coded using content analysis to identify themes. Descriptive statistics (Percentages, Means, SDs) were applied to describe sample characteristics and MISET results. Hypotheses of expected difference were tested using analysis of variance *F* and *t* tests of means. Higher mean MISET total and subscale scores were predicted for nursing students with (1) greater computer competence, (2) more senior year in nursing, and (3) younger (less than 26 years old). Senior nursing students are expected to be more information literate and make complex and evidence-based clinical decisions. Students less than 26 years of age include Millennials who have lived among technology, computers and handheld devices<sup>[11]</sup>. Older nursing students (>26 years) may experience steeper learning curves adapting to use of mobile device-based information in nursing education.

## 3 Results

### 3.1 Sample Characteristics

A final sample of 250 nursing students from Cape Breton University (CBU; n = 90), British Columbia Institute of Technology (BCIT; n = 69), and University of New Brunswick (UNB; n = 91) completed the online survey (Table 1). The sample included students from first (n = 75; 32.3 %), second (n = 68; 29.3%), third (n = 58; 25%), and fourth (n = 31; 13.4%) year of nursing programs. A higher percentage of younger students completed the survey (<= 25 years; n = 122; 62.2%; > 26 years; n = 71; 36.8%). Students were more likely to report 'intermediate' computer competence (n = 175; 76.4%) compared with either 'expert' (n = 48; 21.0%) or 'beginner' (n = 6; 2.6%). Almost all students had used a mobile device longer than one year (n = 213; 92.6%) and over half had used NC mobile information software longer than one year (n = 107; 64.5%).

### 3.2 MISET Means and Differences

The total MISET mean of 3.81 (SD = 0.67) out of a highest possible mean of 5.0 suggested students generally found the mobile software a positive information tool (Table 1). The *Helpfulness/Usefulness* subscale mean was 4.00; item means ranged from a low of 3.98 ('decreased time preparing for patient care') to a high of 4.45 ('information increased my nursing knowledge'). The *Information Literacy Support* subscale was the highest mean, 4.31, and items ranged from a low of 3.87, ('used electronic resources more often than tradition hard copy textbooks') to a high of 4.62 ('helped access needed information'). The mean for the *Use of Evidence Based Sources* subscale was the lowest, 2.86, suggesting the mobile devices were not used to access journal abstracts and/or articles.

Table 1. Mean MISET and Subscale Scores

MISET Scores	Mean (N)	SD	Range
Total score	3.81 (141)	.67	3.67

Helpfulness/useful	3.99 (202)	.85	4.0
Information literacy support	4.31 (199)	.75	4.0
Use of Evidence-based sources	2.86 (181)	1.28	4.0

Younger nursing students (25 years or less) reported higher *Information Literacy Support* (4.44;  $p=.05$ ) compared with older students (4.20). However, no significant difference for age group was seen on other subscales or total MASET. All total MASET and subscale means were significantly higher for nursing students self-rated as having 'expert' level computer competence. In fact, having 'expert' computer competence was the sole characteristic associated with higher *Use of Evidence Based Sources* ( $p=.001$ ). A learning curve, or increase in mean scores, was seen across the four years in the program. However, only the difference between first and fourth year students was significant for the total MASET ( $p=.05$ ), Information Literacy Support ( $p=.05$ ), and Helpfulness/Usefulness ( $p=.001$ ). Differences for mean *Use of Evidence Based Sources* were not significant for any year.

### 3.3 Content Analysis

The qualitative responses supported the quantitative findings; mobile information resources were helpful and supported student learning. Students provided many examples of how they accessed and used mobile information resources in clinical practice. Application of the mobile information was seen with learning about patient medications, patient medical diagnoses and conditions, and informing clinical decisions. While mobile resources were accessed mainly for these 'task' oriented purposes, students reported improved information literacy in increased confidence and lower stress accessing clinical information to apply in practice. So although students did not describe accessing scholarly journals for abstracts or articles, they reported application difficulties when attempting to apply mobile information when completing patient tasks in complex clinical practice situations. This finding is of no surprise, however it warrants the attention of nurse educators who may be inclined to focus solely on information access; in this study, students identified difficulties with the interpretation and application of mobile information.

## 4 Discussion

This collaborative research team explored nursing students' perspectives on whether and how mobile information supports learning. Integration of mobile information within nursing curricula is assumed to promote computer and informatics competencies – yet findings from this study suggest information literacy was limited. Student challenges in their use of mobile information were of interest to researchers. In addition, study findings suggested students used mobile information mainly to support patient care-related tasks but did not access research-based journal articles to support evidence-based practice. This finding was evident in both quantitative and qualitative student responses across all three nursing programs. The qualitative findings suggested students mainly used and applied the mobile information resources in clinical practice learning as most of the examples provided were based in clinical settings. Through an in-depth analysis, it was unclear whether this limited access was due to lack of awareness that the mobile resources allowed access to scholarly journals and/or a devaluing of theoretical and research-based nursing knowledge. Interestingly, although

all students across all three nursing programs reported low use of journal articles and abstracts, one nursing program reported significantly higher use. It is important for future research to assess whether nurse educators are praxis-oriented and encourage students to apply current research and nursing theoretical knowledge in clinical learning situations.

In this paper, researchers examined students' use of mobile devices to access and use information to support their learning and promote higher level nursing information and knowledge. Researchers propose that the time has arrived to evaluate if mobile information promotes student informatics skills and abilities as defined by the Canadian Association of Schools of Nursing's entry-to-practice competencies<sup>[1]</sup>. The timeliness of this research is evident as researchers emphasize the importance of linking information access to nursing knowledge development – a learning domain that is made possible when nurse educators foreground information rather than technology.

Using Nelson and Staggers<sup>[12]</sup> work, researchers suggest concrete teaching and learning strategies for educators to foster nursing students' information literacy and evidence-based practice. These suggestions are offered within the domains of tacit, experiential knowledge and higher level nursing knowledge and wisdom. Educators need to promote student information literacy – a basic nursing competency required to support nursing excellence in a digital era.

## References

- [1] Canadian Association of Schools of Nursing. Nursing informatics entry-to-practice competencies for registered nurses. Retrieved from [http://www.casn.ca/en/Whats\\_new\\_at\\_CASN\\_108/items/123.html](http://www.casn.ca/en/Whats_new_at_CASN_108/items/123.html). 2012.
- [2] C.M. Smith. Harnessing mobile devices in the classroom. *Journal of Continuing Education in Nursing*, **43**(2012), 539-540.
- [3] D. Doran, R. Haynes, A. Kushniruk, S. Straus, J. Grimshaw, L. McGillis Hall. Supporting evidence-based practice for nurses through information technologies. *Worldviews on Evidence-Based Nursing* **7** (2011), 4-15.
- [4] J. Zurmehly. Personal digital assistants (PDAs): review and evaluation. *Nursing Education Perspectives* **31** (2010), 179-182.
- [5] G.J. Doyle, B. Garrett, L.M. Currie. Integrating mobile devices into nursing curricula: Opportunities for implementation using Rogers' Diffusion of Innovation model. *Nurse Education Today*, **34**(2014), 775-782.
- [6] M.J. Farrell, L. Rose. Use of mobile handheld computers in clinical nursing education. *Journal of Nursing Education*, **47**(2008), 13.
- [7] A. White, P. Allen, L. Goodwin, D. Breckinridge, J. Dowell, R. Garvy. Infusing PDA technology into nursing education. *Nurse Educator* **30** (2005), 150-154.
- [8] B. Jamieson, L.M. Secco, S. Profit, J. Bailey, D. Brennick, J. Whitty-Rogers, A. MacIsaac. An evidence-based pilot project: the influence of information-laden handheld computers on computer competence, information sources, and stress levels of nursing students. *Canadian Journal of Nursing Informatics* **4** (2000), 3-34.
- [9] R. DeVellis. Scale Development: Theory and Applications (University of ed., Vol. 26 Applied Social Reserch Methods Series, pp. 171). Thousand Oaks, California: SAGE Publications, Inc, 2013.
- [10] H.A. DeVon, M.E. Block, P. Moyle-Wright, D.M. Ernst, et al. A Psychometric Toolbox for Testing Validity and Reliability. *Journal of Nursing Scholarship*, **39**(2007), 155-164.
- [11] K.T. Pardue, P. Morgan. Millennials considered: a new generation, new approaches, and implications for nursing education. *Nursing Education Perspectives*, **29**(2008). 74.
- [12] R. Nelson, N. Staggers. Health Informatics: An Interprofessional Approach. Elsevier Mosby: St Louis, MI., 2014.

# Integrating Informatics Content into the Nursing Curriculum

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**Abstract.** Contemporary nursing curricula require that nursing informatics content be integrated across the various levels of the programs that are offered. Many such programs face national accreditation requirements that typically relate more to technology than to informatics. International standards vary in these requirements. How can nursing programs meet these vastly different criteria yet continue to level informatics content that follows quality curriculum standards? This presentation describes one approach across programs that considers already developed competencies in nursing informatics while also taking into consideration the various roles that the graduates will have to assume in advanced practice nursing roles. Levels discussed include the baccalaureate, master's, doctorate in nursing practice, and the traditional Doctor of Philosophy degrees.

**Keywords.** Nursing informatics; education, nursing; competency based education; advanced practice nursing; evidence-based nursing

## 1. Introduction

The growth and maturation of nursing informatics has created the need to integrate essential content into all levels of today's contemporary nursing curricula. Complicating this integration issue is the lack of understanding that nursing informatics is a specialty while at the same time a process that is critical to all general and nursing specialty options. An additional concern is that nursing faculty are not themselves well versed in the content, and there is a documented shortage of nursing informatics faculty [1].

One solution has been to focus on a competency based approach to curriculum development. While that solution offers more of a checklist approach, it can sometimes be limiting when users are self-reporting their competency levels. A more general leveled approach may be a realistic solution to this curricular integration. This paper seeks to describe the leveling of informatics content to meet the needs of the various academic programs at one institution, while integrating mandated accreditation content related to both informatics and technology. It is anticipated that this approach would be useful to others at both the U.S. and international levels, although accrediting standards will vary by country.

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## 2. Background

These authors have prior experience in attempting the competency based approach to curricular integration of nursing informatics. Through a funded grant from the U.S. Department of Health and Human Services Administration (Grant # D11HP05290), Drs. Trangenstein and Weiner developed competencies based on the work of Staggers, Gassert, and Curran, the Canadian Nurses), and nurse practitioners identified by Curran [2,3,4]. Competencies were organized by course clusters (several courses with similar content) with key concepts for the baccalaureate level, master's level, and doctoral level of the nursing program. These competencies were reported a decade ago at the NI 2006 Conference [5]. At that time, the doctoral level included only the PhD program, as the Doctorate in Nursing Practice degree had not yet been instituted at Vanderbilt University.

Implementation of the competency approach was not successful. Using the cluster approach to courses rather than identifying individual courses meant that designated faculty found it simple to abdicate responsibilities for implementation by assuming other courses in the cluster were including the content. No formalized meetings between the course cluster faculty members took place to specifically discuss this implementation. In addition, over time, some of the competencies became dated. The world of informatics is increasingly dependent on current internal and external factors like no other, and it is often difficult to keep content current. For example, computer-assisted instruction (CAI) is no longer a contemporary term; it has been replaced by online learning. The importance of population based care, personalized medicine, quality improvement, data analytics, policy advocacy, and patient engagement were not terms that were typically used at that time.

It was determined that an update to the competency approach needed to take place. That same year (2006) was when the American Association of Colleges of Nursing published *The Essentials of Doctoral Education for Advanced Nursing Practice* [6]. Essential IV has an emphasis on information systems/technology and patient care technology. Other Essentials (II, III, and V) have their foci on quality, outcomes, analytics, systems thinking, and advocating policy – all requiring informatics knowledge. As of June 6, 2015, 264 DNP programs are enrolling students in U.S. schools, with an additional 60 DNP programs in the planning stages [7]. This practice based nursing degree is considered an alternative to the research focused PhD. The DNP has been determined to include systems majors such as nursing informatics [8]. It is difficult to ascertain whether the practice doctorate will grow outside of the U.S. According to a recent survey of National Nursing Organizations by Heale and Buckley, there is wide variation internationally in education requirements, regulation and scope of practice of advanced practice nurses [9].

The TIGER Initiative (Technology Informatics Guiding Education Reform) held a 2006 summit of nursing stakeholders to develop a shared vision, strategies, and specific actions for improving nursing practice, education, and the delivery of patient care through the use of health information technology [10]. One of the nine collaborative teams that resulted was in the area of informatics competencies. After reviewing over 1,000 informatics competencies from published literature and practice examples, the group described the minimum set of competencies for practicing nurses and graduating nursing students. Their competencies consisted of three parts, basic computer competencies, information literacy, and information management. Essentially, the model adopted the standards of the European Computer Driving License (ECDL) and

the Information Literacy Competency Standards from the American Library Association [11,12]. Although the ECDL does have an international focus, today's modules include base, standard, and advanced module levels. There are unwieldy detailed course syllabi, and testing centers require additional costs for certification. The ALA standards were updated in 2013 to include information literacy competency standards specific for nursing across all degree programs and continuing education (<http://www.ala.org/acrl/standards/nursing>). Five standards with specific performance indicators were defined. The information literate nurse 1) determines the nature and extent of the information needed, 2) accesses needed information effectively and efficiently, 3) critically evaluates the procured information and its sources, and as a result, decides whether or not to modify the initial query and/or seek additional sources and whether to develop a new research process, 4) uses information effectively to accomplish a specific purpose, and 5) understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally. Performance indicators for all standards were quite detailed.

The authors concluded that a more generalized leveling approach would have more success in assisting faculty to examine their course objectives and outcome criteria to meet the designated terminal objectives. Models were created to illustrate the differences between informatics as a specialty and informatics as a process, along with varying informatics proficiencies based on the curricular level of instruction.

### 3. Results

Figure 1 describes the resulting model for curricular integration. Note the entry level

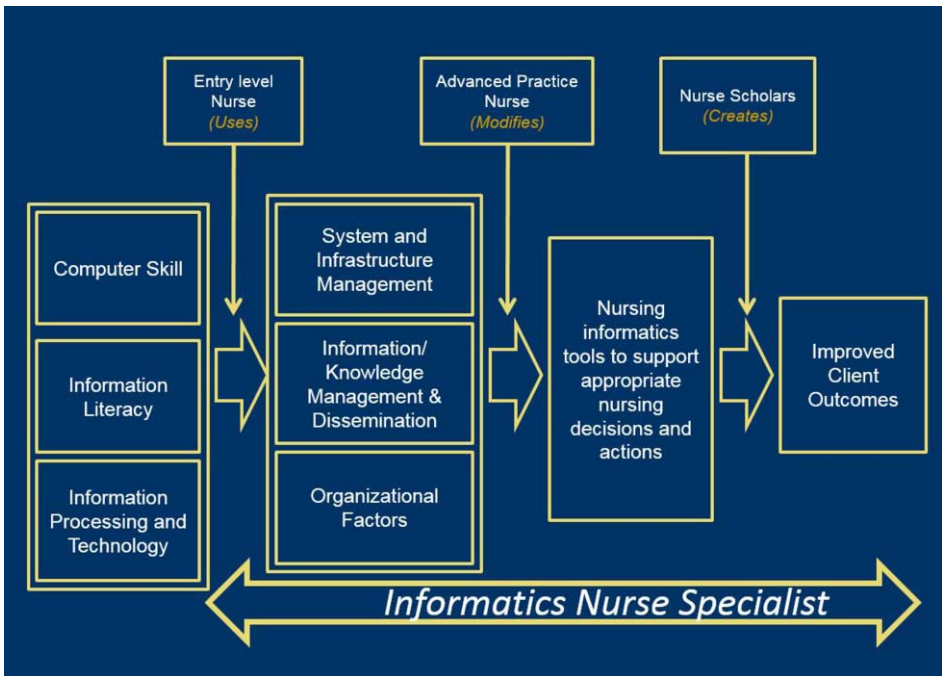
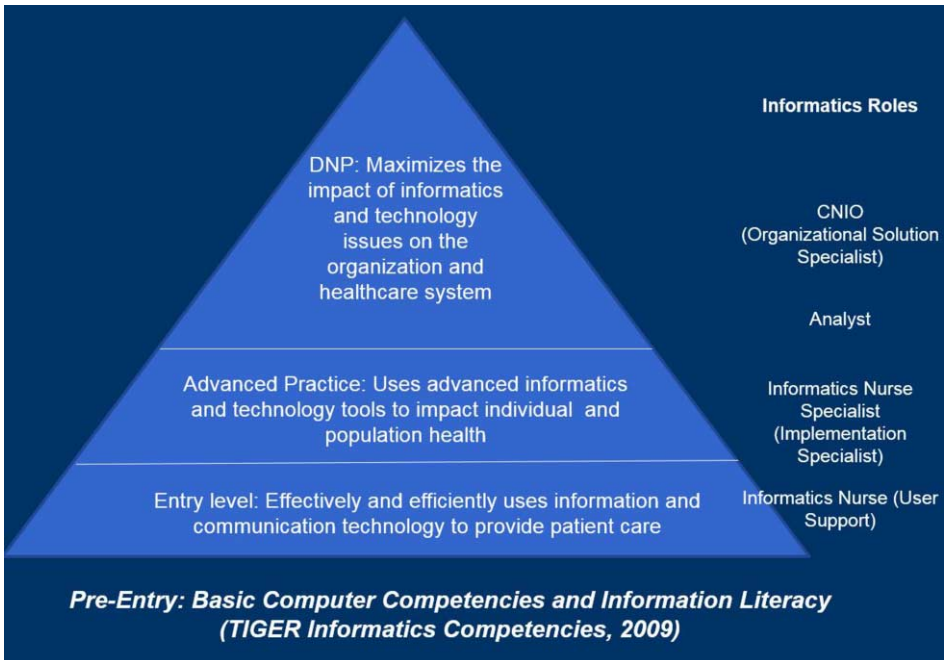


Figure1. Curricular Model by Nursing Preparation.

(BSN), advanced practice level (MSN), and the nurse scholars (doctoral – PhD as research scholars and DNP as practice scholars). All have varying roles related to the improvement of client outcomes. Informatics nurse specialists are responsible for the entire process, although assuming various informatics roles.

These informatics roles can be superimposed on Figure 2. Informatics specialists may be employed in user support roles (typically entry level) up to the Chief Nursing Informatics Officer (at the organizational level). Those nurses in clinical practice may be entry level (using information and communication technology to provide patient care) on up to the DNP level (organizational).



**Figure 2.** Practice Levels of Informatics Use.

#### 4. Discussion

Competencies are the skills and abilities which are required for a desired level of performance. They have typically been popular in nursing curriculum development. However, in reality, nursing faculty have been dependent on assigned course objectives and accreditation criteria rather than on defined competencies. One reason seems to be the level of detail in the specific performance indicators, making them lengthy in nature and unrealistic for integration.

Further complicating the competency issue for informatics is that the content changes rapidly, and is easily influenced by external factors. As technology and policy changes, so do the capabilities of nurses to influence the building and use of knowledgebases.

This paper presents a more global approach, intertwining informatics roles with curricular levels of nursing preparation. It is hoped that this approach will clarify for all nursing faculty what the terminal expectations are for the various nurses, and allow them the professional courtesy to choose course content that will contribute to that overall goal. This solution supports the academic freedom of the nursing faculty, while respecting the learning needs of today's nurses who are expected to fulfill a variety of roles. Continued dialogue regarding the DNP at the international level will need to take place in order to ascertain the reliability of the practice level model.

## 5. Acknowledgments

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## References

- [1] B. W. Thompson, D. J. Skiba. Informatics in the nursing curriculum: a national survey of nursing informatics requirements in nursing curricula. *NURS EDUC Perspect.* 2008; 29(5):312-317.
- [2] N. Stagers, C. A. Gassert, C. Curran. Informatics competencies for nurses at four levels of practice. *J Nurs Educ.* 2001; 40:303-316.
- [3] Canada Health Infoway. Nursing informatics entry-to-practice competencies for registered nurses. [cited 2015 Sept 26]. Available from <http://casn.ca/wp-content/uploads/2014/12/NursingInformaticsEntryToPracticeCompetenciesFINALENG.pdf>
- [4] C. R. Curran. Informatics competencies for nurse practitioners. *AACN Clin Issues*; 2003: 320-330.
- [5] P. Trangenstein, E. Weiner. Meeting the informatics needs of today's nursing students. *Proceedings of Nursing Informatics 2006*. Seoul, South Korea: IOS Press. 2006:205-210.
- [6] S. G. McBride, M. Tietze, M. V. Fenton. Developing an applied informatics course for a doctor of nursing practice program. *Nurse Educator.* 2013;38(1):37-42.
- [7] American Association of Colleges of Nursing. DNP Fact Sheet. [cited 2015 Sept 26]. Available from <http://www.aacn.nche.edu/media-relations/fact-sheets/dnp>
- [8] American Association of Colleges of Nursing. The doctor of nursing practice: current issues and clarifying recommendations, report from the Task Force on the Implementation of the DNP, August 2015. [cited 2015 Sept 26]. Available from <http://www.aacn.nche.edu/media-relations/fact-sheets/dnp>
- [9] R. Heale, C. R. Buckley. An international perspective of advanced practice nursing regulation. *International Nursing Review.* 2015; 62:421-429.
- [10] Technology Informatics Guiding Education Reform (TIGER). Collaborating to integrate evidence and informatics into nursing practice and education: an executive summary, 2009. [cited 2015 Sept 26]. Available from [http://thetigerinitiative.org/docs/TIGERCollaborativeExecSummary\\_20090405\\_001.pdf](http://thetigerinitiative.org/docs/TIGERCollaborativeExecSummary_20090405_001.pdf)
- [11] ECDL Foundation. [cited 2015 Sept 26]. Available from <http://ecdll.com/>
- [12] Association of College & Research Libraries. Information literacy competency standards for nursing, 2013. [cited 2015 Sept 26]. Available from <http://www.ala.org/acrl/standards/nursing>



# Preparing the Next Generation of Advanced Practice Nurses for Connected Care

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**Abstract.** The health care delivery system in the United States is transforming at a rapid pace. Several trends, including the emergence of a Connected Health care system, will require advanced nurse practitioners to have new knowledge, skills and competencies to practice in the future. This paper describes the redesign of coursework and the development of a Connected Care Framework to guide the learning needs of nurse practitioners. A Connected Care Quotient consisting of ten relevant questions and learning activities will serve as a guide for the future development of competencies for advanced practice nurses.

**Keywords.** Connected Health, Education, Competencies, eHealth

## 1. Introduction

Since the introduction of the Health Information Technology for Economic and Clinical Health (HITEC) Act of 2009, the United States health care system has increased adoption of electronic health records systems (EHRs) across hospitals, clinics and physician practices. In *The Future of Nursing: Leading Change, Advancing Health* Report, health information technologies, primarily EHRs were highlighted as a fundamental change in how “RNs plan, deliver, document, and review clinical care.”<sup>1(104)</sup> The report noted that nurses were “expected to use a variety of technological tools and complex information management systems that require skills in analysis and synthesis to improve the quality and effectiveness of care.”<sup>1(7)</sup> In response to the increased adoption of EHRs, the American Association of Colleges of Nursing has defined information management competencies for baccalaureate, masters and doctorate of nursing practice academic programs.

To prepare our graduate level nurses to practice in an ever increasing technology enabled health care system, the College of Nursing received a Health Resources and Services Administration (HRSA) advanced nursing education training grant focused on interprofessional education (IPE) and the use of technologies. The goal of the iTEAM (*Interprofessional Technology Enhanced Advanced practice Model*) is preparing advanced practice nurses (APNs), physicians and pharmacists with the necessary interprofessional (IP) core competencies to “provide technology enhanced collaborative care by: offering technology enhanced learning opportunities through a required informatics course, advanced practice courses (team based experiences with both standardized and virtual patients) and team based clinical experiences including eHealth experiences.”<sup>2(58)</sup> *The Core Competencies for Interprofessional Collaborative*

*Practice* identified by the Interprofessional Education Collaborative Practice (IPEC)<sup>3</sup> focused on values/ethics, roles and responsibilities, IP communication, and teams and teamwork.

The initial objective was to develop a series of learning activities to address the IP communications using the EHR to facilitate teamwork and the care of patients. As described in an earlier publication, learners were engaged in various courses using a variety of tools to foster communication and practice as a collaborative team to provide care.<sup>1</sup> After some experimentation with several types of learning activities (EHR assignments, simulations with patients in a face-to-face experience, virtual simulations with virtual patients in Second Life- a 3D virtual world with avatars), it was realized that our project focused on the current health care system and was not focused on the emerging changes in the health care system. Our task then was to examine current trends in health care as it entered into the Post-EHR era<sup>4</sup> and revise our learning activities and formulate new competencies for our future nurse practitioners.

The Post EHR era is being fueled by three major trends. The first trend is the concept of the Connected Age. According to Siemens Internet of Things Facts and Figures,<sup>5</sup> there are currently close to 20 Billion connected devices linked to the Internet and forecasts from 26 to 33 Billion expected by the year 2020. The connected age is all about everything and everyone being connected. Oblinger described it best as “*Connecting* is about reaching out and bringing in, about building synergies to create a whole that is greater than the sum of its parts. *Connecting* is a powerful metaphor. Everyone and everything—people, resources, data, ideas—are interconnected: linked and tagged, tweeted and texted, followed and friended.”<sup>6(4)</sup> In higher education, connected age is described as an environment that “offers new ways to connect things that were previously considered disparate and ‘un-connectable’: people, resources, experiences, diverse content, and communities, as well as experts and novices, formal and informal modes, mentors and advisors.”<sup>7(88)</sup> In this environment, “learning pathways can be created by the individual or can be guided by other students or faculty. The bottom line is... learning pathways are about connecting the dots through connections that can be in the classroom, online or even with people and places outside the traditional academic environment.”<sup>8(63)</sup>

It is not surprising that the health care community has also recognized the concept of connectedness. Caufield and Donnelly defined connected health as “a conceptual model for health management where devices, services or interventions are designed around the patient’s needs, and health related data is shared, in such a way that the patient can receive care in the most proactive and efficient manner possible.”<sup>8(704)</sup> Iglehart<sup>9</sup> views connected health as an umbrella concept that incorporates telemedicine, telehealth and m-health. Although connected health incorporates many digital tools as part of its infrastructure, it is also about connecting people, ideas, resources and communities. It is about putting the patient front and center in the care process.

The second trend is that “the health care system is undergoing rapid changes that put new emphasis on population health, quality of care, and the value of the services delivered.”<sup>11(1)</sup> New health care delivery systems are being implemented that require a shifting of the workforce from acute to outpatient settings. “In this new system, nurses will need to consistently apply skills associated with a continuous learning health system, including care coordination and transitional care; optimize care through use of data and evidence, often gleaned from electronic medical records; collaborate interprofessionally, and actively engage in performance improvement.”<sup>11(2)</sup> This second

trend is built upon the Institute of Medicine's initiative, Better Care at Lower Cost and the Continuously Learning Health Care System.<sup>12</sup>

The third trend is the rise of patient engagement and their use of digital tools. The engagement of patients, families, caregivers and consumer in their health care is an important component of the transformation of health care. Leonard Kish refers to Patient Engagement "as the blockbuster drug of the century."<sup>13(1)</sup> *The National Action Plan to Support Consumer Engagement via E-Health* proposed in 2013 highlights the importance of patients, families, caregivers and consumers being engaged in their care and having access to their health information. Their three-pronged strategy is "to increase patients' Access to their health information; to enable consumers to take Action with that information; and to shift Attitudes so that patients and providers think and act as partners in managing health and health care using health information technology."<sup>14(378)</sup> Their e-health tools include patient portals to access information from their EHRs as well as secure messaging with their clinicians, personal monitoring devices, mobile apps, health information websites and social media sites for peer support.

The three trends are also influenced by two recent strategic initiatives proposed by the Office of the National Coordinator for health information technology. The first is the proposed *Connecting Health and Care for the Nation A Shared Nationwide Interoperability Roadmap*.<sup>15</sup> If the United States Health care system is to reach its goals of improving health outcomes, improving the quality of care and lowering costs, it is important that health information from institutions, providers and the patient are accessible at the point of care. The goal is to create a nationwide learning health care system, which is an "interoperable health IT ecosystem that is person-centered makes the right electronic health information available to the right people at the right time across products and organizations, in a way that can be relied upon and meaningfully used by recipients."<sup>15(9)</sup> The roadmap defines the functional and business requirements for technical and semantic interoperability. The second initiative encompassed a five-year *Federal Health IT Strategic Plan*.<sup>16</sup> This plan builds on the better health, better care and lower costs aim but also now included the engaged patient as part of the vision. There are three overarching goals set forward. The first is "to advance person-centered and self-managed care"<sup>16(9)</sup> by engaging patients, families and caregivers to manage their health care and to facilitate partnerships among individuals, clinicians and communities. The second goal is "to transform the delivery of health care and community health."<sup>16(9)</sup> The last two goals focus on facilitating research, science & innovation as well as enhancing the Health IT infrastructure of the United States.

## 2. Methods

Upon completion of our analysis of trends, review of the literature and the newest federal strategic initiatives, a Connected Care Framework was developed to guide the curriculum development and create an initial set of competencies for our APNs. Advanced practice nurses include direct practice roles such as nurse practitioners and clinical nurse specialists as well as indirect care roles such as informatics specialists and administrators. The Connected Care Framework allows the inclusion of the IP core competencies, their use of the EHR and a new set of knowledge, skills and attitudes build upon the concepts of connected health, patient engagement, clinical transformations and new digital tools. These new concepts were framed within the

context of the continuously learning health care system, interoperability principles and the federal health IT strategic plan. A diagram of the Connected Care Framework is shown below.

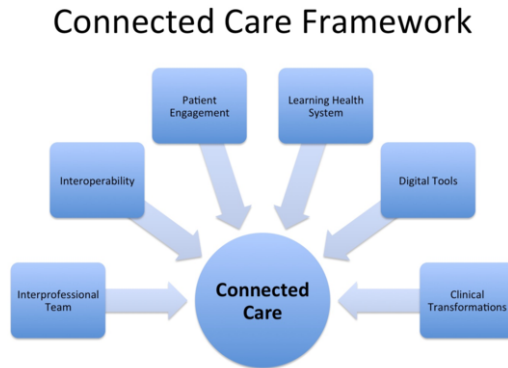


Figure 1: Connected Care Framework

Coursework was then redesigned to incorporate all the concepts of Connected Care. Interprofessional learning activities were redesigned to focus on three areas: electronic communication for teams, patient engagement and conducting an eVisit with patients. Each are briefly described highlighting the IP experiences in Connected Care.

### 3. Results

#### 3.1 Electronic Team Communication

In the Health Assessment and Advanced Pharmacology courses, APN students are paired with second or third year PharmD students for various IP experiences. Both nursing and pharmacy students have access to patient electronic record through the Cerner Academic Education Solution EHRs. These records are crafted by faculty and serve as a means of the team sharing information about the patient and developing collaborative care plans. “These various IPE experiences allow students to understand how EHRs can be used as a communication mechanism to provide collaborative care when all disciplines are not present with the patient. It is also used as a mechanism to keep teams informed of their patient’s health progress and to insure teams are working together to provide the best care.”<sup>15</sup>

#### 3.2 Patient Engagement

All students receiving a Master of Science (MS) or a Doctorate of Nursing Practice (DNP) degree are required to enroll in the Foundations of Health Care Informatics course. There are four modules in the course that include students learning the core concepts of informatics, data-information-knowledge continuum & decision support tools, consumer engagement and professional issues (privacy, security, roles). The course is taught within the context of a continuously learning health care system and takes into account the Federal Health IT Strategic Plan and the Interoperability. The consumer engagement module involves an IP learning experience. This module focuses on the use of digital tools with patients, families, caregivers and consumers to encourage engagement in their health care. Digital tools covered in the course are:

personal health records/patient portals with secure messaging, mobile apps, consumer-facing tools, social media, and patient generated health data tools. For their IPE experience, the collaborative care team (nursing & pharmacy students and the patient) helps a patient who has requested advice for some digital tools to manage their health condition. The patient has sent a secure message to the team requesting a trusted website, a social network group for peer support and any mobile apps that can help to manage his care. Both the nursing and pharmacy students have access to the patient's EHR. The team accesses the patient record and then meets virtually to determine how to proceed and accomplish this patient request. Students can meet using one of several platforms (Skype, Zoom, Canvas Learning Management system, Google Hangouts or Firefox Hello) to review the patient's health record, determine criteria to use for the evaluation of these requested items (website, social network and mobile apps). The students must then find the tools, evaluate them and write a response to the patient taking into account the patient's knowledge and health literacy.

### 3.3 eVisits

With increasing demand for eVisits, nursing and pharmacy students were given connected care opportunities to practice using patient digital tools (ThinkLabs Digital Stethoscope, Masimo iSpO2 Pulse Oximeter, Withings Wireless Blood Pressure Monitor & Withings Smart Body Analyzer) and to conduct an eVisit with a standardized patient (SP). A SP is an "actor" trained to portray a particular patient scenario. The SP was a 74-year-old man who was comfortable using technology. The pharmacy and advanced practice nursing student had to virtually meet to review the patient record using the Cerner Academic Education Solution EHRs, determine the intent of the eVisit and then conduct the eVisit.<sup>17</sup> The virtual platform was Zoom (<https://www.zoom.us/>). It is easy to use and allows participants to use their speakers, microphones and cameras on their computers, tablets or smartphone to have an interactive virtual meeting.<sup>17</sup>

## Discussion

For each of these areas, we learned many valuable lessons to inform our curriculum redesign. There were several challenges from these experiences. First, there is a need to challenge nurses to reflect on their engagement with patients, families and caregivers. There is a need to give them more experiences to include patients as a part of the health care team. Second, nurses "need more experiences not only using digital tools themselves, but to gain a greater understanding of how patients, families, and caregivers use these tools."<sup>17(201)</sup> Third, nurses need more knowledge, guidance and skills in conducting eVisits with patients and within a collaborative care team. In response to these challenges, A *Connected Care Quotient (CCQ)* was developed as part of a talk for the Institute of Medicine's five year review of *The Future of Nursing: Leading Change, Advancing Health Report*.<sup>1</sup> The CCQ was adapted from Topol's "Digital Quotient,"<sup>18 (178)</sup> which is composed of five questions one can ask potential graduates of medical school. The CCQ poses 10 questions<sup>19 (347)</sup> to ask future APNs in direct care roles:

- Will you & the care team include me as an active partner in the collaborative care team?
- Will you & the care team advocate patient generated health data (PGHD) so I can choose the right digital tools to capture essential data relevant to my health?

- Will you and the care team be supportive of patients/families/caregivers activation and maximum engagement in my care?
- Will you & the care team share your clinical notes with me?
- Will you & the care team leverage numerous forms of data to inform my clinical decision making?
- Will you & the care team recognize that health and health care go beyond your walls and provide care through various digital tools?
- Will you & the care team connect me to patients, resources and evidence based practices?
- Will you & your care team help to transform the way health care is experienced and delivered?
- Will you & the care team provide personalized health care based not only clinical data but social & behavioral measures & patient preferences?
- Will you & the care team help me understand my health data to make better health decisions?

The next step will be to translate these connected care quotient into measurable competencies and to develop the curricular materials to support student learning.

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#### References

- [1] Institute of Medicine. *The future of nursing: Leading change, advancing health*. Washington, DC: National Academies Press; 2010.
- [2] Skiba D, Barton A, Knappfel, S, Moore G & Trinkley K. (2014). Infusing informatics into interprofessional education: The iTEAM (Interprofessional Technology Enhanced Advanced practice Model) project. In K. Saranto, C. Weaver & P. Chang (eds). *East Meets West: eSMART. Proceedings of the 12<sup>th</sup> International Congress on Nursing Informatics*. Leiden, Netherlands: IOS Press.
- [3] Interprofessional Education Collaborative Expert Panel. *Core competencies for interprofessional collaborative practice. Report of an expert panel*. Washington, DC: Interprofessional Education Collaborative; 2011.
- [4] Millard, M. Is the Post-EHRs era upon us? [Internet] *HealthCare IT News*. 2014 October. Available from: <http://www.healthcareitnews.com/news/post-ehr-era-upon-us>
- [5] Siemens *Pictures of the Future: Facts and Forecasts: Billions of Things, Trillions of Dollars*. [Internet] 2014 October. Available from: <http://www.siemens.com/innovation/en/home/pictures-of-the-future/digitalization-and-software/internet-of-things-facts-and-forecasts.html>
- [6] Oblinger, D. The connected age for higher education is here. Are we ready for the future? *EDUCAUSE Rev.* 2013;48(5): 4-5.
- [7] Abel R, Brown M & Suess, J. A new architecture for learning. *EDUCAUSE Rev.* 2013;48 (5): 88,90,92,96,98,100,102.
- [8] Skiba D. The Connected Age: Implications for 2014. *Nurs Ed Perspect.* 35 (1) 2014. 63-65.

- [9] Caulfield BM & Donnelly SC. What is Connected Health and why will it change your practice? *QJM: An Inter J of Med.* 2013; 106(8): 703-707.
- [10] Iglehart, JK. Connected Health: Emerging disruptive technologies. *Hlth Affairs.* 2014;33(2):190.
- [11] Fraher E, Spetz J & Naylor M. *Nursing in a transformed health care system: New roles, new rules.* 2015 Jun. Available from: <http://ldi.upenn.edu/brief/nursing-transformed-health-care-system-new-roles-new-rules>
- [12] Institute of Medicine. *Best care at lower cost: The path to continuously learning health care in America.* 2012. Available from: <http://iom.nationalacademies.org/Reports/2012/Best-Care-at-Lower-Cost-The-Path-to-Continuously-Learning-Health-Care-in-America.aspx>
- [13] Kish. The blockbuster drug of the century: An engaged patient. HL7 Health Standards. 28 August 2012. Available from: <http://hl7standards.com/blog/2012/08/28/drug-of-the-century/>.
- [14] Ricciardi L, Mostashari F, Murphy J, Daniel J & Siminerio E. A national action plan to support consumer engagement via e-health. *Hlth Affairs.* 2013;32(2): 376-384.
- [15] Office of the National Coordinator for Health Information Technology. *Connecting Health and Care for the Nation A Shared Nationwide Interoperability Roadmap: DRAFT Version 1.0.* 2015. Available from: <https://www.healthit.gov/sites/default/files/nationwide-interoperability-roadmap-draft-version-1.0.pdf>
- [16] Office of the National Coordinator for Health Information Technology. *Federal Health IT Strategy Plan 2015-2020.* 2015 September. Available from: [https://www.healthit.gov/sites/default/files/9-5-federalhealthitstratplanfinal\\_0.pdf](https://www.healthit.gov/sites/default/files/9-5-federalhealthitstratplanfinal_0.pdf)
- [17] Skiba, D. Connected Health: Preparing Practitioners. *Nurs Ed Perspect.* 2015; 36 (3): 198-201.
- [18] Topol E. *The patient will see you now: The future of medicine is in your hands.* New York: Basic Books; 2015.
- [19] Skiba D. Connected Care Quotient (CCQ) and the Future of Nursing. *Nurs Ed Perspect.* 2015; 36(5): 345-348.

# Technology Readiness of Early Career Nurse Trainees: Utilization of the Technology Readiness Index (TRI)

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**Abstract.** Health Information Technology (HIT) adoption by clinicians, including nurses, will lead to reduction in healthcare costs and clinical errors and improve health outcomes. Understanding the importance of technology adoption, the current study utilized the Technology Readiness Index to explore technology perceptions of nursing students. Our analysis identifies factors that may influence perceptions of technology, including decreased optimism for students with clinical experience and increased discomfort of US born students. Our study provides insight to inform training programs to further meet the increasing demands of skilled nursing staff.

**Keywords.** Technology Readiness, Health Information Technology, Nurse Trainees

## 1. Introduction

Technology readiness is the propensity of individuals to use new technologies in the accomplishment of goals [1]. It encompasses technology-related beliefs. These beliefs determine the predisposition of an individual to embrace and interact with new technology, independent of actual competence of technology use [1]. Electronic Health Records (EHRs) ensure access to relevant patient-level information. EHRs and other technologies in the healthcare setting, result in different modes [2] of practice amongst healthcare professionals. For optimal utilization of these and developing technologies, healthcare professionals must be receptive to their use. Understanding technology perceptions including the readiness of use by early career professionals in primary care fields such as nursing, is critical [1]. Such knowledge can enhance training and success in practice settings. This study seeks to assess the technology readiness of nurse trainees; guided by the Technology Readiness Index (TRI). Prior studies have found it to be effective for studying the propensity of technology adoption [1]. Studies have also proven the importance of considering perceptions to determine intervention such as technical support and training to ensure successful technology use [2].

## 2. Methods

A web-based version of the TRI survey was administered to a convenience sample of 43 urban nursing students. The design was cross-sectional, aimed at capturing a

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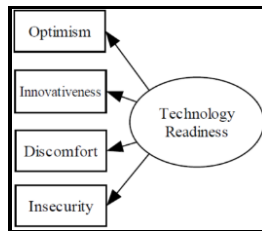
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representative sample. The demographic portion of the survey comprised of questions evidenced to indicate the acceptance of technology [1, 3, 5]. Our study was approved by the Columbia University Medical Center Institutional Review Board.

*2.1. Instruments*

The Technology Readiness Index (TRI) is a 36 item tool to assess technology use readiness on a 5-point Likert scale of strongly disagree to strongly agree [1]. The TRI is based on four domains: two contributors (Optimism and Innovativeness) and two inhibitors (Discomfort and Insecurity). Optimism is the view of technology in a positive way and the belief that its use offers efficacy, flexibility and control. Innovativeness is the propensity for one to be a technological pioneer. Discomfort is the belief there is a lack of control over technology use and Insecurity is the disbelief and skepticism in the ability for technology to work correctly [1]. These personality dimensions affect the tendency of individuals to use and embrace new technologies.



**Figure 1.** The Technology Readiness Index

*2.2. Data Analysis*

Mean scores were calculated for items that comprise the domains of Optimism, Innovativeness, Discomfort and Insecurity. Scores were reverse coded for the inhibitor domains. The appropriate weighting for domains with fewer items (i.e., Innovation and Insecurity) was conducted to allow for score equivalence. A mean total score for technology readiness was also computed. Internal reliability was calculated for each domain scale and for the overall TR score, Table 1. Pearson Product Moment Correlations (PPMCs) were calculated to determine the relationship between TRI domains and participant characteristics. Descriptive statistics were calculated for demographics. T-tests and analysis of variance assessed differences in continuous variables and chi square analyses assessed differences in categorical variables.

**3. Results**

The four TRI domains and overall TR total score demonstrate an acceptable level of internal consistency with Cronbach’s Alpha scores of 0.80 (Optimism), and 0.7 (Innovation), 0.8 (Discomfort), 0.7 (Insecurity) and 0.9 (Overall TR), Table 1.

*3.1. Descriptive statistics*

Forty three students completed the survey. Participant mean age was 28.3 years (SD=4, range=23-39). Participants mean years of Nursing experience was less than a year with

the average healthcare experience in any capacity at 2.4 years (SD=2.3). The sample was predominantly White (N=35, 81.4%), followed by Black (N=4, 9.3%) and Other/Mixed Race (N=4, 9.3%). Participants who identified as Hispanic comprised 7% (N=3) of the sample. Most were born in the United States (N=31, 72.1%), Table 2.

**Table 1.** Internal Consistency for TRI domains and total score

TR Components	Cronbach's alpha
Optimism	0.8
Innovation	0.7
Discomfort	0.8
Insecurity	0.7
Overall Total Score	0.9

PPMCs in Table 3 pertains to the distribution of respondents' scores on the four domains and the overall TRI score. Results indicate that significant correlations exist between the two contributors (Optimism and Innovativeness) and two inhibitors (Discomfort and Insecurity). The overall TRI score significantly correlated with all four technology readiness domains.

**Table 2.** Descriptive Statistics: Characteristics of Study Participants

Variable	Mean	N	%
Age	28.3±4.0	43	
Years of Nursing Experience	0.3±00.7	43	
Years of Healthcare Experience	2.4±20.3	43	
<b>Country of Origin</b>			
USA		31	72.1
<b>Race</b>			
White		35	81.4
Black		4	9.3
Other/Mixed Race		4	9.3
<b>Ethnicity</b>			
Hispanic		3	7.0

### 3.2. Technology readiness of participants

Results for the TR domains indicate that participants overall had positive outcomes of technology, indicating readiness. Many were optimistic about technology ( $\bar{x}$ =3.5) and are not insecure ( $\bar{x}$ =2.9) concerning technologies role. Participants also on average, did not show high levels of discomfort ( $\bar{x}$ =3.0). The overall TRI total score ( $\bar{x}$ =3.1) indicates an adequate level of technology readiness of participants. Although, the Insecurity score was higher than those found in the literature [1, 3, 5], scores align with a 2013 study of full-time nurses (N=878), assessed on acceptance of a mobile EHR [5].

### 3.3. Technology readiness by demographic variables

Independent samples t-tests were used to explore relationships between the TR domains and demographic characteristics of the study participants. Nursing students were asked to indicate the type of healthcare experience they obtained before enrolling in Nursing School. This would allow for us to assess participants who have actually used clinical based technologies including EHRs. Participants who indicated clinical care experience

were less optimistic about technology readiness than those who had no direct clinical experience, Table 4. TRI domain scores were categorized as low medium and high. Although low discomfort levels were the same for US born compared to non-US born participants, those born in the US, had significantly greater levels of Discomfort than non-US born participants, Table 5.

**Table 3.** Pearson Product Moment Correlations (PPMCs) for TRI domains and total score

TR Components	Mean	SD	Correlation Coefficient			
			OPT	INN	DIS	INS
Optimism (OPT)	3.5	0.5	1.0			
Innovation (INN)	3.1	0.5	0.5**	1.0		
Discomfort (DIS)	3.0	0.5	0.3	0.2	1.0	
Insecurity (INS)	2.9	0.6	0.1	0.1	0.4**	1.0
Overall Total Score	3.1	0.4	0.7**	0.7**	0.7**	0.6**

\*\*p < 0.01, \*p < 0.05

#### 4. Discussion

Optimism and innovativeness drive an individual's readiness to use technology, with higher score indicating higher degrees of readiness [1]. Discomfort and insecurity are direct inhibitors of technology readiness, with higher scores indicating a reduction in overall readiness for technology use [1]. Results of our study indicate two major findings. First, people in actual clinical practice are less optimistic about technology use than those who have not used such tools in the clinic setting. Demographic study information indicated that healthcare experience in the clinical setting prior to attending nursing school, had an impact on Optimism scores, with significantly lower scores for those who worked with patients including Medical Assistants, Patient Care Technologists, and Physical Therapists. Our findings may shed insight into the actual use of technologies such as EHRs and difficulties experienced in clinic settings. Second, in spite of the young age of the sample ( $\bar{x}=28.3\pm 4.0$ ), there was significant discomfort levels, with US-born participants having greater discomfort. Other countries or origin include India and Portugal. Further exploration of the differences indicate no significant age difference between groups. Although not significant, non-US born reported more clinical experience (58.3%) than US born (48.4%). Computer self-efficacy can significantly influence a person's perception of new technology [4]. Clinical experience can also serve as an indicator of higher levels of discomfort resulting from in-experience with computer use in the clinical setting.

Several limitations exist. Our survey was a self-report instrument and limited by potential self-report bias. Future studies should consider additional measures that best captures technology readiness in addition to competencies and acceptance [2, 5]. Furthermore, due to its small sample size, our study is not generalizable.

**Table 4.** T-test for TRI domains and total score for healthcare experience

TR Components	Type of Healthcare Experience	
	Patient Care	Other
Optimism*	3.3±.50	3.7±.46
Innovation	3.0±.70	3.1±.47
Discomfort	2.9±.57	3.0±.45
Insecurity	2.8±.51	2.8±.53
Overall Total Score	3.0±.40	3.2±.30

\*\*p < 0.01, \*p < 0.05

Academic instruction can support increase optimism and decrease discomfort to improve technology readiness of new trainees. Efforts may include the direct use, of such technologies (i.e., EHRs) in the classroom setting, well before clinical training. Early and ongoing exposure will contribute to the reduction in discomfort, further preparing students for clinical training and future practice. Barrier and obstacles to technology use in the clinic setting must also be addressed in academic training. Courses should cover evidence-based practice including workflow analysis, barriers to EHR system use and identify effective approaches used to overcome such challenges.

**Table 5.** X<sup>2</sup> for TRI domains and total score for US born

Born in the US	Optimism			Innovation		
	Low	Medium	High	Low	Medium	High
No	12.5%	31.3%	45.5%	21.4%	31.3%	30.8%
Yes	87.5%	68.8%	54.5%	78.6%	68.8%	69.2%
	Discomfort**			Insecurity		
	Low	Medium	High	Low	Medium	High
No	50.0%	29.4%	41.7%	38.9%	30.8%	8.3%
Yes	50.0%	70.6%	38.7%	61.6%	69.2%	91.7%
	Overall TR					
	Low	Medium	High			
No	35.0%	18.0%	25.0%			
Yes	65.0%	82.0%	75.0%			

\*\*p < 0.01, \*p < 0.05

This study provides valuable insight into technology readiness of nursing trainees. Results can inform the teaching of technology related skills with optimal instructional methods to meet the needs of nursing students at all levels of technology acceptance.

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## References

- [1] A. Parasuraman, Technology Readiness Index. *J Serv Res* 2 (2000), 307-20.
- [2] C.S. Gadd, P. Baskaran, & D.F. Lobach, Identification of design features to enhance utilization & acceptance of systems for Internet-based decision support at point of care. *AMIA Proc* (1998), 91-95.
- [3] D.A. Adams, et al. Perceived usefulness, ease of use, and usage of information technology. *MIS Quarterly* 16 (1992), 227-247.
- [4] M.E. Poter, Health Care A Strategy for Health Care Reform. *N Engl J Med* 361 (2009), 109-112.
- [5] K.M. Kuo, C-F Liu & C.C. Ma, An investigation of the effect of nurses' technology readiness on the acceptance of mobile electronic medical record systems. *BMC Medical Informatics and Decision Making* 13 (2013), 1-14.

# Development and Evaluation for Active Learning Instructional Design of Epidemiology in Nursing Informatics Field

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**Abstract.** Nursing education classes are classifiable into three types: lectures, classroom practice, and clinical practice. In this study, we implemented a class that incorporated elements of active learning, including clickers, minutes papers, quizzes, and group work and presentation, in the subject of “epidemiology”, which is often positioned in the field of nursing informatics and which is usually taught in conventional knowledge-transmission style lectures, to help students understand knowledge and achieve seven class goals. Results revealed that the average scores of the class achievement (five levels of evaluation) were 3.6–3.9, which was good overall. The highest average score of the evaluation of teaching materials by students (five levels of evaluation) was 4.6 for quizzes, followed by 4.2 for announcement of test statistics, 4.1 for clickers, and 4.0 for news presentation related to epidemiology. We regard these as useful tools for students to increase their motivation. One problem with the class was that it took time to organize the class: creation of tests, class preparation and marking, such as things to be returned and distribution of clickers, and writing comments on small papers.

**Keywords.** Active Learning, Epidemiology, Instruction Design, Clicker

## 1. Introduction

Classes in nursing education are classifiable into three types of lecture, classroom practice, and clinical practice. In this study, we implemented a class that incorporated elements of active learning, including group work and presentations, clicker, and minutes papers (paper-based class portfolio), in the subject of “epidemiology,” which is usually taught in conventional knowledge-transmission style lectures.

Epidemiology has historically developed as a methodology associated with the prevention of diseases. Today, it has practical purposes in public health nursing that not only analyzes diseases in specific human populations such as regions, occupations, and schools, but also analyzes the distribution of health-related events and associated and influencing factors and controls health-related events based on the obtained knowledge. Epidemiology is included in the scope of the National Examination for Public Health Nurses. In addition, the way of thinking and the research methodology are the bases of providing evidence-based nursing and fundamental knowledge for conducting nursing research. However, because the content is conceptual, it is said to be difficult for

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nursing students to understand technical terms with which they are not familiar. In previous study, the research of thinking out a better method for epidemiologic class is not found. For that reason, to help understand knowledge of epidemiology and to support the achievement of class goals, we designed a blended class using many active learning methods including clickers using ICT, etc.. This paper describes the instructional design to increase student's motivation and considers the effectiveness based on class evaluation by them.

## **2. Previous Study**

### *2.1. Implementation of Active Learning in Nursing Education*

The ability to engage all students actively in a large classroom is challenging and increasingly difficult because the number of nursing students has increased.

The project explored how an audience response system (clickers), combined with case-based questions, caused increased student engagement, attention, and participation in an introductory clinical nursing course [1].

### *2.2. Implementation of Active Learning in Epidemiology Education*

In epidemiology education, only one report [2] presents the possibility that the use of clickers might influence students' self-evaluation of overall understanding of the lectures.

## **3. Implementation Methods for the Class**

### *3.1. Target subject*

This paper reports the implementation of epidemiology class held in the second semester of 2014 (the second semester of junior year, a compulsory subject). The goal is to select students for the public health nurse courses. Students who took the class were 107; 106 of them attended the class through the last day.

### *3.2. Specific class tools*

- 1) Class orientation: The syllabus had been registered in the university's database beforehand. Additionally, we provided guidance during the first session of the class. Not only the topic of each lecture, but also today's news presentation by group, peer review, test, class portfolio, and creation of journal notes were presented in the 15-session class plan. We urged students to do preparation for technical terms to become familiar with them because the focus of explanation in the class would be on the textbooks.
- 2) Structure of each session of the class: The structure and the time allocation of each 90-minute session of the class were presented. This enabled students to participate in the class, understanding the progress of the class.
- 3) Active learning methods: Mizokami considers methods of active learning by

dividing lectures into lecture-style and practice-style classes [3]. We organized them into a list and marked the methods that we introduced to the class (Table 1).

**Table 1.** Active Learning Implemented in the Class

		Content	Implementation in the class	Tool
Learning process	Lecture style	Have students write comments/ questions	○	Class portfolio
		Reflection	○	Peer review
		Debate		
		Response analyzer	○	Clicker
		Make students observe familiar phenomena		
	Practice style	Data collection	○	Task presentation
		Interview/ questionnaire/ experiment		
		Production	○	My note, Question-posing (quiz)
		Field observation		
		Group discussion	○	Today's news presentation, Question PPT
		Group learning	○	
		Presentation	○	
		Question and answer with teachers / other students	○	

We used slightly thicker colored paper for the class portfolio and peer review related to news presentation because they were to be used in every session and needed to be distinguished easily from other documents.

The class portfolio was designed to fit on a sheet of paper using both sides to show the attendance status for 15 sessions of the class at a glance. Furthermore, for students themselves to manage the goals, we had students write their own class goals to be achieved in the first session after the class guidance and the achievement in the last session. Although these are similar tools, shuttle-card “*Daifuku-cho*” [4], it is particularly different in the point that ours is designed to record the “understanding” on a scale of 1–5, separating the “understanding at the time of preparation and that after the class”.

The form of peer review evaluation on today’s news presentation was designed to be able to record not only the evaluation of presentations, but also the classification of survey methods, considering that students would learn epidemiological survey methods during the latter half of the class.

Additionally, we introduced the use of clickers to grasp diverse opinions and conditions of students taking the class, as well as review tests (quiz and test) and group question-posing, which was posted on the home page after creating and sending via email, to fix their knowledge. With regard to question-posing, we made it known to students that good questions might be used for each test, which raised their motivation.

### 3.3. Evaluation methods for learning results

To achieve the class goals, we evaluated learning results as follows.

- (1) Fixation of knowledge: Quiz and test 80%

- (2) Attitude about the class: Class portfolio 10%
- (3) Submission of tasks: Question-posing and today's news 10%

## 4. Discussion

### 4.1. Evaluation methods

In the last session of the class, an anonymous, self-administered questionnaire survey was given. We provided an oral explanation to students that the survey was designed to improve the class and that results might be reported at conferences. We asked them to submit the questionnaire by their own free will. The questionnaires were distributed to 103 students who attended on the day. The number of questionnaires collected was 101 (98.1% collection rate).

### 4.2. Results of class goals

Table 2 presents the five levels of evaluation results as to whether each of the seven class goals was achieved or not. The highest personal average score was 5 points; the lowest was 2 points. The 90% of students assigned scores higher than 3. It is readily apparent that many had been achieved class goals. Students had the best understanding of the concept of epidemiology and the basic terminology, which seems to have led them to understand the importance of epidemiological perspective in public health nurse. Particularly we think that because risk factors by which students who are bad at mathematics often stumble were understood from the results of quizzes and the comments of class portfolio. The understanding was further deepened through the review in the next session of the class and repeated questions in quizzes.

However, 11 students (10.9%) assigned a score lower than 2 for at least one goal. The goal with the lowest achievement was Goal 5: "Able to explain main population statistics and health statistics". Ten of the students were included here. This is a learning item in other subject. Therefore, cooperation between subjects is regarded as necessary.

### 4.3. Results of active learning methods

With regard to the seven methods, the five levels of evaluation results are presented in Table 3 as to whether they were used for the promotion of learning, motivation for learning, and achievement of the class goals. The highest personal average score was 5 points; the lowest was 1.6 points. Most methods were evaluated as scoring higher than 3. However, a lot of students assigned scores lower than 2 only to the home page for quiz learning, which revealed that it was not used very much. Furthermore, students who gave a score lower than 2 for at least one of all methods were 35 (34.7%); 30 of them did not use the home page for quizzes.

Opinions commonly found in free descriptions were the following: "Clicker was interesting"; "It was easy to understand because a quiz was provided in each session"; "I was happy to get a comment to the class portfolio every time"; and to create quizzes was "beneficial", or conversely "a burden." In addition, an opinion that "It was an easy-to-understand class because it had concrete examples and slides with main points"



was commonly shared. Moreover, there was an opinion that “I will mainly use textbooks and class notes for the national examination.” We think the following points led to visualize learning results and presented a clear idea of learning methods for the national examination two years later: conducting the class and tests particularly addressing the textbooks; and having students create journal notes.

Finally, the student whose self-evaluation was the lowest gave the following comment: “It was difficult and full of content, but I think that I was taught in an easy to understand manner. I was glad that you looked at the portfolios carefully. I wish I could have been more interested in epidemiology.” Challenges remain for how to arouse students’ interest in epidemiology.

**Table 2.** Achievement of Class Goals (Average)

Class goals	Average score
1 Able to understand and explain the concept and basic terminology of epidemiology	3.9±0.7
2 Able to explain plague frequency and risk, or effective indicators	3.7±0.7
3 Able to explain survey methods in epidemiology	3.6±0.8
4 Able to explain the principle and method of group medical examinations	3.5±0.7
5 Able to explain main population statistics and health statistics	3.6±0.8
6 Able to explain main diseases’ frequency and distribution, and risk factors and prevention	3.8±0.8
7 Able to explain the importance of an epidemiological perspective in public health nurse activities	3.8±0.8

**Table 3.** Evaluation of Active Learning Methods

Tool	Average score
1 News presentation on epidemiological survey	4.0±1.0
2 Quiz and test	4.6±0.7
3 Class portfolio	3.9±0.9
4 Announcement of test statistics	4.2±0.9
5 Clicker	4.1±1.0
6 Quiz creation	3.8±0.9
7 Quiz home page	3.2±1.2

## 5. Acknowledgments

We appreciate the cooperation of all nursing students for their help in class evaluation.

## References

- [1] J.S. Russell, M. McWilliams, L. Chasen, J. Farley: Using clickers for clinical reasoning and problem solving, *Nurse Educator* **36(1)** (2011), 13-15.
- [2] Y. Nekota: Use of Clickers in an Epidemiology Lecture and the Students’ Reactions, *Journal of Japan Society of Nursing Research* **35(1)** (2012), 137-143.[in Japanese]
- [3] S. Mizokami: Practical issues of Active Learning introduction, *Nagoya Journal of Higher Education* **7** (2012), 269-287. [in Japanese]
- [4] H. Susono, T. Shimomura, K. Oda, H. Koyama: Paper-based and Electronic Daifuku-cho (Shuttle Card) for Future Teachers and Elementary and Secondary Students, *Proceedings of SITE 2005(2005)*, 215–220.

# Changing Educational Paths in an Informatics Course According to the Needs and Expectations of Nursing Degree Students

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**Abstract** Informatics education in the nursing career varies in each curriculum, and directly impact in training and future development of nurses in the professional field. While the proposed curriculum is based on essential minimum content for professional training, it was necessary to update it according to current technological development, considering the different profiles of students and practice settings, labor and academia. The pedagogical proposals were redesigned in two informatics courses of a Bachelor of Science in Nursing (BSN) at Hospital Italiano de Buenos Aires. We adapted the curricula tailored on prior knowledge, educational path and needs of the students identified and made explicit by them at the beginning of the courses. At the end of the courses, the students surveyed said that the changes were appropriate

**Keywords.** Nursing Informatics, Computer science education, Nursing education, Information literacy, Nursing curriculum

## 1. Introduction

The 20th century it has been called the 'age of information'. And it is considered that the current will be described as the era of the 'information process' since it is one of the most valuable contemporary resources as well as also the ability to use it effectively [1]. Historically, the processing of information has been the subject of nurses and integral part of their profession, but since the information technologies and communication were included as tools in hospitals, professional practice; access to information in a timely manner, decision making, monitoring and evaluation of nursing care were significantly modified [2]. 'Information literacy' represents the ability to recognize when information is needed in addition to knowing locate it, evaluate it and use it. As informatics skill means being able to effectively and efficient use technological devices as needed [1]. The level of information literacy and technologies management required for nurses is the expected of any professional of this century with education, so if using them in the professional field increases more and more, possessing proper training is necessary. Nevertheless, these conditions are not met in all cases [3]. Therefore, we consider it essential that both nursing organizations and institutions of formal education to review its curriculum proposals and educational objectives and encourage of digital skills hope the future professionals develop, increasing the computer and informational

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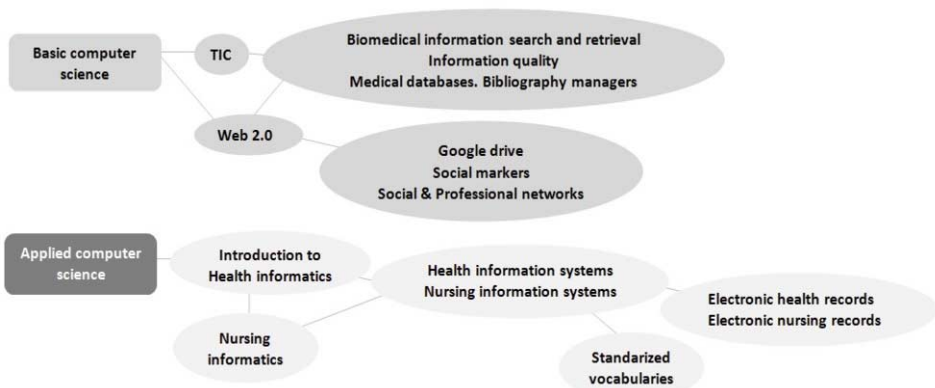
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training, according to the different recommendations [4]. In this regard, some training paths of nursing students have been modified according to technological advances in the field of health, promoting the development of those digital and informatics skills necessary for professional performance. While the literature realizes the different arguments and positions on the incorporation and development of these skills in undergraduate education, inclusion of them in nursing training programs has not been mass, resulting in some limited cases or varied [5-6]. Nor abound studies evaluating the competences of nursing students [7].

Being able to compare the different curricular and pedagogical approaches in the field of computer science undergraduate training in nursing and, to analyze the recommended practices according to the literature, promotes the review and updating content to enrich teaching towards academic quality in line with the demands of today's professional field training. This paper describes the findings of a pilot project of content review and updating in two educational informatics courses in a Baccalaureate Science in Nursing, according to the needs and expectations of students and from teaching strategies and educational decisions carried out.

**2. Methods**

Hospital Italiano de Buenos Aires (HIBA) is a highly complex university hospital with a 150-year history. It belongs to a health nonprofit network with an infrastructure of 750 beds. In addition, 1500 nurses, 2800 doctors and 1900 employees works at the organization. It possesses a research institute and a University Institute (UI) that offers university education in health sciences, between them nursing. Degree in nursing takes place over five years. After the first three years the student gets an intermediate diploma that qualifies for professional practice as registered nurse, and can continue studying for two more years and graduate with a degree in nursing. The computer science course is part of the curriculum, featuring four courses (Basic computer science I and II and Applied computer science I and II) on four of the five years program. The teaching staffs of each subject review and update every semester the proposals and pedagogical objectives with a strong focus on innovation. Figure 1 shown the structure of the courses' contents:



**Figure 1:** Contents of basic and applied computer science courses of the Nursing degree program at HIBA

Student groups are characterized by heterogeneous in age and educational paths partly due to socio-economic and labour conditions that determine the choice of nursing profession in Argentina, influenced by the need to be able to enter the labour market as quickly as possible. In the 3-year program students groups are formed by pupils whose age is usually between 19 and 40 years. In the program of two years remaining to get the nursing degree, the age range in some cases amounting to more than 50 years (for this training program, the UI also accepts nurses of other academic institutions). Accordingly, prior knowledge of students about the field of basic computing and informatics nursing as well as use of technology skills fluctuate, generating the need to adapt the pedagogical proposal at the beginning of each course, in a way that provide comprehensive and relevant training for all recipients.

The development and adaptation of the pedagogical proposal, was carried out during the first semester of 2015. The teaching staff reviewed the educational contents of the two subjects: Basic computer science II and Applied computer science II and then the results of the evaluation surveys of the previous year (the surveys are conducted at the end of each course and research on: student satisfaction, teaching strategies and performance, relevance of subject content, educational resources and assessment, among others). With the aim to collect students' perceptions and expectations about the informatics courses, we held face-to-face meeting and debate with each group for exploratory purposes. Then, we recorded what happened and compared the findings with the subjects' evaluation surveys of 2014, redesigning the proposal of contents according to a) student's needs and expectations, b) curriculums review of other universities that provide Nursing degrees and include informatics in their programs, c) minimum curriculum content pursuant to the recommendations of the International Medical Informatics Association (IMIA) on Education in Health Informatics as part of Nursing programs [8], and feasibility. The updated version of the program was communicated to UI and after approval to the students, and then applied to the courses of the 2015 first semester. At the end of the semester, subjects' satisfaction surveys were administered again, implemented via online questionnaires, conducted with 'Google form®' and available in the online learning platform (Moodle®) of the UI.

### 3. Results

Students accepted with enthusiasm to participate in the program update. The modifications consisted of deepening of content already seen in previous informatics subjects and the introduction of new ones. Nineteen students answered the surveys of the 32 students. Eighteen (95%) of the students expressed being Very satisfied/satisfied with the course general proposal, It is worth noting 12 of the participants (63%) considered the classes were new learning facilitators, and 17 responders (90%) expressed the courses' contents were Very relevant/ relevant for their academic and professional training. The contents highlighted were

- a) search and access information,
- b) web 2.0 tools, and c) electronic nursing record.

The same topics were suggested in the exploratory instance (face-to-face meeting). All of the students expressed the evaluations agreed with the class contents and approach and the comprehension by the students joint with their professional practice environments. Regarding the least liked of the course, most complained about

the infrastructure and logistics (poor internet signal, lack of computers availability or maintenance), and they proposed the improvement of these aspects. Finally they suggested if students have previous knowledge of basic computer science, the courses should be 'optional'.

#### 4. Discussion

We described the experience of updating and adapting the content of informatics courses for nursing degree students, according their needs and expectations, and teaching strategies. When we asked about satisfaction, they responded satisfactorily but some students proposed to change the mandatory nature of the courses. Youngest students with IT background tended to believe that the course should be optional. Students with basic knowledge (usually they resume studies years after the first diploma in nursing) wish to receive instruction on topics related to computer operation or office tools. We included topics that responded to their academic needs, job placement needs and to the recommendations on the levels of knowledge and skills expected developed by healthcare professionals [8].

The speed with which technologies are developed has led to daily appears a new version of a more intelligent, efficient and usable computerized system. The use of computer and technology information has expanded to health information systems and therefore to nursing. Currently, the nursing profession is based more and more on knowledge and technologies where the nurse acts as coordinator among all the information [9-10]. Then, more than ever, the review regarding what to teach about computer science to our nursing students is a discussion that we cannot afford to miss. The debate on the integration of computer science at different levels of nursing training occurs internationally and there are different positions and therefore, different proposals [6-11] Concerning this situation, there is many nursing training institutions where computer science is not even part of the curriculum [5]. Our greatest challenge was to design an updated curriculum, adapted to the students' needs and expectations and related with their development in the professional field. In this experience, we actively engaged students to propose alternatives to its own learning path. The resulting educational proposals reduced the gap between their expectations and the content of current courses. We consider this is a valuable and challenging experience for instructors to continue investigating and enriching the future of education in nursing and informatics

#### References

- [1] J.P. Sewell, Thede LQ. *Informatics and Nursing: Opportunities and Challenges*. 4<sup>th</sup> edition, Wolters Kluwer Health/Lippincott Williams & Wilkins, Philadelphia, 2013.
- [2] H.F. Marin, *Nursing informatics: current issues around the world*. *Int J Med Inf*. 2005 Dec;74(11-12):857-60.
- [3] S. Garde, D. Harrison, E. Hovenga, *Skill needs for nurses in their role as health informatics professionals: a survey in the context of global health informatics education*. *Int J Med Inf*. 2005 Dec;74(11-12):899-907.
- [4] M. Tellez, *Nursing informatics education past, present, and future*. *Comput Inform Nurs CIN*. 2012 May;30(5):229-33.
- [5] L.M.P. Sanches, R. Jensen, M.I. Monteiro, M.H.B. Lopes, *Informatics teaching in undergraduate nursing programs at Brazilian public institutions*. *Rev Lat Am Enfermagem*. 2011 Dec;19(6):1385-90.
- [6] I. Madsen, E. Cummings, E.M. Borycki, *Current Status for Teaching Nursing Informatics in Denmark, Canada, and Australia*. *Stud Health Technol Inform*. 2015;216:1016.

- [7] J. Choi, J.E. De Martinis, Nursing informatics competencies: assessment of undergraduate and graduate nursing students. *J Clin Nurs*. 2013 Jul;22(13-14):1970-6.
- [8] J. Mantas, E. Ammenwerth, G. Demiris, A. Hasman, R. Haux, W. Hersh, et al. Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics. First Revision. *Methods Inf Med*. 2010 Jan 7;49(2):105-20.
- [9] A. Gonen, D. Sharon, A. Offir, L. Lev-Ari, How to enhance nursing students' intention to use information technology: the first step before integrating it in nursing curriculum. *Comput Inform Nurs CIN*. 2014 Jun ;32 (6) : 286-93.
- [10] S.R. Hartranft, T. Garcia, N. Adams, Realizing the anticipated effects of the clinical nurse leader. *J Nurs Adm*. 2007 Jun;37(6):261-3.
- [11] L.M. Nagle, K. Crosby, N. Frisch, E. Borycki, L. Donelle, K. Hannah, et al. Developing entry-to-practice nursing informatics competencies for registered nurses. *Stud Health Technol Inform*. 2014;201:356-63.

# Embedding Nursing Informatics Education into an Australian Undergraduate Nursing Degree

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**Abstract.** Alongside the rapid rise in the adoption of electronic health records and the use of technology to support nursing processes, there is a requirement for nursing students, new graduate nurses, and nursing educators to embrace nursing informatics. Whilst nursing informatics has been taught at post graduate levels for many years, the integration of it into undergraduate studies for entry level nurses has been slow. This is made more complex by the lack of explicit nursing informatics competencies in many countries. Australia has now mandated the inclusion of nursing informatics into all undergraduate nursing curricula but there continues to be an absence of a relevant set of agreed nursing competencies. There is a resulting lack of consistency in nursing curricula content nationally. This paper describes the process used by one Australian university to integrate nursing informatics throughout the undergraduate nursing degree curriculum to ensure entry level nurses have a basic level of skills in the use of informatics.

**Keywords.** Undergraduate nursing, curriculum, nursing informatics, education, curriculum development, competency

## 1. Introduction

In rapidly advancing technology-rich environments worldwide, nurses are expected to have proficiency in nursing informatics (NI) knowledge and skills to enable them to provide patients with high quality, safe and cost-effective care [1,2]. The evolution of information computer technology has had enormous impact on the healthcare sector by expediting healthcare services and enhancing the quality of patient care [1]. The implementation of electronic health record (EHR) systems has been supported by national initiatives and projects internationally since 2000. This support for implementation of technology at all levels has further increased global demand for work-ready graduate nurses who are proficient in using NI tools efficiently and effectively, where in use to support the delivery of high quality and safe patient care in hospital settings [3, 4].

Numerous studies have reported the gap between graduates' knowledge and skills acquired at university and the nursing competencies graduates are expected to

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demonstrate in practice [for example; 5,6]. This paper describes one university's journey in the process of integrating NI in the design phase of a new undergraduate curriculum.

## 2. Background

During the late 1970s informatics researchers began efforts to identify and develop NI competencies [7, 8]. A set of four NI competencies' levels developed by Staggers and her colleagues [8] were later used by other NI researchers to evaluate the extent to which NI knowledge and skills were integrated in nursing courses [9,10,11]. Early NI competencies focused primarily on computer skills and basic information knowledge as the definition of NI emphasised technology use [12].

Academic healthcare educators were urged to teach core informatics competencies to prepare graduates who could be competent in providing safe patient care during the early 2000's [13]. The Technology Informatics Guiding Educational Reform (TIGER) Initiative developed by nurse leaders was specifically aimed at preparing nurses and student nurses to meet NI competency requirements to suit technology-rich work environments [4]. The Quality and Safety Education for Nurses (QSEN) Project focused on six competency domains including informatics and evidence-based practice [4]. These were used to assess new graduates' information technology skills, and measure the extent of NI competencies in nursing curricula [4,14].

Partnerships between nursing schools, health system suppliers and educational software program developers have provided nursing students with opportunities to practice electronic documentations, care planning, medication information management and searching for evidence as part of a decision-making process [13,15,16]. There has been little improvement in NI education at undergraduate level worldwide despite these efforts. There are few nursing programs including in Australia, Canada, Denmark, and the USA where NI is formally integrated as part of the undergraduate nursing curricula [11, 17].

Numerous studies have identified that nursing students are not prepared to use EHRs in clinical settings [18,19]. Even experienced nurses need more training to efficiently and effectively make use of EHRs. Additionally, a lack of national NI competency standards has led to *ad hoc* NI competency levels and statements suitable for graduates nationwide. The purpose of national standards is to prescribe the structure and content for nursing programs to achieve the desired outcomes. They provide a framework for ensuring high quality nursing education is able to be delivered by educational institutions to ensure graduates are prepared for using NI competence in the workplace [20].

In 2012 the Australian Nursing and Midwifery Accreditation Council (ANMAC) released new standards for accreditation of nursing education and acknowledged the importance of developing "the capacity to innovatively use information technology and electronic resources to research the growing evidence base for improved care and treatment methods" [21]. As from 2013, undergraduate nursing degrees must include NI to achieve accreditation in Australia. However, the required curriculum redesign to include NI is complicated by the lack of national NI competencies for undergraduate nursing students.



### **3. Methods**

The nursing undergraduate degree in Australia is a three-year degree, resulting in registration as a graduate nurse. All degrees must be accredited by ANMAC and registered with the Nursing and Midwifery Board of Australia. The accreditation process is comprehensive and takes at least nine months to complete. The initial stage of curriculum development requires the mapping of all content against the nursing competencies and the ANMAC requirements [21]. This includes the development of unit (sometimes known as course in other jurisdictions) outlines for every unit throughout the degree.

Once the unit outlines are assessed by the ANMAC accreditation team the NI specialists review them for areas where NI could and should be included. In this instance there are 25 units across the three-year degree and nursing informatics is overtly included in 21 of these units. The units where NI is not included are where students are on professional experience placement periods in different healthcare environments. However, it is anticipated the students will gain workplace related NI skills during these practicums.

Through this review process a constructivist approach is employed. The principles of educational scaffolding and modular development were used to build knowledge and skills in support of the development of competency. This commenced with the basic premise that although students have experience with technology in their daily lives they are not experts in such use or in concepts underpinning their relevance to the workplace. For example, the understanding of professional use and rules underpinning the use of social media is one of the initial skills required by students, but is rarely taught. The content and context of each NI component was mapped to ensure it linked with the degree requirements.

As there are no currently accepted NI competencies in Australia, the content was mapped against the TIGER [22] and Canadian Association of Schools of Nursing entry level competencies [23]. Each competency from both sets of competencies was found to be included in the newly developed curriculum content.

The work of developing the nursing degree course content was undertaken with the leads for each unit. The lead role was undertaken by a member of faculty with responsibility for, and expertise in, the development and content for the individual unit. The content consistency, continuity, and scaffolding was the responsibility of the year leads who ensured that all nursing competencies were addressed and that content was consistent and not replicated. The introduction of the NI content was undertaken by the NI specialists in collaboration with the writing teams. The core premise was that NI should become integrated throughout the degree, and not be viewed as additional or separate from the core unit content or context.

The final stage, yet to be completed, is the development of an education package for the staff teaching the degree. This package will provide teaching staff with basic skills and understanding of NI to ensure that they are confident and competent in teaching the content to their students. The development of the education package for teaching staff is essential to complete the process of integration.

#### **4. Discussion**

Educational preparation of graduate nurses to be competent in NI is essential in rapidly-evolving, technology-rich and chaotic clinical environments. High quality, safe, and cost-effective patient care can be provided when NI is employed efficiently and effectively within healthcare environments. Unfortunately, nurses' actual NI competency levels are frequently inconsistent and nursing students are inadequately prepared to use NI proficiently. It is also recognized that most newly-registered nurses lack ICT skills, information literacy, and NI knowledge and skills, and they use interpersonal information sources, including their colleagues, rather than using the most up-to-date evidence based resources. These practices can threaten patient safety and contribute to reducing the quality of patient outcomes.

In 2012 a set of national NI competencies was developed for Australian nurses [19] but these are yet to be ratified and adopted by national accreditation bodies. Approved NI competencies linked to the ANMAC accreditation standards are essential for consistent inclusion of NI in all undergraduate curricula. Until NI competencies for undergraduate nurses are mandated we will continue to see underprepared graduate nurses in healthcare organisations.

Lack of faculty NI understanding and confidence has been identified as an inhibitor to the implementation of integration of NI into nursing curricula [19]. The inclusion of an education module on NI for all teaching staff is required to assist them in becoming familiar with, and interested in, the concepts of NI and how these impact on daily nursing practice. Lead time and time to practice newly acquired skills will also impact on the preparedness of faculty to be able to competently and comfortably integrate NI into their teaching.

Integration of NI both vertically and horizontally throughout the undergraduate nursing degree is essential to normalise NI as integral to core nursing activities. This process will ensure that NI becomes embedded as part of learning to become a nursing rather than an adjunct activity. To date the majority of NI courses have been post-graduate specialist degrees. These degrees remain essential for those intent on becoming NI specialists, but the inclusion of NI throughout undergraduate degrees is the starting point for cementing NI as a recognised function within all healthcare organisations.

#### **5. Conclusion**

Early education of nurses in the principles and use of NI is essential to enable them to provide high quality, safe and effective care in healthcare environments for today and the future. Whilst there is a continued need to maintain specialist post-graduate courses in NI there must be a set of workforce entry level NI competencies and requirements for all nurses. This paper has described the process used by one Australian university to integrate NI throughout the undergraduate nursing degree to ensure entry level nurses have a basic understanding and appreciation of NI. It is anticipated that this process can be used to guide other Universities integrating NI into undergraduate nursing curricula.

## References

- [1] R Booth, 2006, 'Educating the Future eHealth Professional Nurse', *International Journal of Nursing Education Scholarship*, vol. 3, no. 1, pp. 1-10.
- [2] HF Marin, 2005, 'New frontiers for nursing and health care informatics', *International journal of medical informatics*, vol. 74, no. 7, pp. 695-704.
- [3] EM Borycki, J Foster, T Sahama, N Frisch, AW Kushniruk, Developing national level informatics competencies for undergraduate nurses: methodological approaches from Australia and Canada, *Studies in Health Technology and Informatics: Enabling Health and Healthcare through ICT*, 2013, vol183, pp 345-349
- [4] National League for Nursing, 2008, Preparing the next generation of nurses to practice in a technology rich environment: An informatics agenda [Position Statement]. Retrieved from <http://www.nln.org/about/nln/PositionStatements/index.htm>.
- [5] SM Dyess, RO Sherman, 2009, 'The first year of practice: new graduate nurses' transition and learning needs', *Journal of Continuing Education in Nursing*, vol. 40, no. 9, pp. 403-410.
- [6] M El Haddad, L Moxham, M Broadbent, 2013, Graduate registered nurse practice readiness in the Australian context: an issue worthy of discussion, *Collegian*, vol. 20, pp. 233-238.
- [7] N Stagers, CA Gassert, C Curran, A Delphi Study to Determine Informatics Competencies for Nurses at Four Levels of Practice *Nursing Research: November/December* **51**(6) (2002), 383-390
- [8] E Hovenga, Nursing informatics in Australia, *MD Computing* **14** (1997), 119–25. \*
- [9] J Choi, JE De Martinis, 2013, 'Nursing informatics competencies: assessment of undergraduate and graduate nursing students', *J Clin Nurs*, vol. 22, no. 13-14, pp. 1970-1976.
- [10] MS Fetter, 2009, 'Graduating nurses' self-evaluation of information technology competencies', *Journal of Nursing Education*, vol. 48, no. 2, pp. 86-90.
- [11] LL Ornes, C Gassert, 2007, 'Computer competencies in a BSN program', *Journal of Nursing Education*, vol. 46, no. 2, pp. 75-78.
- [12] N Stagers, CB Thompson, 2002, 'The evolution of definitions for nursing informatics: a critical analysis and revised definition', *J Am Med Inform Assoc*, vol. 9, no. 3, pp. 255-261.
- [13] J Warren, HR Connors, 2007, 'Health information technology can and will transform nursing education', *Nursing outlook*, vol. 55, no. 1, pp. 58-60.
- [14] J Barnsteiner, J Disch, J Johnson, K McGuinn, K Chappell, E Swartwout, 2013, 'Original Article: Diffusing QSEN Competencies Across Schools of Nursing: The AACN/RWJF Faculty Development Institutes', *Journal of Professional Nursing*, vol. 29, pp. 68-74.
- [15] Y Kowitlawakul, L Wang, SW-C Chan, 2013, 'Development of the electronic health records for nursing education (EHRNE) software program', *Nurse Education Today*, vol. 33, no. 12, pp. 1529-1535.
- [16] T Pobocik, 2015, 'Using an Educational Electronic Documentation System to Help Nursing Students Accurately Identify Patient Data', *International journal of nursing knowledge*, vol. 26, no. 1, pp. 26-34.
- [17] EA Cummings, EM Borycki, I Madsen, Teaching Nursing Informatics in Australia, Canada and Denmark, *Studies in Health Technology and Informatics*, 2015, 218 pp. 39-44.
- [18] LM Akhu-Zaheya, W Khater, M Nasar, O Khraisat, 2011, 'Baccalaureate nursing students' anxiety related computer literacy: a sample from Jordan', *Journal of Research in Nursing*, vol. 18, no. 1, pp. 36-48.
- [19] E.M. Borycki, J. Foster, A comparison of Australian and Canadian informatics competencies for undergraduate nurses. *Stud Health Technol Inform.* 201: p. 349-55.
- [20] SW Davis, D Weed, JW Forehand. Improving the nursing accreditation process, *Teaching and Learning in Nursing*, 2015 Volume 10:1 35 - 38
- [21] ANMAC, 2012, Australian Nursing and Midwifery Accreditation Council Registered Nurse Accreditation Standards, available at: <http://www.anmac.org.au/accreditation-standards>, accessed 23 July 2013
- [22] Technology Informatics Guiding Educational Reform (TIGER), TIGER Informatics Competencies Collaborative (TICC) Final Report, August 2009, available at: [http://tigercompetencies.pbworks.com/f/TICC\\_Final.pdf](http://tigercompetencies.pbworks.com/f/TICC_Final.pdf)
- [23] Canadian Association of Schools of Nursing and Canada Health Infoway. Nursing informatics: Entry-to-practice Competencies for Registered Nurses. 2013.

# Using Co-Design with Nursing Students to Create Educational Apps for Clinical Training

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**Abstract.** Mobile technology is being trialed in nursing education to support students in clinical practice, as it can provide instant access to high quality educational material at the point of care. However, most educational mobile apps are generic, off-the-shelf applications that do not take into consideration the unique needs of nursing students, who can require personalised software solutions. This study adapted a socio-cognitive engineering approach and through a series of focus groups with final year nursing students explored the co-design process and gained their input on the design and functionality of a clinical skills based educational app. Results showed students required an uncluttered interface that was fast to navigate and easy to use in busy clinical environments. They also requested simple visual descriptions of key clinical skills and equipment to enable them to quickly refresh their memory so they could perform the skill in practice.

**Keywords.** Nursing student; clinical education; mobile technology; mobile app; co-design; co-production; co-creation

## 1. Introduction

Nursing students often find clinical practice a challenging environment due to a number of issues that affect their learning processes. These include but are not limited to the theory-practice gap [1], nursing students' lack of experience [2], the ad-hoc nature of learning in acute ward environments [3] and poor clinical supervision [4]. Alternative ways to support the education of undergraduate nursing students in clinical settings include the use of different types of information and communication technologies (ICT) [5]. However, numerous barriers exist for nursing students who want to use ICT in clinical areas such as sharing limited computer resources and having poor digital literacy skills [6].

Mobile technology has been the dominant digital platform over the last decade due to its ever advancing functionality, low cost, portability and ease of use which help address many of these difficulties. As the technology has progressed so has its use in nursing education with Personal Digital Assistants (PDAs), iPods and tablet computers

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all being trialed and evaluated to provide better access to quality educational material for nursing students at the point of care [7].

However, many challenges to using mobile technology in clinical nursing education exist such as a lack of tailored applications that suit the specific needs of nursing students [8]. The aim of this study is to explore the co-design process when creating a clinical skills based smartphone app and identify the features and functions nursing students need in a personalised educational app. User-centred design principles should help to create m-learning solutions that better fit the needs of nursing students and ease some of the pressures they experience training in clinical settings [7].

## 2. Methods

The study was grounded in the Theory of Mobile Learning (see Figure 1) as it provides a dual framework that on the one hand offers a technological model for software developers to propose design requirements for mobile learning platforms and also provides a communication or semiotic model to better understand pedagogy and learning in a mobile age [9]. Ethical approval for this study was granted by the Social Research Ethics Committee at University College Cork, Ireland. A convenience sample of final year undergraduate nursing students from a Bachelor of Science Nursing programme were recruited to the study via Clinical Placement Coordinators in a local training hospital. Participation was entirely voluntary and the research team was not involved in teaching this group or evaluating their academic or clinical work.

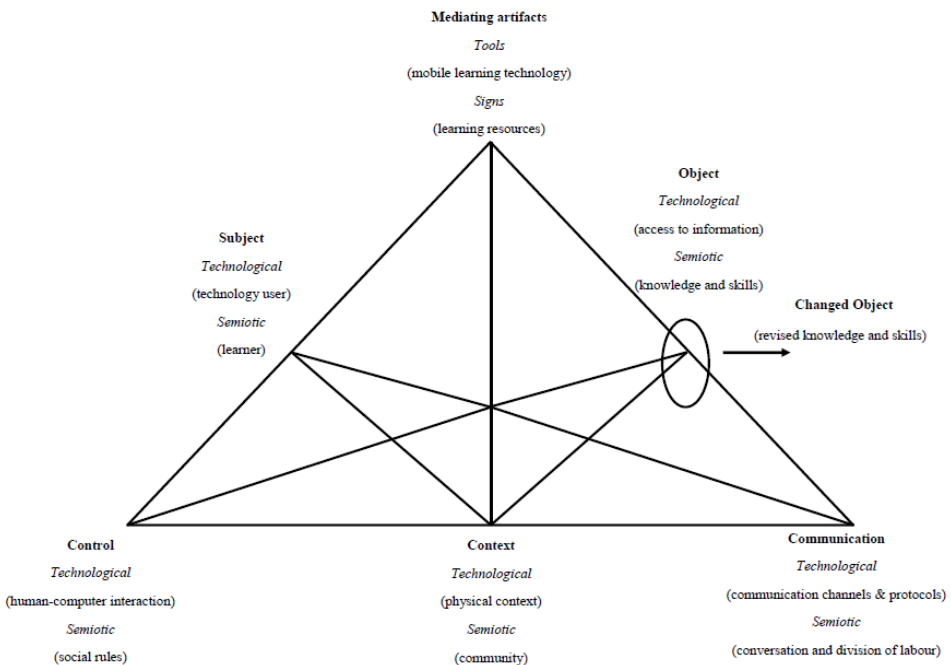


Figure 1: Theory of Learning for the Mobile Age [9]

### *2.1. Data Collection & Analysis*

Two in-depth co-design workshops, lasting 60 minutes each, were held in July 2015 during a continuing professional development day at a local hospital where students were completing their clinical training. Each workshop consisted of ten final year nursing students and a facilitator (SOC). Informed consent was gained from all participants and the discussions were audio-recorded and transcribed verbatim. A co-design methodology was adapted and began with an analysis of nursing students' needs through a general question and answer session. This was followed by discussing specific clinical scenarios and sharing personal stories of learning challenges students encountered in practice. A brainstorming session concluded the workshop which involved drawing design diagrams and brainstorming charts of how the educational app should look and function [10]. Data was analysed thematically using the framework approach [11] and informed by the Theory of Mobile Learning. A thematic coding framework was developed collaboratively by coding, indexing and charting the data into an overarching matrix of themes. QSR NVivo 10 was used to facilitate analysis.

## **3. Results**

The results of the co-production workshops centred around three themes namely; how the app should look and function, what types of educational content nursing students required and how to use the mobile application in clinical settings.

### *3.1. Design & Functionality*

Simplicity in terms of design and function was the overriding factor for students who wanted an app that could be used quickly in clinical areas. Students requested an uncluttered interface which would not distract them from the task of refreshing their knowledge on a particular nursing skill. A straight forward navigational menu and search bar were other items students felt would help them reach educational information they needed quickly. They requested content be presented in an easily understandable format such as images with basic text descriptions, that were free of medical jargon, as they would be quick to review and assimilate.

Short video clips of clinical skills were discussed as another option but some nursing students felt they could be impractical to use as a quiet environment would be necessary to absorb the information. Overall students preferred a streamlined tree like menu structure that could be drilled down to access visual educational material or searched quickly from the main menu (see Figure 2).

### *3.2. Educational Content*

The educational material which was most sought after by nursing students was in relation to pharmacology. Several expressed concern about the complexities of medication management and thought the app could help them prepare and administer drugs more safely. Information on wound care, in particular how to correctly grade pressure ulcers and choose wound dressing, was also highly valued as training material as it would aid decision making and enable students to work more efficiently.

Educational information about more advanced skills and specific pieces of equipment was also requested as nursing students often encountered different versions of the same device across a variety of clinical areas and were asked to perform additional nursing skills in the final year of their training. Other non-skills related content for the app such as a description of medical abbreviations, general anatomy and physiology related to specific diseases and conditions, and information on biochemistry and blood results was also mentioned by nursing students as being valuable educational material.

### 3.3. Usability

Although the focus of the co-design workshops were to discuss nursing students educational needs in relation to clinical skills and how an app should look and work, aspects related to how mobile applications should be used in clinical practice also emerged. For example, one participant noted that students should inform patients of why they were using mobile technology to avoid any confusion and to maintain the professional image of nursing. Other students felt this should extended hospital wide to circumvent negative attitudes held by some nursing staff and other health professionals in relation to using mobile technology in clinical settings.



Figure 2. Screenshots of the prototype app as a result of the co-design workshops

## 4. Discussion

The results demonstrate that mobile devices and educational apps are used within socio-cultural systems and nursing students' educational needs are influenced by established practices in health service settings. Any clinical skills based app needs to ensure students maximise their time and learn the required skills quickly and effectively in busy clinical environments. A preference for visual content, supported with simple short textual descriptions of clinical skills, was highlighted as important as this communication medium would be quick to process and put into practice.

The dialectical relationship between the semiotic and technological systems was also apparent in the type of educational content nursing students required and how they

thought the m-learning platform should be used. Students clearly wanted more control over the educational material available to them and requested detailed step-by-step instructions on how to perform clinical skills as well as additional information on specialised pieces of equipment and more advanced techniques. This could reflect limitations within the context of their undergraduate education and the type of clinical environments students were training in. Finally, nursing students wanted any educational app to be accepted by both patients and health professionals, which would require clear communication about its use to ensure the professional image of nursing was maintained and students were supported to use mobile technology in practice.

The first phase of the co-design process was effective in highlighting the learning needs of nursing students in relation to clinical skills and in gaining their input into creating a personalised mobile learning solution. The next step in co-creating the educational app will encompass a refinement and implementation phase, where detailed use cases and activity diagrams will lead to a specific prototype app and the m-learning system will then be piloted with nursing students in clinical settings and further refined. More research on co-design methodologies and educational apps in nursing education is needed to ensure the right technological systems are created to support student learning in both academic and clinical settings [7].

## 5. Acknowledgments

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## References

- [1] M.G. Landers, The theory–practice gap in nursing: the role of the nurse teacher, *Journal of Advanced Nursing* **32**(2000),1550-1556.
- [2] F. Sharif, S. Masoumi, A qualitative study of nursing student experiences of clinical practice, *BMC Nursing* **4**(2005). 6.
- [3] A. Windsor, Nursing students' perceptions of clinical experience, *Journal of Nursing Education*, **26**(1987),150-154.
- [4] C. Webb, P. Shakespeare, Judgements about mentoring relationships in nurse education, *Nurse Education Today*, **28**(2008),563-571.
- [5] D. Button, A. Harrington, I. Belan, E-learning & information communication technology (ICT) in nursing education: A review of the literature, *Nurse Education Today* **34**(2014),1311-1323.
- [6] M. Willmer. How nursing leadership and management interventions could facilitate the effective use of ICT by student nurses, *Journal of Nursing Management* **15**(2007),207-213.
- [7] S. O'Connor, T. Andrews. Mobile Technology and Its Use in Clinical Nursing Education: A Literature Review, *Journal of Nursing Education* **54**(2015),137.
- [8] P.E. Johansson, G.I. Petersson, G.C. Nilsson, Nursing students' experience of using a personal digital assistant (PDA) in clinical practice - An intervention study, *Nurse Education Today* **33**(2013),1246-1251.
- [9] M. Sharples, J. Taylor, G. Vavoula, Towards a theory of mobile learning, *Proceedings of mLearn 1*(2005),1-9.
- [10] D. Millard, Y. Howard, L. Gilbert, G. Wills, Co-design and co-deployment methodologies for innovative m-learning systems. *Multiplatform E-Learning Systems and Technologies: Mobile Devices for Ubiquitous ICT-Based Education: Mobile Devices for Ubiquitous ICT-Based Education*, (2009), 147. [http://eprints.soton.ac.uk/267555/1/Co-design\\_and\\_deployment\\_chapter-preprint.pdf](http://eprints.soton.ac.uk/267555/1/Co-design_and_deployment_chapter-preprint.pdf)
- [11] R. Ritchie, L. Spencer, Qualitative Data Analysis for Applied Policy Research, In: M. Hubermann, M. Miles, *The Qualitative Researcher's Companion*, Sage Publications, California, 2002.



# Educational Requirements for Mobile Applications in Nursing: Applying the User-Task-Context Matrix to Identify User Classes and Contexts of Use

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**Abstract.** Mobile applications are increasingly being deployed in healthcare and nurses are expected to use them during their education, practice and during training of patients. In this paper we describe how an approach to modelling user needs known as the user-task-context matrix has been applied to help guide in developing requirements for new mobile applications as well as for selecting applications to be used in different aspects of nursing and patient education. The approach involves first brainstorming the different classes of users of an application and then specifying possible tasks the application can be used for. In addition, different contexts of use of the application are then specified. Application of the method is described for improving understanding of user needs in both design and procurement of healthcare apps related to nursing education.

**Keywords.** Nursing informatics, mobile applications, education, user requirements

## 1. Introduction

In health education there is a need to expose students to a range of information technologies that they will use once they graduate. The use of mobile applications in nursing education programs is also becoming more widespread. Students are expected to understand how to use mobile devices and health care applications to provide patient care. Internationally, mobile computing competencies have been identified as being a competency that needs to be acquired to work effectively in health care [1]. This has arisen from the need of clinicians to be able to document clinical care at point of care at the bedside using mobile phones, tablets and/or wireless carts. Such pressures have given rise to a need among nursing faculty and school educators to effectively identify how to educate nursing students about the use of mobile devices at point of care effectively. Despite these needs there are few frameworks that support nursing faculty and health informatics professionals in understanding how software could be used to

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train nursing students about mobile applications and mobile devices. In this paper we extend the work of Kushniruk and Turner [2] in the application of the user-task-matrix to supporting nursing faculty and health informatics professionals in identifying users and uses of mobile applications to support student nurse learning.

## **2. Background: Review of the Literature**

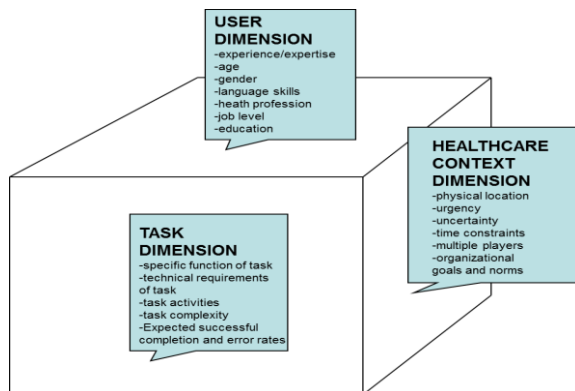
With the introduction of health information technologies such as electronic health records, personal health records and mobile health care apps, health care software is used at point of care in the hospital and home care settings. The modernization of health care has also fueled demands for health information technology literate (i.e. eHealth literate) student nurses [3]. In response to these pressures national nursing accreditation bodies have developed nursing informatics competency statements with the aim of encouraging colleges and universities who train nurses to integrate these competencies into their curricula [4]. In addition to this we have seen the development of varying strategies to support nursing faculty in integrating these competencies [3,4]. There is a need to develop frameworks that can be used at a faculty level during curriculum meetings in conjunction with health informatics/information technology staff. Such an approach could facilitate across the board nursing faculty and school level integration of competencies across a curriculum with the introduction of point of care mobile software used in healthcare settings.

Over the past several years, there have been many mobile software applications that have been suggested for nursing student use. In extensions of this work nurse faculty have also begun to examine the role of mobile health applications as a tool that nursing students can use to support patient wellness and chronic disease management activities. In terms of possible uses, such digital tools can be used by student nurses when educating patients about the quality of mobile health care applications and as interventions, prescribed by a physician, for a period of time with the known benefit of improving some patient outcomes. In addition to this work researchers are beginning to identify opportunities for using mobile applications in the process of patient care. Here, nursing students would learn about how a mobile application can be used to document the patient's current health status (e.g. documenting vital signs), record medication reconciliation activities, medication administration or to document nursing care. In this paper we describe an approach that can be used to identify the types of software that students and faculty would benefit from in the varying contexts of an undergraduate nursing program.

## **3. The User-Task-Context Matrix**

We employ the user-task-context matrix (described below) in identifying requirements for mobile health applications and devices for nursing students. The matrix can be used by nursing faculty to identify requirements for nursing education and use of mobile health applications in different contexts of use. In order to specify the types of users of a health application (either under development or actively deployed), the types of functions or tasks that can be achieved using the application, and the range of contexts the application can be used for, the authors of this paper have created the User-Task-Context Matrix. This extends a formalism known as the user-task matrix, to include a third dimension – namely context of use (an essential consideration in

healthcare) [2]. In developing requirements for a health information system or application the matrix can be used to help define three dimensions: (1) the user dimension, which delineates the type or classes of users that use an application or system, (2) the task dimension, which specifies the type of tasks that different users are expected to be able to do using the system or application, and (3) the context of in which users carry out specified tasks (see Figure 1).



**Figure 1.** User-Task-Context matrix (adapted from Kushniruk & Turner, 2012)

Table 1 shows an example of how the concept has been extended in this paper to consider educational uses of mobile eHealth applications by different types of nurses. Along the left-hand side of the table is the list of possible classes of users of mobile applications in nursing. Along the columns of the matrix are the different tasks (or functions) that mobile applications could be used for in nursing education. The cells of the matrix specify the contexts in which a specific user group could use a mobile app for carrying out tasks. For example, in Table 1 the user group “Nursing students” could use a mobile application as a reference source in the classroom (in Context 1) or in the clinical setting (in Context 3). Applications can then be designed (or selected) in order to meet the needs of nursing students in these two different context by specifying use cases or design scenarios for each user-task-context combination.

#### 4. Applying the User-Task-Context Matrix

We are currently using the user-task-context matrix to guide the development and specification of requirements for new systems and mobile apps being developed. This involves specifying the use of that device or application in terms of type of users, type of tasks and contexts of use. For each combination of user-task-context, specific use cases can be developed that describe scenarios (or examples) of that particular combination, and these can be used for driving development of storyboards for application design [2]. These scenarios can be used to guide the design of systems and applications. The scenarios can also be used to create clinical information processing scenarios (CLIPS) that can be used when testing already developed products to see if they meet educational needs and objectives in terms of users, tasks and contexts.

**Table 1.** User-Task-Context for differing possible uses of mobile apps in nursing education.

			<b>TASK</b>				
<b>USER</b>	<i>Use of mobile app as reference tools</i>	<i>Use of mobile app in documenting</i>	<i>Use of mobile app to learn how to perform a procedure</i>	<i>Use of mobile app for deploying quizzes</i>	<i>Use of mobile app to demonstrate technology to students</i>	<i>Use of mobile app in training patients for use</i>	
<i>Nursing students</i>	<b>Context 1</b> – in the classroom <b>Context 2</b> – on wards <b>Context 3</b> – in the clinical setting	<b>Context 1</b> – documenting while on practica <b>Context 2</b> – documenting in labs <b>Context 3</b> – documenting in clinics	<b>Context 1</b> – in the classroom <b>Context 2</b> - in labs <b>Context 3</b> - in the clinical setting	<b>Context 1</b> – in the class <b>Context 2</b> - in labs <b>Context 3</b> – during take home exams	<b>Context 1</b> – in the classroom <b>Context 2</b> – in simulation labs	<b>Context 1</b> – in the office <b>Context 2</b> – in a patient’s home	
<i>Lab instructors</i>	<b>Context 1</b> – teach evidence-based practice <b>Context 2</b> – to test students	<b>Context 1</b> – to teach documentation in labs	<b>Context 1</b> – demonstrating procedures in lab <b>Context 2</b> – demonstrating procedures during practica	<b>Context 1</b> – giving tests in class <b>Context 2</b> - giving tests in labs <b>Context 3</b> – giving take home exams	<b>Context 1</b> – in class <b>Context 2</b> – in simulation lab		
<i>Teaching faculty</i>	<b>Context 1</b> – as reference during lectures <b>Context 2</b> – as reference during labs <b>Context 3</b> – to test students	<b>Context 1</b> - teaching documentation in class setting <b>Context 2</b> – teaching documentation in clinical settings	<b>Context 1</b> - teaching procedures in class setting <b>Context 2</b> – teaching procedures in clinical settings	<b>Context 1</b> – giving tests in class <b>Context 2</b> - giving tests in labs <b>Context 3</b> – giving take homes	<b>Context 1</b> – in the classroom <b>Context 2</b> – in simulation lab		
<i>Research faculty</i>	<b>Context 1</b> – to provide patient interventions that include references	<b>Context 1</b> – to enter documentation during research studies	<b>Context 1</b> – testing and evaluating ways of teaching about new procedures		<b>Context 1</b> – demonstrating a mobile application	<b>Context 1</b> – studying a mobile application	
<i>Practicing nurses wanting continuing education</i>	<b>Context 1</b> - to update knowledge	<b>Context 1</b> – to learn how to document using mobile apps	<b>Context 1</b> – to learn about new procedures			<b>Context 1</b> – in office <b>Context 2</b> – in a patient’s home	

We can also use the user-task-context matrix to derive a checklist for matching educational apps to user needs in terms of tasks and contexts of use. In addition, for systems under development, the user-task-context matrix generated during requirements gathering can be used later in the SDLC (System Development Life

Cycle) for creating scenarios that can be used to test a resultant system (to ensure it meets user and educational needs for different tasks and contexts)

From our work we have arrived at the following sets of steps for creating and applying a user-task-context matrix:

1. **Brainstorming a list of user classes** (e.g. nursing students, faculty, IT staff) – this can be done by setting up focus groups with faculty, students and IT support staff.
2. **Brainstorming a list of tasks the application can support in educational settings** – for development of new applications, envisaged tasks the application would be expected to support are listed.
3. **For each user-task combination, brainstorming different possible contexts** – here the possible settings where the application could be used by different type of users are delineated.
4. **For each user-task-context creating one or more scenarios of use** (i.e. use cases) - these scenarios typically consist of page long descriptions of typical examples of a use of the application by a particular type of user in a particular context.
5. **Testing assumptions of the user-task-context matrix** – this can involve brainstorming to check that all users, tasks and contexts are defined (in a focus group).
6. **Application of the User-Task-Context** – We can use the matrix to help identify requirements for new software to be developed (as well as using it to identify potential commercially available software) that would support nursing education for different types of users in different context by creating testing scenario (or CLIPS) for each user-task context combination as described above.

## 5. Discussion

In our current work we are applying the approach described in this paper to guide the design of new applications through a process of scenario-based design. For example, we are prototyping a range of mobile apps for use in nursing education as a reference tool for varying types of nursing students and faculty, for each of the varying contexts described in our user-task-context matrix. The approach is leading to more informed discussion about type of user, uses and contexts in which healthcare applications can be embedded in nursing education. We are also employing this structured framework when considering purchase of commercially available applications and software systems (for use in education and practice) by using the framework to test candidate systems for use by particular users for particular tasks in different contexts of use.

## References

- [1] C. Mather, E. Cummings. Mobile learning: a workforce development strategy for nurse supervisors. *Stud Health Technol Inform*, **204**(2014), 98-103.
- [2] A.W. Kushniruk, P. Turner, A. framework for user involvement and context in the design and development of safe e-Health Systems. *Studies in Health Technology and Informatics* **180**(2012), 353-7.
- [3] E. M. Borycki, J. Foster, T. Sahama, N. Frisch, A.W. Kushniruk. Developing national level informatics competencies for undergraduate nurses: methodological approaches from Australia and Canada. *Studies in Health Technology and Informatics: Enabling Health and Healthcare through ICT*, **183** (2013), 345-349.
- [4] E. Cummings, E.M. Borycki, I. Madsen. Teaching nursing informatics in Australia, Canada and Denmark. *Context Sensitive Health Informatics: Many Places, Many Users, Many Contexts, Many Uses*, 218 (2015), 39.

# Social Media Training for Professional Identity Development in Undergraduate Nurses

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**Abstract** The growth of social media use has led to tension affecting the perception of professionalism of nurses in healthcare environments. The aim of this cross-sectional study was to explore first and final year undergraduate student use of social media to understand how it was utilised by them during their course. Descriptive statistical analysis was undertaken to compare differences between first and final year student use. No difference indicated there was a lack of development in the use of social media, particularly concerning in relation to expanding their professional networks. There is a need for the curriculum to include opportunities to teach student nurses methods to ensure the appropriate and safe use of social media. Overt teaching and modelling of desired behaviour to guide and support the use of social media to positively promote professional identity formation, which is essential for work-readiness at graduation, is necessary.

**Key words:** Undergraduate nurse; social media; curriculum design; professional identity.

## 1. Introduction

In early 2015, the social media market leader Facebook had over one billion active accounts, of which 14 million were from Australia [1]. Responding to the growth in the use of social media and increasing tension about the effect of use on the perception of professionalism of health workers, professional bodies and higher education institutions developed social media guidelines [2, 3, 4]. Studies have documented that healthcare workers may inappropriately use the internet and social media in the workplace [5] and this may increase the perception that students use digital technology inappropriately [6, 7]. The rapid increase in the use of digital technology has led to the situation where acceptability of social media has outpaced the development of policy or guidelines to govern its use in healthcare environments [8, 7]. The integration of work and personal life afforded by mobile technology further complicates traditional boundaries between the workplace and private life that can cause confusion for students [9]. Current curriculum design for nursing courses in Australia does not include social media etiquette [10, 11] for use during work integrated learning or for professional

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networking. Enabling access to technology while ensuring appropriate and safe use, in healthcare environments, must be addressed by educational institutions, healthcare organisations, professional groups and individual nurses.

In 2012, the Australian Nursing and Midwifery Accreditation Council, the body governing nursing education in Australia, added the requirement that all accredited undergraduate curricula must include nursing informatics [12]. Interestingly, for many universities, informatics including social media etiquette has not been overtly included in the curriculum, and more specifically in the teaching about professional identity formation or professionalism. Despite efforts that have resulted in the development of Australian nursing informatics competencies [13] the current Nursing and Midwifery Board of Australia competency standards do not include nursing informatics [14]. Learning appropriate use of social media is an element of nursing competency in relation to developing professionalism. Understanding the use of social media by undergraduate students can assist in appropriate curriculum development. This paper reports on a study that aimed to explore student nurses use of social media and their media preferences for sourcing information.

## 2. Methodology

This cross sectional study was part of a larger, multi-site survey of undergraduate students undertaking Australian health profession training. Data collection was undertaken between July and November 2013, using a validated online survey, originally developed by Giordano and Giordano [15, 16]. This paper reports on information collected from undergraduate nurses at the University of Tasmania. Descriptive statistical analysis was undertaken using R to compare differences between responses from first and final year nursing students.

## 3. Results

Demographically there was little difference in the gender balance between the first and final year students (Table 1). The gender distribution of this cohort demonstrated females outweighed male participants in both first and final year cohorts. The mean age of female participants was 30.5 years with the mean age for males significantly higher at 37.8 years ( $p=0.012$ ). When comparing first and final year participants the mean age of first year participants was 31.8 years with the mean age for final year participants 31.9 years.

**Table 1.** Respondents by gender and year.

	First year (n=65) 51%		Final year (n=61) 49%		All (n=126)	
Male	12	18.50%	11	18%	23	18.25%
Female	53	81.50%	50	82%	103	81.75%

Respondents were asked, *which of the following (radio, newspaper, magazines, journals, online media, television) is your primary source of information?* Online media was identified as the preferred primary source of information by 43% of female respondents and 26% of male respondents. Thirty-two percent of female respondents

identified journals as their preferred primary source of information compared to only 13% of male respondents ( $p=0.078$ ). Male students were more likely to access radio (30%) as their preferred primary source of information compared to almost 5% of females ( $p=0.0012$ ). Again, a greater percentage of males 30% identified television as their preferred primary source of information compared to females (15%).

Respondents were asked about their usage of specific social media sites including Facebook and Twitter. Twitter was used by only 12% of nursing students, in contrast, Facebook was used by 87% of them. Female respondents ( $n=103$ ) were more likely to use Facebook (89%) compared to males (78%;  $n=23$ ). However, male respondents indicated that they were more likely to access Facebook on a daily basis (69%) compared to females (32%). Independent of frequency of usage females were more likely to follow a link to gain health related information with 37%, indicating that they would follow a link compare to 26% of males.

When comparing first and final year respondents, Facebook was utilised by 89% of first year and 85% of final year respondents. Forty-six percent of first year and 68% of final year students indicating they used Facebook at least daily. Independent of the frequency of usage, 32% of first year students and 38% of final year students indicated they would follow a link to gain health related information.

Final year students were asked if and how they used LinkedIn. Only 11% ( $n=7$ ) of respondents indicated they did for connecting with employers, networking or job opportunities. Frequency of use by these students varied from once per day to about once per month.

#### 4. Discussion

The survey results indicated nursing students used a variety of media platforms for information, knowledge building and connection. The lack of development from first to final year in the use of social media and their media preferences indicates there is also currently a gap in the curriculum to ensure appropriate guidance and support in the use of newer platforms. Curriculum design to enhance development of professionalism and promotion of positive professional identity formation by modelling and informing students about how to appropriately use social media in the classroom and during work integrated learning, is required. The similarity between first and final year nursing student's use of social media may indicate limited development of online information seeking skills and behaviour. This deficit may impact on professionalism and reflect the need for curriculum development to ensure students use mobile technology and social media appropriately and safely.

Social media has the ability to connect students with peers, colleagues and experts or organisations locally, nationally and internationally to assist them to remain up to date with important professional changes. Many organisations and recruitment agencies use social media, such as LinkedIn, to vet candidates, so maintenance of online public profiles to enhance employment potential is necessary. It is important that students learn to manage their social media presence early in their education. By understanding how to use social media professionally, through showcasing their knowledge, expertise and connections it is possible to forge professional connections and strengthen their position for future employment.

While professional social media guidelines are available, they lack specific information about how to use social media appropriately in the classroom or workplace.



The widespread use of Facebook by students indicates that preparation for use of social media is required. The findings of Pauleen et al [9] and McBride et al [5] indicate there is a blurring of boundaries by workers that requires guidance of students. This preparation of appropriate use needs to occur in the classroom or during simulation activities, to ensure the potential risks, benefits and challenges are understood by students. For example, modelling and practising appropriate use by demonstration of positive use to gain information about University or facilities; knowledge building about nursing; networking among peers in the classroom and colleagues in the workplace; finding resources; undertaking professional development and engaging in nursing activities. Undertaking simulation activities that promote clinical reasoning about the risks and challenges will enable students to gain an understanding about positive professional behaviour. Students can also learn about the need for maintaining infection control procedures. The promotion of a positive learning environment can reduce the risk of students being enculturated into current workaroud practices or modelling poor professional behaviour during work integrated learning.

There is a need to embed strategies to scaffold learning about professionalism in the use of social media across the units delivered in nursing courses at this regional university will assist with ameliorating the current situation where access to technology for learning is ad hoc [11]. The lack of consistency of access within and between units is confusing for educators, clinicians and students. It is up to leaders in nursing education to lead and develop mechanisms to ensure the next generation of nurses are equipped to manage and filter the overload of information to ensure students remain focused on the learning and when in the clinical setting they are patient-centred and aware health professionals. Incumbent on Faculty is the need to integrate and model appropriate use into classrooms and during work integrated learning, to ensure that at graduation nurses can interact with professional learning opportunities, minimise distraction of non-work related activities and be work-ready professional users of mobile technology.

Limitations of the study include the self-reporting of data as well as the social desirability inherent in self-report measures. This may have resulted in social media usage being under or over reported. Whilst the cohorts were of similar size, there was an over representation of female students, however, this is consistent with the nursing workforce. The survey tool itself is potentially problematic as social media trends are rapidly changing and platforms regularly superseded.

Further research to evaluate the impact of including social media etiquette in curriculum design could inform whether it has an effect on perceptions of nurses using social media and any change in professional identity formation or perceptions regarding professionalism. Additional study to capture the use of social media in healthcare environments will ensure that curriculum development remains abreast of emerging trends.

## **5. Conclusion**

The majority of nursing students use social media for a range of purposes and in a range of locations, indicating a need to update nursing curricula to enable learning about appropriate use of these platforms. Classroom and simulation activities should be used to model appropriate use of social media. Teaching undergraduate students social media etiquette in a safe environment can ensure the next generation of health

professionals develop and promote positive professional identity and professionalism regarding the use of digital technologies and social media. Overt teaching about appropriate use will maximise employment opportunities for students whilst minimising privacy risks and ensure that patient safety remains paramount in this rapidly changing environment.

## 6. References

- [1] D Cowling, Social Media Statistics Australia, March 2015, <http://www.socialmedianews.com.au/social-media-statistics-australia-march-2015/> retrieved 31 July 2015.
- [2] ACN, Social Media Guidelines for Nurses, 2015, [http://www.acn.edu.au/sites/default/files/social\\_media/acn\\_social\\_media\\_guidelines.pdf](http://www.acn.edu.au/sites/default/files/social_media/acn_social_media_guidelines.pdf) retrieved 31 July 2015.
- [3] AHPRA, For registered health practitioners, Social Media Policy, 2014, <http://www.nursingmidwiferyboard.gov.au/Codes-Guidelines-Statements/Codes-Guidelines/Social-media-policy.aspx> retrieved 31 July 2015.
- [4] UTAS, Social media guidelines 2010, [http://www.utas.edu.au/\\_data/assets/pdf\\_file/0007/82843/Social-Media-Guidelines.pdf](http://www.utas.edu.au/_data/assets/pdf_file/0007/82843/Social-Media-Guidelines.pdf) retrieved 23 July 2013.
- [5] D McBride, SA Le Vasseur, D Li, Non-Work-Related Use of Personal Mobile Phones by Hospital Registered Nurses. *JMIR Mhealth Uhealth*, 2015, 3(1):e3, doi 10.2196/mhealth.4001.
- [6] EG Mann, J Medeves, EG Vandenberg, Accessing best practice resources using mobile technology in an undergraduate nursing program. A feasibility study. *Computers, Informatics, Nursing* 2015, 33(3): 122-128.
- [7] S Cho, E Lee, Development of a brief instrument to measure smartphone addiction among nursing students. *Computers, Informatics, Nursing* 2015, 33(5): 216-224.
- [8] CA Mather, E Cummings, P Allen, Nurses' use of mobile devices to access information in health care environments in Australia: A survey of undergraduate students, *JMIR Mhealth and Uhealth*, 2014, 2(4):1 - 10. doi:10.2196/mhealth.3467 ISSN 2291-5222.
- [9] D Pauleen, J Campbell, B Harmer, A Intezari, Making sense of mobile technology: The integration of work and private life. *Sage Open* April/May 2015, Doi: 10.1177/2158244015583859. <http://sgo.sagepub.com/content/5/2/2158244015583859> retrieved 30 July 2015.
- [10] CA Mather, AH Marlow, EA Cummings, Digital communication to support clinical supervision: Considering the human factors, *Studies in Health Technology and Informatics: Context Sensitive Health Informatics - Human and Sociotechnical Approaches*, 2013, 194, 160-165. Doi:10.3233/978-1-61499-293-6-160 ISSN 0926-9630.
- [11] CA Mather, EA Cummings, Unveiling the Mobile Learning Paradox, *Studies in Health Technology and Informatics*, 2015, 218, 126-31. Doi:10.3233/978-1-61499-574-6-126, ISSN 0926-9630.
- [12] ANMAC, Australian Nursing and Midwifery Accreditation Council Registered Nurse Accreditation Standards. 2012. [http://www.anmac.org.au/sites/default/files/documents/ANMAC\\_RN\\_Accreditation\\_Standards\\_2012.pdf](http://www.anmac.org.au/sites/default/files/documents/ANMAC_RN_Accreditation_Standards_2012.pdf) retrieved 23 July 2013.
- [13] E Borycki, J Foster, T Sahama, N Frisch, A Kushniruk, Developing national level informatics competencies for undergraduate nurses: Methodological approaches from Australia and Canada. *Studies in Health Technology and Informatics*, 2013, 183, 345-349. PMID: 23388312.
- [14] NMBA, Framework for assessing standards for practice for registered nurses, enrolled nurses and midwives 2015, <http://www.nursingmidwiferyboard.gov.au/Codes-Guidelines-Statements/Codes-Guidelines/Framework-for-assessing-national-competency-standards.aspx> retrieved 30 July 2015.
- [15] K Usher, C Wood, N Glass, R Wilson, L Mayner, D Jackson, J Brown, E Duffy, C Mather, E Cummings, P Irwin, Australian health professions student use of social media, 2014, 21, 95-101.
- [16] C Giordano, C Giordano. Health professions students' use of social media, *Journal of Allied Health*, 2011, 40(2): 78-81.

# Exchange of Information Between Hospital and Home Health Care: A Longitudinal Perspective

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**Abstract.** In this paper we present a longitudinal perspective of exchange of information providers in hospital and home health care. More specifically we address how this practice has changed over the last six years. In three different studies we have investigated how the information exchange between hospital and home health care throughout a patient transition from admission to discharge has changed over the last six years. The information processes have gone from being mainly paper-based to being digitalized. However, there are still professional challenges to overcome which may contribute to improvements for patients in transition.

**Keywords:** Patient trajectory, hospital, exchange of information, longitudinal study, discharge, electronic patient record, electronic health record

## 1. Introduction

Efforts to keep patients out of hospital and care for them in their homes have become a mantra for meeting future health care challenges [1]. One consequence is that patients living at home, who are characterized by multiple co-morbidities and rapid changes in health status, frequently need health care from different professionals and across care settings [2]. However, it is well recognized that the exchange of information needed to support such transitional care has been challenging for many years [3-7]. These challenges have implications for how patients manage their situation after a hospital stay [8, 9]. Providers report that information is insufficient or lacking at patient discharge [10]. Access to relevant, accurate, and timely information for providers who are involved in caring for patients is recognized as being significant for providing high quality and safe health care [11]. Therefore, it is imperative to improve how information is exchanged in health care.

Introduction and use of EPRs has been proven to facilitate the provision of care [12]. In Norway, where the current study was conducted, all hospitals and municipal health care services have implemented and used electronic patient records (EPR) for

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years. However, hospital and home health care settings have different EPR systems which are not compatible. Thus, oral communications, use of telephone and ordinary mail have been the usual ways of exchanging patient information across health care settings [13].

To overcome this shortcoming, national initiatives were taken in 2011 and an electronic messaging system (e-messages) has been introduced in Norwegian healthcare. The e-message system was designed to support different phases of a hospital stay with a set of specific messages for targeted purposes, including some standardized messages and a dialog message. Our research question was: how has information exchange between hospitals and home health care throughout a patient's transition from admission to discharge changed over the last six years?

## 2. Methods

This paper departs from three explorative studies addressing exchange of information between hospital and home health care services during patients' transition between the two. All three studies were conducted in Norway. Data were collected by semi-structured interviews in 2008, 2011/12 and 2014. Providers in both the hospital and home health care services were interviewed, but for the purpose of the present paper, we report on the hospital providers' perspective. The hospitals were big university hospitals and at the two latter data collections providers at the same university hospital were approached. Of the total 53 participants who were interviewed, 22 were interviewed in 2008, 14 in 2011/12, and 17 in 2014. The inclusion criterion was that the informants must have been working for a minimum of six months to be able to have gained experiences about collaboration and information processes with the home health care services.

All the interviews opened with the following question: 'Tell me about your collaboration with the home health care sector'. This opening question guided us in the rest of the interview with the main topic of how they experienced their information processes and how they assessed the quality of their collaboration. All the projects were approved by the Norwegian Social Science Data Service. Access to the hospitals was given by the directors and the providers were recruited through a contact person in each department. All informants gave their informed consent.

### 2.1. Analysis

For the purpose of the current paper, we analysed data from all the three studies applying a deductive–inductive approach [14]. First, a matrix was developed for each of the studies in which a text element about the clinicians explained how information was exchanged at patients' admittance to hospital, during the patients' stay at hospital including discharge planning, and at patients' discharge from hospital to home health care. Thereafter we identified text elements regarding how the providers exchanged information across the settings for each of the phases. Then we identified texts that highlighted critical information aspects during the patients' transition and hospital stay. The matrix was useful for further inductive in-depth analysis of identifying changes over time. To ensure trustworthiness, the analysis was discussed in the team several times during the process.

### 3. Results

The analysis showed two overall findings. The first finding was that the mode of exchanging information changed across the three data sets. The most remarkable change was the transition from using mainly paper-based and oral information exchange in 2008, via hybrid systems in 2011/12, to becoming digitalized in 2014, as shown in Table 1. The reason for these changes was that the collaborating organisations had developed and implemented integrated e-messaging in their EPR systems. At all the three points of data collection the informants pointed out that even though electronic communication had improved their access to each other, the telephone was still an important tool for them to discuss relevant information.

**Table 1.** Modes of information exchange

2008	2011/12	2014
Mainly paper-based and oral exchange of information across settings	Initiatives for electronic exchange of information across settings	Electronic messages integrated in EPR and the main mode for information exchange across settings

The second overall finding was less visible but significant with regard to how communication and collaboration between the hospital and home care setting intervene in information processes and management in a patient trajectory from hospitalization to discharge. Table 2 shows how the characteristics of the collaboration in patient transition between hospital and home health care changed throughout a patient hospital stay from admission to discharge.

**Table 2.** Characteristics of the collaboration in patient transition between the hospital and home health care setting

Patient trajectory	2008	2011/12	2014
Admission	Information almost absent but wanted and requested	Increased attention but not incorporated in daily routines	Routinized but still vulnerable
During hospital stay	Power hierarchy	Contracting perspectives of patients needs	Communicating and negotiating right level of care
Discharge	Limited awareness but arbitrary	Increased awareness but insufficient	Embedded in practice but not professionally anchored

The “distance” between hospital and home health care diminished from 2008 to 2014. At the first data collection there was little attention to the need for exchanging information at admission. With the introduction of e-messages to the nursing staff, this exchange of information went from being almost absent to being the normal practice. However, information exchange can still fail if nurses do not follow the guidelines.

The power hierarchy identified for the hospital stay period in 2008 refers to patients' post-discharge needs. Hospital providers were not very aware of the knowledge the home health care nurses had about the patients. This tendency was obvious in the next study as well; however, in the second sample they had more discussions and addressed the level of information exchange at admission and discharge, while during the hospital stay reflects more the interaction and collaboration between hospital and home health care sector in their planning for the patients discharge and future care. In 2014 they communicated and negotiated about the patients' post-hospital need via the electronic dialog message. And if they found it necessary they also used the telephone.

At patient discharge the awareness of the need for discharge information went on a continuum from being very scarce and limited to some awareness and to become embedded in the nurses' daily practice.

#### **4. Discussion and conclusion**

Most studies have addressed the exchange of information at patient discharge [10]. In this paper we explored exchange of information across the patients' trajectory from hospitalization to discharge over the last six years. For the 10 last years the authorities in Norway have made recommendations and launched strategies to improve the information exchange between different health care settings [2, 15]. Our study shows that changes have occurred from the first initiatives taken at the national level in 2005 to the present practice. The change that has had the most evident impact has been the introduction of the e-message system. Not only does it work as a tool for exchanging information but it also serves as a catalyst for the nurses' awareness and reflection on what information collaborators need to receive to care for the patients. However, in line with previous studies, our study suggests that there are still professional challenges to overcome to ensure accurate information [7].

The advantages of using e-messages go beyond what EPR provides as an information system. Even more than the EPR, which mostly documents treatment and care that already has taken place, e-messages also serves as a tool for communication and planning future actions. Nurses report that being able to connect with other care providers has led to more efficient, better quality and safer patient transitions [3]. Based on these studies we do not know the effect of these new systems on patients. This should be investigated in future studies. However, we conclude that the digitalization of patient transitions has improved the care processes.

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## References

- [1] European Commission, Long-term care in the European Union, Brussel: EU, 2008.
- [2] Helse- og omsorgsdepartementet, *Samhandlingsreformen. Rett behandling - på rett sted - til rett tid*, [The Norwegian Coordination Reform], Helse- og omsorgsdepartementet, Oslo, 2009.
- [3] L. Melby, B.J. Brattheim, R. Hellesø, Patients in transition – improving hospital–home care collaboration through electronic messaging: providers’ perspectives, *J Clin Nurs*. 2015:n/a-n/a.
- [4] E. Gronroos, M.L. Perala, Home care personnel's perspectives on successful discharge of elderly clients from hospital to home setting, *Scand J Caring Sci*. 2005;19(3):288-95.
- [5] R. Hellesø, M. Lorensen, L. Sorensen, Challenging the information gap-the patients transfer from hospital to home health care, *Int J Med Inf*. 2004;73(7-8):569-80.
- [6] R.M. Olsen, O. Hellzen, L.H. Skotnes, I. Enmarker, Breakdown in informational continuity of care during hospitalization of older home-living patients: a case study, *Int J Integr Care*. [Electronic Resource]14:e012.
- [7] T. Wibe, M. Ekstedt, R. Hellesø, Information practices of health care professionals related to patient discharge from hospital, *Informatics for health & social care* 2015;40(3):198-209
- [8] R. Hellesø, J. Eines, M.S. Fagermoen, The significance of informal caregivers in information management from the perspective of heart failure patients, *J Clin Nurs*. 2012;21(3-4):495-503.
- [9] T. Wibe, R. Hellesø, L. Slaughter, M. Ekstedt, Lay people's experiences with reading their medical record, *Soc Sci Med*. 2011;72(9):1570-3.
- [10] L. Melby, R. Hellesø, Electronic exchange of discharge summaries between hospital and municipal care from health personnel’s perspectives, *Int J Integr Care*, 2010;10(21 April):1-9.
- [11] S. Kripalani, F. LeFevre, C.O. Phillips, M.V. Williams, P. Basaviah, D.W. Baker, Deficits in communication and information transfer between hospital-based and primary care physicians – Implications for patient safety and continuity of care, *Jama-J Am Med Assoc*. 2007;297(8):831-41.
- [12] C. Kimble, Electronic Health Records: Cure-All or Chronic Condition? *Global Business and Organizational Excellence*, 2014;33(4):63-74.
- [13] R.M. Olsen, O. Hellzén, I. Enmarker, Nurses' information exchange during older patient transfer: prevalence and associations with patient and transfer characteristics, *Int J Integr Care*, 2012; <http://www.ijic.org/index.php/ijic/article/view/879/1968>. Date accessed: 04 Apr. 2013.
- [14] A.H. Tjora, *Kvalitative forskningsmetoder i praksis*. 2 ed. Gyldendal Akademisk, Oslo, 2012.
- [15] Helse- og omsorgsdepartementet, *Fra stykkevis til helt. En sammenhengende helsetjeneste*, Helse- og omsorgsdepartementet, Oslo, 2005.

# Use of Patient Portals in Older Adults: A Comparison of Three Samples

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**Abstract.** Recently, there have been national efforts to use patient portals (PPs) to engage patients in their care. Through PPs, patient can access their health records and communicate with care providers. These functions can be beneficial for older adults who manage multiple chronic conditions. The current nationwide PP implementation, however, lacks strategies for facilitating PP use in older adults. As a first step to fill this gap, this study examined the prevalence of PP use among older adults, the demographic characteristics of older adult PP users, and self-efficacy for using PPs using three samples (two national, one local). Findings suggest that older adult online users are receptive to PPs and can use them like other age groups. Approaches to engage older adults in PP use may differ from those for younger adults, as they have additional support needs. Further research is needed to identify optimal approaches to support older adult populations.

**Keywords.** patient portal, older adults, health information technology

## 1. Introduction

The high prevalence of chronic illnesses is a serious public health problem in the United States, accounting for 70% of all deaths [1]. Older adults are at especially high risk for developing multiple chronic illnesses. Management of chronic conditions often requires long-term use of complex treatment plans [1]. Recently there have been national efforts to use health information technology (HIT) to empower patients to manage their health [2, 3]. One of the seminal HIT initiatives is the Meaningful Use (MU) incentive payment program [3]. Under this program, healthcare organizations nationwide are implementing secure patient portal (PP) websites, where patients can access their electronic health records (EHRs), send providers eMessages, and request medication refills [2]. These functions can be especially helpful for patients managing chronic illnesses [4].

Despite the potential benefits and widespread availability of PPs, only a small number of Americans are using them [5]. In a 2014 national household survey (N=3,677) [5], only 26.8% of adults reported using PPs. In the same year, 89% of Americans were Internet users, and the majority (72%) used the Internet to look for health information [6]. In addition to the overall low adoption rate, lack of PP use among older adults has been reported as a particular issue [7]. Recently, however, Internet use among older adults has increased rapidly, reaching 79% of adults age 55-65 and 57% of adults 65 and older in 2014 [8]. Prior findings suggest that older adults are receptive to using PPs [9]. Findings from our previous studies with clinic patients [10] also showed that most older adult patients who are online users are willing to use a PP when its use is fully explained.

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Many older adults, however, are not technologically savvy and have unique challenges in using PPs, such as training needs, privacy and security concerns, and usability issues [7]. The current nationwide PP implementation has not addressed its use among older adults, missing an important opportunity to improve health outcomes in a group that has high healthcare resource utilization. As a first step to fill this gap, it is important to understand the current PP use in different older adult populations and identify opportunities to maximize the benefits of PPs. In this study, we examined the prevalence of PP use among older adults, demographic characteristics of PP users, and the self-efficacy for using PPs in three different older adult samples (two national and one local) [5,10,11]. We also assessed the differences in PP use among older adults (adults age 50–64 vs. adults 65+).

## 2. Methods

### 2.1. Design

This was a secondary data analysis using selected data from three data sets: (1) a subgroup of older adult online users from the 2014 Health Information National Trends Survey (HINTS) (national sample) [5]; (2) older adult online users from a 2015 SeniorNet member survey (national sample) [11]; and (3) older adult online users recruited from a large ambulatory clinic in an underserved area for a randomized clinical trial (RCT) that tested effects of a PP education program (baseline data set) [10].

### 2.2. Data Sets and Variables Extracted

The following three data sets are included in this study.

**Health Information National Trends Survey 4 (HINTS 4).** Using nationally representative samples, the HINTS regularly assesses the Americans' need for, access to, and use of health information, as well as their health-related behaviors, perceptions, and knowledge [5]. HINTS 4 was conducted in 2014 (N=3,677 adults  $\geq 18$  yrs). Among the entire sample, 77.2% (n=2809) were online users. Among those, 36.3% (n=980) were adults age 50 to 64 and 22.9% (n=619) were adults 65 and older.

**A Survey of SeniorNet Members on Patient Portal Use.** SeniorNet (SeniorNet.org) is a leading online organization for older adults. It has more than 2 million members and 25 older adult learning centers across the nation [12]. The median age range is 60–75 years. In July 2015, an online survey was conducted among its members to assess their PP use (having PP accounts) [11]. The 17-item questionnaire included variables on participants' Internet experience, PP use, and self-efficacy for using PPs, as well as selected demographic information. A total of 553 older adults completed the survey.

**Older Adult Clinic Patients Who Participated in an Online PP Education Trial.** A baseline data set from a two-armed RCT that tested the effects of a PP education program was included in this study. Adult patients 40 years and older who used the Internet but did not have a PP account were recruited from an outpatient clinic located in an underserved inner city [10,11]. Among 74 participants, 58 (78.4%) were 50 years or older and included in this study. During the enrollment, all patients received a brief face-to-face introduction to the PP and were encouraged to sign up for it.

The variables extracted from the datasets include (\* missing from a dataset):

- Demographics (age, gender, ethnicity, race, education etc.)\*
- Internet experience (years)\*
- Self-efficacy\* for using PPs was assessed by a modified 4-item Self-Efficacy for Computer-Based PHR scale [13]. ( $\alpha = .97$  [10])
- PP use was assessed by whether the participant had an active PP account.

### 2.3. Data analysis

The extracted data were cleaned and screened for any missing data and out-of-range values. The mean missingness was 4.4% for the Senior Net (n=553) and 1.4% for HINTS 4 (n=1519) datasets. There was no missing data in the clinic dataset (n=58). Descriptive data analyses were performed using means, standard deviations, ranges, proportions, and frequencies. Chi-square tests were used to test whether proportion of PP use differs by age group among the whole sample and among the online users, respectively.

### 3. Findings

Table 1 summarizes the overall findings from the three samples.

**Table 1.** Demographic and descriptive characteristics of three Internet user samples

	Clinic (N=58)		SeniorNet (N=553)		HINTS 4 (N=1519)	
	50-64 (n=45)	≥65 (n=13)	50-64 (n=54)	≥65 (n=470)	50-64 (n=931)	≥65 (n=588)
Age (yrs; Mean [SD])	58.1 (3.6)	70.1 (3.9)	60.0 (3.6)	75.16 (6.7)	57.0 (4.3)	71.3 (SD, 9.6)
Gender: Female (n, %)	34 (75.6)	8 (61.5)	44 (81.5)	291 (61.9)	527 (56.6)	296 (51.5)
Race (n, %)						
White	17 (37.8)	7 (53.8)	47 (87.0)	428 (91.1)	708 (76.0)	588 (85.5)
African American	22 (48.9)	5 (38.5)	3 (5.6)	14 (3.0)	171 (18.4)	61 (10.4)
Educational status (n, %)						
Up to high school	11 (24.4)	11 (24.4)	0	35 (7.4)	185 (19.9)	131 (21.3)
> Some college	34 (75.6)	15 (33.3)	54 (100.0)	435 (92.6)	744 (80.0)	485 (78.8)
Internet use (yrs; Mean [SD])	15.6 (7.8)	14.2 (8.4)	20.2 (6.1)	18.6 (7.21)		
PP Self-Efficacy (Mean, [SD])	309.6 (96.2)	310.0 (86.7)	298.2 (108.1)	273.5 (127.7)		
Have PP: Yes	31 (68.9)	12 (92.3)	32 (59.3)	288 (61.3)	309 (32.0)	175 (29.8)

The following describes the findings from the three samples.

Older adult online users from HINTS. Among adults age  $\geq 50$ , 71.0% (n=1519) were online users. The mean age of those was 62.9±9.1 years (range, 50–98). Among those age 50-64, 81.0% (n=931) were online users, and among those age  $\geq 65$ , 59.5% (n=588) were online users. The percentage of PP use differ across age groups ( $p < .001$ ) in the entire HINTS sample, while the difference disappear in the online users ( $p = .199$ ) (Table 2).

**Table 2.** HINTS PP use per age group

	≥18, n (%)	18-49, n (%)	50-64, n (%)	≥65, n (%)	p-value
All participants (N=3617)	953 (26.3)	381 (32.1)	318 (27.7)	193 (19.5)	<.001
Online user subsample (N=2772)	892 (32.2)	365 (34.1)	304 (32.7)	175 (29.8)	0.199

Survey of SeniorNet Members. The mean age of participants was  $73.59 \pm 7.92$  years (range, 50–95), and the average web experience was  $18.58 \pm 7.12$  years. More than half of participants had in at least one PP account ( $n=327$ , 60.6%), and 12.0% ( $n=65$ ) reported that they did not know what a PP is. The mean PP self-efficacy was  $27.4 \pm 12.8$  (range, 0–40).

Older Adult Clinic Patients Who Participated in an Online PP Education Trial. In the original trial, all participants were encouraged to sign up for a PP after a brief face-to-face introduction to PPs. A total of 55 (74.3%) participants signed up for a PP after enrolling in the study. The mean age of participants was  $60.8 \pm 6.2$  years (range, 51–78) with an average Internet experience of  $15.3 \pm 7.9$  years. The average PP self-efficacy was  $31.1 \pm 9$ .

#### 4. Discussion

Prior findings on the predictors of older adults' online use included age, race, education, and economic status [14]. Based on our comparison of the three samples, the older adult online users recruited from the clinic that serves underserved population were younger than the samples from the national data set or older adult online community. The clinic and the HINTS samples showed similar educational backgrounds, as opposed to higher levels in the SeniorNet group. Both SeniorNet and the clinic patients included more women than men. The HINTS dataset, however, showed a more even ratio of women to men, which could have been due to the stratified sampling method used in the HINTS. The findings from this study suggest that the disparity in age groups may be greater in underserved population and mediated by education levels. Further research is needed with larger and more diverse samples. Regarding the differences in gender and race, findings must be interpreted in specific context. Based on 2014 national data [15], the Internet penetration rates between whites (85%) and blacks (81%) were similar, but only 12.7% of Americans are black. In this study, the selected clinic had a higher percentage of black patients (~60%) due to its location. The national survey [15] also reports a near-even ratio of men (87%) to women (86%); however, online studies often showed higher participation in women [16].

Recent studies [7] have consistently addressed a lack of PP use by older adults. However, when PP use was assessed using only online user samples, the differences in age groups disappeared (Table 2). These findings were also confirmed by the 2015 SeniorNet member survey [10] as evidenced by the fact that more than half (60.6%) had PP accounts. Based on the recruitment data from our clinic trial, 47.7% of participants who initially approached signed up for the trial, and a majority (74.3%) of participants activated their PP accounts. Overall, patients in the clinic had a PP activation rate of 20% to 25%.

With the rapid growth of older adult online users, the findings from this study suggest a great potential to engage older adults in using PPs to manage their health. In particular, PPs can serve as an excellent tool to engage family caregivers in their care. Simply having a PP account, however, does not guarantee that older adults will use it to manage their health. Prior finding reported the importance of training in PP adoption [7]. More research is needed to identify effective approaches to offer necessary support to this group.

This study has several limitations. First, a few variables were not available in all three data sets. Second, SeniorNet members might not be representative of all older adult online users. For the local samples, this study included only one clinic.

## 5. Conclusion

PPs can be effective tools to engage and empower older adults to better manage their health. To obtain expected outcomes from this potentially robust tool, it is vital to prepare and motivate older adults to use the technology. The findings from this study suggest that older adult online users can use PPs, just like other age groups. However, the approaches to engaging older adults in PP use may need to differ. Additional research and national policy support are needed in the current PP implementation to support this important population.

## References

- [1] Institute of Medicine. *Living Well with Chronic Illness: A Call for Public Health Action* Washington D.C. : The National Academic Press 2012.
- [2] Office of the National Coordinator for Health Information Technology. What is a patient portal? [cited 2014 May 7]. Available from: <http://www.healthit.gov/providers-professionals/faqs/what-patient-portal>.
- [3] HealthIT.gov. Meaningful use n.d. [cited 2015 August 8]. Available from: <http://www.healthit.gov/policy-researchers-implementers/meaningful-use>.
- [4] C.S. Kruse, K. Bolton, G. Freriks, The effect of patient portals on quality outcomes and its implications to meaningful use: a systematic review. *Journal of Medical Internet Research* **17** (2015), e44
- [5] National Cancer Institute. Health information national trends survey 4 (HINTS 4): Cycle 1 methodology report 2014 [cited 2014 May 27]. Available from: <http://hints.cancer.gov/instrument.aspx>.
- [6] S. Fox, M. Duggan. Health Online 2013 2013 [cited 2015 May 27]. Available from: [http://www.pewinternet.org/files/old-media//Files/Reports/PIP\\_HealthOnline.pdf](http://www.pewinternet.org/files/old-media//Files/Reports/PIP_HealthOnline.pdf).
- [7] D.J. Amante, T.P. Hogan, S.L. Pagoto, T.M. English, A systematic review of electronic portal usage among patients with diabetes. *Diabetes Technology & Therapeutics* **16**(11) (2014), 784-793.11.
- [8] Smith A. Older Adults and Technology Use 2014 [cited 2015 September 15]. Available from: <http://www.pewinternet.org/2014/04/03/older-adults-and-technology-use/>.
- [9] J. Barron, M. Bedra, J. Wood, J. Finkelstein, Exploring three perspectives on feasibility of a patient portal for older adults, *Studies in Health Technology & Informatics* **202** (2014), 181-184.
- [10] E.S. Nahm, C.C. DiBalsi, K. Silver, J. Kapustin, E. Gonzales, "Patient-Centered PHR/Portal Implementation Toolkit for Ambulatory Clinics" 10/1/2014-9/31/2015, UMMC/UMSON Grant.
- [11] E.S. Nahm, Use of Patient Portals Among Older Adult Online Users. UMSON Biology and Behavior Across the Life Span Center of Excellence Research Facilitation Award; 06/2015-08/2015.
- [12] SeniorNet. SeniorNet 2015 [cited 2015 July 8]. Available from: <http://www.seniornet.org/>.
- [13] K.M. Nokes, J. Verkuilen, D.E. Hickey, J.C. James-Borga, J. Shan, Developing a personal health record self-efficacy tool, *Applied Nursing Research* **26** (2013), 32-39.
- [14] J.M. Werner, M. Carlson, M. Jordan-Marsh, F. Clark, Predictors of computer use in community-dwelling, ethnically diverse older adults, *Human Factors* **53** (2011), 431-447.
- [15] Pew Internet. Demographics of Internet users 2014 [cited 2015 September 2]. Available from: <http://www.pewinternet.org/data-trend/internet-use/latest-stats/>.
- [16] A. Schickedanz, D. Huang, A. Lopez, E. Cheung, C.R. Lyles, T. Bodenheimer, U. Sarkar, Access, interest, and attitudes toward electronic communication for health care among patients in the medical safety net, *Journal of General Internal Medicine* **28** (2013), 914-920.

# Medication Information Flow in Home Care

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**Abstract.** Critical success factors in medication care involve communication and information sharing. Knowing the information needs of each actor in medication process in home care, is the first step to ensure that the right type of information is available, when needed. The aim of the study was to describe the needed and delivered information in home care in order to perform medication care successfully. A total of 15 nurses from primary home care participated a workshop focusing on medication treatment. The qualitative data was collected by focus group technique. Data was analyzed according to content analysis. Three medication information themes were formulated: Client-related information, medication, and medication error. The critical medication information were generic drug information, validity of the list of medication and client's clinical status. As a conclusion findings, show the diversity of the medication information in home care.

**Keywords.** Information flow, medication care, home care, critical information, care transition

## 1. Introduction

Medication care in the home context is challenging and complex. Many actors and organizations are involved. In addition to healthcare professionals, the older people and their caregivers as well as relatives have an important role in the medication management [1]. One vulnerable point in the care process, is care transition. Safe patient transitions depend on effective communication and a functioning care coordination process. [2]. During transitions from one healthcare setting to another, it is important to provide necessary information to patients, caregivers, and healthcare providers [3]. One of the critical success factors in medication care is communication and information sharing. Poor communication about patients' medication across the levels of the health care system leads to numerous and potentially harmful medication error and increases risks associated with medication management [2][4].

According to Choo [5] an accurate description of information requirements is a prerequisite for effective information management. Knowing the information needs of each actor in medication process in home care, is the first step to ensure that the right type of information is available, when needed. Because information needs vary, based on the task and the goal, one needs to understand what kind of information is important to each actor's role [6]. The purpose of this study was to find out what type of critical

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information home health nurses require in home context. The aim of the study was to describe the needed and delivered information in the home care in order to perform medication care successfully.

## **2. Methods**

This study used a qualitative approach [7] and the data were collected in a workshop in March 2014. A workshop technique was chosen to enable the collection of diverse and in-depth data. With this technique the participants were able to combine their own knowledge and reflective discussion with colleagues. The workshop was part of a regional development project related to means and models for medication information management in home care in Northern Savonia, Finland. The participants (15) in this study were registered nurses (13) and practical nurses (2) from primary home care representing different areas of Kuopio, which is a town in eastern part of Finland with 107,000 inhabitants.

Workshop cases included six themes with 25 cases related to medication treatment in home care: Medication information, medication dispensing, medication administration, medication change, medication error, and instruction error. The focus of the day was information.

The participants were asked to describe what type of information they needed and how they received it. They were also asked what kind of information they delivered, to whom and what the method was. In first phase, the participants worked 30 minutes independently with their own theme and cases by adding their thoughts with post-its to flip chart. Then they continued as a group by discussing and adding more post-its to their own cases. In second phase, the groups circulated and added ideas to other participants' cases with post-its, by using a different so-called "visitor" color. In the third phase the teams continued with their own themes, seeing what other groups had added to their own cases. Finally, each group wrote a summary of their ideas. Notable is that participants had also two other colors they could use, red for the critical issues and green color for the new ideas.

Inductive content analysis was performed [7]. The analysis involved three phases. First, the original data source from the flip charts were transferred to an excel sheet to enable the sorting of data and providing an overall understanding. Secondly, the categories and sub-categories (meaning units) were formulated intuitively based on the first author's experience. This was done by using a mind map-technique. These categories were checked and modified independently by a third author. Finally, the authors discussed and reflected together and three main categories and nine sub-categories emerged.

Participants were informed about the study. The study was approved by Kuopio City, Social and Health Services administration. There was no relationship between the researchers and the participants.

## **3. Results**

The findings related to medication information flow in home care are presented according to the themes that were elaborated in the workshops where data were collected: Medication information, medication dispensing, medication administration,

medication change, medication error, and instruction error. For the sake of legibility, however, the themes medication information, medication dispensing, medication administration, and medication change are merged under broader theme Medication. Medication error composes its own theme. In addition to the aforementioned themes, a theme titled Client-related information will also be highlighted. The results (Table 1.) are presented by theme identifying the information needed and information delivered at the same time.

**Table 1.** Medication information needed and delivered in home care

Theme	Needed Information	Delivered Information
Client-related information	Basic knowledge of client's clinical status Last epicrisis Details of the discharging hospital and the department Any history of substance or violence Next of kin	Clinical status
Medication	Generic drug information Validity of the list of medication Medication dispensing principles	Generic drug information
Medication error	Generic drug information	Generic drug information

### 3.1. Client-related information

Under this theme the most important information was the basic knowledge of the clinical status of the client. The demographics, medical diagnoses, ability to function, and what were the causes for recent hospital visits were found to be of vital importance for the home care personnel. Furthermore, the last epicrisis and information on the hospital and particular department where the client was discharged from were considered useful. Does the client have a history of substance abuse or violent behavior, and who is the next of kin of the client, were questions frequently raised.

Under the theme Client-related information, the information delivered focused almost solely on the clinical status of the client.

### 3.2. Medication

The information the home care personnel needed and delivered in all the sub-categories under this theme was overwhelmingly related both to generic drug information and the validity of the list of medication that the client has. Issues of concern in terms of generic drug information were related to the name of the drug, i.e. the registered trademark, what pharmaceutical preparation the drug consists of, the effecting substance, the indications, contraindications, and possible side-effects for the drug. The validity of the list of medication was challenged by issues such as is the list of medicine up-to-date, medication dispensing principles, is the medication delivered appropriately to the client, does he/she refuse from taking the medication, has this happened previously, what to do in such a situation, and whether as-needed drugs have been delivered appropriately. These concerns were prominent especially in terms of strong pain killers. Adequate measurement of the client's pain caused concern, and the maximal dosing of pain killers in situations, when the client continues to be in pain.

In home care, it seems to be a common situation that a client has two lists of medication, and verification of the most recent medication list is challenging. Even the

electronic version of a patient records accessible to home care personnel could not always be relied on.

A common challenge turned out to be the delivery of client's medication to a medication dispenser. If doubts about the appropriateness of the drugs delivered are raised, it seems to be burdensome and time-consuming to solve the problem.

Some future ideas under the theme Medication were also revealed. Prehospital emergency medical care personnel should have access to the electronic patient records nationally, and it should thus be possible for paramedics to check the patient's current medication. All the changes made to home care clients' medication should be automatically registered to electronic patient records. It was also suggested that each person has a subcutaneous chip where all the patient records' data are stored and could be retrieved.

### 3.3. Medication error

The information needed and delivered did not differ. The main issues included generic drug information, especially possible side-effects, and the means to ascertain the relevance and accuracy of the client's list of medication. These issues were raised in almost every answer the participants gave. It was unanimously expressed or even a call that there should be organized one source where the patient data is updated without exceptions. The verification of the home care clients' list of medication could be made of this point.

## 4. Discussion

The aim of this study was to describe the needed and delivered information in home care in order to perform medication care successfully. In summary, three themes came up: client-related information, medication, and medication error.

It was hardly a surprise that the clinical status of the client in home care was the most important piece of client-related information needed as well as delivered. Especially the latest hospital visits and diagnoses related to hospital stay should be at the disposal of home care personnel. Clearly, organizations should carefully analyze care transition processes, especially from an information flow perspective. Nurses encounter challenges in ensuring successful information exchange during older patients' care transitions. [2][4][8]. Unexpectedly information related to client's possible history of substance abuse and/or violent behavior were high on the list of information needed. However, information delivered focused on the clinical status of the client.

The overwhelming share of information needed as well as delivered was to do with generic drug information and the validity of the client's list of medication. This might reflect the home care personnel's status and mastery of clinical pharmacy. Overall, this is an issue raising concern among Finnish healthcare personnel and institutes providing education and training for nurses. The need to improve knowledge of medications such as indications, contra-indications, side effects, and interactions, has been indicated in other studies [9].

The challenge of providing the home-care personnel with a reliable and updated list of client's medication appears to be a major finding. This is above all a patient-safety issue, as well as an issue that appears to be placing excessive strain to home-care



personnel. One option is to start using more the medication reconciliation approach. It is a process of creating a complete and accurate list of a patient's medications, including drug name, dosage, frequency, and route of administration, and comparing that list with the physician's admission, transfer, and/or discharge orders, with the goal of providing correct medications to the patient at all transition points [3]. The rationale behind introducing this process is to protect patients from adverse drug events related to medication discrepancies that might occur during patient transfer between various healthcare settings.

The possibility of medication error turned out to be anxiety arousing. In this respect information needed and delivered did not differ and was mostly related to generic drug information, especially the possible side-effects. Ways to confirm the validity of client's list of medication were prayed for by most of the participants, which is an expected finding.

These data must be interpreted with caution because it is based on personal opinions, although the participants were experienced nurses. However, that is a feature in qualitative research [7]. As a conclusion, these findings show the diversity of the medication information in home care. Further research is needed to describe the methods medication information is delivered in home care and how information technology can support this

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## References

- [1] S.A. Francis, F. Smith, N. Gray, M. Denham, Partnerships between older people and their carers in the management of medication, *International Journal of Older People Nursing* **1** (2006), 201-2017.
- [2] K. Frydenberg, M. Brekke, Poor communication on patients' medication across health care levels leads to potentially harmful medication errors, *Scandinavian Journal of Primary Health Care* **30** (2012), 234-240.
- [3] P.T. Chhabra, G.B. Rattinger, M.E. Hare, I.H. Zuckerman, Medication reconciliation during the transition to and from long-term care settings: A systematic review, *Research in Social and Administrative Pharmacy* **8** (2012), 60-75.
- [4] A. Coffey, Discharging older people from hospital to home: what do we know? *International Journal of Older People Nursing* **1** (2006), 141-150.
- [5] C.W. Choo, *Information management for the intelligent organization: the art of scanning the environment*. 3<sup>rd</sup> edition, Information Today, Medford, USA, 2002.
- [6] M. Endsley, *Theoretical underpinnings of situation awareness: a critical review*. In: Endsley, M., Garland, D.J. (eds.) *Situation Awareness Analysis and Measurement*, pp. 3– 32. Lawrence Erlbaum Associates, New Jersey, 2000.
- [7] M.Q. Patton, *Qualitative Research & Evaluation Methods*, 3rd ed. Sage Publications, Thousand Oaks, USA, 2002.
- [8] R.M. Olsen, H.B. Østnor, I. Enmarker, O. Hellzén, Barriers to information exchange during older patients' transfer: nurses' experiences *Journal of Clinical Nursing* **22** (2013), 2964-2973
- [9] C.G.M. Sino, A. Munnik, M.J. Schuurmans, Knowledge and perspectives of Dutch home healthcare nurses regarding medication frequently used by older people. *International Journal of Older People Nursing* **8** (2013), 131-138.

# Using Dashboard Technology and Clinical Decision Support Systems to Improve Heart Team Efficiency and Accuracy: Review of the Literature

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**Abstract.** Aim: This review aimed to provide a comprehensive overview of the current state of evidence for the use of clinical dashboards and clinical decision support systems (CDSS) in multidisciplinary teams. Methods: A literature search was performed for the dates 2004-2014 on CINAHL, Medline, Embase, and Cochrane Library. A citation search and a hand search of relevant papers were also conducted. Results: (One hundred and twelve full text papers were retrieved of which 22 were included in the review.) There was considerable heterogeneity in setting, users, and indicators utilized. Information on usability and human-computer interaction was thoroughly reviewed. There was evidence that dashboards were associated with improved care processes when end-user input was incorporated and information was concurrent, pertinent and intuitive. Conclusion: There is some evidence that implementing clinical dashboards and/or CDSS that provide immediate access to current patient information for clinicians can improve processes and patient outcomes.

**Keywords.** Clinical dashboard, review, clinical decision support systems

## 1. Introduction

The multidisciplinary Heart Team is becoming the standard of care for patients undergoing Transcatheter Aortic Valve Implantation (TAVI). Governmental and professional groups have stressed the importance of having a heart team to collaborate and come to a consensus on candidacy for TAVI [1-3]. The goal of the heart team is to use a patient-centered approach to determine the optimal treatment plan of the patient. This cohesive approach is imperative in elderly patients with critical aortic stenosis and multiple comorbidities.

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Care of patients undergoing TAVI requires assimilation of data from multiple sources and coordination between multiple caregivers. Patients screened for TAVI undergo numerous diagnostic tests that generate more than 150 data points necessary for patient and therapy selection. An increasingly significant observation is that the volume of data that needs to be processed in our TAVI meeting is not only large and variable, but also comes from different sources, making consolidation more difficult. Adding to the complexity of the situation, TAVI teams work against compressed time schedules, and often need to determine the best treatment option within a matter of minutes. Consequently, the heart team is inherently prone to inefficiencies and errors, primarily because relevant information may not be considered. This necessitates the availability of accurate and timely information on patient status.

Electronic health records (EHRs) have the potential to increase efficiencies and increase patient care. Unfortunately they inexplicably function more as data warehouses than as robust databases [4]. Researchers have documented positive effects of several interventions on communicating information and status to the heart team. Informatics tools, such as dashboards, Clinical Decision Support Systems (CDSS), and alerts have been shown to aid in clinician compliance with guidelines or protocols. Research into the impact of CDSS on healthcare practitioner performance and patient outcomes in hospital settings has increased.

## 2. Methods

A literature review was completed using PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Embase to find relevant, high-quality evidence. The search terms (i.e., surgical procedures, outcome and process assessment, information dissemination, quality improvement, dashboard, benchmark, clinical decision support system) were used independently and in varied combinations using AND and OR as the Boolean concepts. Included studies described an aspect of dashboard or clinical decision support system that addressed at least one element of quality improvement such as patient outcome, process or system improvement. Reviews were appraised for studies that included outcomes. Twenty-two studies remained for final analysis. In evaluating the evidence based on Johns Hopkins University Research Evidence Appraisal Tool [5], the overwhelming majority of the evidence was garnered from descriptive or observational studies. The appraisal tool was used to evaluate not only the strength but also the quality of the data. Critical aspects were synthesized.

### 2.1 System Development

Several commercial platforms exist that incorporate information visualization strategies. However, integrating user-centered design principles is critical for successful implementation. System development is comprehensive and requires clear communication and input from stakeholders such as physicians, nurses, administration, and information technology. Careful attention must be paid to the human-computer interaction to ensure enduring practice changes. CDSS displaying high-density clinically relevant information also helps streamline communications and efficiencies.

## 2.2 System Workflow

Providers and healthcare institutions are under considerable pressure to improve efficiencies. CDSS is a proven tool and can increase productivity and decrease errors when it integrates into existing clinical workflows. Pertinent clinical information at the point of care is required to improve provider decisions.

## 3. Results

Synthesis of the evidence identifies key components of system development and workflow. Early end-user involvement is an iterative process with a clear-cut return on investment. Continuous feedback and demonstrated improvements to the CDSS safeguard usability, scalability and portability. Indeed, a lack of fit between a CDSS and its users can create inefficiencies and prevent achievement of intended results.

Ensuring quality and accuracy of the information provided in the CDSS is of the utmost importance. Collaborative efforts with the Information Technology team are necessary to conduct a phased-approach to implementation while minimizing errors in data entry, data interface, and information translation.

## 4. Discussion

A well-defined, intuitive and comprehensive CDSS can streamline communication, reduce errors, improve efficiency and ultimately impact patient outcomes. CDSS and dashboards are utilized more consistently and demonstrate improved outcomes when they are easy for the clinicians to use and findings suggest that an effective clinical decision support system must minimize the effort required by clinicians to receive and act on system recommendations. The advanced practice nurse with clinical expertise has the opportunity to collaborate with the creation, testing, and utilizing CDSS in an interdisciplinary and multifaceted approach. The next logical step would be to create a clinical decision support using identified concepts and conduct usability testing.

## 5. References

- [1] Centers for Medicare and Medicaid Services. Decision Memo for Transcatheter Aortic Valve Replacement (TAVR) (CAG-00430N0, 2012. Retrieved from <http://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=257>.
- [2] Institute of Medicine. (1999). To err is human: Building a safer health system. Retrieved from [http://books.nap.edu/openbook.php?record\\_id=9728](http://books.nap.edu/openbook.php?record_id=9728). (pp. 180-182)
- [3] The Joint Task Force on the Management of Valvular Heart Disease, of the European Society of Cardiology and European Society of Cardio-Thoracic Surgery. Guidelines on the management of valvular heart disease. *European Heart Journal*, 2012. doi:10.1093/eurheartj/ehs109
- [4] DF Sittig, A Wright, JA Osherooff, et al. Grand challenges in clinical decision support. *J Biomed Inform.* 2008;41(2):387-392.

# Checking the Quality of Detailed Clinical Models: Instrument Application

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**Abstract.** Background: The exchange of clinical data between electronic health records is a challenge and need flexible models that adapt to clinical needs. Detailed Clinical Models (DCM) are used for this purpose, however, what is their quality? This paper's objective is to report on the application of an existing instrument to determine DCM quality. Methods: A selection of 9 DCMs about oncology care was tested using the 'Quality Metrics for DCM'. Results: The instrument revealed scores per DCM varying from 16 to 26, rendering one DCM insufficient and five requiring upgrading. Conclusion: The instrument proved practical in its administration and revealed useful feedback for DCM improvement. A core part of a DCM, the actual specification of data elements, is not included in the instrument and is suggested to be added.

**Keywords.** Electronic Health Records, Medical Records Systems, Health Care/standards, Detailed Clinical Models, Electronic Messages, HL7 v3.

## 1. Introduction

Exchange of health data is often quite cumbersome [1-6]. A study from the Netherlands in 2008 illustrates that follow up care is required for thirteen percent of all patients that are discharged from hospital [5], many of these need homecare. This situation calls for data exchanges between care professionals and facilities [5]. Issues include absence of important documents, recent data are missing, or wrong data are exchanged [5]. The solution to proper data exchange is promoted as semantic interoperability [3, 6]. To prevent problems with data exchange, electronic data exchange standards are developed and applied, such as Health Level 7, ISO 13606, openEHR, among others [7-10]. Standards that consist of use cases, logical models (Reference Models for the semantics), and technical specifications for the syntactical exchange of data [1, 2, 4, 6-13]. With electronic data exchange, digitized data are send from one care professional (sender) to another care professional (receiver), using secure digital transport [1-4, 6, 7]. It is often impossible to create a one size fits all technical format due to the hundreds of different systems, hence the solution "Detailed Clinical Models" (DCM) has been introduced [11-13]. DCM are logical information model specifying knowledge, clinical data elements, data types and code bindings at the logical level using standardized terminologies, and offer meta-information about authorship and versioning for governance [13]. DCM allow technical representation in a number of formalisms, such as Unified Modeling Language (UML), eXtended Markup Language (XML), and

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Archetype Definition Language (ADL) [11, 12]. For the project ‘Clinical Data Warehouse (CDWH)’, DCMs are applied to standardize nursing data for permanent storage and reuse [14]. In addition, DCMs are used to define the data for electronic exchange, using the Health Level 7 version 3 format for oncology care data for discharge to home care [14, 15]. This approach requires high quality DCMs [14]. The purpose is to provide insight in the determination of the quality of DCMs. Conveniently, the instrument ‘Quality Metrics for Detailed Clinical Models’ was available for this quality control [16]. Aside from this primary purpose, also some first validation of this instrument can be identified as important result of this study.

## **2. Methods**

One aspect of DCMs is a control of their quality and fitness for purpose [16]. Hence, the project team decided to set up a quality evaluation of the core set of DCMs. To test the DCM quality, there is only one published instrument. Ahn et al developed the ‘Quality Metrics for Detailed Clinical Models’ [16] consisting of 8 domains and 29 quality metrics. The quality is established based on these metrics. The quality domains include 1 ‘scope and purpose’, 2 ‘stakeholder involvement’, 3 ‘rigor of development’, 4 ‘clarity and presentation’ 5 ‘compliance to standard’, 6 ‘general methodology’, 7 ‘metadata’, and 8 ‘management and maintenance’. The standard referred to is ISO Technical Specification 13972:2015 [13].

The CDWH project has worked with 4 groups of developers [14, 15]. Each clinical group reviewed or developed a specific set of DCMs for oncology nursing care [14]. A convenience sample of 9 DCMs (Table 1) was scored by the measure ‘Quality Metrics for Detailed Clinical Models’ [16]. Before these 9 DCMs could be scored, the English ‘Quality Metrics for Detailed Clinical Models’ by Ahn et al [26] was translated into Dutch. The translation has been checked and feedback was given within the CDWH team. Next, the translated instrument was reviewed to determine its face validity by the editor of the Dutch guideline for Detailed Clinical Models and considered adequate. Each of the nine DCMs was scored on all 29 quality metrics. Each metric gets a score of ‘0’ or ‘1’, where ‘0’ implies absence of the metric and ‘1’ indicates presence. All scores per DCM are summed up, resulting in the total score, with a maximum of 29. Ahn et al determined that a score of 26-29 for the DCM is sufficient [16]. A score of 21-25 indicates a DCM of doubtful quality, and a score of 20 or less implies the quality of the DCM is insufficient [16].

## **3. Results**

The results on the 9 DCMs are presented both quantitative and qualitative [14]. The qualitative scores are presented for the scores on each metric and the total score for each DCM. These scores are presented in Table 1. In the columns 9 DCMs are presented, using letters. On the rows, decimal numbers present scores per DCM on each metric, ending with a total score per DCM. Results show that DCMs Body Weight and Nutrition have sufficient quality. The DCMs for Tumor Node Metastases (TNM) classification for stomach and esophagus carcinoma, tube feeding, pain score, person data, referrals and consultations have a low quality score on ‘Compliance to standard’. The DCM G ‘social data’ is of insufficient quality scoring low on ‘Meta data’ and ‘Management and Maintenance’. When we look closer at the different domains for the

quality metrics, we see that only in 3 (Rigor of Development) and 6 (General Methodology) all quality metrics are present for all 9 DCM. Other domains are not or insufficient present for more than half of the DCMs. For each DCM qualitative results are available and used for improvement.

**Table 1.** Score Results for 9 identified Detailed Clinical Models

<b>DCM: Metric:</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>G</b>	<b>H</b>	<b>I</b>
1.1 Purpose	1	1	1	1	1	1	0	1	1
1.2 Target	1	1	1	1	1	0	0	0	0
2.1 Involvement	1	1	1	1	1	1	1	1	1
2.2 Approval	1	1	1	0	1	1	0	0	0
3.1 References	1	1	1	1	1	1	1	1	1
3.2 Correctness	1	1	1	1	1	1	1	1	1
4.1 Syntax	1	1	1	1	0	1	0	1	1
4.2 Coding	1	1	0	1	1	1	0	1	0
4.3 Cardinality	0	0	0	0	0	0	1	0	0
4.4 Domain	1	1	1	1	1	1	1	1	1
5.1 Terminology	1	1	1	1	1	1	1	1	1
5.2 Data types	0	0	0	1	0	1	1	1	0
5.3 Units	1	1	0	1	1	1	1	1	1
5.4 Use data types	0	0	0	1	0	1	1	1	0
5.5 Exceptions	1	1	1	1	1	1	0	1	1
5.6 Mapping	0	0	0	0	0	0	0	0	0
6.1 Modifiers	1	1	1	1	1	1	1	1	1
6.2 Provenance	1	1	1	1	1	1	1	1	1
6.3 Negation	1	1	1	1	1	1	1	1	1
6.4 History	1	1	1	1	1	1	1	1	1
6.5 Narratives	1	1	1	1	1	1	1	1	1
7.1 Developer	1	1	1	1	1	1	1	1	1
7.2 Discipline	0	0	1	1	1	1	0	0	0
7.3 Versioning	1	1	1	1	1	1	1	1	1
7.4 Access metadata	0	0	0	1	0	1	0	1	1
7.5 Extent metadata	1	1	1	1	1	1	0	1	1
7.6 Review access	1	1	1	1	1	1	0	1	1
8.1 Maintenance org.	0	0	0	1	0	1	0	1	1
8.2 Feedback	1	1	1	1	1	1	0	1	1
<b>Total score / DCM</b>	<b>22</b>	<b>22</b>	<b>21</b>	<b>26</b>	<b>22</b>	<b>26</b>	<b>16</b>	<b>24</b>	<b>21</b>

The first digit on the row represents the domain, the second digit the metric. The column letters present the DCM A = TNM Classification stomach carcinoma, B = TNM Classification esophagus carcinoma C = Tube feeding, D = Body weight, E = Pain score, F = Nutrition, G = Social data, H = Person data, J = Referrals, consultations. This scoring was done with the translated original scale.

#### 4. Discussion

The scoring instrument ‘Quality Metrics for Detailed Clinical Models’ aims towards the various quality domains of a DCM [16].

The scoring instrument holds different domains to determine the quality of a DCM, each with several score items. However, we found areas for improvement. First is that depending on the purpose of the DCM, one metric can be more important than another. It is very well possible that the DCM with score 27 lacks 2 very important metrics. An example could be that the DCM with a score of 27 misses out on the complete specification of data elements, or semantic code bindings to e.g. a unique code from

Snomed CT. When these data elements and their specification are missing, it will be very hard to store the data in an electronic health record, and even harder to store them according the DCM specification in the CDWH [14]. When data cannot be stored properly, reuse will be harder and leads to non-semantic interoperability [6]. One way to overcome these difficulties might be to weigh the different quality domains or to weigh some of the 29 metrics.

Second, the core purpose of DCMs is to give a detailed specification of data to be used in electronic health records, electronic messages, or data marts for secondary data use. Although metric 3.2 discusses the conceptual part of the correctness of data [16], and metric 4.1 checks for the syntactical data representation, the core logical part of the DCM is missing as a separate score! For this reason we suggest including an additional quality metric for the data element specification at the logical level in domain 4 'clarity and presentation'. This could look like the following: (4.1) data element specification, (4.2.) syntax, (4.3) codification, (4.4) cardinality, and (4.5) domain description. Next, the total score needs adjustment: with a score of 27-30 the DCM will have sufficient quality, a score of 22-26 leads to a doubtful quality of the DCM and with a score of 21 or lower, the quality of the DCM is insufficient.

When applying the instrument, one needs to be aware that it only covers only a part of the DCM quality. The scoring instrument is neither aiming at the correctness of the clinical content itself, nor at the completeness and correctness of data elements description, data types, coding nor cardinalities that are included in a DCM [16]. Also, the scoring instrument does not address the question if what is presented is sufficient for its purpose, or if it is evidence based [16]. Hence, the instrument does not fully allow for a control of the quality of the medical knowledge presentation. That aspect should ideally be performed by a review procedure, similar to the peer review of scientific papers. In ISO TS 13972:2015 [13] procedures are suggested. In other words, quality control of DCM implies both a peer review towards the medical content and a quality testing according to this scoring instrument. Another area the instrument does not address are the technical formalisms that can be derived from the DCM logical models. In order to create valid 13606/OpenEHR archetypes or HL7 v3 templates, the UML/XML representation of a DCM would require additional technical validations. DCM tooling applied in the project offers a validation component that checks the logical model of the DCM on the presence of a unique code per data element, data type, and cardinalities.

Through this study we can conclude that the instrument developed by Ahn et al [16], the 'Quality Metrics for Detailed Clinical Models' indeed measures quality of DCMs. To conclude, the results of the application show that most DCM considered for CDWH score low on the same quality metrics. Relative simple improvements contribute to a much greater quality of the DCM. In particular cardinalities, data type specification and semantic codes are quick wins at definition phase and a painful corrective operation in running systems. There is common sense that the content of DCM requires a separate review procedure to check for its (clinical) correctness, evidence, and completeness [13]. Further, DCMs are developed to fit several implementations. Some examples of different implementations have been reported [18], and comparisons with other approaches have been made [19, 20], but testing at such a small scale gives insufficient proof. Larger sets of DCMs brought into real world implementations are required to get more confidence. However, this is necessary to do and only then the whole governance structure for DCMs as outlined in the ISO TS 13972 will be in place. Our sample and approach was too small to give detailed recommendations for the instrument, however, the inclusion of the data element definitions at logical level in quality domain 4, is what we suggest to include. More knowledge on the future administration of the instrument



will probably reveal more precise insight to judge a DCM against. To further enhance the quality instrument, we suggest having the quality metrics instrument applied by more than one investigator and determine inter rater reliability.

## 5. Acknowledgments

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## References

- [1] K.U. Heitmann, R. Schweiger, J. Dudeck. (2003). *Discharge and referral data exchange using global standards--the SCIPHOX project in Germany*. Int J Med Inf. 2003 Jul;70(2-3):195-203.
- [2] R.H. Dolin, L. Alschuler, S. Boyer, C. Beebe, F.M. Behlen, P.V. Biron, A. Shabo Shvo. *HL7 Clinical Document Architecture, Release 2*. J Am Med Inform Assoc. 2006 Jan-Feb;13(1):30-9.
- [3] W. Goossen (2009). *Sending Electronic Nursing Discharge Messages using the HL7 v3 Care Provision standard*. Proceedings NI 2009, Helsinki. Stud Health Technol Inform. 2009;146:269-75.
- [4] W. Goossen, L.H. Langford. *Exchanging care records using HL7 V3 care provision messages*. J Am Med Inform Assoc. 2014 Apr 19. doi: 10.1136/amiajnl-2013-002264. [Epub ahead of print]
- [5] A. Boersma. (2008) *To the POINT?, een onderzoek naar de ondersteuning door POINT van het patiënt transferproces* (Webpagina).URL:<http://www.verzorgdeoverdracht.nl/SiteCollectionDocuments/Downloads/To%20The%20Point.pdf> Laatst gezien: 18-06-2013.
- [6] F. Oemig, B. Blobel. *Semantic interoperability adheres to proper models and code systems. A detailed examination of different approaches for score systems*. Methods Inf Med. 2010;49(2):148-55. doi: 10.3414/ME9304. Epub 2010 Feb 5.
- [7] Health Level 7 International. *HL7 Clinical Templates*. [www.hl7.org](http://www.hl7.org) Last access: 10 December 2013.
- [8] ISO 13606 *Health informatics - EHR communication*. Geneva, International Standards Organization.
- [9] openEHR Foundation. [www.openehr.org](http://www.openehr.org) Last access: 10 December 2013.
- [10] CIMI. *Clinical Information Modeling Initiative*. [http://informatics.mayo.edu/CIMI/index.php/Main\\_Page](http://informatics.mayo.edu/CIMI/index.php/Main_Page) . Last access: December 10 2013.
- [11] S. Huff, R. Rocha., J. Coyle, & S. Narus. (2004). *Integrating detailed clinical models into application development tools*. Medinfo, 11(Pt 2):1058-62.
- [12] William Goossen, Anneke Goossen-Baremans, Michael van der Zel, (2010). *Detailed Clinical Models: A Review*. Health Inform Res. 2010 December;16(4):201-214. doi: 10.4258/hir.2010.16.4.201.
- [13] ISO TS 13972: 2015. *Health Informatics Detailed Clinical Models characteristics and processes*.
- [14] F. Boterenbrood., I. Krediet, W. Goossen. *Building a High Quality Multi-Stakeholder Medical Data Provisioning Architecture in a Big Data Health Care Environment*. 2014, Journal of Hospital Administration, 3, 5, e-issue: <http://www.sciedu.ca/journal/index.php/jha/article/view/3904>
- [15] Mitchell Duim, Frank Boterenbrood, William TF Goossen (2014). *Continuity of Care with HL7 v3 Care Record for Oncology Nursing*. Stud Health Technol Inform. 2014;201:476-82.
- [16] S. Ahn, S.M. Huff, Y. Kim, D. Kalra (2012) *Quality metrics for detailed clinical models*. International Journal of medical informatics 2013 May;82(5):408-17.
- [17] R. Verwey., I. van Duijvendijk, E. Vreeke & R. Zondervan. (2010). *e-Overdracht in de Care, een inventarisatie*. V&VN, Nictiz, Actiz.
- [18] Niels Jansen; Tino Bekkering; Alexander Ruber et al (2012). *Towards a Model Based Electronic Nursing Record*. AMIA, paper at NI 2012, 11th International Congress on Nursing Informatics, pp. 189 - 193.
- [19] M. Cuggia, S. Bayat, D. Rossille, P. Poulain, P. Pladys, H. Robert, R. Duvauferrier. (2009). *Comparing the Apgar Score Representation in HL7 and OpenEHR Formalisms*. Stud Health Technol Inform. 2009;150:250-4.
- [20] W.T. Goossen, A. Goossen-Baremans. *Bridging the HL7 template - 13606 archetype gap with detailed clinical models*. Stud Health Technol Inform. 2010;160(Pt 2):932-6.

# Low-Cost Wearable for Fatigue and Back-Stress Measurement in Nursing

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**Abstract.** In recent years the need for informal home care in European countries is growing quickly due to increased life expectancy and demographic change. Informal caregivers have to overcome many obstacles ranging from a lack of adequate training to misjudging their physical and psychological abilities. The aim of this project is to create a low cost wearable device, which unobtrusively measures the physical stress load on caregivers. Two parameters with the most impact on performance and well-being of the caregiver have been identified: (i) fatigue and (ii) back-stress. Based on the measurements, an alert is issued if caregivers are not performing a task correctly, or if they are overexerting themselves. This paper discusses the design of such device and description of an initial prototype, its advantages and possible further development and applications.

**Keywords.** LillyPad, fatigue, homecare, signal processing, low-cost

## 1. Introduction

There is a growing need for caregivers in Germany, professional and non-professional, as the population is gradually growing older due to healthcare improvements and demographic change [1]. Informal caregivers face many challenges, from insecurity due to improper training for the performed tasks and lack of funding to overestimating themselves physically and psychologically. The problem however is not limited to informal care only. Trained healthcare workers experience fatigue-related problems as well [2]. Our research aims to provide an effective way to monitor physical characteristics of caregivers through a low-cost wearable device. The optimal solution would allow the measurements to be performed unobtrusively in a clinical as well as a home environment. The goal is to build a system which would warn the caregivers if they might injure themselves while performing a task and/or if they are over exerting themselves. Low-cost solutions are most important in the healthcare setting, because a permanent and affordable monitoring of the health status of a caregiver is desirable. Especially because informal caregivers generally lack funding for expensive equipment.

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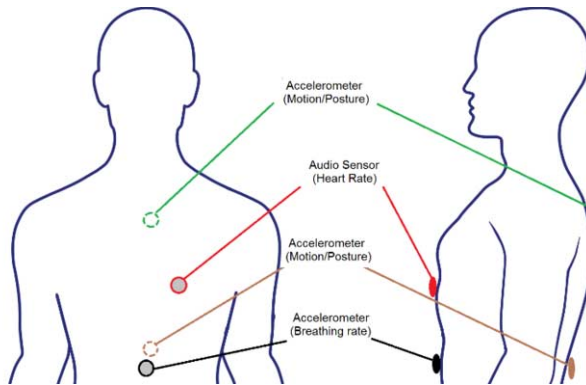


Figure 1. Positioning of the sensors

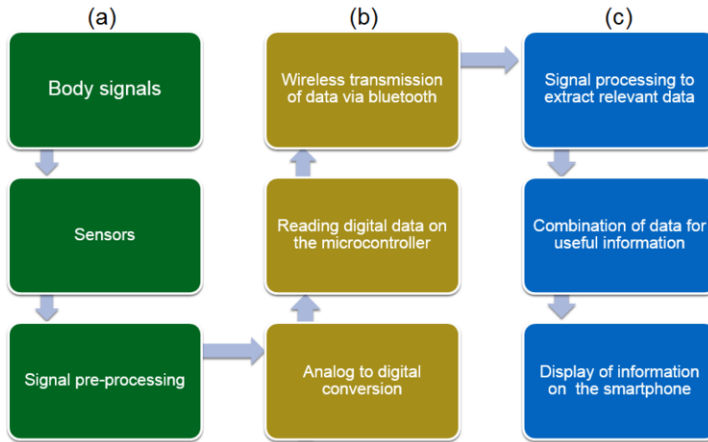
A wearable prototype electronic system to measure various physical indications of stress and tiredness in caregivers is proposed here and implemented using inexpensive hardware readily available on the market.

There are many relatively low-cost wearable devices available in the market that measure energy expenditure and motion, and provide information on the activity of the wearer. These devices are mostly targeted towards fitness monitoring and are predominantly designed to analyze activities such as walking and running. Examples include Fitbit ([fitbit.com](http://fitbit.com)) and Epson PULSESENSE ([epson.com/pulsense](http://epson.com/pulsense)). They focus on heart rate, sleep patterns and other activity tracking. While they provide long battery life and permanent coverage, the sensors are designed for fitness tracking and too imprecise to measure specific tasks. An example of a professional class wearable device is the SenseWear Armband ([sensewear.bodymedia.com](http://sensewear.bodymedia.com)). It is a clinical device, used mostly in research, and has highly specialized sensors. It is used to measure fatigue in a clinical and a home setting [3]. SenseWear and similar devices are no good candidates for a permanent analysis of the health status of caregivers on a larger scale due to their high cost or physical dimensions.

## 2. Methods

The key features of the wearable device are: (i) unobtrusiveness, (ii) inexpensiveness and availability of components, (iii) measurement accuracy and (iv) intuitive mobile interface.

As (i) unobtrusiveness was a key factor in design, the system is planned as a wearable vest. With that in mind, it was made sure that no sensors were extended outside the vest, therefore some of the more clinically commonplace sensors were rejected, such as pulse oximeters, in the favor of compactness and ease of wear. The electronics onboard are powered by the Arduino Lilypad board, which contains the ATmega328 controller. The controller board receives input from three 'ADXL335' accelerometers and a 'BOB-09964' audio sensor (Fig. 1). The front accelerometer is placed on the midriff of the wearer and is used to detect the breathing rate. There are two accelerometers on the back of the vest to record the correct posture and motion of the wearer, and as a reference signal to reduce the noise of the respiratory accelerometer. The audio sensor is placed on top of the fifth intercostal space, closest to



**Figure 2.** Process workflow with sensors (a), on the ATmega328 (b) and smartphone (c).

the apex of the heart. This allows us to pick up the heart rate of the wearer. The hardware is readily available on the market and accumulates to a total cost of about 150 US\$ for a prototype implementation, which addresses the key feature of availability and inexpensiveness (ii).

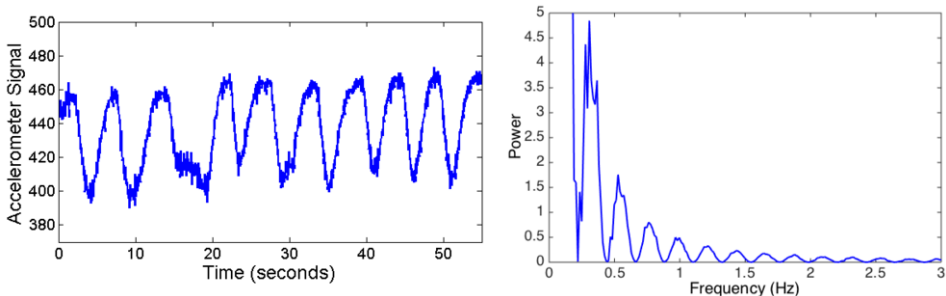
The signal-processing performed in three steps: (a) analog, (b) digital on wearable, and (c) digital on smartphone. The signals coming from the described sensors are pre-processed to remove noise already at this stage (key feature iii, Fig. 2.a). In the next step, signals are passed to the onboard ADC (Analog to Digital Converter) which converts the analog signals into 10bit digital signals (Fig. 2.b). These digital signals are read by the ATmega328 controller and are temporarily stored on the onboard memory as they are prepared to be passed on to an Android based smartphone.

A Bluetooth module WRL-12580 is connected to the microcontroller serial transmission pins. This module enables the controller to wirelessly transmit these signals to a smartphone. The smartphone receives and stores this data through an application designed specifically for this purpose (Fig. 2.c). The data is then processed on the smartphone, where the appropriate information from these signals will be extracted and the user will be notified via sound or vibration to check the phone, if anything of concern is recorded (key feature iv). In particular, for the early stage of this project, we are focusing on movement of the wearer as well as on breathing rate. This information is then analyzed and used to produce an application output. Several different charts would be available for the user, so he or she could see if they are overexerting themselves and if their body posture is correct. This information will be displayed on the smartphone to show the wearer whether they are performing their tasks within acceptable limits.

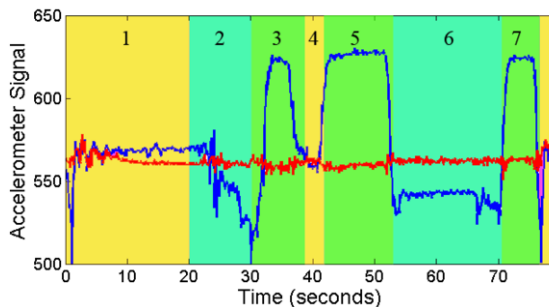
### 3. Results

After the first prototype was designed and fabricated, a set of initial tests were done to see the signal response of the various sensors. These experiments were performed as a proof of concept for the actual signal measurements and sensor viability and therefore, are performed on a single test subject in resting and controlled conditions. Subsequent

testing will be expanded to include more test subjects and real world test conditions. The first experiment was for the respiratory sensor and the wearer was stationary and in a relaxing sitting position. The resulting graph was obtained and a clear oscillation



**Figure 3.** Respiratory accelerometer data (left) and Fourier analysis (right) in a sitting position. The maximum frequency of 0.3 Hz corresponds 8 breathes per minute (physiologically normal).



**Figure 4.** Movement and bending the back. Upper (blue) and lower (red) back accelerometers are displayed, adjusted for visualization. Background colors indicate back movement.

pattern is visible, which can be used to determine the breathing rate (Fig. 3).

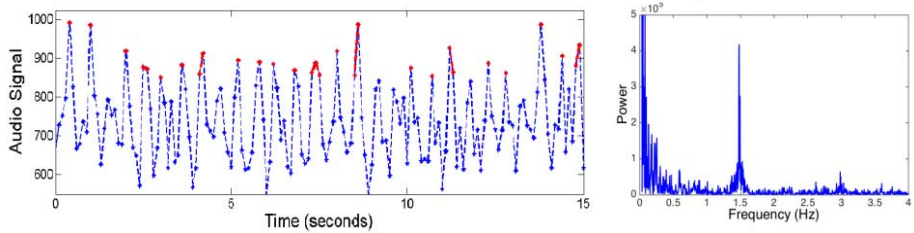
The next experiment involved movement of the user and bending of the back. The user followed a protocol simulating nursing routine wearing the vest (Fig. 4):

1. Standing in an upright position with a straight back (20 seconds)
2. Movement of daily activities (10 seconds)
3. Bending of the back and remaining in this position (10 seconds)
4. Straightening of the back (5 seconds)
5. Bending again (10 seconds)
6. General movement in the room (15 seconds)
7. Bending of the back (5 seconds)

In the last experiment, the wearer stood still in a relaxed posture and using the audio sensor, the data was recorded (Fig. 5).

#### 4. Discussion

There is a clear necessity for research to be conducted to support the caregiver community. The development of mobile technologies opened many opportunities in



**Figure 5.** Detecting heart rate from the audio sensor data (left) and Fourier analysis (right). The maximum frequency of 1.48 Hz corresponds to a heart rate of 88 beats per minute (physiologically normal).

this area, but the current market still lacks the unobtrusive and cheap devices, tailored specifically to meet caregivers' needs. With the initial data that we have been able to collect using the first prototype, this project shows promise towards these goals while keeping costs low by using very inexpensive and common sensors.

In this project we are using the available knowledge about mechanisms and effects of fatigue to design a simple and cheap monitoring system. Our physiological measures can be translated to fatigue and back stress [4] as investigated in prior work from wireless fatigue monitoring in multiple sclerosis patients [5], through tiredness and sleepiness issues in nurses [6] to symptoms in maritime pilots [7]. Furthermore, ergonomic interventions have also been implemented to reduce back stress in nursing personnel [8].

In the current state, the most challenging parts of the project are useful analysis of the collected data and designing robust hardware, so that the developed system would work efficiently in clinical environments, and also in real life scenarios.

## 5. Acknowledgments

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## References

- [1] N. Genet, W. Boerma, M. Kroneman, A. Hutchinson, and R.B. Saltman, *Home care across Europe*. European Observatory on Health Systems and Policies, UK, 2013.
- [2] G.E. Hardy, D.A. Shapiro, C.S. Borrill, Fatigue in the workforce of national health service trusts: Levels of symptomatology and links with minor psychiatric disorder, demographic, occupational and work role factors, *Journal of Psychosomatic Research* **43.1** (1997), 83-92.
- [3] S.L. Shuger, V.W. Barry, X. Sui, A. McClain, G.A. Hand, S. Wilcox, R.A. Meriwether, J.W. Hardin, and S.N. Blair, Electronic feedback in a diet-and physical activity-based lifestyle intervention for weight loss: a randomized controlled trial, *International Journal of Behavioral Nutrition and Physical Activity* **8.41** (2011), 1-8.
- [4] J.J. Knibbe, R.D. Friele, Prevalence of back pain and characteristics of the physical workload of community nurses, *Ergonomics* **39** (1996), 186-198.
- [5] F. Yu, A. Bilberg, E. Stenager, C. Rabotti, B. Zhang, and M. Mischi, A wireless body measurement system to study fatigue in multiple sclerosis, *Physiological Measurement* **33.12** (2012), 2033-2048.
- [6] R.G. Hughes and A.E. Rogers, *The effects of fatigue and sleepiness on nurse performance and patient safety*, Agency for Healthcare Research and Quality, US, 2008.
- [7] T.P. Chambers, L.C. Main, Symptoms of fatigue and coping strategies in maritime pilotage, *International maritime health* **66.1** (2015), 43-48.
- [8] A. Garg, B. Owen, Reducing back stress to nursing personnel: an ergonomic intervention in a nursing home, *Ergonomics* **35.11** (1992), 1353-1375.

# Smart Glasses in Nursing Training – Redundant Gadget or Precious Tool? A Pilot Study

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**Abstract.** *Introduction:* Heavy workloads in nursing care and high employee turnover call for efficient methods to support on-the-job training. Within the *Witra Care* project – aiming to develop mobile technologies to support knowledge transfer between experienced and inexperienced nurses – the objective was to investigate the feasibility and perceived usefulness of advanced smart glasses for an exemplary, specific activity in nursing training – preparation of a surgical instrument table in an operating room. *Methods:* Four trainee nurses performed different tasks using speech-command operated smart glasses within an operating room setting and were asked for their expectations towards this technology, their experiences and perceptions. *Results:* All tasks could be achieved by the trainee nurses, and the overall perception was that the technology is supportive and helpful. *Discussion:* Our results indicate interest in new wearable technologies for supporting training in nursing care. Limitations include small sample size, selection bias and several technical issues such as speech recognition accuracy or short battery lifetime. More research is necessary to evaluate the usefulness and usability of advanced wearable devices for supporting knowledge transfer and training in nursing care.

**Keywords:** inpatient care, learning, knowledge transfer, mobile devices, smart glasses

## 1. Introduction

It is well known that nursing care, for both inpatients and outpatients, often is characterized by tight working schedules, heavy workloads and a shortage of workforce [4], sometimes affecting the quality of care [2]. Heavy workload, especially in terms of physically demanding care processes, frequently leads to inability to continue the job and causes a high turnover within the workforce [5]. As a consequence of this high turnover, huge amounts of experiential and practical knowledge are lost in the process. Thus, efficient methods for on-the-job training and knowledge transfer between experienced nurses and those who are new on the job or new within an organization become more and more important.

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The *Witra Care* (a German acronym for knowledge transfer) project aims to employ mobile technologies to support on-the-job training processes for nurses by recording, categorizing and re-providing little knowledge snippets in the form of micro-learning modules. Mobile devices such as smart phones or tablets are used for six weeks in tandem teams of an experienced and a non-experienced nurse during initial training [3].

Within this project, in addition to the above-mentioned devices, we have also investigated the use of advanced mobile devices to support knowledge transfer processes. While augmented reality methods are already used for training medical students [1] or physicians [7; 8], little is known whether these technologies are accepted by nurses and whether they can enhance training for nursing care.

The aim of our research for this paper was to investigate the feasibility and perceived usefulness of advanced smart glasses for an exemplary, specific activity in nursing training – preparation of a surgical instrument table in an operating room – and to shed light on nurses' attitudes towards such technologies.

## 2. Methods

For our pilot study, we chose a setting in which there is a permanent need to perform complex, yet often well-defined procedures, namely an operating room. Four nurses, local trainees to become specialized as operating room nurses and aged between 22 and 25 years (two women and two men), took part in our study. The study took place at Hannover Medical School's skills lab (*SkiLaH*), featuring – amongst others – a fully equipped operating theatre. The task for the nurses was to prepare a surgical instrument table for a gynecologic procedure as defined by local standards for this preparation. Participants were equipped with Vuzix M100 smart glasses, featuring – apart from a display – a speech recognition software trained to understand commands for showing pictures of the procedure, as well as for zooming in on specific picture areas as desired (Fig. 1a and 1b).

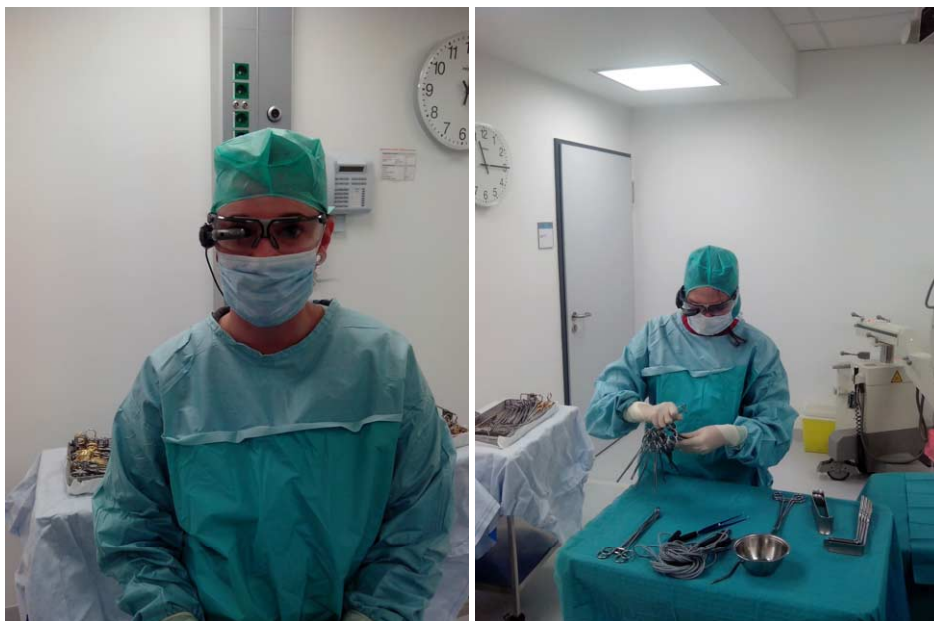
A second task for the nurses included navigating through a menu on the smart glasses' display via speech commands to find an exemplary specific piece of patient information (information about patient insurance, Fig. 2). During the whole experiment, the nurses were scrubbed in so that they fully depended on speech recognition. All possible speech commands were written on a whiteboard on the operating room's wall.

After the experiment, the participants filled in a questionnaire and were – in a semi-structured interview – asked for their opinions and the perceived usefulness of these technologies [6].

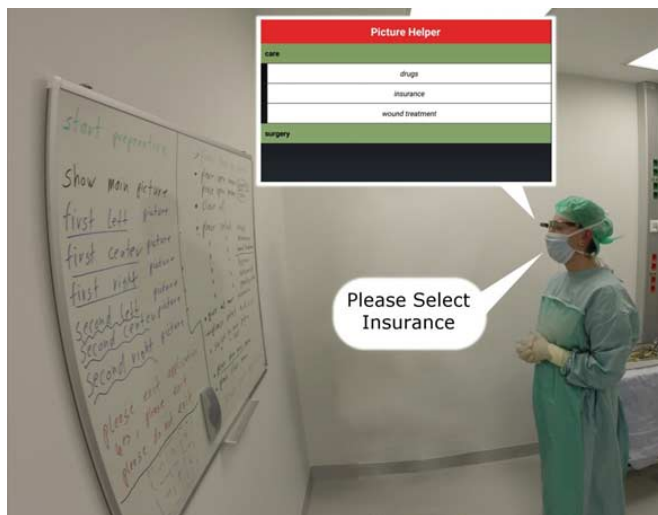
## 3. Results

All four nurses completed both tasks demanded. Preparation of the unknown operating room table setup took them between 10 and 16 minutes, during which the participants used 8 to 17 picture zooming-in commands. The insurance information seeking task – while being completed by all – proved more difficult due to multiple attempts necessary because of incorrect speech recognition and subsequent problems when navigating the menu.





**Figure 1a and 1b:** Nurse equipped with smart glasses to support the training process of preparing an operating room table for a gynecologic procedure (location: skills lab at Hannover Medical School)



**Figure 2:** Navigating through a menu on the smart glasses via speech commands to find specific patient information (location: skills lab at Hannover Medical School)

The questionnaire results and face-to-face interviews showed that the general impression of the device and working with it was very positive. Problems mentioned by our participants included a long setup time (several minutes) for the experiment,

out-of-focus display and insufficient fixation of the glasses, mediocre speech recognition in this scenario (median score: 3 points [1-very good to 6- very bad]), and short battery lifetime. Three of our four nurses stated that they would like to use smart glasses for their job in the future, one denied this.

Expectations towards smart glasses – not met in our experiment – included the wish to include audio information for training, more specific information such as textbook knowledge on operating procedures (e.g. concerning incision lines), trouble-free speech recognition, and reduction of workload. Additionally, participants expressed the need for automated recognition of instruments, other articles or scenes and situations, to provide additional, situational support and information.

#### 4. Discussion

The pilot study on hand indicates that nurses are interested in new technologies – in this case smart wearables – for supporting on-the-job training. Our specific scenario was well-accepted, and all nurses were able to achieve the aims set in this experiment, despite some limitations in the speech recognition software. Future applications might include e.g. support for assessing and treating wounds or situation-adaptive information provision, also employing potential sensing capacities of such devices (e.g. activity recognition using accelerometer data).

Considering our results, several limitations need to be mentioned. First of all, the sample size of this experiment is very small, and the sample is likely biased. Therefore, we cannot generalize our findings. Nevertheless, we feel that our findings, however preliminary, may reveal some of the strengths as well as weaknesses of current wearable technologies for nursing training, and may thus help to support future research in this area.

Technical limitations include that enhancing the linguistic scope of the speech recognition software with German words turned out to be infeasible, because the dictionary file could not be replaced despite several efforts. Therefore, only commands in English could be used, which may have affected the correct recognition of terms. Battery lifetime was short when using the speech recognition feature, severely limiting the current usability in real-life settings.

#### 5. Acknowledgments

The project *Witra Care* was carried out on behalf of the German Federal Ministry for Education and Research (*BMBF*) under grant number 16SV6380. Responsibility for the contents of this publication lies with the authors. We thank Dr. Sabine Schneidewind for supporting our study in the Skills Lab (SkilLaH) at Hannover Medical School.

#### References

- [1] U.V. Albrecht, C. Noll, and U. von Jan, Explore and experience: mobile augmented reality for medical training, *Stud Health Technol Inform* 192 (2013), 382-386.
- [2] J.E. Ball, T. Murrells, A.M. Rafferty, E. Morrow, and P. Griffiths, 'Care left undone' during nursing shifts: associations with workload and perceived quality of care, *BMJ Qual Saf* 23 (2014), 116-125.

- [3] M.B. Becker, M. Behrends, C. Barthel, T. Kupka, R. Schmeer, I. Meyenburg-Altward, and M. Marschollek, Developing a mobile application for recording learning experiences in nursing practice, *Stud Health Technol Inform* 210 (2015), 899-903.
- [4] C. Duffield, D. Diers, L. O'Brien-Pallas, C. Aisbett, M. Roche, M. King, and K. Aisbett, Nursing staffing, nursing workload, the work environment and patient outcomes, *Appl Nurs Res* 24 (2011), 244-255.
- [5] M. Lavoie-Tremblay, L. O'Brien-Pallas, C. Gelin, N. Desforges, and C. Marchionni, Addressing the turnover issue among new nurses from a generational viewpoint, *J Nurs Manag* 16 (2008), 724-733.
- [6] F.J. Neyer, J. Felber, and C. Gebhardt, Entwicklung und Validierung einer Kurzskaala zur Erfassung von Technikbereitschaft [Development and validation of a short scale to assess technology readiness], *Diagnostica* 58 (2012), 87-99.
- [7] C. Sutherland, K. Hashtrudi-Zaad, R. Sellens, P. Abolmaesumi, and P. Mousavi, An augmented reality haptic training simulator for spinal needle procedures, *IEEE Trans Biomed Eng* 60 (2013), 3009-3018.
- [8] Y. Yamauchi, Smart Dry Lab: An Augmented Reality (AR) Based Surgical Training Box, *Stud Health Technol Inform* 196 (2014), 476-478.

# Clustering the Whole-Person Health Data to Predict Liver Transplant Survival

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**Abstract.** This study aims to discover groups (clusters) of patient who share whole-person characteristics. An unsupervised clustering analysis using a hierarchical agglomerative approach was applied to identify meaningful groups of patient characteristics. Results showed that is possible to identify clusters that have similar patient characteristics, and that these characteristics may be associated with survival.

**Keywords** Liver Transplantation, Predictors, Health Data, Cluster Analysis, Informatics.

## 1. Introduction

Transplantation is increasingly used as a treatment of choice for severe and acute chronic end-stage liver diseases. The patient population that underwent liver transplantation is highly heterogeneous in terms of their clinical presentation, their non-clinical characteristics and their outcomes. Despite this known heterogeneity, little is known about a broad array of potential predictors and how combinations affect patient outcomes. The Wellbeing model [1] was adopted in a critical review as a framework to categorize predictors and detect gaps using a whole-person perspective [2]. The majority of prior studies focuses on the Health (physiological) dimension, such as age, hepatocarcinoma, and hepatitis C [3-5]. Few studies showed additional dimensions such as Environment, Community, Security, Relationship or Purpose dimensions from the Wellbeing Model. Often there were contradictory results across studies.

Heterogeneity arises as a result of the presence of patient groups with distinct characteristics within a population. Data mining techniques can be used to discover such groups, which might otherwise remain unknown [6]. Specifically, clustering can discover groups (clusters) of patients, such that patients within each cluster are very similar to each other, while patients from different clusters are distinct. These patient groups can represent different subcategories of a disease, such as novel groupings of liver transplant patient characteristics [6-8] and can thus explain the heterogeneity that exist in the liver transplant patient population. This study aims to apply hierarchical

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clustering, using a whole-person representation, to identify novel and meaningful patient clusters that can explain heterogeneity.

## 2. Methods

After approval from the Institutional Review Board (IRB), Organ Transplant Tracking Registry (OTTR) data from a Transplant Information System (TIS) in the Midwest United States containing all adults that underwent liver transplantation from 2008 to 2014 were selected. A total of 358 patients composed the sample of unique patients that underwent liver transplant as for the first time. From this sample, a cohort of 156 patients that answered the SF-36 survey prior to surgery was selected.

Data were selected from the TIS, evaluated for data quality, pre-processed, and transformed for analysis. The Short-Form Health Survey (SF-36) was selected to expand predictors representing the whole-person, as it includes eight health domains and detects changes in health over time [9]. SF-36 items and responses were scored based on the RAND-36-Item Health Survey (Version 1.0) [9,10]. In addition to the SF-36 health domain scores, primary reason for undergoing transplantation, age, gender, MELD (Model for End Liver Disease) score, and recipient vital status after transplant were included. Imputation was necessary for five data points in the SF-36 results, and the imputed values were based on the similarity in health status at that time. No other missing data was found. The primary disease for the transplant included non-alcoholic cirrhosis, alcoholic cirrhosis, malignant neoplasm, and others liver diseases. Variables were scaled based on the current literature in transplantation, representing those that are in more or less risk for the outcome. Age was considered as younger or older than 60 (older than 60 is in higher risk), gender as binary (male or female), primary disease as categorical, and MELD score as binary (greater than 28 or not). SF-36 domains scores were transformed into binary variables for data analysis (value of '1' indicated deterioration of health (score < 50), and value of '0' indicated better health, score >= 50).

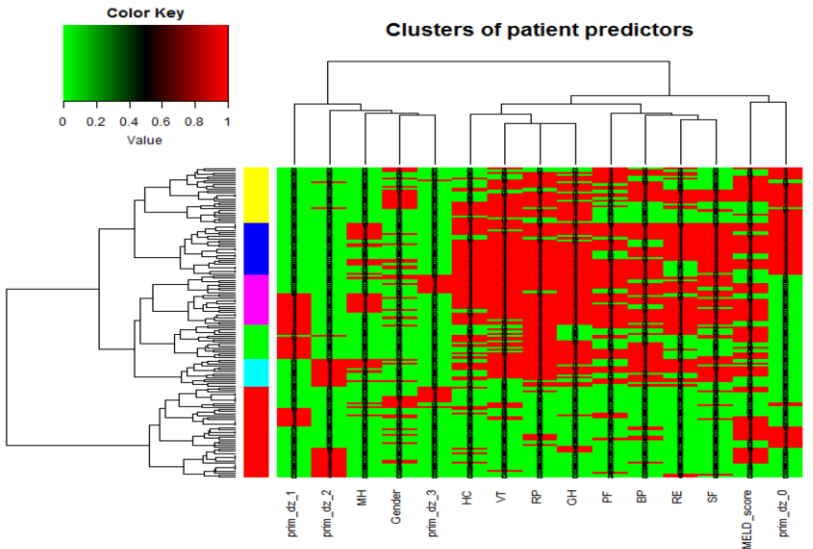
An unsupervised clustering analysis using a hierarchical agglomerative approach was applied to identify meaningful groups of patient characteristics [6]. The purpose of clustering is to create groups of elements (patients in this case) such that patient within a group are similar to each other, while patients from different clusters are dissimilar. Agglomerative clustering works in a bottom-up manner. That is, initially all elements are considered as single-element clusters, and at each step of the algorithm, elements of the two most similar clusters are combined to form a bigger cluster. The process continues until all elements become members of a single cluster. (Dis)similarity of clusters are measured through the Euclidean distance, and Ward's method was adopted to measure the total within-cluster variance, i.e. how similar are the patients to each other within a cluster [6]. Then, a Lasso-penalized logistic regression model was applied to identify the most relevant patient characteristics that can distinguish one cluster from the others.

## 3. Results

The final sample for the clustering analysis consisted of 156 observations or patients, and 16 predictor variables. The sample had a mean age of 56 (IQR=11), with 72%

males, and an overall health status slightly poorer than the general population, with a SF-36 total mean score of 48. SF-36 scores were incorporated in the analysis using its eight health domains, and health change status over time.

The cluster analysis was able to identify clinically meaningful patient subpopulations. The agglomerative coefficient, which measures the quality of the cluster structure in the data was 0.92 (1=very clear, 0=no structure was found). This means that the cluster structure found was of high quality. We identified six clusters and their sizes are: C1=28, C2=25, C3=13, C4=35, C5=16, C6=39. Figure 1 shows how patients and characteristics were clustered together. Red color represents the presence of a higher risk, and green represent a lower risk for each specific cluster. The left “rainbow” color bar represent the 6 clusters analyzed.



**Figure 1:** Heatmap for patient characteristics showing how clusters were merged regarding patients and predictors. **Legend:** Rainbow color left label = clusters, prim\_dz\_1 = alcoholic cirrhosis, Prim\_dz\_2 = malignant neoplasm, MH = deterioration of mental health, prim\_dz\_3 = other liver diseases, HC = worsening health change, VT = deterioration of vitality, RP = deterioration of role-physical, GH = deterioration of general health, PF = deterioration of physical functioning, BP = deterioration of bodily pain, RE = deterioration of role-emotional, SF = deterioration of social functioning, prim\_dz\_0 = non-alcoholic cirrhosis.

Logistic regression models were used to identify the most relevant patient characteristics that discriminate clusters from each other. Age, gender, MELD score and health status change did not show any impact in determining if a patient was in one cluster or another. Significant variables within clusters are described.

1. In comparison to the other clusters, patients in C1 had a higher prevalence of malignant neoplasm, and lower prevalence of non-alcoholic cirrhosis. Patients had much lower role limitations due to physical health and less deterioration of vitality, and general health. The survival rate was 89.3%.
2. Patients in the C2 cluster had a much higher prevalence of non-alcoholic cirrhosis, a much lower prevalence of deterioration of social functioning, and a lower prevalence of deterioration of physical functioning, mental health, and bodily pain than the other clusters. The survival rate was 84%.

3. In the C3 cluster, patients had an extremely high prevalence of non-alcoholic cirrhosis and lower deterioration of physical functioning, social functioning, and bodily pain; they also had a much lower deterioration of general health than the other clusters. The survival rate was 84.7%.
4. Patients in the C4 cluster had a higher prevalence of alcoholic cirrhosis and a slightly higher prevalence of other liver diseases. There was a higher deterioration of physical functioning, bodily pain, and much higher deterioration of general health. The survival rate was 88.6%.
5. In the C5 cluster, patients had a very high prevalence of malignant neoplasm and role limitations due to physical health, with a slightly higher prevalence of deterioration of social functioning. The survival rate was 93.8%.
6. Patients in the C6 cluster had a higher prevalence of non-alcoholic cirrhosis and deterioration of physical functioning, social functioning, bodily pain, and general health. The survival rate was 89.8%.

#### 4. Discussion

This study aimed to discover groups (clusters) of patients who share several whole-person characteristics from multiple domains and thus identify heterogeneity into the liver transplant patient population. The results showed that it was possible to identify patient groups with similar health status using an unsupervised clustering analysis.

Substantial heterogeneity is known to exist in patients who underwent liver transplant in terms of their clinical presentation, their non-clinical characteristics and their outcomes. Prior research focused on clinical presentation. In this work, we aimed to characterize liver transplant patient population heterogeneity from a whole-person perspective, going beyond considering only physiological factors. Heterogeneity arises as a result of the presence of patient groups with distinct characteristics. Using unsupervised clustering we successfully identified six such patient groups. Our preliminary findings suggest that these clusters not only explain heterogeneity in the patient population from a whole-person perspective, but are also associated with survival outcomes. Once we obtain detailed survival data, in a follow-up study, we will analyze this association rigorously and determine its significance.

We found that the survival rate of all patients who underwent liver transplantation in that period was lower (79%) than the patients who answered the SF-36 (88.4%). It is possible that patients who answered the SF-36 were in better health condition than the overall patients that underwent liver transplant and they were able to answer the survey, while other patients were too sick to complete the questionnaire. Further study is needed to investigate this difference, with survival time incorporated, and its implications on the results.

Although some limitations, such as small sample size, and the difference in survival for responders and non-responders to the SF-36 survey exist, this study showed that deterioration of health status measured by the SF-36 may be used for analyzing patients that undergo liver transplantation, and some association may exist with survival. Further, this study showed that the SF-36 domains can be used to model a whole person perspective for liver transplantation patients. While our preliminary findings are very promising, future research should validate the association between health scores and certain diseases, and cross validate these findings with larger and different patient samples. In addition, different methodological approaches and an expanded set of

comorbidities can be considered in order to capture the heterogeneity in the data more fully, and to further refine our patient clusters with an aim towards improving our ability to predict patient outcomes.

## 5. Acknowledgments

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## References

- [1] M.J. Kreitzer, Spirituality and well-being: Focusing on what matters, *West J Nurs Res* 34 (2012), 707-711.
- [2] L. Pruinelli, Predictors and outcomes for liver transplantation - a critical review of the literature, (2014).
- [3] C.S. Cho, S.J. Knechtle, D.M. Heisey, et al., Analysis of tumor characteristics and survival in liver transplant recipients with incidentally diagnosed hepatocellular carcinoma, *J Gastrointest Surg* 5 (2001), 594-601.
- [4] R.C. Dickson, S. Pungpapong, A.P. Keaveny, et al., Improving graft survival for patients undergoing liver transplantation, *Clin Transplant* 25 (2011), E345-55.
- [5] S.S. Patel, A.K. Arrington, S. McKenzie, et al., Milan criteria and UCSF criteria: A preliminary comparative study of liver transplantation outcomes in the United States *Int J Hepatol* (2012), 253517.
- [6] P. Tan, M. Steinbach, V. Kumar, *Introduction to data mining*. Pearson Education Inc., 2006.
- [7] S. Dey, G.J. Simon, B.L. Westra, M. Steinbach, V. Kumar, Mining interpretable and predictive diagnosis codes for multi-source electronic health records, 2014.
- [8] G. Lanzola, E. Parimbelli, G. Micieli, A. Cavallini, S. Quaglino, Data quality and completeness in a web stroke registry as the basis for data and process mining, *J Healthc Eng* 5 (2014), 163-184.
- [9] J.E. Ware, C.D. Sherbourne, The MOS 36-Item Short-Form Survey (SF-36), *Med Care* 30 (1992), 473-483.
- [10] RAND. Medical Outcomes Study: 36-Item Short Form Survey Scoring Instructions, [http://www.rand.org/health/surveys\\_tools/mos/mos\\_core\\_36item\\_scoring.html](http://www.rand.org/health/surveys_tools/mos/mos_core_36item_scoring.html) (Last accessed 3 December, 2015).



# Integration and Analysis of Heterogeneous Colorectal Cancer Data for Translational Research

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**Abstract.** Cancer is the number one cause of death in Australia with colorectal cancer being the second most common cancer type. The translation of cancer research into clinical practice is hindered by the lack of integration of heterogeneous and autonomous data from various data sources. Integration of heterogeneous data can offer researchers a comprehensive source for biospecimen identification, hypothesis formulation, hypothesis validation, cohort discovery and biomarker discovery. Alongside the increasing prominence of big data, various translational research tools such as transSMART have emerged that can converge and analyse different types of data. In this study, we show the integration of different data types from a significant Australian colorectal cancer cohort. Additionally, colorectal cancer datasets from The Cancer Genome Atlas were also integrated for comparison. These integrated data are accessible via <http://www.tcrn.unsw.edu.au/transmart>. The use of translational research tools for data integration can provide a cost-effective and rapid approach to translational cancer research.

**Keywords.** Colorectal cancer, data integration, data analysis, cohort discovery, biomarker discovery

## 1. Introduction

Cancer is one of the leading causes of mortality in Australia with estimated deaths of 45,700 per year. Colorectal cancer (CRC) is the second most common type of cancer in Australia. It is also one of the major burdens to health expenditure [1]. The basic biology of CRC development is well studied with major discoveries made in the last two decades. However, the translation of new discoveries into practice often takes many years. The analysis of vast amounts of heterogeneous data collected and generated over long periods is a key issue hindering the implementation of translational research. Often this valuable data is derived from varied data sources, while its storage using different formats and standards makes the data difficult to integrate and analyse. Clinical data, experimental data, biospecimen data and imaging data are the major heterogeneous data types observed in colorectal cancer translational research. From a personalized medicine point of view, integrating heterogeneous data is needed to provide a unified view for analysis [2, 3]. It

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could provide translational researchers a comprehensive source for hypothesis formulation and validation, as well as cohort and biomarker discovery. At the same time, it also enables reuse of valuable existing data, thereby minimising cost and increasing research effectiveness.

The aims of this study are to i) integrate heterogeneous CRC data from both public and private sources ii) increase and provide easy global access to an Australian CRC study data and associated biospecimens, thereby fostering global collaborations and data reuse and iii) analyse and generate hypothesis using the integrated data.

## 2. Methods

The Molecular and Cellular Oncology (MCO) study is a major CRC study in Australia, recruiting over 1,500 participants between 1993 and 2010 [4]. Biospecimens were collected along with clinical data. During this time, large amounts of experimental and imaging data were also generated. Imaging data mainly included whole slide images. All patients were assessed for key biomarkers such as microsatellite instability (MSI), CIMP status, KRAS mutation and BRAF mutation. Additionally, public data was sourced from The Cancer Genome Atlas (TCGA), specifically the Colon adenocarcinoma (COAD) and Rectum adenocarcinoma (READ) studies [5]. The TCGA COAD and READ open access tier data was used for this project which included de-identified clinical and biospecimen data.

### 2.1. Distributed Data Sources

The MCO study clinical data was originally stored in a Microsoft Access<sup>TM</sup> database. As part of this study, the clinical data was extracted, clinically coded using SNOMED-CT terminology and migrated into the clinical data management system OpenClinica<sup>2</sup> to improve management of clinical data. The biospecimens collected as part of the MCO study are physically stored in the UNSW Biorepository. The associated biospecimen data, including specimen type, morphological abnormality and tissue site are stored in the biobanking laboratory information system (LIMS) OpenSpecimen (previously known as caTissue) [6, 7]. Over 1,700 whole slide images together with their metadata are stored in the web-based application Aperio Spectrum<sup>3</sup> (now part of Leica Biosystems). However, due to the size of the whole slides images are large only metadata of these images was used for data integration. The experimental data, mainly biomarker-related data was stored in Microsoft Excel. Figure 1 illustrates the distributed data sources and flow of data at a high level.

### 2.2. Development of Use Cases

The integration of heterogeneous data for translational research is challenging and the expected outcome of data integration widely varies from one translational researcher to another. In order to overcome this issue, we developed use cases by seeking feedback from translational researchers with diverse backgrounds, including pathologists, cancer epidemiologists, molecular biologists, bioinformaticians and medical oncologists. The

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<sup>2</sup> <https://openclinica.com/>

<sup>3</sup> <http://www.leicabiosystems.com/pathology-imaging/aperio-digital-pathology/>

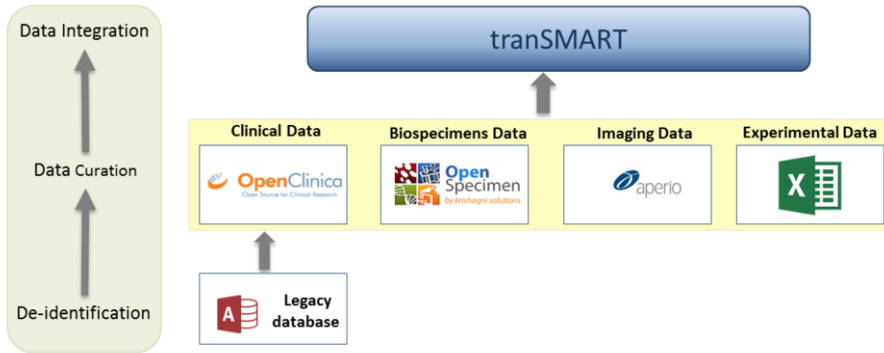


Figure 1. Distributed data sources and flow of data.

main use cases for this study included capabilities like biospecimen identification, cohort discovery, survival analysis, hypothesis generation and comparisons across other public datasets. The development of use cases helped us to identify the need to collect new data or summarise existing data. These developed use cases were later validated with the newly integrated data.

### 2.3. Hierarchical Representation of Heterogeneous Data

Flexible and sustainable representation of data in a hierarchical format is vital for effective downstream analysis of the integrated data in tools such as tranSMART. Thus, we employed an iterative design process with constant feedback from translation researchers to develop a model suitable for our developed use cases. The model was designed by employing a three step approach: i) evaluate and assess the suitability of existing models, ii) assess the standards and terminologies used in conjunction with data sources and iii) design and extend the model beyond CRC. The final model heavily relied on SNOMED-CT and ICD-10 terminologies for clinical data. The data from distributed data sources was curated to comply with the designed model and finally integrated using the tranSMART tool. Based on privacy and confidentiality requirements, potentially identifiable data were removed or replaced. Figure 2 below illustrates the high level structure of the hierarchical data model.

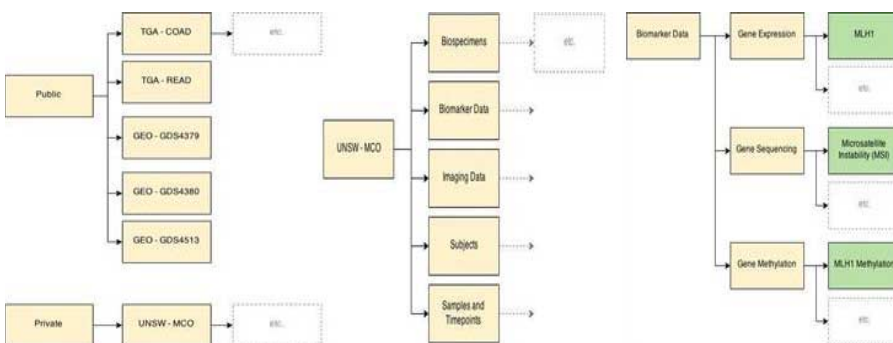


Figure 2. Snapshot of the data hierarchy at the study and data type level.

### 3. Results

Different types of CRC data, has been successfully integrated and analysed by adopting the tranSMART tool. The study took a little over 12 months to achieve its aims. More than 600 data variables were curated and integrated, representing more than 1,500 patients and thousands of associated biospecimens and whole slide images. TCGA data representing more than 600 patients was also integrated. Over twenty key clinical and biospecimen data variables were included for each of the TCGA COAD and READ datasets. Different use cases were identified and were verified using the integrated CRC data via the tranSMART tool. Complex queries can be constructed without any SQL programming experience. Biospecimen and cohort discovery has been made accessible with the added advantage of being able to request access to the biospecimens of patients from the subsequently identified cohort. Biospecimens may be browsed based on data variables such as anatomical site, specimen type, morphological abnormality and pathological status. Physical access to identified biospecimens (from the MCO cohort) is subject to standard governance and request procedures set forth by the UNSW Biorepository [8]. Cross study comparisons was also made available by integrating the Australian MCO and the American TCGA CRC cohort. Hypothesis generation was another important use case identified in this study. The integrated CRC data can assist researchers in developing new hypotheses or in validating an existing hypothesis using the tranSMART tool. In the absence of access to integrated CRC data via tools like tranSMART, similar analyses would take from weeks to months.

### 4. Discussion

TranSMART an open source translational research tool was implemented in Australia for the first time with access to MCO & TCGA CRC data. The custom features developed for the tranSMART tool as part of this project are available<sup>4</sup> under open source license.

There are some limitations in this study. Firstly, although high dimensional data is available for MCO and TCGA studies, integration of this data was outside the scope of this initial project and remains a planned future development. In addition, we observed that there is no support for temporal data in the tranSMART tool causing an overlap between some queries [9]. For example, a simple query was constructed to identify patients with and without MLH1 biomarker expression. From the descriptive statistics generated, we observed that 181 patients had loss of MLH1 staining, 1,311 with normal MLH1 staining and 17 with both loss and normal MLH1 staining. Given the query, it would be logical to observe absolute patient count for one or the other but not for both. In addition, for the calculation of survival time, the date of the initial surgical resection is considered as entry point due to the lack of diagnosis date data. Similar types of assumptions have been made with other data variables either because of missing data or noisy data [10]. Therefore, it is important for researchers to understand the underlying assumptions made during data integration and the limitations of translational tools during data analysis.

Data integration depends on numerous factors including heterogeneity, temporality and granularity of data; number of data sources; amount of missing and noisy data; common data models used and specific research objectives [11, 12]. While the

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<sup>4</sup> <https://github.com/TCRNBioinformatics/UNSWTransMart>

development of use cases and data hierarchies was a useful process, some important technical limitations were identified during data integration, testing and analysis. A rigorous requirements analysis, technical solutions review and biocuration framework is recommended. The framework should take into account factors like quality of data, governance, validation, privacy, compliance and security requirements. Furthermore, with the rise of institutional biobanking, biospecimens are now associated with rich and routinely collected clinical data [13], prompting the need for sophisticated translational tools capable of integrating data in real time.

In summary, this study has used a large Australian colorectal cancer study to demonstrate the feasibility of using transSMART as a tool for supporting translational cancer research. In future, we would like to explore the possibilities of integrating high dimensional data, and other CRC datasets from Australia and other countries. In addition, we also would like to develop a conceptual manual-biocuration framework for translational research based on our experiences from this study.

## Acknowledgements

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## References

- [1] AIHW, *Cancer in Australia: an overview*, Australian Institute of Health and Welfare, Canberra, Australia, 2014.
- [2] A. Halevy, A. Rajaraman & J. Ordille, *Data integration: the teenage years*. Paper presented at the Proceedings of the 32nd international conference on Very large data bases, Seoul, Korea, 2006.
- [3] M. Lenzerini, *Data integration: a theoretical perspective*. Paper presented at the Proceedings of the twenty-first ACM SIGMOD-SIGACT-SIGART symposium on Principles of database systems, Madison, Wisconsin, 2002.
- [4] R. Ward, & N. Hawkins, *Molecular and Cellular Oncology (MCO) Study Data*. Retrieved from: <https://researchdata.ands.org.au/mco-study-tumour-collection/17113>, 2014.
- [5] TCGA Research Network. TCGA. Retrieved from <http://cancergenome.nih.gov/>, 2015.
- [6] J. Jonnagaddala, J. Li & P. Ray, *Evaluation of caBIG® caTissue Software*. Paper presented at the World Congress on Medical Physics and Biomedical Engineering May 26-31, 2012, Beijing, China, 2013.
- [7] L.D. McIntosh, et al., Catissue Suite to Openspecimen: Developing An Extensible, Open Source, Web-Based Biobanking Management System, *Journal of Biomedical Informatics* **57** (2015): 456-464.
- [8] UNSW Australia. Lowy Biorepository. Retrieved from <http://biorepository.unsw.edu.au/>, 2015.
- [9] V. Canuel, B. Rance, P. Avillach, P. Degoulet & A. Burgun, Translational research platforms integrating clinical and omics data: a review of publicly available solutions, *Brief Bioinformatics* **16** (2014), 280-290.
- [10] L. Ohno-Machado, Modeling medical prognosis: survival analysis techniques, *Journal of Biomedical Informatics* **34(6)** (2001), 428-439.
- [11] C. Goble, R. Stevens, D. Hull, K. Wolstencroft & Lopez, R., Data curation + process curation = data integration + science, *Brief Bioinformatics*, **9** (2008), 506-517.
- [12] J. Jonnagaddala, T.R. Jue, P. Ray & A. Talaci-Khoei, Data Sharing Challenges and Recommendations for Human Biorepositories: A Systematic Literature Review, *The International Technology Management Review* **4** (2014), 68 - 77.
- [13] L. Wyld, S. Smith, N.J. Hawkins, J. Long, & R.L. Ward, Introducing Research Initiatives into Healthcare: What Do Doctors Think? *Biopreservation and Biobanking*, **12** (2014), 91-98.

# A Workflow Framework for Health Management in Daily Living Settings

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**Abstract.** Daily-living settings are increasingly becoming care delivery settings, particularly for chronic conditions. Workflow studies can help understand care delivery in daily-living settings, but traditional frameworks originally developed for institutional settings may not be appropriate to study health management in daily-living settings. Based on a qualitative study of health management patterns among eight patients at an academic hospital anticoagulation clinic, we have developed a model for examining daily living setting-based workflow. This model can inform consumer informatics interventions.

**Keywords.** Workflow, daily-living settings, routines, context

## Introduction

Healthcare delivery practices have had to change in response to (1) fragmentation of care delivery services [1]; (2) increased pressure for earlier discharge, turning daily-living environments into primary settings for healthcare [2, 3]; (3) increased use of health information technologies in clinics and homes [4, 5]; and (4) increased patient engagement [6]. These changes mean that daily living settings are becoming important care delivery settings, particularly for chronic conditions.

Workflow—the flow of work through space and time [7]—(a) contributes to comprehensive, systematic examination of care delivery systems, (b) helps identify quality of care and efficiency problems, and (c) leads to development of systematic interventions to remedy these problems. Workflow analysis facilitates modeling and makes complex phenomena (e.g., health management) more comprehensible. The health IT literature clearly indicates that an integrated understanding of workflow is essential to obtaining desired results from technology [8-10].

This study advances a framework to guide workflow studies in daily-living environments. These innovative workflow studies can capture home-based health-related activities, roles, sequences, and information use, just as traditional workflow study methods have captured these important details in institutional settings.

The literatures of human factors, health informatics, and engineering include well-established tools and techniques for studying workflow in formal, structured settings [11, 12]. These tools and techniques (e.g., data collection protocols, visualization tools, modeling tools, and data analysis techniques) have been applied in clinical settings to

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capture care delivery activities. As a result, important usability [13], safety [14] and quality of care related problems were identified, and the findings informed the design and implementation of health IT interventions. Capturing the systematic organization of care delivery activities has allowed researchers to link resource deployment patterns to desired/undesired outcomes. Applying workflow daily living setting could improve patients' health management practice, thus the patient outcomes.

Moreover, because some activities are planned and some emerged, actual workflow is influenced by physical, social, and cultural context variables [15]. But while known workflow tools and techniques are successful in structured and relatively standardized settings, little attention has been paid to tools that can codify health-related workflow in unstructured, diverse daily-living environments [10, 16, 17].

Workflow in formal, clinical settings is driven by providers and organizational policies (compliance-driven); however, home/community workflow is driven by patients and patient-related dynamics (goal-driven).

In this study, we develop an understanding of how chronic disease management happens in daily-living environments. We fill an important gap in the literature by proposing a framework that supports workflow studies and can inform the design, implementation, and evaluation of consumer informatics interventions.

## 1. Methods

We conducted a qualitative study of eight patients recruited from an anticoagulation clinic attached to an urban academic hospital. Patient ages varied from 30 to 83. Patients had been receiving anticoagulation therapy for from 3 weeks to 26 years. We collected data about health management through (1) one-hour initial patient interviews with patients; (2) one-month Tablet-based patient journals of important activities and challenges; (3) 30-minute patient exit interviews; (4) 30-minute patient healthcare provider exit interviews.

All interviews were semi-structured and conducted by the first author. A second interviewer was present at patient interviews. Both patient interviews provided (a) a rich background for each patient and (b) a sense of each patient's perceptions of his/her own chronic disease management. Journaling was supported by Tablet computers, which included voice data-entry software. Journaling with tablets provided in situ data about healthcare activities, the people involved in the activities, the temporal organization of the activities, and the social, cultural, and physical contexts in which the activities were embedded. The three questions guiding patient journaling were (1) "What have you done in your anticoagulation treatment recently?" (2) "Do you experience any challenges today (or have you, recently) in following your provider's instructions and recommendations?" (3) "How do you believe your physical, social and cultural contexts affect your anticoagulation treatment?" Follow-up prompts were also suggested. Journaling was used to mitigate somewhat the recall bias. Provider interviews provided information about care delivery activities in the anticoagulation clinic. Together, these data sources also provided information about (a) how clinical healthcare activities *shape* healthcare activities in daily-living settings and (b) how healthcare activities in daily-living settings *inform* clinical healthcare activities. We utilized these four data collection methods sequentially so that preceding methods informed the design of succeeding methods.

Data were analyzed by the first two authors using Dedoose® to support applied qualitative content analytic techniques. All data from four data collection methods were coded, main themes determined, and relationships between main themes examined.

## 2. Results

Our qualitative inquiry revealed the workflow model presented in Figure 1. In brief, this model highlights the following: (1) Routines v. one-off instances; (2) Context; (3) Temporality; (4) Tools and technologies.

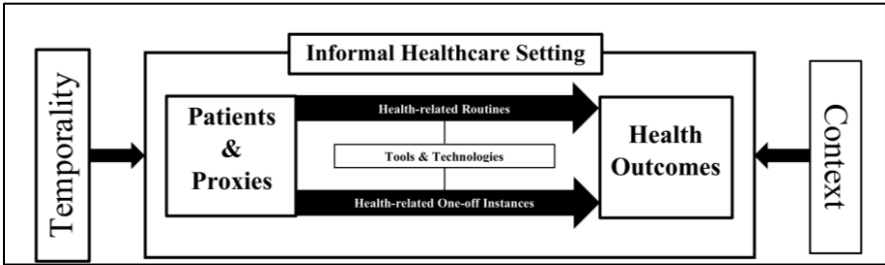


Figure 1. Health-related workflow in daily-living settings.

Our analysis revealed that health-related activities fall into two main categories: routines and one-off instances. Health-related routines are conducted regularly (e.g., medication use, meal-taking, family customs). One-off instances are rare-yet-still-significant activities (e.g., medication use during a camping trip, ED visits).

The quotations below show how patients add *routinized* health-related elements in shaping their daily living setting-based chronic disease management:

“[I] go to the library after taking medications ... in the afternoon or maybe the evening.” [Participant #7]

“I was just like in a habit. To come home from work or come home from the ballgame and have a beer.” [Participant #6]

“[I] get up in the morning and ... I'll rinse my teeth and I'll put my teeth in. I'll take my medicine and I'll inject my Viada [Byetta]. That's basically what I do before I get dressed in the morning. I take my shower at night because of the blood clots.” [Participant #5]

“I take my Coumadin usually at 4:30 every afternoon. And that's when we feed the dogs. So it is kind of a routine ... when we are on the road, we do the same thing. The dogs have to be fed at 4:30. There ain't no ifs, ands or buts.” [Participant #1]

However, anticoagulation therapy may subtract routinized elements as well:

“I've stopped mountain bike riding aggressively, just from my own fears.” [Participant #2]

*One-off instances* may require deviation from routine but still necessitate integration health-related activities in daily-living settings for desired health outcomes:

Because I'm traveling out tomorrow morning, on a plane, I made sure I have my medication in my purse. I keep it in my purse now...keep it at home and I would have to go back and get it because I can't afford to not be without that pill. [Participant #3]



Contextual factors affect both health-related routines and health-related one-off instances:

“We [my roommates] cook for everybody and sometimes so have a lot of items that I have to be more careful on and they try to be very considerate [of] Vitamin K [content] since I started on this medication”. [Participant #3]

“My neighbor is always worrying about me falling down in driveways..., because they are kind of ‘slopey.’” [Participant #1]

“[Our house] is relatively small for the 5 of us...the children and I run into each other a lot. So we try to spend a lot of the time out of the house...things that they can do so we are not always crowded into the house trying to do home school work...it would be easier to eat meals at home, if I didn't always want to get out of the house!” [Participant #2]

It's kind of a bummer that she has to think about me when we are going out. But like if we are going out for Sushi, she knows that I can't have lots of seaweed or whatever, if I've had a salad for lunch. So she'll ask, “Did you have a salad for lunch? Then let's go have something instead of sushi.” [Participant #2]

Temporality—as also highlighted by Unertl et al. [18]—refers to the ways in which the “dimension of time impacts tasks, the relationships among routine and one-time tasks, and interactions among workers.” As stated above in various quotations, workflow study in daily-living settings must incorporate the importance of temporal rhythms. Interviews revealed the use of various tools and technologies (e.g., pill boxes, smart phone apps) that support the temporal component of home-based health-related activities.

### 3. Discussion

Effective design, implementation, and evaluation of consumer informatics interventions requires first a thorough understanding of workflow in daily-living settings. A good understanding of workflow requires (a) identification of routine and one-off activities, (b) the contextual embed for (a), and (c) incorporation of the temporal component and supporting tools/technologies. This model can contribute to the thorough understanding of daily-living workflow and inform consumer health informatics interventions.

A contextual understanding of individuals' daily living-based chronic disease self-management (e.g., anticoagulation therapy) can help nurses tailor education strategies or better develop in-home or transitional nursing interventions. They can better integrate tools and technologies into the home landscape and better partner with patients.

Methodological challenges are probably the most important obstacles to capturing routines, one-off instances, contexts, temporality, and tools and technologies in daily-living settings. Traditional methods such as observations and interviews may be limited in capturing these details. Sensor-based measures of patient activity hold great promise for comparing *actual patient workflow* in informal settings, particularly the home, to *self-reported perceptions of workflow*. Sensor-based measures of activity can be collected by “smart home” sensors that are environment-embedded (e.g., room-level motion sensors [19]), wearable (e.g., wrist-worn [20]) or mobile (e.g., smart phone-

based [21]). However, the relationship of sensor-based measures from different devices is poorly understood, as is the relationship of these various measures to validated self-reported measures of health, as is how sensor-based measures might collectively inform workflow in informal settings.

## References

1. Medicine, I.O.M.I.o., *Crossing the Quality Chasm: A New Health System for the 21st Century*. 2001, Washington DC: National Academy Press.
2. Aliotta, S. and J.A. Andre, *Case Management and Home Health Care: An Integrated Model*. Home Health Care Management & Practice, 1997. **9**(2): p. 1-12.
3. Wagner, E.H., et al., *Quality improvement in chronic illness care: a collaborative approach*. The Joint Commission journal on quality improvement, 2001. **27**: p. 63-80.
4. Koch, S., *Home telehealth—Current state and future trends*. International Journal of Medical Informatics, 2006. **75**: p. 565-576.
5. Brennan, P.F., S. Downs, and G. Casper, *Project HealthDesign: rethinking the power and potential of personal health records*. Journal of biomedical informatics, 2010. **43**(5 Suppl): p. S3-5.
6. Carman, K.L., et al., *Patient and family engagement: a framework for understanding the elements and developing interventions and policies*. Health affairs (Project Hope), 2013. **32**: p. 223-31.
7. Karsh, B.-T., *Clinical Practice Improvement and Redesign: How Change in Workflow Can Be Supported by Clinical Decision Support*. 2009: Rockville, MD.
8. Brennan, P.F. and G. Casper, *Observing health in everyday living: ODLs and the care-between-the-care*. Personal and Ubiquitous Computing, 2014.
9. Kaufman, D.R., et al., *Understanding workflow in telehealth video visits: Observations from the IDEATel project*. Journal of Biomedical Informatics, 2009. **42**(4): p. 581-592.
10. Moen, A. and P.F. Brennan, *Health@Home: The Work of Health Information Management in the Household (HIMH): Implications for Consumer Health Informatics (CHI) Innovations*. Journal of the American Medical Informatics Association, 2005. **12**(6): p. 648-656.
11. Ozkaynak, M. and P.F. Brennan, *An Observation Tool for Studying Patient-Oriented Workflow in Hospital Emergency Departments*. Methods of Information in Medicine, 2013. **52**(6): p. 503-13.
12. *Handbook of Human Factors and Ergonomics in Health Care and Patient Safety*. 2nd ed. 2012, Boca Raton, FL: Taylor and Francis Group.
13. Kushniruk, A.W., et al., *Technology induced error and usability: The relationship between usability problems and prescription errors when using a handheld application*. International Journal of Medical Informatics, 2005. **74**: p. 519-526.
14. Koppel, R., et al., *Workarounds to Barcode Medication Administration Systems: Their Occurrences, Causes, and Threats to Patient Safety*. Journal of the American Medical Informatics Association, 2008. **15**(4): p. 408-423.
15. Mutlu, B. and J. Forlizzi. *Robots in Organizations : The Role of Workflow , Social , and Environmental Factors in Human-Robot Interaction*.
16. Holden, R.J., C.C. Schubert, and R.S. Mickelson, *The patient work system: An analysis of self-care performance barriers among elderly heart failure patients and their informal caregivers*. Applied Ergonomics, 2015. **47**: p. 133-150.
17. Valdez, R.S., et al., *Transforming consumer health informatics through a patient work framework: connecting patients to context*. Journal of the American Medical Informatics Association, 2014.
18. Unertl, K.M., et al., *Traversing the many paths of workflow research: developing a conceptual framework of workflow terminology through a systematic literature review*. Journal of the American Medical Informatics Association : JAMIA, 2010. **17**(3): p. 265-273.
19. Reeder, B., et al., *Framing the evidence for health smart homes and home-based consumer health technologies as a public health intervention for independent aging: a systematic review*. Int J Med Inform, 2013. **82**(7): p. 565-79.
20. Allet, L., et al., *Wearable Systems for Monitoring Mobility-Related Activities in Chronic Disease: A Systematic Review*. Sensors, 2010. **10**(10): p. 9026.
21. Case, M.A., et al., *Accuracy of smartphone applications and wearable devices for tracking physical activity data*. JAMA, 2015. **313**(6): p. 625-626.

# Feasibility of the Rule-Based Approach to Creating Complex Pictograms

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**Abstract.** To test the effectiveness of the health pictograms created based on the pictogram composite rules, we created 7 new composite pictograms following the composite rules extracted from the USP pictograms. We then tested their understandability by surveying 42 volunteers recruited at a senior wellness center in San Diego, CA. Lower level of comprehension was observed in all 7 new composite pictograms when compared to the USP pictograms with similar styles. No consistent socio-demographic effect on the comprehension of the pictograms was discerned. The major sources of misinterpretations were (1) misunderstanding the main action depicted in the image, (2) ignoring the conditional information, and (3) making an incorrect semantic association between the main information and the conditional information. Design rules from the validated set of pictograms might serve as the starting point for creating a new health pictogram. However, rigorous validation and revision of the initial design should follow.

**Keywords.** Medication instruction, health pictograms, composite pictograms, patient education, health literacy

## 1 Introduction

Correct understanding of a health instruction is a prerequisite to achieving positive health outcomes [1–3]. Pictures and images are frequently used to convey various types of health information in an easy-to-understand way. Many studies show that using pictograms could improve health communication, especially with people who have a low level of health literacy [4-7]. For example, United States Pharmacopeial Convention (USP) pictograms are the most widely used and studied pictograms in the healthcare domain [2]. USP is a nonprofit volunteer-led organization that develops standards for various properties of medicines, food ingredients and dietary supplements. The USP pictograms are 81 standardized graphic images developed to help convey medication instructions, precautions, and or warnings to patients and consumers. However, these 81 pictograms by no means address the complete need for graphical representations of medication related information.

Designing a pictogram is also a laborious process that involves multiple iterations of testing and revision. Although no clear step-by-step guideline exists for developing

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<sup>2</sup> <http://www.usp.org/usp-healthcare-professionals/related-topics-resources/usp-pictograms>.

health pictograms, a common process of pictogram creation is observed in many published studies [4-9]. Development of a health pictogram usually starts with an initial design, which is finalized through the iterative process of focus group feedback and revision. Once the initial design of a pictogram is deemed finalized, the pictogram is tested and validated with a larger target audience. Considering the vast amount of health information that can be relevant for pictorial representation, creating a separate pictogram for each piece of health information and ensuring stylistic consistency can be a daunting task, where an automated approach can be helpful.

Pictogram Evaluation and Authoring Collaboration Environment (PEACE) is a web-based tool that supports creating, validating, storing, and reusing health pictograms (<http://peace.ucsd.edu>) [10]. PEACE was developed to support health communication to facilitate healthcare in the countries with limited resources. The goal of this study was to test the feasibility of composing pictograms based on rules before implementing a semi-automated rule-based pictogram composition module in PEACE.

## 2. Methods

### 2.1 Pictogram preparation

We first selected the USP pictograms that consist of more than one image, then analyzed their textual instructions and identified granular semantic constructs, such as frequencies, amount, action types (e.g., do or don't, particular sequence), and conditions/situations associated with the actions. We used the USP pictograms as a reference as they are validated and widely used in presenting medication instructions in various settings. We also identified the corresponding pictorial construct for each semantic construct and documented its notable design characteristics such as position, size, repetition, and specific icons/diagrams utilized. This analysis also enabled us to categorize the composite pictograms into 7 types based on the syntactic characteristics of the information that they convey. Through this analysis, we identified 7 pictogram design rules and types.

We manually created 7 new composite pictograms based on the design rules. We tried to utilize the images from the USP pictograms to avoid any potential bias caused by using an image construct that has not been validated. We also selected additional 7 USP pictograms created with the same design rules. This was to test whether the pictogram composite rules were successfully applied to the new pictograms by comparing the comprehension of the two pictograms with the same style.

### 2.2 Study site and survey conduct

After obtaining approval from the Institutional Review Board, we tested 14 pictograms through one-on-one interviews of the elderly people using a community senior wellness center in San Diego, who volunteered to participate in this study. The interview started by explaining the purpose of this study and the participants' identity would not be collected in this study.

Pictograms were presented as Microsoft power point slides on an i-pad. We adopted open-ended questions "What do you think this picture means?" to avoid any

**Table 1.** Sample Demographics

Demographics		N (total 42)
Age	<= 70	28
	> 70	14
Sex	Male	28
	Female	14
Edu	Up to High school	20
	College or more	22
Race	Non-Whites	23
	Whites	19

framing effect that pre-defined answer options may cause. The participants were encouraged to take as much time as they needed to understand and explain what they thought the pictograms meant. The interviewer wrote down the answers on a notepad then coded for further analyses (i.e., 0 for incorrect and 1 for correct answers). Nonspecific demographic information was also collected. Data analyses were done using Statistical Analysis System (SAS) version 9.3 (<http://www.sas.com>).

### 3. Results

In total, 42 senior center users participated in this study. The demographic distributions of the participants are presented in **Table 1**. The pictogram composite rules we extracted from the USP pictograms, and the USP pictogram and the new pictogram that share a similar design principle are presented side by side in **Table 2** with the correct interpretation rates. The USP pictograms showed higher correct interpretation rates in all 7 pairs. And the differences in correct interpretation rates between the paired pictograms were statistically significant for the pair 2, 3, and 6 when tested with Wilcoxon signed rank sum test. The overall mean correct interpretation rate was 61.56% (*s.d.*=22.41%) for the 7 USP pictograms and 40.48% (*s.d.*=20.67%) for the 7 new pictograms. This difference was also statistically significant ( $p < 0.005$ ) when tested with the Wilcoxon signed rank sum test. Higher mean correct interpretation rates were observed in the participant groups of at least college level of education, male, younger than 70 years old, and Whites. This trend was observed in all 14 pictograms. However, only the mean difference between the two age groups (i.e., age  $\leq 70$  vs. age  $> 70$ ) was statistically significant when tested with Wilcoxon rank sum test.

The highest correct response was observed with Type 7, the medication schedule pictograms where no conditional information is attached. Type 4 medication side effect pictograms and Type 5 simple question pictograms were associated with high misinterpretation rates. Relatively complex pictograms with 3 image constructs (i.e., Type 1, 6, 7) tend to show higher correct interpretation rate than simpler pictograms. Most misinterpretations occurred with the image constructs that represent main actions, followed by those that represent the conditional and/or auxiliary information for the main action. Incorrect semantic associations between the main image construct and the conditional image construct were the third most frequent source of misinterpretation. Ignoring the images carrying conditional information was also noted.

### 4. Discussion

All 7 new pictograms showed lower correct interpretation rates than their USP counterparts. This difference was notable considering that the paired pictograms have the same design style, complexity, and carry the similar types of health information. This study showed important considerations in designing health pictograms. The position of the main information (usually related to an action) and the direction of the information flow need to be carefully coordinated. The participants seemed to read the pictograms from the center, where the main information is represented with a larger image, to the periphery. Then they seemed to try to make an association among the presented pieces of information based on their prior knowledge and beliefs, which occasionally caused ignoring the peripheral images. For example, Type 2 and 3 pictograms deliver the same

type of information ‘don’t [action] when [condition]’ using different design styles. In the former, the action constructs are placed in the center but in the latter they are placed in the left upper corner. In this study, Type 3 showed higher correct interpretation where the conditional information takes the center position. Ignoring the conditional information caused the majority of the misinterpretation in Type 2 pictograms.

Type 4 pictograms, which represent the precautions on medication side effects, are another example that shows the potential effects of the directionality of image reading. Many participants read the images from the center to the periphery and interpreted these pictogram as ‘when [side effect] happens take this medication to resolve it’. This is quite concerning as it could potentially harm the patients. Finally an image seemingly conveying an apparent piece of information was not always interpreted as such. For example, crossing out an action image with X to indicate prohibition or discouragement of an action, copying an image multiple times to indicate frequencies, and showing sun and moon images to indicate time points of the day were not successful in conveying the intended meaning to many participants. This warrants caution when designing a pictogram with such constructs.

**Table 2.** Information types, design rules, and the correct response rates in parentheses

Information types	Rules	USP pictograms	New pictograms
<b>1. Simple instruction</b> <i>Do A if B</i>			
<b>2. Conditional instruction (negation as main)</b> <i>If A don't do B</i>			
<b>3. Conditional instruction (action as main)</b> <i>Don't do B if A</i>			
<b>4. Precaution</b> <i>A may cause B</i>			
<b>5. Question</b> <i>Is A true?</i>			
<b>6. Conditional actions with time interval</b> <i>If do A then wait for time t then do B</i>			
<b>7. Medication administration</b> <i>Take this drug via A at time t for n times per day</i>			

This study was done with a relatively small number of elderly volunteers thus the findings of this study might not be generalized to other populations. Meaningful socio-demographic and/or cultural influence on pictogram interpretation might have been missed due to the small sample size. Relevance of the presented information to the personal situation is an important factor that affects the comprehensibility of the information. A lack of saliency of the presented pictograms to some of the participants might have affected how they interpreted the pictograms. We didn't collect the health status information from the participants as we assumed the majority of the elderly people could relate to health instructions, especially medication instructions. However, it is possible that some participants found the pictograms having little relevance to them. A larger scale study needs to be conducted to confirm the findings of this study.

Pictograms have a high potential to facilitate the communication of complex health information such as medication instructions. However, creating pictograms is a time consuming and laborious process that also requires rigorous validation. This study tested whether leveraging the existing insights on pictogram design can alleviate these challenges. The results of this study showed that applying the design rules extracted from the validated set of pictograms to create a new pictogram is not a straightforward task. A larger scale study needs to be conducted to confirm and better characterize the challenges that we discovered in this study.

## 5. Acknowledgment

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## References

- [1] L.G. Doak, C.C. Doak, C.D. Meade. Strategies to improve cancer education materials. *Oncol Nurs Forum*. **23** (1996), 1305–1312.
- [2] J.A. Gazmararian, D.W. Baker, M.V. Williams, et al. Health literacy among Medicare enrollees in a managed care organization. *JAMA*. **281** (1999), 545–551.
- [3] R.M. Parker, J.A. Gazmararian. Health literacy: essential for health communication. *J Health Commun*. **8** (2003), 116–118.
- [4] A. Korenevsky, R. Vaillancourt, A. Pouliot, et al. How Many Words Does a Picture Really Tell? Cross-sectional Descriptive Study of Pictogram Evaluation by Youth. *Can J Hosp Pharm*. **66** (2013), 219–226.
- [5] Q. Zeng-Treitler, H. Kim, M. Hunter. Improving patient comprehension and recall of discharge instructions by supplementing free texts with pictographs. *AMIA Annu Symp Proc*. 2008, 849–853.
- [6] R. Dowse, T. Ramela, S. H. Browne. An illustrated leaflet containing antiretroviral information targeted for low-literate readers: development and evaluation. *Patient Educ Couns*. **85** (2011), 508–515.
- [7] E. Beaufils, C. Hommet, F. Brault, et al. The effect of age and educational level on the cognitive processes used to comprehend the meaning of pictograms. *Aging Clin Exp Res*. **26** (2014), 61–65.
- [8] L.N. Ngho, M.D. Shepherd. Design, development, and evaluation of visual aids for communicating prescription drug instructions to nonliterate patients in rural Cameroon. *Patient Educ Couns*. **30** (1997), 257–270.
- [9] R. Dowse, M.S. Ehlers. The evaluation of pharmaceutical pictograms in a low-literate South African population. *Patient Educ Couns*. **45** (2001), 87–99.
- [10] H. Kim, D. Tamayo, M. Muhkin, et al. Pictogram evaluation and authoring collaboration environment. *Nursing informatics*. 2012, 214.

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<sup>3</sup> <https://idash-data.ucsd.edu/download/folder/4712/NI16A.zip>

# Identifying Outliers in Data from Patient Record

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**Abstract.** It is important for health services to be able to identify potential outliers with minimal effort as part of their daily evaluation of care data from patient record. This study evaluates the suitability of three statistical methods for identifying nursing outliers. The results show that by using methods implemented in the nursing workload measurement system “LEP” with reference to real data, unusual LEP minute profiles (movement, nutrition and so on) can be identified with little effort and therefore seem promising for application to the health services' daily evaluation process. The lessons learned are used to create requirement criteria for the further development of software solutions. It is recommended that the methods for identifying outliers in the daily evaluation process should be standardized in order to increase the efficiency of secondary use of care data from patient record.

**Keywords.** Secondary use of Care Data, Evaluation of Care Data, Identification of Outliers, Statistical Methods, Diagnosis Related Groups, Nursing Workload, Electronic Patient Records System.

## 1. Introduction

Electronic patient record is being used increasingly often by today's health services as a reference point for the secondary use of nursing data [1, 2]. Around 250 health services in Germany, Switzerland, Austria and Italy are using LEP (“Leistungserfassung in der Pflege”, nursing workload measurement) for the statistical evaluation of nursing data [3]. The latest generation, LEP Nursing 3, is a classification for around 500 nursing interventions that will be employed in electronic patient record and for automated nursing workload measurement. [4, 5]. It is semantically focused on ICNP and is structured in line with ISO-18104 [6, 7]. When applied in nursing practice, it follows the methodical approach of 'collect once, use in many cases', with regard to documented data [8]. LEP service data is automatically channeled from patient record in order to perform statistical evaluations. This may be to gather evidence of the treatment quality, for analysis of the nursing workload, for benchmarking, the calculation of nursing costs or DRG coding. By using this method, any additional measurement expense required for performing statistical evaluations will be limited to the essential. 'Bureaucratic burdens' and redundant data collection at the point of care may be avoided [9]. As part of the daily evaluation process, it is important for the health services to be able to identify potential outliers in the care data from patient record with minimal effort. A health service may be interested in methods for identifying outliers for various reasons. For example, the objective of identifying

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outliers may simply be to ascertain the volume of documentation or coding errors, but it may also be to determine medicinal or nursing outliers.

The driving force behind this study was enabling the discovery of new information in relation to care data from patient record. The aim was to find statistical methods to identify nursing outliers, which could be put to use in the health services' day-to-day evaluation process. The health services would then be able use the subsequent knowledge of outliers to gain new insights towards the improvement of treatment processes or for change management.

## 2. Methods

The statistical methods 'k-means' [10], 'k-medoids' [11] and 'trimmed k-means' [12] were implemented for the identification of outliers and evaluated using real data from health services. We are specifically interested in the extent to which unusual LEP minute profiles comprising several dimensions (movement, nutrition and so on) can be identified using these methods. The three methods extract standard LEP minute profiles from the given data, and individual profiles deviating substantially from these standard profiles are classified as outliers.

**Table 1** shows six artificial LEP minute profiles. The first three are identical, thus their pattern may be seen as a standard profile. The profiles 4 to 6 show different outlier patterns. In profile 4 the number of LEP minutes in the activity dimension is substantially higher than compared to other, profile 5 has a somewhat inverse pattern compared to profiles 1 to 3 and in profile 6 all entries are zero.

**Table 1.** Artificial data of LEP-minutes profiles of six persons. Each profile has four values in minutes concerning the LEP dimensions movement, activity, safety and medication.

Person	Movement	Activity	Safety	Medication
1	10	30	10	30
2	10	30	10	30
3	10	30	10	30
4	10	150	10	30
5	30	10	30	10
6	0	0	0	0

Table 2 shows the resulting standard profiles from using the three considered methods. For example the standard profile from k-medoids is identical to the pattern of the profiles 1 to 3 of **Table 1**. Based on the standard profiles it is possible measure the extent to which individual profiles are outliers. This extent may be quantified by the Euclidean distance between the standard profiles and the individual profiles.

**Table 2.** Extracted standard profiles using the methods k-means, k-medoids and trimmed k-means for the data of table 1.

	Movement	Activity	Safety	Medication
k-means	11.6	41.6	11.6	21.6
k-medoids	10	30	10	30
trimmed k-means	12	20	12	20

**Table 3** gives the Euclidean distances between the individual profiles of **Table 1** and the standard profiles of **Table 2**. With all three methods the profiles 4 to 6 deviate most. Profile 4 is best identified by the trimmed k-means method, and k-means detects best the profiles of person 5 and person 6.

**Table 3.** Euclidean distances between individual profiles of table 1 and the standard profiles of table 2.

Person	k-means	k-mediods	trimmed k-means
1	14.5	0	14.4
2	14.5	0	14.4
3	14.5	0	14.4
4	108.7	120	130.4
5	42.6	40	29.1
6	49.8	44.7	33

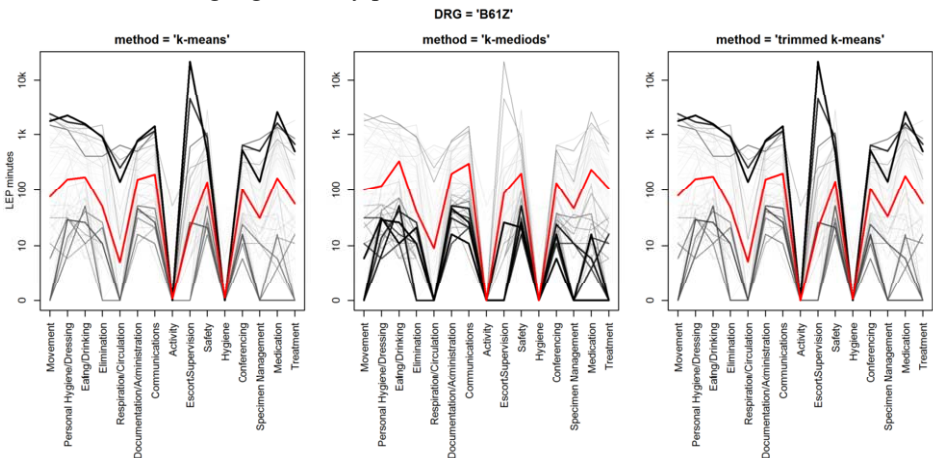
In the applications to real data below the three methods were applied separately for DRGs (Diagnoses Related Groups, such as strokes for example), so that outliers can be defined specifically according to patient-groups. Data transformations, such as logarithms, were examined for the minute scale. The data transformations appear to be encouraging for certain types of outliers. The three methods, 'k-means', 'k-medoid' and 'trimmed k-means', are freely available in the statistical software environment R [13].

### 3. Results

The three methods were evaluated by using real care data from twelve Swiss hospitals. The used data include 73'930 LEP minutes profiles from 213 DRGs [14]. Each LEP minutes profile includes LEP minutes of 15 dimensions.

The methods were applied separately for each of the 213 DRGs. Logarithm transformations were used because these improved the identification of profiles with unusually low LEP minutes.

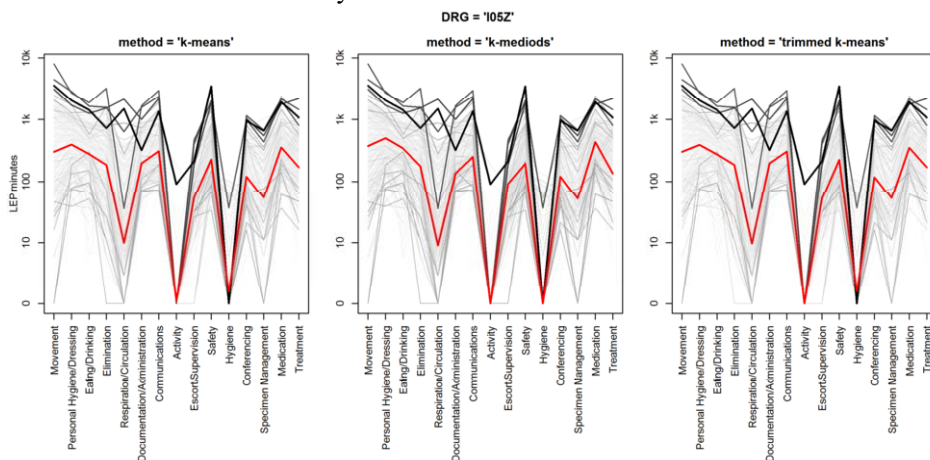
We found that for most of the DRGs the methods identify very similar or exactly the same outliers. Figure 1 shows with B61Z<sup>2</sup> one of the rare DRGs for which the outlier identification differs between the three methods. In this case, k-means and trimmed k-means identify both profiles with low and high LEP minutes while the k-mediods method highlights solely profiles with low minutes.



**Figure 1.** Outlier detection for the DRG B61Z (N=91). Red lines present extracted standard LEP minutes profiles. Grey lines present observed LEP minute profiles. Line widths and grey levels are proportional to the Euclidean distance of the profiles to the standard profile.

<sup>2</sup> SwissDRG B61Z: Specific acute disorders and injuries of the spinal cord (Original description: Bestimmte akute Erkrankungen und Verletzungen des Rückenmarks)

The implementation proved to be particularly useful for identifying outliers, where the documented LEP minutes were very high in particular dimensions. **Figure 2** exemplifies this by using the results for the DRG I05Z<sup>3</sup>. In this case, the results of the three methods do not drastically differ.



**Figure 2.** Outlier detection for the DRG I05Z (N=291). Red lines present extracted standard LEP minute profiles and grey lines observed LEP minutes profiles.

In practice the identified outliers may be classified. Some outliers may be coding errors, some may not be outliers from a medical perspective but show a rare pattern and some outliers may be studied in more detail.

The lessons learned make it clear that the implementation of these methods into the health service evaluation processes can provide valuable and sometimes surprising insights into the data and can help to improve the data quality. However, we found that the use of these methods requires a certain degree of knowledge of statistical methods so that interesting outlier patterns can be identified in a reliable manner.

#### 4. Discussion

The results show that outliers can easily be identified from the care data from patient record using the three statistical methods. The knowledge gleaned from the identified outliers is useful for change management within the health services. Lessons learned from the implementation of statistical methods have been used for generating requirement criteria for software solutions for identifying outliers in LEP service data from patient record; the fact that scatter diagrams need to be available, for example. It is recommended that the methods for identifying outliers in the health services' daily evaluation process should be standardized in order to increase the efficiency of the secondary use of care data from patient record.

<sup>3</sup> DRG I05Z Other major joint replacement or revision or hip joint replacement without complicated diagnosis, without arthrodesis, without complex procedure, with extremely severe CC (original description: Anderer grosser Gelenkersatz oder Revision oder Ersatz des Hüftgelenkes ohne komplizierende Diagnose, ohne Arthrodesse, ohne komplexen Eingriff, mit äusserst schweren CC)

## References

- [1] W.O. Hackl, F. Rauchegger, E. Ammenwerth, A Nursing Intelligence System to Support Secondary Use of Nursing Routine Data. *Applied clinical informatics* **6** (2015), 418–428.
- [2] B. Sellemann, J. Stausberg, U. Hübner, Nursing routine data as a basis for association analysis in the domain of nursing knowledge. *Nursing informatics* (2012), 366.
- [3] LEP AG. References. LEP Method for documentation and analysis of care activities. <http://lep.ch/de/referenzen.html>, last access: 17.09.2015.
- [4] D. Baumberger, G. Kühne, LEP Nursing 3 for the linkage of electronic patient record and nursing workload measurement. In: N. Oud, F. Sheerin, M. Ehnfors, W. Sermeus, (ed.), *Proceedings of the 6th European Conference of ACENDIO. Nursing Communication in Multidisciplinary Practice* (161), Oud Consultancy, Amsterdam, 2007.
- [5] M. Oertle, A. Baumgartner, Ausmass der vollständigen Automatisierung von Pflegeleistungserfassungen basierend auf der elektronischen Patientenakte. *Swiss Medical Informatics* **69** (2010), 37–40.
- [6] D. Baumberger, K. Jansen, N.R. Hardiker, M. Studer, P. Tackenberg, P. König, ICNP Projects. Mapping ICNP and LEP Nursing. <http://www.icn.ch/details/2/154.html> [15.09.2015].
- [7] D. Baumberger, M. Stadler, D. Buchmann, Mapping LEP Nursing 3 and ISO reference terminology model for nursing action (ISO-RTM). *Swiss Medical Informatics* **28** (2012), 47–48.
- [8] J.J. Cimino, Collect once, use many. Enabling the reuse of clinical data through controlled terminologies. *JAHIMA* **78** (2007), 24-9.
- [9] P. Schulz, Kontroversen in der Medizinischen Informatik. Wozu benötigen wir standardisierte Terminologien wie SNOMED CT? *Swiss Medical Informatics* **73**, (2011), 27–32.
- [10] J.A. Hartigan, M.A. Wong, A K-Means clustering algorithm. *Applied Statistics* **28** (1979), 100-108.
- [11] A. Reynolds, G. Richards, B. de la Iglesia, V. Rayward-Smith, Clustering rules: A comparison of partitioning and hierarchical clustering algorithms. *Journal of Mathematical Modelling and Algorithms*, (1992), 475–504.
- [12] J.A. Cuesta-Albertos, A. Gordaliza, C. Matrán, Trimmed k-means: an attempt to robustify quantizers. *Annals of Statistics* (1997), 553-576.
- [13] R Core Team, *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, 2015.
- [14] D. Baumberger, W. Bosshard, L. Portenier, M. Wittwer, R. Bürgin, M. Müller, Projekt SwissDRG und Pflege. Teilaufgabe 1. Quantitative Analyse Pflegeaufwand. [http://www.nursingdrg.ch/files/4714/2798/8923/SwissDRG\\_Pflege\\_Analyse\\_Pflegeaufwand\\_2009\\_10\\_14.pdf](http://www.nursingdrg.ch/files/4714/2798/8923/SwissDRG_Pflege_Analyse_Pflegeaufwand_2009_10_14.pdf), last access: 17.09.2015.

# Analysis of the Nursing Documentation in Use in Portugal – Building a Clinical Data Model of Nursing Centered on the Management of Treatment Regimen

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**Abstract.** The use of technology to support information produced by nurses, especially information and communication technologies, is a current reality, but the proliferation of different statements of nursing diagnosis has made it more difficult for the production of indicators, hindering semantic interoperability of data. This study analyzed all statements of diagnosis focused on the management of medication regimen, customized to the Nursing Practice Support System (SAPE®) that was being used in Portugal in 2013. A total of 598 statements of nursing diagnoses about the phenomenon under study were analyzed, through an *a priori* analysis model - the ISO 18104 standard: 2003. The purpose was to identify terms used by nurses to describe the range of diagnoses, thus avoiding conceptual redundancy. After a content analysis process conducted by researchers and a broader group of experts, and when excluded all conceptual redundancy, 30 statements of nursing diagnosis were identified.

**Keywords.** Nursing Information Systems, Nursing Diagnosis, Clinical Data Model, Management of Treatment Regimen

## 1. Introduction

Since 1999 a digital platform of a Nursing Information System (NIS) is being used, comprising the International Classification for Nursing Practice (ICNP® beta 2 version) [1]. Nowadays, the majority of the Portuguese health care services have adopted this information system. This NIS is used in more than 50 hospital units and more than 300 primary health centres. The main features of the NIS are: the inclusion of ICNP® language; customized contents for care units; referential data integrity; and the NIS integration in the Health Information Network [2].

One of the goals in the genesis of this NIS was contributing to "nurses' reflection on their practice through the need of customization in each care unit" [3]. This initial goal, which was decisive for the dissemination of the NIS, has led to the conception of a vast number of statements of diagnosis in each institution over the past few years. The proliferation of different statements of diagnosis and interventions in the NIS,

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often reflecting the same reality, makes information management and production of indicators more difficult, highlighting semantic interoperability problems [4, 5]. These interoperability problems disclose the need for harmonization of available contents through the definition of clinical data models (CDM) based on archetypes [4, 5].

The Centre for Information Systems Research and Development (CIDESI) of Nursing School of Porto, a research centre devoted to Information Systems (IS) and the use of ICNP® language, accredited by the International Council of Nurses, is engaged in an ongoing research project – “Conception of nursing care: clinical data models and IS” – aiming at the development of CDM in nursing. One of the primary phases of the project includes the analysis of customized nursing documentation in the most widely used IS in Portugal.

The complexity of therapeutic regimen management as a phenomenon related with self-care of people with chronic disease is a central area for nursing practice [6, 7]. Self-care can be interpreted as personal and daily care required by the individual to regulate his own operation and development [7]. This analysis focuses on “health deviation self-care requisites” [8], which are requirements arising from illness or injury situations.

In fact, one of the great challenges that health systems, their employees and clients face nowadays is the substantial increase of chronic diseases, which already represent the leading cause of death and morbidity in Portugal and in the world [9].

In this study, our concern is focused on management of the therapeutic regimen. However, given the extent and complexity of the subject, we limit the analysis to one aspect of the regimen cross-related to all situations of chronic disease – the medication regimen. The selection of this component of the regimen is motivated by the significant increase in the number of chronic diseases. In many cases several chronic diseases coexist in the same individual, adding the need to take multiple medications to control them, thus increasing the complexity of the regimen and the difficulty in managing it.

## **2. Methods**

This study is thus focused on the analysis of nursing documentation being used in the Portuguese NIS. It is a qualitative study, as insofar identifies exemplarities and takes into account the dimension of the phenomena represented in the NIS. The aim of this study was to identify the terms used by nurses to document nursing diagnoses centered on the management of therapeutic regimen, more specifically on one of its components – the medication regimen.

The aim of the analysis in this study was the customization of the NIS in use, known as SAPE® (Nursing Practice Support System) concerning all health centres and public hospitals in Portugal, dated January 1, 2013. Content analysis was conducted by the main researcher and validated by the two other researchers. After this first stage of analysis, data was presented to a group of fourteen Portuguese experts in the field of NIS, particularly those integrating CIDESI, with the final purpose of reaching consensus on the content to be included in the CDM.

Content analysis of nursing documentation was based on the 2013 ICNP® version, to make easier future "migration" of terms and clinical content to a more up-to-date version of the ICNP®. The analysis was structured based on the ISO 18104: 2003 standard [10].

### 3. Results

A total of 598 statements of nursing diagnoses centered in management of medication regimen were identified. The comparative analysis of different statements disclosed multiple redundancies, i.e. different syntaxes for the same semantics. Redundancy resulted from the use of different focuses to represent the same diagnosis, as well as different terms to represent judgments or dimensions in which the focus was envisaged.

To represent the core focus, 24 terms were considered, such as adherence to therapeutic regimen, self-medication, management of therapeutic regimen, etc. From the analysis and reached consensus, it was decided that the focus would be "Managing medication regimen".

After an analysis of the judgments about this focus, 32 different terms were identified. Since the majority of these 32 different terms refer to damage or ineffectiveness, they can be represented as "impaired" (10012938).

However, one of the terms that appear in customizations of the NIS, as judgment on the focus refers to "chance for", having a positive connotation. The "chance for", which is a concept of probability axis in beta 2 version of ICNP®, is used when considering that "a desirable nursing phenomenon is estimated to occur with a certain probability" [1]. This judgment is used in some services adopting a more focused nursing diagnoses in the client's potential to develop or improve the "management of medication regimen" and less concerned with the "problem" or person limitation. The way to represent this documentation logic with the 2013 version of ICNP® requires the use of concatenation of the term "potentiality" (10015151), which is a "state" with the term "enhancing" (10006945) – "potential to enhancing".

In some statements of nursing diagnoses, nurses used gradients to judge the problem more specifically, such as: low, moderate, high and very high grade (example: "Management of therapeutic regimen ineffective in very high degree". It is worth noticing the lack of evidence and formal knowledge support to sustain the use of these gradients. After expert consensus, different judgments with low and moderate gradients were categorized as "partial" (10014081); due to the semantic proximity the high and very high gradients were categorized as "total" (10019876).

As for the statements of diagnoses being used, we found that often such terms – other focus – were used to compose the syntax. These terms, considering ISO 18104: 2003 standard, are understood as "dimensions" for which the principal focus is to be put in perspective, or as a quality owned by the individual or group that offers a perspective on the focus as to the nursing diagnosis [9]. A total of 20 different "dimensions" were found, such as cognitive learning, knowledge, decision making, support, willpower, health belief, etc. After analysis by the expert group, they were reduced to 6: knowledge (10011042); ability (10000034); awareness (10003083); meaninglessness (10023900); support (we suggest the inclusion of this term) and family support (10023680) (table 1).

**Table 1.** Examples of the new categorized dimensions

Focus	Dimension
Managing medication regimen	Knowledge about ....
	Ability to...
	Awareness of ...

When we looked at the judgments associated with dimensions in which the focus is put in perspective we found 8 terms, such as "not demonstrated", "demonstrated in moderate degree", "chance for", etc. These 8 terms can be represented by a single expression – "potential to enhancing". The following sentences are examples of using this expression in statements of diagnoses to be included in the CDM: "Potential to enhancing knowledge and the ability to administering medication" and "Potential to enhancing family support to manage the medication regimen".

From the content analysis comprising the various dimensions in which the focus is put in perspective, the need to "specify" the content of each dimension associated with the focus has emerged. The specification of dimensions found can be summarized as follows: ways of administering medication (inhaled, subcutaneous); type of medication (insulin, vaccine, etc.); monitoring physiological parameters (blood glucose, blood pressure, etc.); effects of medication (response to medication and side effect of medication); complications of compromised drug regimen, and the use of devices.

The 589 statements of nursing diagnoses identified, after comparative analysis and consensus among experts, were reduced to 30 clinically useful statements, which will be included in the CDM to be specified.

#### **4. Discussion**

The few existent studies that make a conceptual analysis of the terms used to identify the nursing diagnoses in the NIS highlights the importance of this type of studies, with the aim of improving the disciplinary knowledge in this area. The 2013 version of ICNP® does not consider the concept of management of therapeutic regimen, but self-management of disease, that is not necessarily a synonym. Whereas managing the therapeutic regimen, and in particular the medication regimen, is related with the individual's ability of managing a pharmacological treatment plan to control his/her disease, settled with the health professional, the disease self-management encompasses other aspects, such as signals and symptoms management [7].

In the absence of a classified term to represent the "focus", we believe that the concatenation of the terms "managing" (10011625) and "medication regimen" (10011884), in the expression "Managing medication regimen" is quite representative of the concept under study. Managing (10011625) is, according to ICN (2013), a self-initiated and intentional action. It can thus be understood as a self-care behaviour, which must be held and managed by the individual, and the medication regimen (10011884) relates to a specific component of the regimen.

The intention to eliminate the conceptual redundancy concerning terms to represent judgments about the focus allowed us to identify two "judgments": "impaired" to represent diagnoses with a negative formulation; and "potential to enhancing" to represent diagnoses with a positive connotation. Two examples of the new categorization of these sentences of diagnoses are: "Managing medication regimen impaired", and "Potential to enhancing managing of medication regimen".

As for the judgment gradients on the focus, in this area of self-care, a self-initiated behaviour, the evidence to support the appropriate definition of gradients or the intensity of the diagnoses centered on managing medication regimen is diminished. Even its clinical usefulness is questionable. We believe that it is very difficult to distinguish between "low level", "moderate" or "high". It may be useful to speak of, for example, "partial" or "total" impaired when we refer to the extension of the "problem".



The dimensions of the focus – "Managing medication regimen" – according to what has emerged in this phase of the project are 6: knowledge (10011042); ability (10000034); awareness (10003083); meaninglessness (10023900); support and family support (10023680). Knowledge refers to the development of the client's informational content about how to manage his medication regimen. The ability reports to the development of client instrumental skills, concerning the way of administering and managing his/her medication. The awareness [11] reports to the knowledge and the client recognition of his/her ability to manage the medication regimen, which somehow brings us to the client perception of the ability to take and manage medication. The meaninglessness [11] is associated with the meaning that the client attributes to the medication management, and the difficulties that he/she encounters in this process. The support [11] is related to the external resources of the client, and can be multiple, which may be a facilitating factor in managing drug regimen. One of these external resources is the family; therefore the last dimension is family support.

These 6 dimensions, according to Meleis et al. [11], refer to conditions that can influence, positively or negatively, the development process of client mastery to manage their medication regimen. As for terms that can be used as judgments, in association with these 6 dimensions, our findings suggest that nurses should not only identify constraints or "problems" of clients, but also proceed to the identification of each person's potential to improve.

We believe this will be a first contribution to the definition of a CDM on management of the medication regimen, which will facilitate semantic interoperability between different information systems. Moreover, these results will be confronted and expanded with literature reviews about the phenomenon under study at a later stage.

## References

- [1] International Council of Nurses, *Classificação Internacional para a Prática de Enfermagem: Versão Beta*. Instituto de Gestão Informática e Financeira da Saúde e Associação Portuguesa de Enfermeiros, Lisboa, 2000.
- [2] F. Pereira, A. Silva, Information technologies and nursing practice: the Portuguese case. In *Nursing and informatics for the 21st century: an international look at practice, education and HER trends*. C. Weaver, C. Delaney, P. Weber, et al., AMIA, USA, 2010. 435-441.
- [3] A. Paiva, A. Cardoso, C. Sequeira, et al., *Análise da Parametrização Nacional do Sistema de Apoio à Prática de Enfermagem - SAPE®*, Escola Superior de Enfermagem do Porto. Porto, 2014.
- [4] D. Wollersheim, A. Sari, W. Rahayu, Archetype-based electronic health records: a literature review and evaluation of their applicability to health data interoperability and access, *Health Information Management Journal* **38** (2009), 7-17.
- [5] S. Garde, R. Chen, H. Leslie, et al., Archetype-based knowledge management for semantic interoperability of electronic health records, *Studies in Health Technology and Informatics* **150** (2009), 1007-1011.
- [6] I. Cruz, *A adesão ao regime terapêutico nas pessoas com hipertensão arterial*, Dissertação de Mestrado em Ciências de Enfermagem, apresentada no Instituto de Ciências Biomédicas Abel Salazar. Porto, 2005.
- [7] F. Bastos, *Teoria explicativa sobre a gestão da doença e do regime terapêutico*. Novas Edições Acadêmicas, Germany, 2015.
- [8] D. Orem, *Modelo de Orem: Conceptos de enfermería en la práctica*. Masson, Barcelona, 2001.
- [9] World Health Organization, *Noncommunicable diseases – country profiles 2014*. Geneva, 2014. [http://apps.who.int/iris/bitstream/10665/128038/1/9789241507509\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/128038/1/9789241507509_eng.pdf)
- [10] International Standard Organization ISO/FDIS 18104, *Health informatics: Integration of a reference terminology model for nursing*. Geneva, 2003.
- [11] A. Meleis, L. Sawyer, E. Im, et al., Experiencing transitions: an emerging middle-range theory, *Advanced in Nursing Science* **23** (2000), 12-28.

# Advancing the Digital Health Discourse for Nurse Leaders

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**Abstract.** Limited informatics competency uptake is a recognized nursing leadership challenge impacting digital practice settings. The health system's inability to reap the promised benefits of EHRs is a manifestation of inadequate development of informatics competencies by chief nurse executives (CNEs) and other clinicians. Through the application of Transformational Leadership Theory (TL), this discussion paper explains how informatics competencies enable CNEs to become transformational nursing leaders in digital health allowing them to meet their accountabilities to lead integrated, high-quality care delivery through evidence based practices (EBPs). It is proposed that successful CNE eHealth sponsors will be those armed with informatics competencies who can drive health organizations' investment in technology and innovation. Finally, some considerations are suggested in how nurse informaticists globally play a critical role in preparing our existing and future CNEs to fulfill their transformational leader roles in the digital age.

**Keywords.** digital health, informatics competencies, transformational nursing leadership

## 1. Introduction

According to Simpson, information technology (IT) implementations are political processes that occur in cost-controlled, high-tech health care environments [1]. Chief Nurse Executives (CNEs) who are politically naïve and lack contemporary informatics competency<sup>2</sup> (skills/knowledge) may acquiesce to others for IT decisions such as, electronic patient record (EPR<sup>3</sup>) selection that fails to meet nursing practice needs [1,3]. Further, these CNEs who are informatics illiterate may be less influential and disadvantaged in executing new eHealth project sponsor roles successfully for EPR implementations [4-5]. Informatics competency adoption is a recognized ongoing leadership challenge; it may also be a manifestation of the health system's inability to reap the promised benefits of EPRs [6-8]. Given the importance of EPRs in facilitating

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<sup>2</sup> Broadly envisioned, a nurse leader who has proficiency in informatics literacy, computer literacy and informatics competency skills to lead clinical transformation in technology enabled healthcare settings [2].

<sup>3</sup> Electronic Medical Records (EMRs) terminology used in the United States is synonymous with the term, electronic Patient Records (EPRs) in the Canadian context. Electronic Health Records (EHRs) represent integration of relevant patient information from EMRs/EPRs accessible to authorized providers across the continuum of care.

sustainable, publicly funded health systems; successful IT implementations are highly dependent on CNEs in hospital settings [9]. Therefore, CNEs who already are charged with leading and directing strategies to improve patient and organizational outcomes and advance clinical practice must now be informatics literate to execute their roles as effective eHealth sponsors [10-12]. This author argues that successful CNE eHealth sponsors of the digital era will be those *armed* with informatics competencies and represent the next generation of transformational nurse leaders who will drive health organizations' investment in technology and innovation [13-15]. This discussion paper will apply Transformational Leadership Theory (TL) to explain how informatics competencies enable CNEs to be recognized as leaders in the digital age in meeting their accountabilities to lead integrated, high-quality care delivery through evidence based practices (EBPs) [16-17].

## 2. Methods

This paper is prepared based upon a literature review spanning more than three years of peer reviewed and grey, English language literature published from 1995. The time frame was chosen to investigate this topic because of the anticipated limited research findings, opportunity to monitor industry trends, and identify new themes/issues occurring across evolving digital health landscapes. Only publications and research related to CNE transformational nurse leaders, accountabilities in digital health settings, informatics competency and EPR implementations are included. Eminent TL theorists, Burns, Bass and Avolio's work is applied to support the in-depth analysis that yields the link between TL, informatics competencies and CNEs [16-17].

## 3. Results

### 3.1 Transformational Leadership Theory (TL) and Informatics Competencies

Transformational Leadership Theory (TL) has *four dimensions*: idealized influence, inspirational motivation, intellectual stimulation and idealized consideration [16-17]. *Idealized influence* or charisma are consistent leader behaviours based upon values, principles and ethics that resonate with followers. *Inspirational motivation* occurs when the leader gains commitment and inspires followers with a shared vision. *Intellectual stimulation* reflects leader behaviours that challenge the status quo, facilitate innovative thinking and risk-taking in implementing solutions. *Individualized consideration* relates to leader behaviours that attend to individual needs through listening, coaching and mentorship [16,18-19]. As an adjunct to TL dimensions and behaviours, the *concept of e-leadership* was introduced to support how *advanced information technology*, rich environments (the context) interact with organizational leadership systems (i.e., people, processes); as information is a fundamental building block of how organizations function [20]. E-leadership updates transformational leadership theory by demonstrating how roles (i.e., CNE eHealth sponsors) that adopt one or more of the four TL dimensions, result in leadership behaviours that transform digital environments (i.e., hospitals). Therefore, digital hospitals that are successfully transformed by CNE transformational leaders offer clinicians practice environments where effective, safe, quality care is enabled through evolving health IT systems.

The American Organization of Nurse Executives (AONE) [21] has developed and endorsed CNE competencies that include nursing informatics competencies. Based upon seminal informatics research, nursing informatics competencies and behaviours for nurse leaders fall under three main concepts: informatics literacy, computer literacy and informatics competency [2,22]. Informatics literacy (knowledge) behaviours are demonstrated when nurses can leverage (interpret) data/information and apply (knowledge) or use it appropriately (e.g., knowledge of data issues and information system concepts). Computer literacy behaviours are evident when nurse executives leverage software applications (e.g., email/business/EPR applications) proficiently in everyday practice. Informatics competency skills are demonstrated by proficiency in advocating for and leading IT system procurements (i.e., requirements, selection and implementation) and in executing relevant practice policies (e.g., privacy/security and confidentiality) as eHealth sponsors [2,5,21,23].

### *3.2 The Link: Transformational Leadership Theory (TL) and Informatics Competencies*

Nurse leaders armed with nursing informatics competencies are positioned to lead, influence and make changes as transformational leaders in digital environments. CNEs who already are charged with leading and directing strategies to improve patient and organizational outcomes, advance clinical practice and who are informatics literate will also successfully execute their eHealth roles [2,5,10-12,15,24]. Amendola's nursing leadership study emphasizes the link between requisite informatics competencies and the leadership style for effective nurse leaders [23]. His description of leader behaviours and competencies match the four dimensions of TL behaviours and informatics competencies. Specifically, when a CNE is transformational in style, she/he will know that informatics competencies, skills and knowledge affect how he/she leads clinical transformation (e.g., EPR implementations) in digital practice settings.

## **4. Discussion**

Malloch and Melnyk urge executive nurse leaders to adopt contemporary leadership approaches that align with the information era [25]. Further, leaders must discard traditional models of bureaucratic leadership (i.e., command/control) and adopt content (i.e., new informatics competencies) and behaviours (i.e., facilitation, collaboration, transdisciplinary teamwork, evidence, and point of care experience excellence) that are congruent with the digital context in which healthcare occurs [25]. CNE eHealth sponsors who are armed with informatics competencies are able to operationalize: idealized influence (role modeling that optimizes patient care), inspirational motivation (through a collective vision that inspires meaning to transdisciplinary teamwork in evolving IT enabled environments), intellectual stimulation (challenging the status quo, engaged in advancing the culture of healthcare with EBPs) and individual consideration (attending to the learning needs of a multi-generational workforce, and leading nurses in point of care, service excellence); the TL dimensions and behaviours of contemporary transformational nurse leaders [18-19].

Collaborative transformational leadership behaviours and skills (i.e., mentorship, support, informatics knowledge) that are applied in the current health system context (i.e., organizational structures, IT, nursing resources) offer hope for CNEs to address nursing practice and program impacts. Specifically, transformational CNEs can begin

to mitigate the unfulfilled promises of EPRs by improving clinical care delivery through the necessary work redesign efforts (e.g., clinical processes, IT design enhancements) that will position nurses to deliver evidence-based, high-quality, value-driven health services [8]. Transformational nursing leaders have a key role in creating infrastructures that influence organizational factors, processes and expectations, to enable sustainability of EBPs [26].

At the strategic level (i.e., corporate/policy tables), transformational CNEs armed with informatics will be seen initiating and leading eHealth discussions such as advocating for ICT solutions that meet patient quality initiatives, nursing practice and funding needs. Further, these successful CNE eHealth sponsors will be positioned to provide expert advice to professional regulatory bodies that will inform and align digital health practice standards. This describes transformational leadership in action when the CNE operationalizes: idealized influence (role modeling), inspirational motivation (clear vision of modernizing, professional practice standards/policies), intellectual stimulation (challenging the status quo, advancing healthcare through optimizing digital solutions) and individual consideration (attending to the fiscal environment and practice needs involved in sustainable clinical transformation).

Nurse informaticians (NIs) are the catalysts who need to play critical roles in building informatics capacity for all nurses. Upfront, two practical considerations that leverage NI's expertise must be targeted at supporting CNEs in digital health settings. NIs need to self-organize and create global NI network teams that develop EPR implementation best practice guidelines (EPR-BPGs) as recommended next steps. These EPR-BPGs will offer hospital CNEs guidance in developing EPR implementation strategies that balance organizational demands (e.g., resources), social demands (i.e., user requirements) and technical demands (i.e., IT needs) [27]. Concurrently, the NI network team members need to establish innovative NI/CNE dyad partnerships that facilitate informatics skills/knowledge transfer, enhancing the CNE's capacity as an effective eHealth sponsor in clinical transformation. These new dyads could be initiated either through formalized roles (i.e., Chief Nursing Informatics Officer) or informal NI mentorship roles that *enable/coach* CNEs in leading EPR implementations successfully.

## 5. Summary

CNEs who can fulfill this new transformational leadership vision by embracing informatics competencies will take the lead and assume pivotal clinical transformation roles in 21st century health care systems. CNEs who adopt informatics competencies and implement TL leadership behaviours will position nurses and the nursing profession to achieve its preferred future. A future where nurses are perceived by patients and professionals alike as knowledge workers, providing the leadership essential to quality care, and demonstrating nursing's unique contributions to fiscal health through clinically relevant, evidenced based practices [28].

## References

- [1] R. L. Simpson, Nursing Informatics – The politics of information technology, *Nursing Administration Quarterly* **31(4)** (2007), 354-358.

- [2] B.L. Westra & C.W. Delaney, Opinion: Informatics competencies for nursing leaders, *Nursing Outlook* **55(4)** (2007), 210-211.
- [3] R. L. Simpson, Nurse informaticians critical to providing meaningful us, *Nursing Administration Quarterly* **35(1)** (2011), 82-84.
- [4] J.A. Batcheller, On-boarding and enculturation of new chief nursing officers, *Journal of Nursing Administration*, **41(5)** (2011), 235-239.
- [5] E. Pitcher, CNO role in the implementation of an electronic health record, *Nurse Leader*, **18(3)** (2010), 32-35.
- [6] Institute of Medicine (IOM) & Robert Johnson Wood Foundation (RJWF), *The Future of Nursing: Leading Change, Advancing Health*, National Academies Press, Washington, DC, 2010.
- [7] S. Poe, Building nursing intellectual capital for safe use of information technology. A systematic review, *Journal of Nursing Care Quality*, **26(1)** (2011), 4-12.
- [8] A.L. Kellermann & S. Jones, Analysis & Commentary: What will it take to achieve the as-yet-unfulfilled promises of health information technology, *Health Affairs*, **32(1)** (2013), 63-68.
- [9] K.M. Kerfoot, F.H. Zwi, F. Milecarek, & J. Beaudette, A clinically intelligent nursing care system: What the CNE needs to know, *Nurse Leader*, **8(4)** (2010), 37-40.
- [10] M.D. Byrne, Informatics competence in the EHR era, *Journal of PeriAnesthesia Nursing*, **27(1)** (2012), 42-45.
- [11] J. Englebright & J. Perlin, The chief nurse executive role in large healthcare systems. *Nursing Administration Quarterly*, **32(3)** (2008), 188-194.
- [12] C.H. Mays, W. Kelley & K. Sanford, The nurse executive's present and future role in information technology, *Nursing Administration Quarterly*, **32(3)** (2008), 230-234.
- [13] S. Remus & M. Kennedy, Innovation in transformative nursing leadership: nursing informatics competencies and roles, *Canadian Journal of Nursing Leadership*, **25(2)** (2012), 14-26.
- [14] R. L. Simpson, Chief nurse executives need contemporary informatics competencies. *Nursing Economics*, **31(6)** (2013), 277-288.
- [15] C. Gassert, Technology and informatics competencies. *Nursing Clinics of North America*, **43(4)** (2008), 507-521.
- [16] J. M. Burns, *Leadership* (1st Ed.), Harper & Row, New York, NY, 1978.
- [17] B. M. Bass & B.J. Avolio, *Improving Organizational Effectiveness through Transformational Leadership*, Sage Publications Inc., Thousand Oaks, CA, 1994.
- [18] P.G. Northouse, *Theory and practice* (6th Ed.), Sage Publications Inc, Thousand Oaks, CA, 2013.
- [19] C.A. Wong, & L. Giallonardo, Leadership and its influence on patient outcomes. In J. Daly, S. Speedy, D. Jackson (Eds.), *Leadership and Nursing: Contemporary Perspectives* 2nd ed. (chapter 12), pp153-169. Elsevier Australia, Sydney, AUS, 2015.
- [20] B.J. Avolio, J.J. Sosik, S.S. Kahai, & B. Baker, E-leadership: Re-examining transformations in leadership source and transmission, *The Leadership Quarterly*, **25(1)** (2014), 105-131.
- [21] American Organization of Nurse Executives (AONE). *The AONE nurse executive Competencies*, AONE, Chicago Ill, 2011.
- [22] N. Stagers, C.A. Gassert & C. Curran, C., A Delphi study to determine informatics competencies for nurses at four levels of practice, *Nursing Research*, **51(6)** (2002), 383-390.
- [23] M.L. Amendola. An Examination of the Leadership Competency Requirements of Nurse Executives in Healthcare Information Technology (Doctoral dissertation) 2008.
- [24] B.L. Westra, T.R. Clancy, J. Sensmeier, J.J. Warren, C. Weaver & C. Delaney, Nursing knowledge: Big data science – implications for nurse leaders, *Nursing Administration Quarterly*, **39(4)** (2015), 304-310.
- [25] K. Malloch. & B.M. Melnyk, Developing high-level change and innovation agents: Competencies and challenges for executive leadership, *Nursing Administration Quarterly*, **37(1)** (2013), 60-66.
- [26] L. Q. Everett & M.C. Sitterding, Transformational leadership required to design and sustain evidence-based practice: A system exemplar, *Western Journal of Nursing Research*, **33(3)** (2011), 398-426
- [27] K. Cresswell & A. Sheik, Organizational issues in the implementation and adoption of health information technology innovations: An interpretative review, *International Journal of Medical Informatics*, **82** (2013), e73-e86.
- [28] A.B. McBride, Actually achieving our preferred future, *Reflections on Nursing Leadership, Sigma Theta Tau International- Honor Society of Nursing*, **31(4)** (2005), 22-23, 28.

# Adaptive Practice: Next Generation Evidence-Based Practice in Digital Environments

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**Abstract.** Evidence-based practice in nursing is considered foundational to safe, competent care. To date, rigid traditional perceptions of what constitutes ‘evidence’ have constrained the recognition and use of practice-based evidence and the exploitation of novel forms of evidence from data rich environments. Advancements such as the conceptualization of clinical intelligence, the prevalence of increasingly sophisticated digital health information systems, and the advancement of the Big Data phenomenon have converged to generate a new contemporary context. In today’s dynamic data-rich environments, clinicians have new sources of valid evidence, and need a new paradigm supporting clinical practice that is adaptive to information generated by diverse electronic sources. This opinion paper presents adaptive practice as the next generation of evidence-based practice in contemporary evidence-rich environments and provides recommendations for the next phase of evolution.

**Keywords.** Evidence-based practice, clinical intelligence, electronic health information systems, big data, practice-based evidence, adaptive practice

## 1. Introduction

The evolution of clinical practice for all health professions has progressed from rudimentary, intuitive or faith-based interventions to increasingly scientific approaches, models, and theories informed through evidence and research. Despite the evolution of complex electronic health information systems capturing vast volumes of health information and generating enormous amounts of information that could be used to support practice, healthcare continues to rely predominantly on rigid interpretations of what constitutes “evidence”.

Practice-based evidence generated through analytics, data science and big data, as well as through electronic health information systems and remote patient monitoring must be considered valid evidence and used to support timely decisions in healthcare and responsive clinical practice. The purpose of this opinion paper is to challenge our collective thinking about whether the types of evidence supporting clinical practice lie exclusively within traditional research methodologies, and to initiate discussion on a

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novel paradigm of adaptive practice reflecting the next generation of practice-based evidence within data rich environments.

## **2. Methods**

This work was conducted using purposeful literature reviews, environmental scans, and trend analyses on terms that included data management, nursing and health care, evidence-based practice, clinical intelligence, big data, and data analytics. Sources included CINAHL, Medline, PubMed, government reports, and gray literature.

## **3. Results**

### *3.1. Evidence-based Nursing*

The escalating prominence of evidence-based practice (EBP) since the 1990s is significant. Across all healthcare professions, there is widespread acceptance and endorsement of the need for sound, reliable, and accurate evidence generated through rigorous research methodologies to inform clinical practice and optimize patient outcomes [1-6]. Evidence guiding practice is recommended to be based on “methodologically sound, clinically relevant research” about such topics as assessments, interventions, and costs [2]. Acceptable sources of evidence include empirical research with randomized control trials (RCT) which is considered the most authoritative type of research, systematic reviews, and clinical practice guidelines [1-3,6].

The traditional process of generating health-related evidence through empirical research depends on translating research data through publication and transitioning into clinical practice. However, this process can take as long as 7 years, and in fact, may take even longer [8,10]. According to Mowinski Jennings & Loan [6], the EBM paradigm presents a significant conflict to clinicians in that EBP’s inherent rules of evidence “lower the value of authority opinion and raise the value of data-based studies and research critiques.”

This rigid perspective about the source and quality of evidence is in stark contrast to the concept of evidence-informed decision-making, which is defined by the Canadian Nurses Association (CNA)[2] as an ongoing process of deliberate consideration of “best available evidence” to inform practice and care provision”. CNA [2] further noted that evidence-informed nursing should, by necessity, include evidence from “research, clinical practice, client preferences and other available resources to make nursing decisions about clients”. According to DiCenso [3], “research evidence alone is never enough”, and this sentiment is increasingly echoed by others [2,7-9]. Practice-based evidence and clinical intelligence offer new opportunities to support clinical practice in timely, transparent, and valid ways.



### 3.2. Clinical Intelligence and Practice-based Evidence

Harrington [8,10] defined clinical intelligence as the “electronic aggregation of accurate, relevant and timely clinical data in a meaningful information and actionable knowledge in order to achieve optimal structures, processes, and outcomes”. Derived from the traditional business intelligence concept of transforming raw data into information and then knowledge, CI’s clear clinical focus is able to inform clinicians in both actual and potential clinical situations. The ultimate benefit of electronic health systems is clinical intelligence, and systems should generate actionable guidance in the form of prescriptive analytics for clinicians where and when needed [8].

Practice-based evidence (PBE) is defined as aggregated clinical data, subsequently used to support clinical practice [8]. Harrington distinguishes PBE from traditional EBP by noting that EBP is constrained to traditional sources of evidence and governed by highly controlled research rules of inclusion and exclusion. In comparison, PBE represents the reality of healthcare, including all patients, treatments, interventions, and variables [8]. In fact, PBE provides clinicians with the greatest degree of accuracy for clinical decisions based on the reality of data generated by medical devices, health information systems, consumer apps, biosensors and remote patient monitoring, and other digital information sources across the healthcare system [4,5,8,10].

### 3.3. The Evidence in Data Rich Environments

As the "Big Data" phenomenon continues to evolve, health care is increasingly compelled to examine ways of capitalizing on the methodologies and outputs via complex analytics in data rich environments. Understanding the explosion of data in healthcare and how to capitalize on it has been strongly advocated in industry publications - “if Big Data is the new oil in healthcare, clinical and business intelligence is the refinery” [7]. This reflects the increasing clarity about the roles of analytics and how to derive intelligence from volumes of data generated through diverse points across the healthcare system, including remote client monitoring, smart technology, personal health records, and clinician documentation.

Four key characteristics of big data include: *volume* that was historically inconceivable, *variety* or diversity of data sources, *velocity* of processing and analysis conducted closer to the point of care and being distributed or available online, and *veracity* or variability of trust [11]. Westra et al [4] note that the integration of health information systems provides enormous volumes of data supporting nursing practice and decisions in clinical care, and further note that actionable data may be generated from both traditional and nontraditional sources in a big data context. Brennan & Bakken’s [5] key point about the relevance of data at the point of use rather than collection emphasizes that clinicians should focus on the value of knowledge generation in clinical practice and for adapting practice to optimize care outcomes.

Recognition of the novel ways of using the volume of client-relevant information being generated by data rich environments is expanding across the healthcare system in the form of Big Data Institutes, conferences focused on big data, and government-sponsored Task Forces. Among the recommendations provided by report of the AMIA EHR-2020 Task Force [12], is the recommendation the electronic health records have the potential to be evidence-generating, fostering a learning health system and supporting point-of-care decision-making. Additional recommendations included

encouraging vendors to extract information in novel ways from electronic health records and the aggregated patient data should be available in a number of views for a variety of purposes.

## **4. Discussion**

### *4.1. Adaptation*

Adaptive information technology is defined as technology that can be adapted to changing or dynamic environments, balancing between process and information technology and supporting reactive decision-making [13]. Most smart technology has adopted adaptive architecture and configuration to adjust processes in response to varied inputs and feedback, and support greater accuracy and flexibility for users.

Operating in the same way as complex adaptive information systems, clinicians and clinical practice models must move away from the notion of static evidence and adopt a more responsive approach to practice informed through information. In healthcare, the dynamic environment may be considered from a systems perspective or a macro level, but perhaps most importantly, should be inclusive of the individual client's dynamic response to interventions. Clinical practice is ideally responsive - or adaptive, to information about the client's responses to care and treatment. Although many existing health information systems incorporate clinical decision support, there is a need for real time data analytics to enable clinicians to adapt their interventions for optimal patient outcomes.

### *4.2. Next Generation Paradigm*

Adaptive practice is the next generation of evidence-based practice and it must be based on the new reality of data generation and management in healthcare and grounded firmly in clinical intelligence. Key tenets of this new paradigm include the following:

- Evidence as a concept extends beyond traditional empirical research and rules of evidence to reflect the reality of healthcare;
- Practice-based evidence [8] is generated across the healthcare system, through a variety of data collection points and mechanisms, each of which are valid sources, and leads to data-informed nursing practice [5]
- CI is highly dependent on data accuracy and quality [8,10], and both concepts should be included in all formalized training and educational curricula;
- Advanced analytics and electronic health information systems should prioritize real-time information provision to clinicians to support timely clinical decision-making and the adaptation of clinical practice interventions in response to client outcomes;
- Nurse leaders, researchers, and educators must support a cultural shift to recognize and foster use of data from all sources to comprehensively inform clinical decision making;

- Nursing leaders must support practice transformation by incorporating practice-based evidence models into practice and strategic planning, and by deliberately leveraging all ways of generating nursing knowledge [1-5,8-10].

Adaptive practice is aligned with practice-based evidence and CI in that “data collection, analysis, presentation and use must be seamlessly integrated at the point of care”[8]. Adaptive practice is not finding the "needle in the haystack" [11] characterized by the current priorities of big data, but leveraging clinical evidence from a variety of valid sources to support decisions and enabling clinicians to adapt their interventions to client responses and needs, thereby optimizing clinical outcomes. Fundamentally, adaptive practice is about pushing beyond outdated perceptions of evidence to fully embrace the knowledge opportunities of contemporary data-rich environments.

Contemporary models of nursing practice must move toward embracing and emphasizing the adaptive aspect of practice within dynamic data rich environments and continue to demand sophisticated health information systems that provide real time information access to clinicians, effectively decreasing the time from information generation to clinician access and improved client outcomes. Nursing leaders, and particularly Chief Nursing Informatics Officers have a central role to play in developing and expanding new models of practice incorporating the role of clinical intelligence [8], adaptive practice, and the use of all data sources including big data [4].

## References

- [1] S. Udod & W.D. Care, Setting the climate for evidence-based nursing practice: what is the leader's role? *Nursing Leadership* 17:4 (2004), 64-75.
- [2] Canadian Nurses Association, Evidence-informed decision-making and nursing practice: Position statement. Canadian Nurses Association Ottawa, 2010.
- [3] A. DiCenso, Evidence-based nursing practice: how to get there from here, *Nursing Leadership* 16:4 (2003), 20-26
- [4] B. L. Westra, T.R. Clancy, J. Sensmeier, J.J. Warren, C. Weaver, & C. W. Delaney Nursing knowledge: Big data science – implications for nurse leaders, *Nursing Administration* 39 (2015), 304-310.
- [5] P.F. Brennan, S. Bakken, Nursing needs big data and big data needs nursing, *Journal of Nursing Scholarship* 47:5 (2015), 477-484.
- [6] B. Mowinski Jennings & L.A. Loan, Misconceptions among nurses about evidence-based practice, *Journal of Nursing Scholarship* 33:2 (2001), 121-127.
- [7] B. Fitzgerald, Infographic: the future of clinical and business intelligence in healthcare, Healthcare IT News (May 26, 2015).
- [8] L. Harrington, Clinical intelligence, *Journal of Nursing Administration*, 41:12 (2011), 507-509.
- [9] S. Remus & M.A. Kennedy, Innovation in transformative nursing leadership: nursing informatics competencies and roles. *Canadian Journal of Nursing Leadership* 25:2 (2012), 14-26.
- [10] L. Harrington, The Role of nurse informaticists in the emerging field of clinical intelligence, *Proceedings NI2012: 11<sup>th</sup> International congress on nursing informatics*, Montreal, QC, Canada (2012) 162-165.
- [11] R. Bellazzi Big data and biomedical informatics: A challenging opportunity, *Yearbook of Medical Informatics*, AMIA, 2014.
- [12] T.H. Payne, S. Corley , T.A. Cullen, T.K. Gandhi, L. Harrington, G.J. Kuperman, J.E. Mattison, D.P. McCallie, C.J. McDonald, P.C. Tang, W.M. Tierney, C. Weaver, C.R. Weir, 7 M.H. Zaroukian, Report of the AMIA ERH-2020 Task Force on the status and the future direction of EHRs, *JAMIA* 22 (2015), 1102-1110.
- [13] N. Wickramasinghe & E. Geisler (Eds.), *Encyclopedia of Healthcare Information Systems*, Medical Information Science Reference, New York, 2008.

# Robotic Assistance in Medication Management: Development and Evaluation of a Prototype

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**Abstract.** An increasing number of elderly people and the prevalence of multimorbid conditions often lead to age-related problems for patients in handling their common polypharmaceutical, domestic everyday medication. Ambient Assisted Living therefore provides means to support an elderly's everyday life. In the present paper we investigated the viability of using a commercial mass-produced humanoid robot system to support the domestic medication of an elderly person. A prototypical software application based on the NAO-robot platform was implemented to remind the patient for drug intakes, check for drug-drug-interactions, document the compliance and assist through the complete process of individual medication. A technical and functional evaluation of the system in a laboratory setting revealed versatile and viable results, though further investigations are needed to examine the practical use in an applied field.

**Keywords.** Ambient Assisted Living, humanoid robot, medication management

## 1. Introduction

Our society is currently influenced by a demographic transition. Socio-economic factors as well as medical progress lead to a rising life expectancy and a decline in birthrate. Statistical trends in Europe show, that life expectancy for a newborn in the year 2002 is expected to be 74.5 years, which is estimated to rise to 77.4 years for newborns in 2012 [1]. European population is ageing rapidly. A far reaching consequence of this trend is the need for an increased number of nursing services in future which can hardly be provided by our current healthcare system.

The old and elderly are also more likely to develop multimorbid diseases, which often need to be treated through multiple medications, also known as polypharmacy. Age-related impairment in cognitive, visual, fine and gross motor skills lead to problems in taking the right drug at the right time in the right dosage. Studies show, ~60% of patients >75 years need to take 6 or more drugs per day [2], 17% of people >70 years have harmful practical problems with their everyday medication [3] and ~50% of all chronically ill patients >60 years are not compliant to their medication [4].

The rapid evolution of information and communication technology (ICT) produced viable assistive systems in the last decade. Most attention is currently given to Ambient Assisted Living (AAL) which comprises technical products, services and concepts to individually support people in need of care managing their everyday life properly [5]. Smartphone-Apps, reminder-systems, intelligent drug boxes and many other systems

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turned out to be useful for the elderly in administering medication for different cases and situations.

Apart from core ICT also the domain of robots showed a remarkable development in the past. Even humanoid robots as off-the-shelf products have emerged more frequently because they tend to have a high potential as assistive systems.

However, little effort is given to AAL making use of (humanoid) robots though there do exist affordable systems with feasible hardware. Hence, it's not clear if such humanoid robots are suitable for homecare medication assistance scenarios.

In this study we used the humanoid robot *NAO* to investigate, if and to what extend a mass-produced robot system can be used to manage and support the everyday medication of an elderly person at home. The current paper addresses in particular the development process of the prototype application.

## 2. Methods

*NAO* is a 57cm tall robot system made from Aldebaran robotics [6] which has 14 motors (results in 25 Degrees of freedom), cameras (960p@30fps with fixed focus), loudspeakers, microphones, sonars, gyroscopes, accelerometers, force sensitive resistors, touch- and pressure sensors and LEDs. A Linux Gentoo OS runs on an Intel Atom platform and allows accessing all actors and sensors through a service called *NAOqi*, which provides all necessary software interfaces. *NAO* is freely programmable using Python or C++, provides hardware interfaces for LAN, WLAN as well as USB. Further information about the robot is available online at Aldebaran's website [6].

With regard to the planned application a literature review was conducted first, to find out problems for the elderly in the domain of domestic medication as well as initial functional and non-functional requirements for an assistive medication management system (user and system requirements). We searched for publications in PubMed and Google Scholar between 1995 and 2013 using the search term depicted in figure 1. These results were then refined in cooperation with a physician, who provided his view and expertise on the problem. Resulting requirements were then modeled in UML use-cases to show the aims of the proposed medication management support system (MMS).

(automatic OR technical OR AAL OR "Ambient Assisted Living" OR assisted)  
 AND (drug OR pill OR medication) AND (dispenser OR planner OR reminder OR documentation OR  
 tracer OR monitoring) AND (system OR robot OR assistant)

**Figure 1.** Used search term for PubMed and Google Scholar.

The software development was based on a prototype approach combined with an iterative development of components: First a base prototype acting as the main component was developed which got iteratively extended by more specific components. Each component in this sense is responsible for a well-defined task according to the requirements. An iteration cycle is composed of requirements engineering, system design, implementation and testing. All components were designed through different UML diagrams (class diagrams, activity diagrams, sequence diagrams as well as flowcharts) and a prototype was implemented using Python 2.7. Each component needed to pass several unit tests.

After developing the components separately, an integration step combined all elements and tested the overall MMS in a final technical and functional evaluation under laboratory conditions. This evaluation encompassed a final test-scenario dealing with different medications and situations. In this paper our main attention is given to the test of the drug identification component.

### 3. Results

#### 3.1. Requirements Engineering

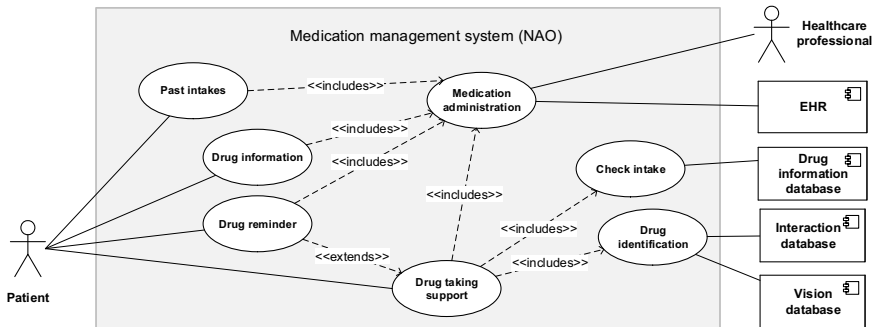
The requirements gathering step lead to the main problems given in Table 1. According to those problems the following requirements/aims were derived:

- The MMS is able to support the domestic medication process to avoid intakes of wrong drugs, wrong times or wrong dosages.
- The MMS reminds the patient at the right time to take the drugs.
- The MMS checks every intake and warns the patient before intake if necessary.
- The MMS manages a full documentation of all intakes, remotely accessible by authorized users.
- The MMS administers all prescriptions and allows remote edit of prescriptions for authorized users.

Those requirements were then used to model relevant uses cases as shown in the use-case diagram in figure 2 which maps the requirements to the robot system setting.

**Table 1.** Main identified problems and consequences in the medication process of elderlies gathered from literature review and physician input.

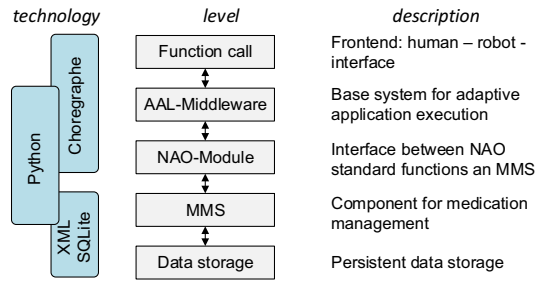
Problem	Consequence
Identifying drug/medication	Patient takes wrong drug.
Timetable	Patient takes drug at wrong time or forgets to take it.
Dosage	Patient takes the wrong dosage of a drug.
	Patient forgets that a drug has already been taken and takes it again.
Drug handling	Patient is not able to open drug box.



**Figure 2.** Use case diagram of proposed MMS.

#### 3.2. Software architecture

In general, a software architecture describes the different layers of well-separated intercommunicating components. The *NAO* system with its determined modular structure claims for an architecture with high cohesion and low coupling. We designed a 5-layered software architecture comprising the levels in figure 3. The layer for the MMS is fully decoupled from the robot system connected through an interface level. The AAL-middleware represents a mediation level in order to execute more than one application in parallel (e.g. in addition to medication assistance an application for handling emergency cases). Each level has interfaces to connect with the adjacent levels and all are realized through different technologies. Choregraphe is Aldebaran’s provided IDE for developing *NAO* applications and accessing standard-functions in a useful way.



**Figure 3.** Implemented software architecture showing the different levels with utilized technologies.

### 3.3. Developed components

According to the use-cases and derived requirements, the following components were implemented in the MMS according to the proposed architecture and development process:

- *Medication administration:* The robot knows prescribed drugs as well as the specific regime. All intakes were documented in a medication history.
- *Medication identification:* Through its cameras the robot is able to detect and identify drug boxes by using either vision recognition (feature-based with prior object learning) or barcode scanning.
- *Drug–drug interaction checker:* An implementation of a drug–drug interaction database allows the robot to check for interactions between medications.
- *Reminding function:* The robot reminds the person to take the drugs.
- *Remote connection:* Authorized persons can access the documentation and administration using a client-server connection (XML-based).
- *Communication with a standard-based electronic health record (EHR):* The robot can import medications from a standards-based HL7 CDA document.

The communication between the user and *NAO* is entirely done verbally by speech-control using the standard speech recognition functions.

### 3.4. Evaluation

All components were tested through several unit tests during implementation. For the drug box identification, a set of real drug boxes were manually tested with the robot's cameras for recognition under different distances, orientations, occlusions and movement of drug boxes during the recognition process. Twenty different boxes have undergone three testing rounds for all aforementioned settings for both feature-based recognition and barcode scanning. The complete test protocol can be requested from the authors.

In good light conditions (daylight) and the preferred distance of 15 cm in front of the camera 100% (n=60) of drug boxes were identified right with no false positives (n=0) for both identification types. Feature-based identification shows very good results to changed orientation (98.3% recognition rate) and moved test objects (96.7%). Barcode scanning lead to worse results for orientation (26.7%) and movement (33.3%). This was due to the fixed focused cameras, which also led to problems in distance for barcode scanning, as the maximum focus was attained with holding the box in a 15 cm distance.

#### 4. Discussion

In this paper we investigated if an off-the-shelf humanoid robot system with unmodified hardware was able to support the everyday medication process of an elderly person. For this project we chose the humanoid robot *NAO*. The system provides a very well designed architecture, where *NAOqi* is acting as an interface between software and hardware and allows the use of predefined functions in own projects. Beside the versatile access from a technical perspective, *NAO* offers a very intuitive way of human-machine-interaction through speech, vision and movement. The system has already been used in other healthcare related projects [7], also revealing that the childish appearance leads to high acceptance for people of all generations [8,9].

The evaluation of the implemented prototype reveals potential for using a free-programmable robot to support the everyday medication process and to provide support in polypharmaceutical settings on a cognitive base. The recognition component exposed very good detection rates, though it might be too specific for practical use in the sense of just detecting pre-learned drug boxes. More complex detection methods, e.g. utilizing RFID, or more specialized methods, e.g. to identify the different pills without box, will be needed. Other available robot systems, focusing on medication management, as well as pill dispensing systems [10] are often limited to the domain of medication support. However, one big advantage of *NAO* is that the system is also able to handle additional problem domains (e.g. emergency detection), all within one system without changing hardware and only adapting its software. Physical limitations, e.g. difficulties for a patient to open a drug box, could not be solved by this robot as hardware is limited.

As the system was only evaluated under laboratory conditions, further investigations are needed to examine the practical use of the proposed system in an applied field. Upcoming robot systems could even contribute to more acceptable results: Aldebaran robotics has already developed *Pepper*, which is a 130 cm tall humanoid robot, driving on omnidirectional wheels and offering better hardware like a chest-integrated tablet. As this system uses the same architecture as *NAO*, applications can be easily transferred.

#### References

- [1] Eurostat, online: <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tps00025&plugin=1> [accessed: 28.09.2015].
- [2] J. Schuler, C. Dückelmann, W. Beindl, E. Prinz, T. Michalski, and M. Pichler, Polypharmacy and inappropriate prescribing in elderly internal-medicine patients in Austria., *Wien. Klin. Wochenschr.* **120** (2008), 733–741.
- [3] K. Notenboom, E. Beers, D.A. van Riet-Nales, T.C. Egberts, et al., Practical problems with medication use that older people experience: a qualitative stud, *J Am Geriatr Soc.* **62** (2014), 2339–44
- [4] T. Kleinberger, M. Becker, E. Ras, Ambient intelligence in assisted living: enable elderly people to handle future interfaces, *Universal Access in Human-Computer Interaction. Ambient Interaction* **4555** (2007), 103–112.
- [5] M.D. Murray, D.G. Morrow, M. Weiner, et al., A conceptual framework to study medication adherence in older adults, *Am. J. Geriatr. Pharmacother* **2** (2004), 36–43.
- [6] Aldebaran Robotics. online: <http://aldebaran-robotics.com/> [accessed: 02.10.2015].
- [7] KSERA - Project; 2010. online: <http://ksera.iéis.tue.nl> [accessed: 21.09.15].
- [8] F. Martín, C. Agüero, J. Cañas, Robots in Therapy for Dementia Patients. *Journal of Physical Agents.* **7** (2013), 48–55.
- [9] M. Fridin, H. Angel, S. Azery, Acceptance, Interaction, and Authority of Educational Robots: An ethnography study of child-robot interaction, *IEEE Workshop on advanced robotics and its social impacts*, USA, 2011.
- [10] C. Datta, H.Y. Yang, P. Tiwari, I.H. Kuo, B.A. MacDonald, End user programming to enable closed-loop medication management using a healthcare robot, *Proceedings Australasian Conference on Robotics & Automation*, Australia, 2011.



# Strategic Deployment of Clinical Models

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**Abstract.** The selection, implementation, and certification of electronic health records (EHR) could benefit from the required use of one of the established clinical model approaches. For the lifelong record of data about individuals, issues arise about the permanence and preservation of data during or even beyond a lifetime. Current EHR do not fully adhere to pertinent standards for clinical data, where it is known for some 20 plus years that standardization of health data is a cornerstone for patient safety, interoperability, data retrieval for various purposes and the lifelong preservation of such data. This paper briefly introduces the issues and gives a brief recommendation for future work in this area.

**Keywords.** Electronic Health Record, Standards, HL7, ISO 13606, ISO 13972

## 1. Introduction

Information exchange is important for a well-functioning health care and there are various examples of clinical modeling initiatives to facilitate this. The clinical modeling work started with the invention of the two level modeling approach for electronic health records (EHR) by Rector et al [1]. In this approach, the EHR system functions and the specification of medical content are separated out in two levels, each handling parts of the EHR functionality. Level one addresses the basic system functions, level two the required variations in medical content to address the diversity of patient populations. Applying clinical models allows for required variations, while at the same time, the highest level of standardization is possible that facilitates data exchange.

Goossen et al reviewed 6 clinical modeling initiatives, with each a specific implementation [2]. The examples reviewed include the Intermountain Health Care Clinical Element Models (CEM), the ISO 13606 archetypes, the OpenEHR archetypes, the HL7 v3 templates for Care Record message and for CDA, the Korean Clinical Contents Models, and finally the ISO 13972 based Detailed Clinical Models specified in Unified Modeling Language (UML) as practiced by HL7 International and in the Netherlands. However, since 2010, three additional initiatives evolved: First is the development of the Clinical Information Modeling Initiative (CIMI) [3]. The second new initiative is the Fast Health Interoperable Resources (FHIR) ® from HL7 [4]. FHIR uses modern technology as Restful interfaces and JSON. Finally, the Semantic Health Net approach deploys ontology based modeling, using the Web Ontology Language (OWL) representations in which the triplets are the core [5].

The research question for the project deliverable reported here was: What should professionals, vendors and regulators do with the various standards for data specifications?

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## 2. Methods

The review carried out by Goossen et al [2] used a bottom up approach, identifying the single data element as the atomic level of modeling, specify this, and from the detailed specification move upward to nesting models, compose models into clinical meaningful functions, and combine it all to a EHR. This approach proves still very workable, and moves to become the gold standard for comparing clinical models and the options to transform data from one system / model to another without loss of semantics. In particular, now the ISO Technical Specification 13972 on Detailed Clinical Models expresses the requirements for the logical clinical models independent of the technical modeling approach or the technical implementation formalism of choice [6]. It is beyond this contribution to discuss all of the TS 13972, but the core will be discussed here.

The core requirements for clinical models are: a name for each data element in the model, definition of the data element, unique binding of the data element to a unique semantic code from a standardized terminology, data type, if data type is a physical quantity then the unit must be added, if data type is a coded element with a value set, then each value must be expressed and have an unique code. The original review proved it possible to compare models for equivalence of semantic clinical content. The first impression is that the new approaches CIMI [3], FHIR® [4], and SHN[5] also meet these minimum requirements, but additional review is recommended to get a precise comparison.

Data models are used for capturing, managing and storing clinical care data, facilitate decision support, allow aggregations for quality indicators, epidemiology, trials and management information. Such use and reuse of clinical data require unique semantics of each data element to compare data over use and time. Hence, storage of the unique code together with the data, and preferably also with a tag to the clinical model the data is based, will largely facilitate lifelong use of a person's data for his/her health. This implies the golden rule that every data element must have a unique semantic code from a controlled and standardized terminology like Snomed CT, LOINC or ICNP, etc.

## 3. Results

### 3.1. Transformation of clinical models and issues coming up

Various projects assume that their clinical models, when the logical model is iso-semantic (that is: depicts the same semantics in another technical format) it can be transformed from one format to another [3]. Smits et al argue such transforms carried out between DCM in UML and FHIR® lead to information loss [7]. However, their paper is based on DCMs that are not completely expressed in the appropriate tools and are not fully computable, e.g. have specifications attached in text files [7].

Another issue in clinical modeling is where does the clinical model stop and where does another model approach (e.g. that of compositions) start. There is some understanding that a clinical model is small, has up to tens of data elements, but must be seen either as atomic, such as the Body Mass Index with a single derived data element, or as molecular [6]. Molecular examples include a blood pressure model covering data elements for systolic value, diastolic value, average value, body position etc. Other molecular examples are assessment scales, such as Apgar score [8], Glasgow Coma Score [9], and similar instruments that have a sum score derived from 1-n data elements.

On the other hand we have seen in SHN that conversion from one model to another is very well doable, and SHN promotes the use ontologies in the background to analyze the

source model, set the rules for proper representation and from this representation move to an equivalent target model [5,10]. Proper transforms between iso-semantic models is possible, but certainly an issue to address in further research and practice environments [3,5,7,8,9].

### *3.2. Nesting required for multidisciplinary approaches and contexts*

Some of the core standards used in clinical modeling have one thing in common: they create a reference (information) model which holds the small classes with baseline characteristics (the first of the two level modeling [1]). From these classes domain models can be developed, using overall characteristics for that clinical domain. These models are often specified into implementation artifacts as an EHR summary, a message, entry form etc. And then, the second level specifies the clinical content in the various clinical models. This way a cascade of models can be created from a domain to a section to a model to a data element. Some models are generic and can be specialized. Nesting becomes possible for even further details or variations. On the other hand, the bottom up approach from many small clinical models to numerous compositions becomes complimentary: standardizing to the maximum on detail and allowing maximal variations in compositions [6, 15]. Two well-known specifications include the 13606-1 [11], where the single entry is clustered into sections, folders and finally the full health record, and HL7 CCD. The HL7 CCD standard has 15 base categories such as patient, diagnose, vital signs, medications, allergies and more [12]. Such standards are very useful for organizing the content into clinical meaningful construct. Hence it offers context and multidisciplinary recognition. Contexts exist in many forms, such as time and location, phase in a care process, a small component in a whole such as one data element as part of a whole clinical model, or a DCM as part of a larger composition such as the discharge summary. Also, whether something is a request, a promise, a goal, or an event (to paraphrase the HL7 v3 mood codes that define this), forms an important context. Clinical Models thus must be able to define multiple contexts, either intrinsic to the model, or relevant to its use in a process or composition. The use of clinical models can to a large extent be discipline independent. For example, in principle, when the proper instructions are used, it would not matter for normal circumstances for many health care observations or actions which discipline is performing it. However, the discipline carrying it out would be part of the context. Some health care activities are exclusive to specific disciplines. This is often regulated by legal boundaries or guidelines. The use of clinical models would support multidisciplinary work due to better mutual understanding on behalf of the patient.

### *3.3. The fools with the tools make the rules*

This saying of a DCM tool developer illustrates well how important tools are in the development, maintenance and deployment of clinical models. An evaluation is included in the review of clinical modeling tools by Moreno Conde [13]. He summarizes requirements for clinical modeling tools and reviews several examples as for archetypes, HL7 templates and Detailed Clinical Models, and specifies these for various roles in the creation, modeling, implementation, and governance of clinical models, among others. It is beyond the scope of this short contribution to go into details, but suffice with pointing to the importance of this, in particular where such tooling facilitates in the validation of the quality of content, modeling, semantic code bindings and additional criteria.

### 3.4. Towards lifelong preservation of clinical data

While the papyrus roles, the 5th century codexes, the large foliants in paper manually copied by monks last for many centuries, and similarly the paper medical records stay in good shape for decades, it is well known that the 'smart' digital data storage based on magnetic appliances we use in modern computer systems definitely do not last longer than a decade. In some instances it will be only some years. So were paper can simply get lost by misplacing, bytes can vanish too. The Committee on Data for Science addressed this issue in the 2012 CODATA conference in Taipei where the topic of lifelong preservation of health records content was addressed a first time [14, 15].

Data-intensive science plays an important role in transforming raw observations into applicable, intelligible results and discoveries expressed as data elements. In healthcare such discoveries will increasingly be based on observational patient data coming from electronic health records, apps and devices and clinical data warehouses. Of course this implies storage of Petabytes, and even more of patient related data. And these data must be stored lifetime for individuals, and grouped into meaningful DataMarts for populations' research. An additional issue is the need to integrate diverse health records that have been captured in different settings and different EHR systems, and data from various source systems and in modern times apps on smart phones and other e-health applications. Hence the question about permanence of clinical data becomes obvious. This means that not the hardware on which data are stored is key and not the software, but the informational structures and very importantly, the meta-data about clinical data [15]. Goossen addresses these issues of data permanence and preservation, and gives some first directions how to handle this both on conceptual, logical and technical levels [15]. Clinical data modeling, and governing these models is of the highest value for healthcare. Goossen & Goossen-Baremans specify how the clinical governance of detailed clinical models can be carried out, and that this even would require national organizations working on this [16]. Discussions in SHN show that the scope of governance should even be the European level, in particular since we do see increased cross boarder data exchange in healthcare.

## 4. Discussion

We see several approaches in clinical modeling emerging in the past decade. Important is that despite some different approaches, commonalities get more attention. With the ISO TS 13972 criteria are expressed for the conceptual component of clinical models (the evidence base from the medical knowledge), the logical model (data elements, semantic code bindings, data types, units, value sets, relationships), and the way various technical formats can be supported [6]. The options provided by CIMI, DCM tooling and SHN to transform iso-semantic models is seen as an important way format, e.g. to capture on the enormous investments in time, money and energy put in the clinical model development and deployment [3, 5, 13].

This situation also implies that there should be *no excuse* for escaping the use of clinical models in EHR systems and other health information technology. The recommendation is to use at least one clinical model formalism. The translation tools already facilitate exchanging data between various systems based on different modeling paradigms. So, there is a choice between the various clinical models and formalisms, but it is a must to choose at least one. Clinical models do serve many purposes in clinical practice, decision support and aggregation purposes. One additional use becomes

increasingly important: clinical models are a cornerstone for data preservation during a person's lifetime [15] and require governance [16].

All these arguments for use however, are dwarfed by the ultimate reason for required application of clinical models. To answer the research question, we believe that patients are entitled to receiving the best electronic support of their care based on the state of the art technology for data modeling. Using any format of clinical models implies that we can move from semantic interoperability – i.e. understanding what is exchanged – to focus on pragmatic interoperability: that is to do the right thing on behalf of our patients when the information is understood and put into proper actions.

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## References

- [1] A.L. Rector, W.A. Nowlan, S. Kay, C.A. Goble, T.J. Howkins. *A framework for modelling the electronic medical record*. Methods Inf Med. 1993 Apr;32(2):109-19.
- [2] William Goossen, Anneke Goossen-Baremans, Michael van der Zel, (2010). *Detailed Clinical Models: A Review*. Healthc Inform Research. 2010 December;16(4):201-214. doi: 10.4258/hir.2010.16.4.201. <http://pdf.medrang.co.kr/Hir/2010/016/Hir016-04-01.pdf>
- [3] (CIMI) *Clinical Information Modeling Initiative*. [www.openCIMI.org](http://www.openCIMI.org) (visited 27 march 2015).
- [4] HL7 (2015). *Fast Healthcare Interoperability Resources (FHIR)*. <https://www.hl7.org/fhir/directory.html> Web documents, visited October 1, 2015.
- [5] C. Martínez-Costa, R. Cornet, D. Karlsson, S. Schulz, D. Kalra. (2015). *Semantic enrichment of clinical models towards semantic interoperability*. The heart failure summary use case. J Am Med Inform Assoc. 2015 Feb 10. pii: ocu013. doi: 10.1093/jamia/ocu013. [Epub ahead of print]
- [6] ISO TS 13972: 2015. *Health informatics — Detailed clinical models, characteristics and processes*.
- [7] Marten Smits, Ewout Kramer, Martijn Harthoorn, Ronald Cornet (2015). *A comparison of two Detailed Clinical Model representations: FHIR and CDA*. EJBI 2015; 11(2):en7–en17.
- [8] M. Cuggia, S. Bayat, D. Rossille, P. Poulain, P. Pladys, H. Robert, R. Duvauferrier. (2009). *Comparing the Apgar Score Representation in HL7 and OpenEHR Formalisms*. Stud Health Technol Inform. 2009;150:250-4.
- [9] W Goossen, F Oemig. *Representing the Glasgow Coma Scale in IT: Proper Specification is Required for Assessment Scales*. Stud Health Technol Inform. 2014;200:42-8.
- [10] Semantic Health Net (2015). *Deliverables*. <http://www.semantichhealthnet.eu/index.cfm/deliverables/> Web documents, visited October 1, 2015.
- [11] ISO 13606-1:2008 *Health informatics -- Electronic health record communication -- Part 1*.
- [12] Health Level 7. HL7/ASTM *Implementation Guide for CDA® R2 -Continuity of Care Document (CCD®) Release 1*. [http://www.hl7.org/implementation/standards/product\\_brief.cfm?product\\_id=6](http://www.hl7.org/implementation/standards/product_brief.cfm?product_id=6)
- [13] Alberto Moreno-Conde, Francisco Jódar-Sánchez, Dipak Kalra (2015). *Requirements for Clinical Information Modelling Tools*. International Journal of Medical Informatics doi: 10.1016/j.ijmedinf.2015.03.005
- [14] Committee on Data for Science and Technology of the International Council for Science (ICSU). *Conference Sessions on Electronic Health Record Management and Preservation (EHR-MP)*. 23rd International CODATA 2012 Conference October 28 - 31, Taipei, Taiwan.
- [15] W. Goossen (2014). *Detailed clinical models: representing knowledge, data and semantics in healthcare information technology*. *Healthc Inform Res*, 2014 Jul;20(3):163-72. doi: 10.4258/hir.2014.20.3.163.
- [16] William Goossen and Anneke Goossen-Baremans (2013). *Clinical Professional Governance for Detailed Clinical Models*. In: E Hovenga, H Grain and A Coote (2013) Editors. *Health Information Governance in a Digital Environment*. Amsterdam, IOS press series Stud Health Technol Inform.

# Towards a HPV Vaccine Knowledgebase for Patient Education Content

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**Abstract.** Human papillomavirus is a widespread sexually transmitted infection that can be prevented with vaccination. However, HPV vaccination rates in the United States are disappointingly low. This paper will introduce a patient oriented web ontology intended to provide an interactive way to educate patients about HPV and the HPV vaccine that will to empower patients to make the right vaccination decision. The information gathered for this initial draft of the ontology was primarily taken from the Centers for Disease Control and Prevention's Vaccine Information Statements. The ontology currently consists of 160 triples, 141 classes, 52 properties and 55 individuals. For future iterations, we aim to incorporate more information as well as obtain subject matter expert feedback to improve the overall quality of the ontology.

**Keywords.** Ontology, Vaccine, Human Papillomavirus, Knowledgebase, Patient education.

## 1. Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection in the United States and currently affects 79 million individuals [3]. There are more than 120 types of HPV [11], some of which are considered high risk and can cause many types of cancers. HPV is spread through the skin and mucous membranes during direct skin-to-skin contact.

Fortunately, the HPV vaccine is an effective tool that can prevent the most common types of HPV infection, which can lead to several types of cancer. Studies have demonstrated that vaccinating young children before they are sexually active produces the strongest immune response and offers the best protection [1]. According to the Centers for Disease Control and Prevention (CDC), HPV vaccine coverage throughout the United States has been dismal compared to other vaccines recommended at the same age, in large part due to a lack of parental understanding about the disease and vaccine [13].

In today's age of information and technology, patients are offered many options to educate themselves about vaccines. One study indicated that regardless of the accuracy

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of information, 70% of people turn towards Internet-based sources to retrieve knowledge about vaccines [19]. Other studies have pointed at the prevalence of anti-vaccination content on the web [15; 22]. While it is beneficial for health care providers to communicate to patients directly [20; 27], time constraints can limit and sometimes prohibit these interactions [17; 23]. Most clinics provide printed vaccine educational materials such as brochures, handouts, and booklets for patients to educate themselves [4]. Moreover, federal law requires that healthcare providers give a copy of the current Vaccine Information Statement (VIS) to all patients prior to vaccination. However, the reading levels of parents many times are often below that of the VIS and other patient materials [16; 18; 25], and patients sometimes ignore or do not receive adequate understanding from this kind of inactive learning approach to make critical vaccination decisions [28].

For this project, we propose the use of an ontological knowledgebase that stores patient-focused vaccine information. An ontology can semantically represent domain knowledge in a machine-understandable format, which enables automatic and intelligent queries. Our knowledgebase can represent complex vaccination information and make it scalable and query-able to deliver rich vaccine information as needed. In addition, the information is represented in a patient-friendly format with limited medical jargon so that patients can better understand the information [21]. Moreover, an ontology for patients creates opportunities for more interactive and precise delivery of vaccine information using patient-friendly natural language queries, where patients and parents receive direct and personalized answers, like VAMATA, a “Siri-like” application for online medical assistance in the military setting [26] or for a prototype interactive mobile application for vaccine education [9]. Therefore, we believe that a HPV ontology can serve as a foundation for an application that will empower patients to make vaccination decisions.

The Vaccine Information Statement Ontology (VISO) is an already existing ontology knowledgebase that contains defined classes and relationships pertaining to vaccines and their pathogens [8]. Using the developed VISO framework, our objective is to define HPV knowledge that is machine-readable and semantically-rich so that it can be incorporated into an interactive learning application for patients.

## 2. Methods

HPV vaccine information was collected from the VISs from the CDC website [1; 2; 6]. Supplemental information was also gathered from Offit and Moser’s *Vaccines and Your Child* handbook [24]. Sentences relevant to HPV, and its vaccine were parsed into simple statements called triples, consisting of a subject, predicate, and object. Using the VISO ontology specification, we incorporated the knowledge triples gathered from the sources into the ontology by either using an existing relationship within VISO or creating new ones to better include and represent information. The program we used to construct the ontology is Protégé 5.0, a commonly acknowledged, open-source software for ontology authoring. The ontology is represented using the Web Ontology language (OWL), which is a standard ontology language. The ontology was evaluated using the Semiotic Evaluation Management System (SEMS). SEMS is a prototype web-based tool that rates an ontology based on different aspects that factor into the overall score [12]. The main qualities that were assessed are *syntactic*, *pragmatic*, and *semantic*. The *syntactic* quality rates the ontology’s machine-readability, the *semantic*

quality measures the usefulness of the ontology based on the terms' *ambiguity* and *consistency*, and *pragmatic* measures the extensiveness of the ontology. Based on the evaluation result, the ontology can be further improved with several additional iterations.

### 3. Results

The ontology uses the previously developed VISO representation to define the conceptual class level, but also includes some refinement to accommodate complex HPV vaccine knowledge. The current version of the Vaccine Information Statement Ontology For Human Papillomavirus (VISO for HPV [7], and figure [5]) contains 160 triples, 141 classes (125 subclasses), 52 properties (36 object properties and 16 data properties), and 55 individuals.

We also obtained quality metrics using the semiotic metric evaluation from [10]. Using the SEMS web-based tool, we automatically generated the *syntactic*, *pragmatic*, and *semantic* scores. Table 1 outlines the quality score breakdown.

**Table 1.** Ontology evaluation scores.

	Quality	Quality Score
Syntactic	Lawfulness	1.00
	Richness	0.51
Semantic		0.93
	Interpretability	0.88
	Consistency	0.97
	Clarity	0.98
Pragmatic		0.50
	Comprehensiveness	0.50
<b>Overall Score</b>		<b>0.73</b>

The overall quality score based on the three quality aspects amounted to 0.73. The *syntactic* score is 0.76 and is comprised of *lawfulness* and *richness* qualities, which are 1.00 and 0.51, respectively. *Semantic* aspect of the ontology scored 0.93. The *interpretability*, *consistency*, and *clarity* qualities make up the *semantic* aspect, which ranks, 0.88, 0.97, and 0.96, respectively. The *pragmatic* aspect score only included one factor, *comprehensiveness*, so its score is 0.50. Currently, the SEMS tool is still under development, and the *accuracy* quality (an aspect of the *pragmatic* quality) could not be calculated.

### 4. Discussion

Based on the analysis of the scores, our initial HPV ontology proves promising. The *syntactic* score (0.76) demonstrates that the high machine readability of the ontology due to correct use of syntax (*lawfulness*), and lack of total utilization of OWL features (*richness*). However, for this specific ontology and its use-case of only representing vaccine patient knowledge, some of the features may not be necessary, but as we continually develop VISO for HPV, there may be knowledge that may require other OWL features to better model the vaccine information. The *semantic* quality is also relatively high (0.93) resulting from low use of repetitive terms (*consistency*) and low use of ambiguous terms (*clarity*). Overall, the scores are quite promising for initial



work, but evaluating the *accuracy* and expanding the use of OWL-based features are needed to fully evaluate the quality.

Creating the ontology posed many challenges. Even though there is already an existing VISO representation from which the HPV ontology is based, a few concept classes and subclasses had to be created or modified in order to better represent some knowledge triples. For example, a subclass called “*Adjuvant*” was conceptualized to describe specific ingredients added to vaccines, like monophosphoryl lipid A which is added to Cervarix, one of the licensed HPV vaccines. Another example, the subclass “*DNA Virus*” to describe Human Papillomavirus (HPV) was also created to elaborate on the type of virus that the HPV vaccines target. Another difficulty that we experienced was determining whether to include some of the information found pertaining to HPV in the ontology such as side effects, contraindications, and mechanism of action. Ultimately, any information determined to be beneficial and helpful to the patient was included. Additionally, some of the medical terms in the VIS documents are subject to interpretation and could be ambiguous to patients, such as the terms “*mildly ill*” versus “*moderately ill*”. Most patients will be unable to discern the difference between the degrees of illness; therefore, it can become misleading to patients.

By attaining a functional knowledgebase, we can potentially power the intelligence behind patient-centered interactive agents – mobile devices, kiosks, etc. – to improve patient vaccine literacy and address patient questions in which patient-provider interaction is lacking or could be improved. As for the *accuracy* quality, we will need to obtain feedback from subject matter experts to improve the overall quality once the prototype SEMS tool can facilitate *accuracy* evaluation for subject matter experts to rate. We are investigating the possibility of growing the knowledgebase with any information that is lacking; for example, inclusion of additional patient-level education about the cancers caused by HPV, such as cervical and oropharyngeal cancer. While the initial knowledgebase included basic information regarding HPV-related cancers, additional information is needed to improve the robustness of the knowledgebase. Encoding extended information like these into the knowledgebase can help raise awareness for the need of HPV vaccination from a cancer-awareness perspective. A neglected aspect, yet of great interest to us, is to go beyond encoding facts and information about HPV vaccine and consider incorporating multimedia content to enrich the knowledgebase. Ontological knowledgebases could indeed link the various concepts with complementary multimedia content, like video and images, to deliver dynamic information through the patient-centered interactive agents. In addition, there is also evidence that storytelling may have an impact to educate and raise awareness of vaccination [14]. Whether it would be specific stories linked to certain vaccine concepts or a method to semi-automatically generate a story, the implementation of storytelling components in a machine-readable knowledgebase is of interest and will be further explored.

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## References

- [1] Vaccine Information Statements (VIS): HPV (Human Papillomavirus) Cervarix® VIS, in, Centers for Disease Control and Prevention, 2011.

- [2] Vaccine Information Statements (VIS): HPV (Human Papillomavirus) Gardasil® VIS, in: Centers for Disease Control and Prevention, ed., Centers for Disease and Control and Prevention, 2013.
- [3] Genital HPV Infection - CDC Fact Sheet, in: Centers for Disease Control and Prevention, ed., Centers for Disease Control and Prevention, 2014.
- [4] Vaccine Information Statement: Facts About VISs - Vaccines - CDC, in: Centers for Disease Control and Prevention, ed., Centers for Disease Control and Prevention, 2014.
- [5] Vaccine Information Statement Ontology (VISO), in, Ontology Research Group, School of Biomedical Informatics, University of Texas Health Science center, 2015.
- [6] Vaccine Information Statements (VIS): HPV (Human Papillomavirus) Gardasil®-9 VIS, in: Centers for Disease Control and Prevention, ed., Centers for Disease Control and Prevention, 2015.
- [7] VISO for HPV, in, Bitbucket, <https://bitbucket.org/uthealthontology/viso-for-hpv>, 2015.
- [8] M. Amith, Y. Gong, R. Cunningham, J. Boom, and C. Tao, Developing VISO: Vaccine Information Statement Ontology for patient education, *Journal of Biomedical Semantics* 6 (2015), 23.
- [9] M. Amith and C. Tao, A Prototype Mobile Virtual Assistant for Semantic-Based Vaccine Information Retrieval, in: *Smart Health*, X. Zheng, D. Zeng, H. Chen, Y. Zhang, C. Xing, and D. Neill, eds., Springer International Publishing, 2014, pp. 200-205.
- [10] M. Amith and C. Tao, A Web Application Towards Semiotic-based Evaluation of Biomedical Ontologies, in: *The 14th International Semantic Web Conference (ISWC 2015)*, Bethlehem, United States, 2015.
- [11] W. Atkinson, C. Wolfe, and J. Hamborsky, *Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases*, Public Health Foundation, Washington DC, 2012.
- [12] A. Burton-Jones, V.C. Storey, V. Sugumaran, and P. Ahluwalia, A semiotic metrics suite for assessing the quality of ontologies, *Data & Knowledge Engineering* 55 (2005), 84-102.
- [13] R. Cunningham and J. Boom, Vaccine-Preventable Disease Human Papillomavirus (HPV), in: Texas Children's Hospital, ed.
- [14] R.M. Cunningham and J.A. Boom, Telling stories of vaccine-preventable diseases: Why it works, *SD Med* (2013), 21-26.
- [15] P. Davies, S. Chapman, and J. Leask, Antivaccination activists on the world wide web, *Archives of Disease in Childhood* 87 (2002), 22-25.
- [16] T.C. Davis, J.A. Bocchini, D. Fredrickson, C. Arnold, E.J. Mayeaux, P.W. Murphy, R.H. Jackson, N. Hanna, and M. Paterson, Parent Comprehension of Polio Vaccine Information Pamphlets, *Pediatrics* 97 (1996), 804-810.
- [17] T.C. Davis, D.D. Fredrickson, C.L. Arnold, J.T. Cross, S.G. Humiston, K.W. Green, and J.A. Bocchini, Childhood Vaccine Risk/Benefit Communication in Private Practice Office Settings: A National Survey, *Pediatrics* 107 (2001), e17-e17.
- [18] T.C. Davis, E.J. Mayeaux, D. Fredrickson, J.A. Bocchini, R.H. Jackson, and P.W. Murphy, Reading ability of parents compared with reading level of pediatric patient education materials, *Pediatrics* 93 (1994), 460-468.
- [19] S. Fox and L. Rainie, The online health care revolution: How the Web helps Americans take better care of themselves, in: *Pew Internet & American Life Project: Online life report*, Pew Research Center, 2000.
- [20] D.A. Gust, N. Darling, A. Kennedy, and B. Schwartz, Parents With Doubts About Vaccines: Which Vaccines and Reasons Why, *Pediatrics* 122 (2008), 718-725.
- [21] T.A. Jacobson, D.M. Thomas, F. Morton, G. Offutt, J. Shevlin, and S. Ray, Use of a low-literacy patient education tool to enhance pneumococcal vaccination rates: A randomized controlled trial, *JAMA* 282 (1999), 646-650.
- [22] A. Kata, Anti-vaccine activists, Web 2.0, and the postmodern paradigm – An overview of tactics and tropes used online by the anti-vaccination movement, *Vaccine* 30 (2012), 3778-3789.
- [23] C. LeBaron, L. Rodewald, and S. Humiston, How much time is spent on well-child care and vaccinations?, *Archives of Pediatrics & Adolescent Medicine* 153 (1999), 1154-1159.
- [24] P.A. Offit and C.A. Moser, *Vaccines & your child: separating fact from fiction*, Columbia University Press, 2011.
- [25] R.D. Powers, Emergency department patient literacy and the readability of patient-directed materials, *Annals of Emergency Medicine* 17 (1988), 124-126.
- [26] J. Rodger and J. George, Mobile Speech and the Armed Services: Making a Case for Adding Siri-like Features to VAMTA (Voice-Activated Medical Tracking Application), in: *Mobile Speech and Advanced Natural Language Solutions*, A. Neustein and J.A. Markowitz, eds., Springer New York, 2013, pp. 319-332.
- [27] P.J. Smith, A.M. Kennedy, K. Wooten, D.A. Gust, and L.K. Pickering, Association Between Health Care Providers' Influence on Parents Who Have Concerns About Vaccine Safety and Vaccination Coverage, *Pediatrics* 118 (2006), e1287-e1292.
- [28] F.L. Wilson, D.L. Brown, and M. Stephens-Ferris, Can Easy-to-Read Immunization Information Increase Knowledge in Urban Low-Income Mothers?, *Journal of Pediatric Nursing* 21 (2006), 4-12.

# The Pilot Evaluation of Using the International Classification for Nursing Practice<sup>®</sup> (ICNP) as the Electronic Nursing Data Exchange Standardization in Taiwan

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**Abstract.** International Classification for Nursing Practice (ICNP<sup>®</sup>) was developed as the standardized terminology by the International Council of Nursing (ICN) since 1999. It is important to evaluate the applicability of using ICNP<sup>®</sup> as the electronic nursing data exchange standardization when adopting in Taiwan. A total of 87% clinical nursing problems could be cross-mapped to DC axis of ICNP<sup>®</sup> version 2 in traditional Chinese language (Kappa = .96). Only five nursing problems (following care problem; blood transfusion; potential risk for unstable blood sugar level; hyperbilirubinemia; and caregiver anxiety) couldn't be matched. ICNP<sup>®</sup> could mostly support the electronic nursing data exchange standardization. Developing Taiwan-ICNP<sup>®</sup> as the local terminology was seemed to be the strategy to create a more adoptive standardization across the country for Taiwan health care data exchange in the future.

**Keywords.** ICNP<sup>®</sup>, clinical nursing records, terminology, data exchange

## 1. Introduction

Standards and interoperability are integral factors in the implementation of EHR. Without standardization, it is difficult to process data exchange, analysis, sharing and reusing. Standardized terminology is a key infrastructure component of EHR. It is also an important data source to support hospital management, decision-making and financial analysis processes. The benefits of adopting standardized terminology in the EHR would be creating the value of EHR and getting to meaningful use.

In Taiwan, about sixty percent of hospitals are developing nursing informatics systems[1]. Most hospitals use translated NANDA, NIC and NOC as their standardized interface terminologies when document their nursing care plan. However, there are still no national wide standardized nursing terminologies among different Taiwan hospitals for lacking of essential benefits to use standardized terminology cross the country (e.g. financial support from government).

International Classification for Nursing Practice (ICNP<sup>®</sup>) was developed and updated as the standardized terminology by the International Council of Nursing (ICN)

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since 1999. The World Health Organization (WHO) accepted ICNP<sup>®</sup> within the WHO Family of International Classification (WHO-FIC) to extend coverage of the domain of nursing practice as an essential and complementary part of professional health service. The purpose of this study was to evaluate the applicability of using ICNP<sup>®</sup> as the electronic nursing data exchange standardization for future adopting in Taiwan.

## 2. Methods

In this pilot study, the researcher choose electronic nursing care plan (ENCP) as the main clinical nursing records. ENCP was recorded by every nurse in every clinical ward to document the hospitalized patients' care problems (e.g. ineffective breathing pattern), etiology (e.g. impaired lung function), supportive data (e.g. short of breathing), goal(e.g. effective breathing pattern in three days), intervention(e.g. oxygen supply), and outcome(e.g. achieved SPO<sub>2</sub> 98%). ENCP helped nurses take care of patients more systematically and prioritized and also the important legal documentation among electronic health records. When using ENCP as the target clinical terminology, we can evaluate the applicability of using ICNP<sup>®</sup> as the electronic nursing data exchange standardization for ENCP is the general and critical documentation in Taiwan.

The researcher who was authorized as the ICNP<sup>®</sup> translator in Taiwan had completed ICNP<sup>®</sup> Version 2 traditional Chinese translation and validation[2]. The translated terminologies were published on the ICN website for non-profit use. Thus, the researcher used the ICNP<sup>®</sup> Version 2 traditional Chinese translation as the standardized terminology in this study. For clinical nursing records, the researcher used ENCP, which was implemented since 2010 in one 2,300-beds medical center in northern Taiwan. Then the researcher invited one clinical nurse with more than ten years emergency department intensive care unit (ED-ICU) working experiences in that medical center and used ENCP in every working day as the ICNP<sup>®</sup>-ENCP cross-mapper. She was toughed the knowledge of ICNP<sup>®</sup> and then trained the ICNP<sup>®</sup>-ENCP cross mapping skill by the researcher.

### 2.1. ICNP<sup>®</sup> cross mapped to electronic nursing care plan

According to the ICN (2005) recommended the guidelines for using ICNP<sup>®</sup> seven model (Figure 1) to create nursing diagnoses, nursing outcome and nursing intervention statements[3], the researcher used three categories (e.g. C1, C2, C3) to rate the matching levels between the clinical terms of nursing problems in ENCP[ENCP(NP)] and preferred terms in ICNP<sup>®</sup> DC axis. The definitions of these categories were described below:

C1: the clinical term of the ECNP(NP) is also the translated preferred term (e.g. completely matched) in the ICNP<sup>®</sup> DC axis.

C2: the clinical term of the ECNP(NP) is the synonym of translated preferred term in the ICNP<sup>®</sup> DC axis.

C3: the clinical term of ECNP(NP) is neither the translated preferred term nor the synonym term in the ICNP<sup>®</sup> DC axis.

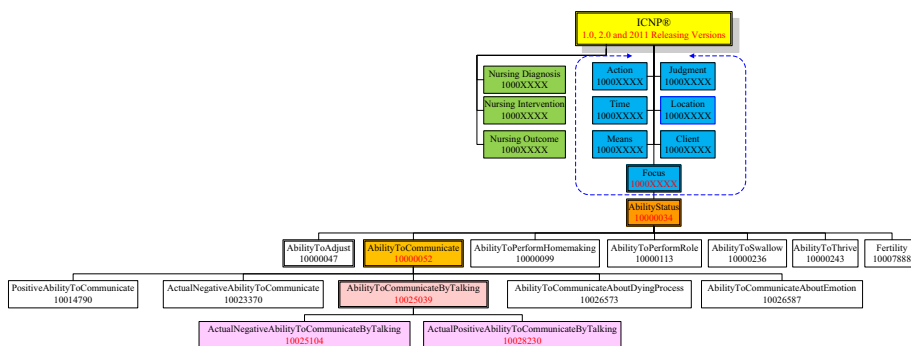


Figure 1. The hierarchy and codes of ICNP® (Portion)

An interrater reliability analysis using the Kappa statistic was performed to determine consistency among two raters and was found to be  $Kappa = .96$  ( $p < 0.001$ ), which was almost perfect agreement[4]

### 3. Results

A total of 39 nursing problems were cross-mapped according to the ICNP® structure. For the definitions of matching levels between the clinical terms of the ENCP(NP) and translated preferred terms in ICNP® DC axis, the total numbers and percentage of three categories were showed in table 1. It showed that 87% of clinical terms of the ENCP(NP) were consistency with ICNP® DC axis. There were still five nursing problems can't be matched. Those clinical terms of nursing problems were “following care problem”, “blood transfusion”, potential risk for unstable blood sugar level”, “hyperbilirubinemia”, “caregiver nervous”.

Table 1. The total numbers (%) of three categories between ENCP(NP)-ICNP® DC axis

ICNP® \ ENCP	Category(C)	Definitions	n(%) of C
Clinical terms of nursing problem	C1	The clinical term of the ECNP(NP) is also the translated preferred term (e.g. completely matched) in the ICNP® DC axis.	21(54%)
	C2	The clinical term of the ECNP(NP) is the synonym of translated preferred term in the ICNP® DC axis.	13(33%)
	C3	The clinical term of ECNP(NP) is neither the translated preferred term nor the synonym term in the ICNP® DC axis	5(13%)

### 4. Discussion

A total of 39 nursing problems were cross-mapped to ICNP® and 87% of these problems have completed matched to the preferred terms or synonyms. Though ICNP® DC Axis can't cover the entire clinical nursing problems in Taiwan, it still had high cover rate. From those that can't be matched, we find out some un-matched reasons:

#### *4.1. ICNP<sup>®</sup> DC Axis lack of enough preferred terms to describe patients who had specific physiological status.*

As we know, there are many existing laboratory testing items (e.g. CBC, BCS etc.), once human body has abnormal laboratory testing result, there were sometimes be diagnosed as hyper- (e.g. hyperkalemia) or hypo- (e.g. hypokalemia). In our study, we found the clinical nursing problem: hyperbilirubinemia were not existing in the ICNP<sup>®</sup> DC Axis. Though hyperbilirubinemia is caused by some underlying diseases (e.g. liver or biliary), this is the medical diagnosis and easily perceived and used by nurse as nursing problem. In the updated ICNP<sup>®</sup> version, more and more physiological oriented preferred terms were used as nursing diagnoses (e.g. hypertension v.s. hypotension). But there are more and more new diseases occurred nowadays, ICNP<sup>®</sup> version should have more flexibility and efficiency update process to fully support clinical using around the world. Thus, we would recommend that ICN could have effective feedback channel like internet access that help the adopting country feedback the local terminologies and getting the valid code when they need to be exchange among different health care institutions.

#### *4.2. ICNP<sup>®</sup> DC Axis lack of enough preferred terms to describe high physiological variability status.*

When ENCP existed the clinical nursing problem: potential risk for unstable blood sugar level, we found two ICNP<sup>®</sup> DC Axis preferred terms could be and could not be matched. One was hyperglycaemia and the other was hypoglycemia. Clinical nurses sometime will take care of the diet mellitus patients whose blood sugars were poor controlled. Thus they have high blood sugar variability and they would not show absolutely hyperglycaemia or hypoglycemia, the clinical nurses trend to use the potential risk for unstable blood sugar level when they made the nursing problem. In ICNP<sup>®</sup> DC Axis, there were many preferred terms using “risk for ...” which meant potential negative situation. For the patients with high physiological variability status, clinical nurses will have difficulties using the one-way (e.g. hyper or hypo) nursing problem to matched the real clinical situation. In such case, we would recommend that ICNP<sup>®</sup> DC Axis can adopt more preferred terms to support high physiological variability status.

#### *4.3. ENCP trend to use multiple-in-one caregiver problems*

In Taiwan, the inpatients were taken care of not only by the medical staffs but also their families. Caregiver management was also thought to be the responsibility of clinical nurses. However, they rarely have simple care problems like caregiver stress. Most of caregivers encounter multiple problems but when making the nursing documentation, most nurses would use the multiple-in-one caregiver problems such as following care problem in the study hospital instead of expressing the different caregiver problems even ICNP<sup>®</sup> DC Axis offer varied preferred terms to describe caregiver problem (e.g. negative caregiver attitude; lack Of trust in healthcare provider). We assume that clinical nurses lacking of fully support to record caregiver’s problems more detail in their nursing records.

#### 4.4. Policy oriented nursing problems

Following the discussion in point three, we also learned that the nurses' documentation focus on recording the patients' health problems. Moreover, the national medical record and national health insurance regulations play two important roles guiding the content of nursing records. From the results, the unmatched clinical nursing problem: blood transfusion is obviously belonged to the nursing action or intervention. Blood transfusing existing in the nursing problems was considered as the important procedure for every nurse to make the record. It is also related to patient safety, thus, hospital nurse manager decided to put in the clinical nursing problems. In such policy oriented nursing problem, the ICNP<sup>®</sup> DC Axis need not to include them.

### 5. Conclusion

In our preliminary study, clinical nursing care plan can mostly be cross-matched to ICNP<sup>®</sup> that mean ICNP<sup>®</sup> can support the electronic nursing data exchange standardization. However, there were few clinical nursing care problems could not be mapped to ICNP<sup>®</sup> because of lacking appropriate preferred terms. In such cases, the research team would recommend that the ICN consider adopting these clinical terms or extending more common used clinical terms in the future. In the real medical environment, some policies will influence the medical decision and will also reflect on the medical records. No golden medical exchange standardization could be completely matched to the clinical medical terms. For the high policy decision makers, it is important to investigate the purpose of medical data exchange. Then the following data creation, collection, analysis process could facilitate the decision-making. In the future, we have two recommendations. The first was to use more nursing records like discharge planning and investigate their applicability with ICNP<sup>®</sup>. The second was to develop Taiwan-ICNP<sup>®</sup> as the local terminology, and that seem to be another strategy to create a more adoptive standardization across the country for our health care data exchange in the future. In this study, we also have some limitations such as the synonyms judgment between ENCP and ICNP<sup>®</sup>. Perhaps the communication with clinical and ICNP<sup>®</sup> experts will eliminate the synonyms.

### 6. Acknowledgments

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### References

- [1] H.C. Chen, International Connection: The Current and Development of Nursing Informatics in Taiwan. *The Journal of Nursing*, 2009. **56**(3): p. 5-11.
- [2] I.C. Hou, et al., A modified Delphi translation strategy and challenges of International Classification for Nursing Practice (ICNP<sup>®</sup>). *Int J Med Inform*, 2013. **82**(5): p. 418-26.
- [3] *ICNP<sup>®</sup> Version 1.0-International Classification For Nursing Practice*, in CHAPTER 4-THE 7 AXIS MODEL OF ICNP<sup>®</sup> VERSION 1. 2005: Geneva(Switzerland). p. 30-31.
- [4] J.R. Landis, and G.G. Koch, The measurement of observer agreement for categorical data. *Biometrics*, 1977. **33**: p. 159-174

# Development and Evaluation of an Adolescents' Depression Ontology for Analyzing Social Data

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**Abstract.** This study aims to develop and evaluate an ontology for adolescents' depression to be used for collecting and analyzing social data. The ontology was developed according to the 'ontology development 101' methodology. Concepts were extracted from clinical practice guidelines and related literatures. The ontology is composed of five sub-ontologies which represent risk factors, sign and symptoms, measurement, diagnostic result and management care. The ontology was evaluated in four different ways: First, we examined the frequency of ontology concept appeared in social data; Second, the content coverage of ontology was evaluated by comparing ontology concepts with concepts extracted from the youth depression counseling records; Third, the structural and representational layer of the ontology were evaluated by 5 ontology and psychiatric nursing experts; Fourth, the scope of the ontology was examined by answering 59 competency questions. The ontology was improved by adding new concepts and synonyms and revising the level of structure.

**Keywords.** adolescents' depression, ontology, social data analysis, youth counseling record,

## 1. Introduction

According to WHO statistics, the rates of suicide among young person aged between 10 and 24 in South Korea were 9.4 per 100,000 people in 2010, ranked the sixth among OECD members [1]. In addition, suicide is the leading cause of adolescents' death in South Korea. A study has shown a strong link between suicide and depression, with 80% of the people who die by suicide having a depression at the time of their deaths [2]. In Korea, 77.1% of adolescents own the SNS (Social Network Service) accounts [3] and they record their emotion and activities on social network platforms. Therefore, it is possible to extract valuable information about youth depression by analyzing social data.

An ontology for adolescents' depression, a semantic framework for depression concepts and their relationships can be used as a basis of social data retrieval and analysis [4]. This study aims to develop and evaluate an ontology for adolescents' depression to be used for collecting and analyzing social data.

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## 2. Methods

### 2.1. Development

The ontology was developed using the 'Ontology Development 101' methodology. The process of iterative design continued through the whole lifecycle of the ontology [5].

- Step 1, we determined the domain and scope of the ontology.
- Step 2, we searched existing ontologies representing youth depression on the web (Google Scholar, Pubmed) and in the literatures.
- Step 3, we extracted key terms from four clinical practice guidelines (NICE(2005, 2015), USPSTF(2009), beyondblue(2011) and Korean Clinical Research Center For Depression (2011)) and related literatures.
- Step 4, we defined the classes and the class hierarchy using top-down process.
- Step 5, we analyzed the questionnaires such as 'Korea National Survey of Domestic Violence and Sexual Violence', 'Korean National Survey of School Violence' to extract the properties and values.
- Step 6, we designed the ontology representing classes, properties, values and their relationships. We also developed terminology with synonyms for classes.

### 2.2. Evaluation

The ontology was evaluated in four different ways.

- First, we examined the frequency of ontology concept appeared in depression-related social data. Social data with the keywords 'depression' or 'depressed' was searched by web-crawler.
- Second, we also examined the content of coverage by mapping concepts in counseling records posted at the Korean Youth Counseling and Welfare Institute's website to the ontology concepts. We extracted key concepts from the counseling records using KoNLP package with R. We classified results of mapping into 'lexically mapped', 'semantically mapped', 'mapped to a broader/narrower/more than one concept' and 'not mapped' [6].
- Third, Three experts with experience in ontology design and Two experts specialized in psychiatric nursing evaluated the structural and representational layer [7] using Likert scales with 5-point scores. All of five experts were asked to provide free text comments about the feasibility of the ontology.
- Fourth, the scope of the ontology was examined using competency questions. We made a list of questions that the ontology should be able to answer and tested the extent to which these questions were answered correctly. The list of questions was extracted from FAQs posted at the American Academy Of Child & Adolescent Psychiatry website.

## 3. Results

### 3.1. Development

There were no ontologies available to describe youth depression. Thus we have decided to develop a new ontology for adolescent depression.



3.2.3. The structural and representational layer of the ontology

The structural and representational layer scores of the ontology are presented in Table 1. All items scored above 4 in average, with depth of hierarchy, balance and overall complexity criteria scoring 5 point. The criterion with the lowest score was density.

Table 1. Average score of evaluation on the structural and representational layer

Structural layer		Representational layer	
Criteria	Mean score	Criteria	Mean score
Size	4.7	Match between formal and cognitive semantics	4.7
Depth of hierarchy	5.0	Consistency	4.6
Breadth of hierarchy	4.7	Clarity	4.6
Density	4.3	Explicitness	4.7
Balance	5.0	Interpretability	4.6
Overall complexity	5.0	Accuracy	4.4
Connectivity	4.7	Comprehensiveness	4.6
		Granularity	4.7
		Relevance	4.5
		Description	4.8
Total	4.8	Total	4.6

Ontology and psychiatric nursing experts recommended that the concepts representing 'Risk factors' and 'Sign and symptoms' sub-ontology should be expressed in a different way to convey the meaning more clearly. In addition, two experts pointed out that 'diversional activity' class in the 'management care' sub-ontology was too detailed to be harmonious with other classes.

3.2.4. The scope of the ontology

Table 2 displays five competency questions and their answers derived from the ontology as an example. We drew up a list of 59 competency questions and the ontology was able to answer to all of these questions correctly.

Table 2. An example of competency questions and answers

CQ	Answer	Correct?
Which is the IndividualRiskFactorsOf depression?	Biochemical factors, biological factors, genetic factors, lifestyle, mental disease, physical disease, psychological factors, socio-demographic factors, temperamental factors, undesirable life event	Yes
Which is the NeurotransmitterRelatedTo depression?	Dopamine, epinephrine, serotonin, norepinephrine	Yes
Which is the PhysicalSignOf depression?	Change of appetite, change of psychomotor, change of weight, disrupted sleep rhythms, fatigue, lowered libido, pain	Yes
Which is the PsychotherapyOf depression?	CBT, IPT, psychodynamic therapy	Yes
Which is the GoodEnvironmentForCaring depression?	Family cohesion, family concord, health family value, stable socioeconomic status	Yes

4. Discussion

It was found that the ontology developed in this study could represent most of concepts used in social media (78.0%) and counseling records (73.1%). This result reflects that the ontology could be an effective framework for collecting and analyzing social data. Meanwhile, most of the ontology concepts not appeared in social data were related to

names of pharmaceutical drugs and screening tools for depression. These concepts are terms that the public did not use in social media postings.

We improved the initial ontology by adding new terms used in social media and counseling records and modifying the structure. About 500 terms were newly added and most of them were synonyms for existing concepts.

In this study, we developed an ontology to be used as a framework for collecting and analyzing social media data. Most of big data are being analyzed without a formal framework. However, if we use ontology-centered framework, the phenomenon hidden in big data can be analyzed more delicately and scientifically [9]. Song [10] utilized the ontology developed in this study for predicting depression risk factors among Korea adolescents by using social big data. He found that trends of posting volumes on youth depression resembled statistics published by Korean government.

Standardized terminologies were not used to describe the terms in our ontology due to lack of standardized terminology in Korean. However it would be possible to map the terms in the ontology to standardized terminologies such as SNOMED CT in the future. Also, this ontology could be generalized to describe social problems such as youth suicide and youth delinquency.

A further study aligning our ontology with upper ontology such as BFO and DOLCE is needed to improve its interoperability with other ontologies. For example, 'lifestyle' could be placed under Dependent-Continuant, 'medication' under Independent-Continuant, and 'treatment' under Processual Entity in BFO.

## 5. Acknowledgments

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## References

- [1] WHO mortality database. [http://apps.who.int/healthinfo/statistics/mortality/causeofdeath\\_query/](http://apps.who.int/healthinfo/statistics/mortality/causeofdeath_query/)
- [2] Ministry of Health and Welfare. Master Plan for Prevention of Suicide. Seoul (Korea): Ministry of Health and Welfare; 2005.
- [3] National Youth Policy Institute, Ministry of Gender Equity and Family. Study of media use among Children and Youth. Seoul (Korea): Ministry of Gender Equity and Family; 2013
- [4] M.Hadzic, M.Chen, T.S.Dillon. Towards the Mental Health Ontology. IEEE International Conference on Bioinformatics and Biomedicine; Nov 3-5, 2008; Philadelphia, USA. 2008
- [5] N.F.Noy, D.L.McGuinness. Ontology Development 101: A Guide to Creating Your First Ontology. Stanford Knowledge Systems Laboratory Technical Report. 2001
- [6] H.A.Park, C.B.Lundberg, A.Coenen, D.J.Konicek. Evaluation of the content coverage of SNOMED-CT to represent ICNP Version 1 catalogues. *Stud Health Technol Inform* **146** (2009), 303-307.
- [7] D.D.Kehagias, I.Papadimitriou, J.Hois, D.Tzovaras, J.Bateman. A methodological approach for ontology evaluation and refinement. ASK-IT International Conference; June 26-27, 2008; Nuremburg, Germany. 2008.
- [8] M.E.O'Connell, T.Boat, K.E.Warner. *Preventing mental, emotional, and behavioral disorders among young people: Progress and possibilities*. The National Academies Press, Washington, D.C. 2009.
- [9] E.W.Kuiler. From Big Data to Knowledge: An Ontological Approach to Big Data Analytics. *Review of Policy Research* **31**(2014), 311-318.
- [10] T.M.Song. Predicting depression risk factors among Korean adolescents by using social big data. *Health-Welfare Issue&Focus* **296**(2015)

# Developing a Semantic Model to Describe Physical Activity Data

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**Abstract.** The importance of data in the social and behavioral domains to biomedical research is increasing, but ensuring the reusability of such data through standardization is not a trivial task. To start addressing this challenge, we developed a semantic model of the physical activity domain by reviewing 302 physical activity questions collected from standardized questionnaires and public data repositories. Our semantic model is comprised of activity keywords, qualifiers, response measures and context. We identified three types of contexts: *active lifestyle*, *physical capacity*, and *environment*. The majority (94%) of the 204 activity keywords extracted from the 302 questions were mapped to the UMLS Metathesaurus. Preliminary evaluation of our model with 309 additional activity questions showed that the majority of the questions were related to one of the three context categories. We also noted the need to expand context categories to incorporate the questions assessing psychological aspects of dealing with physical activities.

**Keywords.** physical activity, data standardization, data modeling, standardized terminology, data discoverability

## 1. Introduction

Physically active people generally have longer lifespans and lower risks for developing cardiovascular disease, diabetes, depression and some cancers [1]. Many clinical and genome wide association studies (GWAS) provide supporting evidence to this claim. One example is the discovery and validation of the interaction between the FTO gene locus and physical activity, in which the phenotype variables were collected from self-administered questionnaires of participating subjects [2]. Many clinical and genome wide association studies (GWAS) collect such data using separate data collection forms, and precision medicine calls for comprehensive analyses of patient genomics, phenotypes, and environmental exposures [3]. The Institute of Medicine (IOM) also urges social and behavioral domains of data to be incorporated into electronic health records (EHRs) in a standardized manner and identified nine high priority domains to consider [4].

Unlike genotype data, where array probes and genes are well-annotated and universally standardized, phenotype and exposure variables such as physical activity are managed in a non-standard way requiring advanced algorithms for standardization.

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For example, we had reported in our variable standardization study for phenotypic and exposure data in NCBI database of Genotypes and Phenotypes (dbGaP) [5] using UMLS based automated semantic annotation [6].

Standardizing social and behavioral data is especially challenging because they are often described with lengthy and non-technical terms. Our previous experiences with standardizing phenotype and exposure data stored in dbGaP confirmed this challenge [6]. PhenX aims to standardize key behavioral and environmental measures in 21 research domains to support GWAS and other large-scale genomic research [7,8]. Adopting PhenX measures will undoubtedly facilitate standardization and integration of the social and behavioral domains of data. However, the majority of the data, which have been collected without adopting any data standard in this domain, would still require separate standardization efforts.

This study reports our early efforts to standardize physical activity data, which the IOM recognizes as one of the nine high priority social and behavioral domains [4]. Our efforts focused on building an underlying semantic model of the physical activity data, where key semantic components need to be captured in a standardized manner to convey the intended meaning. This semantic model may serve as a type system that guides an NLP (Natural Language Processing) pipeline for automating the standardization of physical activity data. Note that the complete data file of this study that contains data sources, annotations, and concept mapping is available at <https://idash-data.ucsd.edu/download/folder/4732/N116B.zip>

## 2. Methods

### 2.1. Data collection

We first collected and compiled a total of 361 convenience samples of physical activity related questions and/or measurements from standardized questionnaires such as the National Health and Nutrition Examination Survey (NHANES) [9] and Rapid Assessment of Physical Activity [10]. We also looked into public research data repositories such as dbGaP [5] and cancer Data Standards Repository (caDSR) [11]. Next, we removed duplicate entries from our compilation. We considered only the items that were identically worded as duplicates, as our ultimate goal is to develop an algorithm to identify and standardize physical activity related variables described in various lexical manners. For example, “*how many days of the week do you exercise?*” and “*exercise: frequency/week*” were treated as distinct questions even if they carry identical semantics because they pose different standardization challenges. After removing the duplicates, a total of 302 questions were included in this analysis. We will refer to this dataset as “dataset A.”

### 2.2. Modeling physical activity questions

Four reviewers identified the physical activity keywords that carried the core semantics of a given activity related question. Challenging cases were collaboratively reviewed. One of the authors (HK) identified emerging general semantic components that can be used to characterize the activity questions from the annotated questions. HK also identified the terms used to describe the semantic components. The extracted physical activity keywords were also mapped to the Unified Medical Language System (UMLS)

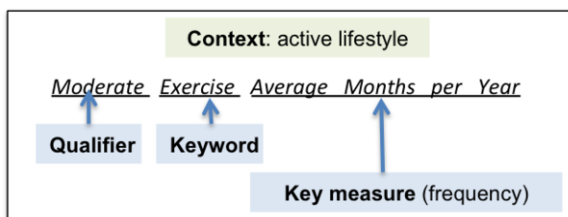
Metathesaurus [12] using MetaMap [13]. The mapping results were reviewed and the items that MetaMap failed to provide proper matches for were manually mapped to the UMLS Metathesaurus.

As a preliminary evaluation of our semantic model, we collected 309 additional activity related questions from 17 different sources and annotated them using the semantic model. We will refer to these 309 questions as “dataset B.”

### 3. Results

#### 3.1. The semantic model

Four semantic components – *activity keyword*, *key measure*, *context*, and *qualifier* – were identified from 302 questions (i.e., dataset A). The *activity keyword* is a physical activity term mentioned in the question. The *key measure* describes what is being asked about the physical activity such as amount, duration, types of activities, etc. The *qualifier* is the term used to describe the intensity or amount of an activity mentioned in the question. We identified three *Context* areas. First, *active lifestyle* questions assess the level of physical activities that a respondent gets. Next, *physical capacity* questions assess functional status of a respondent and/or physical responses to any physical activities. Finally, *environment* questions are to assess non-organic barriers or facilitators to physical activities that a respondent is having. **Figure 1** shows an example of the annotating of an activity related question using the aforementioned semantic categories. **Table 1** shows the three different contexts along with the total number of questions falling within that context and an example question from each category.



**Figure 1.** Annotation example.

From Dataset A we extracted 557 activity keywords, which were consolidated to 204 unique keywords concerning physical activity. The most frequently appearing keyword was “Walk” (N=77) followed by “exercise” (N=61) and “physical activity” (N=35). Specific sports or exercise names, general leisure/recreational activity names, and house chores also frequently appeared.

*Qualifiers* were used in 86 questions (28%). Most concerned the intensity of an activity. Intensity was described using categorical extent qualifiers such as *low*, *moderate*, *strenuous*, *vigorous*, etc. (N=54); and they were most frequently used for the questions within the *active lifestyle* context. The questions with the *physical capacity* context often described intensity using amount (N=18), speed (N=5, e.g., “*number of feet walked in 6 minutes*”), and the level of physical exertion after the activities (N=4, e.g., “*what activities make you feel short of breath?*”). The majority of the questions (39%) were designed to collect binary answers (i.e., true/false) as in “*do you exercise*

regularly?” The questions on *physical capacity* often sought for vital sign measures or physical symptoms responses.

**Table 1.** Example questions and frequencies of the context categories

Context	Set A	Set B	Example questions
Active lifestyle	185	162	<ul style="list-style-type: none"> <li>Over the past 6 months, have you gone to parks for picnics, walks or other outings?</li> <li>Have you done light strength training in the past 4 weeks?</li> </ul>
Physical capacity	99	55	<ul style="list-style-type: none"> <li>Does your health limit you in these activities: walking more than a mile</li> <li>Exercise peak blood pressure</li> </ul>
Environment	18	74	<ul style="list-style-type: none"> <li>Over the past 6 months have your family or friends exercised with you?</li> <li>Constraints on outdoor activities (e.g., lack of money; lack of time due to work, family, or other obligations, etc)</li> </ul>

The UMLS Metathesaurus provided complete and partial matches to 86% and 8% of the 204 activity keywords respectively. Examples of partial matches are *mow lawn with push-mower* mapped to “yard work (C2986650)”, *backpacking* mapped to “hiking (C2136024)”, and *rowing* mapped to “activity, rowing, canoeing, kayaking, rafting and tubing (C2712393).” *Heavy carpentry, auto repair, triathlon, and toning* are a few examples of the activity keywords that are not mapped to the UMLS Metathesaurus.

### 3.2. Model evaluation

The main focus of this preliminary evaluation was to ensure the semantic coverage of the context categories and to collect additional activity keywords. With the preliminary evaluation of our information model, 291 (94%) of the 309 additional activity questions (i.e., Dataset B) were classified into one of the three context categories. The majority of the items in Dataset B fell into the *Active lifestyle* context. The frequency distributions of the context categories in dataset B are presented in **Table 1**.

Among the remaining 18 items, 3 were associated with multiple context categories. For example, the question “*Were you sick last week, or did anything prevent you from doing your normal physical activities?*” could be classified as *Physical Capacity* or *Environment* (i.e., barrier). The remaining 15 questions did not fit into any of the three context categories. Six of them were related to the attitude and/or motivation towards physical activity such as “*do you usually feel motivated to exercise?*” and “*I may miss a day of exercise for no good reason.*” Nine items were related to assessing exercise addiction such as “*I have had daydreams about exercising*” and “*when I miss a scheduled exercise session I may feel tense, irritable or depressed.*”

From dataset B, we extracted 632 physical activity related keywords, which were consolidated into 244 unique keywords. Dataset B shared the same top 3 keywords with dataset A. The most frequently appeared keyword was “Walk” (N=76) followed by “physical activity” (N=69) and subsequently “exercise” (N=50). No significant difference in the activity keywords was observed among the three context categories of both dataset A and dataset B.

## 4. Discussion

We developed an initial semantic model that comprises of 4 semantic components for



the physical activity domain by analyzing 302 physical activity questions. Our preliminary evaluation showed that this model has the potential to serve as a framework for structuring physical activity data. However, it also revealed the additional context areas that physical activity questions can be related to, mostly psychological aspects of dealing with physical activities such as motivation level and exercise addiction. We plan to collect and review additional activity questions to evaluate this semantic model more thoroughly and to augment it with additional context categories.

High concept coverage of the activity keywords provided by the UMLS Methathesaurus is promising, but it also indicates the need for a sophisticated text processing pipeline that performs the parsing and the mapping of activity keywords with high accuracy. Our prior work on phenotypic and exposure data standardization struggled with the variables related to physical activities. This was caused in part by designing the standardization pipeline in such a way that MetaMap handles identifying and mapping activity keywords to the UMLS Metathesaurus. Failure to produce correct concept mappings was one of the major reasons for failed standardization in this domain. For example, in this study, MetaMap failed to map 81 activity keywords to corresponding concepts. However, we were able to find acceptable matches for the majority (N=66) of those failed mappings via manual mapping.

We did not observe any major differences in the activity keywords used in different context categories. However, we started noticing certain patterns in the use of qualifiers and the response measures that can potentially be related to different context categories. We will continue this work to develop more sophisticated semantic models that characterize physical activity data at the context level. Future work will also include applying machine-learning approaches to the identification and classification of physical activity data.

## 5. Acknowledgments

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## References

- [1] Center for Disease Control and Prevention. The State Indicator Report on Physical Activity 2014
- [2] S. Ahmad, G. Rukh, T. V. Varga, et al. Gene  $\times$  physical activity interactions in obesity: combined analysis of 111,421 individuals of European ancestry. *PLoS Genet. Public Library of Science*; **9** (2013), e1003607.
- [3] F. S. Collins, H. Varmus. A New Initiative on Precision Medicine. *N Engl J Med*. **372** (2015), 793–795.
- [4] Capturing Social and Behavioral Domains and Measures in Electronic Health Records: Phase 2 | The National Academies Press. 2014.
- [5] dbGaP - NCBI. Available from: <http://www.ncbi.nlm.nih.gov/gap>
- [6] S. Doan, K.W. Lin, M. Conway, et al. PhenDisco: phenotype discovery system for the database of genotypes and phenotypes. *J Am Med Inform Assoc*. **21** (2013), 31–36.
- [7] P.J. Stover, W.R. Harlan, J.A. Hammond, et al, PhenX: a toolkit for interdisciplinary genetics research. *Curr Opin Lipidol*. **21** (2010), 136–140.
- [8] PhenX: consensus measures for Phenotypes and eXposures. <https://www.phenxtoolkit.org/>
- [9] National Health and Nutrition Examination Survey (NHNES). <http://www.cdc.gov/nchs/nhanes.htm>
- [10] Rapid Assessment of Physical Activity (RAPA). <http://depts.washington.edu/hprc/rapa>
- [11] National Cancer Institute. caDSR CDE Browser. <https://cdebrowser.nci.nih.gov/CDEBrowser/>
- [12] UMLS Metathesaurus fact sheet. 2013. <http://www.nlm.nih.gov/pubs/factsheets/umlsmeta.html>
- [13] MetaMap - A Tool For Recognizing UMLS Concepts in Text. <http://metamap.nlm.nih.gov/>

# Event Reports Promoting Root Cause Analysis

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**Abstract.** Improving health is the sole objective of medical care. Unfortunately, mishaps or patient safety events happen during the care. If the safety events were collected effectively, they would help identify patterns, underlying causes, and ultimately generate proactive and remedial solutions for prevention of recurrence. Based on the AHRQ Common Formats, we examine the quality of patient safety incident reports and describe the initial data requirement that can support and accelerate effective root cause analysis. The ultimate goal is to develop a knowledge base of patient safety events and their common solutions which can be readily available for sharing and learning.

**Keywords.** Patient safety event, incident reporting system, data quality, root cause analysis (RCA), AHRQ Common Formats

## 1. Introduction

Patient safety events are serious threats to health care. Recent evidence based estimate of the annual number of deaths in the US is over 400,000 associated with preventable medical errors in hospitals [1]. The seminal report, *To Err Is Human: Building A Safer Health System*, significantly raised the awareness of patient safety events and underlined a need for a culture of patient safety that would view these events as learning opportunities – a major shift from blame and shame to analyzing root causes of these preventable safety events and achieving improved delivery of health care through error prevention [2]. Among the reporters of patient safety events, nurses, as a major group of contributors, generate over 70% the overall reports [3].

Defined by WHO, “*Patient safety incident is an event or circumstance that could have resulted, or did result, in unnecessary harm to a patient*”[4]. A patient safety incident can be a reportable circumstance including near miss, no harm incident or harmful incident (adverse event). One of the major obstacles in learning lessons from patient safety incident reporting lies in the absence of a universally agreed taxonomy to define, name and categorize the range of possible incidents, their contributing factors and consequences [5]. If the patient safety data are collected effectively in a structured format, it would be easier to learn from them, identify patterns, underlying causes, and learn from their threats to patient safety, and ultimately generate proactive and remedial solutions in future [6] [7]. In practice, an effective and practical way to learn from the

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patient safety events is through incident reporting systems, where error data is collected in structured format [6]. The ultimate purpose of a reporting system is to collect, analyze and learn from the existing mistakes [8]. Yet the effectiveness of such systems remains unclear in terms of effective learning [8]. The purpose of this project was to examine how patient safety event reporting could help accelerate or support effective root cause analysis (RCA) of patient safety incidents and ultimately an organizational learning rather than merely counting the event occurrence [9]. This project benefits the reporters and may increase the awareness of patient safety reporting through the interaction with nursing informatics communities.

## 2. Reporting an Event

Toward successful learning from the event reporting, it depends upon the following four basic activities [10] [11].

1. *Data input*. It should be discrete and non-punitive to enhance safety culture.
2. *The data*. It is vital that reporter has the opportunity to narrate his own version of events. Such data would express true nature of the incident and facilitate better understanding of the factors linked to the incident.
3. *Analysis*. The analysis turns a report into a lesson. Patient safety initiatives of investigating and analyzing incidents are critical to get into the root causes of the incident and how these can be prevented in the future.
4. *Feedback*. The goal of feedback is to learn from mistakes, and to ensure that the systems are improved for better patient safety in the future.

All the personnel involved in reporting, including nurses, physicians and other healthcare providers, even patients and family members, need to share a culture of safety and improvement that would encourage event reporting. The reported incidents must be analyzed in a timely fashion, and the results must be communicated back to the reporters and to the rest of the system for improvements [4].

Standardization and better management of information on patient safety incidents are highly recommended to develop the strategies for reducing the risk of preventable medical incidents [12]. In the US, patient safety organizations (PSOs) are utilizing the Common Formats (released by The Agency for Healthcare Research and Quality, AHRQ) intended to enhance healthcare quality improvement efforts by creation of a network of patient safety databases where patient safety event can be reported voluntarily and be analyzed to reduce the risk of medical errors [13]. The AHRQ Common Formats (CF) include generic and event-specific forms. Generic reporting forms collect general contributing factors and risk factors in a structured format and allow using brief descriptive text to document the specific details of the patient safety event. The event-specific forms allow reporting of contributing factors that are unique to the event type including the degree of harm and applicable preventive measures.

## 3. Reporting Quality of Patient Safety Events

A major barrier to patient safety research appears to be the lack of reliable information on patient safety events [8]. Quality of data has been a major concern. Effectiveness of the data is largely impacted by the process of data entry, a critical factor in determining the utilization of the data in future [14]. Reporting incomplete data (omission error) or incorrect data (error rate) were identified as leading causes of unreliable information in such systems [15]. We compared two data sources to reveal the reporting quality of

patient safety events, as shown in Table 1. Analysis between the two data sets indicates the lack of accuracy and completeness in reporting patient fall in hospital systems. An overwhelming portion of “unknown” answers as well as the questions that were “not answered” are typical in the current reporting systems.

**Table 1.** Percentage of “unknown” answers and “not answered” questions

Common Formats: Patient Fall Questions	University based Hospital System (364 cases)	Hospital Systems reporting to a state PSO (373 cases)
	Unknown	Unknown + Not Answered
Q1. Was the fall unassisted or assisted	0.82%	3.75%
Q2. Was the fall observed?	11.8%	4.02%
Q4. Did the patient sustain physical injury as a result of fall?	16.48%	9.38%
Q6. Prior to the fall, what was the patient doing or trying to do?	16.2%	25.2%
Q7. Prior to the fall, was a fall risk assessment documented?	0.54%	35.65%
Q9. At the time of the fall, were any of the following risk factors present?	63.18%	68.63%
Q10. Which of the following were in place and being used to prevent falls for this patient?	40.93%	34.58%
Q11. At the time of fall, was the patient on medication known to increase the risk of fall?	90.1%	80.16%
Q13. Did restraints, bedrails, or other physical device contribute to the fall?	37.63%	39.63%

Note: Q3, Q5, Q8 and Q12 are child questions, their availabilities depend on the positive answers to their individual parent questions.

The results of the comparison are consistent with the previous issues of underreporting and low-quality reporting. However, this pilot study is based on the AHRQ CF for evaluating the quality of reported patient safety data. There has been a compelling need for improving the quality of patient safety incident reports. Usually, such reports carry poor descriptions of incidents as well as missing vital information, which can adversely affect the outcome of a subsequent RCA [16]. Frontline reporters, usually nurses, tend to choose “other”, “miscellaneous” or “unknown” if given such options to choose from [3]. The stressful nature of preventable patient safety incidents under which the healthcare providers work might be one of the reasons why we are seeing a lot of unknown and unanswered questions in this study. In addition, fears of legal consequences, lacking knowledge about what is done with collected data, lack of feedback on the results of data analysis, attitude towards the relevance of data collection, and unsatisfactory working conditions are few of the leading barriers to incident reporting [17]. It has been recommended that enhancing targeted formal training of staff members in patient safety incident classification and reporting, and presently reporting are insightful for improving the quality of incident reports [16].

#### 4. Root Cause Analysis (RCA)

Detection of underlying cause of the patient safety incidents is the key to minimizing the risk of their recurrence. RCA is the way of retrospective analysis of the patient safety incidents, near misses and sentinel events to understand the underlying causes [18]. It fits with the concept of turning a safety incident into a lesson. RCA is a step-by-step approach to review the chronology of events and contributing factors until the root cause is identified, often including the following steps: identify the incident to be analyzed, organize a team to carry out the RCA, study the work processes, collect the

facts, search for causes, take action, and evaluate the actions taken [19]. Current CF, taking patient fall as an example, collect the initial information which can be used to identify the incidents and determine their relative priority for further RCA.

To promote the interoperability between patient safety event reports and consequential RCA, questions regarding the type of fall risk assessment tool used and identified risk level should be included in the form. These data elements identify the recommended fall prevention interventions and thus can lead to more details on the clinical context of an incident. We recommend adding a question that asks particularly about the environmental factors that could have led the patient to fall in addition to the risk factors listed in the CF: Patient Fall. Our analysis suggests that the majority of reporters did not know if any fall related medications were the reason for a fall. There are certain types of medication that have been known to increase the risk fall. Thus, we recommend the question that particularly asks if any such a medication has been administered 12 hours before the incident. Medication is one of the modifiable risk factors of patient fall and related injuries and should be reflected with certain level of details in the design of fall preventive measures.

Based on the interoperable data fields, an organized RCA team can further investigate the facts about the incident by reviewing the report, interviewing the reporter or even patient as deemed necessary, and reviewing witness statements, patient's medical records, and the work protocols and processes to determine all the possible causes that could have led to the particular incident.

## 5. Discussion

Data quality has been a barrier to improving healthcare quality through the development of an effective patient safety event reporting system. AHRQ CF serve as a common structure to the data elements that are most important to identify the risks and causal factors of safety events. Structured data permit sorting of patient safety events for event analysis, pattern analysis and trend analysis. A significant challenge to increase data quality remains in the development of a unified domain knowledge base where all reports are organized and the effective use of the data. In sum, more efforts are needed for improving reporting quality, sharing and learning from patient safety events across the individual systems. Realization of relevance and purpose of incident reporting, and adaptation of culture of safety across healthcare institutions and societies are critical to learn from patient safety events.

The present pilot study serves as an initial step toward an advanced patient safety reporting system which can raise awareness among the frontline reporters to reduce "unknown" and "miscellaneous" responses. As CF are subject to further revision, our suggestions based on the data analysis may be helpful for improvement in the reporting quality of patient safety events and the utilization of data elements in eventual RCA. It is a general belief that good quality of reporting can accelerate the development of the real-time information, guidance, and tools that will translate patient safety data into safer clinical practices.

Quality and safety are central topics of nowadays' healthcare practice and research. Nurses, who play a key role in creating, maintaining, and analyzing patient data, could lead the research through an informatics perspective. Fighting against patient safety incidents is a global endeavor which relies on strategies of collaboration, coordination, and cooperation on healthcare practice and research. Our team calls for collaborations

from nurses of all disciplines across the world in providing insightful experience, suggestion, or comment on their event reporting systems.

## 6. Acknowledgments

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## References

- [1] J.T. James. A new, evidence-based estimate of patient harms associated with hospital care. *Journal of patient safety*. 2013 Sep;9(3):122-8. PubMed PMID: 23860193.
- [2] K. Hershey. Culture of safety. *The Nursing clinics of North America*. 2015 Mar;50(1):139-52. PubMed PMID: 25680493.
- [3] Y. Gong. Data consistency in a voluntary medical incident reporting system. *Journal of Medical Systems*. 2009.
- [4] I. Larizgoitia, Bouesseau M.C., Kelley E. WHO Efforts to Promote Reporting of Adverse Events and Global Learning. *Journal of public health research*. 2013 Dec 1;2(3):e29. PubMed PMID: 25170500. Pubmed Central PMCID: 4147748.
- [5] S.L. Donaldson. An international language for patient safety: Global progress in patient safety requires classification of key concepts. *International journal for quality in health care : journal of the International Society for Quality in Health Care / ISQua*. 2009 Feb;21(1):1. PubMed PMID: 19147594. Pubmed Central PMCID: 2638756.
- [6] H.J. Murff, Patel V.L., Hripcsak G., Bates D.W. Detecting adverse events for patient safety research: a review of current methodologies. *JBI*. 2003;36(1-2):131-43.
- [7] L. Hua, Gong Y. Developing a user-centered voluntary medical incident reporting system. *Studies in health technology and informatics*. 2010;160(Pt 1):203-7. PubMed PMID: 20841678.
- [8] C. Liang, Gong Y. On Building an Ontological Knowledge Base for Managing Patient Safety Events. *Studies in health technology and informatics*. 2015;216:202-6. PubMed PMID: 26262039.
- [9] J.E. Anderson, Kodate N., Walters R., Dodds A. Can incident reporting improve safety? Healthcare practitioners' views of the effectiveness of incident reporting. *International journal for quality in health care : journal of the International Society for Quality in Health Care / ISQua*. 2013 Apr;25(2):141-50. PubMed PMID: 23335058.
- [10] T.-A.S. Seckler-Walker J. Clinical incident reporting. In: C V, editor. *Clinical Risk Management: Enhancing Patient Safety* 2nd ed. ed. London: BMJ Books; 2001. p. 419-38.
- [11] R.P. Mahajan. Critical incident reporting and learning. *British journal of anaesthesia*. 2010 Jul;105(1):69-75. PubMed PMID: 20551028.
- [12] A. Chang, Schyve P.M., Croteau R.J., O'Leary D.S., Loeb J.M. The JCAHO patient safety event taxonomy: a standardized terminology and classification schema for near misses and adverse events. *International journal for quality in health care : journal of the International Society for Quality in Health Care / ISQua*. 2005 Apr;17(2):95-105. PubMed PMID: 15723817.
- [13] C.M. Clancy. Common formats allow uniform collection and reporting of patient safety data by patient safety organizations. *American journal of medical quality : the official journal of the American College of Medical Quality*. 2010 Jan-Feb;25(1):73-5. PubMed PMID: 20042765.
- [14] S.H. Walsh. The clinician's perspective on electronic health records and how they can affect patient care. *Bmj*. 2004 May 15;328(7449):1184-7. PubMed PMID: 15142929. Pubmed Central PMCID: 411103.
- [15] A.L. Shroyer, Edwards F.H., Grover F.L. Updates to the Data Quality Review Program: the Society of Thoracic Surgeons Adult Cardiac National Database. *The Annals of thoracic surgery*. 1998 May;65(5):1494-7. PubMed PMID: 9594906.
- [16] M. Khorsandi, Skouras C., Beatson K., Alijani A. Quality review of an adverse incident reporting system and root cause analysis of serious adverse surgical incidents in a teaching hospital of Scotland. *Patient safety in surgery*. 2012;6(1):21. PubMed PMID: 22931540. Pubmed Central PMCID: 3499447.
- [17] J. Benn, Arnold G., Wei I., Riley C., Aleva F. Using quality indicators in anaesthesia: feeding back data to improve care. *British journal of anaesthesia*. 2012 Jul;109(1):80-91. PubMed PMID: 22661749.
- [18] D. Nicolini, Waring J., Mengis J. Policy and practice in the use of root cause analysis to investigate clinical adverse events: mind the gap. *Social science & medicine*. 2011 Jul;73(2):217-25. PubMed PMID: 21683494.
- [19] M.F. Amo. Root cause analysis. A tool for understanding why accidents occur. *Balance*. 1998 Jul-Aug;2(5):12-5. PubMed PMID: 10186013.

# Outcome Calculations Based on Nursing Documentation in the First Generation of Electronic Health Records in the Netherlands

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**Abstract.** Objectives. Previous studies regarding nursing documentation focused primarily on documentation quality, for instance, in terms of the accuracy of the documentation. The combination between accuracy measurements and the quality and frequencies of outcome variables such as the length of the hospital stay were only minimally addressed. Method. An audit of 300 randomly selected digital nursing records of patients (age of >70 years) admitted between 2013-2014 for hip surgery in two orthopaedic wards of a general Dutch hospital was conducted. Results. Nursing diagnoses: Impaired tissue perfusion (wound), Pressure ulcer, and Deficient fluid volume had significant influence on the length of the hospital stay. Conclusion. Nursing process documentation can be used for outcome calculations. Nevertheless, in the first generation of electronic health records, nursing diagnoses were not documented in a standardized manner (First generation 2010-2015; the first generation of electronic records implemented in clinical practice in the Netherlands).

**Keywords.** nursing documentation, outcome calculation, nursing process, orthopedic surgery, electronic health record.

## 1. Introduction

Studies addressing outcome calculations based on the Nursing Process Documentation (NPD) in electronic health records (EHRs) are inadequate [1], and the influence of nursing diagnoses on the length of stay (LOS) is unknown [2]. Reliable and valid analyses on the LOS as a dependent outcome variable rely on accurately documented nursing diagnoses, interventions, and background information for care planning and evaluations [3].

The explanatory power of documented nursing diagnoses can be calculated based on accurately stored nursing information in EHRs [4,5]. Accurate nursing (risk) diagnoses can be employed for early detection in care plans to prevent patients' health complications. Early interventions to solve issues in nursing diagnoses may positively effect hospital efficiency and, therefore, decrease hospital expenditures. Nursing care must be documented in a standardized nursing language for valid outcome calculations [5, 6]. Current developments of EHRs require the use of Standardized Nursing

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Language (SNL). SNL describes the literature-based Nursing Process [7], which is taught and implemented utilizing a standardized nursing language. It includes assessment, nursing diagnoses, nursing interventions, and nursing outcomes that are established in scientifically based nursing classifications [8].

Only on the basis of classification does the Nursing Process serve its purpose: an application of scientific knowledge being appropriate to the clinical patient situation that is defined and validated as concepts [9, 10].

## 2. Objectives

This study focused on the implementation of nursing documentation in EHRs in order to evaluate the explanatory power of nursing diagnoses on the LOS in hip fracture patients admitted for surgery in orthopedic hospital settings. The research question was: “What is the predictive power of nursing diagnoses documented in electronic health records on the depended variable Length of Hospital Stay (LOS)?”

## 3. Materials and Methods

A retrospective cross-sectional record audit was performed by using the D-Catch instrument for the assessment of nursing documentation in EHRs. Two independent data collectors performed the audit and came to a consensus on the scores based on the D-Catch guidelines [11]. The predictive power of nursing diagnoses on the LOS was subsequently calculated.

## 4. Sample and Population

An audit of 300 randomly selected digital nursing records of patients (age of >70 years) admitted between 2013-2014 for hip surgery in two orthopaedic wards of a general Dutch hospital was performed. Records were digitally archived and selected by digital blind random sampling based on record number. The sample was selected from an EHR software that is used in 50% (n= 45) of all Dutch hospitals (N= 90).

## 5. Data-analyses

With the D-Catch instrument, a total of 300 EHR's of elderly patients (age > 70) with hip fractures were examined. Measurements of nursing records according to the D-Catch variables were carried out in three phases: admission phase, post-operative phase, and the phase of discharge, i.e., the last day of a patient's hospital stay. Interrater reliability of the D-Catch instrument was calculated by using Cohen's weighted kappa. The Advanced Nursing Process documentation was subdivided into: a) documentation in score lists such as delirium scores, Visual Analogue Scales for pain measurement, SNAQ-scores for malnutrition, and scales for pressure ulcer measurements; and b) Nursing Process Documentation in free text. In the EHR software, no technical or content associations existed between score lists, nursing diagnoses, nursing interventions, or nursing outcomes. Therefore, connecting and inter-correlating nursing information required the researchers to use the D-Catch instrument for nursing documentation auditing [11]. The aforementioned score lists and the documentation in free text analyzed the prevalence of nursing diagnoses in the post-operative phase by using consensus scores.

Multivariate logistic regression analysis explored independent explanatory factors for the LOS. The independent variables included: medical diagnoses (co-morbidities), medical treatment, and nursing diagnosis. The dependent variable was the length of the hospital stay.



Less than 25 total rates of medical diagnoses, co-morbidities, medical treatments, and nursing diagnoses were excluded from the analysis. There are 21 explanatory variables and 262 cases included for further analysis. Thirty-eight cases were excluded as the information in the record was not feasible to use for final analysis.

Bayesian Model Averaging was used for variable selection by averaging the best models in the model class according to approximate posterior model probability. The counts of the number of days hospitalized forms the response which is modeled by Poisson regression including a dispersion parameter for increasing variance. After controlling for other explanatory variables, the exponent of the estimated parameters are interpreted as the rate ratio which is the expected number of days hospitalized considering the diagnosis related to the number of days hospitalized without the diagnosis.

## 6. Ethical considerations

The ethic committee of the hospital approved the research plan. To guarantee patients' anonymity, nursing documentations were anonymized and coded.

## 7. Results

In most records, the admission and the discharge documentation were incomplete or did not exist, and explanatory power calculations based on admission or discharge data were not possible. The nature of nurses' documentation in the current EHR's is narrative and unstructured with numerous redundancies. However, post-operative nursing diagnosis documentation was determined to be feasible for use as a final analysis.

Results are calculated from modeling the days hospitalized with Poisson regression in terms of the estimated parameters, their standard errors (SE), t-value, significance measured by the p-value, the rate ratio, and their 95% Confidence interval (Table 1).

Analyses of electronically stored nursing diagnosis documentation revealed the prevalence of post-operative nursing diagnoses that had a positive significant influence on the LOS. The most prevalent nursing diagnoses were: Nausea, Acute pain, Deficient fluid volume, Imbalanced nutrition less than body requirements, and Impaired skin integrity (pressure ulcer). The number of nursing diagnoses documented in the EHR also had a significant influence on the LOS; however, documented medical treatments had no significant influence. Co-morbidities documented in medical diagnoses related to the LOS were ascertained to significantly influence those patients experiencing cardiac disease, stroke, and diabetes.

## 8. Discussion

New knowledge is required regarding the effects of SNL implementation, education, and training on the quality of the outcome documentation; more important is to know if SNL has an influence on actual care quality and patient outcomes.

It is unknown if SNL, assisted by computer tools, has an influence on actual care quality and patient outcomes [10, 11]. To evaluate nursing outcomes, controlled experimental studies are suggested. New studies on nursing-sensitive patient outcomes should focus on teaching nurses how to use SNLs in practice and compare documentation of the findings of EHRs with nurses' perceptions and experiences.

Nursing diagnoses demonstrated having explanatory power on the LOS, and the prevalence of nursing diagnoses was strongly related to the LOS. Yet, the assumption

is that the Nursing Process with valid assessments, evidence-based nursing diagnoses, interventions, and nursing-sensitive patient outcomes based on SNL has not yet been entirely implemented in the current generation of EHR's. One of the difficulties for nurses is how to make the transfer from their own reasoning process related to the assessment of the patient into SNL, which defines patient care needs as nursing diagnoses, nursing interventions, and nursing-sensitive patient outcomes, as the documentation systems do not provide SNLs. Studies addressing effects of the use of SNL by nurses in clinical practice are lacking, therefore, it is ambiguous whether using SNL applied to Nursing Process documentation in the EHR leads to improved patient outcomes, therefore, it is an important topic for future research.

**Table 1.** Results from modeling days hospitalized by Poisson regression in terms of the estimated parameters, their standard errors (SE), t-value, significance measured by p-value, the rate ratio, and their 95% Confidence interval.

	Estimate	SE	t-value	P-value	RR		
					Estimate	CLL	CLR
(Intercept)	1,2688	0,3657	3,47	6,00E-04	3,5567	1,7312	7,2595
Age	0,0103	0,0043	2,3788	0,0181	1,0104	1,0018	1,019
Impaired tissue perfusion (wound)	0,3423	0,0768	4,46	0,0000	1,4082	1,2091	1,6338
Pressure ulcer	0,2607	0,0808	3,2261	0,0014	1,2979	1,1059	1,5183
Deficient fluid volume	0,3464	0,0899	3,8546	1,00E-04	1,414	1,1828	1,6826
Diabetes	0,214	0,0672	3,1848	0,0016	1,2386	1,0843	1,4111
Dementia	-0,1984	0,0782	-2,5378	0,0118	0,8201	0,7021	0,9539

## References

- [1] K. Saranto & U.M. Kinnunen, Evaluating nursing documentation – research designs and methods: Systematic review, *Journal of Advanced Nursing*, 65(3), (2009), 464-476.
- [2] F. Germini, E. Vellone, G. Venturini & R. Alvaro, Nursing outcomes: instruments for visualizing the effectiveness of nursing care, *Professioni infermieristiche*, 63(4), (2010), 205-210.
- [3] J.M. Brokel, K. Avant & M. Odenbreit, The value of nursing diagnoses in electronic health records. In T. H. Herdman (Ed.), *NANDA International nursing diagnoses: Definitions and classification 2012-2014* (pp. 99-113), Wiley-Blackwell, Oxford, 2012.
- [4] M. Bruylants, W. Paans, H. Hediger & M. Muller-Staub, Effects on the quality of the nursing care process through an educational program and the use of electronic nursing documentation, *International journal of nursing knowledge*, 24(3), (2013)163-170, doi: 10.1111/j.2047-3095.2013.01248.x.
- [5] J.M. Welton & E.J. Halloran, Nursing diagnoses, diagnosis-related group, and hospital outcomes, *Journal of Nursing Administration*, 35(12), (2005)541-549.
- [6] A. Freitas, T. Silva-Costa, F. Lopes, I. Garcia-Lema, A. Teixeira-Pinto, P. Brazdil & A. Costa-Pereira, Factors influencing hospital high length of stay outliers, *BMC health services research*, 12, (2012)265, doi: 10.1186/1472-6963-12-265.
- [7] B.J. Ackley & G.B. Ladwig, *Nursing diagnosis handbook: An evidence-based guide to planning care* (10 ed.), Mosby/Elsevier, St. Louis, 2014.
- [8] M. Müller-Staub & W. Paans, Diagnosis-Related Groups and Electronic Nursing Documentation: Risks and Chances, *Comput Inform Nurs*, (2010), doi: 1097/NCN.0b013e3181fc814.
- [9] G. Keenan, E. Yakel, K. Dunn Lopez, D. Tschannen & Y.B. Ford, Challenges to nurses' efforts of retrieving, documenting, and communicating patient care information, *Journal of the American Medical Informatics Association*, (2013)20(2)245-251 doi: 10.1136/amiainjnl-2012-000894.
- [10] C. Urquhart, R. Currell, M.J. Grant & N.R. Hardiker, Nursing record systems: effects on nursing practice and healthcare outcomes, *Cochrane Database Systematic Review*, 1, (2009) CD002099.
- [11] W. Paans, W. Sermeus, R.M. Nieweg & C.P. van der Schans, D-Catch instrument: development and psychometric testing of a measurement instrument for nursing documentation in hospitals, *Journal of Advanced Nursing*, 66(6), (2010)1388-1400, doi: 10.1111/j.1365-2648.2010.05302.x.

# Testing of Triggers by Data Mining of Epilepsy Patients' Structured Nursing Records

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**Abstract.** Epilepsies are neurological disorders with many different etiologies, symptoms and prognoses. Care for epilepsy patients should be uniform, homogeneous and optimized to avoid unnecessary hospitalizations or even worse outcomes. FinCC-based structured nursing documentation facilitates analyzing patient profiles and populations, developing care processes, nursing documentation, decision-making, and data reuse. This research aimed to determine the potential for finding possible risks for epilepsy patients' health and well-being from the structured nursing data with defined triggers for epilepsy patients. The research data included structured documentation of nursing diagnoses of and interventions for adult epilepsy patients (n=100) at one neurological ward in a university hospital in 2009–2013. The results showed that nurses documented abundantly, and all triggers were mostly found. The study results will be reviewed by the neurological ward nurses to assess the FinCC and highlight the importance of documentation.

**Keywords.** Data mining, text mining, documentation, terminology, trigger

## 1. Introduction

Efforts to improve patient care and make it safer, and to avoid errors and adverse events, have been made for several years. A method of measuring harm, a trigger tool, has been developed [1]. There is also some evidence of developing triggers to be used with epilepsy patients. The triggers (n=38) most frequently mentioned by patients included missing medication, emotional stress, sleep deprivation, fatigue, missing meals, fever, and smoking [2]. In a most recent research 13 triggers were identified on the development of triggers in epilepsy patients. (Table 2) The aim of the triggers was to indicate changes in the epilepsy patient's health and well-being [3]. Also in the patient care for and clinical research of epilepsy patients, an epilepsy and seizure

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ontology has been developed (EpSO), e.g., for patient data entry and clinical free text processing [4].

Uniform terminology is essential for ensuring data quality and data reuse in the documentation of patient care. Structured data in the form of, e.g., classifications, terminologies and nomenclatures, are essential for health care management and service planning, clinical research, and reporting [5]. The same also applies to nursing, where structured documentation has been utilized in the decision-making process and in different terminologies [5-7]. Structured data has been defined in multiple ways, which makes it difficult to group and summarize results of its use [8-9].

In Finland, the national nursing documentation model includes structured nursing documentation in the form of the Finnish Care Classification (FinCC) and a decision-making process in nursing. FinCC is a terminology based on the Clinical Care Classification (CCC) by Virginia Saba, and has been culturally validated by Anneli Ensio. The FinCC consists of the Finnish classification of nursing diagnoses (FiCND), the Finnish classification of nursing interventions (FiCNI) and the Finnish classification of nursing outcomes (FiCNO). Both the FiCND and the FiCNI have 17 components, which, according to CCC, can be divided into four care patterns: health behaviors, psychological, physiological, and functional patterns [10-11].

The number of main categories and sub-categories under each component varies. The FiCND has 88 main categories and 150 subcategories, while the FiCNI has 127 main categories and 180 subcategories. The FinCC has been updated according to a lot of end-user feedback [10-11]. Together with the FinCC expert group, a national project is currently working towards a better usability, acceptability, uniformity and usefulness of the FinCC [11].

Epilepsy is a disease characterized by an enduring predisposition to generate epileptic seizures and by the neurobiological, cognitive, psychological, and social consequences of this condition [12]. All in all, the condition is often manifested in the form of weakening in a person's quality of life and loss of empowerment [13]. Care and care pathways for epilepsy patients should be uniform, homogeneous and optimized in order to avoid unnecessary hospitalization [14] or even suicides in the patient group [15].

The aim of this research is to examine if it is possible to find potential risks for epilepsy patients' health and well-being from the recorded, structured nursing data with defined triggers for epilepsy patients [3].

## 2. Methods

The research data included structured documentation of nursing diagnoses and interventions for adult epilepsy patients (n=100) at one neurological ward in a university hospital during the years 2009–2013. FinCC has been in use in this particular ward since 2009. Data were extracted and delivered in text stored into a secured memory stick by the ICT organization providing services to the hospital. Data and text mining were used as research methods because they are suitable methods for analyzing specifically structured data. SAS (SAS® Content Categorization Studio 12.1) software was utilized.

Research data were mapped with the FinCC (Table 2). Data were imported into an Excel sheet. Using Excel functions, numbers of the components and the main and subcategories were calculated. With TRIM-function, extra spaces were removed from the names of the components and the main and subcategories in the FinCC Excel sheet. Then, by using the COUNTIF-function, it was calculated how many times each of the components and the main and subcategories appeared. Finally, data mining with different search phrases was used to find previously developed triggers [3] from the research data.

### 3. Results

In total, 100 nursing records were reviewed using the triggers. According to text mining, the triggers of cognitive symptoms, socioeconomic problems, quality of social life, and sleep and insomnia were very often found from the nursing documentations (n=100). There were fewer instances of the triggers skin problems, visual symptoms, and hormonal imbalance. (Table 1)

**Table 1.** Epilepsy patients' triggers and trigger frequencies in nursing records

Triggers (n=13)	Nursing records (n=100)
Cognitive symptoms	98
Socioeconomic problems	98
Quality of social life	96
Sleep and insomnia	96
Vitality	93
Headaches	87
Mental symptoms	83
Dizziness	75
Weight fluctuation	70
Bowel symptoms	69
Skin problems	63
Visual symptoms	63
Hormonal imbalance	53

The most frequently used components of nursing diagnoses were coping, sensory and neurologic functions, and coordination of care. In addition, of nursing interventions, the most often used were coping, activity, sensory and neurologic functions, and medication. Nursing diagnoses have been documented less than nursing interventions. Nurses seldom documented nursing diagnosis of a patient's safety, nutrition or metabolic issues. Nursing interventions of metabolic, safety, life cycle or health behavior were poorly documented. (Table 2)

**Table 2.** FinCC components and the frequency of FiCND and FiCNI in nursing records

<b>FinCC components (n=17)</b>	<b>FiCND (fr)</b>	<b>FiCNI (fr)</b>
<b>Coping</b>	1976	2566
<b>Sensory and Neurologic Functions</b>	1126	1965
<b>Coordination of Care</b>	1032	1470
<b>Circulation</b>	492	733
<b>Medication</b>	484	1814
<b>Skin Integrity</b>	367	612
<b>Mental Balance</b>	310	377
<b>Respiration</b>	227	526
<b>Activity</b>	166	2511
<b>Health Behavior</b>	123	101
<b>Secretion</b>	114	1045
<b>Daily Activities</b>	103	641
<b>Fluid Balance</b>	84	711
<b>Life Cycle</b>	51	100
<b>Metabolic</b>	39	30
<b>Nutrition</b>	29	627
<b>Safety</b>	29	72

#### 4. Discussion

In this study two different data schemes of patient documentation were cross-mapped for the purpose of examining if it is possible to find potential risks for epilepsy patients' health and well-being from the recorded, structured nursing data with defined triggers for epilepsy patients. The results of cross-mapping showed that nurses documented notably specific issues, important explicitly to the epilepsy patient. However, some of the triggers occurred more rarely, and this finding requires more examination. Epilepsy is a diverse and multidimensional brain disorder weakening the patient's quality of life and loss of empowerment [12-15]. The object of the triggers was to indicate changes in the epilepsy patient's health and well-being [3]. In order to develop care, patient documentation must also be developed [5]. The results of our study will be reviewed also by the nurses at the neurological ward to show them their trigger documentation and to assess the use of the FinCC. In the following study phase, a minimum data set for the nursing documentation of epilepsy patients will be developed. At the same time also development ideas for the FinCC will be aggregated.

Nurses had used the FinCC in the ward since 2009. According to study results, nurses document the nursing actions and interventions, but to decide proper nursing diagnoses after the assessment of patient's problems is probably still challenging for the nurses. However, in some cases, e.g. the nursing diagnoses for health behavior, was more often used than the nursing intervention of that component. FinCC-based structured nursing documentation facilitates the analysis of patient profiles and populations, development of patient care processes, nursing documentation, decision-making, and data reuse [10-11]. However, in order to make utilization of nursing data feasible, nurses, including nursing administrator, must understand its benefits for the development of better patient care.

Coded data facilitates data mining and knowledge discovery in databases (KDD). By structuring nursing records and documenting exact patient specific information, we get knowledge for e.g. development of care processes, administrative and research purposes, but, ultimately, also for better patient care and patient safety.

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## References

- [1] R.K. Resar, J.D. Rozich, D. Classen, Methodology and rationale for the measurement of harm with trigger tools, *Quality & Safety in Health Care* 12(Suppl II) (2003), ii39–ii45.
- [2] E. Balamurugan, M. Aggarwal, A. Lamba, N. Dang, M. Tripathi, Perceived trigger factors of seizures in persons with epilepsy, *Seizure* 22 (2013), 743–747.
- [3] E. Kivekäs, U.-M. Kinnunen, K. Haatainen, R. Kälviäinen, K. Saranto. Trigger Development for the Improvement of Neurological Patient Care. I.N. Sarkar et al. (Eds.) *MEDINFO 2015; eHealth-enabled Health*, doi:10.3233/978-1-61499-564-7-1116.
- [4] S.S. Sahoo, S.D. Lhatoo, D. K. Gupta, L. Cui, M. Zhao, C. Jayapandian, A. Bozorgi, G.-Q. Zhang, Epilepsy and seizure ontology: towards an epilepsy informatics infrastructure for clinical research and patient care, *Journal of the American Medical Informatics Association* 21 (2014), 82–89. Doi:10.1136/amiajnl-2013-001696.
- [5] K. Häyrynen, K. Saranto, P. Nykänen, Definition, structure, content, use and impacts of electronic health records: A review of the research literature, *International Journal of Medical Informatics* 77 (2008), 291–304.
- [6] K. Saranto, U.-M. Kinnunen, E. Kivekäs, A.-M. Lappalainen, P. Liljamo, E. Rajalahti, H. Hyppönen, Impacts of structuring nursing records: a systematic review, *Scandinavian Journal of Caring Sciences* (2013), doi: 10.1111/scs.12094.
- [7] ISO 2014. *International standard ISO 18104:2014(E)*. Health informatics — Categorial structures for representation of nursing diagnoses and nursing actions in terminological systems.
- [8] H. Hyppönen, K. Saranto, R. Vuokko, P. Mäkelä-Bengs, P. Doupi, M. Lindqvist, M. Mäkelä, Impacts of structuring the electronic health record: A systematic review protocol and results of previous reviews, *International Journal of Medical Informatics* 83 (2014), 159–169.
- [9] H. Hyppönen, R. Vuokko, P. Doupi, P. Mäkelä-Bengs (Eds.). *Structuring of the electronic patient record. Methods, assessment practices and impacts*. National Institute for Health and Welfare. Report 31/2014. 143 pages. Helsinki 2014. ISBN 978-952-302-380-2 (printed), ISBN 978-952-302-381-9 (online)
- [10] P. Liljamo, U.-M. Kinnunen, A. Ensio. *FinCC classification system, user's guide. FiCND 3.0, FiCNI 3.0, FiCNO 1.0*. National Institute for Health and Welfare. Classifications, terminologies and statistic guidelines 2/2012. Helsinki 2012. Available from: [http://www.julkari.fi/bitstream/handle/10024/90804/URN\\_ISBN\\_978-952-245-675-5.pdf?sequence=1](http://www.julkari.fi/bitstream/handle/10024/90804/URN_ISBN_978-952-245-675-5.pdf?sequence=1)
- [11] U.-M. Kinnunen, K. Junttila, P. Liljamo, A.L. Sonninen, M. Härkönen, A. Ensio, FinCC and the National Documentation Model in EHR - User Feedback and Development Suggestions, in Kaija Saranto, Charlotte A. Weaver, Polun Chang, *Nursing Informatics 2014, East Meets West eSMART+*, *Proceedings of the 12th International Congress on Nursing Informatics*, Taipei, Taiwan, June 21–25, 2014, IOS Press BV, Netherlands, 2014. ISBN 978-1-61499-414-5 (print), ISBN 978-1-61499-415-2 (online).
- [12] The Finnish Medical Society Duodecim, Epilepsies (adult), *Current Care Guidelines*, 2014.
- [13] M. Persenius, I. Rystedt, B. Wilde-Larsson, C. Bååth, Quality of life and sense of coherence in young people and adults with uncomplicated epilepsy: A longitudinal study, *Epilepsy & Behavior* (2015), <http://dx.doi.org/10.1016/j.yebeh.2015.04.002>
- [14] M. Giroit, H. Hubert, F. Richard, M. Chochoi, D. Deplanque, P. Derambure, P. Girardie, N. Pauchet, S. Leblanc, A. Lim, E. Wiel, P. Williate, W. Szurhaj, X. Lenne, L. Tyvaert, Use of emergency departments by known epileptic patients: An underestimated problem? *Epilepsy Research* 113(2015), 1-4.
- [15] A. Erlangsen, E. Stenager, Y. Conwell, Physical diseases as predictors of suicide in older adults: a nationwide, register-based cohort study, *Social Psychiatry and Psychiatric Epidemiology* (2015), doi:10.1007/s00127-015-1051-0

# Standardized Nursing Documentation Supports Evidence-Based Nursing Management

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**Abstract.** Nursing documentation is crucial to high quality, effective and safe nursing care. According to earlier studies nursing documentation practices vary and nursing classifications used in electronic patient records (EPR) are not yet standardized internationally nor nationally. A unified national model for documenting patient care improves information flow in nursing practice, management, research and development toward evidence-based nursing care. Nursing documentation quality, accuracy and development requires follow-up and evaluation. An audit instrument is used in the Kuopio University Hospital (KUH) when evaluating nursing documentation. The results of the auditing process suggest that the national nursing documentation model fulfills nurses' expectations of electronic tools, facilitating their important documentation duty. This paper discusses the importance of using information about nursing documentation and how we can take advantage of structural information in evidence-based nursing management.

**Keywords.** Nursing documentation, Finnish Care Classification system (FinCC), evidence based nursing care, evaluation, nursing management

## 1. Introduction

Nursing documentation constitutes an integral part of the nurse's daily work (1). The use of an electronic patient record (EPR) and nursing documentation have been shown to lead to higher quality, more comprehensive and more patient-oriented documentation than paper-based nursing documentation (2). In standardized electronic nursing documentation, the structure of the documentation follows the nursing process and also uses standardized terminologies in describing the various phases of the nursing process (3).

The nursing process model has been used as a framework for nursing and nursing documentation. The nursing process model involves assessing, planning, implementing and evaluating patient situations with the ultimate goal of preventing or resolving problematic situations (4). The American Nurses Association describes the nursing process according to six steps: assessment, diagnosis, outcomes identification, planning, implementation and evaluation (5). Earlier studies have reported that nursing documentation has conformed to the nursing process (6), and the use of the nursing process has been shown to improve legislative compliance and the completeness of



nursing documentation (7). In conforming to the nursing process, classifications are still required to standardize nursing documentation (8). Standardization of nursing diagnoses and nursing interventions for documentation purposes has been shown to make the contribution of nursing visible and quantifiable (9).

In Finland, a national model for documenting nursing care was developed between 2005 and 2009 (10). The model incorporates the WHO nursing process model as well as nursing classifications developed in the Clinical Care Classification by Dr. Virginia Saba (11). The Finnish Care Classification (FinCC) includes the categories of Nursing Care Components, Nursing Diagnoses, Nursing Intervention and Nursing Outcomes. The national model has been implemented in various EPR systems in hospitals and health centers in Finland.

Nursing documentation is written evidence of nursing implementation and should show the information used for nursing decisions, as well as the outcomes achieved (4). Saranto & Kinnunen (2009) concluded that the use of structured nursing terminology promotes the standardization of nursing documentation.

Structured nursing documentation produces data from nursing practice. Utilizing other statistical information, we can also show nursing outcomes. Nursing's mission, vision, values, and strategic plan must align with the organization's priorities to improve the organization's performance. Nursing managers are in a lead role in the development of the nursing process in work communities. They must develop structures, process and expectations for clinical nursing, as well as enable input and involvement throughout the organization. Structured statistical information from nursing can be utilized in the development of evidence-based nursing at the unit, service unit, and organizational level (12).

The purpose of this paper is to discuss the importance of utilizing nursing documentation and especially how we can take advantage of structural information in evidence-based nursing management. Crucial aspects include the advantages gained from obtaining nursing process information and improve nursing documentation.

## **2. Methods**

The gradual introduction of the EPR at Kuopio University Hospital (KUH) took place between 1998 and 2007. KUH was involved in several national EPR development projects. The model for systematic documentation was introduced in stages between 2005 and 2010.

A nursing reporting system has been incorporated into the EPR in KUH. Nurses record nursing-related information to the patients' EPR on a daily basis. With the help of the EPR this structured information on nursing care can be compiled into statistical information on nursing performance. Information can also be produced at the unit, service unit and organization level in real time. Statistical reports on the care delivered can be retrieved directly from the EPR databases.

One aspect of the EPR reporting system is the provision of nursing documentation reports. These reports include reports on nursing documentation, structured according to the nursing process, at the care component level, using the main classes and subclasses of the FinCC. In addition, information on the effectiveness of patient care can be compiled into reports, detailing for example changes in patient conditions. Nurses evaluate the patient's condition as either better, worse or unchanged.

This system produces information on the number of patients, nursing care components, and the main FinCC classes and subclasses, as well as how frequently the different stages of the nursing process were used. Reports can be produced according to the organization structure and according to specified time periods.

The following searches were carried out as examples of the possibilities for using the FinCC data:

**1. Search rules:**

Nursing Diagnosis: the proportion of care components and patients  
 Start date: 1 January  
 End date: 31 May  
 Organization level is KUH (Figure 1)

**2. Search rules:**

*Nursing Diagnosis: the proportion of care components and patients*  
 Start date: 1 January  
 End date: 31 May  
 Service unit is the surgery unit, and the unit is Department of Gastroenterologic Surgery ward (Figure 2)

**3. Search rules:**

Nursing documentation: Nursing interventions: the degree of main class and subclass and patients  
 Start date: 1 January  
 End date: 31 May  
 Service unit is the surgery unit, and the unit is Department of Gastroenterologic Surgery ward (Table 1)

The results are presented via graphics (Figures 1 and 2) showing the results at the University Hospital level, service unit and unit level for comparison.

**3. Results**

Figures 1 and 2 indicate the situation in 60 units (hospital level) and describe the nursing diagnoses defined in nursing on the Gastroenterologic Surgery Ward over a five-month period (Figure 1 and 2).

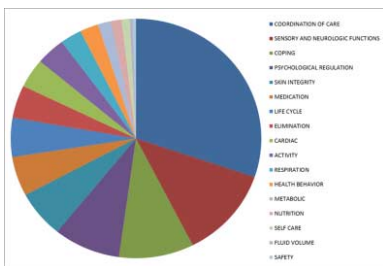


Figure1. Nursing Diagnoses. KUH 60 units.

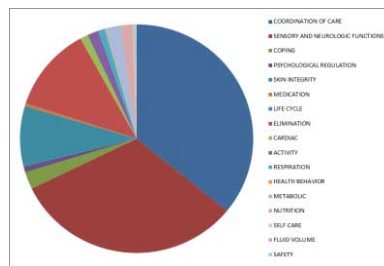


Figure2. Department of Gastroenterologic Surgery Ward Nursing Diagnosis

Infographics can be created from the information in the databases and the proportions of the used nursing care components can be observed. By comparing the

information from the whole hospital or a single unit, differences in care provision can be observed (Figure 1 and 2).

Table 1 indicates the situation at the Department of Gastroenterologic Surgery Ward according to Nursing Interventions over a five-month period. In total, 30 of the most used main FinCC classes and subclasses for care components are presented (Table 1).

Component	Main- and subclass	Amount used	Patients
Sensory and neurologic functions	Pain follow-up	9524	937
Activity	Sleep and awake follow-up	6608	975
Activity	Activity follow-up	5435	855
Elimination	Diuresis follow-up	5404	888
Coping	Patient's coping evaluation	4561	1111
Medication	Administration of injection	4507	574
Medication	Administration of medication	4157	658
Nutrition	Dietary follow-up	3912	737
Medication	Medication per os	3861	743
Elimination	Follow-up of bowel movement	2923	558
Nutrition	Nutrition follow-up	2917	664
Coordination of Care	Preparation and guidance to research and operation	2738	957
Self Care	Assistance in washing and dressing	2612	643
Skin Integrity	Follow-up of wound and elimination	2262	443
Elimination	Follow-up of diuresis and its quality	1867	427
Elimination	Carry out of drain treatment	1626	145
Fluid Volume	Intravenous condense	1566	494
Coordination of Care	Postoperative follow-up	1550	744
Respiration	Follow-up of respiration	1530	276
Skin Integrity	Wound care	1241	320
Cardiac	Follow-up of blood pressure, heart rate and rhythm	1167	381
Elimination	Treatment of stoma	1133	92
Elimination	Prevention and treatment of nausea and vomiting	1071	262
Coordination of Care	Guidance of coordination of care	980	615
Cardiac	Temperature follow-up	974	380

Table 1. Nursing interventions, 30 most used main and subclasses at the Department of Gastroenterologic Surgery Ward.

From our data we can see that on the Gastroenterologic Surgery Ward, patient treatment is focused on the content of the Sensory and Neurologic Functions care component. Patients frequently require follow-up related to pain. Data on the pain needs of patients on the Gastroenterologic Surgery Ward can be utilized to support the development of nursing management. The information allows us to also monitor how the pain is treated. We can also observe if there is any correspondence between the pain treatment and pain evaluation and what kinds of areas for nursing development are identified. Are the nursing interventions the same on different wards?

#### 4. Discussion

Electronic documentation requires that information is stored according to standardized principles in a structured form. This enables information to be searched from patient files and speeds up information retrieval. Structured information also allows for the further processing of information and its utilization in nursing management.

Infographics can be created from database information that show the proportions of care components used. By comparing the information of the whole hospital or a single unit, it is possible to establish differences in the care provision (Figure 1 and 2). This information gives substantive and quantitative information on the content of nursing. This information could be utilized to develop more patient-centered, evidence-

based, and higher quality nursing. The care unit profiles become more visible, which can aid in the allocation of nursing resources, education, research and teaching.

The use of FinCC classification has a different emphasis in different wards. Different classes describe patient's treatment from the nursing point of view and they produce information on the content of nursing care (Table 1). By linking these statistics with other structured information, they can also be used to describe the allocation of resources used, as well as the quality and results of treatment. Nursing outcomes are observable in the nursing documentation, for example, outcomes on pain levels, wound recovery and patient's rehabilitation. By linking nursing interventions (e.g., treatments) to treatment results, one can demonstrate the effectiveness of nursing practice and the effect of the patient nursing process on patient outcomes. Systematic documentation supports a more rigorous evaluation of nursing care and nursing as a function based on expertise, as well as showing its effectiveness.

Nursing statistics support standardized nursing management. The produced data also help to support decision-making. The aim is to utilize statistics in nursing development founded on evidence-based care. Utilization of structured information on nursing care supports the development of nursing practice and the will to utilize nursing information in nursing management to ensure best patient care.

## 5. Acknowledgments

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## References

- [1] M. Heartfield. Nursing documentation and nursing practice: a discourse analysis. *J Adv Nurs* 1996; 24: 98-103.
- [2] K. Saranto, U.-M. Kinnunen. Evaluating nursing documentation – research designs and methods: systematic review. *J Adv Nurs* 2009; 65(3): 464-476.
- [3] K. Häyrynen, K. Saranto, P. Nykänen. Definition, structure, content, use and impacts of electronic health records. *Int J Med Inform* 2008; 79: 291-304.
- [4] H. Yura, M. Walsh. *The Nursing Process: Assessing, Planning, Implementing, Evaluating*. Third ed., Appleton-Century-Crofts, New York, 1978.
- [5] V. K. Saba, K. A. McCormick. *Essentials of Nursing Informatics*. Fifth edition. The McGraw-Hill Companies, 2011.
- [6] A. Ehrenberg, C. Birgersson. Nursing documentation of leg ulcers: Adherence to Clinical Guidelines in a Swedish Primary Health Care District. *Scand J Caring Sci* 2003; 17: 278-284.
- [7] E. Ammenwerth, R. Eichstadter, R. Haux, U. Pohl, S. Rebel, S. Ziegler. A Randomized Evaluation of a Computer-Based Nursing Documentation System. *Method Inform Med* 2001; 40: 61-68.
- [8] C. B. Averill, K. D. Marek, R. Zielstorff, J. Kneeddler, C. Delaney, D. K. Milholland. ANA Standards for Nursing Data Sets in Information Systems. *Comput Nurs* 1998; 16: 157-161.
- [9] J. M. Daly, K. Buckwalter, M. Maas. Written and Computerized Care Plans, Organizational Process and Effect on Patient Outcomes. *J Gerontol Nurs* 2002; 28: 14-23.
- [10] K. Tantu, H. Ikonen. Nationally Standardized Electronic Nursing Documentation in Finland by the Year 2007. *Stud Health Technol Inform* 2006; 122: 540-1.
- [11] K. A. McCormick, N. Lang, R. Zielstorff, K. Milholland, V. Saba, A. Jacox. Toward Standard Classification Schemes for Nursing Language: Recommendations of the American Nurses Association Steering Committee on Databases to Support Clinical Nursing Practice. *J Am Med Inform Assn* 1994; 1 (6): 421-7.
- [12] American Nurses Credentialing Center (ANCC), *The Magnet<sup>®</sup> Model Components and Sources of Evidence, Magnet Recognition Program<sup>®</sup>*, 2014.

# Harmonising Nursing Terminologies Using a Conceptual Framework

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**Abstract.** The International Classification for Nursing Practice (ICNP®) and the Clinical Care Classification (CCC) System are standardised nursing terminologies that identify discrete elements of nursing practice, including nursing diagnoses, interventions, and outcomes. While CCC uses a conceptual framework or model with 21 Care Components to classify these elements, ICNP, built on a formal Web Ontology Language (OWL) description logic foundation, uses a logical hierarchical framework that is useful for computing and maintenance of ICNP. Since the logical framework of ICNP may not always align with the needs of nursing practice, an informal framework may be a more useful organisational tool to represent nursing content. The purpose of this study was to classify ICNP nursing diagnoses using the 21 Care Components of the CCC as a conceptual framework to facilitate usability and inter-operability of nursing diagnoses in electronic health records. Findings resulted in all 521 ICNP diagnoses being assigned to one of the 21 CCC Care Components. Further research is needed to validate the resulting product of this study with practitioners and develop recommendations for improvement of both terminologies.

**Keywords.** Nursing diagnosis, International Classification for Nursing Practice, Clinical Care Classification, nursing terminology, electronic health records

## Introduction

The Clinical Care Classification (CCC) is a terminology that includes nursing diagnoses, outcomes, and interventions organised by 21 Care Components to support documentation of the nursing process. A nursing care component (e.g., Cardiac, Medication) is a navigational or high-level abstract concept or component of the framework within which 176 CCC nursing problems are organised [1]. Similar to CCC, the International Classification for Nursing Practice (ICNP) is used to represent nursing diagnoses, outcomes, and interventions. ICNP is a much larger and more sophisticated terminology that uses a formal ontological approach for organisation. That is, concepts are classified according to their related formal properties [2]. Differences in content coverage and structural foundation mean that these two nursing terminologies have the potential to complement one another. The CCC conceptual framework of 21 high-level categories

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might provide a means of bringing the two terminologies together and examining shared meaning and organisation using a unified, systematic approach.

A harmonisation agreement between the International Council of Nurses (ICN) and SabaCare was established in 2012 [3]. As part of the initial harmonisation project, a subset (n=176) of ICNP nursing diagnoses judged as problems were mapped to the CCC System as the target terminology. This phase of harmonisation resulted in 93% coverage (n=164) by ICNP to an equivalent CCC nursing diagnosis or problem [4]. As part of ongoing efforts, the purpose of this study was to further examine ICNP nursing diagnosis concepts that did not have an equivalent in CCC. The research aim was to classify the ICNP nursing diagnoses or problems into one of the 21 Care Components (the conceptual framework) of the CCC. It is expected that resulting outcomes will become a foundation for enhancing the quality of both terminologies and supporting the harmonisation effort.

## Methods

In this study, ICNP 2015 Release was a source terminology with 805 nursing diagnoses that are judged as either negative or positive. Since CCC Version 2.5 only includes problems, the ICNP concepts were limited to include only those diagnoses judged as negative (n=521). This includes ICNP nursing diagnoses that were either actual problems or potential problems (e.g. risks). Of the 521 ICNP concepts, 164 diagnoses were previously mapped to CCC problems identified in 21 Care Components [4]. Accordingly the remaining 357 ICNP nursing diagnoses became the unique source concepts for this study, requiring manual search of placement within the CCC framework.

In order to classify the 357 ICNP nursing diagnoses with a negative judgment (those representing nursing problems) into the 21 Care Components, two members of the project team independently assigned each ICNP concept to one of the CCC 21 Care Components. Formal ICNP concept definitions and the textual definitions of the CCC Care Components guided this process. Although researchers initially identified multiple categories in the CCC Components for ICNP concepts, the decision was made to be mutually exclusive in categorisation; one category per ICNP concept. It also was decided to “force” each ICNP concept into one of the 21 Care Components. In other words if a match was not immediately apparent, the experts were directed to classify the concept into the best fit using the 21 categories. The experts independently completed the classification and then compared findings to identify any disagreements. When an agreement was not met, a third member of the team was consulted and discussion ensured consensus.

## Results

Table 1 shows a frequency distribution of all CCC and ICNP nursing diagnoses problems assigned to one CCC Care Component. The total frequency reported (n=521) included those ICNP diagnoses with an equivalent CCC problem (n=164) from a previous study [4] and the additional 357 diagnoses categorised in this study). The range of problems or diagnoses per Care Component varied widely. For example, the Care Component “Tissue Perfusion” included only one CCC diagnosis and three ICNP diagnoses while “Safety” included 17 CCC problems and 61 ICNP diagnoses. The CCC Care Component with the most ICNP concepts was “Safety”. Examples of ICNP concepts in the Safety

component included “Tendency to wander” and “Risk for radiation exposure”. The second most frequently assigned Component was “Role Relationship”. Examples of concepts in this category included “Lack of family support” and “Conflicting cultural beliefs”. The least frequently used CCC category was: “Tissue Perfusion”. ICNP diagnoses in this category included “Risk for ineffective tissue perfusion” and “Impaired peripheral tissue perfusion”.

**Table 1.** Frequency of CCC and ICNP Nursing Diagnoses Placed within the CCC Conceptual Framework

CCC Care Components	CCC Problems n (%)	ICNP Problem or Nursing Diagnoses n (%)
Activity	8 (4.5)	26 (5.0)
Bowel/Gastric	9 (5.1)	17 (3.3)
Cardiac	4 (2.8)	10 (1.9)
Cognitive/Neuro	12 (6.8)	48 (9.2)
Coping	16 (9.1)	40 (7.7)
Fluid Volume	6 (3.4)	14 (2.7)
Health Behavior	11 (6.3)	28 (5.4)
Medication	2 (1.1)	13 (2.5)
Metabolic	2 (1.1)	9 (1.7)
Nutritional	8 (4.5)	27 (5.2)
Physical Regulation	8 (4.5)	31 (6.0)
Respiratory	5 (2.8)	15 (2.9)
Role Relationship	13 (7.4)	37 (7.1)
Safety	17 (9.7)	61 (11.7)
Self-Care	8 (4.5)	16 (3.1)
Self-Concept	10 (5.7)	39 (7.5)
Sensory	12 (6.8)	22 (4.2)
Skin Integrity	7 (3.9)	18 (3.5)
Tissue Perfusion	1 (.57)	3 (0.6)
Urinary Elimination	7 (3.9)	19 (3.6)
Life Cycle	10 (5.7)	28 (5.4)
TOTAL	176 (100)	521 (100)

The ICNP source concepts for this study were generally more granular than the CCC concepts in each care component. In the Activity component, the exact ICNP match for “Physical mobility impairment” was “Impaired mobility”. The more granular concepts, “Impaired mobility in bed” and “Impaired wheelchair mobility”, are also included in ICNP. Table 2 shows additional examples of the differences in granularity between CCC and ICNP.

**Table 2.** Comparison of Granularity between CCC and ICNP

CCC Care Components	CCC Problems	ICNP Problem or Nursing Diagnoses
Activity	Physical mobility impairment	Impaired mobility (exact match) Impaired mobility in bed Impaired wheelchair mobility Impaired walking
Safety	Injury risk	Risk for injury (exact match) Physical injury from abuse Transfer injury Risk for fall-related injury
Sensory	Pain	Pain (exact match) Allodynia Phantom pain Hyperalgesia Abdominal pain

Although consensus was reached among the experts, there was considerable discussion about a number of concepts that both experts had difficulty assigning to one of the 21 Care Components. Two major difficulties appeared with: (a) concepts that might fit more than one category and (b) concepts that could not easily fit any category. Examples of ICNP concepts that fit multiple Care Components included “Agitation” which was classified as a Cognitive Component based on the CCC definition “elements involving the mental and cerebral processes”. “Agitation” also was considered as a possible candidate for the “Coping” Component, defined as “elements that involve the ability to deal with responsibilities, problems, or difficulties. An example of an ICNP nursing diagnosis that did not easily classify into any Care Component was “Lack of access to transportation”. The decision was to assign this concept to the Care Component “Health Behavior”.

## Discussion

The findings of this study suggest that the CCC 21 Care Components provide a comprehensive framework for nursing problems. The wide range in the number of ICNP concepts per Care Component (3 to 61) raised some questions about the granularity or specificity of the Components. There also were challenges to classifying a number of ICNP concepts suggesting the need for further research. A framework that is comprehensive enough to capture the scope of nursing and yet also parsimonious and thus able to be applied in practice will always be evolving as the science of the profession evolves. Continuing to test these frameworks can advance the understanding of both the science of nursing and the ability to represent the knowledge of the practice in tools and resources such as terminologies.



This study examined the use of a conceptual framework or model, the CCC Care Components, to classify ICNP nursing diagnosis or patient problem concepts. This project moves us closer to a broader harmonisation of nursing content. In addition, this new classification structure provides an alternative view of ICNP, with diagnostic classes grouped according to the CCC conceptual framework. This project augments the previous equivalency table (1:1 mappings) between CCC and ICNP nursing diagnoses [5]. Data collected and stored using either ICNP or CCC can assist in practitioners' decision-making to improve patient safety, health care quality, and care coordination across settings and healthcare providers.

The classification rules were strict for this study because it was the first attempt at using the CCC Care Components to organise ICNP nursing diagnoses. This initial set of ICNP nursing diagnoses or problems categorised by the 21 Care Component Framework of the CCC will require further review. The plan is to proceed with external validation by experts and potential testing in practice. Mutual improvement to both CCC and ICNP is expected through further research and may for example include consideration of new Care Components.

## Acknowledgments

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## References

- [1] V.K. Saba, *Clinical Care Classification (CCC) System Version 2.5 User's Guide, 2nd ed.*, Springer Publishing Company, New York, NY, 2012.
- [2] International Council of Nurses (ICN). *International Classification for Nursing Practice (ICNP)*. (June 2014). ICN, 2014. Available from: <http://www.icn.ch/what-we-do/international-classification-for-nursing-practice-icnpr/>
- [3] International Council of Nurses (ICN). *Harmonizing nursing terminology internationally: Collaboration between the International Council of Nurses and SabaCare*. (June 2012). ICN, 2012. Available from: [http://www.icn.ch/images/stories/documents/news/press\\_releases/2014\\_PR\\_02\\_ICNP\\_SNOMED.pdf](http://www.icn.ch/images/stories/documents/news/press_releases/2014_PR_02_ICNP_SNOMED.pdf)
- [4] A. Coenen, F. Paese, V. Saba, K. Jansen, N. Hardiker, & T.Y. Kim. Harmonizing Nursing Terminologies. In I. Sarkar, A. Georgiou and P. Marques, (Eds). *Medinfo2015: eHealth-enabled Health, Proceedings of the 15<sup>th</sup> World Congress on Health & Biomedical Informatics*. (pp.776-779). Amsterdam: IOS Press.
- [5] A. Coenen, V. Saba, K. Jansen, N. Hardiker, & T.Y. Kim. *CCC-ICNP Equivalency Table for Nursing Diagnoses*. (May 2015). ICN, 2015. Available from: <http://www.icn.ch/what-we-do/icnp-download/>

# Rationale for Quantification in Nursing Services Using the International Council of Nurses Nurse-Patient Summary

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**Abstract.** This review provides evidence that new data from nurses meets criteria that explains variation in hospital charges, length of hospital stay and end results of hospital care compared with ICD data; that nurses' data can be used to evaluate assignments of nurses to patients; that new data properly distinguishes patients' human needs within ICD categories. These new data are derived from the professional literature indexed and synthesized by Henderson. It is proposed to adopt the ICN-NPSum to standardize quantification in nursing services.

**Keywords.** electronic health records, nurses, International Council of Nurses, quality measurement, evidence, professional literature, human needs, *Basic Principles of Nursing Care*

## 1. Introduction

Assuming that nursing service care quality is a function of structure and process dimensions in value measurement, nurses' capabilities and their match with the human needs of patients represent key components for quantitative analyses of service delivery systems. Rating nurses' educational and experiential backgrounds are structural dimensions in Donabedian's care quality measurement framework. Patients' human needs were identified by the ICN in a process that led to the publication of their widely circulated and translated [32 languages], *Basic Principles of Nursing Care*. The mechanism for recording for retrieval and analysis of nurses' judgements about the patients they are assigned to represents a class of data not now systematically gathered for care quality measurement. The absence of data from nurses about their patients leaves those interested in care quality measurement to subsume nurses' efforts to medical and hospital systems severely limiting the scope of evaluative efforts. The purpose of this paper is to synthesize work done over several decades into a recommendation for the systematic recording of nurses' encounters with patients using the International Council of Nurses Nurse-Patient Summary (ICN NP $\Sigma$ ) for abstraction into hospital records. Such an abstraction is described elsewhere.<sup>1</sup>

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## 2. Criteria I

As the ICN N-P $\Sigma$  recommends new data the first priority is to show existing data is not sufficient to explain and predict phenomena of interest in care quality assessment, namely cost, length of hospital stay and end results of hospital care. Welton performed these analyses using a comparison of nurses' data to data from existing hospital records.<sup>2</sup> All payer refined diagnoses related groups were developed at Yale University when it was shown that diagnosis related groups left considerable unexplained variance in LOS and cost. APR-DRGs were formed from inclusion of data elements on uniform hospital discharge data sets that had not been incorporated into DRG formulas and represented maximum explanatory power of existing abstracted data to explain and predict LOS and cost.

NDX – a previous version of the ICN N-P $\Sigma$ , DRG, and APR-DRG were entered as independent variables into several linear or logistic regression models with the following five dependent variables for each patient hospital stay: hospital length of stay, intensive care length of stay, hospital total charges, death, and discharge to a nursing home. For each dependent variable, five regression or logistic regression models were constructed, one for each of the summary NDX, DRG, or APR-DRG and two models that combined the summary NDX variables with either the DRG or APR-DRG. Results of R<sup>2</sup> or c statistic were examined for explained variance or discrimination of each model.

All relationships between the independent variables of DRG, APR-DRG and NDX and the five outcome variables [LOS, ICU LOS, Charges, Death in Hospital, Transfer to Nursing Home] were statistically significant ( $p < .001$ ). The combined models of DRG + NDX and APR-DRG + NDX were also significantly associated with each outcome variable ( $p < .001$ ).

Summary of R Square and c Statistics

	<i>ICU days</i>					<i>Discharge to NH</i>	
	<i>R<sup>2</sup></i>	<i>R<sup>2</sup></i>	<i>R<sup>2</sup></i>	<i>R<sup>2</sup></i>	<i>c</i>	<i>R<sup>2</sup></i>	<i>c</i>
DRG	0.186	0.253	0.265	0.295	0.891	0.226	0.857
APR-DRG	0.349	0.259	0.327	0.254	0.867	0.211	0.842
NDX	0.240	0.187	0.232	0.558	0.953	0.339	0.918
NDX + DRG	0.321	0.329	0.372	0.637	0.975	0.413	0.942
NDX + APR-DRG	0.448	0.335	0.417	0.626	0.970	0.406	0.939

Note: c statistic is equivalent to area under the ROC curve

Overall, the addition of nursing data to existing DRG or APR-DRG models improved explained variance from 27.5 to 146.4%. New data from nurses are needed.

## 3. Criteria II

A second criteria for recommending the ICN N-P $\Sigma$  concerns the use of this data to examine assignments between nurses and patients, a care quality process measure. Bastin posited that relatively skilled primary nurses would attain greater independence for their patient.<sup>3</sup> We measured the education and experience of nurses and rated them in achieving independence for their patients. From nurses' daily patient classification rated by the assigned nurse we analyzed a systematic sample of 2506 adult hospital discharges occurring in 2265 patients cared for by 535 different nurses. Independence was the difference between highest patient rating and rating closest to discharge with sicker patients having greater differences. Nurses with less education [73 Associate

Degree in Nursing-ADN vs. 462 Bachelor of Science degree in Nursing-BSN] and less experience [5 vs. 6 years] achieved greater differences in independence for their patients [6.14 ADN, 5.33 BSN;  $P=0.008$ ]. The findings were attributable to the nurses being assigned to significantly different patients. The patients, who achieved greater independence tended to be older, have longer hospital stays, have fewer days in ICUs and were medical, as opposed to surgical cases. We concluded the best nurses may not now be assigned to the worst patients. We wonder if further research assigning better educated and more experienced nurses to older, longer staying medical cases would yield greater independence for them. New nurse and patient data are needed for such experimentation.

#### 4. Criteria III

A third criteria for using ICN  $N-P\Sigma$  concerns the relationship between data from nurses and data from physicians. Onori examined the human needs of 445 adults admitted to hospital with the primary medical diagnosis of Type II Diabetes Mellitus [ICD-9CM 240.0-9] and compared the pattern of nursing data (human needs) with those of 5321 patients having Type II DM but admitted to hospital for other reasons and with the 78,480 inpatients with no DM.<sup>4</sup> Length of hospital stay, intensive care unit use and discharge dispositions were examined, controlling for race, poverty, marital status and age, to determine if the nursing data variables were distinctive for any of the three patient groups. A subset of 14 nursing data items were identified from the literature on the care of Type II DM to determine how they varied among the three groups. The nursing data items were also fitted in regression models to explain variances in patient length of stay and to explore patient diabetes status. A multinomial logistic (logit) regression model that included the predictor variables of patient age, race, marital status, socioeconomic position (insurance type), and sex was used to predict patient discharge disposition. This methodological study helped address two related questions in the negative; 1) when the disease is known are the needs of the patient known and, 2) when the needs of the patient are known, is the disease known? New patient data from nurses are needed for further exploration of these phenomena.

#### 5. Fundamentals for Nurses' and Patients

Is there a foundational nursing science applicable to every practicing nurse that comes in direct or indirect contact with patients? Is there a set of concerns that persons have that uniquely fall under the purview of nurses? Answers to these questions are no small matter as the number and type of nursing schools and the employment of graduate nurses in hospitals and other settings depend on who replies to these queries and what responses are used. The past is often used as a guide as when Florence Nightingale is invoked in response to questions of who nurses are and what they do. She wrote:

*"...to the experienced eye of the careful observing nurse, the daily, I had almost said hourly, changes which take place in patients, and which changes rarely come under the cognizance of the periodical medical visitor, afford a still more important class of data, from which to judge of the general adaptation of a hospital for the reception and treatment of sick."* Florence Nightingale *Notes on Hospitals*, 3rd edition, 1863

Replies to these questions need to be more concrete when change creates opportunity to confirm previous answers or modify responses to meet current societal demands. The implementation of the Accountable Care Act in the United States is likely

to prompt new questions about who nurses are, what they do and how many are needed and with what preparation.

That the answers be addressed by those who practice, administer, teach, study or conduct research on nursing seems obvious – nurses are in the best position to direct responses for themselves on the condition that responses focus on the needs of present and future patient/clients. Nurses are seen by the public as professionals they can trust and how publically they respond to these questions will determine the level of support from society to act on behalf of patient/clients of the future. What nurses' say to the public should be understandable, the focus of action by nurses and be fundamental to all who practice in the profession.

Nightingale was the author of the first documents that served both the public and the profession and it is no wonder why we continue to invoke her name. Her *Notes on Nursing* was written for the public. Yet, the sanitary science upon which the profession depended for guidance for nearly 100 years became eclipsed by the introduction of antibiotics that superseded nurses' attention to asepsis. When she realized the scientific basis for nursing had changed, Virginia Henderson composed two sentences that caught the attention of the nursing world. She wrote:

*The unique function of the nurse is to assist the individual, sick or well, in the performance of activities that contribute to health, its recovery (or to a peaceful death) that they would perform unaided if they had the necessary strength, will, or knowledge. It is likewise the function of the nurse to help the individual gain independence as rapidly as possible.* Virginia Henderson *Principles and Practice of Nursing*, 5<sup>th</sup> edition, 1955

Writing for the International Council of Nurses the description of nursing was expanded to include a list of fundamental human needs acknowledging that while all people have common needs these needs are satisfied by infinitely varied patterns of living. A nurse can only assist an individual in those activities to that state which means health – to the person – or recovery from disease – to the person – or what is – to the person – a good death. Viewed as a service derived from an analysis of human needs, nursing care is universally the same. It is the same because all people have common needs; but it is a service of infinite variety because no two persons are alike and each person interprets human needs in such a way that creates a unique pattern.

The ICN's BPNC contains a complex three-tiered structure that can be used to classify human functions and individual characteristics that alter them, as well as pathological states that may modify activities. These human activities are: 1) breathing normally, 2) eating and drinking adequately, 3) eliminating body wastes, 4) moving and maintaining desirable posture, 5) sleeping and resting, 6) dressing and undressing and selecting clothes, 7) maintaining body temperature, 8) keeping clean and well groomed, 9) avoiding dangers in the environment and avoiding injury to others, 10) communicating with others in expressing emotions, needs, fears, et cetera, 11) worshiping according to one's faith, 12) working in such a way that there is a sense of accomplishment, 13) playing or participating in various form of recreation, 14) learning, discovering or satisfying the curiosity that leads to normal development and health and using available health facilities. These are the targets of interventions by nurses.

The ICN conceived the human needs as the basis for standards for basic nursing care that could be represented in hours of nursing care, care cost and in assessments of nursing care quality. Other things being equal, for example, the person of ninety needs more basic nursing care than the young adult and that some pathological states should also be considered in the allocation of basic nursing care. These demands for basic nursing are offset by decisions made about assignments of nurses to patients measuring the educational and experiential capacity of nurses (and their pay) to provide basic nursing.

## 6. Literature Synthesis

Henderson spent more than two decades reading, evaluating and critiquing nursing research and indexing professional literature. Her works, *Survey and Assessment of Nursing Research* and the four-volume *Nursing Studies Index* were prepared in the same era as was the ICNs *Basic Principles of Nursing Care*. The ICN had regularly informed Henderson of the esteem of *Basic Principles of Nursing Care* and that it was being translated by a number of the ICN's member states into many different languages (32 at last count). The universal availability of the ICNs *Basic Principles of Nursing Care* helped standardize world nursing in the latter half of the 20th century. Knowing this she decided to write the last revision of her 1978 [reprinted by ICN in 1997] textbook, *Principles and Practice of Nursing*, 6th edition, and organize it around the standards promulgated in the ICNs classic work. Henderson used the input of the thousands of contributors to the professional nursing literature in order to lend substance to the concept of nursing prompted by the ICN. The ICN perspective was foundational to the three research studies reviewed here.

## 7. Summary and Conclusion

A circle had been drawn to a close – the synthesized professional literature in *Principles and Practice of Nursing*, 6th edition was linked to the standards the ICN commissioned Henderson to prepare for *Basic Principles of Nursing Care*. Theory and research based criteria has demonstrated uses of nurses' data have utility in evaluating care quality. New data from nurses are needed. It is the task of 21st Century nurses to adapt the ICN's universal human needs perspective into a standardized digital form for individual and collective analyses and interpretation.

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## References

- [1] Halloran, E. and Halloran, D. Nurses Own Recordkeeping: The Nursing Minimum Data Set Revisited. *Computers, Informatics and Nursing*, 33(11):487, 2015.
- [2] John Welton, *Comparison of Hospital Outcomes Using Medical and Nursing Data*, PhD., University of North Carolina at Chapel Hill, 1999.
- [3] H. Lee Bastin *Outcomes of Hospital Nursing and Nurses' Education*, EdD, North Carolina State University, 1999.
- [4] Kennedy O. Onori, *Nursing Diagnoses in the Care of Hospitalized Patients With Type 2 Diabetes Mellitus: Pattern Analysis and Correlates of Health Disparities*, University of North Carolina at Chapel Hill, 2013.

# Usability Evaluation of a Prototype Mobile App for Health Management for Persons Living with HIV

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**Abstract.** Mobile health (mHealth) applications (apps) have the potential to support self-management and improve health outcomes in persons living with HIV (PLWH). In this paper, we report on the final step in a three-stage user-centered design process for the development of a mHealth app for PLWH. We conducted a usability evaluation with 10 targeted end-users and a heuristic evaluation with 5 persons with informatics expertise to assess the usability of a prototype mHealth app for PLWH to manage their health. At the end of our usability evaluation, we finalized a Design Document that included the user interface design and functional specifications of the mHealth app. The functional areas which were identified at the end of our iterative process included: Communication, Reminders, Medication Logs, Lab Reports, Pharmacy Info, Nutrition and Fitness, Resources and Settings.

**Keywords.** mHealth, apps, HIV, self-management, end-user design, usability

## 1. Introduction

Mobile health (mHealth) technology shows potential as a highly valuable tool in the management and prevention of chronic illnesses such as HIV [1]. There are a limited number of mHealth applications (apps) specifically designed for persons living with HIV (PLWH). Of those mHealth apps that do exist, few have been developed with end-users' input or rigorous evaluation [2]. This paper reports on the third part of a larger study that employed user-centered design methods to create a Design Document, outlining the blueprint of a health management app for PLWH.

The development of the final Design Document involved the analysis of data from: focus groups, design sessions, and usability testing (heuristic evaluation and end-user). Detailed methods for the focus group data collection study are published elsewhere [3]. Building on the information gathered in our focus group sessions, we conducted two user-centered design sessions [4]. Following these sessions, we created an initial visual framework of the screen content and layout for the app in PowerPoint. The purpose of this paper is to report on the usability evaluation of the mock-ups of a mHealth app for self-management for PLWH.

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To increase the likelihood of technology acceptance, we conducted two types of usability assessments [5]: 1) a heuristic evaluation of the PowerPoint prototype using informaticians with experience in interface design and/or human computer interaction, 2) end-user usability testing by systematically observing how well PLWH used the PowerPoint prototype.

**2. Heuristic Evaluation**

*2.1 Sample*

Five informaticians participated as usability experts. Each expert was at minimum master’s prepared in the field of informatics, had training in human-computer interaction, and had published in the field of informatics.

*2.2 Procedures*

The usability experts were provided with a description of the full functionality of the prototype app. Each expert tested the prototype user interface independently with the use case scenarios (Table 1) for approximately 45-90 minutes. The process was recorded using Morae software™ (Techsmith Corporation, Okemos, MI), [6]. The experts were asked to evaluate the app using a think-aloud protocol and to complete a Heuristic Evaluation Checklist (Likert scale from 0 (not a usability problem) to 4 (usability catastrophe) to evaluate the extent to which the user interface violates a set of usability heuristics [7].

**Table 1. Use Cases for mHealth App Usability Testing**

1.	Please check your viral load
2.	Please check what medications need to be refilled soon
3.	Please find a needle exchange program in your area
4.	Please change your user name
5.	Please find information on the second thing you would do when putting on a condom
6.	Please enter what you had for dinner yesterday
7.	Please find the definition for antibodies
8.	Please locate HIV specialists in your area

Mean severity scores were calculated for each heuristic principle from Nielsen’s checklist. Evaluator’s comments about usability problems on the evaluation form and the Morae recordings were reviewed and analyzed [8]. Based on these findings, we refined the low fidelity PowerPoint prototype.

*2.3 Results of Heuristic Evaluation with Experts*

A total of 77 changes were made to the HIV mock-up based on the heuristic evaluators’ recommendations. Mean scores and sample comments for each usability factor related to the mHealth App are reported in Table 2. In response to a *Match between System and the Real World* issue, an expert suggested that the screen for current prescriptions should be renamed medication refill, which better reflects its functionality. The slider bar should include yellow to represent the medications that are midway the refill mark. To maintain *Consistency and Standards*, one expert recommended that the search button should look the same every time it appears in the app. To improve the design, one expert recommended that the food diary screen include a date at the top, and a scroll bar with the word “Yesterday” on the left side, “Today” in the middle and “Tomorrow” at the right side.



**Table 2. Mean Scores and Sample comments of Heuristic Evaluation of HIV App**

Usability Factor	Mean (S.D.)	Sample Comment
Visibility of System Status	1.80 (0.45)	Screen headers should be changed to words that represent the content
Match between System and the Real World	1.20 (1.10)	Section headings not always ordered in the most logical way
User Control and Freedom	1.40 (0.89)	No clear exit on each document screen
Consistency and Standards	2.20 (0.84)	Should be medication adherence first
Help Users Recognize, Diagnose, and Recover From Errors	0 (0.00)	Did not see any error messages
Error Prevention	1.00 (1.41)	Wellness section was cluttered
Recognition Rather Than Recall	1.20 (1.30)	At times it was difficult to know where to access information
Flexibility and Efficiency of Use	0.20 (0.45)	Search didn't work
Aesthetic and Minimalist Design	1.40 (0.89)	Simplify color scheme, get rid of unnecessary shapes
Help and Documentation	1.00 (1.41)	No help function

### 3. Usability Testing

#### 3.1 Sample

We recruited ten PLWH who did not participate in the design sessions to evaluate the prototype user interface screens. Ten participants were selected because past research has shown that the minimum percentage of problems identified rose from 55% to 82% and the mean percentage of problems rose from 85% to 95% when the number of users was increased from five to ten [9]. There were 4 female and 6 male participants. Six of the participants were current smartphone users.

#### 3.2 Procedures

Participants were provided with the same use cases as the heuristic evaluators and a description of the full functionality of the prototype system. After the usability evaluation, participants were asked to rate the prototype's usability using the Post Study System Usability Questionnaire (PSSUQ) which is a 19-item survey instrument to assess user satisfaction with system usability on a scale ranging from 1 (strongly agree) to 7 (strongly disagree) [11].

The analysis was based on the Morae recordings of user sessions, transcriptions, notes and the PSSUQ survey. The team searched for critical incidents characterized by comments, silence, and repetitive actions. We reviewed these incidents in detail using Morae software. The incidents identified and the users' written comments were summarized. Results from the PSSUQ were analyzed using SPSS version 22.0 (IBM, Armonk, NY) to calculate the descriptive statistics.

#### 3.3 Results of Usability testing with End - Users

Our iterative usability testing resulted in five versions of our mHealth app prototype. At each version, we refined the content, potential functionality and interface. A total of 83 changes were made to the mock-ups based on the end-users' recommendations.

During usability testing, one end-user suggested that HIV medical providers/clinics should have more options, especially from the outer boroughs of New York City. To address this issue and make the app more generalizable in its functionality, we added a box to enter zip code as well as a scroll bar. Information on insurance taken by facility/provider and pharmacies was also added. Another participant commented that the medication refills screen was hard to understand because the colors confused her. She suggested they be taken out and only have the data. Instead, we added a key to the bottom of the screen to explain the colors. PSSUQ scores from the HIV end-user testing were variable over time and related to whether participants were smartphone users. The PSSUQ score was lower at the end of the usability testing process, indicating a more usable app.

At the end of our usability testing, we finalized the Design Document, which included the functional specifications and user interface design of a mHealth app for PLWH to self-manage their illness. Our final Design Document included the following broad functional categories: Communication, Reminders, Medication Logs, Lab Reports, Pharmacy Info, Nutrition and Fitness, Resources and Settings. Screenshots of the mock-ups from version 1 and the final version of our Design Document are included in Figure 1.

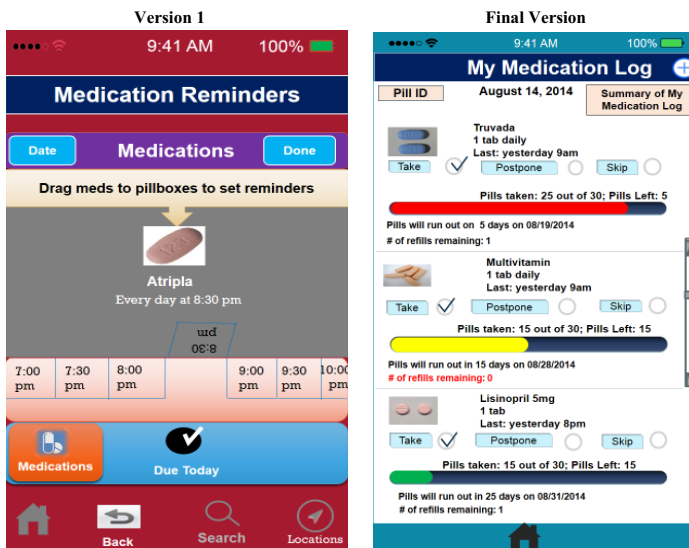


Figure 1. Mock-Ups of App for PLWH.

#### 4. Discussion

In recent years there has been a proliferation of healthcare-related apps designed to promote behavior change and support self-management of chronic diseases. Currently there are more than 40,000 health-related apps available on the app marketplace [10]. Many of the mHealth innovations for PLWH have not gone beyond the pilot stage, or have not been rigorously evaluated [11].

There are a limited number of apps for PLWH and few have been developed with end-user feedback. An additional challenge is that currently available apps for PLWH may be off the marketplace in a few years. For instance, of the 55 apps for

PLWH -which were reported in a 2013 review [2], 15 are no longer available. By contrast, our work employed user-centered design and usability evaluations to identify the functional specifications and user-interface for a mHealth app for self-management in PLWH prior to development.

Previous work has demonstrated the usefulness of rigorous user-centered design methods for informing the development of mHealth applications [12]. The developmental research reported in this paper improves our understanding of how mHealth tools can be appropriately designed by end-users. Despite the growing interest across sectors in mHealth apps, there remains limited evidence on their acceptability and impact on health care outcomes [13]. Further work is needed to compare existing apps for PLWH to the mHealth app that we proposed after our iterative design process. In addition, rigorous evaluation of the app through a trial is needed to assess whether mHealth technology that is designed by end-users results in improved health outcomes.

## 5. Acknowledgments

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## References

- [1] G.D. Kirk, S.S. Himelhoch, R.P. Westergaard, C.G. Beckwith. Using Mobile Health Technology to Improve HIV Care for Persons Living with HIV and Substance Abuse. *AIDS research and treatment*. 2013;2013.
- [2] K.E. Muessig, E.C. Pike, S. Legrand, L.B. Hightow-Weidman. Mobile phone applications for the care and prevention of HIV and other sexually transmitted diseases: a review. *J Med Internet Res*. 2013;15(1):e1.
- [3] R. Schnall, S. Bakken, M. Rojas, J. Travers, A. Carballo-Díeguez. mHealth Technology as a Persuasive Tool for Treatment, Care and Management of Persons Living with HIV. *AIDS Behav*. 2015.
- [4] R. Schnall, M. Rojas, J. Travers, W. Brown, S. Bakken. Use of Design Science for Informing the Development of a Mobile App for Persons Living with HIV. *AMIA Annu Symp Proc*. 2014.
- [5] B. Sheehan, Y-J Lee, M. Rodriguez, V. Tiase, R. Schnall. A Comparison of Usability Factors of Four Mobile Devices for Accessing Healthcare Information by Adolescents. *Appl Clin Infor*. 2012;3(4):356-66.
- [6] TechSmith. Morae Usability and Web Site Testing: TechSmith Corporation; 1995 [cited 2005 July 11]. Available from: <http://www.techsmith.com/products/morae/default.asp>.
- [7] J. Nielsen. Ten Usability Heuristics 2005 [updated 2005]. Available from: [http://www.useit.com/papers/heuristic/heuristic\\_list.html](http://www.useit.com/papers/heuristic/heuristic_list.html).
- [8] J. Nielsen. Heuristic evaluation. In: J. Nielsen, R.L. Mack, editors. *Usability Inspection Methods*. New York, NY: John Wiley & Sons; 1994.
- [9] L. Faulkner. Beyond the five-user assumption: benefits of increased sample sizes in usability testing. *Behav Res Methods Instrum Comput*. 2003;35(3):379-83.
- [10] IMS Institute for Healthcare Informatics. *Patient Apps for Improved Healthcare: From Novelty to Mainstream*. 2013.
- [11] W.H. Curioso, P.N. Mechael. Enhancing 'M-health' with south-to-south collaborations. *Health Aff (Millwood)*. 2010;29(2):264-7.
- [12] R. Schnall, A. Carballo-Díeguez, S. Bakken, M. Rojas, W. Brown, J. Travers et al. A user-centered model for designing consumer mobile health (mHealth) apps. *J Biomed Inform*. In Press.
- [13] L.W. Chang, J. Kagaayi, H. Arem, G. Nakigozi, V. Ssempiija, D. Serwadda et al. Impact of a mHealth Intervention for Peer Health Workers on AIDS Care in Rural Uganda: A Mixed Methods Evaluation of a Cluster-Randomized Trial. *AIDS Behav*. 2011.

# Mobile and Wearable Technology Needs for Aging in Place: Perspectives from Older Adults and Their Caregivers and Providers

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**Abstract.** There is an increasing number of wearable trackers and mobile devices in the burgeoning world of digital health, the purpose of the study is to explore the role of these mobile and wearable tools among older adults aging in place. We conducted a cross sectional study using individual interviews with older adults and surveys with their caregivers or providers. We interviewed 29 residents living in a retirement community, and surveyed 6 caregivers or providers. The older adults had an average age of 88 years, most did not express interests on technology and heavily relied on providers for health tracking, while their professional caregivers or providers saw a great need to access older adults' health information collected from these mobile and wearable tools. Educating the older old on the benefits of mobile and wearable tools may address such discrepancy on needs of adopting mobile and wearable tools for aging in place.

**Keywords.** Aging in place, mobile health, wearable devices, older adults, needs analysis, patient engagement

## 1. Introduction

According to recent reports from the US Census Bureau, the number of people age 65 years or older in the U.S. grew from 44.7 million in 2013 to 46.2 million in 2014. With Americans living longer than they have at any point in history, one of the new Healthy People 2020 goals is to improve the health, function, and quality of life of older adults, many of whom want to age in place.

Aging in place can be defined as living in the community, with some level of independence, rather than living in residential care. Aging in place is beneficial because it enables older people to maintain independence, autonomy, and connection to social support [1]. Aging in place involves a variety of considerations including: finances, built environment, community services, informal caregivers, and professional caregivers. Ideally, the goal of aging in place is to strike a balance between the physical, mental, emotional, and social needs of the person.

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With the progressive growth of the elderly population aging in place, there are growing interests in how technology may enhance the aging in place experience, including the new area on “gerontechnology” [2]. While technological innovations seem promising, there is a number of challenges for implementing technology amongst older adults including economic barriers and challenges unique to the aging population such as familiarity with and access to novel technology [3]. Researchers noted the importance of strengthening the evidence base for these technologies and assessing the efficacy of technology for older adults as it relates to the end goal of aging in place and not merely focusing on the effectiveness of the device in and of itself. In short, it is essential to understand the impact that gerontechnology is having on older adults.

There are increasing numbers of personal health devices including wearable trackers, mobile devices, and remote monitoring devices in the market for individuals at all ages including older adults, however, it is unclear how these technology options can facilitate older adults aging in place and how older adults and their caregivers and providers view these new technology options. The purpose of this study was to explore the perspectives from older adults and their caregivers or providers on the role of these mobile and wearable technology tools for older adults aging in place.

## **2. Methods**

Using a cross sectional study design, we developed needs analysis interview questions for older adults aging in place and surveys for their caregivers or providers. The study was conducted at a retirement community with assisted living, independent living, and healthcare/nursing facility sections. Per aging in place definition, only residents at the assisted living and independent living sections were interviewed for the purpose of the study focusing on aging in place. After completing a community assessment which included conducting a windshield survey, interviewing stakeholders within the retirement community, and interviewing older adult residents, along with a systematic review of currently available mobile apps, wearable trackers, and personal health devices, we developed an interview guide to determine if residents would be interested in mobile and wearable health devices as a means of tracking their health. We also developed a companion survey for their caregivers or health care providers who regularly interact with residents to assess their perspectives on the use of mobile and wearable tools in the retirement community. This study was approved by the Committee for the Protection of Human Subjects, at the University of Texas Health Science Center at Houston.

A structured interview guide was designed to gather information on older adults’ perspectives toward technology for aging in place. Residents were asked questions about aging in place, for example, Do you feel home here? Do you feel safe here? Are you familiar with the place here? Do you feel you have independence here? Do you feel you have autonomy here? And, do you feel you are connected to social support here? As it relates to technology, residents were asked about their experience using computers, mobile devices and applications as well as how often such devices are used. In addition, they were asked about their interest in learning how to use and wear personal health devices, types of information they would be interested in tracking and sharing, concerns about using wearable health devices.

Providers or caregivers were asked to report their interest in having older adults use a device for tracking a variety of health data including daily steps, calories burned,

sleep quality, heart rate, breathing, blood pressure, blood glucose, etc. Those who were interested in having older adults use wearable devices were asked follow-up questions regarding how they would like to access this data (i.e., via electronic health records, a website connected to the personal health device, downloadable files from the devices, smartphone applications, etc.), the format in which they would like to see the health data presented, how often they would be interested in viewing this data, and ways in which they would use the data to provide feedback to the elderly. Additionally, they were asked to select the strategies they believed would help them learn to use wearable devices and explain those devices to the older adults they care for, and their perspectives on the barriers and benefits of mobile and wearable health devices.

### 3. Results

Twenty-nine residents at Holly Hall Continuing Care Retirement Community Center participated in the study: 17 from the Assisted Living section of the retirement community and 12 from the Independent Living section. The activity coordinator at the retirement community placed study flyers and recruitment letters in residents' mail boxes and those who showed interest in the study were interviewed by study personnel. Demographic characteristics of the older adult sample were presented in Table 1.

**Table 1.** Demographic Characteristics of Older Adult Sample

Characteristics	Assisted Living (n=17)	Independent Living (n=12)
<b>Gender</b>		
Female	12 (71%)	9 (75%)
<b>Race</b>		
White	14 (82%)	12 (100%)
Black	2 (12%)	0
<b>Age (in Years: Mean)</b>	90	86
<b>Had A Chronic Illness</b>	14 (82.4%)	8 (66.7%)

#### 3.1 Residents Aging in Place

Of those living in Assisted Living, over half of the residents (9 out of 17) came to this living situation as a result of their increased aging or due to a medical illness. Thirteen of the 17 residents reported feeling at least somewhat at home living at the facility, and 70% (12 out of 17) reported being happy there. In addition, 65% (11 out of 17) reported feeling like they have independence, 29% (5 of 17) feel somewhat independent and 6% (1 of 17) do not feel independent. Eleven of the residents reported feeling at least somewhat connected to social support at the facility.

As it relates to residents living in the Independent Living section of the community, similar to those in Assisted Living, half of the residents (6 out of 12) came to the facility due to their age or illness. Ten out of 12 residents report feeling at least somewhat at home there. All residents living in this section of the retirement community reported feeling as though they had independence as well as autonomy. And all but one resident reported feeling connected to social support at the facility.

### *3.2 Perspectives from Older Adults Aging in Place*

As it relates to their perspective of using technology, 14 out of the total 29 reported having access to a computer, cell phone, or tablet. Of the 14 individuals, eight reported using apps or checking email on these devices. Five said they were introduced to these devices through family or friends, and four said they were introduced to the technology through work.

Only 4 out of the total 29 residents had ever used a wearable health device. Twenty-two reported not being interested in learning how to use or wear a personal health device after being told that these are small devices to be worn on the body and that are used to track various types of health information. Similarly, five of the residents said that they would be interested in having a device that monitors their health for them. Overall, most of the residents (24 of 29) reported a preference that someone else would manage their health for them – someone else being either their health care provider (13 of 29) or a family member (3 of 29).

Six of the total 29 individuals reported that they would be interested in tracking health information such as steps, distance, calories, hours of sleep, falls, active minutes, sleep quality, heart rate, body posture, blood glucose, and blood pressure. For those who are interested in tracking health information (6 out of 29), the most common concern was the price which was reported by 4 of the 6 residents. One person thought it might be burdensome to have to learn how to use it and another person was concerned about the technology getting wet and then not working. This same resident also reported that he/she would be interested in sharing health data collected from the wearable device with other people he knows only from the internet. The other 5 residents who reported being open to wearable devices said that they would not be interested in sharing such data.

### *3.3 Perspective from Caregivers and Health Care Providers*

Six caregivers or health care providers caring for older adults at the Holly Hall Retirement Community Center completed the survey. Three described themselves as certified nursing assistants, one as a charge nurse, one as a caregiver on medication administration, and 1 as a resident life enrichment coordinator. Five of them had over 10 years of experience caring for older adults.

They reported that they would be interested in seeing data on the seniors' breathing, fall risk, walking distance, sleep quality, heart rate, blood oxygen level, body posture, blood pressure, weight, mood, fatigue, blood glucose, steps, hours of sleep, active minutes, calories burned, and location. Some would like for seniors to track this data for self-care, but reported that they would not be interested in reviewing such data.

When asked how they would like to access seniors' data, all responded that electronic health records or downloadable files from the device would be a preferred method. All reported that they would be interested in giving residents who use wearable devices feedback during a face-to-face visit with the individual, and that they believed such devices would help them to individualize care to the older adults living in the facility. Five reported that they believe the major obstacle in accessing and reusing information from wearable devices would be legal and accuracy-related.

Three providers strongly agreed that these devices would help older adults age in place for a longer period of time. Four providers strongly agreed that the devices would help them identify precipitating factors that would prevent adverse events such as heart attacks, falls, etc.

#### 4. Discussion

Older adults living in the assisted living and independent living sections of the retirement community mostly felt like aging in place at their current apartment or cottage homes, they did not express much interests on the use of mobile and wearable healthcare technologies, nor did they understand the existence of these technology tools. However, they trusted and relied on their providers to know their health status including monitoring of blood pressure and other applicable biomarkers to keep them healthy. The professional caregivers or providers mostly expressed needs in accessing such data to facilitate their care of older adults aging in place, though not all are interested in reviewing all data.

There are several limitations to this study. First, the older adult sample had an average age at 86 or 90 years old with relatively higher socioeconomic status before retirement, this sample may have a quite different view from the younger old and those with a lower socioeconomic status. Second, the sample was also all residents at a retirement community with easy access to a nursing facility and health care providers under one roof. Aging in place older adults living in other independent communities may have different opinions. Third, the small sample size limits the study generalizability. There was a lack of family caregivers' perspective in this study. Fourth, as the first exploration of aging in place seniors' preference toward mobile and wearable technology, a cross sectional design was used, participants did not actually try the mobile and wearable technology mentioned in the survey.

In summary, there is a discrepancy between the needs of the older adults on using mobile and wearable technology tools, and the needs of their caregivers or providers wanting to track information collected from these tools. Studies with longitudinal designs and with participants using the actual technology using a larger and more diverse sample are warranted for future investigation. Since mobile and wearable technology tools have the potential to facilitate the needs of caregivers and providers to manage aging in place seniors' health and enhance connection with them, educating the older old on the benefits of these tools may potentially address the challenge of patient adoption and engagement.

#### 5. Acknowledgments

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#### References

- [1] J.L. Wiles, A. Leibing, N. Guberman, J. Reeve, R.E. Allen, The Meaning of "Aging in Place" to Older People, *Gerontologist*, 52 (2012), 357-366.
- [2] M. Renda, Gerontechnology: Technology Helping Older Adults Live at Home, *Gerontology Special Interest Section Quarterly*, 35(2012), 1-4.
- [3] W.A. Satariano, A.E. Scharlach, D. Lindeman, Aging, Place, and Technology: Toward Improving Access and Wellness in Older Populations, *Journal of Aging and Health*, 26 (2014), 1373-1389.



# A Systematic Review and Meta-Analysis of Intervention for Pediatric Obesity Using Mobile Technology

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**Abstract.** We reviewed the effect sizes of pediatric obesity intervention studies using mobile technology. Ten databases (Cochrane CENTRAL, CINAHL, EMBASE, PubMed/Medline, KoreaMED, KMBASE, KISS, NDSL, KSITI, and RISS) were reviewed, and four studies were included in a qualitative synthesis. To obtain significant change in obesity-related outcomes among elementary school students, including parents and utilizing text messages in interventions are recommended. Furthermore, devices such as accelerometers may aid obesity management. A meta-analysis of four studies indicated that the mobile intervention positively influenced dropout rates but was ineffective for outcomes of weight control, exercise, and sugar-sweetened beverage intake.

**Keywords.** Mobile technology, Short Message Service (SMS), Pediatric obesity, Systematic review, Meta-analysis

## 1. Introduction

Pediatric obesity threatens children's health and well-being worldwide. Overweight or obese children are at great risk of diseases such as diabetes and metabolic syndrome, and are also affected psychosocially [1]. The obesity rate of elementary school students in Korea (based on body mass index [BMI]) is 20.6%, and 32% of those aged 2–19 years in the United States are overweight or obese [2,3]. To effectively manage pediatric obesity, some interventions have utilized mobile technology [4–7]. Additionally, smartphone ownership rates are increasing among children, with 72.2% of elementary school students in Korea and 68% of children aged 13–14 in the U. S. owning a smartphone [8,9]. Using Population, Intervention, Comparison, and Outcome (PICO) criteria, we assessed whether mobile technology is effective for weight or behavior change among children. Accordingly, we conducted a systematic review and meta-analysis of pediatric obesity interventions using mobile technology.

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## 2. Methods

The process and manuscript development are consistent with the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [10].

### 2.1. Literature sources and search strategy

Ten databases, Cochrane CENTRAL(27), PubMed/Medline(118), CINAHL(24), EMBASE(95), KISS(0), KoreaMED(0), KMBASE(0), NDSL(1), KSITI(1), and RISS(2), were systematically searched. Search terms were combinations of child (or children/childhood/pediatric), smartphone (mobile phone/cell phones), and obesity (obese/overweight/pediatric obesity). Publication year was limited to after January 2007, as the iPhone, a breakthrough smartphone technology, was released at that time. An additional 8 studies were found manually.

### 2.2. Inclusion and exclusion criteria

Inclusion criteria were as follows:

- Studies with abstract and full text in English or Korean
- Pre- and post-test studies of obesity or weight control using smartphone or mobile technology, including text messages
- Studies identifying weight loss or behavior changes as outcomes
- Elementary school students as a primary study population (interventions conducted with parents are also included)

Exclusion criteria were as follows:

- Studies that target only parents of elementary school children
- Studies that apply smartphones or mobile technology for management of other diseases (e.g., diabetes) besides obesity

### 2.3. Study selection and Study classification

A total of 193 articles (of an initial 276) remained after eliminating duplicates. Titles and abstracts were reviewed independently by two researchers. Studies were chosen per inclusion criteria and 42 articles underwent full text reviews. Two researchers then separately classified four final articles, randomized controlled trials (RCTs), using the study Design Algorithm for Medical literature on Intervention (DAMI) from the National Evidence-based Healthcare Collaborating Agency (NECA) [11].

### 2.4. Data extraction and Data synthesis

Data extraction was completed independently by two researchers with Excel 2010. Disagreements were resolved through discussion. Relevant data on study design and variables were summarized. Qualitative and quantitative syntheses were conducted using Comprehensive Meta-Analysis software.

### 3. Results

Three studies were included for computing BMI effect size. Mobile intervention had no significant effect on BMI (Hedges'  $g$ : -0.073, 95% CI: -0.031 to 0.185). Additionally, two studies were examined for the effect size of daily exercise and sugar-sweetened beverage intake; neither showed any significant effect (Hedges'  $g$ : 0.189, 95% CI: -0.355 to 0.733; Hedges'  $g$ : -0.316, 95% CI: -0.764 to 0.131).

Dropout rates were considered as potential mediators of intervention outcome. Mobile intervention was effective for controlling dropout rates (Odds ratio: 0.363, 95% CI: 0.178 to 0.74).

### 4. Discussion

Three articles had significant results and two commonalities. Parents' participation was part of the study design, and text messaging was used independently or along with the main interventions. Furthermore, two of the three studies added a pedometer or accelerometer to mobile technology. We recommend future studies include parents, text messaging, and activity-measuring accessories in study design.

Mobile intervention had significant effects on dropout rates, but not on weight control, exercise, or intake of sugar-sweetened beverages (SSBs). Nevertheless, all authors positively evaluated the effects of mobile technology on management of pediatric obesity. This finding could be due to the following reasons. First, intervention group attrition rates were twice lower than control group rates in all four studies. Second, four studies obtained positive, although nonsignificant, outcomes of self-monitoring, screen time, SSB intake, weight maintenance, and negative mood control.

A limitation of this study is that only four studies were selected. We recommend additional systematic review and meta-analysis after further studies are performed.

### 5. Acknowledgments

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### References

- [1] S.R. Daniels, D.K. Arnett, R.H. Eckel, S.S. Gidding, L.L. Hayman, S. Kumanyika, T.N. Robinson, B.J. Scott, S.S. Jeor, and C.L. Williams, Overweight in children and adolescents pathophysiology, consequences, prevention, and treatment, *Circulation* **111** (2005), 1999–2012.
- [2] *Sample survey in 2014 students' health* inspection. Ministry of Education, Seoul, 2015.
- [3] M. Ng, T. Fleming, M. Robinson, B. Thomson, N. Graetz, C. Margono, E.C. Mullany, S. Biryukov, C. Abbafati, and S.F. Abera, Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013, *The Lancet* **384** (2014), 766–781.
- [4] J. Niet, R. Timman, So. Bauer, E. Akker, H. Buijks, C. Klerk, H. Kordy, and J. Passchier, The effect of a short message service maintenance treatment on body mass index and psychological well-being in overweight and obese children: a randomized controlled trial, *Pediatric obesity* **7** (2012), 205–219.

- [5] J.S. Huang, L. Dillon, L. Terrones, L. Schubert, W. Roberts, J. Finklestein, M.C. Swartz, G.J. Norman, and K. Patrick, Fit4Life: a weight loss intervention for children who have survived childhood leukemia, *Pediatric blood & cancer* **61** (2014), 894–9000.
- [6] N.L. Nollen, M.S. Mayo, S.E. Carlson, M.A. Rapoff, K.J. Goggin, and E.F. Ellerbeck, Mobile technology for obesity prevention: a randomized pilot study in racial-and ethnic-minority girls, *American journal of preventive medicine* **46** (2014), 404–408.
- [7] J.R. Shapiro, S. Bauer, R.M. Hamer, H. Kordy, D. Ward, and C.M. Bulik, Use of text messaging for monitoring sugar-sweetened beverages, physical activity, and screen time in children: a pilot study, *Journal of nutrition education and behavior* **40** (2008), 385–391.
- [8] *2013 Youth Media Use Survey*. Ministry of Gender Equality and Family, Seoul, 2013.
- [9] A. Lenhart and D. Page, *Teens, Social Media, and Technology Overview 2015*, Pew Research Center, 2015.
- [10] D. Moher, A. Liberati, J. Tetzlaff, and D.G. Altman, Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement, *Annals of internal medicine* **151** (2009), 264–269.
- [11] S. Kim, J. Park, H. Seo, Y. Lee, B. Jang, H. Son, H. Suh, and C. Shin, NECA’s guidance for undertaking systematic review and meta-analyses for intervention, *Seoul: National Evidence-based Healthcare Collaborating Agency* (2011).

# Evaluating the Feasibility of Using Mobile Devices for Nurse Documentation

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**Abstract.** The use of electronic health records (EHR) has changed the quality of clinical documentation and improved quality of patient assistance, allowing better communication between health professionals and increased data recording that helps the nursing assistance process. The use of mobile devices for compiling data at the assistance moment has increased, and more studies have demonstrated its usefulness. The aim of this study was to evaluate the use of mobile devices in the nursing staff of the Hospital Italiano de Buenos Aires, in a pilot test to measure their use and user satisfaction.

**Keywords.** Mobile devices, Nursing process, Nursing informatics, Electronic health record, Nursing assessment.

## 1. Introduction

For nurses, gathering the patient data and information is necessary for helping the nursing assistance process. Information records and detected problems are essential for the continuity of care and a better assistance quality, allowing estimating and planning interventions as well as evaluating the patient's condition. However, patient -centered care remains a difficult goal in acute hospitals because of the fast and complex workflow. The failure in communication between health professionals due to a lack of information associated with poor records is a common cause of medical errors and adverse events to patients [1].

Use of mobile technology is increasing and many studies suggest that its use has several advantages over traditional modes of data compiling, including data accuracy, timeliness, and adherence to protocols for compiling [2]. The use of mobile devices to suit the nurses' needs, can improve and increase the electronic record related to risks and needs estimated in patients, along with a better synchronicity of data and a more effective communication when making decisions regarding their care and allows to plan nursing interventions at the patient bedside. Information systems used on mobile devices have the ability to update the patient's condition in real time and this is important because it supports the tasks performed by nurses, improving access to information and workflow [1,3,4]. The goal of this study was to evaluate the feasibility of using mobile devices for nursing staff.

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## 2. Methods

This evaluation was performed at Hospital Italiano de Buenos Aires (HIBA), a teaching tertiary care hospital with 750 inpatient beds, 3 million of consultations and 45,000 surgical procedures a year. The staff is composed of 2,800 physicians and 1,500 nurses. The EHR is home-developed problem-oriented and patient-centered. The nursing record was developed in phases from paper-based documentation, followed by digitization and computerization in different stages culminating in a nursing e-chart organized by sections according to the nursing process (Assessment, Diagnosis, Planning, Execution and Evaluation).

During September 2015, 203 nurses from different adult general inpatient (AGI) areas, in 4 shifts (morning, afternoon, evening and weekend) participated in a pilot test to evaluate the use of a mobile device (Tablet). For the implementation of this study, 39 tablets of national origin have been bought because of the import restrictions<sup>2</sup> due to the importation problems of our country. The tablets configuration included: a) Installation of geolocator for possible losses, b) PIN access restriction to control patient privacy and data management, and c) Antivirus.

The nursing chart was adapted to mobile systems<sup>2</sup> allowing access to patient data, such as full name, age, primary diagnosis, and relevant data (allergies, blood group and factor, etc.). At this early stage, nurses could only use the assessment and planning section of the nursing chart, and collect the vital signs through the tablet while the rest of the documentation was done from the desktop PC. In the same time that the nurses received the mobile devices, they were trained about how to access the application, basic tablet features, battery management and charging. To evaluate how they felt about the use of tablets, a survey started two weeks later<sup>2</sup>. Through this survey, nurses answered about a) The quality of Wi Fi signal, b) How easy was to use the tablet, c) What information was recorded, d) Size and weight, e) User satisfaction using the tablet, f) Other information to record, and g) Recommendation to other colleagues. Analysis included descriptive statistics for general questions, and content analysis for comments and suggestions.

## 3. Results

From the respondents, 100 answers were received. The average age was 32 years old, 85% were female, and 81% work at adult general inpatient. The highest response rate was from night shift (39%) and from afternoon shift (27%), and 78% were Registered Nurse. 65% of participants reported using the tablet more frequently for the pain assessment (49%), early warnings (53%) and vital signs collection (38%). 35 participants (54%) reported being Very satisfied/satisfied with its use, and 39 (60%) would recommend the use to other colleagues. 56 (86%) of the nurses would like to use the tablet for the medication administration and 39 (60%) for the execution of nursing interventions. 35 participants (53.84%) indicated that the weight was very comfortable/comfortable, respect to the size 30 users (46.15%) indicated it was very comfortable/comfortable. With respect to the WiFi signal 36 (36%) perceived the signal was good / very good and 39 (39%) observed that was bad / very bad (for the rest of results see table 1).

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<sup>2</sup> Online Resource: <http://goo.gl/fcvShm>

**Table 1:** Survey on the use of the tablets

	<b>Browsing</b>	<b>Read on the tablet</b>	<b>Record in the tablet</b>
<b>Very easy</b>	12 (18,46%)	15 (23,08%)	7 (10,77%)
<b>Easy</b>	23 (35,38%)	22 (33,85%)	27 (41,54%)
<b>Neither easy or difficult</b>	19 (29,23%)	14 (21,54%)	10 (15,38%)
<b>Difficult</b>	9 (13,85%)	12 (18,46%)	17 (26,15%)
<b>Very difficult</b>	2 (3,08%)	2 (3,08%)	4 (6,15%)

For the analysis of comments and suggestions from users who used the tablet, three patterns were detected:

**a- Comfort / Ease of Use:** Many users report that the tablet is difficult to use and small for everyday use. Incorporating the new device also requires effort, patience and is more complex to use for older people who have a hard time adopting new technologies.

**b- Workflow:** Tablets make work easier, through the data compiling at real time and so saving it, and allowing being next to the patient, avoiding the use of paper, and facilitating interventions and patient assistance.

**c- Intranet:** The WI FI network is the key for a useful and agile use of tablets. Bad connectivity to the internal network determined slowness of the system.

Among the nurses who did not use the tablets (35), 27 (77.1%) identified inadequate WI FI signal as the main barrier. Two (5.7%) participants indicated they were not interested in using it. Analyzing comments and suggestions the pattern that emerged was similar to "Intranet".

#### 4. Discussion

This study evaluated the feasibility of using mobile devices, and continue the previously started evaluation done at HIBA with the methodology known as Rapid Assessment Process (RAP) [5].

The focus centered in the user [6] is still important to know the nurse needs and recognize what kind of device helps better their workflow.

The nurses who participated in this pilot were receptive to include a mobile device for work practice and recognized that its use improved their routine work. The preliminary results of this study allow us to observe that a mobile device is used to obtain a real-time record at the patient bedside without the need of using paper notes for later transcription in the Electronic Health Record.

The use of the tablet was considered ‘very good’ for half of participants, and they would recommend its use to other colleagues. The heterogeneity of WI FI signal appeared as the most important constraint at the moment of this study.

According to the literature, a mobile device is used in a large amount and is preferred for assessing certain needs. Fall risk, pain, pressure ulcer, aspiration and malnutrition are the most common needs assessed for prevention. Besides the benefits, they suggest the implementation implies more efforts comparing with paper based process [4]. Another study suggests that the collection of data increases when performed at the bedside of the patient instead of using a desktop PC. Nurses prefer to use tablets for the medication administration but the devices did not work in all places at the unit because of connectivity problems [7].

Even if this is a pilot study, and therefore the preliminary results cannot be generalized, we learned some lessons. The inadequate wifi signal was one of the biggest problems when using the device, allowing us to identify the failure and mitigate the risk for the future implementation. The wifi signal was adequate for general purposes but vary at the point of care, therefore we need to make adjustments to suit the bedside long-term project. Despite the drawback mentioned, users of the pilot test considered the use of the tablets is a useful tool for their work and helped them to perform tasks in real time and in a faster way.

Using a mobile device may help nurses’ workflow, allowing more accurate and dynamic records. The continuous training regarding the use of information technologies, and the support were a great help for the pilot test implementation. HIBA continues to work for the full implementation of mobile devices in the context of ‘Bedside project’ that includes barcode medication administration, nursing documentation, census and automatic vital sign capture. As our units of care are very disparate, for every unit the implementation and evaluation will have different approaches and there is a long way to go.

## **Conclusion**

The use of mobile devices can help nurses’ workflow and increase the electronic records, allowing patient information to be constantly updated in real time, improving the assistance quality and the effective communication, and thus having updated data among health professionals.

## **5. Acknowledgements**

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## **References**

- [1] C.A. Caligtan, D.L. Carroll, Hurley AC, R. Gersh-Zaremski, PC. Dykes. Bedside information technology to support patient-centered care. *Int J Med Inform* [Internet]. Elsevier; 2012 Jul 7, 442–51. DOI 10.1016/j.ijmedinf.2011.12.005



- [2] S.J. Lane, N.M. Heddle, E. Arnold, I. Walker, A review of randomized controlled trials comparing the effectiveness of hand held computers with paper methods for data collection. *BMC Med Inform Decis Mak* [Internet]. 2006 Jan; 6:23. DOI 10.1186/1472-6947-6-23
- [3] M.M. Ward, S. Vartak, T. Schwichtenberg, D.S. Wakefield, Nurses' perceptions of how clinical information system implementation affects workflow and patient care. *Comput Inform Nurs*. 2011 Sep;29(9):502-11. DOI: 10.1097/NCN.0b013e31822b8798.
- [4] P.C. Dykes, D.L. Carroll, A. Benoit, A. Coakley, F. Chang, J. Empoliti, et al, A randomized trial of standardized nursing patient assessment using wireless devices. *AMIA Annu Symp Proc* [Internet]. 2007 Jan; 206–10.
- [5] A.A. Almerares, M.Q. Uznayo, D.A. Borbolla, M.B. Schachner, E. Stanziola, D.R. Luna, et al, Use of a Rapid Assessment Process to Compare Three Mobile Multifunction Devices for Nurse Rounds. *MEDINFO 2013* [Internet]. 2013
- [6] J-J. Chen, W-C. Su, P-W. Wang, H-C. Yen, A CMMI-based approach for medical software project life cycle study. *Springerplus* [Internet]. Springer; 2013 Jan 17; 2(1):266. DOI 10.1186/2193-1801-2-266
- [7] E. Carlson, C. Catrambone, K. Oder, S. Nauseda, L. Fogg, B. Garcia, et al. Point-of-care technology supports bedside documentation. *J Nurs Adm* [Internet]. 2010 Sep; 40(9):360–5. DOI 10.1097/NNA.0b013e3181ee4248

# TextWithSurgeryPatients - A Research Hypothesis in Enhancing Education and Physical Assessment for Abdominal Surgical Patients

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**Abstract.** Medical surgical nurses may not have the time or resources to provide effective pre- and post-operative instructions for patients in today's healthcare system. And, making timely physical assessments following discharge from the hospital is not always straightforward. Therefore, the risk for readmission associated with post-surgical complications is a concern. At present, mobile healthcare technologies and patient care are precipitously evolving and may serve as a resource to enhance communication between the healthcare provider and patient. A mobile telephone text message (short message service [SMS]) intervention for abdominal surgical patients may foster effective education (communication) and timely self-reported physical assessment in the home environment hence preventing deleterious outcomes. The aim of this research proposal is to identify the feasibility of using a SMS intervention via smart phones to improve health outcomes via timely communication, reach large numbers of at-risk surgical patients and, establish and sustain uniform protocols in a cost-efficient manner.

**Keywords.** Text Messaging, Perioperative Nursing, Health Education, Mobile Technologies, Surgery

## 1. Introduction

During 2013 there were 51.4 million inpatient surgeries performed in the United States (U.S.) [1]. According to Weiss, Elixhauser and Steiner [2] the 2010 U.S. hospital readmission rates (30-day all cause readmissions) for appendectomy patients were 18,835 (6%), small bowel resections were 15,050 (18.1%) and, debridement of wound, infection or burns were 28,394 (19.1%). Prevention of these post-operative complications is critical in the improvement of clinical outcomes and minimizing healthcare costs following abdominal surgeries. Research conducted by Spalding [3] indicates patient education is effective in reducing anxiety by making the unknown familiar. Communication research indicates in general medicine "effective communication enhances patient compliance, satisfaction and medical outcome" [4, p.1].

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Brief in-person pre-and post-surgical teaching interventions may be effective in reducing complications and increasing healthy behaviours, but require resources that may not always be available to healthcare professionals. Mobile SMS may enhance facilitation of pre-operative reminders, pre- and post-surgical support and, the assessment of self-reported post-surgical healing in adult patients who have undergone abdominal surgery. Furthermore, patients' self-efficacy in healing, anxiety and pain levels may be assessed since these factors affect overall healing and well-being.

Eighty-three per cent of American adults own cell phones and three quarters (73%) of those owners report sending and receiving text messages [5]. Automated text messaging has been used to improve health behaviours associated with hazardous alcohol use in young adults [6], in diabetes care [7, 8], for asthma monitoring [9], in cigarette smoking cessation studies [10, 11], in monitoring posttraumatic stress disorder symptoms [12] and for maternal child health education [13]. However, efficacy remains unknown for its use in surgical patients' self-reported assessment and education. In the following, important reasons for designing a novel randomized controlled trial investigating the effectiveness of an SMS intervention to provide pre- and post-operative education and the assessment of post-operative symptoms are proposed.

## **2. Methods**

### *2.1 Importance of communication*

Today's communication between the patient and healthcare provider is an important reason to look at the novel use of a mobile telephone SMS intervention as an adjunct to traditional education and management of surgical patients. Sutcliffe and colleagues [14] report of the 70 mishap incidents identified in their study, communication and patient management ranked the highest when looking at the occurrence of medical errors. Communication transmission (exchange of information) is clearly a factor in the occurrence of medical errors; however, healthcare hierarchical positions play a significant role as well [14]. Therefore, when developing a SMS intervention it is critical to look at involving the whole healthcare team. Perhaps the development of the text messages to be transmitted to the patients in this proposed study would assist in the amelioration of hierarchical communications, make management of surgical patients more team-based and, be an avenue to intra-professionalism.

### *2.2 Patient centered healthcare and mobile technologies*

Increasingly patients want to be involved in healthcare decisions [15] and mobile phone text messaging to encourage healthy behaviors and manage various health conditions are surfacing [16, 17, 18]. Moreover, the young adult generation uses SMS messaging more than email today. Mobile telephones delivering text messages via SMS may be used pre-operatively to deliver reminder messages regarding nutrition, exercise, surgical wound care, and medication usage. Post-operative care may be improved with the use of organized educational text messages the patient may look forward to receiving in order to enhance self-efficacy in the post-operative healing period. As well, the receiving of text messages from healthcare professionals may bolster the patients' emotional well being with the sense of being cared for in the privacy of the home.

### *2.3 Proposed study aim*

The aim of this proposed study is to identify the short-term effectiveness, feasibility and suitability of a mobile telephone text message intervention (Text With Surgery Patients [TWSP]) to enhance education and timely physical assessment of adult abdominal surgical patients in natural home settings.

### *2.4 Design*

The design of this proposed study is a stratified two-parallel-group randomized controlled trial comparing pre- and post-surgical education and physical assessment (usual care; control) with usual care and the TWSP program (intervention), sent by primary care nurses who will be blinded to the allocation of sequencing.

### *2.5 Setting and participants*

The proposed setting is a teaching university hospital located in Northern California and, the recruited participants will consist of adults (males and females; 18-70 years) preparing for abdominal surgery (e.g. appendectomy, small bowel resection, etc.). Study eligibility will be based upon these participant characteristics: (1) consents to have abdominal surgery prior to recruitment; (2) has a functioning smart phone; (3) has knowledge of how to receive and send text messages; (4) speaks and reads English. Characteristics of participants at baseline, enrollment, and follow-up include: age, race/ethnicity, marital status, education, significant support figures at home, number of children under the age of 18, and technology skills.

### *2.6 Ethics*

The proposed study will be presented and approved by the Institutional Review Board for the Protection of Human Subjects at the University of San Francisco and the hospital's ethics committee. All participants who are eligible, interested in the study, and consent to participate will complete consent and Health Insurance Portability and Accountability Act (HIPAA) agreement forms prior to the commencement of the study. All participants will receive routine pre- and post-surgical care.

### *2.7 Statistics*

Calculating for an independent samples T-test, the total sample size for a small effect size ( $d=0.2$ ); alpha level of 0.05; and a power level of 0.80 is  $N=620$  (control  $n=310$ , intervention  $n=310$ ). Descriptive statistics such as frequencies, proportions, and 95% confidence intervals will be calculated.

### *2.8 Procedure*

Both groups will consent to and thoroughly complete a demographic survey at the surgeon's office during the pre-operative visit. Routine pre-operative education and educational resources (e.g. paper based instructions) will not be controlled for but noted when collecting the data. Randomized consented patients will receive a text message stating if they have been randomized to the control or intervention group prior to the commencement of the study. A telephone system will perform this initial text, thereby allowing for the surgical nurses to be blinded to who is in the sequencing of

randomization. Acknowledgement of this first text message will be required of the intervention participant in order to move forward and take part in the study. Intervention participants will have the option of enrolling in the TWSP program via texting a specific code to a designated phone number or enrolling online at the TWSP website. For both enrollment options the intervention participants will enter their surgery date and home zip code.

### *2.9 Measures*

The primary intervention outcome will be participants' responses to pre- and post-surgical SMS containing educational/motivational content written by expert surgical nurses and physicians (e.g. Nothing per oral after midnight prior to surgical date) and, the secondary content will be responses to physical assessment questions (e.g. Is your surgical wound clean and dry?). The TWSP program messages will be delivered daily directly following the pre-operative visit at the surgeon's office (this time will vary) and for 14 days post-operatively. The intervention participants will receive a follow-up contact phone call by nurses delivering the text messages in order to gather information about the suitability of the TWSP program. If the hospital performs regular follow-up phone calls to all surgical patients then the control participants will receive the routine hospital based phone call, as well.

### *2.10 Incentives*

The incentives to participate in the study will be a \$10 gift card upon completing the initial demographic survey by both groups at the pre-operative visit. Upon completing the final follow-up phone call assessing the suitability of the TWSP program, intervention participants will be mailed a \$20 gift card.

## **3. Results**

The results of this study will be submitted to a peer-reviewed open-source healthcare professional journal for timely release to healthcare professionals.

## **4. Discussion**

Education and physical assessment are two very important factors in the care of surgical patients. Mobile technologies, such as the cell phone, coupled with SMS may have potential to augment abdominal surgical patients' knowledge, motivation, and overall healing. Douglas and Free [19] determined mobile phone-based text messaging for smoking-cessation support is very economical and simultaneously affords emotional support. Randomized controlled trials have examined the use of text messages (SMS) and its role in the adoption of health-related behaviors or the management of diseases [20, 21]. However, the literature lacks the efficacy of a text message intervention for pre- and post-surgical patients' education and self-reported physical assessment. If adopted by the healthcare community, this novel use of mobile health messaging may help providers reach a larger population of surgical patients at a diminished cost. The presentation of this research proposal at the NI2016 conference will provide a field of peer discussion, suggestions, and constructive feedback.

## References

- [1] Centers for Disease Control and Prevention. Fast Stats. [Internet]. <http://www.cdc.gov/nchs/fastats/> (accessed November 30, 2015).
- [2] A. J. Weiss, A. Elixhauser, C. Steiner. Readmissions to U.S. hospitals by procedure, 2010. [Internet]. <http://www.hcup-us.ahrq.gov/reports/statbriefs/sb154.pdf> (accessed November 30, 2015).
- [3] N.J. Spalding. Reducing anxiety by pre-operative education. - *Occupational therapy international*, 2003. [Internet]. [http://www.readcube.com/articles/10.1002%2Foti.191?r3\\_referer=wol&show\\_checkout=1](http://www.readcube.com/articles/10.1002%2Foti.191?r3_referer=wol&show_checkout=1) (accessed November 30, 2015).
- [4] C.H. Kindler, L. Szirt, D. Sommer, R. Hausler, W. Langewitz. 2004. [Internet] <http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2044.2004.03995.x/full> (accessed November 30, 2015).
- [5] A. Smith. Americans and Text Messaging. Washington, D.C.: Pew Research Center; 2011. [Internet] <http://www.pewinternet.org/2011/09/19/americans-and-text-messaging/> (accessed November 30, 2015).
- [6] B. Suffoletto, J. Kristan, C. Callaway, K. H. Kim, T. Chung, P. M. Monti, D. B. Clark. A text message alcohol intervention for young adult emergency departments patients: a randomized clinical trial, *Annals of Emergency Medicine In press* (2014), 1-9.
- [7] V.L. Franklin, A. Waller, C. Pagliari, et al. A randomized controlled trial of Sweet Talk, a text messaging system to support young people with diabetes, *Diabetes Medicine* **23** (2006), 1332-1338.
- [8] No Authors. Text message program improves outcomes, decreases ED utilization among ED patients with poorly controlled diabetes, *Emergency Department Management* **26** (2014), 20-23.
- [9] L. Prabhakaran, W.Y. Chee, K. C. Chua, et al. The use of text messaging to improve asthma control: a pilot study using the mobile phone short messaging service (SMS) **16** (2010). *Journal of Telemedicine Telecare*, 286-290.
- [10] F. Naughton, J. Jaminson, S. Boase et al. Randomized controlled trial to assess the short-term effectiveness of tailored web- and text-based facilitation of smoking cessation in primary care (iQuit in Practice), *Addiction* **109** (2014), 1184-1193.
- [11] N. Douglas, C. Free. 'Someone battling in my corner': experiences of smoking-cessation support via text message **63** (2013), 768-776.
- [12] M. Price, K. J. Ruggiero, P. L. Ferguson, et al. A feasibility pilot study on the use of text messages to track PTSD symptoms after a traumatic injury, *General Hospital Psychiatry* **36** (2014), 249-254.
- [13] J.A. Gazmararian, L. Elon, B. Yang, M. Graham, R. Parker. Text4baby program: an opportunity to reach underserved pregnant and postpartum women? *Maternal Child Health* **18** (2013), 223-232.
- [14] K.M. Sutcliffe, E. Lewton, M.M. Rosenthal. Communication failures: an insidious contributor to medical mishaps, *Academic Medicine* **79** (2004), 186-194.
- [15] R. Rozenblum, D.W. Bates. Patient-centered healthcare, social media and the Internet: The perfect storm? *British Medical Journal Quality and Safety* **0** (2013), 1-4.
- [16] B.S. Gerber, M.R. Stolley, A.L. Thompson, L.K. Sharp, M.L. Fitzgibbon. Mobile phone text messaging to promote healthy behaviors and weight loss maintenance: A feasibility study. *Health Informatics Journal* **15** (2009), 17-25.
- [17] E. Wright, T. Fortune, I. Juzang, S. Bull. Text messaging for HIV prevention with young Black men: Formative research and campaign development. *AIDS Care* **23** (2011), 534-541.
- [18] A.K. Pearson, M.L. Blain, H. Jiang, P.W. Rasmussen, J.E. Stout. Text messaging for enhancement of testing and treatment for tuberculosis, human immunodeficiency virus, and syphilis: A survey of attitudes toward cellular phones and healthcare. *Telemedicine and E-Health* **17** (2011), 189-195.
- [19] N. Douglas, C. Free. 'Someone battling in my corner': Experiences of smoking-cessation support via text message. *British Journal of General Practice* (2013) DOI:10.3300/bjgp13X674459, e768-e776.
- [20] A. Battistotti, S. Quaglini, E. Cuoco. Reducing dropouts in outpatient care through an SMS-based system. *Studies in Health Technology and Informatics* **124** (2005), 935-940.
- [21] T.M. Nelson, J. H. Berg, J.F. Bell, P. J. Leggott, A.L. Seminario. Assessing the effectiveness of text messages as appointment reminders in a pediatric dental setting. *Journal of the American Dental Association* **142** (2011), 397-405.

# A Mobile Care Coordination System for the Management of Complex Chronic Disease

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**Abstract.** There is global concern about healthcare cost, quality, and access as the prevalence of complex and chronic diseases, such as heart disease, continues to grow. Care for patients with complex chronic disease involves diverse practitioners and multiple transitions between medical centers, physician practices, clinics, community resources, and patient homes. There are few systems that provide the flexibility to manage these varied and complex interactions. Participatory and user-centered design methodology was applied to the first stage of building a mobile platform for care coordination for complex, chronic heart disease. Key informant interviews with patients, caregivers, clinicians, and care coordinators were conducted. Thematic analysis led to identification of priority user functions including shared care plan, medication management, symptom management, nutrition, physical activity, appointments, personal monitoring devices, and integration of data and workflow. Meaningful stakeholder engagement contributes to a person-centered system that enhances health and efficiency.

**Keywords.** Care coordination, care management, chronic disease, person-centered, mobile application

## 1. Introduction

Cardiovascular disease accounts for approximately 31% of global deaths, and the global burden continues to rise [1]. Cardiovascular disease often presents with comorbidities such as depression, hypertension, and diabetes, which further complicate the delivery of care. Care for patients managing complex chronic disease involves diverse practitioners, multiple specialists, and numerous transitions between medical centers, physician practices, clinics, rehab centers, community resources, and homes. High quality care coordination allows members of the healthcare team to provide care more efficiently, reduce patient and caregiver burden, and improve health outcomes [2,3]. Globally, for individuals with chronic or prolonged conditions, care is complicated, fragmented and poorly coordinated [4].

Active engagement of individuals with their healthcare teams and participation in care coordination has been shown to be beneficial [5,6] and may improve the quality of care and reduce avoidable emergency department visits, hospital admissions and re-admissions, and other unnecessary healthcare costs [7]. Currently, systems such as electronic health records (EHRs) offer solutions for healthcare teams (including clinicians, staff, and health workers) within individual institutions. For individuals (and family and caregivers), there are numerous mobile health applications or portals

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focused on lifestyle change or limited administrative tasks such as appointment requests. Neither of these systems supports deep engagement. Recently, care coordination technologies have emerged to try and fill this gap. A landscape assessment of 25 commercial systems in 2014 found that none adequately addressed patient engagement, collaboration, and sharing needs [8]. We used principles of stakeholder engagement and user-centered design to develop a mobile application for person-centered care coordination for cardiovascular disease.

## 2. Methods

Key informants were purposively recruited to reflect diversity in experience managing complex chronic disease from the perspectives of patient, caregiver, clinician, care coordinator, and administrator. An interview guide was created that covered topics of current experiences and challenges with care coordination and priorities for a care coordination system. Interviews were conducted one or two interviewers together, and lasted an hour. Detailed notes were taken. Notes were independently coded for major themes and needs by the two interviewers. Two representative scenarios were developed to guide specification of requirements. This project was deemed not human subjects research (UC Davis IRB# 782917-1).

## 3. Results

14 interviews were completed: 4 patients, 2 family caregivers, 3 nurse care coordinators, 2 advanced practice nurses, a cardiac rehabilitation specialist, a cardiologist, and a primary care physician. The scenarios below are followed by priority user needs (Table 1).

### *Scenario A: Long-term management of complex chronic disease*

Ms. A is a 72 year-old woman who has been living with type II diabetes for 12 years. She developed cardiovascular disease and was recently informed that she has heart failure. She has noticed greater difficulty in walking with hip and leg pain. Ms. A takes eight prescription medications: Metoprolol (beta-blocker), Lisinopril (ace inhibitor), Coumadin (anti-coagulant), Lasix (diuretic), Lipitor (statin), and Losartan (angiotensin receptor blocker), as well as Metformin for diabetes and Atavan for anxiety. All are taken daily but on different schedules, e.g. before going to bed, 1 hour before taking food, or with food. Ms. A sometimes doesn't take Lasix if she plans to go out for the afternoon because it causes frequent urination. Several medications cause Ms. A to be dizzy and fatigued. She describes them as making her feel "loopy" and prevents her from driving. She's not sure they are working so she sometimes decides to take a break from them. Ms. A needs to limit intake of vitamin K-rich foods, e.g. kale/collards/grapefruit, pomegranate, as vitamin K can make Coumadin less effective as a blood thinner. She is also on a low-sodium and diabetic diet and restricted fluid intake. Ms. A's healthcare team includes a primary care doctor, cardiologist, diabetes educator, dietician, and pharmacist who are located in four different facilities. She lives alone in a two-story home. Her son lives in the same town and although he works full-time and has a family, he frequently helps with her healthcare and daily living needs. Her daughter lives in another state and checks in regularly with both of them. Ms. A's greatest concerns are remaining independent and having the energy to visit with friends and family.



*Scenario B: Care coordination following a transition from hospital to home*

Mr. B is a 53 year-old man who has recently been diagnosed with heart failure after being admitted to the hospital following an ER visit for shortness of breath. Mr. B has had heart problems before but has never heard of heart failure and doesn't understand what causes it or what it means. He has been prescribed Coreg (carvedilol, a beta blocker) that slows heart rate and helps to manage hypertension, digoxin, a medicine to strengthen and regulate heartbeat, Lasix (diuretic), hydrochlorothiazide (blood pressure medication), and levothyroxine (thyroid medication). Medications are taken on different schedules throughout the day and week. While still in the hospital, he met with a dietician, who explained to him the importance of a low-sodium diet and gave him a packet that included nutrition information for heart failure patients, including specific instructions on how much salt he should be eating (<1500 mg per day). He has also been referred to a cardiac rehab center but has not yet made an appointment. He has follow-up appointments once a month with a cardiologist for the first three months, which will taper off to once every three months. However, since he has been experiencing several problems with his medications, he is seeing the cardiologist every 2 weeks. His cardiologist is working to adjust his blood pressure medication, since his blood pressure is highly unstable. He measures his blood pressure, weight, and pulse every day, and shares this information with his doctor when asked. He has been assigned a care coordinator, who calls him every three weeks to make sure he is ok. When he has a question, he calls the on-call cardiologist, since he does not have a way to get in touch with his care coordinator. He is feeling overwhelmed and depressed with all of the new lifestyle changes and medications. Due to his illness he is taking medical leave from work. He lives alone, around 50 miles away from his cardiologist's office. He has a son in college whom he usually sees during holidays.

**Table 1:** Summary of priorities and corresponding user functions

Priority/Challenge	User Functions
<b>Shared Care Plan</b>	
Goal setting	Document personal goals; document clinical goals.
Measures and outcomes	Collect person-reported outcomes (PROs), e.g. symptom scores, and clinical measures, e.g. HbA1c, lipids, blood pressure, ejection fraction, weight, anxiety and depression scores.
Self-management plan	Dashboard for tracking measures and progress toward outcomes. Commitments, resources, and personal strategies for identified goals where individual management is appropriate.
Roles and contacts	Complete list of healthcare team members, family/caregivers, preferred contact information, e.g. email, phone, PHR. Describe what to do for immediate and urgent care needs. Provide means to publish care plan to others.
<b>Medication Management</b>	
Medication instructions	Complete list of all medications with indications, dose, frequency, timing, and directions.
Medication schedule	Daily medication schedule and reminders with dose, time, and directions for administration.
Purpose of medication	Medication information readily available.
Medication tracking	Tracking of medication adherence including reporting reason for not taking medication. Decision-making tools for appropriate self-titration, or when to contact a provider. For providers: periodic summary of medication adherence, problems and side-effects experienced, and reasons for missed medications.
Prescription refill	Schedule refills at least two weeks before last dose of current supply, and before last refill on prescription.

Medication reconciliation and decision support	Interface with providers, care coordinators, pharmacists for management of drug-drug interactions, prescription changes, side effects.
<b>Symptom Management</b>	
Assessment	Symptom and mood assessment tools that are used with clinicians or care coordinator review and guidance on appropriate interventions. Tracking of data longitudinally.
Support	Motivational aids. Individually tailored suggestions from personal data. Evidence-based recommendations where possible.
<b>Nutrition</b>	
Nutrition education	Library of sample menus and educational resources on nutrition for patient's condition(s)
Tracking food items	Food tracking capability, including micronutrients; Integration of other food trackers.
Support	Motivational aids. Individually-tailored suggestions from personal data. Evidence-based recommendations where possible.
<b>Physical Activity</b>	
Physical activity education	Exercise plan and recommendations; Library of sample exercises specific to condition
Tracking activity	Exercise tracking capability, including ability to report reasons for not exercising or problems experienced
Support	Integration of pedometer data or other wearable devices Individually-tailored suggestions from personal data. Evidence-based recommendations where possible.
<b>Appointments</b>	
Follow up appointments and services	Identify and schedule routine follow-up visits and services needed, timeframes, and referrals, e.g. primary care visits, specialist visits, labs, foot and eye exams
Referrals and scheduling	Store referrals if needed. Set tickler reminders to schedule visits or follow up on referrals.
Reminders	Set appointment reminders
Transportation	Contact and schedule transportation service, caregiver, or other mode of transport.
<b>Personal monitoring devices</b>	
Biometric data	Ability to collect data from personal monitoring devices, e.g., weight scale, blood pressure, heart rate, glucose monitor.
Data analysis	User-friendly analysis tools to understand data. Create actionable data visualizations and integrate or transfer relevant summary data or trend reports to EHRs/PHRs.
<b>Integration</b>	
Preparation for healthcare visits	Provider-friendly presentation of key indicators from functions above, in summary tracking/trending report. Documentation of person's notes, questions and concerns related to functions above included with provider report.
Health documents	Ability for person to store, organize, and retrieve pertinent medical and pharmaceutical records and images, device data, person – generated data.
Workflow	Integrate data from all functions and provide capability to analyze, visualize findings, make decisions, and communicate with healthcare team, family members and other caregivers. Organize activities across these groups.

## Discussion

A shared care plan can align patients and providers by setting shared goals and developing a care plan around these goals. The application will have the capacity to input a comprehensive care plan and will include a dashboard to track person-relevant measures and outcomes. Specific attention in the shared care plan should be paid to

activities that affect both health and quality of life such as medication and symptom management, nutrition, and physical activity. Integration of the data from personal monitoring devices and the ability to push a subset of analyzed and summary data to the EHR will be prioritized. Integration also requires the ability for patients to access their own healthcare records and documents, and to keep these records in a place where they are usable and easily accessible for patients, caregivers, and clinicians. Interoperability between systems will also substantially improve care coordination capacity and allow for the meaningful use of patient data [9,10]. In line with participatory methods, next steps include co-design sessions with key informants. Testing of the resulting prototype will help to assess the extent to which functions meet needs, identify areas for improvement, and discover potential solutions to problems. We will also explore potential limitations to adoption of the technology: technology literacy, health literacy, privacy concerns and patient trust, no or intermittent connectivity, no access to a care coordinator or provider assisting with the creation of shared goals or a long-term care plan or multiple coordinators representing health system or payer. Meaningful stakeholder engagement will help to create a compelling and person-centered system that can improve health, decrease costs, and enhance patient accountability and autonomy.

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#### References

- [1] World Health Organization, Cardiovascular Diseases Fact Sheet N° 317. [updated January 2015; accessed 29 December 2015]: <http://www.who.int/mediacentre/factsheets/fs317/en/>.
- [2] M.D. Naylor, D.A. Brooten, R.L. Campbell, G. Maislin, et al, Transitional care of older adults hospitalized with heart failure: a randomized, controlled trial, *Journal of the American Geriatrics Society* **52:5** (2004), 675-684.
- [3] B.D. Stauffer, C. Fullerton, N. Fleming, et al. Effectiveness and cost of a transitional care program for heart failure: a prospective study with concurrent controls, *Archives of Internal Medicine* **171:14** (2011), 1238-1243.
- [4] C. Schoen, R. Osborn, D. Squires, M. Doty, R. Pierson, S. Applebaum, New 2011 survey of patients with complex care needs in eleven countries finds that care is often poorly coordinated. *Health Affairs* **30:12** (2011), 2437-48
- [5] L.C. Baker, S.J. Johnson, D. Macaulay, H. Birnbaum, Integrated telehealth and disease management to support the care of veteran patients with chronic conditions, *Telemedicine and e-Health* **14:10** (2008), 1118-1126.
- [6] D. Peikes, A. Chen, J. Schore, R. Brown, Effects of care coordination on hospitalization, quality of care, and health care expenditures among Medicare beneficiaries: 15 randomized trials, *JAMA* **301:6** (2009), 603-618.
- [7] A. Philis-Tsimikas, C. Walker, L. Rivard, et al, Improvement in diabetes care of underinsured patients enrolled in Project Dulce: a community-based, culturally appropriate, nurse care management and peer education diabetes care model, *Diabetes care*, **27:10** (2004), 110-115.
- [8] K.K. Kim, D. Lindemann, L. Hack, V. Steinmetz. ACTIVATE Technology Assessment Report Unpublished (2014).
- [9] Office of the National Coordinator for Health Information, Standards and Interoperability Framework. Longitudinal Coordination of Care: Interoperable Care Plan Exchange Use Case v2.0 (2014).
- [10] Alliance for Nursing Informatics, Alliance for Nursing Informatics Position to the ONC Federal Information Technology Strategic Plan 2011-2015. [updated 5 May 2011; accessed 29 December 2015]: <http://www.allianceni.org/documents/ANIPositionONCFederalITStrategicPlan.pdf>.

# Mobile Apps Providing Tailored Nursing Interventions for Patients with Metabolic Syndrome

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**Abstract. Objectives:** This study developed and evaluated four mobile applications (apps) that provide tailored nursing recommendations for metabolic syndrome management. **Methods:** Mobile apps for obesity, gestational diabetes, hypertension, and hyperlipidemia management were developed according to the system development life cycle and evaluations by experts and users. **Results:** Six lifestyle management and five disease-specific knowledge domains were extracted. Functions such as ‘Log in’ and ‘Record data using diary’ to be used in all of the apps were extracted, while disease-specific functions were also extracted, including ‘Determine the goal’ to be used in the obesity app. The proficiency and efficiency of the algorithms ranged from 69.0 to 100.0. In a heuristics evaluation all of the problems were resolved and all of the usability scores exceeded 3.5 out of 5. **Conclusion:** This study demonstrates that metabolic syndrome can be effectively managed using special functions provided by smartphones, such as automatic feedback, alerts, diaries, and social media integration. Future work will include integrating and harmonizing these four apps in order to improve their semantic interoperability.

**Keywords.** Metabolic syndrome X, Self-management, Mobile health, Smartphone application, Nursing Research

## Introduction

Metabolic syndrome is a group of interrelated risk factors of metabolic origin for atherosclerotic cardiovascular disease [1]. Four elements comprising metabolic syndrome have been identified: central obesity (waist circumference), dyslipoproteinemia (triglycerides and high-density lipoprotein cholesterol), hypertension (blood pressure), and glucose intolerance (fasting glucose). Metabolic syndrome is becoming prevalent worldwide due to the increasing rates of obesity and sedentary lifestyles. Metabolic syndrome increases the risk of developing type 2 diabetes and cardiovascular disease [2].

The American Heart Association in conjunction with the American Diabetes Association and the National Heart, Lung, and Blood Institute identified two goals of therapy for patients with metabolic syndrome: (1) lifestyle modifications, which are essential to successful treatment, and (2) pharmacologic therapy for the intensive management of other cardiovascular risk factors and type 2 diabetes [3].

Recent advances in information communication technology such as mobile technology have made tailored interventions possible for health promotion and disease management. For example, mobile healthcare applications (apps) are being used for helping patients to keep track of medication, assess and monitor their self-management behaviors, and record diaries anytime and anywhere [4]. Smartphones have particular advantages over other types of mobile devices in that they provide voice delivery services, location-based services, and camera and recording features that are particularly useful for healthcare [5].

Tailored interventions may provide several advantages, including presenting less redundant information and focusing on aspects specific to the patient, thereby leading to more personal involvement in the healthcare [6]. Studies have found that tailored interventions are more relevant and interesting than nontailored material for lifestyle modification [7]. Even though many Web-based computer-tailored interventions are available for self-management [8], there have been few reports on smartphone-based interventions utilizing mobile-specific functions such as diaries and alerts. Furthermore, there are no mobile apps available that provide evidence-based interventions that are tailored to the patient data using knowledge extracted from clinical guidelines for lifestyle modification as key factors of metabolic disease management.

In this paper we describe four studies involving the development and evaluation of mobile apps providing evidence-based tailored nursing recommendations for metabolic syndrome management.

## **Methods**

Four mobile apps for managing the following aspects of metabolic syndrome were developed: obesity [9], gestational diabetes mellitus (GDM) [10], hypertension [11], and hyperlipidemia [12]. They were developed according to the four stages of the system development life cycle: analysis, design, implementation, and evaluation [13].

In the analysis stage, we extracted knowledge and functional requirements for metabolic syndrome management from clinical practice guidelines, a literature review, and consultations with experts in obesity, GDM, hypertension and hyperlipidemia. In total, 17 clinical practice guidelines recognized internationally for quality, scientific rigor, and consistency on each disease were reviewed. Knowledge requirements were grouped into lifestyle management and disease-specific self-management. Functional requirements were also grouped into common and specific functions.

In the design stage, we developed data models, algorithms linking data and knowledge, and a user interface for mobile apps.

In the implementation stage, we developed apps for use on the Android and iOS platforms.

In the evaluation stage, we evaluated the algorithm proficiency and efficiency, user interface, usability, and effectiveness of the apps. The proficiency and efficiency of the algorithms were evaluated by comparing recommendations suggested by the healthcare providers and generated from the app using scenarios. Proficiency was calculated by

dividing the summation of '+1's (corresponding to full consistency between the expert recommendations and recommendations from the app) and '-1's (full inconsistency) by the total number of '+1's. Efficiency was quantified as the total number of '+1's divided by the total number of recommendations.

The user interface of the apps was evaluated using a mobile heuristics scale with 10 items [14]. The experts were asked to freely comment on any issues about the usability, and evaluate the severity of each problem on a scale from 0 to 4. Items were indicated as faulty if two or more experts scored them as 1 point or higher. Any items that received 4 points were considered to have major usability problems.

Usability was evaluated using the Post-Study System Usability Questionnaire for the obesity app [15] and the System Usability Scale for the GDM app. The usability of the hypertension app was evaluated based on the user satisfaction with 10 functions, with scores ranging from 1 ('very dissatisfied') to 5 ('very satisfied'). The effectiveness of the hypertension app in medication adherence was evaluated using the Modified Morisky Scale [16].

## Results

In the analysis stage, six knowledge domains of lifestyle management (diet, physical activity, weight control, alcohol, smoking, and stress management) and five disease-specific knowledge domains (degree of obesity, blood glucose, ketones, blood pressure, and cholesterol) were extracted from clinical practice guidelines.

Functions of all four apps that were extracted included 'Join,' 'Log in,' 'Record data using dairy,' 'Input data manually,' and 'View automatic feedback based on input data.' The disease-specific functions extracted included 'Determine the goal' in the obesity and hyperlipidemia, 'Social media integration' in the Obesity app, 'Alert setting' in the three apps except obesity app, and 'View medication adherence trends' in the hypertension and hyperlipidemia app (Figure 1). For example, when a patient intakes more calories than needed, the alert function can alert the patient by sending a message based on the daily calorie intake that the diary function has helped the patient to track.

In the design stage, 106 data models were developed, with the following 6 used across all of the apps: height, weight, food name, intake amount, activity name, and activity amount. In total, 27 algorithms were developed by linking the data items and 95 rules. Eight algorithms were developed for GDM: main, display normal range, alert setting, diet, blood glucose control, physical activity, ketone control, and body weight reduction.

In total, 87 screens were designed according to the functional requirements extracted in the analysis phase. Some screens were used across all of the apps (e.g., 'Register,' 'Diary input page,' 'Initial data input page,' 'Displaying recommendations,' and 'App information'), while disease-specific screens (e.g., 'Goal setting,' 'Alert setting,' and 'Medication adherence') were also developed.

In the implementation stage, all of the apps were developed for the Android platform using the Android SDK, Java Development Kit, and Eclipse. The obesity management app was also developed for the iOS platform. Two of the four apps were published: the GDM and hypertension apps were published on Google Play as 'GDM Management' and 'Hypertension Management Assistant' on June 2, 2014 and December 1, 2014, respectively.

In the evaluation stage, the proficiency of the algorithms ranged from 88.2 to 100.0 and their efficiency ranged from 69.0 to 100.0. The obesity app had the lowest proficiency and efficiency. For the GDM and hypertension apps, all recommendations made by the evaluators concurred with recommendations derived from the apps. In the heuristics evaluations, 13 and 10 problems were flagged for the obesity and hypertension apps, respectively. All of these heuristics problems were resolved before the apps were used.

Usability scored 3.5 out of 5 for the obesity app and 3.5 out of 5 for the GDM app. User satisfaction scored 3.6 out of 5 for the hypertension app. The hypertension app increased medication adherence from 4.2 to 5.2 out of 6 ( $p=0.001$ ) for the hypertensive patients.

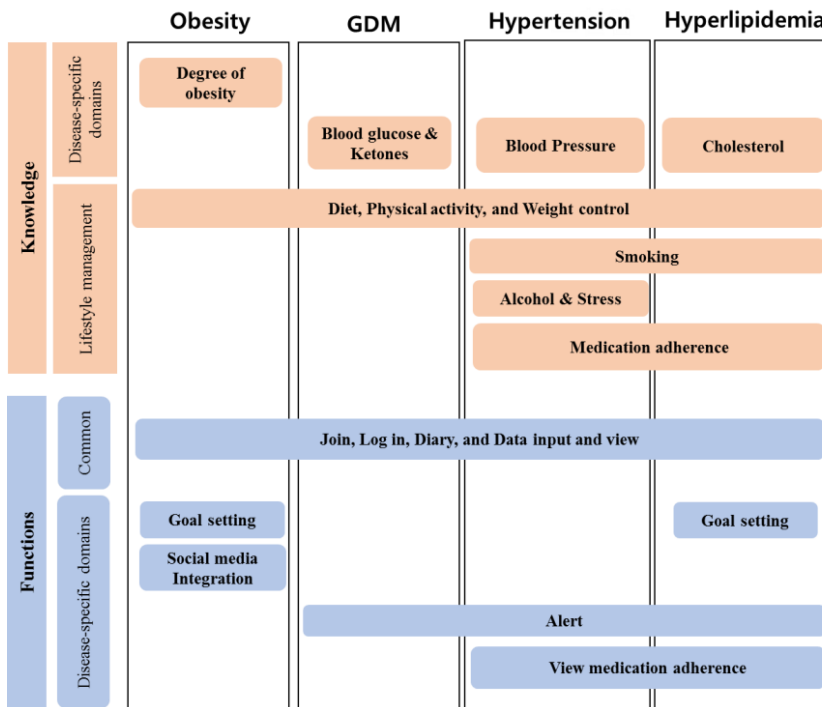


Figure 1. Knowledge domains and functions for metabolic syndrome management

## Discussion

This paper has presented four mobile apps developed for managing metabolic syndrome: specifically obesity, diabetes, hypertension, and hyperlipidemia. These four apps received positive evaluations in terms of algorithm proficiency and efficiency, heuristics, usability, and effectiveness. The results of this study show that a mobile intervention is also effective for hypertension medication adherence. Future studies should evaluate the clinical effectiveness of other apps.

This study investigated the management of metabolic syndrome using special functions provided by smartphones, such as automatic feedback, alerts, diaries, and

social media integration. How the effects of smart devices vary for different functions still needs to be evaluated. Future work will include integrating and harmonizing these four apps in terms of knowledge, data model, functions, and interface in order to improve their semantic interoperability.

## Acknowledgments

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## References

- [1] S.M. Grundy, et al., American Heart Association; National Heart, Lung, and Blood Institute. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement, *Circulation* **112(17)** (2005), 2735-2752.
- [2] K. Yamaoka, T. Tango, Effects of lifestyle modification on metabolic syndrome: a systematic review and meta-analysis, *BMC medicine* **10(1)** (2012), 138.
- [3] N.J. Stone, L.R. Schmelz, Metabolic syndrome management, *Expert opinion on pharmacotherapy* **8(13)** (2007), 2059-2075.
- [4] D.D. Luxton, R.A. McCann, N.E. Bush, M.C. Mishkind, G.M. Reger, mHealth for mental health: Integrating smartphone technology in behavioral healthcare, *Professional psychology: research and practice* **42(6)** (2011), 505-512.
- [5] M.N. Boulos, S. Wheeler, C. Tavares, R. Jones, How smartphones are changing the face of mobile and participatory healthcare: an overview, with example from Ecaalyx, *Biomedical engineering online* **10(1)** (2011), 24.
- [6] H. de Vries, J. Brug. Computer-tailored interventions motivating people to adopt health promoting behaviours: introduction to a new approach, *Patient education and counseling* **36(2)** (1999), 99-105.
- [7] J. Brug, M. Campbell, P. van Assema, The application and impact of computer-generated personalized nutrition education: a review of the literature, *Patient education and counseling* **36(2)** (1999), 145-156.
- [8] A. Oenema, F. Tan, J. Brug. Short-term efficacy of a web-based computer-tailored nutrition intervention: main effects and mediators, *Annals of behavioral medicine* **29(1)** (2005), 54-63.
- [9] E. Jeon, H.A. Park, Development of a smartphone application for clinical-guideline-based obesity management, *Healthcare informatics research* **21(1)** (2015), 10-20.
- [10] S. Jo, Development and evaluation of a tailored gestational diabetes mellitus management smartphone application [dissertation]. [Seoul]: Seoul National University.
- [11] H. Kang, H.A. Park, Development of hypertension management mobile application based on clinical practice guidelines, *Studies in health technology and informatics* **210** (2014), 602-606.
- [12] J.Y. Lee, H.A. Park, Y.H. Min, Trans-theoretical model-based nursing intervention on lifestyle change: a review focused on intervention delivery methods, *Asian nursing research* **9(2)** (2015), 158-167.
- [13] D.E. Avison, H.U. Shah, The information systems development life cycle: A first course in information systems, McGraw-Hill, 1997.
- [14] E. Bertini, S. Gabrielli, S. Kimani, Appropriating and assessing heuristics for mobile computing. *ACM*. (2006), 119-126.
- [15] J.R. Lewis, Psychometric evaluation of the PSSUQ using data from five years of usability studies, *International Journal of Human-Computer Interaction* **14(3-4)** (2002), 463-488.
- [16] A.M. Borzecki, S.A. Oliveria, D.R. Berlowitz, Barriers to hypertension control, *American heart journal* **149(5)** (2005), 785-794.



# What Features of Smartphone Medication Applications Are Patients with Chronic Diseases and Caregivers Looking for?

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**Abstract.** We explored the desired features of medication applications for patients with chronic disease and their caregivers with a questionnaire survey, 50 from patients and 50 from their caregivers. Although the majority of people (75%) are willing to use medication apps, the actual usage rate is quite low (11%). Worrying about privacy of personal information seems to be the main reason of not using applications. The overall score desired for use was  $3.29 \pm 1.02$  (out of 5). *Searching medications and diseases* and *assistance with making doctors' appointments* are the most wanted categories. *Online shopping for drugs and delivery* were the least desired items. The main concerns for people who do not want certain features include: *they are not useful*, *worrying about buying counterfeit drugs* and *reliability of content*. Compared with patients, caregivers seems to be more concerned on *nutrition tips for chronic illness*, *fall detection*, and *privacy protection* ( $P < 0.05$  for all).

**Keywords.** mHealth, Smartphone Application, Medication, Chronic Disease, Cross-sectional Study

## 1. Introduction

Chronic illness is the leading cause of death in China, accounting for 85% of total mortality [1]. Good adherence to medications and healthy lifestyle has been proven to be important in prognosis [1]. However, studies show that medication adherence is poor in patients with chronic illness [2]. In recent years, applications on smartphones have become a new strategy for adherence improvement [3]. Mobile phones have penetrated nearly all strata of society [3]. This trend helps to build a low-cost, large scale implementation of interventions via smartphone and holds promise as a ubiquitous platform by which the connection between interventions and patients is continuous and reciprocal [4]. Currently, there are more than 20,000 health-related apps in Chinese and the medication apps make the largest category. Our pilot study showed that although there are hundreds of medication apps on the market, the current usage is

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not significant. Only 1.5% of medication apps have been downloaded more than 10,000 times, and the quality is still in question, with an average score of 7.8 out of 20.

A good application, aimed at assisting patients to better manage their health and improving medication adherence, should be developed based on detailed and solid requirement analysis. In this study, we surveyed the features of smartphone medication apps that patients with chronic diseases and their caregivers desire.

## 2. Methods

A cross section study was carried out in 2015 in a tertiary hospital in Beijing. Approval for the study was obtained from the Capital Medical University Review Board.

### 2.1. Subjects

Patients and their caregivers were recruited if they met the following criteria: being diagnosed of one of the four chronic diseases: *cardio-cerebrovascular*, *diabetes*, *respiratory*, and *malignant neoplasm*, which were the most important chronic diseases to take care of in China according to the Chinese Chronic Illness Prevention Plan (2012-2015), issued by the Ministry of Health [1]; having smartphone(s) and competent to use it (The competency was determined by self assessment); and being consent to join the study. Those who were critically ill, at an unstable or acute stage of illness, with mental illness, or unable to communicate were excluded.

### 2.2. Measurement

The measurement tool was a self-designed questionnaire. The questionnaire was developed based on the results from following works. A preliminary study was conducted to analyze the features of medication applications on the Chinese App Stores. A small group of five patients and their caregivers were interviewed to understand their needs on medication apps. A total of 9 categories of 53 features were first identified. A literature review was then conducted to explore the current features of medication apps. An extended questionnaire with 11 categories of 54 features was developed. 5 experts of nursing informatics were consulted to finalize the questionnaire draft. 10 patients and 10 caregivers were further invited to assure the clarity of questions and then to finalize the questionnaire.

The questionnaire contained two parts. The first part assesses user's willingness to use apps and their current status of app usage; and the second part surveyed their expectation of features of medication apps with 54 items from 11 dimensions (*searching medications and diseases*, *medication and disease information*, *on-line shopping*, *medication reminders*, *medication documentation*, *pharmacist and doctor consultation*, *assistance with making doctors' appointments*, *risk assessment and guidelines*, *social support*, *easy to use*, *measuring and monitoring with embedded sensors*). Cronbach's  $\alpha$  of the questionnaire was 0.95 and Content Validity Index 0.97.

Patients were asked to indicate their preferences of items in a 5-point Likert Scale, with 1 *Do Not Need*, and 5 *Strongly Need*. Caregivers were asked which items were useful for their patients and to what extent. For the "*Do Not Need*" situation, subjects were asked for explanation. Data analysis was conducted by SPSS 19.0 for Windows

(SPSS Inc, Chicago, Illinois). Independent *t*-test was performed to test the difference in expectation scores between patients and caregivers.

### 3. Results

110 people were recruited, with 100 valid questionnaires returned: 50 from patients and 50 from caregivers. The average age for patients is  $53.36 \pm 10.37$ , with 24 male. For the caregivers,  $43.88 \pm 11.50$  and 21 male. 68% of caregivers is spouse, and 22% is siblings. Most people (89.0%) had not used any health-related apps, though 75% were willing to use apps to help manage their medication. For those who did not want to use medication apps, *worrying about the privacy* was the main reason to say no.

The overall score for 54 items was  $3.29 \pm 1.02$  (out of 5). Three best preferred categories were *searching medications and diseases*, *assistance with making doctors' appointments*, and *easy to use* (see Table 1). For patients, three most wanted items were *searching for drug instructions*, *making doctor's appointments on-line*, and *searching recommended drugs by disease name*. For caregivers, the three most wanted items were *searching for drug instructions*, *making doctor's appointments on-line*, and *explanation of test results*. Interestingly, *online shopping for drugs*, *delivery of drugs to patients' home*, and *providing offers of coupons for monetary credit for using the app* were the least wanted items for both two groups (see Table 2). The main reasons for undesired items include: *they are not useful* (72.8%), *worrying about buying counterfeit drugs* (45.7%), *worrying about the reliability of content* (32.1%), *being afraid of too difficult to operate* (32.1%) (see Figure 1).

Compared with patients, caregivers seems to be more interested in *getting information about nutrition tips for chronic illness* ( $p=0.05$ ), *fall detection* ( $p=0.003$ ), and *privacy protection* ( $p=0.018$ ). Moreover, caregivers rated the medication apps more valuable on all 11 dimensions than patients, though not statistically significant (see Table 1).

**Table 1.** Expectation of features of medication apps from 11 dimensions

Categories	Patients (n=50)	Caregivers (n=50)	P value
Searching medications and diseases	3.68±1.03	3.81±1.20	0.550
Assistance with making doctors' appointments	3.55±1.05	3.79±1.15	0.289
Easy to use	3.50±1.19	3.96±1.22	0.059
Medication and disease information	3.44±1.24	3.59±1.15	0.542
Risk assessment and guidelines	3.28±1.02	3.57±1.18	0.202
Measuring and monitoring with embedded sensors	3.26±1.14	3.53±1.22	0.250
Medication documentation	3.09±1.26	3.48±1.39	0.145
Pharmacist and doctor consultation	3.09±1.27	3.24±1.37	0.575
Social support	2.71±1.25	3.09±1.39	0.154
Medication reminders	2.65±1.20	3.03±1.54	0.172
On-line shopping	2.42±1.18	2.82±1.38	0.122
Mean	3.15±0.92	3.44±1.10	0.149

**Table 2.** Most and least desired items

Items	Patients (n=50)	Caregivers (n=50)
Most wanted items		
Searching for drug instructions	3.98±1.12	3.88±1.37
Making doctors' appointments on-line	4.04±1.05	4.10±0.33
Searching recommended drugs by disease name	3.88±1.27	3.88±1.29

Explanation of test results	3.66±1.27	3.96±1.18
Last wanted items		
On-line shopping for drugs	2.20±1.37	2.68±1.57
Delivery of drugs to patients' home	2.36±1.44	2.90±1.73
Providing offers of coupons for monetary credit for using the app	2.38±1.34	2.73±1.63

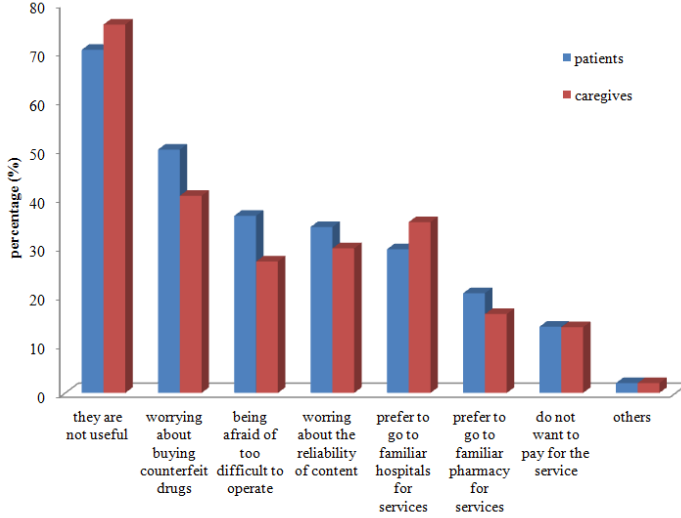


Figure 1. Reasons for undesired features of medication applications

4. Discussion

Continuous evaluation of mHealth activities can greatly enhance the impact of mHealth [5]. Increased guidance is needed to help align mHealth activities with the needs of patients and health care providers. In our study, although the majority of participants were willing to use medication apps, the actual usage rate is quite low. Worrying about privacy of personal information seems to be the main reason for not using health-related apps. In the digital age, security of personal information during data processing and storage has always been a critical question. The World Health Organization (WHO) indicated that they will collaborate with the International Telecommunications Union to provide guidance on content and data privacy and security policy for mHealth [5].

“Searching medications and diseases” and “assistance with making doctors’ appointments” are the most desired functionalities by patients and caregivers. In our study of analyzing features of all available medication applications on the market, 67.9% apps have the search function, while none could help with making doctor appointment on-line (the detail searching and assessment strategy is elaborated in another paper) [6]. This might have to do with the reimbursement system in China, which will automatically pay for appointment fees. Integration with the reimbursement system might be the basic issue for smartphone applications to make doctor’s appointment. As a country with a large population, healthcare providers are always in a shortage. Difficulty of making doctor’s appointments is a problem for all residents [1]. mHealth is beginning to show advances in this field. Some hospitals have already

cooperated with mHealth company for on-line doctor appointment service, such as Zhi Fu Bao by Alibaba company [7].

Incorporating professionals in the development team is another recommendation from this study. As seen in the results, “*explanation of test results*” is one of the most desired items and “*worrying about the reliability of content*” is one of the main concerns. Most of subjects want to “*search recommended drugs by disease name*”. However, this is very risky because this behavior could mislead patients to purchase the wrong drugs at the pharmacy. Clinical pharmacology is complicated and we should never recommend medications only based on disease name or symptoms.

Interestingly, “*online medication shopping and delivery*” and “*providing offers of coupons for monetary credit for using the app*”, the most common features seen in medication apps (30.1% medication apps have these functions by our pilot study) seem to be least wanted. In 2014, China Food and Drug Administration implemented a more flexible policy on on-line medication trade license to create a more open environment for mHealth development [8]. However, it is not easy to change people’s habitual behavior. As shown in this study, worrying about buying counterfeit drugs and loyalty to familiar pharmacy are the main reasons.

Caregivers seem to be more concerned about acquiring relevant medication and disease information than patients. As demonstrated in the results, they had higher scores on all 11 categories and are more concerned about nutrition tips for chronic illness, fall detection, and privacy protection than the patients group. Studies showed that caregivers need our attention as they undertake the responsibility of caring for their loved ones and it is not uncommon for caregivers feel anxious about this role [9].

## 5. Acknowledgments

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## References

- [1] W. Wang, Interpretation of 2012-2015 Chinese chronic disease prevention plan, *Chin J Cardio* **40** (2012), 887-888.
- [2] Q. Chen, Y. Yang, X.Y. Fang, A follow up study of secondary prevention medication for senile patients with chronic heart disease, *Chinese Medical Record* **12**(2014), 69-71.
- [3] A.S.M. Mosa, I. Yoo, L. Sheet, A Systematic Review of Healthcare Applications for Smartphones, *BMC Med Inform Decis Mak* **12** (2012), 67.
- [4] International Atherosclerosis Society, Reducing Cardiovascular Risk Globally Through Improved Dyslipidemia Awareness and Treatment Request for Proposals (RFP), Retrieved Sep 23, 2014 from <http://www.athero.org/>.
- [5] World Health Organization, mHealth new horizons for health through mobile technologies: second global survey on eHealth, *Global observatory for eHealth series* **3**(2011), 1-112.
- [6] Y. Liu, P. Chang, K.V. Lamb, Y. Wu, *Quality of Chinese CVD Medication Apps*, Poster presented at the 13th International Congress in Nursing Informatics, Geneva, 2016 (accepted).
- [7] Alipay, Manage your doctor appointment, Retrieved Sep 23, 2015 from [https://cshall.alipay.com/lab/help\\_detail.htm?help\\_id=255730](https://cshall.alipay.com/lab/help_detail.htm?help_id=255730).
- [8] China Food and Drug Administration, On-line medicine trade regulations, Retrieved Sep 23, 2015 from <http://www.sfda.gov.cn/WS01/CL0001/>.
- [9] R. Tao, X.R. Tao, Policy analysis for home caregivers--caring children with cerebral palsy in Guangzhou, *Chinese public administration* **8**(2013), 49-52.

# Ambulance Protocols: A Mobile Solution

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**Abstract.** The paper illustrates a pilot study involving nurses and paramedic staff to evaluate a mobile platform for rendering and distributing emergency care protocols. Its specific features were developed to simplify the consultation and reduce the factors that negatively affect the adherence to standards. The study was planned to last one month and two questionnaires are administered to the participants: one at the starting phase, pre-intervention, and one at the end, post-intervention. Here we report the results and considerations coming from the first administration.

**Keywords.** Emergency Outpatient Unit, Medical Informatics, Guideline Adherence, Patient Outcome Assessment, Questionnaire Design.

## 1. Introduction

In their every-day life human people are inherently error-prone. That feature exacerbates when they are faced with a large amount of information or with a stressful condition as it customarily happens in a medical work context [1]. This induces a variance in clinical decisions when managing similar cases, leading to inappropriate treatments that may have serious consequences on the patients' health and increase the overall costs borne by the health care institutions [2]. Medical advisory boards were formed to identify suitable courses of actions to be adopted as standards in the most common situations. At first this led to the formulation of Clinical Practice Guidelines (CPGs) as an attempt to combine knowledge described in the literature with clinical experience. CPGs depict the human resources required each time, their roles, and the actions to be accomplished according to the best practices [3]. Unfortunately, CPGs turned out to be often unsuitable for the daily practice because of their bulk size, which makes them difficult to skim quickly, and the expertise required to properly interpret and apply them. That's why, in some medical areas, the current trend is to turn CPGs into medical checklists or protocols having a much smaller size and providing only the operational information required to manage very specific tasks [4]. This simplification, on the other hand, increases their number making them difficult to manage. Thus, even though standards are available, adhering to them still represents a critical point since they are applied in a suboptimal way. Ebben et. al [5] accomplished semi-structured interviews with nurses and found that the main reasons for this lie in individual, organizational and protocol characteristics. Another important factor preventing the exploitation of standards strictly correlates with the level of support (including

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electronic support) provided for protocol development and dissemination also in the light of the high number of procedures available [6].

This paper describes the preliminary evaluation of a mobile platform developed for nurses and paramedic staff working on the ambulances of an emergency department located in the autonomous region of Aosta (Italy). It aims at a rapid and efficient consultation of Emergency Protocols (EPs). After being provided with the platform, operators will be asked to assess the differences in their daily activities. Those will be evaluated through the administration of two questionnaires, a first one at the start (pre-intervention) and another one at the end of the study (post-intervention). Preliminary results regarding the first administration in a pilot study are reported below.

## 2. Methods

We designed a platform supporting EPs deployment and rendering on mobile devices from two different perspectives: the protocols to be rendered on that platform, and the influencing factors preventing their adoption. Going through the paper documents representing the protocols, we realized that all of them could be represented through regular flowcharts, whose different routings are determined by the users' answers to a number of "decision points". Thus, they are similar to questionnaires and this suggested the adoption of G-quest, a mobile application initially designed for administering questionnaires to home patients [7]. G-quest has been subsequently adapted to the context of EPs distribution and rendering by adding new features addressing the following main issues influencing the adoption of standards:

- Physical availability of the standard source for consultation when needed: EPs provided in paper format are quite easily lost or even forgotten outside the ambulance. Moreover, even though the whole package is on-board, the documents could be scattered inside the vehicle, preventing the rapid consultation of a protocol;
- Incapability of consultation due to physical barriers: nurses and paramedic staff work under stressful conditions and their actions have to be accomplished quickly and on time. Those factors hinder the ability of doing simple calculations, such as those required to derive drug dosages based on the patient's weight. Moreover, when the staff people are busy with their hands in manipulating a patient, the consultation of a EP becomes even more difficult;
- Difficulty of consultation due to formal, logic or operational barriers: paper EPs do not undergo formal or logic validations, and errors or omissions are often discovered in them. In addition, the paramedic staff does not always take part in the process of formalizing the protocols and this lack of contribution may affect the contents provided, that sometimes are unrelated from the real practice;
- Limitations in updating and disseminating newer versions: each time EPs contents change accounting for new information or updates, the centre has to face the task of printing the new versions and promptly distributing those to all the staff members;
- Impossibility of collecting feedback about EPs usage: due to clinical and legal reasons, the paramedic staff may need to prove that they adhered to the standards demonstrating that the applicable protocol was properly consulted.

A study was planned to exploit G-quest for rendering the EPs currently adopted by the emergency department of Aosta, that is a mountain region located in the northern part of Italy. Because of the location and conformation of that region, many of its villages are very difficult to reach especially in winter. Thus emergency or first aid care is often accomplished on a local basis by nurses, paramedic staff or even volunteers who did not undergo an extensive training and do not directly possess the skills to manage every possible situation they may face. The availability of a platform supporting them with the application of standard practices is therefore very helpful.

We took advantage of a project that is planning to upgrade some of the emergency vehicles with the *TomTom Bridge* as a device for receiving emergency calls and tracking vehicle operations. This is basically an Android smartphone enclosed in a rugged casing meant to be used for business purposes. Besides hosting a special version of the TomTom software, being an Android device it is able to host any standard application developed for that operating system. On this basis we installed our platform on top of it and undertook the effort to develop, deploy and render the official EPs in use by the Aosta emergency department addressing areas such as: *pediatric or adult cardiac arrest, airways obstruction, ventilation and oxygenation management, pediatric or adult seizure, chest pain, generic pain.*

A pilot study was scheduled in the detached location of Morgex lasting for one month. Eight nurses and paramedics employed by the emergency department were involved, each having more than 8 years of experience. Before starting the study they were gathered for a training phase, during which the mobile platform was introduced, and the first questionnaire assessing the baseline situation was administered. This is composed of the following questions.

- **Physical availability of the standard source for consultation when needed (a):**
  - Do you always find the EPs package on the vehicle ? (1a)
  - Do you always find the needed EP in the package ? (2a)
  - Do you have to search for an EP a long time before finding it ? (3a)
  - Do you have to wait for an EP until another member of the staff finishes his consultation ? (4a)
- **Incapability of consultation due to physical barriers (b):**
  - Are you unable to consult an EP while being busy with your hands ? (1b)
  - Do you find calculating drug dosages difficult under stressful conditions ? (2b)
- **Difficulty of consultation due to formal, logic or operational barriers (c):**
  - Is the information provided in the EPs clear ? (1c)
  - Is the information provided in the EPs complete ? (2c)
  - Is the information provided in the EPs easy to be applied in practice ? (3c)
  - Do you find searching for specific information inside an EP difficult ? (4c)
- **Limitations in updating and disseminating newer versions (d):**
  - Did you find any EP not up-to-date with recent scientific evidences ? (1d)
- **Impossibility of collecting feedback about EPs usage (e):**
  - How often do you consult EPs ? (1e)
  - If the EPs were in computer-interpretable format, would you like a full vocal interaction system for their consultation ? (2e)
  - Do you think it is important proving the consultation of an EP under certain conditions (e.g. for medical and legal problems) ? (3e)
  - Have you ever had this need ? (4e)



- Do you usually consult an EP in order to:
  - Review the protocol ? (5e)
  - Find specific information ? (6e)

Thus, the questionnaire mainly aims at capturing the emergency personnel's needs and the issues related with the current use of the protocols.

### 3. Results

After administering the pre-intervention questionnaire, we collected and analyzed all the answers provided by the eight nurses and the paramedic staff involved in the pilot study. In Table 1 and Table 2 we report the percentages of the selected answers for each question. Almost all the study participants (87.5%) declared to consult the EPs to recall the specific procedures described, while 62.5% do so only when they need to acquire some specific information. All subjects said that sometimes they look for information in the EPs, but only a quarter of them attempt to always consult them.

Considering the influencing factors, what emerges is that working under stressful conditions, being busy with their hands, and the need to avoid wasting time, represent barriers towards consulting EPs for most of the ambulances members. In particular, 87.5% find hard to review an EP while keeping their hands on the patient and trying to intervene on him. More than half (62.5%) would like a full vocal interaction system so that EPs consultation could be supported in any case. Also the same percentage declares to have difficulties in doing mathematical calculations under stress. The opportunity of proving the adherence to an EP under particular conditions is considered an important issue by all of them (100%), even though none has ever had this necessity till now.

Questions concerning the physical availability of the EPs, the formalization quality of their contents and the difficulties arising when updating them received answers that show a general positive feeling. Less than half (37.5%) complained that sometimes EPs are not available on the vehicle or that sometimes it takes time before finding the one they are looking for. Only a quarter of them declared that they had to wait for an EP until another member finished his consultation. EPs provided to the staff seemed to be well formalized since only few of them complained about the clarity (25%), the completeness (12.5%) or the easiness of consultation (25%). Finally, 12.5% asserted that sometimes they did not find the most updated EPs versions on-board.

**Table 1.** Percentages of answers provided by the paramedic staff to questions with four available choices.

Question	Never	Sometimes	Often	Always
1a	0%	37.5%	0%	62.5%
2a	0%	25%	12.5%	62.5%
3a	62.5%	37.5%	0%	0%
4a	75%	25%	0%	0%
1b	12.5%	50%	37.5%	0%
2b	37.5%	50%	12.5%	0%
1c	0%	25%	12.5%	62.5%
2c	0%	12.5%	37.5%	50%
3c	0%	25%	37.5%	37.5%
4c	50%	50%	0%	0%
1d	75%	12.5%	12.5%	0%
1e	0%	50%	25%	25%

**Table 2.** Percentages of answers provided by the paramedic staff to questions with two available choices.

Question	No	Yes
2e	37.5%	62.5%
3e	0%	100%
4e	100%	0%
5e	12.5%	87.5%
6e	37.5%	62.5%

#### 4. Discussion

The administration of the pre-intervention questionnaire to the participants of the pilot study, and the consequent analysis of their answers, lead to interesting results and considerations. Within this pilot study we found out that physical barriers and necessity of proving adherence to EPs really represent critical problems for the staff. On the other hand, we underline that EPs used in this study are regional ones and may considerably differ from country to country. In this specific case, they seem to be quite well formalized and quite often available on the ambulances. In summary the pilot study was satisfactory since it helped in pointing out the critical issues affecting the delivery of emergency care in the Aosta region. We are now waiting for the termination of the pilot study and the subsequent results coming through the administration of the second post-intervention questionnaire. Hopefully they will witness an improvement perceived by the participants in accessing EPs through the mobile platform provided.

#### 5. Acknowledgments

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#### References

- [1] J.L. Koeckeritz, K.V. Hopkins, A.S. Merrill, ILEUM: Interactive learning can be effective using mnemonics, *Nurse Educator* **29** (2004), 75-9.
- [2] T. Van Achterberg, L. Schoonhoven, R. Grol, Nursing implementation science: how evidence-based nursing requires evidence-based implementation, *J Nurs Scholarsh* **40** (2008), 302-10.
- [3] R. Grol, M. Wensing, M. Eccles, *Improving Patient Care: The Implementation of Change in Clinical Practice*, Elsevier, Oxford, 2005.
- [4] B. Hales, M. Terblanche, R. Fowler, W. Sibbald. Development of medical checklists for improved quality of patient care. *Int J Qual Health Care* **20** (2008), 22-30.
- [5] R.H. Ebben, L.C. Vloet, D.M. Schalk, J.A. Mintjes-de Groot, T. van Achterberg, An exploration of factors influencing ambulance and emergency nurses' protocol adherence in the Netherlands, *J Emerg Nurs* **40** (2014), 124-130.
- [6] S. M. Downs, A. Farmer, M. Quintanilha, T. R. Berry, D. R. Mager, N. D. Willows, L. J. McCargar, From paper to practice: barriers to adopting nutrition guidelines in schools, *J Nutr Educ Behav* **44** (2012), 114-122.
- [7] G. Lanzola, M.G. Ginardi, A. Mazzanti, S. Quaglini. Gquest: Modeling patient questionnaires and administering them through a mobile platform application. *Comput Methods Programs Biomed* **117** (2014), 277-291.

# Quantifying Eye Tracking between Skilled Nurses and Nursing Students in Intravenous Injection

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**Abstract.** In nursing education, it is important that nursing students acquire the appropriate nursing knowledge and skills which include the empirical tacit knowledge of the skilled nurses. Verbalizing them is difficult. We paid attention to the eye tracking at the time of the skill enforcement of expert nurses and the nursing students. It is said that the sight accounts for 70% higher than of all sense information. For the purpose of the learning support of the tacit nursing skill, we analyzed the difference of both including the gaze from an actual measured value with the eye mark recorder. In the results the nurses particularly address the part related to inserting a needle among the other actions, they should move their eyes safely, surely, and economically along with the purposes of their tasks.

**Keywords.** Nursing skill, Eye Tracking, Tacit Knowledge, Learning support, Intravenous Injection

## 1. Introduction

In nursing education, it is important that nursing students acquire the appropriate nursing knowledge and skills which include the empirical tacit knowledge of the skilled nurses. Verbalizing them is difficult, so the passing down them are our big tasks. In this study, we paid attention to the eye tracking at the time of the intravenous injection skill enforcement of expert nurses and the nursing students. It is said that the sight accounts for 70% higher than of all sense information [1]. For the purpose of the learning support of the tacit nursing skill, we analyzed the difference of both including the gaze number of times for eyes trend, a gaze part and gaze duration from an actual measured value with the eye mark recorder. Based on these results, we will suggest the self-learning support system of tacit nursing skills.

## 2. Methods

The participants were 31 nurses who consented to participation in the present research (with over five years of clinical experience and able to conduct intravenous injections

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alone) and 30 nursing students (who had acquired credits of nursing skills 6 or more months prior).

### 2.1. Experiment method

Experiments were conducted in the following order:

- (1) Before the intravenous injection experiment, students were asked to review lecture materials and skill videos so that they would be able to imagine conducting the procedure by themselves.
- (2) Each participant wore an eye mark recorder (EMR-8B; nac Image Technology Inc.) for calibration.
- (3) The patients, actually an infusion and a blood collection trainer (Adam Rouilly), were in a sitting position. Intravenous injection was conducted after two tests to let the participants get used to tools, procedures, and models. The whole scene during the experiment was recorded (Figure.1).



Figure 1. Scene of the experiment.

### 2.2. Analytical method

For analysis of eye tracking data obtained from the eye mark recorder and processed by eye tracking analytical software, we used EMR-dFactory (hereinafter “dFactory”) (nac Image Technology Inc.), which enables observations of every frame (about 33 ms) of the data (Figure 2).

The analysis covered the basic actions of intravenous injection process: from having a patient wear a tourniquet, selecting the vessel to insert the needle, sterilizing the skin, inserting the needle, confirming that there is no blood reverse flow, releasing the tourniquet from its clip, injecting liquid medicine, pulling out the needle, to cleaning up. In terms of the six sites, the patient’s arm, puncture point, the tourniquet, patient’s face, articles, and the syringe were the main sites attracting the gaze of participants (the starting points from which a participant’s eyes were tracked), we confirmed and categorized which site the eyes were placed on every frame, visualizing the nurses’ and nursing students’ eyes behaviors in chronological order for comparison. Additionally, calculating the total gaze time of the nurses and students, the average of ratio of each site’s gaze time to the total gaze time, and average of ratio of each site’s number of gaze times to the total number of gaze times, we examined the difference between both groups using Student’s *t*-test.

Regarding data at locations other than the six sites, such actions as wearing rubber gloves for medical treatment and removing a cap from a syringe, which were not directly related to injecting skills and for which the action (gaze) time varied depending among participants, we regarded them as gaze points “others (between each task)” and

excluded them from the present analytical targets of gaze time and number of gaze times.

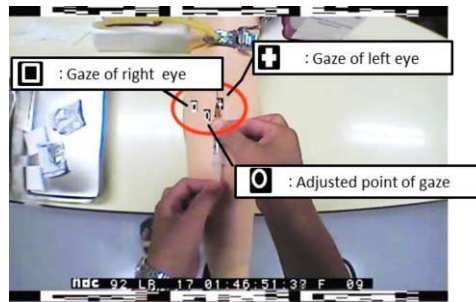


Figure 2. Field of vision of the eye mark recorder and the point of gaze.

### 2.3. Ethical considerations

This study was approved by the university to which the authors belong. We explained to participants the following in writing and obtained their consent: participation is based on free intentions of participants; non-participation is not disadvantageous for non-participants; anonymity is guaranteed; this experiment was not conducted to evaluate any participant; withdrawal from the study is possible at any time.

## 3. Results

From the results, participants with incomplete gaze point eye mark recorder data were excluded from analysis. Results show that the targets for eye tracking analysis consisted of 18 nurses and 17 nursing students.

### 3.1. Gaze movement of nurses and nursing students

Regarding the movement of gaze parts from tying a tourniquet to taking needle and cleaning up, figure 3 and figure 4 respectively portray one case of nurses and nurse students. The vertical axis represents gaze sites and the horizontal axis, time, showing the time-series change of gaze locations of participants as gaze movement. The gaze time of each part of a nursing student was longer than that of a nurse. Generally, students took more time to work on anything. Especially, the gaze time “Others (between each task),” which was not related directly to intravenous injection, was longer, and also the time spent before inserting a needle (the time taken while the gaze point moved to the “puncture point”) was longer.

### 3.2. Ratios of each part gaze time to the total gaze time of nurses and students

The averages of total gaze time of the nurses and students were, respectively,  $77.2 \pm 23.5$  s and  $92.2 \pm 30.9$  s. The gaze time of the former was shorter by about 15 s. The ratios of each part gaze time to the total gaze time of the nurses and students are shown in Table 1. Among the nurses, the ratio of gaze time of the “puncture point” was more than that of the students ( $p < 0.05$ ). Among the students, the ratio of gaze time of

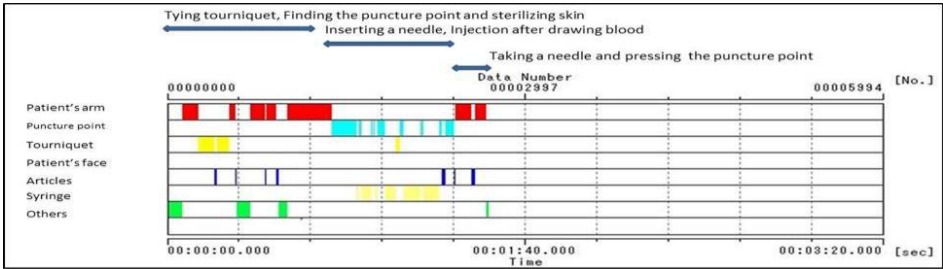


Figure 3. Example of the time-series gaze part of a nurse.

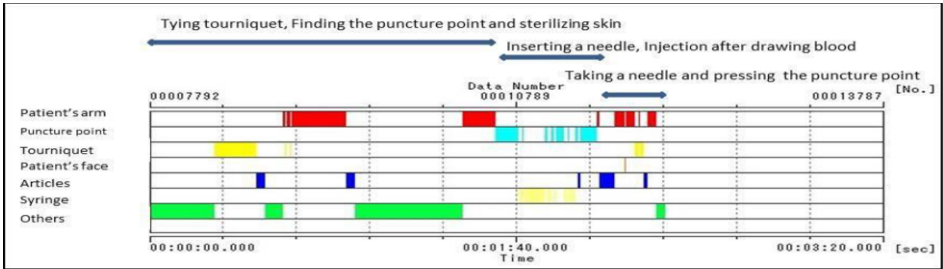


Figure 4. Example of the time-series gaze part of a nursing student.

“article” and “tourniquet” was more ( $p<0.05$ ).

### 3.3. Number of gazes by part

The averages of total number of gaze time of the nurses and students were, respectively,  $36.2 \pm 10.8$  times and  $40.4 \pm 13.4$  times. The numbers of gazes by part are presented in Table 2. Compared with the nurses, the students tended to take more glances of each part, significantly more of the “patient’s arm” and the “patient’s face” ( $p<0.05$ ). Although no significant difference was found, the students tended to take more glances at “article” and “tourniquet”; the nurses tended to take more glances at the “puncture point.”

## 4. Discussion

With gaze movement, although the nurses had a longer gaze time on the “patient’s arm” before inserting a needle, the students had longer gaze time on “articles” and “others” (Figure 3, Figure 4). Additionally, the results of the mean gaze number of times in each part for the whole practice (Table 2) shows that the students took more glances at the “patient’s arm” and “articles” than the nurses did, suggesting that their eyes were not fixed; they were frequently diverted. Kawai[2] reports that when nursing students had not completed their own pattern for patient observation yet, their eyes were dispersed and their viewpoint for observation was not fixed. In the present study, students who had not mastered the movement image of intravenous injection sufficiently also moved their eyes repetitively from the patient’s arm to the articles, which required them to move their eyes with every movement.

In contrast, the nurses’ gaze time on the “puncture point” was significantly longer than the students’ (Table 1), and the number of gaze times tended to be more only on the

Table 1. Mean of ratio of each part gaze duration for the whole practice

		Ave.gaze ratio	Standard deviation
Patient's arm	Nurse	39.2% ±	9.8%
	Student	43.1% ±	8.7%
Puncture point	Nurse	25.4% □* ±	8.3%
	Student	17.7% □ ±	6.9%
Syringe	Nurse	13.9% ±	6.1%
	Student	11.2% ±	7.1%
Articles	Nurse	8.5% □ ±	3.4%
	Student	11.8% □* ±	4.7%
Tourniquet	Nurse	13.0% □* ±	4.4%
	Student	15.4% ±	4.8%
Patient's face	Nurse	0.0% ±	0.1%
	Student	0.7% ±	1.1%

(\*p<0.05)

Table 2. Mean gaze number of times in each part for the whole practice

		Ave.gaze number of times	Standard deviation
Patient's arm	Nurse	9.1 ±	2.5
	Student	11.5 □* ±	3.6
Puncture point	Nurse	9.6 ±	5.0
	Student	8.8 ±	4.3
Syringe	Nurse	6.8 ±	4.4
	Student	6.8 ±	4.0
Articles	Nurse	5.8 ±	1.9
	Student	6.5 ±	3.3
Tourniquet	Nurse	4.9 ±	2.3
	Student	5.8 ±	2.4
Patient's face	Nurse	0.1 □* ±	0.2
	Student	1.0 ±	1.4

(\*p<0.05)

“puncture point” (Table 2). It is presumed that the nurses’ gaze time and number of gaze times on the “puncture point” should be more than those on other parts to elucidate the situation of blood vessels precisely, which varies depending on patients, even if they are accustomed to intravenous injection. In other words, particularly addressing the part related to inserting a needle among the other actions, the nurses should move their eyes safely, surely, and economically along with the purposes of their tasks.

The nursing students described “procedures and placement of articles” as keys of intravenous injection practice, which differed from the nurses [3]. Their gaze movements suggested that many useless actions were spent “others,” which were not related directly to intravenous injection skills. To reduce them as priorities, it is necessary to develop a self-learning support system by which the learners can follow the gaze movement of a skilled nurse for image training and introspective learning. To develop a self-learning support system of nursing skills, the quantification of gaze movements conducted in this research is expected to be meaningful as a method to formulate the skills and knowledge of nurses which have been tacit. Currently, we have produced a trial product of the system proposed in this paper. We are evaluating it in future studies.

### 5. Acknowledgments

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### References

[1] Hiromi Waki, (1995) *Visual World and Tactile World from Brain to Heart Hoping the Elucidation of High-order Function*, 45, Iwanami Shoten, Tokyo, 1995.  
 [2] Chieko Kawai, Importance of Acquiring Patient Observation in Nursing Education, *Journal of the Kurume Medical Association* **63** (2000), 201-210.  
 [3] Yasuko Maekawa and Yukie Majima, Comparison of Consciousness for Intravenous Injection Knacks (Tacit Knowledge) between Skilled Nurses and Students From Interview Survey, *Japanese Society of Nursing Art and Science's 29th Academic Meeting Abstracts* (2009), 315.

# Heuristic Evaluation of a mHealth Diabetes Self-Management System Using Disease Specific Patient Profiles

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**Abstract.** Patient-centeredness is an important concept in diabetes treatment. We modified Nielsen's expert heuristic evaluation method addressing common gaps: a patient perspective and variability in findings. Two expert, dual-domain evaluators referred to validated patient profiles (mild, moderate, severe diabetes) when conducting uniform evaluation processes on a diabetes mHealth system. Evaluators found 103 usability problems and 224 heuristic violations. For 69 % of the problems, the profiles had an effect on severity ratings. "Consistency and Standards" (n=57) and "Match between the System and Real World" (n=55) violations dominated at 50%. The overall system severity rating was major. Severity was highest for a severe diabetic profile due to likely visual issues (crowded elements), cognitive concerns (remembering many steps) and for insufficient medication information. Interrater reliability was respectable at Kappa =0.67. Our novel evaluation method represents one way of improving on a usability expert technique making it more patient-centered with less individual evaluator variability.

**Keywords.** mHealth, diabetes, user-centered design, usability, heuristic evaluation, patient-centered evaluation

## 1. Introduction

About 29.1 million people in the U.S. suffer from diabetes [1] with over 90% having Type 2 diabetes [2]. About 95% of diabetes care is by the patients themselves [3] so self-management support is paramount. More pointedly, the American Diabetes Association 2015 standards indicate patient-centeredness should permeate all areas of disease and lifestyle management including team coordination [4, 5].

Patient-centeredness, or user-centeredness in informatics, is critical for the Information and Communication Technology (ICT) tools patients use. User-centeredness is one of the main concepts of User Centered Design (UCD) that incorporates users throughout the development and evaluation process in the engineering and human-computer interaction disciplines [6]. Usability, also central to UCD, can be measured by several different methods. One of the most common is Heuristic Evaluation (HE), an expert-based inspection method developed by Nielsen and Molich [7]. HE focuses on assessments by usability experts but excludes actual users, one of its major

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drawbacks [8, 9]. A second drawback is that individual evaluators' expertise can vary considerably and result in variable study outcomes [10]. Our objective was to address these two gaps by using validated patient profiles in the expert-based heuristic evaluation process, having dual domain evaluators (usability experts and registered nurses) complete assessments and applying uniform HE evaluation processes. Users (patients) are not involved in HE. The novel method modifications presented can provide improved usability evaluations for contemporary expert-based techniques.

## 2. Methods

The diabetes system we tested is a commercially available mHealth system for diabetes self-management. It consists of a web portal and mobile phone solution. Patients enter values, such as glucose and blood pressures, using their mobile phone. They can track their medical progress, exercise, and medications on the web portal. After a review of validated diabetes instruments, we selected two applicable instruments for the patient profiles. These were descriptions from Grootenhuis et al.'s (1994) [11] Diabetes Symptoms Checklist (DSC-R) validated by Arbuckle et al. [12] that include Psychological cognitive, Neuropathic sensoric, and Ophthalmologic changes [11, 12]. We based ICT proficiency categories on the Computer Proficiency Questionnaire (CPQ) developed/validated by Boot et al [13] and designed for individuals with a wide range of proficiencies [14]. Profiles were for mild, moderate and severe conditions (see Table 1).

**Table 1** Patient profiles

<p><b>Patient Profile 1</b> (Severity level 1) mild            Diabetes related: Visual acuity and sensoric abilities: good visual and sensoric capabilities. Cognitive ability: no difficulties in understanding, concentrating, ICT proficiency: high</p>
<p><b>Patient Profile 2</b> (Severity level 2) moderate            Diabetes related: Visual acuity and sensoric abilities: more visual and sensoric difficulties. Cognitive ability: more difficulties in understanding, concentrating, ICT proficiency: medium</p>
<p><b>Patient Profile 3</b> (Severity level 3) severe            Diabetes related: Visual acuity and sensoric abilities: low visual capability and major sensoric difficulties. Cognitive ability: major difficulties in understanding, concentrating, ICT proficiency: low</p>

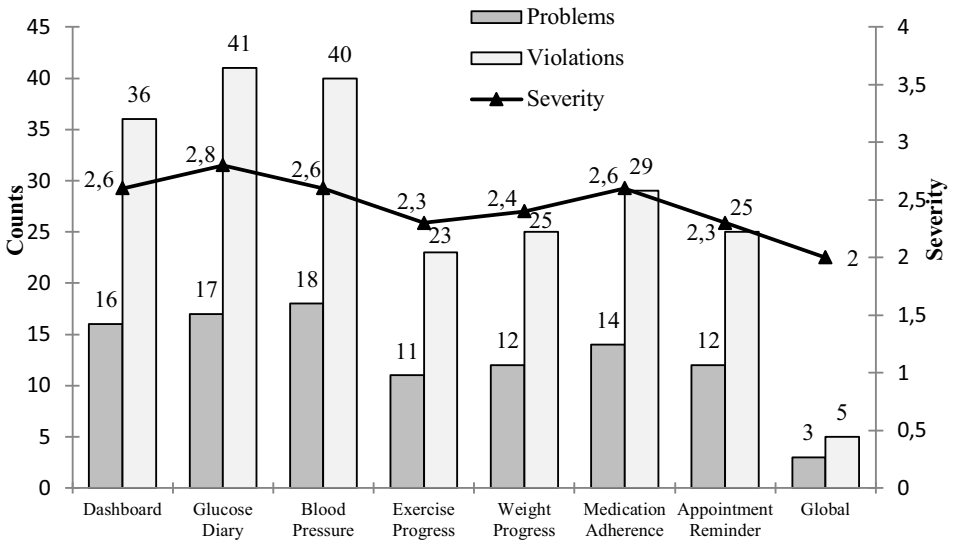
### 2.1. Evaluation Procedure

Each evaluator had the same materials to ensure consistency – a video on portal navigation, a manual of the specific tasks, Nielsen's HE scale with severity ratings and the patient profiles. The evaluators used eight validated tasks to generate a list of usability problems. Sample tasks were viewing and locating glucose values on graphs, correcting values and viewing/exporting summary statements. Following Nielsen's HE process, the evaluators assigned Nielsen's 10 heuristics [15] to the identified usability problems. Problems were consolidated and discussed. A master list of all usability problems and heuristic evaluations was compiled and sent to each evaluator to determine severity ratings using the three patient profiles. For each usability problem, evaluators had to think about how the specific problem would affect someone with mild, moderate and severe diabetes. Nielsen's severity ratings were used: (0) not a usability problem, (1) cosmetic, (2) minor, (3) major, (4) catastrophic [15]. All ratings were averaged for each usability problem and the system as a whole. Percent agreement and interrater reliability

(IRR) Kappa were measured to determine the agreement on assigned severity ratings. Both measures are particularly fitting for assessing two evaluators and categorical variables to determine consistency. Plus, Kappa takes into account the estimated agreement beyond chance.

### 3. Results

The heuristic evaluation resulted in a total of 103 usability problems and 224 heuristic violations. The usability problems by place of occurrence (view), number of heuristic violations and mean severity ratings are summarized in Figure 1.



**Figure 1** Location frequency and averaged severity for usability problems and heuristic violations by place of occurrence

The Blood Pressure, Glucose Diary and Dashboard views had an almost equal number of usability problems at 18, 17 and 16 respectively and the highest number of heuristic violations at 40, 41 and 36. The severity rating for all views averaged 2.53 of 4 (or major severity). The highest severity ratings by view were the Glucose Diary at 2.8, followed by the Medication Adherence, Dashboard and Blood pressure view at 2.6.

A set of 224 heuristic violations was identified. “Consistency and Standards” violations were 57 (25.4%) followed by “Match between the System and Real World” at 55 (24.5%) or 50% combined. The highest number of violations/major issues was in the Dashboard and Blood Pressure views (11 each) followed by the Glucose Diary view (10) and Medication adherence view (7). Catastrophic severity ratings were most frequent in the Glucose Diary view and Medication Adherence with 3 and 2 problems respectively.

In 69% of the usability problems, the patient profiles had an obvious influence on severity ratings, meaning that the disease condition correlated with usability severity ratings. Sample issues in the Glucose values view included elements that were too

crowded. The visual changes in patients with severe diabetes would likely result in the values being difficult to distinguish and read. Cognitive considerations meant a patient would have to remember too many steps when editing and exporting data, including memorizing system quirks such as using the non-intuitive Delete button to export data. Other problems were in the Medication adherence view due to insufficient medication information. Rather than using discrete data, the product only indicated a percent of medications taken (50%, 75% or 100%, for instance).

The percent agreement was 82% (84 problems of 103 rated the same), an excellent agreement level. Using SPSS, Kappa was 0.67 ( $p < 0.001$ ) with a standard error (SE) of 0.067, indicating a substantial agreement across the raters [16].

## 4. Discussion

Results of this evaluation indicated a substantial need for improving the usability of this mHealth system. Usability violations in “Consistency and Standards” and “Match between System and the Real World” comprised 50% of all violations. Severity ratings indicated major issues for individual views as well as the overall system.

A majority of usability problems, 69%, were directly affected by the patient profiles, particularly where cognitive and visual changes might affect users’ interaction performance. The new profiles assisted usability experts in thinking about and painting a clearer picture of specific users in this evaluation. Using patient profiles represents a novel application of methods for HE. In particular, it introduces a beginning patient perspective in a method that would be devoid of any patient-centered considerations.

The profiles were an important influence on how usability problems were viewed by evaluators compared to traditional HE methods which leave it up to each evaluator to imagine how users might interact. The patient profiles assisted in making the evaluation process more uniform and possibly making results more comparable and reproducible. The latter are important because mHealth technology is increasingly being implemented in health care [17]. By combining the profiles with more standardized HE methods, we attempted to decrease the variability of results across evaluators. This was reflected in the high agreement percentage at 82% and good IRR score at Kappa = 0.67 [16].

### 4.1. Limitations and Future Research

The patient profiles described and used in this paper were based on evidence-based guidelines. However, we did make decisions about their content and delimiters, e.g., we predicted that patients with severe diabetes would likely have lower ICT capabilities due to visual and cognitive disease changes. It is possible that an individual patient with severe diabetes might instead have very good ICT skills. This is a limitation to the current work but necessary to develop a specific frame of reference for a beginning evaluation and to limit profile factors to a reasonable number. Future work in usability testing might assess the correlation between disease condition and ICT skills for more definitive data.

Future research could also focus on adding more dimensions to the patient profiles, more disease-related data, and a variety of ICT measures to obtain a wider variety of factors influencing patients in their mHealth interactions. For instance, age could be another dimension potentially making the systems even more difficult for these groups to use [18]. In this paper, we focused on disease progression but future researchers might add aging as an additional factor.

## 4.2. Conclusion

Expert usability evaluation techniques can be improved. Our results showed that patient profiles allowed usability experts to consider disease conditions during a common expert-based evaluation technique. Specific areas, such as medication views, had major and catastrophic issues for patients with severe disease conditions. Experts can anticipate that patients with more severe disease conditions may need improved support and different designs than patients with milder forms of the condition. The outlined modifications improve Nielsen's HE methods through more standardized/uniform methods, more consideration for specific users and less variability of results across evaluators.

## References

- [1] Centers for Disease Control and Prevention, National Diabetes Statistics Report: Estimates of Diabetes and Its Burden in the United States, 2014., Department of Health and Human Services., Atlanta, GA: U.S.
- [2] World Health Organization (WHO), Diabetes Fact Sheet N°312. 2015 January 2015 [cited 2015 06 Sept]; Available from: <http://www.who.int/mediacentre/factsheets/fs312/en/>.
- [3] M.M. Collins et al., Self-care coping strategies in people with diabetes: a qualitative exploratory study. *BMC Endocr Disord*, 2009. 9: p. 6.
- [4] American Diabetes Association, Standards of medical care in diabetes – 2015. *Diabetes Care*, 2015. 38(Suppl 1): p. S1–94.
- [5] M.A. Powers et al., Diabetes self-management education and support in type 2 diabetes: a joint position statement of the American Diabetes Association, the American Association of Diabetes Educators, and the Academy of Nutrition and Dietetics. *Diabetes Educ*, 2015. 41(4): p. 417-30.
- [6] International Organization for Standardization, Ergonomics of human-system interaction - Part 210: Human-centred design for interactive systems. International standard, 9241-210 2010, Geneva: ISO.
- [7] J. Nielsen, R. Molich, Heuristic evaluation of user interfaces, in Proceedings of the SIGCHI conference on Human factors in computing systems: Empowering people. 1990, ACM: Seattle, Washington, United States. p. 249-256.
- [8] R. Jeffries, H. Desurvire, Usability testing vs. heuristic evaluation: was there a contest? *SIGCHI Bull.*, 1992. 24(4): p. 39-41.
- [9] T. Hollingsed, D.G. Novick, Usability inspection methods after 15 years of research and practice, in Proceedings of the 25th annual ACM international conference on Design of communication. 2007, ACM: El Paso, Texas, USA. p. 249-255.
- [10] M. Hertzum, N.E. Jacobsen, The Evaluator Effect: A Chilling Fact About Usability Evaluation Methods. *International Journal of Human-Computer Interaction*, 2003. 15(1): p. 183-204.
- [11] P.A. Grootenhuys et al., Development of a type 2 diabetes symptom checklist: a measure of symptom severity. *Diabet Med*, 1994. 11(3): p. 253-61.
- [12] R.A. Arbuckle et al., Psychometric evaluation of the Diabetes Symptom Checklist-Revised (DSC-R)--a measure of symptom distress. *Value Health*, 2009. 12(8): p. 1168-75.
- [13] W.R. Boot et al., PRISM measure development: The design and validation of the computer proficiency questionnaire. 2014. 2014.
- [14] W.R. Boot et al., Computer proficiency questionnaire: assessing low and high computer proficient seniors. *Gerontologist*, 2015. 55(3): p. 404-11.
- [15] J. Nielsen, Heuristic evaluation, in Usability inspection methods, R.L. Mack and J. Nielsen, Editors. 1994, John Wiley & Sons inc.: New York. p. 25-62.
- [16] J.R. Landis, G.G. Koch, The measurement of observer agreement for categorical data. *Biometrics*, 1977. 33(1): p. 159-74.
- [17] M. Georgsson, N. Staggers, Quantifying usability: an evaluation of a diabetes mHealth system on effectiveness, efficiency, and satisfaction metrics with associated user characteristics. *J Am Med Inform Assoc*, 2015. DOI 10.1093/jamia/ocv099.
- [18] J. Sharit et al., Investigating the Roles of Knowledge and Cognitive Abilities in Older Adult Information Seeking on the Web. *ACM Trans Comput Hum Interact*, 2008. 15(1): p. 3.

# Improving Patients Experience in PEDIATRIC Emergency Waiting Room

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**Abstract** When visiting the emergency department, the perception of the time spent in the waiting room before the beginning of the care, may influence patients' experience. Based on models of service evaluation, highlighting the importance of informing people about their waiting process and their place in the queue, we have developed an innovative information screen aiming at improving perception of time by patients. Following an iterative process, a group of experts including computer scientists, ergonomists and caregivers designed a solution adapted to the pediatric context. The solution includes a screen displaying five lanes representing triage levels. Patients are represented by individual avatars, drawn sequentially in the appropriate line. The interface has been designed using gamification principle, aiming at increasing acceptance, lowering learning curve and improving satisfaction. Questionnaire based evaluation results revealed high satisfaction from the 278 respondents even if the informative content was not always completely clear.

**Keywords.** User-Computer Interface; Human Factors; Quality of Healthcare; Emergency Medicine; Triage; Consumer Behavior; Personal Satisfaction, Organizational Innovation.

## 1. Introduction

Emergency department (ED) can be the place of the first contact between patients and the healthcare institution. The smoothness of this experience is of prime importance as it will further influence the judgment of patient about the whole encounter, but also about future ED choice or the recommendations to other potential patients [1]. One of the recognized problems that alter negatively this experience is an excessive length of the wait. This can happen for patients with a non-urgent condition when they enter an already overcrowded ED [2]. In addition, because patients are taken care according to their condition rather than their arrival sequence, it generates misunderstandings and sometimes frustration, further worsening the experience and the perception of emergency room management [3].

Theoretical researches studying waiting time perception taught us that a key factor behind consumers' stress is the uncertainty of how long they must wait. Therefore, informing people about their positions in the waiting queue is an efficient way of

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improving their affective response to the wait. When the wait is short, with or without information, consumers are not likely to experience stress and consider the wait acceptable [4]. When the wait is intermediate providing information to the people begins to have a significant effect. First, information helps to distract consumers from conscious awareness of the passage of time and improves service evaluation through a reduction of the waiting duration perceived. Second, the information reduces uncertainty, which suggests a significant mediating effect of affective response to the wait. Third, the information facilitates cognitive coping, leading consumers to reappraise the wait as being more acceptable and hence giving a better service evaluation.

Given this theoretical framework, we make the hypothesis that it is possible to improve the patients experience in paediatric emergency waiting room by providing information about the waiting process through a screen. In this article, we present the process leading to the design of this screen and its evaluation through questionnaires.

## 2. Methods

### 2.1. *Interface ergonomic design through an iterative process*

In order to design the screen, an iterative process going through specification, prototyping and development has been performed with a group of experts. This group included two computer scientists, an ergonomist, two ED physicians and a triage nurse. The discussions held during a focus group with the experts have led to the identification of the data source, the functional, environmental and users' requirements, as well as usability goals. Once these requirements translated into specification, a prototype has been realized using sketching, wireframing and mockups. Finally, during the development phase, the screen has been refined through several iterations until a satisfactory solution has been validated.

### 2.2. *Questionnaire driven evaluation*

In order to evaluate the quality of the stay in the waiting room, home-made questionnaires have been prepared. Since we are in a paediatric environment, the questionnaires were targeting the parents of the patients. All the questionnaires' items were assertions for which respondent had to express their level of agreement by choosing one of the answers provided through a five levels Likert scale going from completely agree to completely disagree.

The dimensions evaluated in the questionnaire were the following:

1. **Stress:** You have felt stressed during your stay in the waiting room
2. **Satisfaction:** You are satisfied of your stay in the waiting room
3. **Frustration:** You have been frustrated that other patients have been seen before your child
4. **Information:** You had the feeling to be able to understand the position of your child in the waiting queue compared to other waiting patients

These questionnaires were distributed by nurses to the parents once their child was installed in examination room and therefore ended their wait.

### 3. Results

#### 3.1. Identified requirements

The following requirements have been identified by the experts participating in the focus group

1. The interface must reflect the queuing situation: In ED, the classification of the patients is done into several levels of emergency. Once classified in one of these emergency levels, the patients are taken by order of arrival. A patient with a higher level of emergency has always priority over a patient with lower level of emergency.
2. Patients must be able to identify themselves: The patients must be able to identify themselves in the interface to see their progression in the queue, but without losing their anonymity, without ambiguity and notion of ranking.
3. Patients must be aware that emergency situations tend to slow down the overall progress: In case of serious emergency (such as resuscitation) many physicians and nurses may have to be mobilized to take care of this patient. In such situation, the progress of the care for the other patients will be temporarily slowed and, as a consequence, the progresses in the queue can seem stopped.
4. To maximize user acceptance and satisfaction: The screen must be attractive enough to draw patients' attention and to favour its use over the long term.

#### 3.2. Prototyping

The initial information screen prototype is composed of a stack of five lines representing the levels of emergency defined in the Canadian triage and acuity scale (CTAS). Each line is filled with its associated colour as defined in table 1. Each patient is represented as a circle and is displayed sequentially in order of arrival (Figure 1 left).

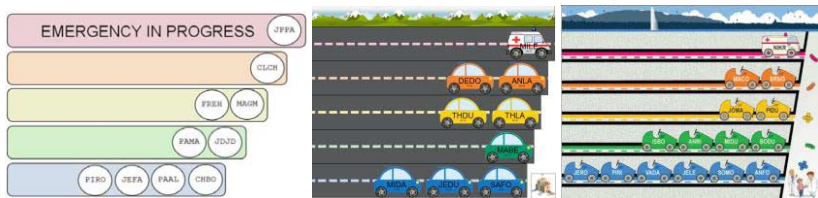
**Table 1.** Level of emergency of the Canadian triage and acuity scale (CTAS)

Level	acuity	Time to physician	Associated color
I	Resuscitation	Immediate	Red
II	Emergent	≤ 15mn	Orange
III	Urgent	≤ 30 min	Yellow
IV	Less urgent	≤ 1 h	Green
V	Non-urgent	≤ 2 h	Blue

The clear separation of the patients into the five levels of emergency is very important since it ensures that every patient is taken in sequence and that none of them will be overtaken by a patient entered later in the queue. The left side of the screen represents the entrance in the emergency department and the right side represents the beginning of the medical care. In order to indicate that patients with higher levels of emergency have priority over patients with lower emergency levels, each of the emergency lines is slightly shifted on the right side. It shows visually that patients with level 1 emergency are the closest to the beginning of the care and will be taken in priority (Figure 2 left). In order for patients to be able to identify themselves on the screen, each of them receives an identifier based on the two first letters of its first name concatenated to the two first letters of its last name. Hence, patient's confidentiality is guaranteed and no language barrier affects the recognition of its identifier.

In order to maximize users' acceptance regarding the screen, we relied on concepts from hedonic information systems. Hedonic information systems aim to provide self-fulfilling rather than instrumental value to the users. They are strongly connected to home and leisure activities, focus on the fun-aspect of using information systems, and encourage prolonged rather than productive use. The hedonic nature of an information system is an important boundary condition to the validity of the technology acceptance model [5]. Specifically, perceived usefulness loses its dominant predictive value in favour of ease of use and enjoyment.

We mostly relied on gamification concepts such as the use of avatar and narrative context to immerse users inside a metaphoric story [6], [7]. This story is pretty simple: it is about the journey of the patients on the ED road, from their entry in the ED till being seen by a clinician. Practically, each waiting queue is represented by a road and each patient is represented by a car. Each time a patient enters the pediatric ED, a new car enters the screen, in the road associated to its emergency level. The car starts from the left side and moves forward until it reaches its final position behind the cars already waiting. Each time a patient leaves the waiting room, all the cars located on the same road move forward to the right. An ambulance enters the screen when a patient with emergency level 1 enters the ED. Finally, since other researches have also highlighted the impact of animations on attention, several parts of the display are animated. For instance, the background and the roads move forward continuously in order to give the impression of constant progression. This impression is further emphasized by the progression of the car along the roads (Figure 1 right).



**Figure 1.** From first prototype to final version of the information screen

### 3.3. Development

The software has been developed with HTML5/Javascript technology and thus can be executed on any platform. The software acts as a client toward the institution clinical information system that stores the current status of each patient. Since, in our hospital, the interface is displayed on a television, the software is executed on a dedicated proxy machine connected, on the one hand to the institution network and linked on the other hand to the television through a HDMI cable. This solution is particularly well adapted to our context since it doesn't require the installation of a whole computer, reduces strongly the necessary maintenance and is very discrete given the reduced size of the dedicated hardware.

### 3.4. Evaluation

The evaluation of the intervention by patients took place in the Geneva paediatric ED, which is a tertiary care, academic medical centre with a Level I trauma service. The paediatric ED provides care for more than 25'000 patients annually. It contains 18



licensed beds, 4 of which are trauma beds and 1 resuscitation room. In addition, 2 fast-track beds are available for low-acuity patients. 273 questionnaires were distributed to the parents of the patients once taken under medical supervision by a clinician.

**Table 2.** Answers distribution at the four questions of the questionnaire

	Stressed	Satisfied	frustrated	Informed
Totally agree	5%	23%	3%	9%
Agree	11%	50%	10%	23%
Nor agree nor disagree	12%	19%	22%	35%
Disagree	31%	5%	27%	19%
Totally disagree	40%	3%	38%	14%

As presented in Table 2, high satisfaction and low level of stress has been reported by the respondents (only 8 percent where unsatisfied). The frustration remains also low since more than 75% of the respondents are positive or neutral regarding the frustration. Finally, regarding the comprehension of the waiting process, 23% of the respondents remain incapable of understanding the position of their own child compared to the other patients.

#### 4. Discussion

In overall, most respondents were highly satisfied. They have not suffered from stress nor frustration during their wait even if 23% of the respondents still remained incapable of evaluating the position of their child in regard to the other patients. Further questioning of some parents revealed that they have found the new information screen aesthetic, playful and easily understandable. Some of the respondents were only disappointed by the absence of precise indications about the waiting time.

#### References

- [1] N. D. Magaret, T. a. Clark, C. R. Warden, a. R. Magnusson, and J. R. Hedges, "Patient Satisfaction in the Emergency Department-A Survey of Pediatric Patients and Their Parents," *Acad. Emerg. Med.*, vol. 9, no. 12, pp. 1379–1388, Dec. 2002.
- [2] I. Higginson, "Emergency department crowding," *Emerg. Med. J.*, vol. 29, no. 6, pp. 437–43, Jun. 2012.
- [3] J. S. Olshaker and N. K. Rathlev, "Emergency Department overcrowding and ambulance diversion: the impact and potential solutions of extended boarding of admitted patients in the Emergency Department.," *J. Emerg. Med.*, vol. 30, no. 3, pp. 351–6, Apr. 2006.
- [4] E. L. Cohen, H. a Wilkin, M. Tannebaum, M. S. Plew, and L. L. Haley, "When patients are impatient: the communication strategies utilized by emergency department employees to manage patients frustrated by wait times.," *Health Commun.*, vol. 28, no. 3, pp. 275–85, Jan. 2013.
- [5] M. E. Bouwman, P. A. M. Kommers, and A. J. A. M. Van Deursen, "Revising TAM for hedonic location-based social networks: the influence of TAM, perceived enjoyment, innovativeness and extraversion," *Int. J. Web Based Communities*, vol. 10, no. 2, p. 188, 2014.
- [6] A. Domínguez, J. Saenz-de-Navarrete, L. de-Marcos, L. Fernández-Sanz, C. Pagés, and J.-J. Martínez-Herráiz, "Gamifying learning experiences: Practical implications and outcomes," *Comput. Educ.*, vol. 63, pp. 380–392, Apr. 2013.
- [7] B. Ben Shneiderman, "Designing for Fun : How Can We Design User Interfaces to Be More Fun ?," pp. 48–50.

# Towards Integrating the Principlist and Casuist Approaches to Ethical Decisions via Multi-Criterial Support

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**Abstract.** An interactive decision support tool based on Multi-Criteria Decision Analysis (MCDA) can help health professionals integrate the principlist (principle-based) and casuist (case-based) approaches to ethical decision making in both their training and practice. MCDA can incorporate generic ethical principles as criteria; then draw on case-based reasoning as the basis for specifying, in the individual case, the available options, the ratings of each option on each criterion, and the relative weighting of the criteria. This produces a personalised, transparent and decomposable opinion on the merits of each option, as a contribution to enhanced deliberation. As proof of concept and method an exemplar aid adds veracity and confidentiality to beneficence, non-maleficence, autonomy and justice, as the criteria, with case-based reasoning supplying the necessary inputs for the decision of whether a nurse should disclose the poor prognosis of a patient to a close relative of the patient, when asked, on their first encounter.

**Keywords.** Ethics; principle-based; case-based; multi-criteria; decision support; nursing

## 1. Introduction

Nurses, other clinicians and all health professionals are regularly called on to make or participate in decisions. The time available varies from a few moments in emergency situations, as in intensive care, to hours or days when there is time to reflect and ‘slow down’ thinking and process information and preferences in a more considered way [1]. The decisions also vary in the extent to which they involve ethical issues. All decisions involve making value judgments as well as processing information, but some are regarded as particularly ethical in character and are referred to as ethical dilemmas.

A disconnect between the Nursing Informatics and Nursing Ethics communities has been observed [2]. This is seen as reflecting the reluctance of both to move beyond supplying inputs to decision makers (high quality information and ethical insights respectively) and to engage with the decisions faced by health professionals, as such. The suggestion that an interactive clinical decision aid could increase cross-disciplinary communication in the context of person-centred care is developed here. The associated aim is to stimulate an enhanced discourse between the principlist and casuistic approaches to ethical decision making, seeking a possible resolution of their conflict at a prescriptive level, rather than either a theoretical or behavioural one.

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A paper by Page provides adequate background, containing all the necessary citations of the wider ethics literature for which there is not space on this occasion [3]. Her research was motivated by what she saw as the surprising lack of empirical investigation of the four Beauchamp and Childress classic ethical principles, and, in particular, the absence of any quantitative exploration of the *relative* importance attached to them. She sought to remedy this in a research study that had two aims.

The first was to establish how the relative importance attached to ethical principles in the abstract - that is without reference to any particular case - *could* be measured, and then to measure them. Her answer was the pairwise elicitation procedure employed within the Analytic Hierarchy Process. Using this she established the individual weights of her subjects and the group average weights. She had added the principles of veracity (truth-telling) and confidentiality to the classic four. The average (percentage) weights obtained were: Beneficence 15, Non-maleficence 25, Autonomy 16, Justice 16, Veracity 12 and Confidentiality 16.

The second aim was to establish the relationship between the subject's importance weights as measured and their ethical judgments about four specific cases involving competing ethical principles (conveyed to the subjects in the form of scenarios). Finding no significant correlation between the weights and judgements, Page explored the possible reasons for what she characterised as the predictive failure of the principles. She concluded that her findings favoured the casuistic (case-based) approach within ethics over the principlist one and that

"It could be that in terms of predicting ethical outcomes the principles may only be useful when evaluated... in the context of a specific scenario. Perhaps situational information, in all its complexity, is such that it "re-weights" the principles, and general weightings are rendered somewhat arbitrary in the face of new specific case-based information... When participants were faced with these cases they may have used the situational information to derive the importance of the principles (or approximation of) in a more casuistical reasoning manner." [3, pp. 6-7]

Page ends by noting that most attempts to resolve the principlist-casuistic tension continue to be made at a discursive theoretical level, such as Kuczewski [4], but is sceptical that the search for a coherent normative/prescriptive resolution will be successful. She argues that the most likely way forward will involve behavioural modeling of ethical decision making. We agree that the principlist-casuist tension is unlikely to be resolved or reduced within a discursive process. Health professionals will continue to be faced, not only by the need to make ethical decisions, but to decide on every occasion *how* to make the ethical decision. In other words, to decide how to bring together the generic ethical principles that have been heavily emphasised in their training and subsequent courses, with the case-specific considerations that immediately surface in the individual case. However, we disagree, that the search for a coherent prescriptive solution should be abandoned in favour of descriptive modeling, not least because such modelling will require value judgments and these will require prescriptive justification. It may be simply a case of ability to use the principles in the specific case that is the problem, as Page acknowledges.

"[My] results pose some questions for the importance and use of the principles in an empirical and applied sense. Their worth in terms of conceptualising the moral issues in a scenario seems obvious but if they are not actually used, *or able to be used*, in decision making by clinicians then it raises questions about their overall utility and applicability (at least in their current guise)." (italics added) [3, p 7]

If it is *inability*, then decision support offers a possible answer, so long as it addresses the multiple considerations present in ethical dilemmas

There are two broad multi-criteria 'decision technologies' and hence types of decision support. Instantiations of 'multi-criteria decision deliberation' (MCDD) characteristically quantify the magnitude of option performance on criteria and the relative importance of the criteria *verbally* and produce the decision (or opinion) through an *argumentation* process ('making up ones mind after taking the pros and cons into account'). The bulk of existing decision aids fall within this category. In contrast, implementations of multi criteria decision analysis (MCDA) quantify these two magnitudes *numerically*, stressing the importance of arriving at them independently to minimise contamination, then integrate them via an explicit *calculation* process (the simple weighted sum approach.)

Many decision aids provide a structure for the deliberation when it concerns test or treatment decision for a specific condition, but none address the point of decision as such. Support for such MCDD in ethical decisions is in the form of procedural guidelines or checklists, of which Manson's is a recent example [5]. Attempts to apply decision analytic principles and produce computer based decision support for ethical decisions have been explored, mainly in the field of Operational Research. It will suffice for present purposes to note the contributions of Brans [6] and Laaksoharju [7]. They present contrasting views on the role of a technique such as MCDA and on what should be the aim of computerised decision support. Brans presents a case for the use of MCDA as a way to improve ethical decision making and, while we use an alternative implementation of that technique in developing a practical support tool, we are very much aligned with his thinking, especially in arguing that the analysis should produce a result, an opinion.

In contrast, Laaksoharju's computerised decision tool is without theoretical grounding, other than psychological propositions, and with

"the main requirement [being] that it should not be making any decisions and not even supporting any specific solutions: it should not be elevated to an authority. The tool should not even give any directions about the correctness of any conclusion. This will force the user to analyze the problem very carefully. The sole intention should be to help the user to organize and structure a problem at hand. At the same time the problem should not be narrowed down, thus risking oversimplification, but instead be expanded and widened so that the user can appreciate the full impact of a decision". [7, p43]

Laaksoharju concedes that some may see his tool as 'pointless'. That is not our view, but we disagree with his basic position, which is based on the empirically unverified assumption that the decision maker's defective decision making processes can be improved by countering various well-publicised biases [1]. Interestingly, he does not address the fundamental issue of what comparator is to be used in the empirical evaluation of alternative decision support approaches. Whether an MCDA prescription-based aid is better or worse than a description-grounded one requires evaluation undertaken with outcome measures that are not biased in favour of one or other. And the evaluation needs to be in a specific ethical case. Since we see our MCDA aid being deployed within a wider deliberative context and as explicitly accepting the need to balance the analytical and the intuitive, we see no reason why decision makers should not be able to access such a prescriptive aid. It is an alternative,

not a replacement. MCDA requires the arguments and reasons to be subsumed in a model of the decision which clearly distinguishes value and factual judgements using numbers and a calculation algorithm to produce an opinion. Most MCDD aids follow Laaksoharju in being committed to *not* producing such an opinion, leaving the person to 'make up their mind'.

## Methods

In the sort of ethical dilemma addressed in the literature we conceptualise the multiple generic ethical principles as the *criteria* in an MCDA, with the alternative possible courses of action as the *options*. The performance ratings of the options on these criteria and the weightings of the criteria are both case-based and so the process is a potential way of integrating the principlist and casuist approaches. The recommended sequence in producing the Annalisa© implementation of MCDA for a specific clinical case [8], from the perspective of a single health professional, is to

- determine the generic ethical principles to be set as the criteria
- rate each of the options on each of these criteria in this specific case (e.g. to what degree does an option fulfill the criterion of beneficence?)
- weight the criteria in this particular case (e.g. what is the relative weight to be assigned to beneficence and the other principles?)
- observe the Scores that result of combining the Weightings and Ratings using the expected value (weighted sum) algorithm
- modify the Weightings and Ratings, if desired, but without being able to see the effect on the Scores until the changes are confirmed
- reflect/deliberate on the opinion produced

As proof of concept and method we applied the proposed approach in a specific case. A close relative of a seriously-ill patient asks his named nurse about the prognosis. To keep this illustration simple, we see the nurse having two broad Options, given that she actually does possess valid prognostic information and that this is her first encounter with the relative. She can disclose fully, or she can deny she has 'significant' relevant information.

We take the 6 ethical principles in the study by Page (Beneficence, Non-Maleficence, Autonomy, Justice, Veracity (truth-telling) and Confidentiality) and enter them as the criteria into the Annalisa [3]. Case-based reasoning is used to assess how each Option performs on each criterion. The best option varies with the weights assigned to the criteria, as well as how well the options perform on those criteria.

## Results

The result from entering one hypothetical set of Weightings and Ratings in the decision support tool appears in Figure 1. This example is found at <http://www.cafeannalisa.org.uk/topics/nursing-2014-05-14/> Any set of Weightings reflects particular trade-offs between the criteria and particular case-specific judgements concerning the content and scale of (e.g.) the beneficence and non-maleficence involved. To see these trade-offs and judgments being explored within a reflection-in-action approach, see the illustrative video with hypothetical numbers at <https://www.youtube.com/watch?v=n8SN20wxRGU&feature=youtu.be>



Figure 1: Screen capture of Annalisa© to document the aid opinion at one point

## Discussion

Ethical debate has become increasingly prominent in healthcare as a result of the movements towards Shared Decision Making and Person-Centred Healthcare in clinical practice, as well as wider demographic, economic and technological changes. Since multiple considerations are important to patients - and different considerations to different patients - the personalised assessment of the benefits and harms from alternative courses of action makes case-based reasoning even more essential than in the past, legally as well as ethically. Yet the high-level generic ethical principles remain attractive and are extensively referred to in both clinical training and practice. For both practical and pedagogical reasons it therefore seems important to pursue their potential integration using an analytical approach rarely exploited in ethics. The aim of multiple criteria analysis is precisely to make transparent the trade-offs in the light of the case-specific considerations (e.g. the content and scope of beneficence and non-maleficence) and make clear whose perspective is being adopted in the analysis.

The prescriptive MCDA approach to decision making is offered as valid for use in most healthcare situations. We invite health professionals (and ethics committees) to add this tool to their portfolio of competencies and introduce it in their teaching and presentations, where it can help students and other decision stakeholders visualise and map the link between generic ethical principles and case-specific information.

## References

- [1] Kahneman, D. (2012). *Thinking, Fast and Slow*. London: Penguin.
- [2] Kaltoft, M. (2013). Nursing Informatics AND Nursing Ethics : addressing their disconnect through an enhanced TIGER vision. *Studies in Health Technology and Informatics*, **192** (Medinfo), 879–883.
- [3] Page, K. (2012). The four principles: can they be measured and do they predict ethical decision making? *BMC Medical Ethics*, **13**, 10.
- [4] Kuczewski, M. (1998). Casuistry and principlism: The convergence of method in biomedical ethics. *Theoretical Medicine and Bioethics*, **19**, 509–524.
- [5] Manson HM. (2012). The development of the CoRE-Values framework as an aid to ethical decision-making. *Medical Teacher*. **34**, e258–68.
- [6] Brans, J. P. (2002). Ethics and decision. *European Journal of Operational Research*, **136**, 340–352.
- [7] Laaksoharju, M. (2010). *Let Us Be Philosophers ! Computerized Support for Ethical Decision Making*. Thesis. University of Uppsala.
- [8] Dowie, J, Kaltoft, MK, Salkeld, G, Cunich, M. (2013) Towards generic online multicriteria decision support in person-centred health care. *Health Expectations*. doi: 10.1111/hex.12111

# Dementia and Robotics: People with Advancing Dementia and Their Carers Driving an Exploration into an Engineering Solution to Maintaining Safe Exercise Regimes

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**Abstract.** The merging of the human world and the information technology world is advancing at a pace, even for those with dementia there are many useful smart 'phone applications including reminders, family pictures display, GPS functions and video communications. This paper will report upon initial collaborative work developing a robotic solution to engaging individuals with advancing dementia in safe exercise regimes. The research team has been driven by the needs of people with advancing dementia and their carers through a focus group methodology, the format, discussions and outcomes of these groups will be reported. The plans for the next stage of the research will be outlined including the continuing collaboration with advancing dementia and their carers.

**Keywords.** Robotics, advancing dementia, exercise, collaborative research, cocreation

## 1. Introduction

The paper is based upon the initial research undertaken exploring the reaction to a basic mobile robot, possible individual acceptance of a mobile robot and potential use of a mobile robot as suggested by the individuals and their carers.

The merging of the human world and the information technology world is advancing at a pace, even for those with dementia there are, for example, many useful smart 'phone applications including reminders, family pictures display, GPS functions and video communications.

Dementia is a progressive disorder which affects many aspects of an individual's life. As problems mount people with dementia and their carers may decide that 24 hour care is needed. At this point carers and people with dementia usually decide that they need to move to a care home. Although as carers we may gradually lose the ability to communicate verbally with people with dementia they still need, and benefit from therapeutic interventions that can stimulate their interests and give them some fun.

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However due to the effect of Dementia on their capabilities this can be problematic as potential risks need to be balanced against perceived benefits.

In health care we know that exercise has positive benefits for individuals of all ages and lack of exercise can have serious adverse effects particularly later in life [1] and yet we frequently see images of people with dementia in care homes sitting alone or in groups.

It has been suggested that the reason for such sedentary care is due to staff wanting to maintain their duty of care and reduce the risk of falls or injury or anxiety to those in their care [2]. However, evidence suggests that exercise engagement is not only possible but also of benefit to those with dementia [3] but there remains very little research around exercise and individual safety.

It is also known that amongst those suffering with dementia there is evidence of 'wandering' [4] which can have serious negative outcomes [5].

Wandering represents one of the three categories of disruptive behaviour of people with dementia. The behaviour is disruptive from the carer's point of view. Restless wanderers may make up 50% of the population of inpatient special care dementia units [6]. However, the behaviour can also be considered as an expression of a person's goal or needs and when treated properly can become meaningful and potentially useful in directing nursing care.

Our vision is to design a companion robot which will move around in a residential area, home or care home. The mobile robot would be made to navigate the environment autonomously. The robot could just be there to provide a (positive) distraction to residents. The more ambitious idea would be that the robot becomes a robotic companion which accompanies restless nursing home residents or invites and persuades inactive residents to walk.

Wu, Fassert & Rigaud [7] tested the impact of representations and perceptions of robots on older people with mild cognitive impairment living at home and suggested that the most attractive robots for their target population should have the following characteristics:

- they should be relatively small in comparison to human-size;
- should have some traits between human/animal and machine.
- should be like a familiar object in a home setting.
- finally, creativity in the design of the robot's appearance is desired.

However, the target population of our project differs from Wu, Fasser & Rigaud's; our robots are designed for users living in nursing home, rather than in their own home. Therefore, we will use these guidelines as a starting point only. Evaluation tests to measure the residents in nursing homes acceptability of the robots will be obtained by adapting Wu, Fasser & Rigaud's study.

The idea of a robot companion for people suffering from dementia was initially discussed with a few professional carers. The feeling was that there needs to be something that connects the resident to the robot. The resident may simply forget that the robot is with him or her. There are a few options. One is that the resident holds a stick which is connected to the robot, as for instance described in Ghosh et al [8]. However this option was judged too rigid. Another option was to use the equivalent of a dog lead as suggested by Young et al [9]. This seemed the better option and we worked it out into a simple demonstration.



## 2. Methods

We wanted the people living with dementia and their carers to drive this research and direct the engineering work. Thus we produced four main research questions to share with focus groups:

- General: is a robot acceptable or are we shown the door immediately?
- What is an appropriate size?
- Are there suggestions on how the robot should look (our Pioneer robot is very much a mechanical device, PARO looks soft)
- Are there suggestions on how the robot should behave, what it should do?

One of our team had links with a local mental health care trust and the local Alzheimer's society who were able to help in the recruitment and facilitation of focus groups. We conducted two rounds of focus groups amounting to three groups in total.

In the first round two groups of people were convened, one being people with dementia who were still able to live at home and communicate verbally accompanied by their carers (n= 16), the other being carers (n= 6) of people with more advanced problems who are living in a 24 hour care setting. Both groups were introduced to the idea of our research in a brief presentation which identified the focus which was to develop a robot for people with dementia living in a 24hour care setting.

Initially the wide use of robots in healthcare was discussed and a clip of the PARO robot (the robot used for some people with dementia [10]) interacting with a person with dementia was shown. The static nature of this was identified and another clip of a mobile search and rescue robot was shown to illustrate potential for a moving robot.

We outlined our idea of a mobile robot that was connected to the person through the use of a lead. A demonstration of the basic idea took place followed by a slide show of pictures of different sizes and shapes of robots. This was used to stimulate discussion around their thoughts on the most acceptable configuration. The demonstration took the form of one student taking the role of a person with dementia by holding the lead and walking along with the robot whilst another student remotely controlled the robot.

For the demonstration we used a Pioneer-3AT 4-wheel robot (dimensions 30x40x20) with a commercially available dog lead: a spring-loaded retractable lead which keeps the lead taut; the end of the lead was fixed on the robot.



**Figure 1.** Robot and lead demonstration photograph

In the second round of focus groups we showed designs for dressing the robot, moving from a 'technical' object towards that of a possible companion to another focus group comprised of people with dementia and two of their carers (n= 5).



**Figure 2.** Three dressed up robots

The designs were not given a name, nor an explanation of what they resembled; they were just shown as they are for the group to consider and discuss.

### 3. Results

All participants in the focus groups were very pleased to have been part of the initial planning stages. They found the relaxed environment helpful in that they were able to be very vocal in their contributions and proposed a wide range of differing formats for the robot. They all fully supported the idea of the robot being an additional therapeutic intervention for people with dementia.

The idea of a lead to connect the person to the robot was also seen as a positive aspect and they were clear that the robot should be robust enough to withstand any destructive behaviour and yet not so large that it was seen as a threatening presence.

The people with dementia felt that they should have some sort of relationship with the robot. They wanted the robot to be engaging and interesting and yet fit for purpose in that its outer covering should be washable. They were clear that it should not be robotic but rather more person/animal like. Warm and friendly were words that were used by one of the participants with dementia.

One participant who is a carer stated that they had been very against the idea initially but following the focus group they were now most definitely in favour. They were all looking forward to working with us in this development and were reassured that we would be continuing our work in this field.

In round two of this study the focus group unanimously chose the middle design as their favourite, with comments that it has a face (the face of the left design was not clearly visible) and it smiles (the right one does not smile).

Though in the discussion it turned out that they were not clear about what the nose or the mouth of this design was. This seems to suggest that the technical/very clean look of the left design was rated lower than the fancier look of the middle design. The right design evokes direct association with a role (school girl) while the middle design does not seem to refer to an everyday role and the confusion in the group about the mouth did not lead to the design being liked less.

#### 4. Discussion

This project has brought together people living with dementia and robotic technology to determine the potential combination that would be acceptable and helpful from the individual's and the carers perspectives to help with managing and maintaining an exercise regime appropriate and safe for the individual.

We will continue to investigate how to improve the acceptability of the robot by varying in the first instance the appearance of the robot (size, material etc.) and at a further stage varying the behaviour of the robot using feedback from people with dementia and their carers.

The future challenge of the project is to investigate whether nursing home residents would be willing to accept a robot companion. We are aware that the appearance of the robot will have a significant impact on how the robot will be perceived by the residents. It should look interesting and be perceived as worthy companion. Through further engagement with those with advancing dementia and their carers we shall design and build a prototype robot and develop appropriate functionality to deliver a 'companion' to an individual in a care home to help with a safe exercise regime.

#### 5. Acknowledgements

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#### References

- [1] Frank W Booth, Christian K Roberts and Matthew J Laye, Lack of Exercise is a Major Cause of Chronic Disease. *Comprehensive Psychology*. 2:1143–1211 (2012)
- [2] Lin GU, Nursing interventions in managing wandering behavior in patients with dementia: A literature review. *Archives of Psychiatric Nursing*, In Press: 17 July 2015
- [3] David W Thomas, Carolyn Glogoski and Jodi Johnson, The effect of a Supervised Walking Program on Wandering Among Residents with Dementia. *Activities, Adaptation and Aging*. Vol 30, Issue 4 (2006)
- [4] N Ali, S L Luther, L Volicer, D Algase, E Beattie, L M Brown, V Molinari, H Moore and I Joseph, Risk assessment of wandering behavior in mild dementia. *International Journal of Geriatric Psychiatry*, doi: [10.1002/gps.4336](https://doi.org/10.1002/gps.4336). (2015)
- [5] Junichi Furumiya and Yoshiaki Hashimoto, A descriptive study of elderly patients with dementia who died wandering outdoors in Kochi Prefecture, Japan. *American Journal of Alzheimer's Disease and Other Dementias*. Vol 30: No 3: 307-312 (2015)
- [6] Cipriani, G. et al., 2014. Wandering and dementia. *Psychogeriatrics*, 14(2), pp.135–142.
- [7] YH Wu, C Fassert and AS Rigaud, Designing robots for the elderly: Appearance issue and beyond. *Archives of Gerontology and Geriatrics*, 54(1), pp.121–126. (2012)
- [8] A.J Ghosh, J Penders, P Jones and L Alboul, Following a Robot using a Haptic Interface without Visual Feedback, *ACHI2014*, Barcelona March (2014).
- [9] JE Young, Y Kamiyama, J Reichenbach, T Igarashi and E Sharlin, How to Walk a Robot: A Dog-Leash Human-Robot Interface. *International Symposium on Robot and Human Interactive Communication, RO-MAN*, pp.376–382. (2011) Available at: <http://medcontent.metapress.com/index/A65RM03P4874243N.pdf> [Accessed April 14, 2014].  
Robinson, Hayley, Elizabeth Broadbent, and Bruce MacDonald. "Group sessions with Paro in a nursing home: Structure, observations and interviews." *Australasian journal on ageing* (2015).

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# Social Media & Participatory Health Conference

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# A Data Mining Approach for Exploring Correlates of Self-Reported Comparative Physical Activity Levels of Urban Latinos

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**Abstract.** We applied data mining techniques to a community-based behavioral dataset to build prediction models to gain insights about physical activity levels as the foundation for future interventions for urban Latinos. Our application of data mining strategies identified environment factors including having a convenient location for physical activity and psychological factors including depression as the strongest correlates of self-reported comparative physical activity among hundreds of variables. The data mining methods were useful to build prediction models to gain insights about perceptions of physical activity behavior as compared to peers.

**Keywords.** Physical activity, motivation, classification, feature selection

## 1. Introduction

Lack of physical activity threatens the health of Latinos in the U.S.<sup>1,2</sup> Peer comparison (“compared to my age group, am I active?”) may influence motivation for change in physical activity behavior. When people self-assess their level of physical activity compared to their own age groups, they are exhibiting the psychological concepts of ‘relatedness’ and ‘competence’. According to self-determination theory, competence and relatedness are human basic psychological needs for forming and maintaining high quality motivation for physical activity.<sup>3</sup> In this study, we applied data mining techniques to explore factors that influence urban Latinos’ perceptions of physical activity levels compared to others in their age groups as a foundation for future targeted intervention development.

Data mining is an iterative process to discover meaningful new knowledge with the help of computing power to search numerous possible relationships among hundreds of variables. It requires the integration of domain knowledge (e.g., physical activity, behavioral science) with the steps of data mining.<sup>4</sup> The Washington Heights/Inwood Informatics Infrastructure for Comparative Effectiveness Research (WICER) project built an informatics infrastructure to understand health behaviors to improve the health of an urban underserved population. One component of the infrastructure is a survey which was collected by bilingual community health workers. The study sample comprised English or Spanish speaking community-dwelling adults in New York City. The WICER survey dataset contains 925 variables from 5429 Latinos including physiological, environmental, behavioral, patient-reported outcomes, and sociodemographic factors.<sup>5</sup>

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## 2. Methods

### 2.1. Theory, Process Model, Dataset and Tools

Self-determination theory<sup>3</sup> and the data mining and knowledge discovery process model<sup>4</sup> guided our data mining process. The process model includes: 1) understanding the problem, 2) understanding data, 3) preprocessing data, 4) reducing dimensionality, 5) applying mining algorithms, and 6) interpreting results. We applied classification methods to the WICER dataset in order to build a prediction model for level of physical activity compared to the peers. WICER data is stored in a secure web application for research, REDCap. We used Weka 3.6 (<http://www.cs.waikato.ac.nz/ml/weka/>) and Tableau 9.0 (<http://www.tableau.com/>) as our analytic tools. The WICER dataset is available to investigators within the institution, and those outside of the institution with data use agreement and institutional review board approval.

### 2.2. Data Mining Process for Self-Reported Comparative Level of Physical Activity

We extracted 925 variables for 5429 Latinos from the local REDCap database. During the prime filtering, a domain expert (SY) selected 118 of 925 variables as relevant. During feature selection, we applied six data mining algorithms<sup>6</sup> to select variables that were strongly correlated to the dichotomous dependent variable ('less active than my peers' versus 'same or more active than my peers'). Six machine learning algorithms with default configuration (Table 1) were chosen in order to avoid algorithm dependency because selected features can vary by machine learning algorithm.<sup>6</sup> We selected 19 final variables based on the criteria of clinical meaningfulness and identified in multiple of the six algorithms and then organized the variables into five conceptual categories: environmental, psychological, behavioral, physiological and demographic factors.

Next, we iteratively applied ten data mining algorithms in Weka (J48, ADTree, DecisionStump, RandomForest, BayesNet, SMO, AdaBoost M1, Bagging, PART, Random Tree) using the top features to build the prediction models for comparative physical activity level ('less active than my peers' and 'same or more active than my peers').<sup>6</sup> As with feature selection, we used multiple algorithms to avoid algorithm dependency. The WICER dataset was randomly divided into training and evaluating datasets for the model validation before applying the algorithm. We chose the final models based on predictive accuracy (i.e., correctly classified survey participants), the area under the receiver operating characteristic curve (AUC), and the model interpretability. Lastly, we interpreted the models according to clinical meaningfulness.

## 3. Results

The majority (n=3,734, 68.8%) of WICER participants reported that they felt 'the same or more physically active', and 31.2% (n=1,695) reported that they felt 'less physically active' compared to their peers. Table 1 summarizes the feature selected by the six algorithms from among 118 of 925 variables selected by the domain expert. The availability of low fat products in neighborhood (environmental factor), depression and anxiety (psychological factors), waist circumference (physiological factor), sugary soda intake, and sleep disturbance (behavioral factors) were selected by at least five



algorithms. In contrast, age and BMI (physiological factors) were selected by one or two algorithms.

The bubble-shaped infographic at the center of Figure 1 shows that psychological factors such as depression and fatigue (purple) and behavioral factors including sugary soda intake and sleep disturbance (blue) are more strongly correlated with physical activity level compared to age-group peers than other demographic factors including age and education (orange).

**Table 1.** Features Selected by Six Algorithms

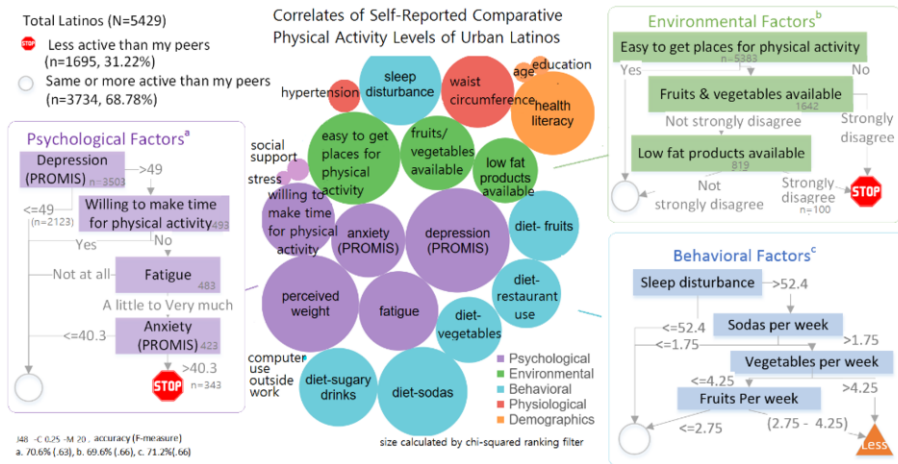
Conceptualized Variables	Feature Selection Algorithms
Environmental: easy to get places for physical activity	● ● ● ● ● ●
Environmental: low fat products in neighborhood	● ● ● ● ● ●
Environmental: fruits/vegetables in neighborhood	● ● ● ● ● ●
Psychological: depression (PROMIS)	● ● ● ● ● ●
Psychological: perceived weight	● ● ● ● ● ●
Psychological: anxiety (PROMIS)	● ● ● ● ● ●
Psychological: fatigue	● ● ● ● ● ●
Psychological: willing to make time for physical activity	● ● ● ● ● ●
Physiological: waist circumference	● ● ● ● ● ●
Physiological: BMI	● ● ● ● ● ●
Behavioral: diet-sodas	● ● ● ● ● ●
Behavioral: sleep disturbance (PROMIS)	● ● ● ● ● ●
Behavioral: diet-sugary drinks	● ● ● ● ● ●
Behavioral: diet-vegetables	● ● ● ● ● ●
Behavioral: diet-fruits	● ● ● ● ● ●
Behavioral: diet-restaurant use	● ● ● ● ● ●
Demographics: health literacy	● ● ● ● ● ●
Demographics: hypertension	● ● ● ● ● ●
Demographics: age	● ● ● ● ● ●

Psychological, environmental and behavioral factors and behavioral factors for physical activity level compared to age-group peers are also displayed along with detailed information on prediction models computed by the J48 algorithm. The psychological model shows that individuals with depression PROMIS score greater than 49 and not willing to make time for physical activity were more likely be feel ‘less active’ compared to their age groups unless they completely free from fatigue and had less than average anxiety (PROMIS score <40.3). The environmental model shows that individuals without convenient places for physical activity, and

living in a neighborhood where fruits, vegetables and low fat products were completely unavailable, are more likely to feel ‘less active. The behavior model shows that individuals with higher disturbed sleep (PROMIS score >52.5) and more sugary soda intake (>1.75 times per week) and less vegetable intake (<=4.25 times per week) were more likely to feel ‘less active.’

#### 4. Discussion

Data mining methods were useful for building prediction models for self-reported, comparative physical activity levels from a large dataset. This paper highlights the feature selection and model building approaches. Data visualizations (e.g., tree infographics) were helpful to detect patterns and gain insights about perceptions of comparative physical activity levels.



**Figure 1.** Prediction models for self-reported level of physical activity compared to peers: strength of correlates (middle) and relations (tree diagrams)

**4.1. Clinical Implications for Correlates of Comparative Physical Activity Levels**

The authors previously found that 90.1% (n=4475) of Latinos answered “zero minutes” for weekly moderate exercise levels.<sup>5</sup> Given this, we learned that the national goals and strategies were unrealistic. In our previous data mining study, we built a correlation model for who engage in physical activity or not, and found that motivation (autonomy) as a strong correlate. According to self-determination theory, three human basic psychological needs (autonomy, relatedness, competence) play an important role for determining intrinsic motivation and this study contributes to the area of the concept ‘relatedness’ by investigating comparisons with age-group peers which may influence motivation. Future research will examine competence as the third psychological need, in order to ultimately develop an effective intervention. Although our approach is based on the well-established self-determination theory, our study is distinctive in its examination of many variables.

From this study, we found new knowledge about strong factors and the relationship among factors for those who perceived themselves as less active compared to others in their age group. According to self-determination theory,<sup>1</sup> low competence discourages physical activity behavior; several psychological factors including depression, perceived weight and willingness to make time for physical activity, were more strongly correlated with the perception of ‘less active’ compared to other known factors such as chronic stress (financial, personal, and relationship), and social support. This warrants future studies to understand subgroup culture and stress measurements.

Our findings regarding the influence of environmental factors on levels of comparative physical activity support the importance of environmental intervention such as gym memberships offered by health insurance or workplaces. The results of our study also suggest that policy and physical environment strategies such as presence of food outlets as a neighborhood destination may facilitate and promote comparative physical activity level. Further research is needed to determine the effectiveness of developing environmental interventions to enhance physical activities.

Modifiable behavior factors such as sleep disturbance and diet (e.g., sugary sodas, vegetables intake) strongly correlate with perceptions of being less active compared to peers. Although diet behaviors were strong factors, we noted that the perception of having a large selection and availability of fresh fruits and vegetables in their neighborhood did not necessarily promote the resident's fruit and vegetable consumption. Unlike other studies about level of physical activity, non-modifiable factors including age, gender, education, language use, birth country, and medical condition had less influence on perceived comparative physical activity level than other modifiable factors. This finding suggests the need for new targets and strategies for physical activity in Latino population.

#### 4.2. Implications for Data Mining

Although data mining techniques are common to detect patterns in genetics within health science, methodological strategies such as selecting features and modeling, which can be intuitively interpreted, have been rarely documented in behavior science. For this reason, this study emphasized the practical approach when, what, who and how to apply data mining algorithms. We described how to comparatively choose important predictors using six algorithms and domain expertise. Domain expertise (e.g., understanding concept, clinical meaningfulness and operationalization of each variable) played crucial role during the feature selection, iterative modeling and interpretation process. For example, 19 clinically meaningful variables were able to be detected as a result of applying machine learning algorithms only after the iterations of careful removal of highly correlated variables, which do not help modeling (e.g., weekly physical activity amount). Further, final model visualization using a tree form was useful in understanding relationships and dynamics among variables. The visualization (Figure 1) provides more transparency of the models than conventional models. Our models should be interpreted with the caution regarding their plausibility given the cross-sectional nature of the data.

### 5. Conclusion

The data mining methods incorporating domain expertise and visualizations may be useful to others to mine a large dataset for gaining insights other behaviors.

### 6. Acknowledgments

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### References

- [1] E.M. Arredondo, D. Sotres-Alvarez, M. Stoutenberg, S.M. Davis, N.C. Crespo, M.R. Carnethon, et al., Physical Activity Levels in U.S. Latino/Hispanic Adults: Results From the Hispanic Community Health Study/Study of Latinos. *American journal of preventive medicine*. 2015.[epub ahead of print]
- [2] M.J. Ickes, M. Sharma, A systematic review of physical activity interventions in Hispanic adults. *Journal of environmental and public health*. 2012;**2012**:156435.
- [3] E.L. Deci, R.M. Ryan. *Intrinsic motivation and self-determination* Springer Science 1985.
- [4] U.M. Fayyad, G. Piatetsky-Shapiro, P. Smyth, R. Uthurusamy, Advances in knowledge discovery 1996.
- [5] S. Yoon, N. Suero-Tejeda, S. Bakken, A Data Mining Approach for Examining Predictors of Physical Activity Among Urban Older Adults. *Journal of gerontological nursing*. 2015;**41**(7):14-20.
- [6] I.H. Witten, E. Frank. *Data Mining: Practical machine learning tools*: Morgan Kaufmann; 2005.

# Decision Support System of Nursing Human Resources Allocation in General Wards Based on Hospital Information System

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**Abstract.** **Aim** To construct a Decision support system of nursing human resources allocation in general wards based on Hospital information system (HIS). **Method** Time series prediction model and Information technical method were used based on data of HIS in West China Hospital, Sichuan University (Chengdu, P.R.China). **Results** This study completed the function design and system implementation of the nursing human resources allocation decision support system. **Discussion** The system would help nursing managers choose the optimal scheme and make scientific decisions in combination with “the actual” situation but more empirical studies are needed.

**Keywords.** Decision support system, Hospital information system, Nursing human resources allocation, workload

## 1. Introduction

First paragraph. Considering the possibility of informational technology, if a predictive nursing human resource allocation could be obtained, it will give a reference for nursing allocation decision. Our previous study had obtained by using the Hospital Information System (HIS) data to capture nurse workload of a general ward everyday automatically. Therefore, this study aimed to construct a Decision support system (DSS) of nursing human resources allocation for general wards with the function of prediction for nursing human resources needs.

## 2. Methods

### 2.1. Time series prediction model

Time series prediction model is a statistical method by using historical data to estimate and predict the future trend [1]. Deterministic model and stochastic model are two types of time series prediction model. Considering the data of nursing workload were produced at midnight 12:00, the models were used to predict today. Deterministic

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model chose four specific model, “yesterday” which use data of previous day to predict today, “seven day” which use data of previous seven days to predict today, “thirty days” which use data of previous 30 days to predict today, and “same day in per year” which use data of previous same day per year to predict today.

Stochastic model chose two specific model, “exponential smoothing (ES)” which use exponential smoothing values with a certain time series prediction model to forecast the future phenomenon [2], and “Autoregressive Integrated Moving Average Model (ARIMA)” which use a sequence of data over time as a random sequence by approximate description with a certain mathematical model to predict the future [3]. This analysis constructed 80% to 95% of prediction interval. Meanwhile, this study used mean square error (MSE) to judge the accuracy of prediction model. Therefore, MSE is smaller, which indicates that the smaller gap between the predicted value and the real value, and the prediction model better.

## 2.2. Data

The workload of wards was summed up by direct nursing activity and indirect nursing activity by our previous study. All data is from West China Hospital, Sichuan University, a tertiary hospital for medical, teaching, scientific research, and prevention in the west of China. Then daily nursing workload data by work hour will be extracted from HIS based on our previous study. The sampled wards had 2191 days of workloads history from Jan 1<sup>st</sup>, 2009 to Dec 31<sup>st</sup>, 2014. These data were used for choosing proper prediction model above.

## 2.3. Information technical method for nursing human resource allocation decision support system (DDS)

Based on the database of Caché of HIS, this study constructed model database by using IBM Cognos. Model database contain the time series prediction model we chose and the need of nursing human resources formula. The nursing item & nursing item work hour data warehouse with technical support by Microsoft SSIS had finished in previous study which extract from Doctor Order system, Nursing activities system and patient acuity of ward system.

Finally, a web interface presented the workload of nursing and the predictive future need of nursing human resources allocation by the Framework Manager and Transformer. All these information technical work were outsourced by a team from information centre in West China Hospital.

## 3. Results

Based on MSE value, no one model is suitable for all wards, “yesterday” model prediction method of five wards is more accurate (Table 1). Besides, “7 days” model, “30 days” model and “yesterday” model could predict today, and “same day in per year” model could predict the future week. This study only took six wards to analysis, all general wards were analysed before determining of best model. Therefore, every ward should choose the best predictive model based on the MSE in the future study. ARIMA has better prediction than ES (Table 2). Moreover, ARIMA could predict a future week.

**Table 1.** Mean square error (MSE) value of deterministic model for workload prediction of general wards

Ward	7days	30days	Yesterday	Same day in per year
Medical A ward	0.004654936	0.005518464	0.005162578	0.011336810
Medical B ward	0.006895211	0.010485470	0.003898860	0.026495500
Medical C ward	0.003589829	0.005370982	0.003552333	0.111856700
Surgery E ward	0.028503100	0.035183360	0.010705280	0.031267940
Surgery F ward	0.029404040	0.043875460	0.010672140	0.044105760
Surgery G ward	0.015932150	0.024713920	0.010368900	0.024602340

**Table 2.** Mean square error value of stochastic model for workload prediction of general wards

Ward	Model	MSE	Predictive interval (%)	
			80%	95%
Medical A ward	ARIMA	0.002905781	91	98
	ES	0.005105226	93	98
Medical B ward	ARIMA	0.003092332	93	100
	ES	0.003940133	92	100
Medical C ward	ARIMA	0.002980658	94	98
	ES	0.003304563	90	99
Surgery E ward	ARIMA	0.003092332	93	100
	ES	0.003940133	92	100
Surgery F ward	ARIMA	0.009648473	92	99
	ES	0.010672460	91	98
Surgery G ward	ARIMA	0.005634050	88	97
	ES	0.005763781	81	97

In order to acquire more details and considering the workload of information technical, all models this study mentioned, except ES model, had written into HIS. The DSS system uses by user name and password login form. Different levels of nursing management share the same login interface with different permission scope. The login interface is showed in Figure 1. The functional interface is showed in Figure 2. The acquirement of nursing workload is showed in Figure 3. The predictive need of nursing human resources is showed in Figure 4.



**Figure 1.** The login interface of DSS



**Figure 2.** The functional interface of DSS



Figure 3. The acquirement of nursing workload of DSS



Figure 4. The predictive need of nursing human resources of DSS

### 4. Discussion

This study completed the function design and system implementation of the nursing human resources allocation decision support system. The system used time series prediction models to help nurse managers to make decision for nursing allocation. However, this DSS have not applied for nursing manager in our hospital. Though a medical ward is trying to use this system, no empirical data is available to test this DSS unfortunately. Therefore, the best prediction model of every general ward should be tested and empirical studies are needed to testify the system in the future studies.

### 5. Acknowledgments

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### References

- [1] C.L. Jia, Study on Railway track irregularity data mining and time series trend prediction, *Beijing Jiaotong University* (2013).
- [2] E.S. Gardner, Exponential smoothing: The state of the art, *Journal of forecasting* 4 (1985),1-28.
- [3] R.J. Hyndman, Y. Khandakar, Automatic time series for forecasting: The forecast package for r, *Monash University* (2008).

# Integrating Social Media and Mobile Sensor Data for Clinical Decision Support: Concept and Requirements

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**Abstract.** Social media are increasingly used by individuals for the purpose of collecting data and reporting on the personal health status, on health issues, symptoms and experiences with treatments. Beyond, fitness trackers are more used by individuals to monitor their fitness and health. The health data that is becoming available due to these developments could provide a valuable source for continuous health monitoring, prevention of unexpected health events and clinical decision making since it gives insights into behavior and life habits. However, an integration of the data is challenging. This paper aims triggering the discussion about this current topic. We present a concept for integrating social media data with mobile sensor data and clinical data using digital patient modelling. Further, we collect requirements and challenges for a possible realization of the concept. Challenges include the data volume, reliability and semantic interoperability.

**Keywords.** Social media, digital patient modelling, wearable sensors, decision support

## 1. Introduction

The individual state of a patient is very complex and concerns besides anatomy, physiology, metabolism, genetics also personal circumstances or life habits. Considering the individual state of the patient already in therapy planning is necessary for avoiding complications, predicting possible patient compliance, or for individualizing treatment decisions. Quantitative measurements as results from examinations are available in the electronic health record, described in clinical narratives or listed in terms of measured values. With an increase of information provision through social media and collected by patients individually through wearable sensors (e.g. fitness trackers), new sources of information reflecting patient's health observations and habits, i.e. quantitative and qualitative information are increasingly available. Activity trackers enable, low-cost wearable, non-invasive alternatives for continuous 24-h-monitoring of health, activity, mobility, life habits and mental status. The technologies have already been tested for their application in health monitoring systems, among others to analyse the tremor in Parkinson patients [1] or determine activity patterns for pulmonary patients [2] or analyse stress levels. Social media data was so far exploited for disease surveillance [9], patient recruitment or health

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communication. For example, studies showed that social media offers a medium to be used by the public, patients, and health professionals to communicate about health issues with the possibility of potentially improving health outcomes [8].

We envision the use of social media and wearable sensor data integrated with clinical data for continuous health monitoring, personalized treatment decisions and clinical decision support. As an example, consider the disease Multiple Sclerosis (MS), a disease that goes hand in hand with multiple symptoms (pain, mobility restrictions etc.) influencing massively the quality of life of patients. The entire care considers a mitigation of symptoms; healing is still unavailable. A continuous monitoring of MS patients could support in facilitating dealing with the situation by adapting the care plan accordingly targeting as hampering the quality of life as less as possible. However, we are still missing means that enable physicians to analyse and consider continuous health data as it could be collected from mobile sensors or from social media platforms within clinical decision making. In this paper, we introduce the concept of digital patient modelling as one possibility to include this non-clinical data in clinical decision-making. We present challenges and requirements towards an integration aiming at triggering the discussion of possible solutions.

## 2. Methods

### 2.1. Medical Social Media Data

With medical social media data we refer to web-based narrative text and data that contains medical content which was written by individuals (potential patients), physicians or other healthcare professionals. In *content communities and social networking sites* patients who suffer from diseases can share health data to empathise with each other or learn about experiences with treatments, physical exercises or medications. For example, PatientsLikeMe [<https://www.patientslikeme.com/>, last access: 17.11.2015] is a social network for patients that allows to share health-related experiences and compare treatments. Data is collected in this particular network partially in a structured manner: for the various features such as quality of life or single symptoms, categories are predefined (e.g. quality of physical life on a scale of 4 between best and worst). Similar to a paper-based diary, the authors of *weblogs or blogs* describe in unstructured format their personal opinions, impressions, feelings. In *online reviews*, individuals describe their experiences on symptoms, complications and effects of treatments with medical products including drugs.

### 2.2. Activity Tracker and Wearable Sensors

Smart wearable sensors are intelligent, low-cost, ultra-low-power sensor networks that enable individuals to collect huge amounts of biomedical information. There is a large variety of wearable sensors available including smart shirts, smart teeth etc.. We are concentrating in this paper on fitness or activity trackers as an example of wearable sensors (e.g. Microsoft Band, Fitbit Surge). However, challenges and requirements will be similar for other wearable devices. Activity tracker determine the activity progress in relation to a daily goal, distance and duration of activities, heart rate, calories burned, elevation, pace, sleep data and they even track food. APIs are provided to transfer the data from the fitness band into a database format, processable by computers (e.g. Apple

Health Kit, Google Kit, IFTTT - If This Then That). Challenges for processing data from fitness trackers are related to the volume of the collected data and the data quality. However, no comprehensive studies are already available on the accuracy of such sensor data.

### 2.3. Digital Patient Modelling for Exploiting Non-Clinical Data

In this section, we introduce digital patient modelling and the concept for integrating social media data and sensor data with clinical data in a digital patient model. We did not yet realized the concept since there are still several requirements and challenges to be addressed. They are summarized in section 3.

A digital patient model can be considered a specific and context-independent representation of a patient or of a specific disease or anatomical structure of a real patient, respectively. It consists of data elements that are semantically linked or grouped and thus provides an integrated view on the patient data reflecting his health status. Integrated in a decision support system digital patient models can support in therapy planning with individual quantitative optimization of clinical output or in predicting disease propagation. Treatment options can be simulated to support decision making. Two large EU initiatives worked towards a digital patient. Within Discipulus (<http://www.digital-patient.net/>), a roadmap, i.e. a research agenda for the digital patient was formulated. The Virtual Physiological Human (VPH, <http://www.vph-institute.org>) is a framework of methods and technologies targeting at integrating fragmented health information. Once established, it will make possible the investigation of the human body as a whole. In this context, a sharing platform for biomedical data, tools, workflows and computing resources has been set up (VPH-Share). In terms of the model methodology, we can distinguish graphical patient models (based on radiologic image data) from probabilistic models. Clearly, social media and activity tracker data could be rather contribute to the latter, thus we are concentrating on this model type.

A frequently used method for knowledge modelling within clinical decision support systems are Bayesian networks which are probabilistic graphical models (e.g. Oniko et al. [4], Leibovici et al. [5]). Random variables represent in these graphs information entities such as medical examinations, medical imaging, patient behavior and patient characteristics (e.g. age, gender, tobacco and alcohol consumption), while directed edges represent the dependencies between information entities. Conditional probabilities need to be set for each information entity based on the graphical model structure. They define the correlation between an information and its direct causes. Bayesian networks allow for example to model dependencies among relevant information entities with respect to treatment decisions [6].

In previous work, we created a model for interdisciplinary treatment decisions related to laryngeal cancer [7]. The model represents a causal structure in the form of a Bayesian network. The graph is constructed using an overall structure of modelling diseases which was a result of the exemplary modelling. The underlying metastructure groups information items falling into the same group. For example, one subgraph integrates all information relevant to the tumor classification. Only clinical data is considered in the graph. Using this metastructure, additional subgraphs could be integrated to include data from social media and wearable sensors into this graph. This requires establishing a corresponding subgraph for reflecting in our case the relevant information from social media and activity trackers. More specifically, we suggest

integrating one subgraph that comprises information on quality of life and behavior with data derived from medical social media. For example, this subgraph would contain nodes representing personal health perception, information on work, financial material wellbeing, personal safety, social relationships, emotional wellbeing, quality of environment, or hobbies (see Fig. 1). Another subgraph could reflect the fitness and activities. It integrates aggregated sensor data such as pulse, activity data, daily walking distance as a further extension. Nodes in these graphs will be instantiated with data collected (filtered and analysed) from social media and the activity trackers.

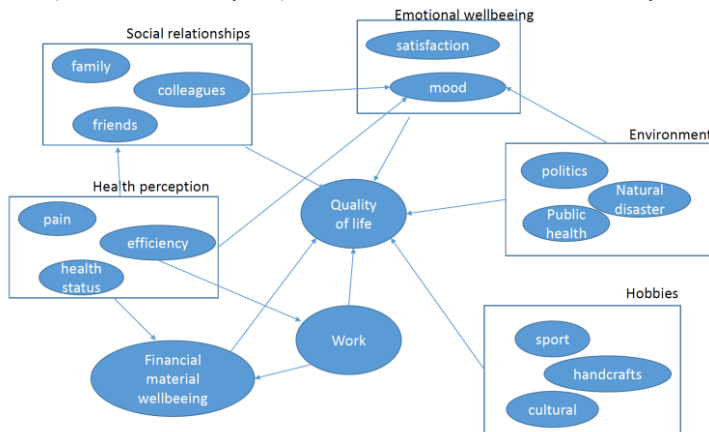


Fig. 1: Example subgraph for quality of life. Nodes of different categories represent the various factors that impact quality of life. For simplification, only few relationships are shown.

### 3. Requirements

Several requirements need to be addressed when realizing the above mentioned concept for clinical decision support. They can be grouped in three main categories.

**1) Collection and analysis of data:** Social media data and fitness tracker data need to be collected from the corresponding devices or sources. This requires actions from the patient side (e.g. posting information in a social media platform). Unstructured social media data needs to be processed, extracted and transformed into structured data that can be used to instantiate corresponding nodes in the patient model. Natural language processing methods are necessary to identify, analyse and process unstructured, free textual data, e.g. methods for extracting and categorizing relevant qualitative information as well as methods for linking diseases or symptoms to habits or treatments. Machine learning methods allow for automatic analysis, classification and clustering. Subjective information need to be interpreted, weighted and linked to objective clinical parameters. Fitness tracker and wearable sensors produce continuously data. To be useful, filtering and classification methods are required. This also includes methods for reasoning and inference to draw automatically conclusions and generate alerts. Methods need to be able to deal with data streams. Another challenge is semantic operability: it needs to be ensured that data from different sources can be integrated semantically in order not to lose or misinterpret information

**2) Data quality:** Exploiting social media and fitness tracker data in clinical decision making is only useful when data has a certain quality, i.e. is correct and time

stamped. It should be possible to determine the identity of the person who is providing the social media and tracker information. Additionally, methods are required to check and weight the reliability of the data. Associated with the reliability of data is a critical interpretation and judgement of the data.

**3) Modelling.** Regarding the modelling, the graphical structure needs to be fixed for each subgraph, i.e. the structure of a quality of life subgraph and a fitness and activity graph needs to be set up. On the other hand, probabilities need to be assigned which is difficult given the fact that there are almost no experiences on correlations between different quality of life factors. In particular it is still unclear, how quality of life and fitness impact on treatment decision. Integration of the new subgraphs with the disease-specific subgraphs is another challenge.

#### 4. Discussion and Conclusion

Through different social media sources and wearable devices, patient-collected clinical values (e.g. blood pressure, pulse, weight...), individual judgements on symptoms or efficacy of drugs and treatments, feelings and sentiments reflecting the health status are available. We suggest the concept of digital patient modelling as a mean to integrate the aggregated and filtered information from social media and sensors with clinical data. It is still unclear how this additional data impacts on decision making. An important issue is to be able to associate the data from social media and wearable sensors to a specific patient. The most efficient solution would be to use specific patient-doctor communication platforms for information provision. The data could then be directly collected from there and included into the model. In future work, the new subgraphs need to be developed and the usefulness of the additional data for patient care needs to be assessed. Once the patient-delivered data can be jointly analysed with clinical data, we are able to learn much more about influences of quality of life and fitness to the recovering process and to the patient's health.

#### References

- [1] D.J. Wile, R.Ranawaya, Z.H.T. Kiss: Smart watch accelerometry for analysis and diagnosis of tremor. *Journal of Neuroscience Methods* 230 (2014): 1-4
- [2] J. Juen, Q. Cheng, B. Schatz: A Natural Walking Monitor for Pulmonary Patients Using Mobile Phones. *IEEE Journal of biomedical and health informatics*, vol. 19, no. 4, 2015: 1399-1405
- [3] K. Denecke: *Health Web Science. Social Media Data for Healthcare*. Springer International Publishing Switzerland, 2015
- [4] Agnieszka Oniko and Marek J. Druzdel. Impact of precision of bayesian network parameters on accuracy of medical diagnostic systems. *Artif. Intell. Med.*, 57(3):197–206, March 2013.L.
- [5] L. Leibovici, M. Paul, AD. Nielsen, E. Tacconelli, and S. Andreassen. The treat project: decision support and prediction using causal probabilistic networks. *International Journal of Antimicrobial Agents*, 30 (Supplement 1):93–102, 2007.
- [6] M. Cypko, M. Stoehr, K. Denecke, A. Dietz, and H.U. Lemke. User interaction with MEBNS for large patient-specific treatment decision models with an example for laryngeal cancer. *Int J CARS, Volume 9 (Suppl 1)*, 2014.
- [7] M. Stöhr, M. Cypko, K. Denecke, HU. Lemke, A. Dietz. A model of the decision-making process: therapy of laryngeal cancer. *Int J Comput Assist Radiol Surg*. 2014;9(Suppl 1):217–8.
- [8] Moorhead, S. Anne, et al. "A new dimension of health care: systematic review of the uses, benefits, and limitations of social media for health communication." *J of medical Internet research* 15.4 (2013).
- [9] Velasco, Edward, et al. "Social Media and Internet-Based Data in Global Systems for Public Health Surveillance: A Systematic Review." *Milbank Quarterly* 92.1 (2014): 7-33.

# Development of an Online Platform to Support the Network of Caregivers of People with Dementia

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**Abstract.** In the Netherlands, care technology is used insufficiently to support people with dementia, their family and professional caregivers. In this project we integrate a range of services and applications into an online platform, with the aim to strengthen these networks and to support communication between their members. The prototype of the platform was made in an iterative user centered way. Semi structured (group) interviews were conducted to specify the requirements. The platform consists of ‘cubes’ with information about dementia (care), video communication options, a calendar and a care plan. The first prototype of the platform was valued by the participants, but privacy matters and registration issues were pointed out when using a shared care plan. Additional applications to monitor health and safety will be integrated in the second prototype. This prototype will be tested on its usability, feasibility and desirability during a pilot study in spring 2016.

**Keywords.** Assistive technology, dementia care, family care, online platform

## 1. Introduction

Worldwide, 47.5 million people have dementia [1] of which 260.000 live in the Netherlands. The number of people with dementia (PWD) is expected to rise significantly in the near future. According to Dutch government healthcare policy, people in need of care have to live at home for as long as possible. Seventy percent of the PWD live at home; 60% with and 40% without a partner or other family members [2]. Without a partner, PWD are dependent of children, friends and neighbors, but not everyone has such a social network [3]. As a result of the increase in the complexity of requests for help and at the same time a decrease in available healthcare professionals, care for PWD shifts from the formal towards the informal network. What are the implications of this transition? Based on research into the quality of care in the networks of community-dwelling PWD, the Dutch Health Care Inspectorate is seriously concerned about the neglect of PWD without a social network, the overload of family caregivers, the problems related to care planning, medication intake and

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continuity of care [4]. Therefore, it is a major challenge to strengthen these networks and the collaboration between formal and informal caregivers.

Online platforms to improve information exchange between healthcare professionals, PWD and their family caregivers as well as other forms of care technology can play an important role in helping PWD and their caregivers to maintain autonomy and continuity in their lives [5-8]. Therefore in this Network Support Dementia project we aim to integrate a range of services and applications into one platform, assuming that such integration will be beneficial.

Three care organizations and four companies were willing to integrate their services via one specific platform, which was already in use in the region to promote cohesion between citizens [9]. The available services of the companies were specifically related to providing information about dementia [10], information exchange between informal caregivers [11] and between family caregivers and healthcare professionals through web collaboration [12]. The design challenge was to provide a flexible platform and to realize custom solutions for different users with different needs and expectations in different settings. Therefore the following research questions were posed:

- Which problems encounter members of the (in) formal network while caring for PWD at home and which type of care technology could be supportive in reducing or eliminating these problems?
- What are the user requirements regarding the online platform; which services and applications should be included in this platform and how should they be presented?

## **2. Methods**

### *2.1. Design*

The two-year Network Support Dementia project started in March 2015. An iterative user-centered design method was used to integrate the services into the platform [13]. Semi-structured (group) interviews with family and professional caregivers were conducted, to specify the user requirements. The study was approved by the medical ethical committee of Zuyderland-Zuyd (15-N-122).

### *2.2. Participants*

Two groups of participants were interviewed, family caregivers of PWD and professional caregivers representing different disciplines. Family caregivers were found through the network of the researchers and via ‘dementia case managers’, in two municipalities in Limburg, the Netherlands. We selected informal caregivers with different characteristics: different relationships to the PWD (partners, siblings, children or neighbors), caregivers of people with different stages of dementia, whether or not resident with the PWD, and living closely or far away. Besides the care professionals, who were selected based on different disciplines and experience, we also interviewed two people with a coordinating role regarding informal care.

### 2.3. Data collection

In the first step nine semi-structured interviews with family caregivers and 15 with professional caregivers were conducted. The topic lists were based on former research into needs of family and professional caregivers of PWD (table 1) [14-16]. At the end of each interview, interviewees were asked to read a “use case” and give comments.

In the ‘use case’ the imaginary platform consisted of an overview of websites with relevant information about dementia (care) and community health and welfare services; video communication between different members of the network; a calendar and scheduling option for family caregivers and volunteers; a shared care plan to be used by both family and professional caregivers; opportunities for support of peers and volunteers; sensors, cameras and GPS surveillance; and a list of recommended apps for entertainment especially for people with cognitive disabilities.

**Table 1.** Interview topics

Family caregivers	Professional caregivers
Screening / general / personalized information	Overview of the network
Support for symptoms of dementia	Communication
Social contact / company / activities	Uniformity in work processes
Monitoring health and safety	Knowledge and expertise
Sharing information / communication/ therapy	Monitoring and evaluation

In the second step focus groups with nine family caregivers and seven professional caregivers were held. First, the results from the interviews were discussed briefly to confirm and complement the findings and then the first prototype of the platform was demonstrated. The platform consists of different ‘cubes’. Per cube participants were asked to answer the following questions on a feedback form: would you use this cube (yes/maybe/no, please explain), what do you like about this cube, what not and provide a ‘valuable tip’.

### 2.4. Data analyses

The interviews were transcribed verbatim and the data were analyzed following a directed content analysis method. The notes of focus groups together with the feedback forms were combined into one summary. General themes emerged and these themes were used as input for the user requirements document.

## 3. Results

### 3.1. The needs of the network of caregivers of PWD

Family caregivers - All nine family caregivers who were interviewed were female, with a mean age of 61 year (range 27 to 77). Four of them were daughters of the PWD; three were partners; one sister in law; and one neighbor. All interviewees indicated that good information provision is very important to fulfill their role of family caregiver. They specifically asked for information about how to deal with difficult behavior of the PWD. They also indicated that they could not find a clear and up-to-date overview of

locally available care facilities. Furthermore, several interviewees expressed their interest in contacts with fellow family caregivers. In many cases, day-care was seen as a good solution to relieve the family caregiver. Some interviewees were looking for suitable volunteers to support them. Besides finding appropriate activities for the PWD, creating a safe environment also proved a recurring theme for most interviewees. Finally, almost all interviewees mentioned the fact that different professional caregivers often ask the same questions and do not know what was previously agreed upon.

Professional caregivers - From the fifteen professional caregivers who were interviewed, twelve were female and three were male with a mean age of 48 year (range 22 to 69). They represented a variety of disciplines with eleven different functions: two General Practitioners (GP's), a home mentor, a counsellor specialized in care for the elderly, three coordinating nurses, two case managers dementia, a domestic assistant, two community nurses, a day activities coach, an employee of a care farm, a care and support consultant and a coordinator of volunteers. Interviewees indicated that because of this large diversity of professional caregivers involved in the care for PWD and the overlap in roles and responsibilities, in many cases they don't know who exactly is involved in a case. As a result, every professional separately identifies the health needs and establishes a care plan. Furthermore, most participants indicated that there is a shortage of information about current changes regarding medications, weight and hospitalization of the PWD, due to the use of different record systems. Most interviewees confirmed the key role of the GP in the care for PWD, but they indicated that it often proved difficult to involve the GP in multidisciplinary consultation because of time constraints and planning problems.

Most professional caregivers indicated that it would be a substantial improvement if they could access a database with information about dementia and treatment options, how to assess care needs of PWD and their family caregivers, assistive technology and a clear and up-to-date overview of locally available care facilities.

### *3.2. From use case to prototype*

The feedback on the use case was positive; family and professional caregivers indicated that such a platform would facilitate communication in the network. There were doubts about the use of one shared care plan because of privacy issues and most professional caregivers were critical about the extra registration time, because they also use the record system of their care organization. Furthermore, some family caregivers thought that clear instructions would be essential for those users with limited computer experience.

Subsequently, the first prototype of the platform was built. In the focus groups the following cubes in the prototype were presented: 'Dementia info', 'Contacts/Clients', 'Messages' and 'Forums', 'Calendar/Share Care', 'We Care', registration of health and care through 'My measurements', 'Medication' and 'Care notebook'. The first impressions of the prototype were also positive. Participants indicated that use of the platform would promote co-operation with other members of the network, this could improve the quality and efficiency of care. Remarks were made about the considerable overlap between the cubes. All participants stressed the importance of simplicity and several tips for improvement were given. All these user requirements were listed in a use requirements document, which was used during further development of the prototype.



#### 4. Discussion

This paper reports about the ongoing process of the user centered development of an online platform to support family and professional caregivers of PWD. Based on the results of the interviews and focus groups a prototype was built, which will be tested on its usability, feasibility and desirability during a pilot study in spring 2016. Participants were positive about the prototype, but there are still some barriers to overcome. Some services, such as providing information about local health and welfare services and monitoring of health and safety through the use of video cameras and sensor technology have not yet been realized within the platform. For a successful implementation, there are issues to be solved concerning privacy and integration with record systems of the different professional caregivers' organizations.

#### 5. Acknowledgments

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#### References

- [1] World Health Organization. 10 facts on dementia. Geneva, Switzerland: World Health Organization; 2015. Available from: <http://www.who.int/features/factfiles/dementia/en/>.
- [2] Alzheimer Nederland. Amersfoort, The Netherlands: Alzheimer Nederland; 2015. Available from: <http://www.alzheimer-nederland.nl/informatie.aspx>.
- [3] I. Zwart-Olde, M. Jacobs, M. van Groenou, M. Broese, M. van Wieringen, Caring together for community dwelling elderly; 2013. Available from: [www.fsu.vu.nl/zorgnetwerk/](http://www.fsu.vu.nl/zorgnetwerk/).
- [4] R. van Diemen-Steenvoorde, Organization care network of community dwelling people with dementia promising, yet some parts are still at risk. Utrecht, the Netherlands: The Health Care Inspectorate (IGZ); 2013.
- [5] Deltaplan Dementie. 2015. Available from: <http://www.deltaplandementie.nl/het-plan/betere-zorg-voor-mensen-met-dementie>.
- [6] K.M. Godwin, W.L. Mills, J.A. Anderson, M.E. Kunik, Technology-driven interventions for caregivers of persons with dementia: a systematic review. *Am J Alzheimers Dis Other Demen* **28** (2013), 216–222.
- [7] M. Mokhtari, H. Aloulou, T. Tiberghien, J. Biswas, D. Racocceanu, P. Yap, New trends to support independence in persons with mild dementia: a mini-review. *Gerontology* **58** (2012), 554–563.
- [8] J.P. Wherton, A.F. Monk, Technological opportunities for supporting people with dementia who are living at home. *Int J Hum Comput Stud* **66** (2008), 571–586.
- [9] Cubigo. 2015. Available from: <http://www.cubigo.com/>.
- [10] Dementiewijzer. 2015. Available from: <http://www.sanenet.nl/dementiewijzer.html>.
- [11] Sharecare. 2015. Available from: <http://www.sharecare.nl>.
- [12] ZoemEurope. 2015. Available from: <http://www.zoemeurope.eu/>.
- [13] S.G. Shah, I. Robinson, User involvement in healthcare technology development and assessment: structured literature review. *Int J Health Care Qual Assur* **19** (2006), 500–515.
- [14] J. Peeters, W. Werkman, A.L. Francke, Dementia monitor Family Care. Utrecht, The Netherlands: NIVEL 2013. Available from: <http://www.nivel.nl/sites/default/files/bestanden/Deelrapportage-1-Kwaliteit-dementiezorg.pdf>
- [15] M. Jacobs, M.B. van Groenou, D. Deeg, Consultation between caregivers and formal caregivers of community-dwelling elderly. *Tijdschr Gerontol Geriatr* **45** (2014), 69–81.
- [16] T. Sugihara, T. Fujinami, R. Phaal, Y. Ikawa, A technology roadmap of assistive technologies for dementia care in Japan. *Dementia* **14** (2015), 80–103.

# Social Media Use Among Nurses: Literature Review

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**Abstract.** *Aim* The scope of the research was to increase the understanding of social media's influence among nurses while highlighting gaps in the literature and areas for further research. *Methods:* The search of PubMed database was performed in November 2015, using terms to identify peer-reviewed articles that describe the use of social media for nursing students or nurse practitioners. A systematic approach was used to retrieve papers and extract relevant data. *Results:* There were identified 23 full text articles involving social media and nurse-related terminology. The majority of the studies were interventional (n=20) that assessed social media as a teaching tool. Podcasts, Multiplayer virtual worlds and mixed social media platforms has also been assessed. *Conclusion:* Social media is used as a tool of information for nurses mainly as the means for engaging and communicating.

**Keywords.** Social media, nurse, nursing students, Blogging.

## 1. Introduction

Through online technologies, it is possible for stakeholders to share health knowledge regardless of geographical constraints, thus encouraging the advancement of knowledge in health and other fields. A literature review of online strategies for knowledge translation showed that knowledge translation is becoming a critical component of the healthcare field, and online technologies are emerging as a key facilitator of efficient and timely knowledge exchange [1].

Social media websites can be classified by Kaplan and Haenlein according to the degree of "social presence" and the degree of "media richness" they hold [2]. According to a literature review social media offers a mechanism for enhancing the education and expanding the knowledge base of students regarding privacy, ethics, health policy, professionalism, and communication, also, it assists nurses in building an earlier professional identity and connection with the profession [3].

The nursing blogosphere is continuously growing. Nurse bloggers share information about case studies of interventions or queried other healthcare professionals about experiences [4]. The blogosphere is involved in the healthcare professional's education, but pedagogical applications of blogging besides the communication of information seem to be scarce within nursing education since research on how blogging stimulates collaborative learning or enhances student engagement and learning is limited [5].

Multiplayer virtual worlds are highly accepted by students, appear to provide learning benefits that align with other models of simulation and are seen have a major place in nursing curricula [6].

The scope of the research is to understand the influence of social media and the importance of nurse's social media usage context in retrieving medical information.

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## 2. Methods

A systematic review followed the Preferred Reporting Items for Systemic Reviews and a Meta-Analyses (PRISMA) guideline [7] was conducted. Studies that described social media, examining relationships between participants through social media usage, stored in PubMed were analyzed.

### 2.1. Criteria for considering studies

Studies in English were included if they reported primary or secondary research, with analytic quantitative designs used to answer whether social media is effective for nurses use, and to provide context to attributes that may contribute to the effectiveness or lack of effectiveness of the tools being studied. This may include: interventional/experimental (engaging the nurse via social media platforms) and observational (data observing nurse's social media behaviors) studies. Social media was defined according to Kaplan and Haenlein's classification scheme [2], including: collaborative projects, blogs or microblogs, content communities, social networking sites, and virtual worlds.

The sample must have included only nurses, nursing students, nursing university staff or midwives, all social media users, all genders, age groups and participants from any racial, ethnic, cultural or religious groups will be eligible for inclusion, regardless of location.

Were excluded studies that examined mobile health (e.g., tracking or medical reference apps), and real-time exchanges mediated by technology (e.g., Skype, chat rooms) [8]. Were excluded any studies that were not available in English.

### 2.2. Search strategy

The PubMed database was searched by November 2015 for relevant articles using 2 search queries (Figure 1). The search was undertaken and included papers published up to then.



Figure 1. PubMed search strategy A (left-hand) and B (right hand)

### 2.3. Selection of studies

Data was extracted using home-made standardized forms and any duplicates were removed. In the first round of screening, titles and abstracts were screened for inclusion. Following preliminary screening, eligibility was assessed through full-text screening.

A data extraction form was developed and pilot-tested on a randomly selected subsection of studies. The data extraction form ensured that the review extracts pertinent data to provide a comprehensive synthesis of the literature regarding social media analysis of medical information usage. As per the PRISMA guidelines, data was extracted from each study that meets the inclusion criteria, including: participants; interventions; results; social media analysis methodology [7]. The extraction was done independently by the two reviewers and a consensus extracted data was analyzed.

### 2.4. Analysis

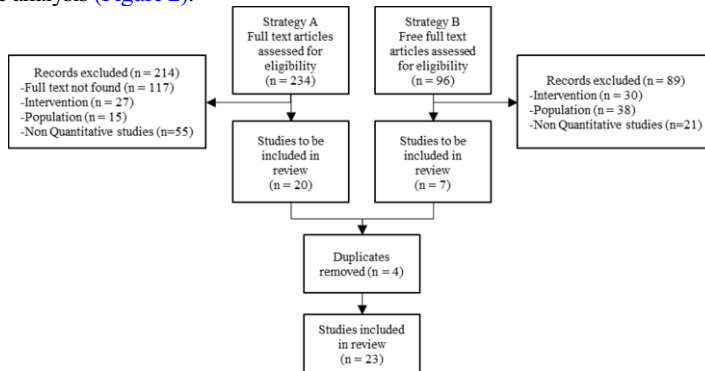
Qualitative, quantitative, and mixed-method data that meets the inclusion criteria for the review, including methodological rigor, credibility, and quality standards as outlined, were described and synthesized using narrative synthesis [9]. Results were presented using a number of outcome

statistics where possible to address each research question.

The narrative synthesis of evidence is expected to be reported, highlighting the key outcomes and addressing the research questions. In order to avoid potential biases, key points of difference between studies were identified.

### 3. Results

A total of 958 studies involving social media, medical information and nurse-related subject headings (MeSH) terminology. Studies not nurse-only-specific (e.g. patient or mixed healthcare providers), those who did not involve social media (e.g. mobile applications, e-learning modules) or those to which the full text was not available were excluded. Twenty-five studies were finally included in the analysis (Figure 2).



**Figure 2.** PRISMA flow diagram of selection procedure Strategy A and B

The largest number of original research studies were published in 2013 and 2014 (21.74% – 95%CI [8.88-43.29]).

Podcasts (34.78% – 95%CI [17.58-56.33]), Multiplayer virtual worlds (26.09% – 95%CI [8.88-47.64]), mixed social media platforms (17.39% – 95%CI [4.54-38.94]), Blogs (13.04% – 95%CI [4.54-34.59]) were the social media platforms identified as being used most. Facebook and wikis were used in one research each.

The highest percent of studies addressed nursing students (73.91% – 95%CI [52.36-91.12]).

Percentage of interventional proved significantly higher compared to the percentage of observational studies ( $Z=-8.4264$ ,  $p<0.0001$ ).

The investigated samples varied from 7 to 676 with a median of 31.5 (IQR (31.5-152.25)) for interventional studies and the sample size varied from 52 to 665 with a median of 276.5 (IQR (276.5-595.75) for observational studies; the difference not being statistically significant (Mann Whitney test: statistic = -1.4133,  $p=0.1576$ ).

### 4. Discussion

Over time, with the emerging of social media, nurse faculties were no longer considered to be the gatekeepers of all nursing content [10]. The majority of the studies in this systematic review were interventional, despite the gap of this type of articles that was previously highlighted by the literature [6]. As most of the studies were addressing students, the outcomes assessed were the results of training through social media platforms.

Podcasts, used as teaching method among nursing students were rated as being helpful learning tools [11,12], especially for students with long-distance commutes or by students with

English as Second Language, studying in English speaking countries [13], and were associated with improved exam performance [11]. The use of podcasts was found to be consistent with the learning styles of nurses and was a demonstrated and valuable educational resource to review, reinforce, and clarify difficult concepts [14].

The papers addressing nursing students and virtual social worlds showed that synchronous online learning had the potential to increase student engagement, which could facilitate learning [15,16], independent of race and ethnicity [17]. A study [18] performed on nurses suggested a potential benefit in using peer storytelling sessions in a Virtual Social World to facilitate emotion expressing. The findings of this review are in line with previous observations [6].

Adding to what was already known about blogs [4,5], it was shown that the use of blogs could support international educational partnerships and the globalization of the curricula [19] and provided the opportunity to enable nursing students to engage in writing reflection, feedback, and having more interactions with others [20]. The observational studies were used to better understand how social media was used.

Among nurses [21] and nursing students [22], there were identified concerns regarding the adoption of Web 2.0 tools like: usefulness, advantages, compatibility, technology availability, resource facilitating conditions and peer, hospital, and senior management attitude.

Among the nursing teaching staff, efforts were made to confront the new challenges posed by social networks to train the professionals. It was demonstrated to be fundamental the staff's skills in managing these tools [23].

The strengths of the paper lie in the comprehensive and systematic approach of the literature review. Nevertheless, there are limitations to this systematic review that warrant considering. First, it is possible that, despite the attempts to capture all pertinent articles through the use of numerous carefully selected search terms, some relevant studies may have unintentionally been excluded. It is possible that studies pertinent to this review may have been missed as a result of keywords used in the article selection process. Secondly, another potential limitation of the study is the deliberate and detailed approach to reviewing only full-text articles, may have excluded relevant articles. However, trends for use of social media within nurses and nursing students were observed, as described above.

Understanding how nurses and nurses-to-be use social media can enable the development of new online-friendly engaging tools. Further exploration and development of these strategies into building effective knowledge platforms that can positively impact the sharing process is warranted.

## 5. Conclusions

Most studies done to date have been interventional, examining the engagement through social media and the resulting implications.

Although many institutions remain timid about the use of social media, this review demonstrates that social media is being used for a variety of purposes and in a number of different ways to engage and educate nurses and they seem to happily accept them educational tools. Nursing faculties should elaborate guidelines based on matching the technology used by students to the level of access, and faculty staff competences. When elaborating such guidelines, it should be taken into account the Nursing National and International Organizations' already existing guidelines on professional usage and privacy issues.

## References

- [1] K. Mairs, H. McNeil, J. McLeod, J. Prorok and P. Stolee, "Online strategies to facilitate health-

- related knowledge transfer: a systematic search and review," *Health Info Libr J*, vol. 30, no. 4, pp. 261-77, Dec 2013.
- [2] A. M. Kaplan and M. Haenlein, "Users of the world, unite! The challenges and opportunities of Social Media," *Business Horizons*, no. 53, pp. 59 - 68, 2010.
  - [3] T. Schmitt, S. Sims-Giddens and R. Booth, "Social media use in nursing education," *Online J Issues Nurs*, vol. 17, no. 3, p. 2, 2012.
  - [4] J. Watson, "The rise of blogs in nursing practice," *Clin J Oncol Nurs.*, vol. 16, no. 2, pp. 215-7, 2012.
  - [5] M. Garrity, K. Jones, K. VanderZwan, A. de la Rocha and I. Epstein, "Integrative review of blogging: implications for nursing education," *J Nurs Educ*, vol. 53, no. 7, pp. 395-401, 2014.
  - [6] R. Cant and S. Cooper, "Simulation in the Internet age: the place of web-based simulation in nursing education. An integrative review," *Nurse Educ Today*, vol. 34, no. 12, pp. 1435-42, 2014.
  - [7] D. Moher, A. Liberati, J. Tetzlaff, D. Altman and The Prisma Group, "Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement," *PLoS Med*, 2009.
  - [8] M. Hamm, A. Chisholm, J. Shulhan, A. Milne, S. Scott, L. Given and L. Hartling, "Social media use among patients and caregivers: a scoping review," *BMJ Open*, vol. 3, no. 5, 2013.
  - [9] J. Popay, H. Roberts, A. Sowden, M. Petticrew, L. Arai, M. Rodgers, N. Britten, K. Roen and S. Duffy, "Guidance on the conduct of narrative synthesis in systematic reviews," *A product from the ESRC Methods Programme Version*, vol. 1, pp. 1-92, 2006.
  - [10] G. Marrocco, M. Kazer and L. Neal-Boylan, "Transformational learning in graduate nurse education through podcasting," *Nurs Educ Perspect*, vol. 35, no. 1, pp. 49-53., 2014.
  - [11] A. Mostyn, C. Jenkinson, D. McCormick, O. Meade and J. Lynn, "An exploration of student experiences of using biology podcasts in nursing training," *BMC Medical Education*, vol. 13, no. 12, 2013.
  - [12] K. Abate, "The effect of podcast lectures on nursing students' knowledge retention and application," *Nurs Educ Perspect*, vol. 34, no. 3, pp. 182-5, 2013.
  - [13] F. Rogan and C. San Miguel, "Improving clinical communication of students with English as a second language (ESL) using online technology: a small scale evaluation study," *Nurse Educ Pract*, vol. 13, no. 5, pp. 40-6, 2013.
  - [14] C. Blum, J. Kamciyan and A. Dean, "Stakeholder Focus Groups to Inform a Technology-Based Strategy of Preceptor Support," *Nurs Res Pract*, 2012.
  - [15] F. Claman, "The impact of multiuser virtual environments on student engagement," *Nurse Educ Pract*, vol. 15, no. 1, pp. 13-6, 2015.
  - [16] J. Giddens, D. Hrabe, L. Carlson-Sabelli, L. Fogg and S. North, "The impact of a virtual community on student engagement and academic performance among baccalaureate nursing students," *J Prof Nurs*, vol. 28, no. 5, pp. 284-90, 2012.
  - [17] L. Fogg, L. Carlson-Sabelli, K. Carlson and J. Giddens, "The perceived benefits of a virtual community: effects of learning style, race, ethnicity, and frequency of use on nursing students," *Nurs Educ Perspect*, vol. 34, no. 6, pp. 39-4, 2013.
  - [18] K. Rice, M. Bennett and L. Billingsley, "Using Second Life to Facilitate Peer Storytelling for Grieving Oncology Nurses," *Ochsner J.*, vol. 14, no. 4, p. 551-562, 2014.
  - [19] B. Garrett and R. Cutting, "Using social media to promote international student partnerships," *Nurse Educ Pract*, vol. 12, no. 6, pp. 340-5, 2012.
  - [20] K. Lin and Y. Shen, "The nursing students' attitude toward using blogs in a nursing clinical practicum in Taiwan: a 3-R framework," *Nurse Educ Today*, vol. 33, no. 9, pp. 1079-82, 2013.
  - [21] D. Wolf, B. Anton and J. Wenskovich, "Promoting health and safety virtually: key recommendations for occupational health nurses," *Workplace Health Saf*, vol. 62, no. 7, pp. 32-6, 2014.
  - [22] D. Morley, "Supporting student nurses in practice with additional online communication tools," *Nurse Educ Pract*, vol. 14, no. 1, pp. 69-75, 2014.
  - [23] J. Fernández-Alemán, A. Sánchez García, M. López Montesinos, P. Marqués-Sánchez, E. Bayón Darkistade and F. Pérez Rivera, "Exploring the Use of information and communication technologies and social networks among university nursing faculty staff. An opinion survey," *Investigación y Educación en Enfermería*, vol. 32, no. 3, 2014.

# Patient Participation in Chronic Pain Management Through Social Media: A Clinical Study

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**Abstract.** Chronic pain places a significant burden on individuals as well as health services. Long wait lists to access public clinical pain management services can result, and health outcomes deteriorate. Innovative technologies, such as social media provide opportunities to support self-management within the participatory health framework. This paper aims to investigate patients' perceptions towards using social media while waiting for clinic access, with a particular focus on therapeutic affordances. Seventeen wait-listed patients underwent intervention using various social media resources as part of self-management. Thematic content analysis of semi-structured interviews examined patients' perceptions about social media use and participation. Three therapeutic affordances were most evident in the qualitative data: exploration, connection and narration. Barriers to participation were also identified, such as 'specificity of the resources'. Findings suggest social media are perceived positively. However, there is also the need to balance a desire to deliver evidence-based practice with patient-preferences in shared-decision making about social media use.

**Keywords.** Chronic Pain; Chronic Disease; Participatory Health; Patient-Reported Outcomes; Self-Management; Social Media; Thematic Content Analysis; Therapeutic Affordances

## 1. Introduction

Chronic pain is a serious burden for individuals and healthcare services [1, 2]. Patient-reported outcomes (PROs) may deteriorate as people wait (often up to 6 months in Australia) for access to specialized multidisciplinary pain management clinics [2, 3].

Innovations with web-based interventions to manage chronic pain have been described [1, 3, 8]. These include social media [9-11]. Social media can be distinguished from other types of web-based interventions by the use of tools to facilitate increased autonomy in user options, engagement in content creation, and interaction with other users, including peer to peer [12, 13]. These functionalities may contribute to patient self-efficacy and empowerment [1, 14-16]. They may give healthcare services the ability to individualize management, reach large diverse populations, and provide out-of-hours support [1, 17].

To date, very few studies have focused on patients' motivations and experiences in using different social media or actively involved patients in the design process [19]. Recent theoretical and empirical work [20-23] has shown clear therapeutic affordances of social media amongst PWCP. To establish a role for social media in self-

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management of chronic pain requires greater patient input within the participatory health paradigm, acknowledging that there are synergies between the functionalities of social media and the individualized needs of patients [24].

Therefore, the aim of this paper is to examine therapeutic affordances of social media that were described by patients within a clinical program of chronic pain management. The authors theorize that the different ways individuals choose to use social media will generate different health outcomes. Greater knowledge in this area may improve patients' and clinicians' decision-making about how to use social media in pain management.

## **2. Methods**

A pilot study implemented a social media intervention for people with chronic pain on the waiting list for a specialized pain service. This paper reports on qualitative research conducted within the project. The Human Research Ethics Committees of Melbourne Health and the University of Melbourne approved this study (ID No. 2014.043).

### *2.1. Recruitment*

Study setting was a large public hospital in Australia serving approximately 900-1100 outpatient referrals a year. There are usually 200-300 PWCP wait-listed, and wait times can be up to 6-8 months for the first appointment. Inclusion criteria included: competent in English, regular Internet access with competent usage abilities [25], medically stable, willing to register with Gmail and Facebook, and not currently undertaking an online intervention and/or using social media for pain management. Exclusion criteria included: change in priority status (i.e. intervention required immediately) or being discharged from the waiting list.

### *2.2. The Intervention*

General chronic pain social media resources rather than resources specific to any one condition were used in this study. This was deliberate and followed an evidence-based practice approach to holistic chronic pain management, which focuses on a general multi-faceted approach to pain, rather than disease specific avenues [8]. Pre-existing social media resources were used in this study, including a large chronic pain support community on Facebook, various chronic pain blogs and YouTube pain management videos. Patients were requested to interact with the suggested pain based social media resources autonomously during the study period. All study investigators (including pain clinicians) reviewed and agreed upon the selection of resources. Participants received an email from the primary investigator, with links to the suggested social media resources and instructional information about how to get started and for using forms of social media that they might not be familiar with. The intervention ran for 12 weeks with participants commencing at different times because of staggered recruitment.

### *2.3 Data Collection and Analysis*

Qualitative data was collected at monthly intervals via semi-structured phone interviews. Interviews were brief (10-15 minutes), giving patients the opportunity to



discuss participation and study progress free of coercion. Interview data were analyzed using thematic content analysis (TCA). Firstly, to categorize data according to five therapeutic affordances: a) self-presentation – interaction preferences regarding one’s online identity, b) connection – connecting with others via social media c) exploration – being guided to useful information, d) narration – the shared experience of chronic pain and finally, e) adaptation - motivation, frequency and type of use. Secondly, to examine any emergent themes surrounding barriers to participation.

### 3. Results

#### 3.1 Participation in the Study

17 chronic pain patients were enrolled into the study. There were slightly more females than males (10/17, 59%) and age was spread, with 13/17 (76%) between 18-39 years old, and only 1 patient aged older than 50. 10/17 (59%) were never married and level of education varied, with 9/17 (53%) completing high school or less and 8/17 (47%) obtaining a university degree or greater. Work status showed over half were not working due to their health (9/17, 53%). 16/17 were contactable during the study (a 94.1% success rate). Of these, 12/17 (70.6%) said they had engaged with the resources. In total, 9.5 hours of qualitative data was collected from 38 phone interviews.

#### 3.2 Therapeutic Affordances of Social Media

35 quotes were tabulated and categorized according to therapeutic affordance; sample quotes are included here. No quotes were negative about social media use and no adverse events were reported. The “exploration” affordance was most noted in quotes (20/35, 57.1%), followed by “connection” (7/35, 20%), “narration” (5/35, 14.3%) and “adaptation” (3/35, 8.6%). No qualitative semi-structured interview data described “self-presentation”.

Descriptive language describing “exploration” included: finding, watching, searching, exploring. Using social media to consume information, and precipitating learning about managing the underlying condition. As SM034 stated: *“I watch a video and all of a sudden I learn something new and I’m like ‘wow’, I didn’t know that!”*. Also described was the utility of using the social media resources to filter useful information/guide towards other management strategies.

Value of the “connection” affordance was supported, with ‘support’ the primary underlying reason suggested for connecting with others via social media. Language used included: connecting, listening, supporting and communicating. SM028 suggested that *“...you feel really connected to other people and supported to do something to help the situation”*.

“Narration” comments described the emotionally cathartic effect of sharing experiences with others. This was entirely skewed towards engaging with the experiences of others. Descriptive language used included: experiences, stories and therapeutic. SM077 said *“it’s good to see this side of things in the videos and learn what other people are going through and suggest”*.

Comments pertaining to “adaptation” demonstrated how patients were able to change their self-management behaviors and social media use dependent on their unique needs at different points in time. These were described using language as

follows: when pain is bad, drowsy, concentrate and when I'm in a hurry. For example: *"I find too much text to read makes it hard to concentrate when the pain is bad or if my meds make me drowsy. Video content is easier to digest"* (SM034).

### 3.3 Barriers to Participation

Most reported barriers to participation were: being time poor (7/17, 41%), low specificity of resources to patient's own condition (6/17, 35%) and effects of medication on patient concentration (4/17, 24%). Once participant captured the essence of resource specificity: *"I have a more localized pain condition and most of the resources were for generalized conditions so I had trouble relating to many of them"* (SM021).

## 4. Discussion

The findings of the present clinical study validate previous findings into therapeutic affordances of social media [21, 22]. The findings also highlight that certain factors can interfere with reaping the benefits of therapeutic affordances of social media. Lack of time, effects of medication and lack of personal relevance are human factors rather than reflections of the functionality of social media tools.

The present study tried to replicate social media use in everyday life, that is, free of coercion (i.e. engaging, autonomous, collaborative and participatory) rather than to deliver a regimented online intervention directing what patients are required to engage with and how. This study is thus aligned with participatory models of healthcare, suggesting rather than prescribing online resources to place greater emphasis on the patient's preferences and perceptions for their management. However, this does then mean study findings are open to analytical bias. This is because freer participant choice as to which resources could be used meant the research team could not clearly verify exactly which resources patients used. The challenge for future research is to balance evidence based practice with patient preferences in shared decision-making between clinicians and patients about social media use [16].

## 5. Conclusion

Results suggest social media use in chronic pain management is perceived positively. Knowing which therapeutic affordances underlie social media use will lead to more personalized and tailored social media use, and ultimately improve health outcomes. However, further larger scale clinical trials and longitudinal follow-up is warranted. Findings also show patients have differing perceptions regarding social media's therapeutic utility. In the future, social media resources must resonate with patients on an individualized level for them to be more accepted and useful. This will influence shared-decision making.

## References

- [1] E.G. Mann, S. Lefort, E.G. Vandenberg, Self-management interventions for chronic pain. *Pain Manag* (2013), 3(3): p. 211-22.

- [2] M.N. Hogg, S. Gibson, A. Helou, J. DeGabriele, M.J. Farrell, Waiting in pain: a systematic investigation into the provision of persistent pain services in Australia. *Med J Aust* (2012), **196**(6): p. 386-90.
- [3] M.E. Lynch, F. Campbell, A.J. Clark, et al, A systematic review of the effect of waiting for treatment for chronic pain. *Pain* (2008), **136**(1-2): p. 97-116.
- [4] A.L. Burke, L.A. Denson, J.L. Mathias, M.N. Hogg, An analysis of multidisciplinary staffing levels and clinical activity in Australian tertiary persistent pain services. *Pain Med* (2015).
- [5] J. Barlow, C. Wright, J. Sheasby, A. Turner, J. Hainsworth, Self-management approaches for people with chronic conditions: a review. *Patient Educ Couns* (2002), **48**(2): p. 177-87.
- [6] D.B. Reuben, M.E. Tinetti, Goal-Oriented Patient Care - An Alternative Health Outcomes Paradigm. *New England Journal of Medicine* (2012), **366**(9): p. 777-779.
- [7] C.F. van Uden-Kraan, C.F. Drossaert, E. Taal, et al, Empowering processes and outcomes of participation in online support groups for patients with breast cancer, arthritis, or fibromyalgia. *Qual Health Res* (2008), **18**(3): p. 405-17.
- [8] T.J. Semple, M.N. Hogg, Waiting in pain. *Med J Aust* (2012), **196**(6): p. 372-3.
- [9] K. Rodham, C. McCabe, D. Blake, Seeking support: An interpretative phenomenological analysis of an internet message board for people with Complex Regional Pain Syndrome. *Psychology & Health* (2009), **24**(6): p. 619-634.
- [10] P.J. Schulz, S. Rubinelli, G. Mariotti, N. Keller, Meeting the ranging of informational needs of chronic low back pain sufferers: conceptual design and rationale of the interactive website ONESELF. *Disabil Rehabil* (2009), **31**(25): p. 2118-24.
- [11] L.S. Ruchman, P. Karoly, C. Enders, A randomized controlled evaluation of an online chronic pain self management program. *Pain* (2012), **153**(2): p. 319-30.
- [12] B.W. Hesse, M. O'Connell, E.M. Auguston, et al, Realizing the promise of Web 2.0: engaging community intelligence. *J Health Commun* (2011), **16** Suppl 1: p. 10-31.
- [13] R. Schein, K. Wilson, J. Keelan, Literature review on effectiveness of the use of social media. *A Report for Peel Public Health*. Ontario, Canada (2010), p. 63.
- [14] M.N. Kamel Boulos, S. Wheeler, The emerging Web 2.0 social software: an enabling suite of sociable technologies in health and health care education. *Health Info Libr J* (2007), **24**(1): p. 2-23.
- [15] P. Glasziou, B. Haynes, The paths from research to improved health outcomes. *ACP J Club* (2005), **142**(2): p. A8-10.
- [16] F. Martin-Sanchez, G. Lopez-Campos, K. Gray, Chapter 11 - Biomedical Informatics Methods for Personalized Medicine and Participatory Health, in *Methods in Biomedical Informatics*, I.N. Sarkar, Editor, (2014), *Academic Press: Oxford*. p. 347-394.
- [17] D.C. Nevedal, C. Wang, L. Oberleitner, et al, Effects of an individually tailored web-based chronic pain management program on pain severity, psychological health, and functioning. *J Med Internet Res* (2013), **15**(9): p. e201.
- [18] C.A. Maher, L.K. Lewis, K. Ferrar, et al, Are health behavior change interventions that use online social networks effective? A systematic review. *J Med Internet Res* (2014), **16**(2): p. e40.
- [19] D. deBronkart, From patient centred to people powered: autonomy on the rise. *BMJ* (2015), Vol. 350.
- [20] M. Merolli, K. Gray, F. Martin-Sanchez F, Developing a Framework to Generate Evidence of Health Outcomes From Social Media Use in Chronic Disease Management. *Med 2.0* (2013), **2**(2): p. e3.
- [21] M. Merolli, K. Gray, F. Martin-Sanchez F, Therapeutic Affordances of Social Media: Emergent Themes From a Global Online Survey of People With Chronic Pain. *J Med Internet Res* (2014), **16**(12): p. e284.
- [22] M. Merolli, K. Gray, F. Martin-Sanchez F, G. Lopez-Campos, Patient-Reported Outcomes and Therapeutic Affordances of Social Media: Findings From a Global Online Survey of People With Chronic Pain. *J Med Internet Res* (2015), **17**(1): p. e20.
- [23] M. Merolli, K. Gray, F. Martin-Sanchez F, S. Mantopoulos, M. Hogg, Using Social Media While Waiting in Pain: A Clinical 12-Week Longitudinal Pilot Study. *JMIR Res Protoc* (2015), **4**(3): p. e101
- [24] J.B. Weiss, E.S. Berner, K.B. Johnson, et al, Recommendations for the design, implementation and evaluation of social support in online communities, networks, and groups. *J Biomed Inform* (2013), **46**(6): p. 970-6.
- [25] Eurostat, Community Survey on ICT usage in households and by individuals. 2011: Luxembourg. Archived at: <http://www.webcitation.org/6XmD21FSN>

# Consumer Health Informatics in the Context of Engaged Citizens and eHealth Services – A new CHI Meta Model

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**Abstract.** Consumer Health Informatics (CHI) is a relatively new and interdisciplinary field in Medical Informatics. It focuses on consumer- rather than professional-centered services. However, the definitions and understanding of a) *what is a “consumer”?* or b) *what is health technology in the context of CHI?* and c) *what factors and actors influence the usage of eHealth services?* vary widely. The CHI special interest group (SIG) – associated with the German Association for Medical Informatics, Biometry and Epidemiology – conducted two workshops in 2015 to improve the common understanding on these topics. The workshop outcomes, the derived CHI-specific meta model and examples how to apply this model are presented in this paper. The model supports the definition of multi-actor contexts, as it not solely reflects the conventional patient-physician relationship but also allows for the description of second health market providers.

**Keywords.** Consumer Health Informatics, eHealth, Meta Model

## 1. Introduction

During recent years, a shift in technology towards mobility and its implications on the patient-physician relationship has been observed [1]. Nowadays, sensor-equipped smartphones enable *consumers* to keep track on their daily activities, measure calorie intake, duration of sleep etc. [2]. This phenomenon is often referred to as “Quantified Self” [3] and expresses a pro-active lifestyle of individuals. Mobile health services are a huge trend: According to *HealthOn*, worldwide over 170,000 health apps exist [4] which provide health-related information and services to users. Forecasts predict that until 2017 about 1.7 billion people will use such services [5]. The market for wearable health devices, such as fitness trackers, smart watches or smart contact lenses, is expected to be worth over 32 billion USD by 2019 [6]. In this context, Consumer Health Informatics (CHI) aims to analyze consumers’ information needs and to integrate their preferences into medical information systems [7]. According to recently published CHI definitions [8], modern information technology should be used to support and empower consumers to manage and make decisions about their own health.

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However, the aforementioned technological shift also raises new research questions. The first question revolves around potential users' needs, wishes and expectations with respect to eHealth services. This is crucial to avoid unsuited software and hardware devices which do not meet these criteria. Second, the (pro-active) target group for eHealth-enabled services needs to be analyzed, for instance by conducting user satisfaction studies. Third, in the domain of eHealth services, the understanding of the term "consumer" is still open for debate<sup>2</sup>. The distinction between *consumer* and *patient* is diffuse or may even be non-existent when technology or related providers are involved.

In 2015, the German SIG Consumer Health Informatics conducted two workshops in which several multidisciplinary Medical and Health Informatics experts discussed their understanding and experience in this field. As a result, a new meta model was defined to reflect CHI actors and their associated relationships. Furthermore, potential barriers for the usage of consumer-oriented eHealth services have been identified. The proposed model can be used to express both (a) relationships and (b) influencing factors.

## 2. Methods

The first workshop was conducted during the 26<sup>th</sup> *Medical Informatics Europe* conference in Madrid and brought together several international experts ( $n=23$ ). Participants discussed the usage of consumer-centric eHealth services in their respective countries. They were encouraged to brainstorm on barriers and facilitators in small groups moderated by SIG members. The primary results were condensed into a workshop report [9]. The second workshop took place during the annual GMDS conference in Germany in September 2015. The workshop attendees ( $n=12$ ) reviewed the findings of the previous workshop. Thereby, early definitions and relationships between four major actors, i.e., consumer – provider – service – technology, could be sharpened and refined. Based on these actors, a new CHI meta model emerged. Factors which influence pairwise interactions among actors were weighted during an open vote at the end of the workshop. For this step, every participant could allocate 1, 2 or 3 points to each diminishing factor (with 3 being perceived as the most relevant barrier).

## 3. Results

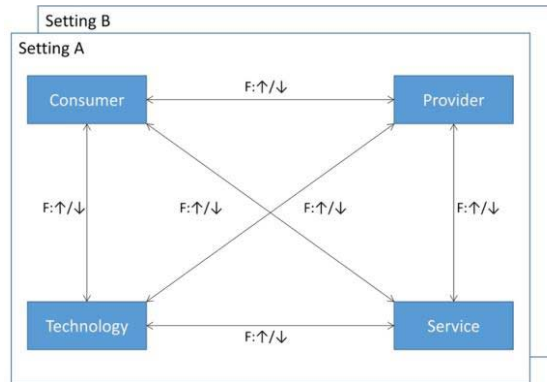
During the workshops, participants developed a common understanding of the terms and relationships presented in the following section.

### 3.1. Definitions & CHI Meta Model

Given a legal and financial **setting**, every citizen or user of health-supporting technology is considered a **Consumer (C)**, is able to choose, to trust and to use a particular service. According to [10], consumers can be divided into three main categories: a) healthy citizens with an interest in personal health and prevention b) citizens with a non-persistent disease, i.e., patients, or c) chronically ill patients.

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<sup>2</sup> This was encountered by the authors during several workshop discussions.



**Figure 1:** The proposed CHI meta model contains four actors applicable in different settings (here: A/B). Edges represent inter-actor relationships influenced in a positive or negative direction by certain factors F.

**Technology (T)** is utilized to gain access to health services. This can be smartphones, web browsers or printed brochures as well. A **Provider (P)** supplies any kind of health service which consumers have access to. Such a **Service (S)** is implemented, offered, maintained, controlled, etc. by one or more providers.

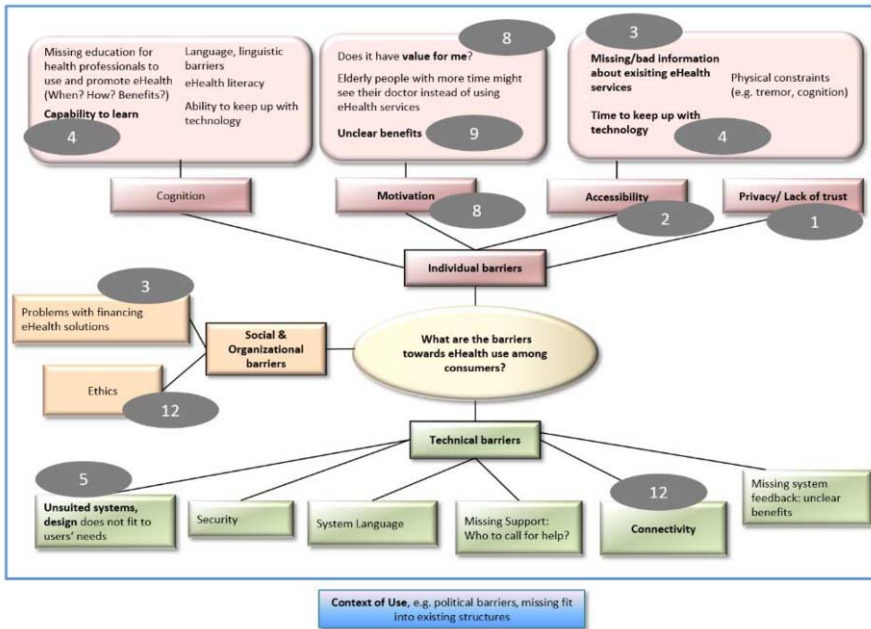
Given the model presented in Figure 1, there is no limitation with regard to the implemented type of health service. Any digital or conventional service offered to consumers fits into this CHI-specific model. Edges between actors represent factors (**F**) which influence the pair-wise relations. Such factors can influence the corresponding relation in a positive (“facilitator”) or negative (“barrier”) direction.

In this context, it is important to understand that most healthcare system stakeholders, businesses and institutions are mainly engaged in the first healthcare market. This core area of the healthcare industry includes reimbursable drugs or hospital treatments. However, CHI extends the focus to the second health market which includes for example new goods related to health such as fitness, wellness, sports, OTC (over the counter) drugs or personal health services of physicians.

The second health market is primarily financed by private payments of consumers and includes services such as wellness, privately purchased medical devices and assistance systems. According to [11], CHI technology should support the following strategic objectives for each type of consumer: For group a) *healthy citizens*: healthy food, exercise, lifestyle and environment; for b) *patients*: efficient and minimally invasive diagnostic, side-effect-free therapy and fast recovery; for c) *chronically ill patients*: efficient and minimally invasive diagnostic and personalized therapy, use of technical possibilities and integration at home. CHI integrates the different roles and needs of the specific consideration of the requirements using modern health technologies.

### 3.2. Diminishing CHI Model Factors – Barriers

During different workshop activities, SIG members identified three categories of barriers: i) *Individual* ii) *Technical* and iii) *Social/Organizational* barriers, as depicted in Figure 2. The blue frame indicates that the context of use plays an important role. For example, political aspects such as eHealth initiatives need to be taken into account as well as the fit of eHealth solutions into organizational structures or the individual’s daily life. Numbers in grey circles indicate the total relevance score of each important



**Figure 2:** Identified eHealth barriers: rectangles colored in red (i), green (ii) and orange (iii) relate to different barrier categories. Grey markers indicate the results of the relevance scoring of the 2<sup>nd</sup> workshop.

barrier as weighted during the voting process at the national workshop (see Section 2). According to the workshop participants, the most relevant barriers were a) bad connectivity to eHealth services, i.e., lack of or insufficient access to the Internet, b) ethical aspects such as trust in online information or the provider itself.

### 3.3. Meta Model Application Scenarios

For exemplification purposes, we present three different scenarios for a particular meta model instance and thus apply the meta model in a practical manner:

(S1) After his appointment with his GP, Mr. Smith is provided with a brochure about type 2 Diabetes prevention. In this “classic” setting, Mr. Smith (C) is a patient, here synonymous with a *consumer* of printed information. His GP takes the role as the P of a certain S. Here, the *paper brochure* is the T used to *supply information* (S). One barrier in this **setting** might be *bad readability of the brochure* (F<sub>1</sub>) or *low level of health literacy* (F<sub>2</sub>) which hinders Mr. Smith to fully understand and implement the proposed suggestions in his daily routine, here: the desired outcome of the brochure.

(S2) Mrs. Smith wants to lower her risk of getting type 2 Diabetes. She discovers that a *startup company* (P) offers a *free app* which provides her (S) with suggestions for a healthier lifestyle, reminders for daily exercises and a dictionary for important terms related to Diabetes. In this **setting**, Mrs. Smith is a *healthy citizen* (C) with a personal interest in her own health and prevention. To access the Diabetes app she uses her *smartphone* (T<sub>1</sub>) and/or the *tablet* (T<sub>2</sub>) of her husband. A facilitator was the *interactive guide* (F<sub>1</sub>) which introduced the features to her at the first launch of the app.

(S3) The GP of family Smith is active on *Facebook* (T). Recently, he discovered that there is a *Diabetes interest group* (S) moderated by several of his *patients* (P<sub>1-n</sub>). Members of this group discuss various personal experiences in coping with this

disease. In this social media environment, Mrs. *Smith* ( $P_x$ ) posted a review on the lifestyle supporting app she recently discovered. Thereby, she gives *motivating advice* ( $F_1$ ) to other *consumers* ( $C$ ) which regularly read posts of this socially-motivated group.

#### 4. Discussion

In this paper a new approach to model and describe CHI-related settings was presented. This model supports the definition of multi-actor contexts, as it not solely reflects the conventional patient-physician relationship but also allows for the description of second health market providers and of social-media environments. This becomes increasingly important as more companies offer services independently of primary care providers. Moreover, the proposed model structure enables a distinctive description of influencing factors. Such factors are often associated with barriers that decrease the quality of inter-actor relationships, thereby diminishing the desired (health) outcome for consumers.

These barriers can be divided into at least three categories. Many of them have been identified by a group of international eHealth experts and condensed by members of the SIG CHI. Yet, the presented collection may not be complete, as it is a broad field of research. Moreover, due to the limited number of participants, the practicability of the model and the obtained scores for the outlined barriers need to be validated with a larger group of eHealth experts. The SIG plans to conduct a related national survey on this topic in 2016 as part of current activities.

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#### References

- [1] J.P. Weiner. Doctor-Patient Communication in the e-Health Era. *IJHPR* **1** (2012), 33.
- [2] G. Appelboom, E. Camacho, M.E. Abraham, et al. Smart Wearable Body Sensors for Patient Self-Assessment and Monitoring. *Archives of Public Health* **72** (2014), 28.
- [3] M. Swan. Emerging Patient-Driven Health Care Models: An Examination of Health Social Networks, Consumer Personalized Medicine and Quantified Self-Tracking. *International Journal of Environmental Research and Public Health* **6** (2009), 492-525.
- [4] Sanawork Gesundheitskommunikation. HealthOn HealthApps dashboard. Available at: [https://www.healthon.de/health-app\\_dashboard](https://www.healthon.de/health-app_dashboard) [accessed on 2015-11-18]
- [5] Research2Guidance (2013). The mobile health global market report 2013–2017: The Commercialization of mHealth Apps. Available at: <https://research2guidance.com/wp-content/uploads/2015/08/Mobile-Health-Market-Report-2013-2017-Preview.pdf> [accessed on 2015-11-18]
- [6] D. Walker, R. Roashan. Wearable Technology: The Small Revolution is Making Big Waves. Available at: <https://technology.ihs.com/515418> [accessed on 2015-11-18]
- [7] G. Eysenbach. Consumer Health Informatics. *BMJ* **320** (2000), 1713–1716.
- [8] D. Flaherty, L. Hoffman-Goetz, J.F. Arocha. What is consumer health informatics? A systematic review of published definitions. *Informatics for Health and Social Care* **40** (2015), 91-112.
- [9] L. Griebel, M. Pobiruchin, M. Wiesner. Report on the MIE2015 Workshop: Consumer Health Informatics – Barriers and Facilitators of eHealth Usage among Consumers, (2015) DOI: 10.13140/RG.2.1.2817.0081
- [10] K. Becker. Customer-Centricity bei Kliniken und Krankenhäusern, in: M.W. Wilkes, K. Stange (ed.) *Customer Centricity - Nachhaltige Unternehmensstrategie im Gesundheitswesen*. Verlagsgsr. Handelsblatt, Düsseldorf, 2012.
- [11] K. Becker, E. Erkens. AAL in the curriculum of health technology degree program. In: Proceedings BMT 2014, DGBMT Conference, Hannover. *Biomed Tech* **59** (2014) 440-442.



# Diabetes Applications for Arabic Speakers: A Critical Review of Available Apps for Android and iOS operated Smartphones

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**Abstract.** Today, 415 million adults have diabetes; more than 35 million of diabetic adults live in the Middle East and North Africa region. Smartphone penetration in the region is high and applications, or apps, for diabetics have shown promising results in recent years. This study took place between September and December 2015 and reviewed all currently available smartphone diabetes apps for Arabic speakers in both the Apple App and Google Play stores. There were only few diabetes apps for Arabic speakers; only eighteen apps were discovered and considered for this study. Most apps were informational. Only three apps offered utilities such as glucose reading conversion. The apps had issues related to information quality and adherence to latest evidence-based medical advice. There is a need for more evidence-based Arabic diabetes apps with improved functionality. Future research of Arabic diabetes apps should also focus on the involvement and engagement of the patients in the design of these apps.

**Keywords.** Diabetes; Arabic; mHealth; Mobile Devices; Healthcare Applications; Apps; Health Informatics

## 1. Introduction

Diabetes is among the top common chronic conditions globally [1]. Today, 415 million adults have diabetes; this number is expected to rise to 642 million by 2040 [2]. There is an increasing concern about diabetes and its associated complications in the Middle East and North Africa (MENA) region [3]; more than 35 million (9%) of adults aged 20-79, live with diabetes in this region [4]. Additionally, smartphone adoption has been on the rise in the MENA region. For instance, recent reports estimate that 86% of Kuwait's entire population owned smartphones [5]. Moreover, healthcare applications, or "apps", on smartphones have been on the rise with more than 100,000 apps [6], [7]; Diabetes apps have a fair share of the apps market [8]–[11]. Diabetes apps enable their users to learn about diabetes and its effects on other organs and body systems. Users can also track their glucose readings, note their dietary intake, record their activity level, and calculate the recommended insulin dosage [12]. Given the rising numbers of diabetics in the MENA region, the growing number of smartphone users in the same region, and the paucity of studies investigating diabetes apps for Arabic speakers, this study was critical. This application review study investigated all currently available

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diabetes apps for Arabic speakers that were available for smartphones operating with the iOS and Android operating systems. Results will provide insights and direction for future research and development of mHealth and diabetes apps targeting Arabic speakers.

## 2. Methods

A systematic and exhaustive critical review of all currently available diabetes apps for Arabic speakers was conducted between September and December 2015. Both iOS and Android operating systems were included. Only apps catering to the Arabic language speakers, or apps that have an Arabic interface were considered. In the first step, Arabic keywords were identified; the following words were used: (Sukkar-سكر; Alsukkar-السكر; Sukkari-سكري; Alsukkari-السكري) To search for the relevant apps, both the Apple App and the Google Play Stores were searched using both the web interface as well as the respective stores on android and iPhone devices. Detailed information on each app were extracted and reviewed including description, functionality, and price. All free apps were downloaded and their functions were examined closely.

**Table 1.** Diabetes apps for Arabic speakers available for Android and iOS smartphones

App	Arabic Name	Platform <sup>†</sup>	Type <sup>‡</sup>	Cost
Diabetes and Fasting	رمضان وداء السكري	A	I	Free
Best Fruit for Diabetics	أفضل الفواكه لمرض السكر	A	I	Free
Diabetes News and Advice	أخبار ونصائح لمرض السكري	A	I	Free
Treatment for High Blood Glucose	ما علاج السكر المرتفع	A	I	Free
Sugar Test Converter	N/A	A	U	Free
Alsukari	السكري	A & i	S	Free
Diabetes Aid by KFH	N/A	i	U	Free
About Diabetes App	عن مرض السكري	i	I	Free
Children's Diabetes	سكري الأطفال	i	I/U	Free
My Life is Diabetes	حياتي سكر	i	I	Free
Advice for Diabetes	نصائح لمرضى السكر	i	I	Free
Diabetes – Alsukari	السكري	i	I	Cost
Webteb	ويب طب	A & i	I	Free
Health Encyclopedia by HON	N/A	A & i	I	Free
How to Stay Healthy	طرق الحفاظ على صحتك	i	I	Free

<sup>†</sup> Platform: (A) Android – (i) iOS

<sup>‡</sup> Type: (I) Informational – (U) Utility – (S) Social Network

## 3. Results

### 3.1. Android Apps

A total of eight Android apps were identified on the Google Play Store (refer to Table 1). *Alsukari* app enabled diabetics to sign up for a social network targeting diabetes management and awareness. The app claimed its ability to connect users with a large number of diabetics and diabetes nurses. The *Diabetes News and Advice* was a news app that offered the latest news in diabetes management, interventions, and studies. *Treatment for High Blood Glucose* was an informational app that offered static advice

for diabetics on how to manage hyperglycemia. Other similar informational apps included *Webteb*, *Health Encyclopedia*, *Diabetes and Fasting*, and *Best Fruit for Diabetics*. The only utility app for Android smartphones was the *Sugar Test Converter* app; it enabled users to convert their blood glucose readings in either mg/dl or mmol/l, which is helpful when using different devices requiring different measurement scales.

### 3.2. iOS Apps

A total of ten apps were identified on the Apple App Store (refer to Table 1); some apps had a similar version for Android devices. The *Diabetes Aid* app offered the most functions and utilities among all diabetes apps for Arabic speakers. Users were able to keep track of their blood glucose readings, medications, and body mass index (BMI). Users were also able to keep notes in a journal and get access to educational information about diabetes. The *Children's Diabetes* app was designed for young users and allowed its users to keep track of their insulin intake, read stories and play diabetes-related games. Users were also able to get access to educational information about diabetes such as the difference between type 1 and type 2 diabetes. The other apps were informational in nature offering general advice and information about diabetes and its prevention. These apps were namely: *About Diabetes*, *Advice for Diabetics*, and *Alsukari*. *My Life is Diabetes* app on the other hand offered users access to embedded and pre-selected YouTube videos explaining diabetes in Arabic. Although not specific for diabetes, the *Webteb* and the *Health Encyclopedia* apps offered good coverage of diabetes-specific information and advice in Arabic for their users.

## 4. Discussion

### 4.1. Availability and Function

As evident from the results, there were few diabetes apps for the Arabic language speakers. Only eighteen apps in total were discovered in both the Apple App and Google Play stores. This number is quite low when compared with the English language diabetes apps, which exceed nine hundred apps [13]. All the apps reviewed in this study, with the exception of four, were educational and informational in nature offering information about diabetes or news articles related to it. Only three apps offered utilities that helped their users with glucose reading conversion, or keeping track of glucose readings for example. Only one app offered a social network platform that connected diabetics with fellow diabetics as well as diabetes nurses.

### 4.2. Health Information Quality

An alarming and critical problem with all the reviewed apps, and many other health apps in fact, is the absence of a quality assurance and safety certification of their contained information; many apps were available without medical review or endorsement and may not have followed evidence-based medical advice [14]. Health apps should be routinely monitored and continuous quality reviews should be enforced [15]. None of the reviewed apps provided information regarding the sources of information or any assurance of their app's information quality or medical endorsement.

Currently, it is not known if there are any regulatory bodies in the MENA region that govern diabetes and other healthcare apps and review them. Moreover, there were two apps, not included in the study, that were “prank” apps. The user was presented with a picture of a fingerprint, instructed to place their finger on the screen, and a false reading of their glucose level was displayed. Such hoax apps can be dangerous if the user did not recognize them as a game-like apps and considered the feedback as a real reading.

#### *4.3. Opportunities*

The results clearly demonstrate the scarcity of diabetes apps for Arabic speakers. There are opportunities for smartphone app developers, health informatics professionals, and healthcare providers to bridge the gaps and build more evidence-based diabetes apps. Governing bodies and health authorities in the MENA region should also consider taking a more active role and offer direction and governance over healthcare and medical apps development. In concordance with recent evidence [16], future research of Arabic diabetes apps should also focus on the involvement and engagement of the patients in the design of these apps. Additionally, patient generated data from these apps should be integrated into the current health information technology systems, e.g. electronic health records [17].

#### *4.4. Study Limitations*

Like other studies, this study has limitations. First, only the Android and iOS operating systems were investigated; Microsoft and Blackberry operating systems were not investigated due to limited adoption and use in the MENA region. Another limitation stems from the focus of the study. There were other apps available for related conditions or relevant to lifestyle changes suggested for diabetics (e.g. nutrition apps) that were not included. Only apps that focused on diabetes and in the Arabic language were studied, because such apps offered the most functions and were most likely to be adopted by diabetics. In spite of these limitations, this study successfully uncovered the paucity of diabetes apps for the Arabic speakers, therefore highlighting opportunities for future research and development.

### **5. Conclusions**

This critical review investigated the availability and functionality of diabetes apps for Arabic speakers that were available on the Apple App and Google Play stores. The number of diabetes apps for Arabic speakers was low; the majority of the currently available apps were educational and informational in nature. There are opportunities for health informatics professionals, app developers and healthcare providers to collaborate to increase the availability and functionality of apps for Arabic speaking diabetics. Patients should be an integral part of any diabetes app development. Future research should investigate how to best engage the patients in the care plan using these apps and making use of patient-generated data. There is also a need to establish mechanisms in the MENA region to ensure that all apps adhere to standards of information quality, and based on the latest evidence-based medical advice.

## References

- [1] World Health Organization, "World Health Day 2016: Diabetes," 2015. [Online]. Available: <http://www.who.int/campaigns/world-health-day/2016/event/en/>. [Accessed: 04-Dec-2015].
- [2] International Diabetes Federation, "Diabetes Atlas 2015," Brussels, Belgium, 2015.
- [3] M. Badran and I. Laher, "Type II Diabetes Mellitus in Arabic-Speaking Countries.," *Int. J. Endocrinol.*, vol. 2012, p. 902873, 2012.
- [4] International Diabetes Federation, "Diabetes Atlas 2015 - Chapter 4: Diabetes by region," Brussels, Belgium, 2015.
- [5] eMarketer, "Smartphones, Tablets Spread Across the Middle East and Africa," 2015. [Online]. Available: <http://www.emarketer.com/Article/Smartphones-Tablets-Spread-Across-Middle-East-Africa/1012989>. [Accessed: 03-Dec-2015].
- [6] W. Xu and Y. Liu, "mHealthApps: A Repository and Database of Mobile Health Apps," *JMIR mHealth uHealth*, vol. 3, p. e28, 2015.
- [7] B. Martínez-Pérez, I. De La Torre-Díez, and M. López-Coronado, "Mobile health applications for the most prevalent conditions by the world health organization: Review and analysis," *J. Med. Internet Res.*, vol. 15, no. 6, pp. 1–29, 2013.
- [8] M. Arnhold, M. Quade, and W. Kirch, "Mobile applications for diabetics: A systematic review and expert-based usability evaluation considering the special requirements of diabetes patients age 50 years or older," *J. Med. Internet Res.*, vol. 16, no. 4, pp. 1–18, 2014.
- [9] O. El-Gayar, P. Timsina, N. Nawar, and W. Eid, "Mobile applications for diabetes self-management: status and potential.," *J. Diabetes Sci. Technol.*, vol. 7, no. 1, pp. 247–62, 2013.
- [10] A. Greene, A. Shaltout, V. Alexander, M. Brillante, S. Cunningham, E. Fairley, N. Halwa, D. Alhuwail, D. J. Wake, and S. A. Greene, "Integrating 'SweetText', a mobile phone behavioural support programme for young people with Type 1 diabetes, into clinical service in Kuwait and Scotland," *Diabetic Medicine*, vol. 29, p. 109, 2012.
- [11] A. P. Demidowich, K. Lu, R. Tamler, and Z. Bloomgarden, "An evaluation of diabetes self-management applications for Android smartphones," *J. Telemed. Telecare*, vol. 18, no. 4, pp. 235–238, 2012.
- [12] S. Goyal and J. A. Cafazzo, "Mobile phone health apps for diabetes management: Current evidence and future developments," *QJM An Int. J. Med.*, vol. 106, no. 12, pp. 1067–1069, 2013.
- [13] T. Chomutare, L. Fernandez-Luque, E. Arsand, and G. Hartvigsen, "Features of mobile diabetes applications: review of the literature and analysis of current applications compared against evidence-based guidelines," *J Med Internet Res*, vol. 13, p. e65, 2011.
- [14] Y. Subhi, S. H. Bube, S. R. Bojsen, A. S. S. Thomsen, and L. Konge, "Expert Involvement and Adherence to Medical Evidence in Medical Mobile Phone Apps: A Systematic Review," *JMIR mHealth uHealth*, vol. 3, no. 3, p. e79, 2015.
- [15] P. Wicks and E. Chiauzzi, "'Trust but verify' – five approaches to ensure safe medical apps," *BMC Medicine*, vol. 13. London, 2015.
- [16] N. Conway, I. Campbell, P. Forbes, S. Cunningham, and D. Wake, "mHealth applications for diabetes: User preference and implications for app development," *Health Informatics J.*, no. Epub ahead of print, 2015.
- [17] T. H. Payne, S. Corley, T. a Cullen, T. K. Gandhi, L. Harrington, G. J. Kuperman, J. E. Mattison, D. P. Mccallie, C. J. Mcdonald, P. C. Tang, W. M. Tierney, C. Weaver, C. R. Weir, and M. H. Zaroukian, "Report of the AMIA EHR 2020 Task Force on the Status and Future Direction of EHRs," *J. Am. Med. Informatics Assoc.*, vol. 0, pp. 1–11, 2015.

# Capturing Provenance, Evolution and Modification of Clinical Protocols via a Heterogeneous, Semantic Social Network

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**Abstract.** Healthcare delivery is largely based on medical best practices as in clinical protocols. Research so far has addressed the computerized execution of clinical protocols by developing a number of related representation languages, execution engines and integrated platforms to support real time execution. However, much less effort has been put into organizing clinical protocols for use and reuse. In this paper we propose a heterogeneous semantic social network to describe and organize clinical protocols based on their provenance, evolution and modifications. The proposed approach allows semantic tagging and enrichment of clinical protocols so that they can be used and re-used across platforms and also be linked directly to other relevant scientific information, e.g. published works in PubMed or personal health records, and other clinical information systems.

**Keywords.** Clinical protocols, semantic social network, ontology, provenance.

## 1. Introduction

Healthcare delivery is largely based on medical best practices. These are typically captured in clinical protocols (or algorithms), that is, detailed statements that set out a precise sequence of activities to be adhered to in the management of a specific clinical condition [1]. Clinical protocols are usually derived from clinical practice guidelines, which are consensus statements, systematically developed to assist health professionals in clinical practice decision-making, and are considered formal general recommendations for prevention, diagnosis, treatment, long-term management of disease or advice and information [2]. Often clinical protocols are merged into care pathways, which are multidisciplinary plans care that outline the optimal sequencing and timing of interventions for patients for integrated care including procedures inside and outside the health care unit [3].

Research so far has rigorously addressed the computerized execution of clinical protocols and this has resulted in a number of related representation languages, execution engines and integrated platforms to support the real time execution [4],[5]. However, much less effort has been put into organizing available clinical protocols. Mainly, they are maintained in data silos of the respective issuing body without means for straightforward seamless integration and open availability.

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In this work we build on the paradigm of social associations among human and non-human entities alike and propose a novel approach to describe and organize clinical protocols for easy use and reuse. The following sections discuss different perspectives of clinical protocol provenance, evolution and modification and present a novel approach for organizing, and managing clinical protocols via a heterogeneous, semantic social network.

## **2. Clinical Protocol Provenance, Evolution and Modification**

The clinical protocol origin is of outmost importance for a number of reasons. The first is provenance: no one could (or should) trust data purporting to represent medical knowledge without the ability to trace it back to its source. Clinical protocols are usually derived as detailed manifestations of clinical practice guidelines, which in turn are based on scientific medical evidence as published in scientific literature. Sources of such evidence can range from small *in vitro* studies or case reports to systematic randomized clinical trials. Evidence based clinical recommendations can be of different quality, thus information on their grading is essential. Several systems and approaches have been proposed for grading clinical practice guidelines; the most widely adopted being the GRADE system [6].

Clinical protocols are issued by authoritative institutions, such as national and international health organizations and other related regulatory bodies. As legal and financial issues may arise from the use and deployment of a clinical protocol, the issuing body may prove to be a critical factor. Finally, a protocol may be altered as new evidence is available, thus leading to updates and new versions. The time evolution of a clinical protocol and the curation of its different versions are important for maintaining continuity, especially for legal, financial and scientific purposes.

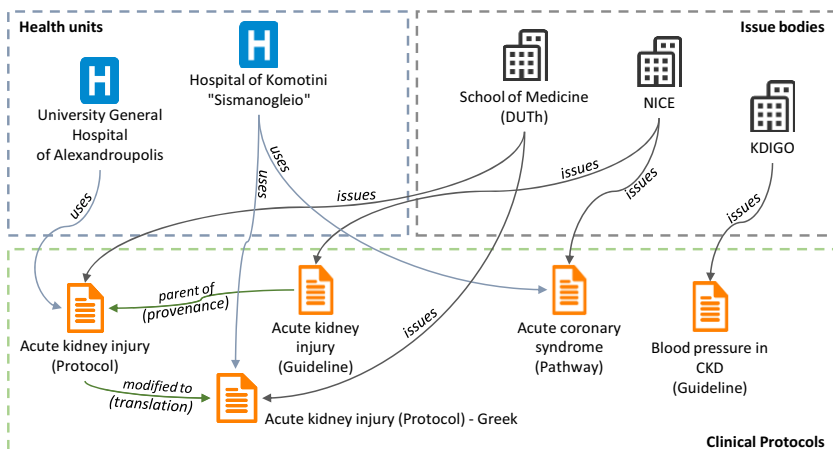
While discussing the origin of a clinical protocol, one should also add another factor: often clinical protocols are subject to changes during their deployment in clinical practice. These deviations may be due to a number of reasons [7]; most common ones include local lack of resources, e.g. diagnostic equipment, a low strength recommendation, specific requirements of a concurrent clinical trial protocol, patient refusal to follow certain protocol's steps (e.g. due to religious or other personal issues), insurance policy requirements (e.g. to firstly perform a lower cost procedure), presenting comorbidities not accounted for in the original protocol, or even health professional's direct disagreement due to new contradicting high level medical evidence. For such justified reasons, clinical protocols may be adapted to local settings. In this case, one has to record the provenance of the adapted protocol i.e. the initial parent protocol.

In this work, the notion of social media is employed to give a different perspective to clinical protocol provenance, evolution and modification, by creating social networks of clinical protocols where, amongst else, provenance, evolution and modification are used as basic social relationships among clinical protocols, issuing bodies and medical practice units in order to drive protocol organization, retrieval, evaluation and reuse.

### 3. A Heterogeneous, Semantic Social Network for Clinical Protocols

In the broader sense, ‘social’ means ‘association, as the word derives from the Latin ‘socius’ meaning a companion or associate [8]. In the first days of deploying social internet applications, the term ‘social’ has been used in the narrower sense to refer primarily to human aggregates among themselves. Following this first generation of human-centered social networks, the notion of object-centered sociality has been introduced to describe the fact that strong social relationships are built mainly when individuals are grouped together around a shared object [9], [10]. In this paper we follow a more radical view [11] for truly heterogeneous social networks where humans and nonhuman entities of various types are integrated into the same conceptual framework and assigned equal amounts of agency.

The proposed heterogeneous network can be viewed as a number of distinctive and interacting networks of clinical protocols, issuing bodies, health units using the protocols, and finally patients who undergo protocols. Interactions and relations between clinical protocols are mainly based on their evolution and modification. Each protocol which has been derived as a new version or a modification of an existing protocol, declares its parent. Following iteratively the ‘parents’ in a chain of ancestors, the entire ‘family’ tree of the particular protocol can be compiled. Additionally, there are relationships between protocols and their issuing bodies and healthcare units that use them in clinical practice. Overall protocol relationships in the social network include (Figure 1): (1) protocol provenance from a clinical practice guideline and/or scientific evidence source; (2) protocol provenance from a particular issuing body; (3) protocol evolution as an update to a previous version; and (4) protocol modification due to a variety of reasons, including different language, clinical restrictions due to concurrent clinical protocols, restrictions due to comorbidities, infrastructure limitations, patient choices and objections, insurance policy constraints.

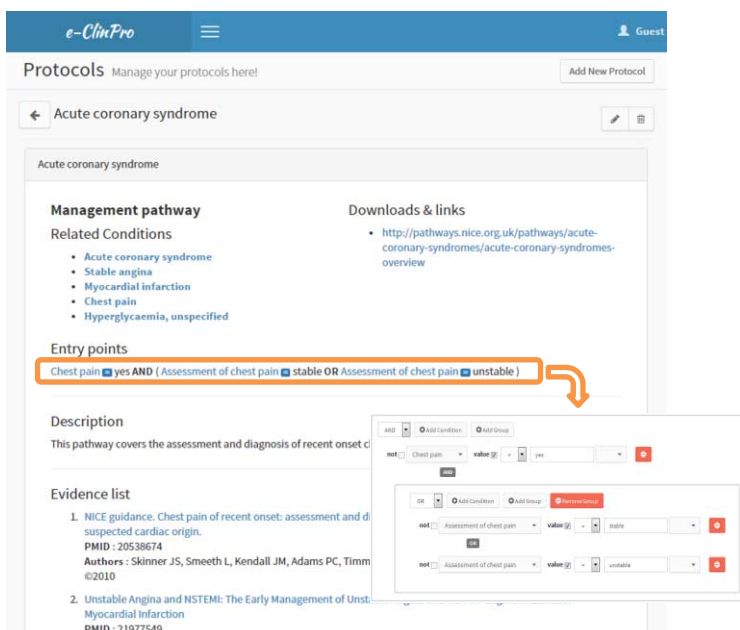


**Figure 1.** Clinical Protocols' relationships in the semantic social network.

In implementing such a network, major challenges include a unified treatment and representation of all types of possible actors as well as the development of a social behavior for various nonhuman actors, and subsequently their own associations and networks. Both challenges can be addressed by semantic technologies. The profile of



the clinical protocol is described by the formal care plan eCP ontology [12] (available at <http://purl.bioontology.org/ontology/ECP>). This includes attributes that pertain to (1) general information, e.g. title, date published, short description; (2) protocol classification based on related health issue, and/or clinical goal; (3) issuing body, evidence source and quality and level of recommendation; (4) medical condition for initializing the protocol; (5) protocol outcomes or exit points; (6) required resources, e.g. imaging or therapeutic equipment; and (7) technical information on the protocol source files. Issuing bodies and healthcare units are described following the SWRC ontology [13]. Also, the social aspect of non-human actors can be created in a variety of ways, including (a) the obvious connections via common tags that are used in their profile description; (b) connections based on collective usage and other related interaction of human users, i.e. what human users do with the nonhuman entities; (c) social connections based on some type of inheritance, i.e. non-human entities that are generated or are the product of other resources, in the sense of the genealogy tree; and (d) semantic connections and similarities that can be built based on profile data enrichment via controlled medical vocabularies, e.g. UMLS.



**Figure 2.** Preview of care plan profile including a preview of the editor for the initialization condition.

The current deployment of the proposed social network engine (Figure 2) is implemented using LoopBack framework (<http://loopback.io>) and is accessible at <http://iris.med.duth.gr/research/ecp>. Data storage is based on the MongoDB (<https://www.mongodb.org>) and is publicly available through the Swagger programming interface (<http://swagger.io/swagger-ui>). The social network frontend is powered by AngularJS framework (<https://angularjs.org>) and the graph visualizations use Vis.JS library (<http://visjs.org>). Integration with controlled vocabularies and ontologies is via the NCBO BioPortal programming interface

(<http://data.bioontology.org>), while scientific evidence source information is automatically retrieved via the PubMed programming interface.

#### 4. Discussion

This paper proposes a heterogeneous semantic social network to describe and organize clinical protocols based on their provenance, evolution and modifications. The goal of our network allows semantic tagging and enrichment of clinical protocols so that they are easily accessible from different platforms and also be linked directly to other relevant scientific sources and vocabularies. Future plans involve the expansion of this social network engine in order to support relationships between doctors and patients. This feature promises to reveal clinical protocols' popularity and acceptability in the medical community and additionally the differentiation between the actual results of their application and their defined outcomes.

#### 5. Acknowledgments

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#### References

- [1] S. Greenfield, Clinical algorithms, *West J Med* **129** (1978), 230-231.
- [2] M.J. Field, K.N. Lohr, *Guidelines for clinical practice: from development to use*, National Academy Press, Washington DC, 1992.
- [3] K. Vanhaecht, M. Panella, R. Zelm et al., An overview of the history and concept of care pathways as complex interventions. *Int J Care Pathways* **14** (2010), 117-123.
- [4] D. Isern, A. Moreno, Computer-based execution of clinical guidelines: a review, *Int J Med Inform* **77**:12 (2008), 787-808.
- [5] M. Peleg, Computer-interpretable clinical guidelines: a methodological review, *J Biomed Inform* **46**:4 (2013), 744-763.
- [6] GRADE working group, Organizations that have endorsed or that are using GRADE, URL: <http://www.gradeworkinggroup.org/society/index.htm> (Accessed: 6-Oct-2015).
- [7] S. Quaglini, Compliance with clinical practice guidelines, *Stud Health Technol Inform*, IOS Press (2008), 160-179.
- [8] J.S. Dolwick, The social and beyond: introducing actor-network theory, *J Mari Arch.* **4** (2009), 21-49.
- [9] J. Engeström, Why some social network services work and others don't. The case for object-centered sociality, URL: <http://www.zengestrom.com/blog/2005/04/why-some-social-network-services-work-and-others-dont-or-the-case-for-object-centered-sociality.html> (Accessed: 4-Dec-2015).
- [10] J. Breslin, S. Decker, The future of social networks on the Internet. The need for semantics, *IEEE Internet Computing.* **11** (2007), 87-90.
- [11] E. Kaldoudi, N. Dovrolis, S. Dietze, Information Organization on the Internet based on Heterogeneous Social Networks, *SIGDOC'11: 29th ACM International Conference on Design of Communication* (2011), 107-114.
- [12] N. Portokallidis, G. Drosatos, E. Kaldoudi, Semantic Conceptual Model for Managing Clinical Protocols, *ELEVIT'15: 6th Panhellenic Conference on Biomedical Technology* (2015).
- [13] Y. Sure, S. Bloehdorn, P. Haase et al., The SWRC ontology-semantic web for research communities, *EPIA'05: 12th Portuguese Conference on Artificial Intelligence*, Vol. **3808** of LNCS, Springer (2005), 218-231.

# Effectiveness of an Internet Community for Severely Obese Women

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**Abstract.** While Internet communities have become thriving sources of support, little is yet known about their effectiveness. We retrospectively sampled morbidly obese (Body Mass Index, BMI>40) women who were active for at least a year in an Internet community. We compared self-reported weight changes between women who had high online participation levels (n=71) versus those with low participation levels as control (n=69). Women who actively participated online lost on average 7.52%, while those who were passive lost 5.39% of their original body weight. For active women, there was positive, albeit weak, correlation (r=0.22, p<0.05) between online participation levels and weight loss, while no significant correlation was noted for the control. Current results indicate modest evidence supporting active participation in Internet groups as an effective weight loss strategy for the target group.

**Keywords.** Diabetes, Social Media, weight loss, Peer Support, Internet Groups

## Introduction

Obesity is one of the major risk factors for Type 2 diabetes (T2D), and several approaches have so far been used to encourage weight-loss without surgery; to delay or even prevent development of secondary complications. Women with extra body fat are at more risk, accounting for an estimated 77% (and for men = 64%) of new cases of Type 2 diabetes [1]. Obese women are at more risk because of the natural tendency to gain weight, coupled with increasingly sedentary lifestyles with age.

Internet groups and communities have become a popular source of support, but little is yet known about their effectiveness [2]. Perhaps these sources of support might be effective for one user group and not necessarily the other, for example, the elderly, women, children or teenagers. Further, our understanding of the social interactions and camaraderie, and how it affects weight loss performance is still limited.

A basic measure of active online participation could be the number of posts a user submits to a community. Using more complex analysis, we have previously shown that we can at least try to predict weight loss based on the interaction patterns among patients in these Internet communities [3], and that persuasive technology could be used to en-

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hance outcomes [4]. The number of protocols for studying Internet systems for solving healthcare problems, such as weight loss, is increasing [5,6]. While this may seem like a promising trend, many of these protocols only concern privacy-deficient social media such as Facebook and Twitter

The goal of this study was to assess effectiveness of a popular Internet group for older women, with a focus on the morbidly obese sub-group, and to show whether there was any difference in outcomes for women who were actively participating online verses those who were passive. This is an important sub-group since physicians would normally recommend more drastic measures such as surgery or pharmaceutical treatments.

## 1. Methods

This paper reports on a retrospective analysis of data on older women who were active for at least one year in an Internet group, and who wanted to loose weight.

We used only the publicly available HTML data from a convenience sample American website. The site has a total of more than 200 thousand registered users. We sampled a subgroup for older women, parsing the data into a more structured form, and going through pseudonymization with one-way hashing before the data was used.

We sampled extremely obese (BMI>40) women (n=140, age>50) who were active for at least a year in an Internet group. We analysed amount of online participation, as well as the self-reported weight-related data, such as initial weight, weight goal, closing weight, height, etc. We sampled the women as 'active' (n=71), in terms of online participation, if they posted on average more than once a week, and 'passive' (n=69) if they posted once or less a week.

Online participation was measured by the amount of messages the participants posted or 'posts'. These messages could be in reply to other messages, or they could be new messages. Private messages within the community were not considered in this study.

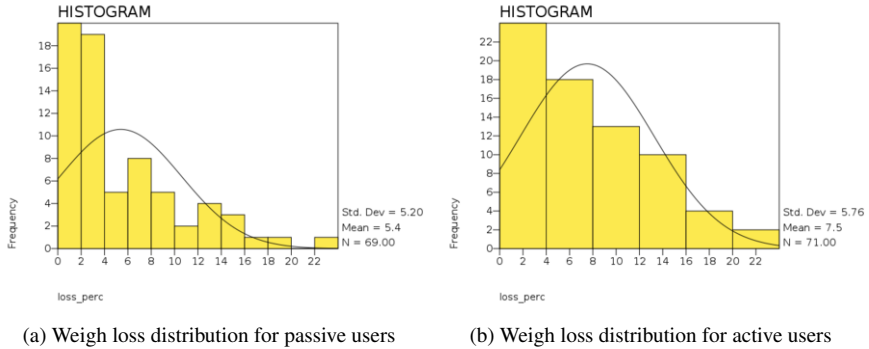
Women who underwent bariatric surgery were excluded from the study. Although drastic measures such as surgery or pharmaceutical treatments are recommended for the user group, our study only considered this Internet-based lifestyle solution.

## 2. Results

Table 1 summarizes the descriptive frequencies observed in the sampled data.

**Table 1.** Descriptive frequencies for the relative weight loss (ie, weight loss in relation to the initial weight, as a percent)

	Active	Passive
Mean weight loss	7.52 %	5.39 %
Std Dev	5.76 %	5.20 %
Mode	0.00 %	0.00 %
Minimum weight loss	0.00 %	0.00 %
Maximum weight loss	23.10 %	22.70 %
Skewness of weight loss distribution	0.83	1.27

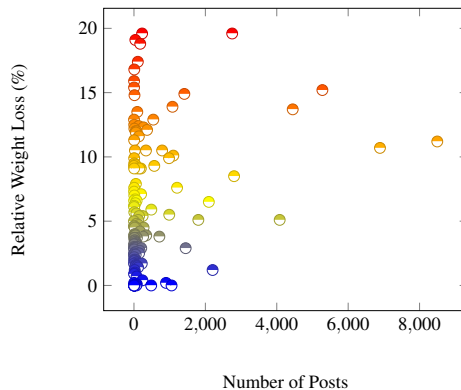


**Figure 1.** Relative weight loss distribution for passive and active users, with a normal distribution curve.

From the Table 1, the mean relative weight loss was 7.52% and 5.39% for active and passive women, respectively. This represents a drop of about 6% of the initial body weight for both groups combined. The modal weight loss percent was zero for both groups, and there was little difference in the other extreme, ie. maximum weight loss between the groups, which was 23.10% and 22.70%.

Fig.(1a) shows the relative weight loss distribution of the passive users, while Fig.(1b) shows the relative weight loss distribution of the active users. The distribution for passive users is highly positively skewed (1.27), while the active distribution is mildly positive (0.83). As can be observed, the majority seem to have lost less than 4% for the passive group, while the active group had a comparatively larger number of women who lost much higher percentages.

The two groups combined, Fig. (2) shows that many of the participants only posted a few posts, a couple of hundreds or less. However, there were some participants who were very active, posting in excess of a thousand posts.



**Figure 2.** Number of posts vs. the relative weight loss

Using bivariate analysis with one-tailed tests, we found positive correlation ( $r=0.22$ ,  $p<0.05$ ) between online participation levels and weight loss for the active group. For the passive group, the correlation was positive but extremely small (0.06) and statistically insignificant ( $p=0.319$ ).

### 3. Discussion

These results initially seem to provide a solid case for active participation in weight loss Internet groups. However, the mean weight loss was not much larger than that of the minimally active or passive group. Perhaps these results suggest that there are only marginal gains in increasing levels of participation, once one becomes part of an online community. However, given that small relative weight losses have been shown to increase insulin sensitivity, perhaps these results provide sufficient evidence of benefits for obese women at high risk of developing T2D.

While it is a reasonable assumption that the women may have had a higher than normal motivation to lose weight because of the excessive weight, we observed that the majority had only modest weight losses. This observation is consistent with previous reports in the literature [7].

It is interesting to note that those who were the most active online did not necessarily perform the best. Perhaps this points to the need for moderation, and the need to move away from the computer or smart-phone; for some real physical exercise. However, those who publicly declared ambitious weight loss goals, achieved better results. Previous studies have also reported improved results with use of weight tracking mechanisms.

While the objective measurements were modest for both groups, perhaps other less objective benefits such as emotional support or just making friends with similar patients are just as important for total quality of life. It may be important for further studies to measure both objective weight losses, as well as consider other qualitative outcomes.

Given that methodologies and measurements in this new field are still poorly understood, we argue that this study contributes to a better understanding of the new roles Internet-based societies play in healthcare.

#### 3.1. Limitations

Our control group consists of women who already had some exposure to Internet groups. Perhaps a better control group might have been women who were not exposed to Internet groups entirely. However, strictly controlled prospective efficacy studies may also be limited for studying online social interactions because of the Hawthorn effect and other confounding factors.

Another limitation is that we do not know the start date of the decision to lose weight; we only know when they joined the Internet group. Additionally, our analyses do not include women who dropped out within a year of joining. Such women might have dropped out because they have in fact gained more weight, they have joined another Internet community, or they simply were not motivated to continue. It could also be because they no longer actively write posts, but rather only follow conversations of others, and are therefore not captured on our data.

Further to that, people who have committed to lose weight likely try several remedies, many of which cannot be known or accounted for in scientific studies. On the whole, however, this is likely not important for this effect study, as long as the observed weight loss can be related to their level of online participation.

Internet data can be unreliable because human input is prone to error or even deceit. Although this limitation can be severe, it is not unique to our study, because any study or survey that relies on human input is susceptible. Since we analyse data from large amounts of participants, it's possible any negative effects are minimized.

### 3.2. Future Work

For the future, it might be an idea to have well-moderated groups, as the limitations of misinformation are well-documented [8]. Smart functions that monitor performance of each individual and issue recommendations or nudges based on prescribed behavior or deviation from model behaviour may be necessary to sustain motivation for active participation.

## 4. Conclusions

Results indicate modest evidence supporting active participation in Internet groups as an effective weight loss strategy for the target group. Although several factors affect BMI and weight loss, decoding intricate online interactions promises a greater understanding of social media, and its relation to weight loss outcomes. This study also raised pertinent methodological questions that warrant further inquiry.

## Acknowledgment

This work was supported in part by the Research Program for Telemedicine, Helse Nord RHF, Norway.

## References

- [1] P. G. Kopelman, I. D. Caterson, and W. H. Dietz, *Clinical Obesity in Adults and Children*. John Wiley & Sons, Limited, 2009. [Online]. Available: <http://books.google.no/books?id=sAmGPwAACAAJ>
- [2] T. Chang, V. Chopra, C. Zhang, and S. J. Woolford, "The role of social media in online weight management: systematic review." *Journal of medical Internet research*, vol. 15, no. 11, pp. 1–15, Nov. 2013. [Online]. Available: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3868982/>
- [3] T. Chomutare, A. Xu, and M. S. Iyengar, "Social network analysis to delineate interaction patterns that predict weight loss performance?" in *CBMS*, 2014, pp. 271–276.
- [4] A. Xu, T. Chomutare, and M. S. Iyengar, "Systematic review of behavioral obesity interventions and their persuasive qualities." in *PERSUASIVE*, 2014, pp. 291–301.
- [5] S. L. Pagoto, M. E. Waring, K. L. Schneider, J. L. Oleski, E. Olenzki, R. B. Hayes, B. M. Appelhans, M. C. Whited, A. M. Busch, and S. C. Lemon, "Twitter-Delivered Behavioral Weight-Loss Interventions: A Pilot Series," *Journal of medical Internet research*, vol. 4, p. e173, 2015.
- [6] M. Jane, J. Foster, M. Hagger, and S. Pal, "Using new technologies to promote weight management: a randomised controlled trial study protocol," *BMC Public Health*, vol. 15, no. 1, p. 509, 2015.
- [7] E. Brindal, J. Freyne, I. Saunders, S. Berkovsky, G. Smith, and M. Noakes, "Features Predicting Weight Loss in Overweight or Obese Participants in a Web-Based Intervention: Randomized Trial," *Journal of medical Internet research*, vol. 14, p. e173, 2012. [Online]. Available: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3558051/>
- [8] A. Y. Lau, E. Gabarron, L. Fernandez-Luque, and M. Armayones, "Social media in health—what are the safety concerns for health consumers?" *HIM J.*, vol. 41, no. 2, pp. 30–5, 2012.

# Social Media as Catalyzer for Connected Health: Hype or Hope? Perspectives from IMIA Working Groups

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**Abstract.** The Internet and social media are becoming ubiquitous technologies that are transforming the health sector. Social media has become an avenue for accessing, creating and sharing health information among patients and healthcare professionals. Furthermore, social media has become a key feature in many eHealth solutions, including wearable technologies, Big Data solutions, eLearning systems, Serious Games, Medical imaging, etc. These hyper-connected technologies are facilitating a paradigm shift towards more connected health. In this panel, representatives of different IMIA Working Groups will explore how both hope and hype contribute to social media's catalyzing role in creating connected health solutions.

**Keywords:** m-Health; Mobile Health; Social Media; Public Health Informatics; Consumer Health Informatics; Connected Health, Patient Safety.

## 1. Panel Overview:

Social media is an enabler of many e-Health applications that are meant to transform healthcare systems with more connected healthcare models and practices. This cannot be achieved without the leadership of the broad medical informatics community. The panel will discuss prospects of social media in medical informatics to achieve a new paradigm of connected health, defined by the ENJECT-COST project as:

*“Connected Health is a new model for health management. It puts the correct information in the correct hands at the correct time. It allows patient and clinicians to make better decisions. Decisions that can save lives, save money and ensure a better quality of life for the patient during and after treatment. Connected Health is not just about technologies. It's about connecting people and information within a system – the healthcare system”<sup>1</sup>*

The role of the medical informatics community in this paradigm shift is crucial to deal with key aspects such as human factors, organizational factors, data, knowledge, etc.. For this reason our panel brings together representatives from different EFMI and IMIA Working Groups. The main objectives of the panel are:

1. To provide an overview of the different EFMI and IMIA Working groups and to foster collaboration among them.
2. To promote discussion of Connected Health within the Medical Informatics research community taking into special consideration the ENJECT - COST Action.
3. To discuss future opportunities and concerns that can leverage the application of social media in the health domain.
4. To discuss approaches for the evaluation of connected health solutions.

An introductory overview by the moderator, will be followed by 5 minute summaries from each WG, a 30 minute Question-and-Answer period for audience discussion, and will end with a brief overview and conclusion by panel members.

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<sup>1</sup> <http://enject.eu/about/>

## 2. Working Group Summaries and Participants:

**Social Media WG** - Brings together professionals in medical informatics and health-related social media.

. Luis Fernandez-Luque, PhD (Salumedia, Sevilla, Spain). He works on eHealth and social media, is Chair of this WG, and is on the ENJECT Management Committee.

**Smart Homes and Ambient Assisted Living WG** – Involves eHealth services and implementation methods for home healthcare (Smart Home) applications.

- Prof. Vivian Vimarlund (Linköping University, Sweden) is the chair of the Working Group, with research focusing on eHealth.

**Health Informatics for Patient Safety WG** – How can social media improve health care safety, through citizen engagement in their health care?

- Dr. Elizabeth Borycki RN PhD (School of Health Information Science, University of Victoria, Canada- is Vice-Chair of this WG and carries out research on health information systems and their impact on patient safety.

**Language and Meaning in Biomedicine WG** – Extraction of meaning from challengingly heterogeneous data sources, especially social media, using semantic technologies will be the focus of discussion.

. Prof Stefan Schulz (University of Graz, Austria) is vice-chair of the working group and has been working for many years on medical language processing and data mining among other fields.

**Organizational and Social Issues WG** - Organizational, socio-technical, ethical, and individual behavioural issues surrounding the introduction and use of informatics applications of social media in the health domain will be the main focus.

- Dr. Craig Kuziemsky (University of Ottawa, Canada) is director of the Health Systems MS program at the University of Ottawa and Chair of this IMIA WG. His research involves novel modeling of information and communication technology systems to enhance collaborative healthcare.

**Wearable Sensors in Healthcare WG** - Promoting comprehensive platforms for information exchange and scientific collaboration incorporating wearable sensors and technologies are a natural application for social media methods.

- Prof. Dr. med. Dr.-Ing. Michael Marschollek (Hannover Medical School and University of Braunschweig - Institute of Technology, Hannover, Germany) chairs the WG, working on the analysis and integration of multimodal data for individualized patient information extraction from sensors within health systems.

**History of Biomedical and Health Informatics WG** The evolution of topics and trends in our field demonstrates the socially-challenging effects of health media, and the difficulties of developing “socially-responsible human-machine systems”.

- Prof. Casimir A. Kulikowski (Rutgers University, USA) carries out research in artificial intelligence and biomedical informatics, focusing on the cognitive and social impact of healthcare systems. He is chair of the History WG of IMIA.

# Gamified Design for Health Workshop

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## 1. Workshop Organization

*Guido Giunti MD, Salumedia, Spain*

Guido Giunti MD is the Medical Advisor at Salumedia Tecnologías and PhD Candidate at the University of Oulu, Finland as part of the Horizon 2020 CHESSE Programme on the subject of the use of gamification for behavioral change in chronic diseases. His PhD project involves persuasive interventions through mobile applications in chronic disease patients and is experienced in the use of game design for health and medical education.

## 2. Workshop Description

### Abstract

Increasing lifespans for chronic disease sufferers means a population of young patients who require lifestyle intervention from an early age. For multiple sclerosis (MS) patients, social problems begin with the decline of cognitive skills and their quality of life is affected.

In this workshop, organizers will propose participants to work on different gamification design approaches to solve MS patients' engagement problem. Participants will obtain skills that can be extrapolated to other conditions that require patients change to adopt a different behavior.

At the end, participants will present their proposed gamification design and discuss and comment each solution, assessing potential unintended outcomes and advantages.

**Keywords:** Gamification, multiple sclerosis, mobile, physical activity

### Format

#### Timeline

- 15' Presentation, and introduction to the problem to solve
- 15' Groups creation, and explanation of the methodologies
- 45' Hands-on exercises
- 15' Results sharing and conclusions

### Description

Increasing lifespans for chronic disease sufferers means a population of young patients who require lifestyle intervention from an early age. For multiple sclerosis (MS) patients, social problems begin with the decline of cognitive skills. Quality of life is

impacted, and embarrassment can lead to avoidance of social situations and work obligations causing societies to suffer economically. Studies show how physical activity can alleviate the fatigue and flu-like symptoms of MS treatment, as well as contribute to the general patients' quality of life. However, adherence to physical activity is generally quite low.

In this workshop, organizers will propose participants to work on different gamification design approaches to solve MS patients' engagement problem. Participants will obtain skills that can be extrapolated to other conditions that require patients change to adopt a different behavior. Through being part of this workshop, participants will be taking part of Dr. Guido Giunti's PhD research project and any output produced may be used for his research.

The workshop will start with an introductory talk about gamification and MS patients' needs with a duration of approximately 15 minutes. Organizers will go through different examples of general gamified social IT-based solutions to help attendees get a better sense of what is currently in the market and any underlying game mechanics. Also during this introduction, participants will receive a brief explanation on what struggles MS patients go through and how physical activity can benefit them.

Participants will be separated into different work groups of similar size where each group will receive instructions on a different method for gamification design. One group will be given Salumedia's Gamification framework that takes advantage of proven gamification techniques and Bartle's Player Typology in combination with User-Centered Design principles. The other group will use the GameOn Toolkit, a Gamification Canvas with similarities to the Business Model Canvas. This model uses a boardgame-like approach to gamification, using cards and boards to clearly differentiate elements and actors of the system they are creating. Participants will use their assigned methodology to brainstorm and produce gamified solutions for MS patients. This activity has an approximate duration of 60 minutes.

Both groups will present their proposed gamification design at the workshop's final section, this will allow participants to discuss and comment each solution, assessing potential unintended outcomes and advantages. A badge and a certificate of completion will be given for each attendee before they leave the workshop.

# Panel: Big Data & Social Media for Empowering Patients with Diabetes

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**Abstract:** Millions of people living with diabetes are using mobile phones, Internet and social media to socialize with other patients, share experience or search information relevant for their self-management. This phenomena is leading towards a new paradigm of hyper-connected diabetes digital self-management. This is also leading towards an explosion on data, a large amount of data is collected on populations around the world. This panel will address the opportunities this data presents, discuss the latest research that uses it, and the limitations and other concerns.

**Keywords:** Big Data, Social Media, Diabetes, mHealth, Internet, Public Health

## 1. Panel Description

We will explore different cases and scenarios in this panel aiming at providing an interesting ground the academic discussion. The following short talks (15 minutes each) are planned to inspire a round table of Questions and Answers (30 minutes).

**Social Media for Diabetes Self-Management** (QCRI-Qatar Foundation, Luis Fernandez-Luque): this talk is designed to provide an overview on the state of the art with regards of the use of social media in diabetes care and prevention. We will focus on several examples on social media applications for diabetes empowerment such as a) social networks, b) social apps, c) social games, d) MOOCs.

**Social Media Analysis for Surveillance of diabetes risk factors** (QCRI-Qatar Foundation, Yelena Mejova PhD): this talk will focus on how social media can be used to monitor risk factors of diabetes. The talk will be based on the experience of the Qatar Computing Research Institute tracking obesity and dietary behavior through social media. This information is highly correlated with nation-wide obesity and diabetes prevalence in US, and provides predictive power beyond demographics. Social media data also allows to observe network effects in health-related behaviors. Social interactions, and the (un)healthy behaviors they encourage, are easily quantifiable on these websites, and allow for global analysis.

**Big Data, Social Media and Clinical Information** (Research Programme on Biomedical Informatics IMIM-UPF, Miguel A. Mayer): In the last few years we have seen an explosion in the number and diversity of resources and databases with health information such as EHR, PHR, epidemiological data, drug databases and all the 'omics' data. In order to exploit this information efficiently, it is critical to develop tools that facilitate the integration of information of different formats and vocabularies. In this context, the European Medical Information Framework (EMIF) is developing a common platform to promote the integration and access to existing information from several resources. In this scenario, the use of health information from social media can contribute to complete the health picture of population and patients. EMIF has received support from the EU/EFPIA Innovative Medicines Initiative JU (grant n° 115372).

**Be Healthy - Social mHealth for Diabetes Management and Prevention** (WHO): Be Healthy – Be Mobile is an initiative by WHO and ITU on mHealth for Non-Communicable Diseases. The program started in 2013 and currently have eight countries (such as India, UK and Senegal) running national mHealth services that are on their way to becoming national services. Be Healthy projects are focused on COPD, cervical cancer, hypertension and diabetes. A wide range of technologies are used in Be Healthy, including SMSs and Social Media. In this talk, we will discuss how social media can be a carrier for health education (including diabetes) in low-income countries and explore the role of governments and global organizations.

## **2. CVs of Panel Organizers**

**Luis Fernandez-Luque PhD** (Qatar Computing Research Institute, Doha, Qatar). He has more than 50 peer-reviewed publications, 32 of them indexed in PubMed and cited over 750 times in the last 5 years (according to Google Scholar). He has been coordinating national projects and participated in numerous international projects. He is currently the Chairman of the Social Media Working Group of the International Medical Informatics Association.

**Yelena Mejova PhD** (Qatar Computing Research Institute, Doha, Qatar) is a researcher in social computing with special interest in public health monitoring using social media, including the surveillance of health risks (e.g. dietary). She got her PhD at the University of Iowa (USA) in the topic of sentiment analysis within and across social media. Currently she works in the Social Computing Research Group at the Qatar Computing Research Institute where she is leading several health-related social computing projects.

**Miguel-Angel Mayer MD, PhD, MPH** (IMIM-Universitat Pompeu Fabra, Barcelona, Spain) is a specialist in Family and Community Medicine with experience in the National Health Service in an Internal Medicine Department and in Primary Care. He was the director of Web Mèdica Acreditada Department of the Medical Association of Barcelona. Currently he is a researcher at the GRIB and associate professor of Biomedical Informatics at the UPF Medical School. He has been involved in eight funded research European projects since 2002, in areas such as ICT strategies, Semantic web, re-use of EHR for research and Social Media analysis.

**Per Erlend Hasvold** (WHO, Geneva, Switzerland) - has over 20 years of experience in Telemedicine and eHealth. Before taking a new position at the World Health Organization he was the section leader at the Norwegian Centre for Integrated Care and Telemedicine, University Hospital of North Norway, and has been a lecturer at the International Master of Science in Telemedicine and eHealth at The Arctic University of Norway, and was the Administration Manager of Tromsø Telemedicine Laboratory.

**Surabhi Joshi** (WHO, Geneva, Switzerland). She is the focal person for country implementation of the mHealth initiative in the African, South-East Asian and Western Pacific Regions of the WHO, and for the monitoring and evaluation of mHealth. Prior to this, Surabhi was working at WHO Geneva on strengthening country health information systems. She has previously worked at the International Union for TB and Lung Diseases (IUTLD) in New Delhi, UNAIDS Technical Support Facility at Nepal, and the National AIDS Control Organization, Ministry of Health, Government of India in New Delhi.

# A Faculty Peer Network for Integrating Consumer Health Solutions in Nursing Education: Contextual Influences and Perspectives

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**Abstract.** The Canadian Association of Schools of Nursing and Canada Health Infoway recently launched a national project to facilitate the integration of digital and consumer health solutions into undergraduate nursing programs across Canada. Led by eleven nursing faculty members with expertise in informatics, the Digital Health Nursing Faculty Peer Network provided a forum for mentorship and support to other nursing faculty (72) across Canada and facilitated the development of a number of strategies to advance the incorporation of digital health content into undergraduate nursing curricula (e.g., the creation of a Faculty Toolkit for teaching Consumer Health Solutions). In this panel presentation, contextual and regional influences as well as specific perspectives related to the experience of each of the panelists within the Faculty Peer Network project will be outlined and discussed.

**Keywords.** Nursing education; consumer health; digital health; peer network; nursing informatics competencies

## 1. Panel Organization

**Elizabeth Borycki, RN, PhD**, School of Health Information Science, University of Victoria, Victoria, British Columbia Canada, [emb@uvic.ca](mailto:emb@uvic.ca), Dr. Elizabeth Borycki RN PhD is an Associate Professor and Vice-Chair of the IMIA Health Informatics for Patient Safety Working Group and has extensive experience examining the effects of health information systems upon Patient Safety.

**Karen Furlong, RN, MN, PhD**, Senior Teaching Associate, University of New Brunswick, Saint John, [Karen.Furlong@unb.ca](mailto:Karen.Furlong@unb.ca) – Dr. Furlong is involved in several informatics-related activities including: President Elect for both the New Brunswick Nursing Informatics Group (NBNIG) and the Canadian Nursing Informatics Association. These professional activities are closely aligned with Dr. Furlong's interest in supporting faculty with the integration of informatics content into nursing curricula.

**Manal Kleib, RN, PhD** Assistant Professor, Faculty of Nursing, University of Alberta and a Health Informatics Consultant at Alberta Health Services,



[manal.kleib@ualberta.ca](mailto:manal.kleib@ualberta.ca) – Dr. Kleib is the founder of the Nursing Informatics Association of Alberta (NIAA) and a strong advocate for advancing nursing practice in Canada through informatics and digital health. Currently, she is leading a number of research projects focused on informatics competencies assessment and development in nursing.

**Lynn Nagle, PhD, RN, FAAN**, Assistant Professor, Lawrence S. Bloomberg, Faculty of Nursing, University of Toronto, [lynn.nagle@utoronto.on.ca](mailto:lynn.nagle@utoronto.on.ca). With more than 30 years of experience, Dr Nagle is recognized internationally for her work in informatics. The Founding President of the Canadian Nursing Informatics Association, she has extensive experience with the use of information and communication technologies in healthcare. She has her own health informatics consulting practice and is also an Assistant Professor at the University of Toronto, Lawrence S. Bloomberg Faculty of Nursing.

### **Timeline of activities**

Ms Doyle will introduce each of the panelists and briefly frame the presentation and the development of The Canadian Association of Schools of Nursing (CASN) and Canada Health Infoway (Infoway) *Digital Health Nursing Faculty Peer Network* in the context of social media and participatory health. Panelist presentations will each last 10 minutes and panelists will emphasize how this project assisted faculty in understanding how nurse-patient relationships and regulatory standards are evolving in response to consumer health solutions with a focus on social media and participatory health.

- Dr. Lynn Nagle will provide an overview of the *Digital Health Nursing Faculty Peer Network* project, describing deliverables, structure, and progress in relation to the development of digital health competencies in undergraduate nursing education.
- Dr. Elizabeth Borycki collaborated with nurse educators and practicum coordinators as part of her Peer Leader work. Elizabeth will discuss the methods, issues and considerations when integrating nursing informatics and social media competencies into a student nurse practicum context.
- Dr. Karen Furlong collaborated with nurse educators within the Atlantic provinces. She will explore two key collaborative peer network projects: 1) a team approach in mapping CASN nursing informatics competencies within a bachelor of nursing program; and, 2) the development an innovative activity for undergraduate nursing students in a classroom setting. Enhancing student awareness of professional accountability was a primary learning objective for this second project in the use of social media.
- Dr. Manal Kleib collaborated with nurse educators as well as nurses in practice to facilitate the uptake of nursing informatics competencies and digital health in Alberta. She will discuss: (1) the development of a nursing informatics specialty practice group in Alberta (NIAA); (2) the importance of creating continuing education opportunities in informatics to support nurses in practice, and (3) examples of learning activities developed through the Peer Leader Network project to increase students' understanding about social media tools.

There will be about 40 minutes for questions and discussion. The following are a sample list of debatable questions:

1. Many clinicians continue to resist consumers having direct access to their clinical data. Is this reasonable?

2. Consumer health solutions are shifting the power differential between clinicians and patients; should this be a concern?
3. What other methods could CASN-Infoway utilize to help spread the diffusion of consumer health competencies and knowledge throughout Canadian nursing educators?

### Panel Description

Over the last decade, digital health technology use in the nursing profession (including electronic health record, medication administration technologies, social media, and other point-of-care and mobile technologies) has become an expectation. Additionally, there has been an increase in society's uptake and interest in the use of consumer health applications such as wearables, remote patient monitoring, social networks and mobile health applications. The field of consumer health informatics has evolved to bridge the gap between patients and healthcare providers. CASN and Infoway recognized the need for support for nursing faculty integrate consumer health informatics education in addition to the already developed *Entry-to-Practice Nursing Informatics Competencies* for baccalaureate nursing programs in Canada <sup>[1]</sup> which resulted in CASN and Infoway's creation of a *Digital Health Nursing Faculty Peer Network*.

Eleven nursing faculty, Peer Leaders, with backgrounds and interest in nursing informatics, are leading and developing this network specific to schools in the region in which they work. These Peer Leaders recruited 72 nursing faculty (with an initial goal to recruit 70), by targeting faculty at schools in their region, to participate in the Peer Network. The Peer Leaders co-develop learning plans with nursing faculty to determine their specific learning objectives. CASN provided access to a learning management system and web conferencing software to facilitate peer-to-peer communication and resource sharing. Peer Leaders and participants in the Network share their success stories and teaching strategies in relation to integrating consumer and digital health, an emerging practice focus currently lacking faculty resources.

Challenges reported by the Peer Leaders and the faculty to date included: connecting by distance, making connections with faculty, competing demands on nursing education, and a lack of support for digital health content inclusion. The Peer Leaders reported some initial successes including course and curriculum reviews to look for opportunities for integrating digital health, increased awareness of the CASN competencies and other digital health resources, and opportunities to conduct research.

The CASN-Infoway Digital Health Nursing Faculty Peer Network has been a successful, innovative grassroots initiative that has produced momentum, awareness, and uptake of nursing informatics specifically related to digital and consumer health within undergraduate nursing education. In addition to overall conclusions related to the Peer Network project as a larger entity, each panel presenter will provide their own unique insights related to the importance of deeper adoption and assimilation of consumer health competencies into undergraduate nursing curricula.

### References

- [1] Canadian Association of Schools of Nursing. Nursing informatics entry-to-practice competencies for registered nurses. Retrieved from [http://www.casn.ca/en/Whats\\_new\\_at\\_CASN\\_108/items/123.html](http://www.casn.ca/en/Whats_new_at_CASN_108/items/123.html). 2012.

# Use of Social Media in Facilitating Health Care Research Among Nursing and Allied Health Undergraduates in Sri Lanka

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**Abstract.** A mentoring program was designed to promote conduction, completion and dissemination of undergraduate research among Nursing and Allied Health students in Sri Lanka. Several social media platforms were used; mainly the Facebook, YouTube and Google Hangouts. Knowledge sharing, interaction and collaboration were promoted. Student motivation was also done. Research presentation skills and applying for conferences was also facilitated. Over 90% of the participated 262 students completed a research project and close to 50% presented them both locally and internationally.

**Keywords.** Social Media for Research, Undergraduate Research, Facebook for Research, Nursing Research, Social Media for Nursing, Health Care Research

## 1. Introduction

The importance of undergraduate research has been emphasized by many researchers and scholars. Lopatto conducting a research on undergraduates tendency to do research, in 2004 stated that among undergraduates who were willing to do research during their undergraduate study period showed a higher tendency to enter post graduate studied (83%)” (1). In Sri Lanka however health fields except medicine (nursing or other allied health fields) have limited opportunities for continuous education, higher education or research. In the present IT and social media dominated era, it was thought to formulate a research question as “Can a social media based mentoring program stimulate Health Care Undergraduates be to conduct and disseminate Research?” Therefore, the objectives were to undertake a strategy to promote undergraduate Research and to assess the presented researches at the end of the promotion strategy

## 2. Methods

An interventional study was conducted from 2013 – 2015 among Nursing (mainly) and Allied health sciences students at the International Institute of Health Sciences, Sri Lanka. 262 students with no research experience (following diplomas and bachelors degrees) were chosen (210 Nursing and 52 Allied health). A mentoring program similar

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to that conducted at the Texas A&M University-Kingsville (2) was conducted to aid in the design, conduct, analysis and dissemination of original undergraduate research projects using the social media platforms like Facebook, Youtube and Google hangouts to facilitate mentoring. A post Interventional analysis was done on the interactions made on Facebook groups, locally and internationally presented researches.

### 3. Results

Of the Facebook interactions 12% of the posts were links, 8% were videos and 22% were photos. On average there were 3.04 comments per post. Out of the entire group activities 23% were comments. 86% of the posts had some sort of an interaction. Out of the 262, 239 students (91.2%) completed their research projects. Out of these 129 were presented. Out of them, 87 were oral and 42 were poster presentations. 54 were individual and 31 were Collaborative projects (24.03%). Out of the entire group (262) students 49.2% have presented researches. Most of the presentations were by Nursing Students (78%). Out of the presented researches 72.86% were from the Diploma level. 104 were surveys, and 25 were qualitative researches. 32 students went out of the country to present their researches. Qualitative Analysis showed Facebook being useful to promote student-teacher interactions in terms of communication, information sharing, providing feedback (in both directions), collaborative learning and for self directed learning. YouTube and Google hangouts were particularly useful in information sharing and retrieval.

### 4. Discussion

Over 90% of students completed their researches and close to 50% presented them. It seems that the use of social media were not merely an adjunct or a paralleled support, but at times may be the main content delivery mode for some aspects of research teaching. Further research should be done on a more structured content delivery plan balanced between class room teaching and using social media.

### 5. Acknowledgments

I acknowledge the support given by IIHS - Sri Lanka.

### References

- [1] D. Lopatto, Survey of Undergraduate Research Experiences (SURE): First Findings, *Cell Biol Educ*, 2004 Dec 21;3(4):270–7.
- [2] DH Kinkel, SE Henke., Impact of undergraduate research on academic performance, educational planning, and career development., *J Nat Resour Life Sci Educ.*, 2006;35(1):194–201.

# Effects of Using Multimedia Situational Teaching in Establish Nurse-Patient Relationship for New Nurses

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**Abstract.** In recent years, endless stream of news for medical violence to make Nurse-Patient Relationship (NPR) was valued. This study is using Multimedia Situation Teaching (MST) to intervene in Nursing training process keep 6 months, probe the effects of new nurses to establish of NPR. Choose 11 new nurses in a medical ward for the study. Using Therapeutic Interpersonal substantive capacity questionnaire survey effects of new nurses establish NPR. After intervention, 94.45% of new nurses can use positive attitude to establish NPR, 90.90% of new nurses represent MST can effectively convey the right attitude in a clinical situation. Using MST can effectively improve new nurses established NPR, we can further enhance the quality of Nursing care, reduce the incidence of medical violence.

**Keywords.** Multimedia Situational Teaching, Nurse-Patient Relationship, New nurses, Positive attitude, clinical dilemma

## 1.Introduction

NPR is a professional process of socialization, with Nursing, attitudes, behavior and get along with patients and their families. A well NPR can enhance the quality of Nursing care, reduce the violence of medical. [1] [2]

Using multimedia teaching can replace the shortcomings of traditional teaching, it can exact convey attitude and behavior, also can use image produces imitative learning. [3] Therefore, this study uses MST to promote new nurse establishes a well NPR.

## 2.Methods

This study adopted convenient sampling, nurses who has over 2years experience was excluded, choose 11 new nurses in a medical ward. MST was made by use clinical situation was divided into two sections, one section showing a nurse establish a well NPR after using empathy, caring, listening, etc., positive attitudes in dealing with the patient's needs. Another one is using impatient dialogue, perfunctory act, ignored, etc., negative attitudes to deal with patient's complain lead to clinical conflict, then use video recording, put in the new nurse training process, and then clinical preceptor guide them to use positive attitude to face a clinical dilemma.

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Using Therapeutic Interpersonal substantive capacity questionnaire of Taiwan Society of Psychiatry, keep using MST after 6 months to fill out the questionnaire. And the last plus new nurse's for MST comment in the questionnaire.

### 3.Results

The results show 94.45% of new nurses can use positive attitude to establish NPR. 4.55% of the new nurses still unable to do that, found that new nurses only have 6-7months of Nursing experience.

Analysis of new nurses who comment on MST, 90.90% of them represents MST compared to traditional teaching can convey the right attitude for them; 9.10% of them represents MST is more easziler to understand how to establish a well NPR.

### 4.Discussion

Under the MST the important effect is new nurse can successfully use positive attitude to establish a well NPR. And Nursing experience will also affect the NPR establishment, new nurse has to still enrich their professional knowledge and skills, can effectively establish a well NPR.

In the future, will modified MST then use in health education group, doctor and nurse's communication, because of need the all of Healthcare team member together effort to build a better medical environment.

### References

- [1] C.A. Segaric; W.A. Hall. Progressively Engaging Constructing Nurse, Patient, and Family Relationships in Acute Care Settings. *Journal of family nursing*, 2015, **21.1**: 35-56.
- [2] A.E. Van Den Heever; M. Oggenpoel.; C.P.H. Myburgh. Nurses' perceptions of facilitating genuineness in a nurse-patient relationship. *health sa gesondheid*, 2015, **20.1**: 109-117.
- [3] M. Omura, et al. Measuring the impact of an interprofessional multimedia learning resource on Japanese nurses and nursing students using the Theory of Planned Behavior Medication Safety Questionnaire. *Nursing & health sciences*, 2015, **17.4**: 500-506.

# Nurses Guidelines for Using Social Media by Finnish Nurses Association

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**Abstract.** To encourage the use of social media, Finnish Nurses Association worked on social media guidelines. The aim was to strengthen the use of social media as a tool for nurses for sharing of professional knowledge as well as the acquisition of knowledge in their free time and in the work field. Guidelines were based on Nurses Ethical Guidelines and was supplemented by literature review. To enforce the guidelines into action, nursing twitter chat, #HOIchat, started. In addition, yearly held Finnish Nurses conference had a workshop where anybody could come for detailed information of social media tools and platforms as well as personal lessons how to get started and how to use various social media tools in everyday nursing.

**Keywords.** Nurses, nursing, guidelines, social media, twitter.

## 1. Introduction

Social media can be one of the operational environment in nursing care. The key is the interaction between nurse and client/patient using electronic tools (eTools). Social media eTools and applications can be used with computer, tablets or smartphones.

Using social media in direct patient contact is rare. However, the society is using social media in communication, information retrieval and information transmission, which can be applied into nursing.

## 2. Methods

Literature review and the nurse's ethical guidelines were used in forming social media guidelines to encourage the use of different tools and environments in nursing. In literature review, the aim was to synthesize the literature of using social media and various eTools in nursing. Also other existing guidelines for using social media in professional purpose were analyzed.

## 3. Results

The guidelines were summarized into six points. Firstly to use only for the benefit of the patient. Secondly to remind of the professionalism in the communication and

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relations with patients. Thirdly to pay attention to confidentiality and professional secrecy. Fourthly to ensure your own safety and privacy in internet. Fifthly to carry the responsibility to the profession and the employer's public image. And lastly to use social media for the common good.

In addition to the guidelines was started a chat in Twitter, #HOIchat. During the first year were 4 discussions held in the field of the health policy, nursing management and nursing care.

Furthermore were also a workshop available during Finnish Nurses conference, where anybody could come for detailed information of social media tools and platforms as well as personal lessons how to get started and how to use various social media tools in everyday nursing.

#### **4. Discussion**

For using social media as professional operational environment apply the same ethical guidelines as elsewhere in nursing. In addition, there is also need to learn new skills and change the view how we see traditional nursing care with a broader perspective, e.g. information security and privacy in social media. With nurses social media guidelines we wanted to encourage nurses to use social media as a tool for nursing, professional distribution of information or the acquisition of knowledge, and collegial networking also in free time. It is important to nursing to anticipate and respond to the challenges of the digitalization of society.

#### **5. Acknowledgments**

We would like to thank all the nurses using social media in nursing care and for sharing their knowledge.



# Development of a Multimedia Dysphagia Assessment Learning System using Responsive Web Design: from e-Learning to m-Learning

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**Abstract.** Swallowing problems have significant affect the health outcome of some residents in long-term care facilities. Nursing staff who care these residents should have the ability of assessing dysphagia. However, nursing continued education to improve the performance of dysphagia assessment is still challenged. To enhance nurses' capability of dysphagia assessment, a Multimedia Dysphagia Assessment learning System was developed for nursing staff in long-term care institutions. This system was evaluated by performing a user usability test.

**Keywords.** Dysphagia, m-learning, e-learning, responsive web design, usability

## 1. Introduction

The early detection swallowing problems among elderly residents with chronic diseases can prevent complications during long-term care, such as malnutrition [1]. Nurses must be given continuing education after they have graduated to learn to assess dysphagia correctly [2]. Continued nursing education can ensure the care that is provided from nursing staff follows the principles of patient safety and quality of care, especially at long-term care institutions. This work describes the development and pilot usability test of a multimedia dysphagia assessment learning system using responsive web design.

## 2. Methods

A multimedia dysphagia assessment learning system (MDALS) was developed in computer languages C#, Javascript, CSS, using ASP.NET web framework and SQL as

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the operational database. The system used Responsive Web Design (RWD) was used to design adaptive navigation across different device. The system runs upon different end user platforms, such as Microsoft's Windows Win7, Macintosh's iOS, and Android Operating System. Web pages are automatically adapted to the size of the screen.

### 3. Results

Three to five experienced nursing staff working in a long-term care institutes had completed the usability test of the system. Most of their responses were positive; some made suggestions for revisions, such as to include a video icon that indicate case condition, an email reminder of question and answer, a picture in a picture to present more information regarding teaching details; increase the number of situations in which dysphagia is assessed, and others

### 4. Discussion

Three to five nurses tested the system for usability on four occasions. Most of their responses were positive; some made suggestions for revisions, such as to include a video icon that indicate case condition, an email reminder of question and answer, a picture in a picture to present more information regarding teaching details; increase the number of situations in which dysphagia is assessed, and others. Figure 1 present the beta version of the system following revisions that are based on the results a usability test.

### 5. Acknowledgments

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### References

- [1] S. J Wu, H.H Wang, K. M Chen, S.H. Yeh. Nutritional status of nursing home residents in Taiwan. *Biological Research for Nursing* **13**(2010), 189-195.
- [2] V. Magnus, Dysphagia training for nurses in an acute hospital setting-a pragmatic approach. *International Journal of Language & Communication Disorders* **36** (2001),375-358.

# A Social Media–Based Mindful Yoga Program for Pregnant Women in Taiwan

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**Abstract.** Social media, a communication tool, is increasingly used to facilitate the engagement of experts (such as a health provider) and other participants in a wide range of programs. However, social media requires study to elucidate its applications under women health-related conditions. This work develops a social media-based mindful yoga program for pregnant women, and delivers media content by ways of Facebook platform and DVD. The results of pilot testing revealed users' preference of using Facebook platform. Developing experience and users' responses can provide valuable information for further implement social-media based interventions.

**Keywords.** Social media, mindful yoga, Facebook, mobile, pregnant women

## 1. Introduction

Social medial is changing the way people communicate, share information, and health education and become educated about health [1]. To change health behaviors, social media-based activities have been initiated in the areas of general healthcare area [2], disease prevention and screening, tobacco use and others . This work develops of a social media-based mindful yoga program multimedia and put media content in two ways of Facebook platform and DVD for pregnant women.

## 2. Methods

A mix-method design is utilized in this study. Two ways of DVD/Facebook are the tools used herein to deliver mindful yoga videos to pregnant women. The mindful yoga program was designed by a team of multi-disciplinary experts – in nursing informatics, obstetric nursing, obstetric medicine, and yoga expertise. A twelve-week video program prenatal mindful yoga class was designed based on the literature ; its main topics included breathing relaxation and stress reduction, releasing prenatal discomfort

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symptoms, and maternal-fetal attachment. The video and audio editing software was CyberLink PowerDirector 13 and Audio director 5 to edit senses (e.g., add narration, titles and transitions between video clips). Then, the video was converted into MP4 and WMV formats thus files were burnt onto DVD discs (4.7G) and distributed to Facebook.

### 3. Results

Concerned with both the effectiveness of learning and associated learning load, the team designed video clips that were 20-to-30 minutes long. Table 1 shows that prenatal yoga poses with mindfulness induction were arranged for each week. Fifty pregnant women had been recruited in the mindful yoga program from a local hospital and a clinic. A telephonic followed up of these users for confirming that their actual usage. The comments from these participants also have been collected that help researchers understand using frequency and their preference. Some of these participants' responded that Facebook was easier to use, as it allowed them to practice in their bedrooms and living rooms. Others commented that they preferred the DVD because the screen was large than that of the mobile devices that they used to access Facebook. Most of participants used both tools by turns. One respondent stated that she firstly learned new yoga poses by watching the video the DVD on TV.

### 4. Discussion

Although this research is still ongoing, considerable experience has been gained concerning the development, and testing of social multimedia content. Regarding Facebook platform, it allows the uploading of video that are less than 1024MB for each video. Facebook via mobile/PC/Smart TV is a feasible platform for some users. Social media sites such as Facebook offer multiple opportunities for both healthcare providers to deliver health educational materials and for women to easy access these resources. During the video conversion process, some issues must be taken into consideration to increase users' satisfaction. Screen type must be considered because displays with aspect ratios of 4:3 or 16:9 are used.

### 5. Acknowledgments

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### References

- [1] B. Eschenbrenner, F.F.-H. Nah, *Social Media in Health Care*, HCI in Business, Springer, 2015, pp. 76-85.
- [2] J. Bae, Effectiveness of Web-Based Multimedia Health Education Program on Maternal Role Strain, Role Attainment and Postpartum Depression, *IJCSNS* 9 (2009) 96.

# Public Use of Mobile Medical Applications: A Case Study on Cloud-Based Medical Service of Taiwan

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**Abstract.** The use of smart mobile devices has been getting increasingly popular. The focus of this study is an attempt to explore the development of mobile medical App by medical centers and regional hospitals of Taiwan and the function of the App for comparison. The results show indicated that many hospitals developed Apps for the public for mobile medical service, of which 26 medical centers (100%) and 72 regional hospitals (84.7%) availed appointment making service via Apps. The result indicated variance at significant level ( $p < 0.01$ ). There are 23 medical centers (88.5%) and 74 regional hospitals (87.1%) availed Apps for checking service progress. The result indicated insignificant variance level ( $p > 0.01$ ). We can see that mobile medical service is gradually emerging as a vital issue. Yet, this is a new domain in medical service. With the mushrooming of medical applications in smart mobile devices, the medical service system is expected to be installed in these devices to enhance interactive mode of operation and inquiry services, such as medication and inquiries into physical examination results. By then, people can learn the status of their health with this system.

**Keywords.** Mobile Medical Applications, Cloud-Based Medical Service, medical centers, Regional hospitals

## 1. Introduction

The use of smart mobile devices has been getting increasingly popular. This has gradually changed the lives and habits of consumers. In recent years, mobile medical Apps have been able to link the hospital and clinics, medical devices manufacturers and the consumers very closely to provide consumers convenient means for self-monitoring and health management [1]. The proliferation of the smart, mobile, and cloud technologies triggered a new wave of revolution in the information industry. As a result, different types of applications in our daily lives were created with the upgrade of medical information accessible by portable devices. How to use cloud technology innovatively will be the foremost challenge to all hospitals nowadays [2].

The service content and the markets are different. The rapid advancement of the hardware technology of mobile devices triggers the launch of new models or versions more quickly. This prompts for the higher efficiency and adaptability of the development of mobile Apps, and poses strong pressure and severe challenge [3]. The focus of this study is an attempt to explore the development of mobile medical App by medical centers and regional hospitals of Taiwan and the function of the App for comparison.

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## 2. Methods

Secondary data were adopted in this study for analysis. The data were collected from the websites of the hospitals and secondary database. A full-range data search has been conducted covering April and May 2015 and classified by hospital accreditation. There were 111 samples including 26 medical centers and 85 regional hospitals sorted out for study. There are six categories, namely, appointment making, inquiry of progress, pharmaceutical information, prescription and dispensing, examination result inquiry, and charge for medical service. Statistical analysis will be conducted based on the responses of either “yes” or “no”.

## 3. Results

The data were collected from the websites of the hospitals and secondary database. A full-range data search has been conducted covering April and May 2015 and classified by hospital accreditation. There were 111 samples including 26 medical centers and 85 regional hospitals sorted out for study. The statistics of the development of mobile medical App by hospitals for public use and the functions is the gravity of this study. There are six categories, namely, appointment making, inquiry of progress, pharmaceutical information, prescription and dispensing, examination result inquiry, and charge for medical service. The research findings indicated that many hospitals developed Apps for the public for mobile medical service, of which 26 medical centers (100%) and 72 regional hospitals (84.7%) availed appointment making service via Apps. The result indicated variance at significant level ( $p < 0.01$ ). There are 23 medical centers (88.5%) and 74 regional hospitals (87.1%) availed Apps for checking service progress. The result indicated insignificant variance level ( $p > 0.01$ ).

## 4. Discussion

The research findings indicated that medical centers and regional hospitals have successfully developed App systems for appointment making and service progress inquiries, which accounted for a very high percentage of utilization. The main cause is that people who made appointments for medical consultations via Apps can also check the progress of the queue with the same device, which will alert them of their appointments so they will not forget or miss the appointment.

Finally, we can see that mobile medical service is gradually emerging as a vital issue. Yet, this is a new domain in medical service. With the mushrooming of medical applications in smart mobile devices, the medical service system is expected to be installed in these devices to enhance interactive mode of operation and inquiry services, such as medication and inquiries into physical examination results. By then, people can learn the status of their health with this system.

## References

- [1]. L. P. Yu. Development initiatives and opportunities for the medical industry in Taiwan - From the American Medical Applications Action Guidelines Reg Med. *Computer*, **42**(2014), 9-22.
- [2]. C. W. Yang. The User-centric Based Mobile Health Apps to Facilitate Patients while Receiving *Medical Treatments*. *Hospital*, **47**(2014), 24-29.
- [3]. C. L. Huntley. Onshore Mobile App Development: Successes and Challenges. *Computer*, **44**(2011), 102-104.

# The New Issue of Social Media in Education and Health Behavior Change - Virtual Visit of Tele-Nursing

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**Abstract.** Tele-Nursing is a kind of virtual visits, to our nursing professional developed as a new future, based on Who's policy that is to deal with nursing shortage in the worldwide. Then how to connect the clinical phenomena to synthesis concept is top urgent. The systemic review method and case manager interview to collect the clinical phenomena, the concepts analyzed by Norris Method to analyze the virtual visit. Finally the results of research finding were five categories which were available; security; science and technology derived consequences for nursing; to monitor quality of nursing care; support from social network. The Virtual Visit of Tele-Nursing's concept will be leading nursing knowledge to theory.

**Keywords.** Virtual Visit; Tele-Nursing, Nurses, Norris method, Concept Analysis.

## 1. Introduction

Tele-Nursing is a kind of virtual visits, one of disadvantage is lack of face to face communication, and the loss of communication message is estimated more than 50%. People with chronic disease and aged in right place that need more nursing care by technology of telephone communication. It's a challenge, meanwhile also opportunities on nursing professional development.

## 2. Methods

The interviews and observation were from clinical phenomena. To analyze the virtual visit phenomenon by Norris Method, and systematic literature review to summarize and interpretation methods. Finally we synthesis a model about Virtual Visit of Tele-Nursing (figure 1)

## 3. Results

There were three levels; five categories, sixty-three property attributes, five categories were "available; security; science and technology derived consequences for nursing; to monitor the nursing care; support from social network." The research hypothesis, one is

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people with chronic diseases who has demand of virtual visits and then communication is smoothly, the pathway is to be “available” and “security”, “science and technology derived consequences for nursing” stages. Otherwise, hypothesis two is about when the demand for people with chronic diseases and communication is not smoothly, then the pathway is to be “to monitor the nursing care”;” support from social network” stages.

#### 4. Discussion

The first impact is to synthesis a new nursing concept and knowledge about Tele-Nursing. Otherwise these five categories and attributes as foundation to construct clinical practice to evidenced knowledge of Tele-Nursing across the beginning of nursing information research.

#### 5. Acknowledgments

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#### References

- [1] G. Demiris, A. Z. Doorenbos, & C. Towle, (2009). Ethical considerations regarding the use of technology for older adults: the case of telehealth. *Research in Gerontological Nursing*, 2(2), 128-136. doi:10.3928/19404921-20090401-02
- [2] D. J. Fishman, (1997). Telemedicine: Bringing the specialist to the patient. *Nursing Management*, 28(7), 30-32.
- [3] A. Glasper, (2011). Telehealth care--where is it going? *British Journal of Nursing (BJN)*, 20(12), 714-714.
- [4] M. E. Greenberg, (2000). The domain of Tele-Nursing: Issues and prospects. *Nursing Economics*, 18(4), 220-222, 201.
- [5] W. R., Hersh, D. H., Hickam, S. M. Severance, T. L., Dana, K. P., Krages, & M. Helfand, (2006). Diagnosis, access and outcomes: update of a systematic review of telemedicine services. *Journal of Telemedicine and Telecare*, 12(1), 3-31.
- [6] S. Hughes, (2003). The use of non face-to-face communication to enhance preventive strategies. *Journal of Cardiovascular Nursing*, 18(4), 267-273.
- [7] L. Kidd, S. Cayless, B. Johnston, & Y. Wengstrom, (2010). Telehealth in palliative care in the UK: a review of the evidence. *Journal of Telemedicine and Telecare*, 16(7), 394-402.
- [8] L. Magnusson, E. Hanson, & M. Nolan, (2005). The impact of information and communication technology on family carers of older people and professionals in Sweden. *Ageing & Society*, 25(05), 693-713. doi:10.1017/S0144686X05003673
- [9] P. Mistiaen, & E. Poot, (1996). Telephone follow-up, initiated by a hospital-based health professional, for postdischarge problems in patients discharged from hospital to home *Cochrane Database of Systematic Reviews*: John Wiley & Sons, Ltd.
- [10] J. J. Moffatt, & D. S. Eley, (2010). The reported benefits of telehealth for rural Australians. *Australian Health Review*, 34(3), 276-281. doi:10.1071/AH09794
- [11] J. J. P. Moffatt, & D. S. M. P. Eley, (2010). The reported benefits of telehealth for rural Australians. *Australian Health Review*, 34(3), 276-281.
- [12] C. M. Norris, (1982). *Concept Clarification in Nursing*. Maryland: Aspen.
- [13] D. Roberts, C. Tayler, D. MacCormack, & D. Barwich, (2007). Tele-Nursing in Hospice Palliative Care. *The Canadian Nurse*, 103(5), 24-27.
- [14] B. L. Rodgers, & K. A. Knafl, (eds.) (2000). *Concept Development in Nursing: Foundation, Techniques, and Applications*. (2<sup>nd</sup> Ed.). Philadelphia: W. B. Saunders.
- [15] M. Sandelowski, (2002). Visible humans, vanishing bodies, and virtual nursing: complications of life, presence, place, and identity. *Advances in Nursing Science*, 24(3), 58-70.



# User-Centric eHealth Tool to Address the Psychosocial Effects of Sickle Cell Disease

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**Abstract.** Sickle cell disease (SCD) is the most prevalent blood inherited disorder in the world. Patients suffer from several chronic issues, comorbidities and high-mortality rates. Despite its prevalence, the disease remains largely ignored. A literature review was conducted and a questionnaire was sent to patients in order to understand the potential of e-health tools to support people with SCD. Additionally, focus groups have been conducted to detail respondents' answers. The results showed that patients felt isolated and misunderstood. They also highlighted patients' wishes for a social network able to make them feel less scattered. Using participatory-design techniques, we designed a prototype of user-centric interface for an online self-supportive SCD patient community. The mock-ups include chatrooms, forums and videoconferences capabilities. They illustrate how SCD patients' social networking and caregivers-patient relationship needs could be met. Future work will focus on the implementation and evaluation of the system.

**Keywords.** Sickle-Cell disease, Self-management, Social networks, Patient empowerment, Participatory design, e-Patients, Doctor-patient relationship

## 1. Introduction

Sickle cell disease (SCD) is one of the most prevalent genetic disease in the world. Approximately 300 million patients are affected [1]. Despite its commonness, the disease remains largely unknown, resulting in suboptimal care and health policies. In particular, limited attention is given to the psycho-social implications of SCD. Since the use of mobile applications and social networks to support self-management of chronic diseases has shown encouraging results [2], the authors were interested in identifying the requirements for the development of comprehensive tools addressing the whole needs of patients.

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## 2. Methods

Beforehand, a literature review was conducted to highlight the common issues faced by patients and to understand the potential of eHealth tools for self-management of patients with SCD. During the study, thirty-three patients answered an online survey, sent worldwide through patient groups. In order to detail the respondents' answers, three focus groups including four patients have been conducted.

## 3. Results and discussion

The results demonstrated that patients are feeling scattered and lonely. They are finding difficult to receive adequate help and support when needed. They associated this with the disease's general lack of awareness and dearth of well-trained and specialized healthcare professionals. Results highlighted also that low-prevalence countries had less patients' communities. Respondents identified tools that could allow them setting up a trusted online patients' community. They demonstrated an interest in using existing social networks platforms such as PatientsLikeMe. On the other hand, they accentuated the need of having a moderation of discussions and a verification of information by medical experts. They appeared willing to share advices enabling other patients to live healthier, exchanging for instance how to make decisions and take actions for a better quality of life (QoL). During the focus groups, we created a user interface prototype for smartwatches and mobile applications. These mock-ups defined a virtual way of communication such as the organization of social activities. Items, such as group discussions, chats, video conferences or forums including doctors were also sketched. Patients argued that the presence of gamification items was not necessary. Indeed, they said that a mobile social networking tool would be a sufficient motivation. Finally, despite the limited number of respondents, our study showed clear tendencies. It demonstrated the potential of such tools in offering an opportunity to meet their social needs and set up self-supportive communities. Ensuring a good quality, trustworthy and accurate information is of major importance. Doctors-moderators could support this constraint. The next step will be to detail the specifications of the system, to implement the online community and to evaluate the QoL outcomes.

## 4. Acknowledgments

Special thanks to the Swiss and Norwegian associations of people with Sickle-Cell disease for their invaluable support.

## References

- [1] WHO | Sickle-cell disease and other haemoglobin disorders
- [2] E. Arsand et al, *Mobile Health Applications to Assist Patients with Diabetes: Lessons Learned and Design Implications*. J Diabetes Sci Technol 2012;6:1197–206.

# Gamification of Clinical Routine: The Dr. Fill Approach

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## 1. Introduction

A severe issue in the clinical routine affecting patient health are medication errors, e.g. handing out wrong medications and wrong doses. We developed a game to train the correct dispensing of drugs, allowing the player to test and evaluate his or her correctness and performance.

Our work *Gamification of Clinical Routine: The Dr. Fill Approach* (Id=219) was strongly accepted as a full paper. In this work we present a real world gamification approach of the medication sorting task in a patient's daily pill organizer.

As we have a working prototype of our gamification approach Dr. Fill, we would like to demonstrate and offer to play the latest version of this interactive serious game. In the following, the general game principle, the status of the current and planned prototype will be discussed. For further information, such as the evaluation of the player's performance, we refer to our submitted paper.

## 2. General Game Principle

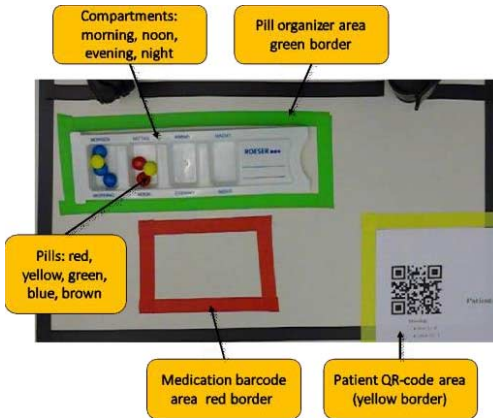
The game Dr. Fill observes and scores a person who is filling a pill organizer. The game is played on a game board with different color-coded areas (Fig. 1) and structured as follows (Fig. 2):

1. Game start: The player places the patient information and an empty pill organizer on the game board. The game phase starts and the time is recorded.
2. Game phase: The player fills the container with pills according to the medication plan into compartments. First, the medication is indicated by placing the barcode of the medication box on the game board and then putting the pills into the organizer. This step is repeated until the user ends the game.
3. Evaluation phase: The player ends the game by removing the pill organizer. The time counter then stops and the evaluation of the player's performance in terms of correct/wrong pills and time are displayed. Points are calculated on the base of correctness and speed. If wanted, the player can enter his or her

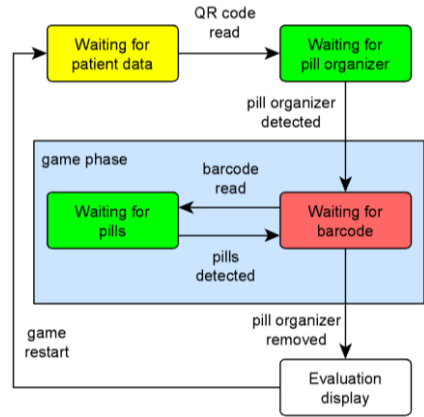
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name to be saved in a highscore list, but it is also possible to only provide a pseudonym or to discard the results.



**Figure 1.** Game board with color-coded areas.



**Figure 2.** Gameflow with game phase, colors indicate board areas.

### 3. Current Prototype

The current prototype of Dr. Fill is a working serious game, which can be played by one person at a time. The areas of the game board are defined by the colored tapes on a white table. The camera captures the real-world situation and transmits the images to the connected laptop, which processes the data in order to play the game regarding the defined game logic and scoring system. The captured images are shown with an overlaying user interface on a display in order to provide immediate feedback on success and errors. At the end of a game, a final game report and the current leaderboard are shown.

So, within the demonstration a player can act as a nurse filling a patient's daily pill organizer according to its requirements. For a pleasing demonstration, the pills are represented as colored chocolate lentils (M&Ms).

### 4. Planned Prototype

Until the conference we have planned to construct a more portable version. The major change is the planned usage of a projector which shall replace the display in order to project immediate feedback on the game board, such as highlighting the correctly or wrongly places pills. Therefore, the player and its interactions are more focused on the real-world environment which is augmented by the real-time projections. Some further improvements of the user interface and scoring systems are also planned.

# Interactive Patient Engagement: System Design to Cross the Continuum of Care

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**Abstract.** Patient Engagement is a critical and fundamental driver in the transformation of healthcare. Patient involvement through interactive care is a proven approach for improved health outcomes; however, a single strategy to achieve success will not suffice. An interactive patient engagement system design, as a multi-tactic landscape of solutions, is necessary to effectively engage patients.

**Keywords.** Interactive Patient Engagement, Consumer Informatics, eHealth, Patient Activation, Patient Education, Patient Portal

## 1. Introduction

Interactive healthcare information technology (IT) leads to increased patient engagement. As a result, healthcare organizations see improved efficiency, clinical outcomes, and satisfaction scores. As the landscape of healthcare changes both nationally and globally, the way in which care is delivered must change as well. Growing evidence supports that patients who are more engaged in their care have more satisfying experiences that result in better health outcomes. The Advisory Board has cited patient engagement as one of its three critical pillars for healthcare transformation. The Agency for Healthcare Research and Quality's *Guide to Patient and Family Engagement* found that patient engagement that focuses on (1) viewing patients and families as part of the healthcare team, (2) facilitating communication between patients and caregivers, (3) increasing patients' knowledge, skills, or abilities, and (4) providing patients with input into how care is delivered, can be highly effective and deliver more meaningful health outcomes.

Interactive Patient Engagement (IPE) pioneers believe that the most effective way to facilitate these strategies is to harness interactive patient technology that is specially designed and proven to improve both patient engagement and quality clinical outcomes. While current implementations are focused on the inpatient acute care setting, organizations must consider the entire patient care continuum in its evaluation for the applicability of an interactive patient engagement solution.

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## **2. Methods**

There are a myriad of tactics that will be employed in the design of this new IPE system. Multi-media interactive software enables patients to receive ordered patient education content. Viewership of patient education material via TV improves the acute patient experience and streamlines care processes such as pain management, discharge and service requests. Likewise, inpatient tablet-based solutions allow patients to view upcoming procedures, treatment team details, and lab results, all with accompanying patient-specific language. Patient-facing IT solutions that can deliver simplified, multi-lingual medication instructions for patients with low health literacy or limited English proficiency will also be explored. Finally, in the personal device integration domain, wireless-enabled devices for disease-specific monitoring (i.e. blood pressure cuffs, scales) as well as apps that support Shared Decision Making (SDM) and capture social determinants of health will be investigated.

## **3. Results**

Because this is an innovative system design in its pilot form, results have not yet been achieved. However, a number of measurable objectives and key performance indicators have been identified. The establishment of an IPE framework will support a culture of patient and family engagement that includes people, processes, and technology at all points throughout the care continuum. Equipment, software, and other infrastructure will be maintained at a level that is optimal to support the Interactive Patient Engagement Experience. Clinical and non-clinical workflow processes that utilize the IPE technology and support nurse, physician, care team, patient, and patient/family will be designed. Finally, a patient education strategy that meets all MUSC patient and family education needs will be developed and implemented.

## **4. Discussion**

Effective patient engagement relies on the design, implementation, and optimization of both established and emerging interactive technologies. A multi-faceted approach, considering various tactics to leverage throughout a patient's care continuum, is critical to the success of a comprehensive interactive patient engagement strategy.

## **5. Acknowledgments**

The author acknowledges the contributions of the Medical University of South Carolina's Patient and Family Education committee and the Interactive Patient Engagement Advisory Committee.

# A Systematic Review of Omaha System Literature in Turkey

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**Keywords.** Omaha System; Systematic review; Standardized terminology; Turkey

## 1. Introduction

The Omaha System is a comprehensive tool for enhancing practice, documentation and information management across health care settings.<sup>1</sup> This systematic review presents the state of science on the use of the Omaha System in practice, research, and education Turkey and to suggest areas for future research.

## 2. Methods

A systematic review of the literature published between 2000 and 2014 was conducted, searching electronic databases of Ovid MEDLINE, PUB MED, Cochrane CENTRAL Register of Controlled Trials, CINAHL, PsycINFO, Web of Knowledge, Scopus, Google Scholar, ULAKBIM Turkish Medical Database and Council of Higher Education Thesis Center. The primary key word “Omaha System” and its Turkish translations were used for searching.

Methodological quality of the reviewed research studies was evaluated with Joanna Briggs Institute MASTARI Critical Appraisal checklists for identifying methodological flaws in the studies included. Articles were included if studies were conducted in Turkey and published in either Turkish or English. All articles were read and then categorized to one of five categories: “analyzing client problems”, “clinical process”, “client outcomes”, “advanced classification research”, and “reports on unpublished master’s and doctoral dissertations”.<sup>2</sup>

## 3. Results

17 articles were identified. The majority (n=12) of the studies were published between 2010 and 2014. All studies authored by nurses and most of them were conducted in community health care settings such as occupational health, school health, public health, home care and nursing homes. More than one fourth of the studies focused on the analysis of clinical process (29%) and reports on unpublished master’s and doctoral

dissertations (29%). Nearly one-fourth of the studies focused on the analysis of client problems (24%). Twelve percent of the studies analyzed either client outcomes (6%) or advanced classification research (6%). The most common research design was descriptive (82%). None of the studies fulfilled all criteria of methodological quality. Methodological quality scores were low to moderate (averaging 5 out of 9 points). The most common methodological issues were: lack of identification of confounding factors, lack of strategies to deal with confounding factors, insufficient description of groups, lack of descriptions of subjects who withdrew from the studies.

#### 4. Discussion

This review identified a substantive body of recent literature that indicates the applicability of the Omaha System in Turkish healthcare settings among diverse populations. Methodological quality was moderate. These findings support continued research using the Omaha System in Turkey. Researchers analyzing Omaha System data should improve methodological quality and expand research to additional populations and settings.

#### References

- [1]. K. S. Martin, *The Omaha System: A Key to Practice, Documentation, and Information Management* (Reprinted 2nd edition ed.). Omaha, NE: Health Connections Press, 2005.
- [2]. M. Topaz, N. Golfenshtein, K.H. Bowles. The Omaha System: A systematic review of the recent literature. *J Am Med Inform Assoc.* 2014; 21: 163–170.

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# Student Documentation of Community Strengths Using Omaha System Terminology

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**Keywords.** Community assessment; Omaha System; Standardized terminology, Strengths

## 1. Introduction

The Omaha System is unique among standardized terminologies in offering a community-level modifier for documentation of community assessments. The conceptual definitions of the Omaha System Problem Classification Scheme are neutral, allowing interpretation in a negative (signs and symptoms) or a positive way. Asset-based community assessments have long been valued in public health to represent a balanced view of a community; however there is not currently a standardized terminology for strengths. Novel use of the Omaha System to describe community strengths would fill this gap<sup>1,2</sup>. It was aimed to determine the feasibility of using the Omaha System Problem Classification Scheme as a standardized terminology to represent community strengths.

## 2. Methods

We analyzed narrative community strengths data from 100 student-generated community assessments of the Omaha System International Windshield Survey project. Students used an online tool incorporating 11 concepts from the Omaha System Problem Classification Scheme to describe community observations during a windshield survey experience in public health nursing.

At least two researchers worked independently to categorize data so that their themes could be compared and discussed to improve congruence. First they eliminated comments that were not substantive or that simply stated the absence of existing Omaha System problems or signs and symptoms<sup>1</sup>. Next they examined the remaining community strength data, identifying unique concepts and grouping them into subthemes and themes. Finally, the researchers met to compare categorizations, discussing and resolving differences.

### 3. Results

Themes and exemplar student quotes will be presented in graphic form depicting strength concepts in three domains of the Omaha System. Sample quotes are: Environmental Health Domain: Residence, “Buildings are seen new, painted, completed and sound”; Neighborhood/ workplace safety, “there are playing and exercise areas”; Sanitation, “Environment hygiene is made by municipality efficiently”; Health Related Behaviors Domain: Nutrition, “It is easy to access all kinds of foods (from both market-greengrocer and farmers market)”; Substance use, “There is a ban to smoke and use tobacco products in all public indoor places”; Health care supervision, “People can easily access health care resources, there are three private hospitals and two public hospitals in the area; and Psychosocial Domain: Communication with community resources, “Schools, family health centers, vocational training centers and municipal recreation centers are nearby to living areas, there are many social activities in the recreation center”; Social contact, “Neighborhood relations are strong; Interpersonal relationship, “It is easy to communicate as people in the living in the area are being from the same place, relations are strong”; Spirituality, “People faith freely, there are mosques and other religious places in the area”.

### 4. Discussion

The Omaha System standardized terminology can describe strengths identified by students in community assessments. Themes and exemplar quotes provide a first step to development of operational definitions of strengths at a more granular level for future electronic health information exchange of community-level information.

### References

- [1]. K. S. Martin. *The Omaha System: A Key to Practice, Documentation, and Information Management* (Reprinted 2nd edition ed.). Omaha, NE: Health Connections Press, 2005.
- [2]. M.J. Kerr, K.A. Monsen, K. Nuxoll, E.A. Jones. *Undergraduate community assessment incorporating Omaha System community-level descriptors*. Paper presented at American Public Health Association Annual Meeting, Washington, DC, 2007.

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# Exploration of Risk Factors for Falls Using Electronic Nursing Records

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**Abstract.** Introduction: The purpose was to identify fall risk factors between admission day and fall occurred day using electronic nursing records and the Morse Fall Scale(MFS). Methods: The MFS and fall related data were obtained through retrospective chart review from June 1, 2014 to May 31, 2015. Descriptive statistics and McNemar test were used for statistical tests. Results: Fall was evaluated in 447 events, 16 patients experienced recurrent fall. Pain, emotional distress, urinary problems and fever were significant differences between admission day and fall occurred day. There were explored significant MFS risk factors in risk group, history of falling, second diagnosis, IV catheter status, medication concerning fall risk, mental status, general weakness and gait in MFS subscales. Discussion: Routine fall screening is important for early detection of fall. Identification of high-risk group and using fall prevention guidelines could improve prevention of fall.

**Keywords.** Fall, electronic nursing records, fall risk factors, fall prevention guidelines

## 1. Introduction

Falls cause injuries and death for hospitalized inpatients as well as physical, emotional, social, and financial consequence, and many fall prevention strategies have been used for reducing fall rates, damages related falls at all levels[1]. Nevertheless, falls are the most common type of inpatient adverse event. The purpose of this study was to identify the fall risk factors and fall related data between admission day and fall occurred day to evaluate the effectiveness of the Morse Fall Scale(MFS)[2] using electronic nursing records among hospitalized inpatients who have experienced fall.

## 2. Methods

We developed fall survey form to take the fall situation fully after reviewing previous literatures, fall guidelines, and patient safety reports. After developing form, reviewers corrected forms and categories to secure consistencies toward data several times (Fleiss Kappa= .83(.68-.94)). The electronic nursing records of total 447 events who reported falls in general nursing inpatient units from June 1, 2014 to May 31, 2015 were

retrospective chart reviewed. Descriptive statistics and McNemar test were used for statistical tests.

### **3. Results**

Fall was evaluated in 447 events, 16 patients experienced recurrent fall. The incidence rate of fall was 0.06% with a higher severity level of fall injury (9 patients, 2.0%) compared to no injury (315patients, 70.5%).

In health related medical record, pain, general weakness, emotional distress, urinary problems and fever were significant risk factors differences between admission day and fall occurred day.

There were explored significant risk factors in risk group, history of falling, second diagnosis, IV catheter status, medication concerning fall risk, mental status, general weakness and gait in MFS subscales between admission day and fall occurred day.

### **4. Discussion**

Routine fall screening is important for early detection of fall. MFS with high/low group was evaluated to be suitable and reasonable for predicting falls of inpatients. Identification of high-risk group and using fall prevention guidelines could improve early recognition and prevention of fall in hospital [3,4] .

### **References**

- [1] DiBardino D, Cohen ER, Didwania A. Meta-analysis: multidisciplinary fall prevention strategies in the acute care inpatient population. *Journal of hospital medicine*. 2012;7(6):497-503.
- [2] Morse, J. M., Morse, R. M., & Tylko, S. J. Development of a scale to identify the fall-prone patient. *Canadian Journal on Aging*. 1989;8:366-371.
- [3] Miake-Lye IM, Hempel S, Ganz DA, Shekelle PG. Inpatient fall prevention programs as a patient safety strategy: a systematic review. *Annals of internal medicine*. 2013;158(5 Pt 2):390-6.
- [4] Dykes PC, Carroll DL, Hurley A, Lipsitz S, Benoit A, Chang F, et al. Fall prevention in acute care hospitals: a randomized trial. *Jama*. 2010;304(17):1912-8.

# Evaluation of Nursing Actions Documented in EHRs for Patients Falls Against Clinical Practice Guidelines in a Korean Tertiary Hospital

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**Abstract** Purpose: Many fall prevention strategies have been used for reducing fall rates. The purpose was to evaluate fall prevention nursing against clinical practice guidelines and effectiveness of preventing strategies according to risk group. Methods: We developed fall survey form after securing consistencies (Fleiss Kappa= .83). The EHRs of 447 events from June 1, 2014 to May 31, 2015 were reviewed. Descriptive statistics and Chi-square test were used for statistical tests. Results: There were recorded 'Keep bed with brakes locked' in 272 patients (60.9%). Compared with clinical practice guidelines, 'instruction of patients to ask for help actively' and 'keep patients care areas uncluttered.' actions were few in EHRs. There were significant differences between risk groups in 28 nursing actions. Discussion: This study shows that fall prevention strategies according to risk groups are insufficient to prevent falls. Instruction about critical time that patients should ask for help should be considered.

**Keywords.** fall, electronic nursing records, fall risk, nursing actions, fall prevention guidelines

## 1. Introduction

Falls cause injuries and death for hospitalized inpatients and many fall prevention strategies have been used for reducing fall rates, damages related falls at all levels [1-3]. Nevertheless, Falls are the most common type of inpatient adverse event [4]. The purpose of this study was to compare fall prevention nursing interventions with fall prevention guidelines among fall patients and to evaluate the effectiveness of preventing strategies according to risk as a tool for predicting falls.

## 2. Methods

We developed fall survey form to take the fall situation fully after reviewing previous literatures, fall guidelines, and patient safety reports. After developing form, reviewers corrected forms and categories to secure consistencies toward data at several times

(Fleiss Kappa= .83(.68-.94)). We categorized fall prevention nursing practices in 24 hours before falls into 28. The electronic nursing records of total 447 patients who reported falls in general nursing inpatient units from June 1, 2014 to May 31, 2015 were reviewed. Chi-square test, Fisher's exact test were used for statistical tests.

### 3. Results

There were recorded 'Keep bed with brakes locked' in 272 patients (60.9%), and 'Keep bed side rails with rocked' 271 (60.6%), 'Keep caregivers besides patients' 261 (58.4%). Compared with fall prevention guidelines, 'instruction of patients to ask for help actively' and 'keep patients care areas uncluttered.' were few in EHRs. Two hundreds fifteen patients(48.1%) who categorized as high risk with MFS, medication, and symptoms at admission, and falls occurred within 21.5days(SD±40) following admission. At fall occurred day, Eighty-five patients (19%) were re-categorized to high risk. There were significant differences between risk groups in 28 nursing practices.

### 4. Discussion

The analysis of this study show that fall prevention strategies according to risk category are insufficient to prevent falls, especially low risk patients. Instruction about critical times that patients ask for help should be considered with cultural differences when implement fall prevention strategies and interventions.

### References

- [1] DiBardino D, Cohen ER, Didwania A. Meta-analysis: multidisciplinary fall prevention strategies in the acute care inpatient population. *Journal of hospital medicine.* 2012;7(6):497-503.
- [2] Miake-Lye IM, Hempel S, Ganz DA, Shekelle PG. Inpatient fall prevention programs as a patient safety strategy: a systematic review. *Annals of internal medicine.* 2013;158(5 Pt 2):390-6.
- [3] Dykes PC, Carroll DL, Hurley A, Lipsitz S, Benoit A, Chang F, et al. Fall prevention in acute care hospitals: a randomized trial. *Jama.* 2010;304(17):1912-8.
- [4] Jang IS, Lee SG. Fall Risk Factors and Characteristics of an Acute Hospital Setting across Clinical Departments. *Journal of Korean academy of fundamentals of nursing.* 2014; 21(3):264-74.

# Information Content Across Types of Nurse Cognitive Artifacts

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**Abstract.** Acute care nurses commonly use personalized cognitive artifacts to organize information during a shift. The purpose of this content analysis is to compare information content across three formats of cognitive artifacts used by acute care nurses in a medical oncology unit: hand-made free-form, preprinted skeleton, and EHR-generated. Information contained in free-form and skeleton artifacts is more tailored to specific patient context than the NSR. Free-form and skeleton artifacts provide a space for synthesizing information to construct a “story of the patient” that is missing in the NSR. Future design of standardized handoff tools will need to take these differences into account for successful adoption by acute care nurses, including tailoring of information by patient, not just unit type, and allowing a space for nurses to construct a narrative describing the patients “story.”

**Keywords.** Handoff, Nursing Documentation, Cognitive Artifacts, Electronic Health Records

## 1. Introduction

Acute care nurses commonly use personalized cognitive artifacts to organize information during a shift [1]. Artifacts’ information content and overlap with physicians’ artifacts has been examined [2]. However, differences across individual formats of artifacts within acute care nurses have yet to be examined. The purpose of this presentation is to compare information content across three formats of cognitive artifacts used by acute care nurses in a medical oncology unit.

## 2. Methods

A grounded theory approach was used. Seventy-three hours of field observation in a medical oncology unit led to 13 purposely sampled nurses who were shadowed for a single shift and interviewed. Each nurse’s paper-based cognitive artifact was digitally scanned and analyzed using content analysis [3]. Nurses’ cognitive artifacts were grouped into three types: hand-made ‘free-form’ (N=3), pre-printed ‘skeletons’ (N=7), and EHR-generated Nursing Summary Report (NSR) (N=3).

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### 3. Results

Content over all artifacts fell into 21 broad categories. Each type of artifact contained information from every category; however, the NSR printed some information not seen in any free-form or skeleton. Some information not printed on the NSR by the EHR was handwritten by the nurse. Information in free-forms and skeletons was more tailored than in the NSR, e.g., only writing down the most recent set of vitals or just out-of-range values, rather than the last five sets printed on the NSR. Additionally, information included varied across patient within a single free-form or skeleton—tailored to specific patient context.

Though, across all artifact types, data items were generally grouped into broad categories within each patient, all but one skeleton and every free-form had an area displaying data items from across multiple categories that synthesized patient context representing a “story of the patient” constructed by the nurse at the beginning of the shift. This space was missing from the NSR.

### 4. Discussion

The information contained in nurses' cognitive artifacts is similar across artifact types, however differences exist. Information contained in free-form and skeleton artifacts are more tailored to specific patient context than the NSR. Free-form and skeleton artifacts provide a space for synthesizing information to construct a “story of the patient” that is missing in the NSR. Future design of standardized handoff tools will need to take these differences into account for successful adoption by acute care nurses, including tailoring of information by patient, not just unit type, and allowing a space for nurses to construct a narrative describing a patient's “story.”

### 5. Acknowledgments

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### References

- [1] N. Stagers, L. Clark, J.W. Blaz, S. Kapsandoy, Why patient summaries in electronic health records do not provide the cognitive support necessary for nurses' handoffs on medical and surgical units: insights from interviews and observations. *Health Informatics Journal*, 17(3) (2011), 209-23.
- [2] S.A. Collins, D.M. Stein, D.K. Vawdrey, P.D. Stetson, S. Bakken, Content overlap in nurse and physician handoff artifacts and the potential role of electronic health records: A systematic review, *Journal of Biomedical Informatics* 44(4) (2001), 701-712.
- [3] K. Krippendorff, *Content analysis: An introduction to its methodology* (2<sup>nd</sup> ed.), Thousand Oaks: Sage Publications, Inc, 2004.



# Applications of Information Technology in Nursing During 2005-15: Evidence from Iran

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**Abstract.** In this ever-changing health care environment, nurses employ technologies and information systems to accomplish the intentions of the practice of nursing. Information technology supports the basic and advanced nursing practices in all settings. This review provides evidence about applications of information technology in Iranian nursing. We systematically searched all papers about applications of information technology in nursing in Iran that were indexed in SID, Magiran, Iran medex, PubMed and scopus databases. This study indicated that 12 (%52) studies used information technologies in the nursing education domain. Also, in 6 (%26) studies telenursing was used for patient care. 3 (13%) of the articles were related to the impact of the use of computer-based information system on nursing practice. In 2 (%9) papers the researchers developed computerized software for nursing processes. The results of this study indicate the use of information technology in nearly every aspect of nursing in Iran.

**Keywords.** Information Technology, Nursing, Systematic review

## 1. Introduction

Nursing, one of the most important roles in all health care setting, is also affected by information technology [1]. Information Technology supports the basic and advanced nursing practices in all settings [2]. Caring and technology must go hand in hand to assist for the management and processing of nursing data, information, and knowledge to support the practice of nursing and the delivery of nursing [3,4].

Hence, the objective of this study is to systematically review studies about applications of information technology in Iranian nursing.

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## 2. Methods

We systematically searched all English and Persian papers about applications of information technology in nursing in Iran that were indexed in SID, Magiran, Iran medex, PubMed and scopus databases from January 2005 until Aug 2015. A data collection form was designed to extract required data, such as types the authors' names, year of publication, study population, type of study, type of information technologies, application of health information technology.

## 3. Results

In this study, 23 out of 2343 retrieved articles were selected as relevant and reviewed by the authors. All results were screened so that the year of publication was between 2005 and 2015. The Study population consisted of nurses, nursing student, and patients. The principle potential study designs included analytical-descriptive, developmental, prospective, quasi-experimental, randomized clinical trials (RCT) .

This study indicated that 12 (%52) studies used information technologies such as simulations, e-learning, educational software and tele-education in the nursing education domain. Also, in 6 (%26) studies telenursing was used to track patients and adherence to the treatment plan via Telephone and Short Message Service. It was mentioned that telephone follow-up was more efficient. 3 (13%) of the studies were related to the impact of the use of computer-based information system on nursing practice. In 2 (%9) papers the researchers developed computerized software for nursing processes.

## 4. Discussion

Overall, the results of this study indicate the use of information technology in nearly every aspect of nursing in Iran, including, nursing education, better doing the tasks, promoting nursing skills, making appropriate- timely decisions, providing a persuasive and effective tool to track patients. Despite the various utilization of information technology in nursing education, a limited number of methods has been used to develop application of nursing processes in Iran.

It is suggested that further studies to be conducted concerning the design and development of the computer softwares for nursing process and care planning at health care centers.

## References

- [1] R.J. Piscotty, B.K. Alisch, A. Gracey-Thomas. Impact of Healthcare Information Technology on Nursing Practice, *Journal of Nursing Scholarship*, 2015.
- [2] J.T. Guenther, Mapping the literature of nursing informatics. *Journal of the Medical Library Association*, 2006;94(2 Suppl):E92.
- [3] N. Stagers, CB Thompson, The evolution of definitions for nursing informatics, *Journal of the American Medical Informatics Association*, 2002;9(3):255-61
- [4] S. McBride, J.M. Delaney, M. Tietze, Health information technology and nursing, *The American Journal of Nursing*; 112(8):36-42.

# Study of Learning by the Virtual Patient Case Created

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**Abstract.** We develop the Virtual Patient Creation Format to perform the process online and to verify the operational effects. Having nursing students create virtual patients by themselves enabled us to imagine patients in the nursing process.

**Keywords.** virtual patient, creation format, nursing student, e-learning, operational effect

## 1. Introduction

This study induced nursing students to create patient examples to develop learners' ability to think, link knowledge, skills, and attitudes relevant to the examples, and also develop master nursing skills. The process to extract specific information, such as consideration of physical information about patients and their life stories, particularly makes students form images of patients and helps to increase learning effects. For this reason, we develop the Virtual Patient Creation Format to perform the process online and to verify the operational effects.

## 2. Methods

We asked eight nursing university students who gave consent to participate in the study to do online learning using Virtual Patient Creation Format. This study was conducted with the approval of the ethics committee of the institute to which the authors belong. Virtual Patient Creation Format: All exchanges between students and teachers were made online. Students did not use paper, but used the Virtual Patient Creation Format by which they were able to input data directly into a spreadsheet (Excel; Microsoft Corp.).

Outline of Learning Process: First, we presented students a task theme. The task theme was: "You are going to be in charge of a patient who needs excretion care." Let us add information, imagining what kind of patient the patient will be." A student creates a picture of the patient, imagining what kind of excretion care might be needed for a patient who needs excretion care. Starting with writing down the information about the

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imaged patient example, the student organizes the information by pattern and changes the abstractly expressed information into more specific information. The student checks the learning tasks as needed. An overall picture of the virtual patient is created in the end.

### 3. Results

Presents an overview of the virtual patients that students created. In Step 1, the information relating to excretion was small. On the other hand, there is information such as a patient's background and living environment. In particular, there is also information relating to diseases or symptoms. However, there were many abstract representation by its contents. In Step2, it had issued a learning task in the body surface, such as a required knowledge of Anatomy and Physiology. Furthermore, information that describes the particular situation of the patient information in Step3 had been added.

Theme: "You are going to be in charge of a patient who needs excretion care." Let us add information, imagining what kind of patient the patient will be."					
Information about Example	Category/Pattern	Comment	Necessary Learning Point	Additional Information	Virtual Patient

### 4. Discussion

Many students imagined an elderly woman at an initial stage of illness because of the theme for the creation of a virtual patient. Using the virtual patient format enabled students to input information they thought about. Thereby, they imagined a patient using freewheeling thinking. Students organized the information by pattern/ category in Step 2 to understand the target completely. It enabled them to check their knowledge and consider the consistency of the information based on the learning tasks related to the information.

Furthermore, use of the format enabled the visualization of missing information and facilitated the input of additional information. One matter that deserves particular mention is that they added feelings of the virtual patient to the information. The points above revealed that the creation of a virtual patient facilitated imagination of a patient and that the creation format was a tool that was useful to deepen the understanding of the target.

### 5. Acknowledgments

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# Student Contest

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# Adoption of Speech Recognition Technology in Community Healthcare Nursing

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**Abstract.** Adoption of new health information technology is shown to be challenging. However, the degree to which new technology will be adopted can be predicted by measures of usefulness and ease of use. In this work these key determining factors are focused on for design of a wound documentation tool. In the context of wound care at home, consistent with evidence in the literature from similar settings, use of Speech Recognition Technology (SRT) for patient documentation has shown promise. To achieve a user-centred design, the results from a conducted ethnographic fieldwork are used to inform SRT features; furthermore, exploratory prototyping is used to collect feedback about the wound documentation tool from home care nurses. During this study, measures developed for healthcare applications of the Technology Acceptance Model will be used, to identify SRT features that improve usefulness (e.g. increased accuracy, saving time) or ease of use (e.g. lowering mental/physical effort, easy to remember tasks). The identified features will be used to create a low fidelity prototype that will be evaluated in future experiments.

**Keywords.** Nursing informatics, speech-recognition, wearables, wound care, prototyping, user-centered design

## 1. Background

The prevalence of chronic wounds is estimated to be between 26% to 35.5% in Canada [1]. In Canada, it is estimated that 15% of all patients with diabetes will develop a foot ulcer in their lifetime; concerning as 85% of amputations are the result of non-healing foot ulcers [2-3]. Health Information Technology (HIT) is proven to benefit and improve the nursing practice of home care nurses who visit patients with wounds [4]. However, adoption rates of HIT has varied [5]. In the province of British Columbia, Canada, a wound documentation system has been implemented and used for a number of years now which makes it a fit candidate to study technology adoption [6]. However, it has been found that nurses have not fully adopted the system and developed workarounds to the system limitations.

In our initial fieldwork it was found that the main challenges are related to usefulness and ease of use; these align with our clinical experience and findings in similar settings [6, 7]. Such system issues include: inconsistent access at the patient

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bedside; mismatch of data entry requirements and data needs of the nurses; unnecessary alerts and reminders; and unclear communication methods.

Based on the initial observations, the current wound documentation system is not being fully adopted during the home visits. As such, nurses often review all patient wound records in the morning prior to leaving for home visits to get the most recent patient data. Nurses are then unable to update wound profiles until after completing all patient visits, at the end of their shift. As the system was not being accessed by nurses during home visits, there is a gap between the point of care and point of documentation, resulting in loss of information and communication breakdown, ultimately impacting quality of care. This is consistent with other findings in the acute care setting [6]. To work around these system limitations, nurses use other means and workarounds to be able to get their job done and attempt to mitigate this gap between care and documentation.

Speech recognition technology (SRT) provides a possible solution. By facilitating the automated capture of patient data and its transcription into the health information systems, SRT can change and support communication [8]. Benefits of SRT for nursing includes timely capture and accessibility of verbal data, information loss avoidance, and a decrease in misinterpreted patient information [8]. However, the full benefits of this technology may be unrealized yet as early studies have been marred with software failure, voice transcription inaccuracy, equipment variability, unstructured educational approaches, and nurse skepticism [8-10].

## **2. Purpose**

To investigate adoption of SRT using community wound care nursing as a case study.

## **3. Objectives**

To achieve the proposed purpose, the project team, comprised of graduate students in engineering and nursing, will work collaboratively and leverage each other's complementary technical and content expertise. Our specific objectives are as follows:

- 1) To use community healthcare nurses' participation in designing a wound documentation prototype that is practical for point of care use.
- 2) To develop a mobile prototype with SRT to support point of care wound documentation for community healthcare nurses informed by objective 1.
- 3) To evaluate the developed prototype in simulated experiments.

## **4. Participatory design and development sessions**

Recruited participants would be community healthcare nurses who visit patients with wounds receiving care in their home. The authors have existing relationships among this population in Vancouver, British Columbia, which will facilitate recruitment. Our design approach will centre around eliciting the daily clinical documentation needs at the point of care. This will be coupled with rapid prototyping. In the participatory design sessions, non/minimally-functional prototypes will be designed rapidly until the



features of the prototype seems to be reasonably practical with regards to the users' perspective and in line with the design principles followed by the designer.

## 5. The prototype

A prototype will be developed after the participatory design to use SRT in documentation of data elements that are identified as key to the nurses' practice in the initial fieldwork. Appendix A exhibits a preliminary design for the prototype, and the developed back-end infrastructure that will be used.

## 6. Evaluation plan

We will conduct experiments using patient scenarios that simulate home visits by nurses. There will be two groups of patient scenarios, first is a scenario in which the nurse is expected to make changes to the wound care plan within the duration of the experiment session. The second is a scenario in which the nurse is expected to not to make changes to the wound care plan within the duration of the experiment session.

Evaluation will aim to identify the effects of SRT on adoption of wound documentation systems in home care nursing. A mix of qualitative and quantitative data will be collected. For the qualitative data the Think Aloud protocol will be used to collect verbalizations of the users while they are in the experiment session [11]. The data will be coded topically and analyzed thematically to identify issues related to usefulness and ease of use [6]. Quantitative data will be collected using the instruments developed to measure technology adoption [6].

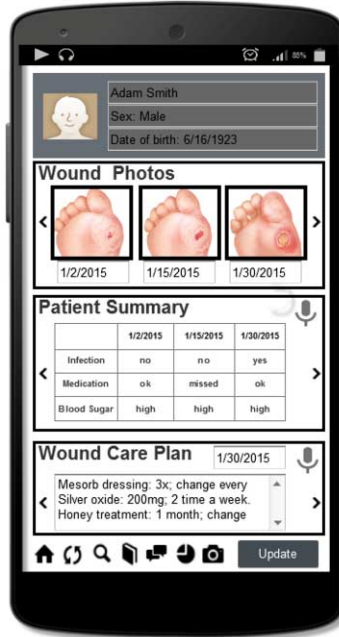
## References

- [1] Woodbury MG, Houghton PE. The extent of chronic wounds in Canada. *Wound Care Canada*. 2005; 3(1), 18.
- [2] Statistics - Canadian Association of Wound Care. (n.d.). 2004. Retrieved November 14, 2014 from <http://cawc.net/index.php/public/facts-stats-and-tools/statistics>.
- [3] Woodbury MG, Houghton PE. Prevalence of pressure ulcers in Canadian healthcare settings. *Ostomy Wound Management*, 2004; 50, 22–39.
- [4] Chanussot-Deprez C, Contreras-Ruiz J. Telemedicine in wound care: A review. *Advances in Skin & Wound Care*, 2013; 26(2), 78–82.
- [5] Holden RJ, Karsh BT. The Technology Acceptance Model: Its past and its future in health care. *Journal of Biomedical Informatics*, 2010; 43(1), 159–172. <http://doi.org/10.1016/j.jbi.2009.07.002>.
- [6] Rawstorne P, Jayasuriya R, Caputi P. Issues in predicting and explaining usage behaviors with the technology acceptance model and the theory of planned behavior when usage is mandatory. In *Proceedings of the twenty first international conference on Information systems, Association for Information Systems*. 2000; pp. 35–44. Retrieved from <http://dl.acm.org/citation.cfm?id=359721>
- [7] Halbesleben JRB, Rathert C, Bennett SF. Measuring Nursing Workarounds: Tests of the Reliability and Validity of a Tool. *JONA: The Journal of Nursing Administration*, 2013; 43(1), 50–55. <http://doi.org/10.1097/NNA.0b013e31827860ff>
- [8] Dawson L, Johnson M, Suominen H, et al. A usability framework for speech recognition technologies in clinical handover: A pre-implementation study. *Journal of medical systems*. 2014;38(6):1-9.
- [9] Fratzke J, Tucker S, Shedenhelm H, Arnold J, Belda T, Petera M. Enhancing Nursing Practice by Utilizing Voice Recognition for Direct Documentation. *J Nurs Adm*. 2014;44(2):79-86.

- [10] Hoyt R, Yoshihashi A. Lessons learned from implementation of voice recognition for documentation in the military electronic health record system. *Perspectives in health information management/AHIMA*, American Health Information Management Association. 2010;7(Winter).
- [11] Ericsson KA, Simon HA. *Protocol analysis*. Cambridge, Ma: MIT Press; 1993.

## 7. APPENDIX A.

### Preliminary Design and the Back-End Infrastructure.



**Figure 1.** Preliminary design of a wound documentation prototype.



Figure 2. The developed back-end infrastructure.

# Individual Nomad Clinical Assistant: Supporting Nurses at the Point of Care

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**Abstract.** Accessing patients' data at the point of care has the potential to ease the workflow of nurses and to improve the documentation. We have launched an initiative to develop a mobile assistant focused on managing nurses' daily intervention. The design has required the involvement of many stakeholder and has followed a user centered design process. The evaluation is planned in two stages with an increasing level of ecology. The solution is a client server application displaying a contextualized view on nurses' interventions. It allows to validate and comment each intervention presented as an item in a list. Deploying mobile client applications in healthcare is a challenging task not only from a technical point of view but also regarding organizational factors and human factors.

**Keywords.** mHealth, Software Design, Nurses; Hospital Information Systems, Mobile Applications, Nurses, User-Computer Interface

## 1. Introduction

Mobile client applications for Hospital Information Systems (HISs), such as electronic health records (EHR) provide the flexibility of accessing patient information from anywhere at any time [1-9].

In order to simplify nurses' workflow, we have launched an initiative to develop an individual nomad clinical assistant (INCA<sup>©</sup>), a mobile app running on smartphone aiming at displaying relevant clinical information at the point of care. The first release of the application is mostly focused on nurses' daily interventions but will be extended in the future.

## 2. Methods

The design of the global architecture of INCA<sup>©</sup> has required the involvement of many stakeholders representing the different domains impacted in several rounds of discussions. The user interface development has followed a user centered design including mainly nurses in focus group.

In order to evaluate the solution, a two stage usability evaluation must be carried out. In a first phase, a think aloud protocol will be prepared to identify usability issues

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among a limited number of nurses performing predefined scenarios. In a second phase, a usability test will be carried out to compare nurses' performance with and without the mobile tool in their usual working environment.

### 3. Results

The global architecture of the solution is composed of a server responsible to query the existing services of the HIS in order to collect and format the relevant information for a given nurses. The information is then sent and displayed on the mobile application.

INCA© is a multiplatform smartphone application displaying a contextualized view on nurses' interventions. It allows them to validate and comment each intervention presented as an item on a list.

### 4. Discussion

Deploying mobile client applications in healthcare environment opens much wider questions than purely technical ones. The design of the global architecture requested to collaborate closely with many stakeholders of the existing EHR. Among the toughest challenges, security, infrastructure and users' adherence questions must be clearly solved in order to ensure the success of the solution.

### References

- [1] Lin AC, Chang M, Chen MY, et al. Mobility Patterns of Doctors Using Electronic Health Records on iPads. 933–939.
- [2] Paper R. The Impact of Electronic Health Records on Time Efficiency of Physicians and Nurses: A Systematic Review. 12: 505–516.
- [3] Briggs J, Curry R. Towards the integration of near-patient collection of information for the delivery of healthcare services. *ACM SIGHIT Rec*; 2: 31–35.
- [4] Tang C, Carpendale S. Evaluating the deployment of a mobile technology in a hospital ward. *Proc ACM 2008 Conf Comput Support Coop Work - CSCW '08*; 205.
- [5] Ehrler F, Wipfli R, Teodoro D, et al. Challenges in the Implementation of a Mobile Application in Clinical Practice: Case Study in the Context of an Application that Manages the Daily Interventions of Nurses. *JMIR mHealth uHealth*; 1: e7.
- [6] Ehrler F. Assessing the Usability of Six Data Entry Mobile Interfaces for Caregivers: A Randomized Trial. *JMIR Hum Factors*; 2: e15.
- [7] Wu J, Wang S, Lin L. Mobile computing acceptance factors in the healthcare industry: A structural equation model. 6: 66–77.
- [8] Eom H-E, Lee S-W. Human-centered software development methodology in mobile computing environment: agent-supported agile approach. *EURASIP J Wirel Commun Netw*; 2013: 1–16.
- [9] Zhang M, Cheow E, Ho CS, et al. Application of low-cost methodologies for mobile phone app development. *JMIR mHealth uHealth*; 2: e55.

# Improving Drugs Administration Safety in Pediatric Resuscitation Using Mobile Technology

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**Abstract.** The fast preparation of drugs during pediatric resuscitation is of utmost importance. The influence of the patient's weight on the drug doses requires to perform complex calculations and is a source of errors. A technological solution could be a real help in avoiding these kinds of mistakes. Relying on a user centered approach we have developed an application supporting drug preparation. It has been tested in simulations with predefined scenario. The developed tool consists of a screen displaying a list of drug that can be administered. When the user select a drug, the instructions regarding its preparation are displayed with all dosage precisely calculated. The tool has demonstrated a significant reduction of errors associated to administration, a speeding up the overall process and has been well received by the nurses.

## 1. Introduction

In pediatric emergency department critical situations where a patient's life is at risk may require fast preparation and administration of drugs. If some of these administrations are straightforward, other drugs require complex dosage computations that are dependent of the speed of infusion as well as the weight of the patient. Due to the stress of resuscitation and the infrequent practice of such complex calculation, errors and delays can happen [1, 2]. To assist caregivers in drugs preparation, caregivers currently use paper support such as double entry tables. The problem of this kind of support is the cognitive effort induced by the search of relevant information as well as the complicated calculations that have been to do without making any mistakes.

A technological solution could be a real help in avoiding these kinds of mistakes. We present here, the creation and evaluation of an application relieving caregivers of cumbersome calculations.

## 2. Methods

The product development followed a user centered design methodology where cycles of user requirement, prototyping development and validation stages were performed to provide a tool that fits to the specific constraints linked to resuscitation.

The evaluation of the usability consisted of nurses performing in simulations. The caregivers were requested to use the tool to perform the drug preparation and administration. At the end of the simulation the caregivers were interviewed to discover the strength and weakness of the proposed solution.

## 3. Results

The developed solution consist of a tablet application running both on android and IOS where the nurses can enter the weight of the patient. The application propose then a list of drugs that can be administered to the patient. When the user select a drug all the preparation step and the dosage adapted to the patient weight are displayed (Figure 1).

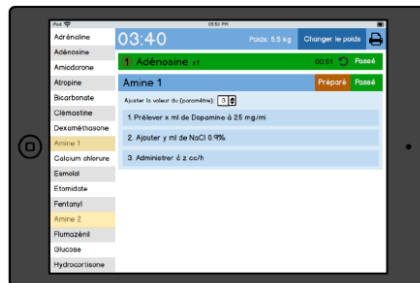


Figure 1 View of the application

The evaluation revealed a significant reduction of errors linked to drug administration and a reduction of time for the preparation of the drug. The tool received also a very good welcome from the nurses that have tested it.

## 4. Discussion

Dedicated mobile application have the opportunity to facilitate nurse's work even in stressful situations. The application aims both to improve efficiency and safety of the drugs administration process. The tool will provide a clear view on the ongoing medication plan and provide the necessary instructions that will relieve the caregiver of cumbersome calculations.

## References

- [1] Kaufmann J, Laschat M, Wappler F. Medication errors in pediatric emergencies: a systematic analysis. *Dtsch Arztebl Int* 2012; 109(38): 609-16.
- [2] Wright K. Do calculation errors by nurses cause medication errors in clinical practice? A literature review *Nurse Education Today* 30(1) 2010 85-97

# The Hygiene Games

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Marko JOVANOVIĆ<sup>2</sup> and Milad EYVAZI HESAR<sup>2</sup>

**Abstract.** Addressing the correlation of hospital acquired infections and insufficient hand hygiene, we propose a supportive system to enhance the individual hygiene habits of health care workers. By applying *gamification* to incentivize health care professionals while maintaining a high standard of privacy and usability, the system focuses on technical simplicity by using concepts like *bring your own device* in a scaleable proof of concept implementation.

**Keywords.** Hospital Hygiene, Gamification, Beacons, Nearables, Wearables, Bluetooth Low Energy, Hospital Acquired Infections, Nosocomial Infections

## 1. Introduction

*Hospital Acquired Infections* (HAIs, also *nosocomial infections*) present a threat to patients, affecting even highly developed countries with advanced health care hygiene protocols. The European Centre of Disease Prevention and Control reports that about 4.1 million of EU patients may acquire a health care related infection per year. 37,000 and 110,000 are estimations for respectively direct and indirect cause of death. 20 to 30% of HAI are probably preventable by practicing better hand hygiene.

Traditional methods of measuring compliance rates for hand hygiene include observation of the availability of hand sanitizers near treatment areas and their daily amount of usage. For evaluating the correct use of hand sanitizer stations a monitoring person is needed [1]. During recent years, progress was made in using mobile devices to support and measure hand hygiene procedures. Our approach focuses on two main points: *simplicity* and *gamification*. To ensure simplicity, only basic tools like smartphones and affordable sensors are used, user-interaction is minimized to improve compliance, and no additional device is required to be worn. Gamification takes advantage of human's competitive nature. Recent publications (e.g. [2]) suggest that gamification likely yields positive learning effects.

Our solution automatically and unobtrusively tracks the daily hand hygiene routine of health professionals in a hospital. Anonymized statistical data is subsequently used to drive competition between individuals (comparison of personal score against minimum, maximum and average score) and between clinics. The data is gathered by placing bluetooth beacon sensors on the hygiene relevant points of the health facility: water faucets, soap and hand sanitizer dispensers and examination glove containers (Figure 1), creating smart objects detectable by our smartphone application. Depending on the hygiene process, the duration of item usage and order of related processes will be taken in account when awarding points to the game participants. After submission of

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anonymized score data and calculation of department statistics, the application presents the scoreboards and personal statistics in a game-like visualization.

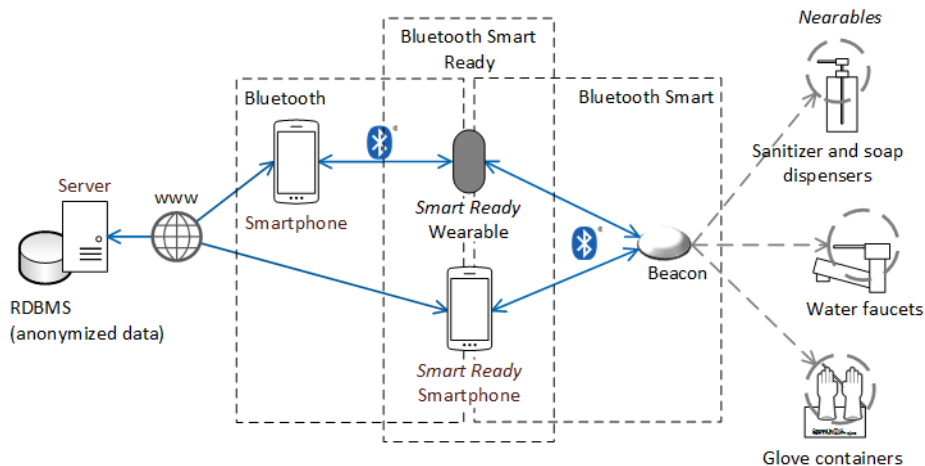


Figure 1. Schematic representation of the system components

## 2. System Architecture

In order to increase hand hygiene awareness and the usage of hand hygiene opportunities, our system consists of two core features: (i) monitoring of hygiene opportunities and actions, and (ii) user motivation by means of gamification. An additional component (iii) supplies educational information.

We describe the first two features and their architecture in detail in the following sections.

### 2.1. Monitoring Process

The monitoring of hygiene opportunities is performed by attaching Bluetooth Low Energy (BLE, or Bluetooth Smart) beacons to all hygiene stations. The beacons indicate proximity through signal strength. Usage of opportunities is detected through a built-in accelerometer. A background service running on a user’s smartphone tracks the occurrence of an opportunity and whether it was seized (Figure 1).

To keep the approach simple, cost-effective, and to increase compliance, participants can use their own smartphones (bring-your-own/BYO device) and thus do not need to wear and charge any additional devices. If a participant does not have a compatible smartphone or does not want to use it for our system, we propose an alternatively usable wearable device to record hygiene activities.

The following sections describe the roles of the key components.

#### 2.1.1. Beacons

Since clinical health regulations often prohibit wearing devices on lower arms, the BLE beacons will be installed on points of hygiene opportunities and, where applicable, on

mobile parts while in use. The combination of BLE beacons and hygiene related items (hygiene opportunities) create *nearables* or *smart objects*.

### 2.1.2. *Smartphone or Wearable device*

Mobile platforms are targeted for the smartphone application to cover a large market share. Both the smartphone and the wearable have to support BLE mode to monitor the beacons and the wearable has to provide classic bluetooth for communication with non-BLE smartphones (see Bluetooth ranges in Figure 1).

The application running on the monitoring devices detects broadcasting nearables. Based on the received identifier (water faucet, soap dispenser, glove container or sanitizer dispenser), the application applies various rulesets and resulting fulfillment-grades (none, partial, full) are recorded.

### 2.1.3. *Server*

A first implementation utilizes a centralized web server to calculate the reference values (minimum, maximum and average score). Further development goals target a decentralized implementation of the system.

## 2.2. *Gamification Process*

The hygiene actions are subsequently transformed into points and achievements. This gamification approach transforms statistics into comprehensible figures that offer users the possibility to compare their hygiene habits to the medical standard in an objective way. This is important because their own hygiene performance can easily be overestimated when routine fortifies over the years. The system also supports the user in identifying the actual flaws in their hygiene habits by analysing missed hygiene opportunities and informing the user where those happened frequently. This feature is intended for personal use only. The competition aspect takes place on the group level (e.g. consisting of members of a hospital clinic) where information about individual users is aggregated into a group statistic. This is done to avoid the occurrence of personal pressure in connection to the competition.

## 3. **Conformity & Data Protection**

Our solution follows the World Health Organization (WHO) regulations for hand hygiene [3,4]. Since our prototype solution is implemented in Germany, the Robert Koch Institute (RKI, part of the Federal Ministry of Health) guidelines also serve as a code of practice [5].

Personal data of participants could potentially be misused, therefore, high standards of data protection are necessary. Following the Handbook on European Data Protection Law, data that permits identification should not be kept for processing longer than necessary [6]. All identifying elements have to be removed to anonymize data, so that no re-identification is possible with reasonable effort [6,7].

Our solution does not request further personal data in its smartphone application and scores are exchanged in anonymized form. The personal score is kept on the personal

device, allowing the participants to keep data sovereignty at all times. The concrete privacy requirements we pose at our system are: (i) it should not be computationally feasible to reveal or corrupt an individual's score if the network connection to a central server is compromised during submission of individual scores to the server; (ii) it should not be easy to deduct individual contributions from a department's overall score; (iii) on the department's server side, at no time individual plaintext contributions must be stored.

Requirement (i) can be satisfied by utilizing standardized network connection encryption schemes such as *Transport Layer Security*. A naive approach for satisfying requirement (ii) can be averaging a department's summary score over the number of individual participants at the department. The requirement can be strongly fulfilled if *Differential Privacy* (DP) is applied to the department score, before releasing it to the public. DP allows to learn properties of a basic population as a whole, while preserving the privacy of the individuals in the sample [11].

For requirement (iii), we propose to utilize a well-researched cryptography scheme which has found its use in electronic voting systems, where the identity of individual voters needs to be kept in secret. In its essence, the *Secure Multiparty Computation* (MPC) protocol allows for multiple parties to compute a function (e.g. an arithmetical average) on their individually held private data, while keeping the input data to the function secret. MPC schemes typically make use of *secret sharing*, where the secret data is split among a group of participants, each of them calculating the function over a single share of the secret. Our system applies *Shamir's Secret Sharing scheme* [12], or a variant thereof, making it compliant with the advice stated in the Handbook on European data protection law [6].

#### 4. Usability

As the system we propose is designed to be as non-invasive as possible and hand sanitizing gets tracked automatically by the system, only a small amount of direct user-interaction is needed. The user mainly interacts with the application to view his personal statistics and the scoreboards, so the keypoint to reach user acceptance is to develop a user friendly application.

As the beacons are self-adhesive, their installation is easy and require low maintenance once installed (see section 2). The whole system is scalable at any point: it is neither limited regarding the number of participants nor the number of monitored smart objects. Also the system offers modularity regarding implementation of other guidelines and hygiene opportunities by variation of rulesets.

The participants can use either their own smartphone or a provided wearable device (see section 2). The wearable is intended to be nonobstructive (either worn as a pendant or clipped to clothing) and fitted with a durable and sanitizer resistant housing. The dialogue principles [8] from the International Organization for Standardization covering human-computer interaction are followed: the application should be (i) suitable for the task, (ii) suitable for learning, (iii) conform with user expectations, and (iv) self descriptive. Correspondingly, the target is a simple, game-like user interface with self descriptive controls and comprehensible information.

During the design and implementation process, we conduct user tests that fit the current stage of development. We plan to evaluate the product application based on the ISONORM 9241/110-S questionnaire [9].

## 5. Conclusion

To our best knowledge, all existing solutions addressing hand hygiene require additional wearable devices such as alcohol detectors or dispensers. Furthermore, the gaming approach to the hand hygiene issues is commonly explored with a focus on training [10].

The system is following a high standard of data protection without limiting the usability of the application. This alleviates initial burdens which may arise when a new system is introduced in an established work environment. The simplicity and affordability of the sensor devices make it easy to install the infrastructure and design it to be non-invasive for the users (and non-users). Private data is kept locally on the user's device. The minimally required exchange of information for a competitive game is done in an anonymized fashion, hence it renders monitoring of individual user data impossible.

The gamification approach is utilized to motivate the participating health care professionals to perform repetitive tasks in a competitive scenario. In comparison to traditional methods, our solution is tailored to the needs of the actual users and their work background. The users are kept motivated over a long time period and in succession hand hygiene can become a good habit, hence HAIs could be reduced.

## Acknowledgements

This project is supported by the Chair of Communication and Distributed Systems - COMSYS of the RWTH Aachen University and the mHealth Division of the Department of Medical Informatics Uniklinik RWTH Aachen University. We thank our advisory board for their advice and patience, especially Dr. Ekaterina Kutafina, Dipl.-Inform. Jó Agila Bitsch and Dr. Stephan Jonas for guiding the team throughout the entire project.

## References

- [1] Klauber H, Geraedts M, Friedrich J, Wasem J. Krankenhaus-Report 2014 - Schwerpunkt: Patientensicherheit. Stuttgart: Schattauer; 2014.
- [2] Lister C, West JH, Cannon B, Sax T, Brodegard D. Just a fad? Gamification in health and fitness apps. *JMIR Serious Games* 2014;2(2):e9.
- [3] WHO Guidelines on Hand Hygiene in Health Care, 2009.
- [4] WHO brochure, Hand hygiene: why how and when.
- [5] Robert Koch Institut. Händehygiene - Mitteilung der Kommission für Krankenhaushygiene und Infektionsprävention am Robert Koch-Institut. *Bundesgesundheitsblatt - Gesundheitsforschung - Gesundheitsschutz* 2000;43:230-3.
- [6] European Union Agency for Fundamental Rights. Handbook on European data protection law. 2014.
- [7] US Department of Health and Human Services. Health insurance portability and accountability act of 1996 - Section 1173: Standards for information transactions and data elements. 1996.
- [8] ISO 9241-110:2006. Ergonomics of human-system interaction Part 110: Dialogue principles.
- [9] Prümper J, ISONORM 241/110-S: Evaluation of software based upon International Standard ISO 9241, Part 110, 2010.
- [10] Kutafina E, Laukamp D, Jonas SM. Wearable sensors in medical education: supporting hand hygiene teaching with a forearm EMG. *Studies in health technology and informatics* 05/2015; 211:286-91.
- [11] Dwork C. Differential Privacy. *Encyclopedia of Cryptography and Security*, Springer US. 2011;338-340.
- [12] Shamir, A. How to share a secret. *Communications of the ACM* 22.11 (1979), 612-613.

Gloves in Figure 1 created by TNS from the Noun Project

# Instrumented Shoes for Real-Time Activity Monitoring Applications

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**Abstract.** Activity monitoring in daily life is gaining momentum as a health assessment tool, especially in older adults and at-risk populations. Several research-based and commercial systems have been proposed with varying performances in classification accuracy. Configurations with many sensors are generally accurate but cumbersome, whereas single sensors tend to have lower accuracies. To this end, we propose an instrumented shoes system capable of accurate activity classification and gait analysis that contains sensors located entirely at the level of the shoes. One challenge in daily activity monitoring is providing punctual and subject-tailored feedback to improve mobility. Therefore, the instrumented shoe system was equipped with a Bluetooth® module to transmit data to a smartphone and perform detailed activity profiling of the monitored subjects. The potential applications of such a system are numerous in mobility and fall risk-assessment as well as in fall prevention.

**Keywords.** Activity monitoring, wearable sensors, inertial measurement unit, force sensing insole, real-time

## 1. Introduction

Frailty can be defined as a gradual physiological degradation that results in detrimental outcomes in older adults, especially when reacting to environmental stimuli [1]. As a result, a notable worsening of mobility and social activity is perceived in frail older adults [2]. Approximately 35-40 % of community-dwelling, healthy older adults aged 65 or more experience at least one fall every year, and the fall incidence rate increases with age [3]. Fear of falling is manifestly prevalent within older adults with up to 65 % in some populations, leading in many cases to a significant decline in activity levels [4]. Consequently, increased activity avoidance can lead to a reduced quality of life. Certain activities accompanied by well-suited exercise programs have shown potential in maintaining balance, strength, endurance, bone density and functional ability; which in turn can lead to a better quality of life and reduce the risk of falling [5].

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Furthermore, such interventions can be tailored for every individual based on their mobility and activity levels. Traditionally, clinical assessment of motor function in elderly people is mainly based on questionnaires, which are considered subjective and suffer from poor recall. Technology-based assessment of functional mobility, e.g. gait and balance, generally utilizes stationary stereophotogrammetric motion capture tools and force plates. This limits the assessment to the small volume of the lab and does not provide actual activity of the subject during daily conditions. Thus, monitoring time and space volume are limiting factors, insufficient to characterize daily life. With recent progresses in communication systems and smartphones, motion sensors have witnessed a considerable boom in research. Miniature inertial sensors such as accelerometers and gyroscopes are integrated in light box designs that can be placed on the body and collect movement data autonomously for up to several days. However, the devices currently existing on the market or in research laboratories can only perform the recognition of a few types of activity, although more detail on lack of mobility and balance is needed for monitoring elderly subjects, e.g. the detection of transfer between postures, ability to avoid obstacles, climbing and turning. Furthermore, accurate classification of activity is accompanied by a high number of sensors, hindering the movement of the elderly person wearing them. Additionally, only a handful of systems have been validated for real life monitoring of elderly individuals.

In this context, we propose a wearable device consisting of an inertial sensor and a force-sensing insole that will be placed entirely at the shoe level to provide comfort and unobtrusiveness. The device will be used to monitor the daily-life movements of the user and accurately recognize the type of activity, its duration, frequency and intensity (FITT principle [6]). The data from all sensors will be transmitted from the shoes to a smartphone for online activity profiling and further conveyance to geriatric care units.

## 2. Methods

### 2.1. Instrumented shoe system

The development prototype of the instrumented shoes consists of the Physilog® (Gaitup, CH) inertial sensing and data logging unit, and the plantar pressure insole (IEE, LU) shown in Figure 1. The system contains 3D accelerometers, 3D gyroscopes, barometric pressure sensor, and 8 plantar pressure cells at relevant anatomical locations under the foot: medial and lateral heel, lateral arch, 1<sup>st</sup>/3<sup>rd</sup>/5<sup>th</sup> metatarsals, hallux and the remaining toes. All signals are logged on the Physilog device and can be transferred via USB to a laptop. An electronics box is used to digitize and amplify the pressure sensor data. The system additionally includes a magnetometer and can incorporate a GPS unit. Our concept is innovative in its design and the fact that it can be worn in the shoes during daily life without hindering the user. Recently, a Bluetooth module was added to the system (incorporated within the Physilog box) enabling real-time data transmission of all the sensors to a smartphone or PC.

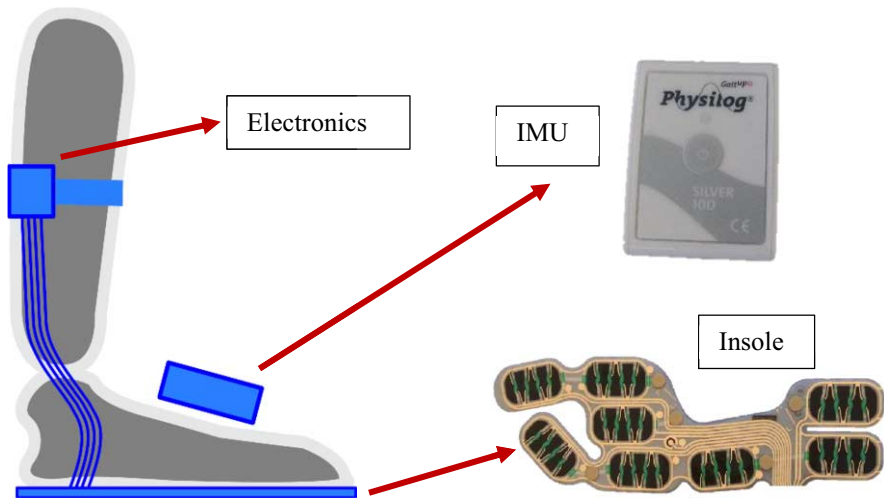


Figure 1 – Instrumented shoe system: Physilog® inertial sensor placed on the shoe, insole inserted inside the shoes and converting electronics placed above the ankle.

## 2.2. System architecture

The proposed system architecture is oriented towards collecting data from the instrumented shoe in real-time and perform online activity classification and characterization (e.g. gait analysis of locomotion periods and postural transition analysis). Data from all sensors is also stored on a memory card to prevent data losses when the subject is out of smartphone or PC range. Dedicated algorithms will be implemented on the smartphone to perform the analysis and send relevant outcome parameters to a geriatrician including postural allocation, spatio-temporal gait parameters and other information such as symmetry and variability. In turn, the clinician can provide feedback for the user on their mobility levels via the smartphone interface. The system architecture is detailed in [Figure 2](#).

## 2.3. Activity classification

We have previously validated an activity classification algorithm and its initial in-lab results were described in [7]. The algorithm was based on a biomechanical model and achieved a global accuracy of 97% in detecting activities such as sitting, standing, and level walking as well as stairs, ramps, and elevators, in offline mode after data collection.

The data collected in real-time from the sensors could be used in a similar fashion, i.e. applying a decision tree where the activity types are classified based on the biomechanical model. However, some aspects of the decision tree might not be applicable online because of the need to post-process the data. Alternatively, machine learning techniques could be implemented to recognize the activity in real-time [8]. A short time window (e.g. 5 seconds) would be selected and signal features during this window calculated to provide the activity class.

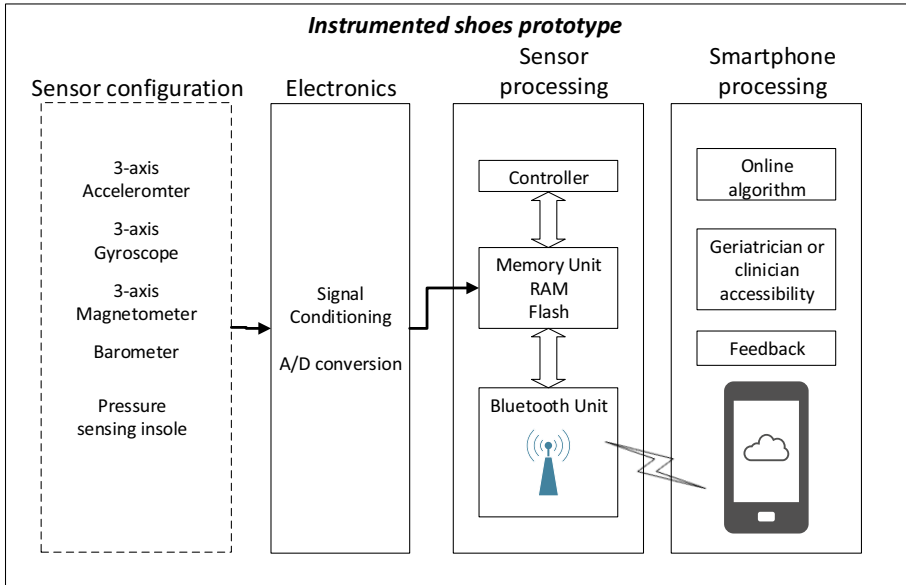


Figure 2 – Final prototype technical architecture

### 3. Results

Preliminary testing of the real-time Bluetooth data transmission was completed during different activities (sitting, standing, in-place stepping, and level walking). Data were collected wirelessly on a PC. A custom plotting interface was implemented in C++ to visualize the data in real-time. The data collection could be achieved with no losses for the two feet sensors simultaneously as compared to the data that was logged on the memory card for each IMU.

### 4. Discussion

In this study we proposed an instrumented shoe system for real-time activity monitoring. The preliminary testing of real-time data transmission from the sensors to a PC and smartphone proved to be satisfactory. The next step would be to implement the real-time classification algorithm on the smartphone to provide online activity monitoring and daily logging of the activity profile. Several considerations must be accounted for, including power consumption and algorithm performance tradeoff.

Real-time activity monitoring could have major implications on health assessment in community-dwelling older adults. Postural allocation could inform about sedentary periods, which could be fragmented to increase health benefits [9]. Gait analysis of locomotion periods would be used to output parameters such as stride velocity and foot clearance which have been associated with frailty and fall risk [10], [11]. Thus, the system architecture offers geriatricians several tools with which to assess mobility and provide prompt and tailored feedback to older adults. The current prototype could also be miniaturized to provide maximum comfort to the user.



## 5. Acknowledgments

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## References

- [1] L. P. Fried, C. M. Tangen, J. Walston, a. B. Newman, C. Hirsch, J. Gottdiener, T. Seeman, R. Tracy, W. J. Kop, G. Burke, and M. a. McBurnie, "Frailty in Older Adults: Evidence for a Phenotype," *Journals Gerontol. Ser. A Biol. Sci. Med. Sci.*, vol. 56, no. 3, pp. M146–M157, Mar. 2001.
- [2] J. E. Morley, H. M. P. Iii, and D. K. Miller, "Something About Frailty," vol. 57, no. 11, pp. 698–704, 2002.
- [3] "Guideline for the Prevention of Falls in Older Persons," *J. Am. Geriatr. Soc.*, vol. 49, no. 5, pp. 664–672, May 2001.
- [4] K. Delbaere, G. Crombez, G. Vanderstraeten, T. Willems, and D. Cambier, "Fear-related avoidance of activities, falls and physical frailty. A prospective community-based cohort study.," *Age Ageing*, vol. 33, no. 4, pp. 368–73, Jul. 2004.
- [5] D. A. Skelton, "Effects of physical activity on postural stability.," *Age Ageing*, vol. 30 Suppl 4, pp. 33–9, Nov. 2001.
- [6] V. Power and A. M. Clifford, "Characteristics of optimum falls prevention exercise programmes for community-dwelling older adults using the FITT principle," *Eur. Rev. Aging Phys. Act.*, vol. 10, no. 2, pp. 95–106, Jan. 2013.
- [7] C. Moufawad el Achkar, C. Lenoble-Hoskovec, A. Paraschiv-Ionescu, K. Major, C. Büla, and K. Aminian, "Instrumented shoes for activity classification in the elderly," *Gait Posture*, vol. 44, pp. 12–17, 2015.
- [8] A. Mannini and A. M. Sabatini, "Machine learning methods for classifying human physical activity from on-body accelerometers.," *Sensors (Basel)*, vol. 10, no. 2, pp. 1154–75, Jan. 2010.
- [9] G. Healy, D. W. Dunstan, J. Salmon, E. Cerin, J. Shaw, P. Zimmet, and N. Owen, "Breaks in Sedentary Time: Beneficial associations with metabolic risk," *Diabetes Care*, vol. 31, no. 4, pp. 661–666, 2008.
- [10] S. Studenski, K. Faulkner, M. Inzitari, J. Brach, J. Chandler, P. Cawthon, E. B. Connor, S. Kritchevsky, S. Badinelli, T. Harris, and A. B. Newman, "Gait Speed and Survival in Older Adults," *JAMA*, vol. 305, no. 1, pp. 50–58, 2011.
- [11] R. S. Barrett, P. M. Mills, and R. K. Begg, "A systematic review of the effect of ageing and falls history on minimum foot clearance characteristics during level walking," *Gait Posture*, vol. 32, no. 4, pp. 429–435, 2010.

# The Development and Evaluation of Delirium Assessment and Nursing Care Decision-Making Assistant Mobile Application for Intensive Care Unit

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**Abstract.** Delirium is a common complication among patients in ICU settings. Although it has been repeatedly confirmed that Confusion Assessment Model for Intensive Care Unit (CAM-ICU), one of the most commonly used ICU delirium assessment tool, is highly accurate in validation studies, its sensitivity and specificity is relatively low during routine practice among bedside nurses. The aim of this study is to develop a mobile application (app) to detect delirium and to test its reliability and validity both by research nurses and among ICU bedside nurses. The app was programmed with Java and installed on a mobile device with Android system. After completion of reliability and validity testing, the app will be integrated into the existing Hospital Information System in order to automatically retrieve essential information for risk factor identification and formulation of care plan accordingly to prevent or manage ICU delirium.

**Keywords.** ICU delirium ; mobile application ; Confusion Assessment Model for Intensive Care Unit ; diagnostic test study ; usability evaluation

## 1. Introduction

Delirium is one of the most common complications among ICU patients. The reported incidence for delirium ranged from 30%-83.3% depends on patient population studied [1-2]. ICU patients developed delirium will have adverse short and long-term outcomes, such as increased incidence of complications and prolonged ICU and hospital stay, impaired cognitive function, and even increasing mortality [3]. Evidences have shown that routine assessment could effectively reduce the risk for developing delirium or early detect the occurrence of delirium therefore reduce the severity/duration of delirium, and reverse the adverse outcomes related to delirium [4]. It is recommended by American College of Critical Care Medicine that delirium should be monitored routinely (at least every day, better each shift) using Confusion Assessment Model for Intensive Care Unit (CAM-ICU) for ICU patients [5]. Although the sensitivity and specificity of CAM-ICU in detecting delirium is reported repeatedly high (> 90%) in various research papers from different countries, **the accuracy in detecting delirium**

**is relatively low when used in routine practice among bedside nurses (it's sensitivity is only around 50%)<sup>[6-7]</sup>.** The reason for such result maybe complicated, lack of adequate training, inaccurate and incomplete interpretation of assessment data or using variable patient baselines when making diagnosis are possible causes for misdiagnosis or missed diagnosis of delirium in ICU settings. **To our knowledge, there is no smart app exists.**

The purpose of this study are: (1) to develop a standardized and easy to use mobile CAM-ICU delirium detecting app with incorporation of automatic risk factor identification and personalized delirium care planning for bedside nurses; (2) to evaluate its reliability and validity in detecting delirium using diagnostic testing study design; (3) to evaluate its reliability and validity in detecting delirium by ICU bed side nurses during routine practice; and (4) to evaluate its effects on assisting decision making of patient management among bedside nurses and physicians as well as patient's clinical outcomes.

The study is **conducted by nursing students and computer science students through collaboration between Capital Medical University and National Yang-Ming University.**

## 2. Methods

The study includes four stages:

### *2.1. Stage I: Development of the Alpha Version of mobile app and evaluation of its usability.*

The Alpha Version of the app was designed with Java and installed on a mobile device. A modified usability evaluation questionnaire based on Technology Acceptance Model (TAM)<sup>[8]</sup>, which includes four domains and 46 items and rated with 5-Likert scale, was used **to test the usability of the developed app.** Convenience sampling was used and ICU nurses from three hospitals were recruited.

### *2.2. Stage II: Revision of the Alpha Version and evaluation of its reliability and validity.*

The Alpha Version of the mobile app was refined based on the result of stage I to reprogram the mobile app in terms of its user friendly interface/layout, ease of use, and usefulness to create the Beta Version (Fig 2). Risk factors and nursing intervention options is integrated into the app.

**We followed the GB17859-1999** "Classification Criteria for Security Protection of Computer Information System" codes and **the GB/T 18336-2001** "Information Technology Security Evaluation Criteria" codes on confidentiality and safety. Both of them are national standards in china and are equivalent to the principles of US Trusted Computer System Evaluation Criteria (TCSEC) and ISO/IEC 15408 respectively. **Data transmission was secured with SSL protocol.**

Its reliability and validity is evaluated using diagnostic test study design and the diagnosis of delirium from a psychiatrist using Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) is used as the gold standard. Each patient in four ICUs of Chaoyang hospital is assessed with the mobile app and the CAM-ICU

paper version by two nurse investigators, and by the psychiatrist separately but within 2 hours. Both the two nurse investigators and the psychiatrist are blinded to each other's assessment results.

### *2.3. Stage III: Evaluation of its reliability and validity in detecting delirium by ICU bedside nurses during routine practice*

The validated CAM-ICU app is installed into ICU nurse's PDA they used in their daily practice, and incorporated into the Hospital Information System in our affiliated hospitals. Sensitivity and specificity will be determined through a diagnostic test study design and using DSM-IV as the gold standard. Nurses from four ICUs in our affiliated hospital will use the app to assess their patients between 9 am and 11 am in their routine practice. The psychiatrist who are blinded to the results of bedside nurses' assessment will also assess these patients during this time frame to ensure that the patients are in the same condition.

### *2.4. Stage IV: Effects of the mobile app on nurses' and physician's actions and patient's clinical outcomes*

A concurrent controlled clinical trial study will be conducted during stage III. Our another affiliated hospital will be used as control. ICU nurses in the intervention hospital will use the mobile app routinely to detect delirium among admitted patients, and ICU nurses in the control hospital will conduct neurological assessment in their daily practice. Data on nurses' actions and physicians' actions in terms of delirium prevention and management, incidence of delirium, short term hospital outcomes, and ICU and in-hospital cost will be collected prospectively.

## **3. Results**

### *3.1. Stage I: Development of the Alpha Version mobile app and evaluation of its usability.*

The screenshots of the app (Version Alpha) are shown in Figure 1. The app was programmed to automatically retrieve baseline data for comparison and provide the result on whether or not the patient has delirium. One hundred and two nurses from ICU settings of three hospitals completed the questionnaire after using both mobile and regular paper CAM-ICU tools. The mean score of the four domains are: perceived usefulness: 4.09-4.22, perceived ease of use: 4.07-4.33, attitudes towards usage: 3.90-4.16, behavior intention to use: 3.97-4.24.

### *3.2. Stage II: Revision of the mobile app and evaluation of its reliability and validity.*

Refining the interfaces was conducted through Axsure to prototype the mobile app layout and customize the functional components (Version Beta, Figure 2) base on the result of stage I. The final layout of the mobile app was completed through Java programming (Final Version, Figure 3), and is finalized after multiple testing until the research investigator and try-use nurses were satisfied with its layout and function. **The**

technical architecture of the mobile app is shown in Figure 4. The reliability and validity of the final version are currently under investigation. By now, there are 45 patients has been enrolled in this study.



Figure 1. Screenshots of the mobile app (Version Alpha)



Figure 2. Screenshots of the mobile app (Version Beta)

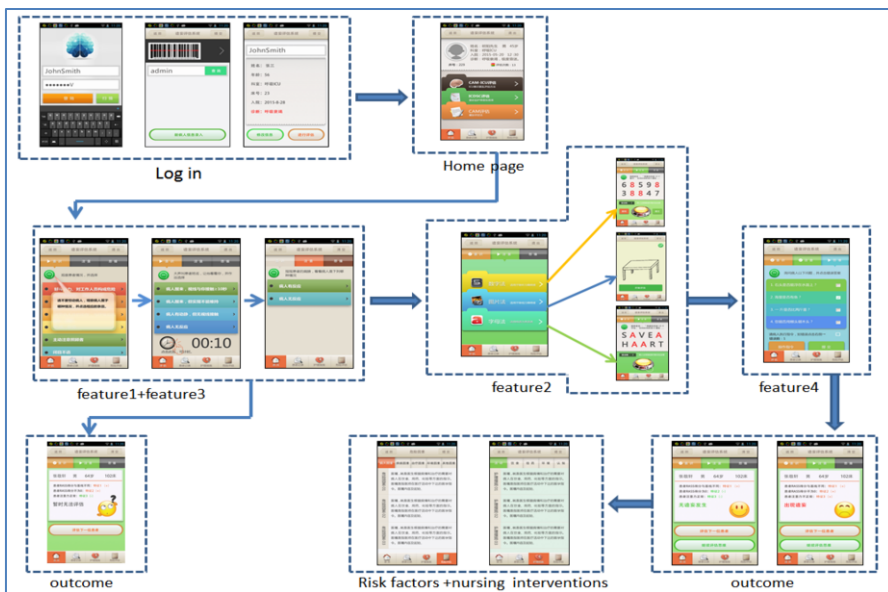


Figure 3. Final version and the flow chart of the mobile app

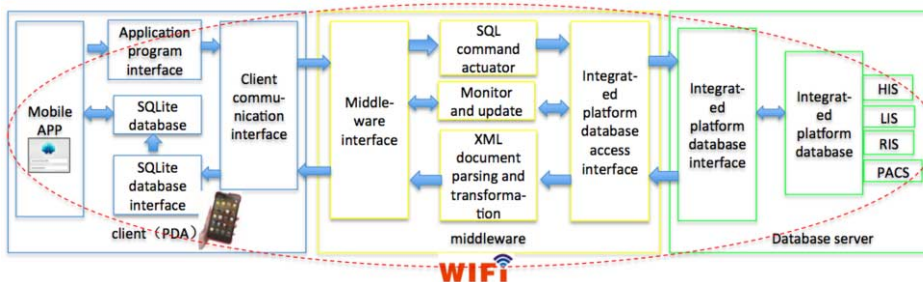


Figure 4. The technical architecture of the mobile app

3.3. Stage III: Evaluation of its reliability and validity in detecting delirium by ICU bed side nurses during routine practice

This will be ready for NI2016 (June 2016)

### 3.4. Stage IV: Effects of the mobile app on nurses' and physician's actions and patient's clinical outcomes

This will be partially ready for NI2016 (June 2016)

## 4. Discussion

The mobile CAM-ICU app we developed has interfaces that are user friendly and easy to use. The evaluation study indicated that its accuracy was identical to its regular paper form but was easier to use compared with the regular paper form. The full discussion will be completed after having all the results.

## 5. Maturity at presentation

At the time of presentation, we will be able to present the result of Stage II and Stage III. We will showcase a complete delirium assessment process, decision-making assistance with delirium risk factor identification and individualized preventive and management interventions at presentation.

## 6. Acknowledgments

We thank the ICU nurses who work at Chaoyao Hospital and the control hospital for their participation and collaboration in making this study possible. Corresponding author: Ying Wu, PhD, [helenywu@vip.163.com](mailto:helenywu@vip.163.com). Authors have no conflict of interests to disclose.

## References

- [1] Ely EW, Inouye SK, Bernard GR, et al. Delirium in mechanically ventilated patients: Validity and reliability of the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU). *JAMA* 2001;286:2703–2710.
- [2] Pandharipande P, Cotton BA, Shintani A, et al. Prevalence and risk factors for development of delirium in surgical and trauma Intensive Care Unit patients. *The Journal of Trauma Injury, Infection, and Critical Care*.2008;65(1):34-41.
- [3] Eric B, Stephen D, Patricia L, et al. Costs associated with delirium in mechanically ventilated patients. *Critical Care Medicine*. 2004;32(4):955-962.
- [4] Gunther ML, Morandi A, Krauskopf E et al. The association between brain volumes, delirium duration, and cognitive outcomes in intensive care unit survivors: the VISIONS cohort magnetic resonance imaging study. *Crit Care Med*. 2012; 40(7):2022-32.
- [5] Barr J, Fraser GL, Puntillo K, et al. Clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit[J]. *Crit Care Med*, 2013;3(1):263–306.
- [6] Reade M C, Eastwood G M, Peck L, Bellomo R & Baldwin I. Routine use of the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) by bedside nurses may under diagnose delirium. *Critical Care and Resuscitation*, 2011; 13: 217-224.
- [7] Maarten M. et al. Routine Use of the Confusion Assessment Method for the Intensive Care Unit. *American Journal of Respiratory And Critical Care Medicine*, 2011; 184:340-344.
- [8] Davis, F. D. Perceived usefulness, perceived ease of use, and user acceptance of information technology, *MIS Quarterly*, 1989; 13 (3): 319–340.

## Pre-Conference Tutorials

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# Analytic Strategies of Streaming Data for eHealth

Organizer: Sunmoo YOON, RN, PhD

Columbia University, School of Nursing, Division of General Medicine  
Sy2102@columbia.edu

**Abstract** New analytic strategies for streaming big data from wearable devices and social media are emerging in ehealth. We face challenges to find meaningful patterns from big data because researchers face difficulties to process big volume of streaming data using traditional processing applications.1 This introductory 180 minutes tutorial offers hand-on instruction on analytics2 (e.g., topic modeling, social network analysis) of streaming data. This tutorial aims to provide practical strategies of information on reducing dimensionality using examples of big data. This tutorial will highlight strategies of incorporating domain experts and a comprehensive approach to streaming social media data.

**Keywords.** Streaming data, big data, social network analysis, topic modeling, data mining

## 1. Tutorial Organization

The proposed tutorial speakers are:

**Sunmoo Yoon**, RN, PhD, Columbia University, sy2102@columbia.edu

Dr Yoon's research focus is on using data science for health. She is a pioneer of developing analytics for Twitter. Her recent work has been recognized as a ground breaking finding by other disciplines including business and pharmacology.

**Michelle Odlum**, MPH, PhD, Columbia University, mlo12@columbia.edu

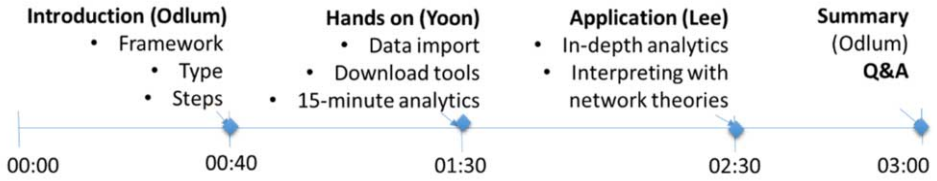
Dr Odlum's research focus is on global health and social, cultural & economic determinants of health and social equity. Her recent transdisciplinary work on Ebola social media mining has been globally press-released over 30 news media.

**Young Ji Lee**, RN, PhD, University of Pittsburgh, leeyoung@pitt.edu

Dr. Lee's research focus is on revealing hidden relationship between agents using network analysis. Her recent work has been recognized by medical informatics society as an innovative method to assess the association between comorbidity and re-admissions.

## 2. Tutorial Description

Format: a mix of breakout group discussion and hand-on interactive section.  
Timeline



### 3. Description

After the tutorial, participants will be able to know six steps of data mining process for analyzing streaming social media data; 1) how to formulate domain application, 2) how to select and understand data using visualization tool<sup>3</sup>, 3) how to clean and preprocess data, 4) how to reduce dimensionality and big volumes, 5) how to choose data mining algorithms (natural language processing, clustering and grouping focused), and 6) how to interpret and evaluate data mining results. The tutorial will provide step-by-step interactive section during the class using open-source softwares, which require minimal programming skills. At the end of the tutorial, this highly interactive tutorial will ensure the audience to extract social media data and use analytic tools. Further, the participants will discuss and practice interpretation of the data mining results and how to incorporate domain expertise.

The outline of the tutorial is described in Table 1.

Table 1. Outline

1. Introduction to social media mining
<ul style="list-style-type: none"> <li>Overview</li> <li>Framework of data mining process</li> <li>Types of data mining</li> <li>6 Steps of data mining process</li> </ul>
2. Application of social media mining (hands on)
<ul style="list-style-type: none"> <li>Importing social media data</li> <li>Downloading tools (Ncapture, NodeXL, ORA, Automap, Tableau)</li> <li>15-minute analytics techniques</li> <li>In-depth analytic techniques</li> <li>Interpreting results according to network theories</li> </ul>
3. Summary and Q&A

#### 3.1. Objectives of Tutorial

Specific educational objectives that participants can expect to achieve are 1) to learn social media mining process, 2) to learn how to reduce the volume of big data and 3) to interpret mining results in their own field.

### 3.2. Target Audience

Researchers, nurses, educators and policy makers who are interested in analyzing large and complex data should attend.

### 3.3. Level of the Content

Basic 65%

Intermediate and advanced: 35% covered

Prerequisites: None

Experience of instructors in teaching similar content

Subject	Year	Audience	Location
Social media mining	2011, 2012, 2013, 2014, 2015	Doctoral students of nursing practice at an informatics class Faculties and PhD students at a workshop	Columbia University, U.S University of Texas, Austin, U.S.
Data mining of big data for health	2013, 2014	Master's students of a medical informatics class	New York State University Downstate Medical Center, U.S
Data mining of big data for self-management	2012, 2014	PhDs and research scientists at workshops	Industrial Technology Research Institute, Taiwan
Social media mining	2009, 2010	High school students	Gregorio Luperon High School, U.S.

## References

- [1] P. Tan, M. Steinbach, V. Kumar, Introduction to data mining, : Addison Wesley. 2006.
- [2] I.H. Witten, E. Frank, M.A. Hall, Data mining: practical machine learning tools and techniques, Morgan Kaufmann Publishers. 2011
- [3] G. J. Myatt, W. P. Johnson, Making sense of data III: a practical guide to designing interactive data visualizations, A John Wiley & Sons, INC., 2012

# NI Continuing Education: Replicating a U.S. Model in Other Countries?

Carol J. BICKFORD  
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**Abstract.** The need for nursing informatics continuing education is ongoing as informatics nurses and informatics nurse specialists are expected to be lifelong learners. This tutorial will explore how a very successful U.S. model, Weekend Immersion in Nursing Informatics (WINI), might be considered for replication in other countries. Details about the initial course design, presentation content outline, and sustainability will be shared. Participant input and discussion will be an integral component of this tutorial. The target audience includes informatics nurses, professional development and academic faculty, and those creating interprofessional informatics education programs.

**Keywords.** Continuing education, nursing informatics, scope and standards of practice

## 1. Speakers

Carol J. BICKFORD, ICCE, LLC, carol.bickford@ana.org

Dr. Bickford completed a 22 year US Navy Nurse Corps career, completed her doctorate in nursing informatics, and has served as an American Nurses Association senior policy fellow/advisor for over 18 years. She has published and presented both nationally and internationally. Dr. Bickford was one of the creators of the Weekend/Weekday Immersion in Nursing Informatics (WINI) and continues in her faculty role for this innovative and very successful continuing education program that builds on the framework of the nursing informatics scope and standards of practice.

Kathleen SMITH, ICCE, LLC, ksmith1963@verizon.net

Ms. Smith completed a 30 year US Navy Nurse Corps career, holds a master's degree in education, and has extensive and diverse project management and informatics consulting experience. She has published and presented both nationally and internationally. Ms. Smith was one of the creators of the Weekend/Weekday Immersion in Nursing Informatics (WINI) and continues in her faculty role for this innovative and very successful continuing education program that builds on the framework of the nursing informatics scope and standards of practice.

## 2. Tutorial Format.

This tutorial will involve faculty presentations about the Weekend Immersion in Nursing Informatics (WINI) intended to promote facilitated discussion, networking, and innovative problem solving. Examination of the rationale for development and implementation of this continuing education program will reflect the innovative nature of informatics nurses and informatics nurse specialists. WINI was first presented in November 1995 as a preparatory continuing education event primarily for individuals electing to complete a self-assessment and then apply for the American Nurses Credentialing Center (ANCC) nursing informatics certification credential.

Over the past twenty years, over 4471 participants have attended the 129 WINI sessions. Each participant has received a personal print copy of the current nursing informatics scope and standards book [1]. After 2003, each registrant also received a contemporary nursing textbook, as well as the course presentation materials and supplemental nursing and informatics related items. Each continuing education course has provided ANCC approved continuing education credits that are applicable for certification and state nursing license renewal processing.

Participants will have the opportunity to examine current course materials, evaluation tool, and sample textbooks provided to all WINI registrants. Faculty will discuss pricing, marketing, logistics, and continued refinement of course materials. The facilitated discussion and ongoing question and answer opportunities are intended to promote examination and consideration of the implementation of this educational methodology in other settings and countries.

## References.

- [1] American Nurses Association. (2015). *Nursing Informatics: Scope and Standards of Practice, Second Edition*. Silver Spring, MD: Nursesbooks.org.

# Public Health Information Systems: Priorities and Practices for Successful Deployments

Martin Pearce  
Gevity Consulting Inc.  
mpearce@gevityinc.com

**Abstract** A fast paced workshop designed for senior public health decision makers and clinical leaders implementing information systems to support delivery of public health programs. The tutorial will introduce public health information systems and provide best practices for implementing solutions related to immunization, communicable disease case management and outbreak management.

- Using a combination of formats, the tutorial will:
- Highlight key functionality of public health information systems.
- Review global crises currently exposing gaps and deficiencies in public health information.
- Examine governance, planning, and implementation priorities.
- Highlight considerations supporting implementations nationally and in special populations.
- Provide real, actionable lessons learned to take away and apply in the real world.

**Keywords.** Public Health Information Systems, Communicable Disease, Immunizations, Best Practices

## 1. Tutorial Organization

The proposed tutorial speakers are:

Martin Pearce, Managing Partner for Public Health Solutions Practice, Gevity Consulting Inc., [mpearce@gevityinc.com](mailto:mpearce@gevityinc.com)

Mr. Pearce is a Public Health Epidemiologist experienced in all aspects of public health. Marty has provided support for several public health information systems throughout his 25-year career. He has practiced in Environmental Health and Communicable Disease Management internationally. Marty holds a Master of Public Health, Bachelor of Science (Microbiology).

Maureen Perrin, Gevity Consulting Inc., [mperrin@gevityinc.com](mailto:mperrin@gevityinc.com)

Ms. Maureen Perrin is a senior Gevity consultant and infectious disease epidemiologist who is proud to have supported many public health initiatives over the last 20 years. From

leading notifiable diseases data management to providing strategic advice for a pan-Canadian public health surveillance system, Maureen ensures that the public health priorities emerging from stakeholder concerns are met with optimal solutions. Maureen holds an MSc. in Epidemiology from the School of Tropical Hygiene and Tropical Medicine at the University of London.

Margaret Kennedy, Chief Nursing Informatics Officer and Managing Partner for Clinical Informatics, Gevity Consulting Inc., [mkennedy@gevityinc.com](mailto:mkennedy@gevityinc.com)

Dr. Margie Kennedy is a Registered Nurse with 28+ years experience across a variety of practice domains and a senior nursing informatics expert. Dr. Kennedy led the C-HOBIC mapping in ICNP® and SNOMED CT, as well as leading clinical change management and information system deployments across Canada with First Nations. She holds baccalaureate, masters, and doctoral degrees in nursing and is a co-editor of *Introduction to Nursing Informatics (4<sup>th</sup> ed)*. In addition to serving on multiple national and international informatics boards, she is the Canadian representative to IMIA-NI.

## 2. Tutorial Description

Advances in the understanding of what it takes to have effective public health mandated programs and set priorities for action often come at times of stress on the public health infrastructure. The 2003 Severe Acute Respiratory Syndrome (SARS) epidemic in Canada exposed a glaring deficit regarding clinical documentation and practices in public health practice. Client data in public health practice was recorded in fragmented narrative notes and often supplemented with post it notes or other ad hoc notations on client records that failed to inform rapid decision-making and support emergency responses. Where electronic systems existed, they were archaic, cumbersome, and ill-suited to provide integrated documentation and responsive aggregation for reports and analysis. The lack of a modern health information management solution resulted in significant adverse impacts on information flow to public and international agencies.

The 438 probable cases and 44 deaths in Canada attributed to SARS prompted a national commission and the resulting Naylor Report. The Naylor Report, *Learning from SARS: Renewal of Public Health In Canada*, provided numerous recommendations, including the development of a national public health strategy, the establishment of a public health partnerships program, and a health human resources strategy specifically aimed at public health. Also among these recommendations was a strenuous call for improved information management and collaboration among public health professionals.

Key requirements for future public health information systems were developed as a direct response to the Naylor Report's recommendation regarding information management systems and interprofessional collaboration. Best of breed systems are web-based communicable disease management and surveillance solutions that links public health nurses, medical officers of health, other public health professionals, physicians, hospitals, and other authorized health stakeholders together into an electronic data network. Systems must provide authorized health professionals with a comprehensive public health-focused

documentation approach, enable timely access to key client data and to communicable disease management and surveillance functions, and provides decision support tools designed to help improve the delivery of public health services to citizens.

Major components of best of breed systems include, in addition to the many common services required such as client registration, clinical notes, document management, reports services:

- Communicable disease case management;
- Outbreak management;
- Immunization management;
- Family Health;
- Materials / vaccine inventory management;
- Notifications management; and
- Work management.

Intense participation by public health professionals from across the national geography, and representing all business areas in the development and deployment of systems helps to ensure the design meets the needs of local and national public health professionals. Implementations involving vulnerable populations such as indigenous persons, challenged socio-economic groups, and geographically isolated populations require approaches tailored to the situation.

Key objectives include:

1. Introduce the concept of public health information systems and provide best practices related to immunization, case management and outbreak management for communicable diseases
2. Introduce the necessary functionality of a comprehensive public health information system, using SDSM as a case study
3. Review some of the global crises exposing gaps and deficiencies in public health information management and reporting
4. Examine governance, planning, and implementation priorities to establish a public health information system
5. Highlight consideration supporting implementations in jurisdictions and with specialized populations
6. Provide real, actionable lessons that participants can take away to inform their public health information system deployments



# The Need for a Global Language – SNOMED CT Introduction

Jane Millar

*International Health Terminology Standards Development Organisation(IHTSDO)*  
*jmi@ihtsdo.org*

**Abstract** SNOMED CT is the most comprehensive, multilingual clinical healthcare terminology in the world. It is a resource with comprehensive, scientifically validated clinical content. SNOMED CT enables consistent, processable representation of clinical content in electronic health records.

When implemented in software applications, SNOMED CT can be used to represent clinically relevant information consistently, reliably and comprehensively as an integral part of producing electronic health information. SNOMED CT supports the development of comprehensive high-quality clinical content in health records. It provides a standardized way to represent clinical phrases captured by the healthcare professional and enables automatic interpretation of these. SNOMED CT is a clinically validated, semantically rich, controlled vocabulary that facilitates evolutionary growth in expressivity to meet emerging requirements. SNOMED CT based clinical information benefits individual patients and clinicians as well as populations and it supports evidence based care.

The use of an Electronic Health Record (EHR) improves communication and increases the availability of relevant information. IHTSDO works with other standards organisations to ensure interoperability and a key area has been the work with ICN to enable the use of ICNP and SNOMED CT by the nursing profession internationally.

**Keywords:** SNOMED CT, Nursing, ICN, Interoperability, Terminology

## 1. Tutorial Organization

The proposed tutorial speakers are:

- Jane Millar, IHTSDO, [jmi@ihtsdo.org](mailto:jmi@ihtsdo.org)

Jane is IHTSDO's Collaboration Lead. Her role focuses on ensuring that SNOMED CT can operate with other standards in the EHR and that healthcare professionals have the relevant language that they need. Prior to joining IHTSDO, she held the position of Head of Information Standard Services in the National Health Service in England, a role she held from 2001. As a Physiotherapist, Jane started work in terminology development in the UK in 1993, working on the UK Clinical Terms project. Working on this multidisciplinary project, she recognized early the need to collaborate with other professionals in order to reach a shared understanding of the language used for the EHR.

- Ian Green, IHTSDO, [igr@ihtsdo.org](mailto:igr@ihtsdo.org)

Ian is the IHTSDO's Business Service Executive. He has a clinical background in nursing, specialising in cardiac nursing and Advanced Life Support. He has worked in the English NHS for 26 years as a nurse, healthcare manager and then at the UK Terminology Centre with Read Codes and SNOMED CT. He has a degree in Nursing practice and a Master's degree in Healthcare Quality Management. He has been involved with the IHTSDO since its origination in 2007, serving as a member of the Quality Committee and on a number of other IHTSDO groups. As IHTSDO's Business Service Executive, Ian provides management across SNOMED CT content, mapping, education and implementation lines of business.

## 2. Tutorial Description

IHTSDO will provide a SNOMED CT tutorial during NI2016 with the purpose of:

- a. Increasing knowledge of SNOMED CT and its applicability for healthcare professionals,
- b. Outlining how SNOMED CT contributes to the EHR and the benefits for those caring for individuals.
- c. Provides details of the work with ICN to align SNOMED CT and ICNP and practically what this means for nursing documentation and the shared EHR

IHTSDO, as the owner of SNOMED CT, will manage the tutorial. The tutorial will include:

### 2.1. *What is SNOMED CT and what is it for?*

The increasing number of EHRs implemented in countries offers opportunities for improving healthcare by better using clinical data. This does pose challenges on the way in which data is collected and stored in these EHRs.

This part of the tutorial will begin with addressing the reasons and clinical benefits for standardization of EHR content. It will go on to explain the role of information models and terminological systems such as LOINC, ICD-10, and SNOMED CT for standardization of the structure and the content of the EHR. It will then focus on SNOMED CT and its concept-based nature, explicitly separating concepts from terms. We will elaborate on its hierarchies, and the way in which definitions of concept are provided, including an explanation of the reasoning capabilities provided by these definitions. Finally, we will address steps to be taken to use SNOMED CT in practice.

### 2.2. *SNOMED CT in Nursing*

We will discuss in detail the work undertaken to develop nursing content in SNOMED CT as part of the collaboration between IHTSDO and ICN. We will describe how the work on Nursing Diagnoses and Interventions has influenced the development of SNOMED CT content, as well as aiming to present a number of practical implementations related to nursing documentation.

### *2.3. IHTSDO as an organization and its interaction with other SDOs*

This part of the tutorial presents ways in which the IHTSDO (the organisation owning, distributing and maintaining SNOMED CT) works with other organisations to support interoperability. There are a number of collaboration agreements between IHTSDO and other SDOs, and profile organisations such as WHO, WONCA, ICN, HL7, LOINC and these will be described at a high level. We will provide information on how to obtain SNOMED CT as well as opportunities to engage with the IHTSDO and take part in the work undertaken within the community focusing on information to support patient care delivery.

# Understanding New Types of Evidence Ready for Translation into Nursing Informatics

*Kathleen McCormick, Ph.D., R.N., FACMI, FAAN, FHIMSS  
SciMind, LLC, USA  
Scimind2@gmail.com*

**Abstract.** Nurses are the primary deliverers of patient care and observers of patient side effects to medications. The primary objective of this tutorial is to bring the participants up to date in genomic applications for nursing from birth until death. A secondary objective is to define at least 17 pharmacogenomics evidence guidelines ready for implementation into the Electronic Health Record. The target audience are nurses in practice, implementers of EHRs, nursing in leadership and policy-making positions, those focused on defining new areas for nursing research, and educators who are in need of defining criteria for integrating genomics into nursing education.

**Keywords.** Evidence-based practice, genomics, pharmacogenomics, nursing observations of adverse effects, integration into EHR

## 1. Tutorial Organization

Dr. McCormick is a senior practitioner, researcher, and policy executive in health informatics, bioinformatics, and gerontology. Dr. McCormick spent 13 years as an informatics scientist and clinical trial researcher within the NIH, the National Institute on Aging and Clinical Center. Dr. McCormick then joined the Agency for Health Care Policy and Research (AHRQ) and directed the first Clinical Practice Guideline program, the Computer Decision Support grant programs, and the accelerated Electronic Health Record grant program. She retired as a 06 (Captain) in the USPHS after 30 years of service. Then Dr. McCormick began her business career with SRA International, Inc. and developed their Genomics, Bioinformatics and Life Sciences Solutions program that supported the NIH, CDC, DoD, VA, and the FDA. She received the Vision Award from SRA for her business development in Genomics and Bioinformatics. In May 2004 Dr. McCormick became a Chief Scientist/Vice President at SAIC working to advance innovation in the Health Solutions business unit. In January 2009 she joined SAIC-Frederick (now Leidos Biomedical Research, Inc.) as Senior Principal Scientist/Vice President. This position principally supported the NIH, National Cancer Institute.

She established SciMind, LLC in the spring of 2012. In 2013 she was honored for her work in innovation with the International Informatics Award from Sigma Theta Tau. This is in addition to her multiple awards for her professional accomplishments. She is a member of the prestigious National Academy of Sciences, Institute of Medicine, and Past-President of the Academy of Medicine of Washington,

DC, a fellow of the American College of Medical Informatics (ACMI), and the Healthcare Information Management Systems Society (HIMSS), and the Academy of Nursing (AAN). She is an author of over 6 books, and the coauthor of **Essentials in Nursing Informatics**, now in its 6<sup>th</sup> ed. (2015) which is considered a classic in nursing informatics and recommended for certification in Primary Care and Nursing Informatics. She is also the coauthor of *Healthcare Information Technology: Exam Guide for CompTIA and Healthcare IT Technician and HIT Pro Certifications*, 2012. With over 150 publications, she is frequently sought after as a consultant and speaker for many national and international healthcare and professional organizations. Recently she received the Friends of the National Library of Medicine Nursing Informatics Award.

## 2. Tutorial Description

### 2.1. Format

#### Timeline

- Presentation of content - 90 minutes
- Case Study Discussion - 30 minutes
- Group Discussion, Q & As = 60 minutes

### 2.2. Description

According to the United States Institute of Medicine in February 2015, there is sufficient evidence to warrant inclusion of genetic/genomic and pharmacogenomics information into the Electronic Health Record. In addition, the price of testing for genetics has come down to about \$1000 US dollars. There are nursing standards of practice that now include genomics from the American Nurses Association. The ability to document genomic conditions is available in the ICD 10 coding structure. The Centers for Medicare and Medicaid in the US also reimburses for at least 9 genetic tests.

Lawsuits have begun to challenge healthcare providers and deliverers regarding serious side effects of drugs prescribed and delivered to patients with the inability to metabolize those drugs. Educational criteria for nurses have been developed and proposed internationally for almost 10 years. This tutorial proposes to define the birth to death genetic and genomic conditions in various health conditions. Another objective of this tutorial is to present at least 17 pharmacogenomics evidence guidelines ready for implementation into the Electronic Health Record (EHR). Since nurses are the primary care givers, deliverers of medication, and witnesses to patients drug reactions, toxicities, and other complications, they need to know the implications of a patient's genomics on the ability of the patient to metabolize, transport, or regulate medications. The importance of ethnic variation in populations will be described to a diverse international audience. The major side effects of genomic mismatches for the guidelines currently developed will be presented. Four case studies in pediatrics, cardiovascular disease, pain management, and cancer will be handed out to participant with discussion questions. Strategic roadmaps, workflows, algorithms, and clinical decision support tools under development will be described. Barriers to full implementation will be discussed, including standards, integration of healthcare records, and ethical issues. Important implications for nursing in practice will be presented from

the results of a study implementing genomics education and policies into Magnet Hospitals in the United States. The participants will receive a listing of valuable international references and resources to keep abreast of educational resources in nursing, future guidelines and evidence that are available internationally.

# Human Factors for Nursing: From In-Situ Testing to Mobile Usability Engineering

Andre W. KUSHNIRUK<sup>a,1</sup>, Elizabeth M. Borycki<sup>b</sup>,  
Terje SOLVOLL<sup>b</sup>, and Carola HULLIN<sup>c</sup>

<sup>a</sup>*School of Health Information Science, University of Victoria, Victoria, Canada*

<sup>b</sup>*Norwegian Centre for Integrated Care and Telemedicine,  
University Hospital of North Norway, Norway*

<sup>c</sup>*School of Health, DuocUC Catholic University, Chile*

**Abstract.** The tutorial goal is to familiarize participants with human aspects of health informatics and human-centered approaches to the design, evaluation and deployment of both usable and safe healthcare information systems. The focus will be on demonstrating and teaching practical and low-cost methods for evaluating mobile applications in nursing. Basic background to testing methods will be provided, followed by live demonstration of the methods. Then the audience will break into small groups to explore the application of the methods to applications of interest (there will be a number of possible applications that will be available for applications in areas such as electronic health records and decision support, however, if the groups have applications of specific interest to them that will be possible). The challenges of conducting usability testing, and in particular mobile usability testing will be discussed along with practical solutions. The target audience includes practicing nurses and nurse researchers, nursing informatics specialists, nursing students, nursing managers and health informatics professionals interested in improving the usability and safety of healthcare applications.

**Keywords.** Usability, usability engineering, human factors, in-situ, mobile, patient safety

## 1. Introduction

In this tutorial we will discuss human aspects of health informatics and human-centered approaches to the design, evaluation and deployment of safe, usable and useful healthcare software, in particular mobile applications and devices used by nurses. Ensuring the effectiveness, safety and usability of mobile health care software that supports nurses' work is an important area of focus for nursing informatics professionals. In recent years there has developed a need for understanding human factors as accelerated by the development and proliferation of differing types of mobile health technologies used by health care consumers and nursing informatics professionals such mobile fitness applications, weight management applications and electronic medication reconciliation applications used by patients and nurses.

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<sup>1</sup> Andre Kushniruk email: andrek@uvic.ca

## 2. Literature Review

Improvements in human factors, usability and clinical workflow have been linked to higher rates of health information technology system adoption and improved safety. On the other hand, issues associated with poor human factors have been increasingly associated with failures to adopt systems and health information systems safety issues. Furthermore, it has become increasingly recognized that ensuring the usability of healthcare information systems (such as the electronic health record) is a key factor to successful system deployment and adoption. Usability can be defined as a measure of how effective, efficient, safe, easy to learn and enjoyable a system is to use. Successful design, implementation and deployment of healthcare information systems is dependent on careful consideration of usability. This includes the study of the impact of systems on healthcare workers' cognition and workflow as well as consideration of interrelated social factors related to successful technology deployment. Such study can be conducted in real-life healthcare contexts (in-situ testing) in rapid and economical ways.

## 3. Methods

### 3.1. *Approach to Usability Testing*

This tutorial is designed to introduce some critical advances in usability engineering and human factors that can be applied by nursing informatics professionals to improve the quality and safety of a range of healthcare applications, with a focus on mobile software applications. In the tutorial examples will be given of low-cost rapid usability engineering performed in-situ in real healthcare and home environments. The examples will range from studying usability of systems such as mobile personal health records to the study of mobile healthcare applications designed for both patients and providers. Challenges associated with conducting mobile usability evaluation will be presented along with practical approaches to the testing of mobile healthcare applications.

The tutorial will help nurses and nursing informatics professionals who are involved in the process of designing, developing, testing, procuring or implementing of applications and systems in hospital, community and clinic settings to identify potential human factors issues as well as to identify strategies for addressing these issues to improve the quality and safety of health information systems. Participants will work through some practical examples of how to improve the human factors, usability and clinical workflow of mobile applications in healthcare.

### 3.2. *Type of Format*

A range of teaching and learning strategies will be used in this tutorial. There will be an initial discussion of basic methods for conducting usability testing and for evaluating mobile applications. This will be followed by a live demonstration by the presenters of usability testing using a mobile device and will be followed by an opportunity for the audience breaking into small groups where they will work together to create evaluation plans for mobile applications they are interested in.



### 3.3. *Timeline*

The session will begin with presentations by the tutorial speakers to provide background context and to describe methods that can be used (for approximately 45 minutes). This will be followed by a live demonstration (involving audience engagement) of the usability evaluation of a nursing application (for approximately 45 minutes). This will be followed by a 20 minute break. After the break and until the end of the session, participants will break into small groups, where they will consider the design of a study for a healthcare mobile application that is of interest to them (for approximately 35 minutes). Towards the end of this part of the tutorial, the break-out groups will report back to the tutorial speakers and the other participants about their evaluation plans to obtain feedback and input (for approximately 35 minutes).

## 4. Discussion

The tutorial will introduce the concept of usability in healthcare and nursing informatics in the context of mobile health care software applications. It will also provide examples of applying usability engineering methods to ensure usability of mobile healthcare applications. A variety of methods to conducting usability and safety testing will be presented as well as practical approaches to low-cost rapid usability engineering that can be applied economically and in any type of healthcare setting.

## References

- [1] E.M. Borycki, H. Monkman, J. Griffith, A. Kushniruk. Mobile usability testing in healthcare: Methodological approaches, *Studies in Healthcare Technology and Informatics*, 216 (2015), 338-342.
- [2] A.W. Kushniruk, E. Borycki. Low-cost rapid usability engineering: designing and customizing usable healthcare information systems. *Healthcare Quarterly*, 9(4) (2006), 98-100, 102.
- [3] A. W. Kushniruk, M. Triola, E. Borycki, B. Stein, J. Kannry. Technology induced error and usability: The relationship between usability problems and prescription errors when using a handheld application. *International Journal of Medical Informatics*, 74 (2005), 519-526.

# User-Centred Design Using Gamestorming

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**Abstract.** User-centered design (UX) is becoming a standard in software engineering and has tremendous potential in healthcare. The purpose of this tutorial will be to demonstrate and provide participants with practice in user-centred design methods that involve 'Gamestorming', a form of brainstorming where 'the rules of life are temporarily suspended'. Participants will learn and apply gamestorming methods including persona development via empathy mapping and methods to translate artefacts derived from participatory design sessions into functional and design requirements.

**Keywords.** User-centred design, end-user design, participatory design, usability

## 1. Tutorial Organization

The proposed tutorial speakers are:

Leanne Currie, RN, PhD, University of British Columbia, School of Nursing.  
[Leanne.currie@nursing.ubc.ca](mailto:Leanne.currie@nursing.ubc.ca)

Dr. Leanne Currie is an Associate Professor at the University of British Columbia School of Nursing where she conducts research in the field of nursing, biomedical and health informatics. Dr. Currie's program of research is in clinical informatics with research projects related to wound care documentation by nurses, smoking cessation, personal health records for patients with chronic diseases, data mining, and informatics competencies in healthcare providers and healthcare students.

J. Craig Phillips, RN, ARNP, LLM, PhD, University of Ottawa, School of Nursing,  
[craig.phillips@uottawa.ca](mailto:craig.phillips@uottawa.ca)

Dr. Phillips is an Associate Professor at the University of Ottawa School of Nursing where he conducts research in ecological epidemiology, intercultural human rights law and participatory design for marginalized populations. He has been funded by the Canadian Institutes of Health Research towards the development of a tailored smoking cessation website with HIV+ gay men using an emancipatory framework.

Charlene Ronquillo, RN, MSN, PhD student, University of British Columbia, School of Nursing. [cronquillo@alumni.ubc.ca](mailto:cronquillo@alumni.ubc.ca)

Ms Ronquillo is a doctoral student at the University of British Columbia School of Nursing where her research will focus on technology use by healthcare providers in low resource settings. She has been involved in development and prototyping of a Web-based tool to support smoking cessation with HIV+ gay men in Western Canada.

Derek Roswell, RN, BScN, MScN student, University of Ottawa, School of Nursing. [Derek.roswell@gmail.com](mailto:Derek.roswell@gmail.com)

Mr. Roswell is a registered nurse working in mental health and community health. Prior to becoming a nurse, Mr Roswell was a project manager for community-based healthcare initiatives seeking equitable healthcare solutions. Most recently, he has been part of a team working towards the development and prototyping of a Web-based tool to support smoking cessation with HIV+ gay men in Western Canada.

## 2. Tutorial Description

### 2.1. Format

Breakout group discussion

Timeline

- 1<sup>st</sup> hour: Theory and application of user-centred and participatory design; types of Gamestorming activities and application to requirements elicitation and expert usability testing
- 2<sup>nd</sup> hour: Application of select Gamestorming activities
- 3<sup>rd</sup> hour: Strategies to translate artifacts derived from user-centred design sessions to actual user interface design.

### 2.2. Description

User-centered design (UX) is becoming a standard in software engineering and has tremendous potential in healthcare. The purpose of this tutorial will be to demonstrate and provide participants with practice in user-centred design methods that involve ‘Gamestorming’, a form of brainstorming where ‘the rules of life are temporarily suspended’. The workshop will begin with a discussion of general methods for inviting and involving participants in the elicitation of requirements for materials that participants would use in the development of software systems including how to build a safe space for novel ideas to be brought forward. The tutorial will describe how to apply the ten essentials of gamestorming in the context of software design or refinement of existing software systems. The ten essentials of gamestorming include opening and closing; fire starting; artifact generation; node generation; developing a meaningful space; using sketching to elicit ideas; valuing randomness; referral, reframing, improvisation; selection; and trying something new.

Key aspects of user-centred design and iterative evaluation will be described and participants will have an opportunity to practice with wire-framing software for rapid prototyping and engaging in user-centred usability testing ‘on-the-fly’.

The use of personas is commonly applied in user-centred design to provide examples of typical target end-users. Personas are also key to expert usability evaluation, and as such, methods to develop valid personas are crucial in software design. In this tutorial, we will provide participants with a tool kit of methods to elicit and validate personas that have been developed by participants who are part of the target end-user population. Key processes for identifying personas to use for usability

testing and system design will be addressed including persona development via empathy mapping and persona validation via peer feedback.

The tutorial will also focus on how to translate artefacts derived from user-centred design sessions to actual software by using value mapping and using a gamestorming approach called product Pinocchio by which the participatory design team apply human characteristics to software so that the most important features can be identified.

## Panels and Workshops

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# Accelerating the Global Workforce Demand for Nurse Informaticians: Advanced Health Informatics Certification (AHIC)

Cynthia GADD<sup>a</sup>, Connie W, DELANEY<sup>b</sup>, Heimar de FÁTIMA MARIN<sup>c</sup>,  
Karen GREENWOOD<sup>d</sup>, Jeffrey J. WILLIAMSON<sup>d</sup>

<sup>a</sup> Vanderbilt University, Nashville, TN, USA; <sup>b</sup> University of Minnesota, Minneapolis, MN, USA; <sup>c</sup> Universidade Federal de São Paulo (UNIFESP), São Paulo, Brazil;  
<sup>d</sup> American Medical Informatics Association (AMIA), Bethesda, MD, USA

**Abstract:** Advances in professional recognition of nursing informatics vary by country but examples exist of training programs moving from curriculum-based education to competency based frameworks to produce highly skilled nursing informaticians. This panel will discuss a significant credentialing project in the United States that should further enhance professional recognition of highly skilled nurses matriculating from NI programs as well as nurses functioning in positions where informatics-induced transformation is occurring. The panel will discuss the professionalization of health informatics by describing core content, training requirements, education needs, and administrative framework applicable for the creation of an Advanced Health Informatics Certification (AHIC).

**Keywords:** Clinical Competence; Informatics; Health Education; Workforce Development

## 1. Panel Description

The goal of this panel is to describe development efforts by the AMIA to create an advanced health informatics certification credential (AHIC) for the informatics workforce including nurse informaticians. Panelists describe the project from inception to its current state of maturity. We will highlight training efforts at different levels of maturity for nurses in Brazil and the interprofessional education movement in North America in order to demonstrate progress toward the global need for an AHIC-type credential. Perhaps most importantly, this panel will identify opportunities for leveraging certification and education resources through dialogue from the world's top informatics subject matter experts through moderated interactive panel discussion.

AMIA has been working on the issue of certification for individuals who practice clinical and health informatics since 2005. AMIA's efforts led to the medical subspecialty of clinical informatics, Board certification, the AMIA Clinical Informatics Board Review Program, and formal relationship with the Commission on Accreditation

of Health Informatics and Information Management (CAHIIM). In February 2012, the AMIA Academic Forum created a Task Force on Advanced Interprofessional Informatics Certification (AIIC) and turned its attention to creating a credential serving a complimentary and equivalent health informatics certification program. This task force issued a consensus statement that established three basic principles:

- a pathway to certification for individuals not eligible for the subspecialty certification is critical,
- such a pathway should focus on the core informatics content that is relevant to all professions, and
- health informatics certification should be at the graduate level, based on the same core content used for the subspecialty certification, have the same rigor as the subspecialty certification process and convey the same level of assurance of competency as the subspecialty certification.

In December 2014, AMIA convened a multi-disciplinary work group to build on the work of the AIIC task force and recommend the core content and eligibility pathways for AIIC. This work group includes representatives from clinical informatics research, dentistry, nutrition, nursing, osteopathy pharmacy, public health, and radiology. To inform their deliberations, work group members have solicited input from related AMIA Working Group Chairs and over 45 individuals from the various disciplines. The work group's recommendations were approved by the AMIA Board of Directors in November 2015 and two official AMIA White Papers will be published in the Journal of the American Medical Informatics Association (JAMIA) in July 2016 entitled *Creating Advanced Health Informatics Certification and Eligibility Requirements for Advanced Health Informatics Certification*.

AMIA is analyzing options for establishing a trusted, professionally neutral home for developing and administering the examination. A new organization would establish the final core content and eligibility pathways for AHIC. These advances in professional recognition of nurse informaticians through certification activities have implications that extend beyond certification and impact training program curriculum, accreditation efforts, and workforce development as individuals train, learn, and are recognized for the informatics competence by the public. The goal of this panel is share with the global nursing informatics audience AHIC progress in the USA and have interactive discussion about implications and collaborations throughout the world.

## 2. Panelists and Moderator

**Cynthia Gadd**, Vice Chair for Education and a Professor of Biomedical Informatics, Vanderbilt University, Nashville, TN, USA, [cindy.gadd@Vanderbilt.Edu](mailto:cindy.gadd@Vanderbilt.Edu). Dr. Gadd has published numerous articles in her primary area of research, the implementation and evaluation of integrated clinical information systems from a sociotechnical perspective.

**Connie White Delaney**, Dean and Professor, School of Nursing, University of Minnesota, Minneapolis, MN USA, [delaney@umn.edu](mailto:delaney@umn.edu) [delaney@umn.edu](http://delaney@umn.edu). Dr. Delaney, an internationally recognized health informatics scholar educator, researcher, writer and sought after speaker in the areas of national standards development for essential nursing outcomes/safety data.



**Heimar de Fátima Marin**, Full Professor and Director of the graduate Program in Health Informatics at the Federal University of São Paulo (UNIFESP), São Paulo, Brazil, [heimarfm@gmail.com](mailto:heimarfm@gmail.com). Dr. Marin is a nurse who has devoted her professional career to improving patient care using information and communication technologies.

**Karen Greenwood**, Executive Vice President and Chief Operating Officer, AMIA, Bethesda, MD, USA, [karen@amia.org](mailto:karen@amia.org). Karen serves as a member of AMIA's Executive Committee and is the organizational liaison to several other associations including the Alliance for Nursing Informatics.

**Jeffrey J. Williamson**, Vice President of Education and Academic Affairs, AMIA, Bethesda, MD, USA, [jeff@amia.org](mailto:jeff@amia.org). Jeff's experience is in informatics training, education, workforce development, and he is responsible for AMIA certification and accreditation.

### 3. Timeline of Panel Activities

**J. Williamson** will provide brief introductions, panel topics, panelist introductions, discussion guidelines, and moderate a discussion with the audience. (5 Minutes)

**C. Gadd** is the Chair of the AIIC Work Group and will describe the effort to produce the core content and training requirements to frame the certification, as well as other general information about the rationale for the project. (10 Minutes)

**C. Delaney** is a member of the AIIC Work Group and will discuss outreach to the nursing informatics community as well as efforts to nurture interprofessional education in the USA. (10 Minutes)

**K. Greenwood** will discuss AMIA's involvement in CAHIIM and effort to create an entity to host, administer and sustain AHIC. (10 Minutes)

**H. Marin** will talk about nursing informatics education and workforce development in Brazil and provide her reaction to the AHIC efforts including global opportunities and possible barriers in adoption of the credential. (10 Minutes)

#### **Example Discussion Forum Questions** (Remaining Time)

1. What are examples of advances in informatics professional recognition from around the world? How is AHIC similar or different?
2. How will health informatics certification activities impact accreditation and informatics educators in training programs?
3. Will the professionalization of informatics through certification and accreditation fundamentally alter the discipline of informatics? In what ways?
4. Will the AHIC credential have a leveling effect in professional status for nurses who perform equivalent informatics functions to their medical colleagues?
5. What professional roles and titles will individuals with an advanced informatics credential assume?
6. Can efforts like AHIC and other informatics certifications help the public better understand what informaticians do? If so, how?

# MonDossierMedical.ch – The Personal Health Record for Every Geneva Citizen

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<sup>1</sup>*Direction générale de la santé – Etat de Genève*

<sup>2</sup>*eHealth Suisse Bern*

**Abstract.** MonDossierMedical.ch is a project led by the canton of Geneva, making it possible for every patient to access his own electronic health record (EHR) and to share the medical files with his doctors. It was introduced across the canton in mid-2013, and provided to all patients free of charge. It is based on the first Swiss-wide eHealth-compliant pilot project "e-toile". The canton of Geneva developed "e-toile" as a public-private partnership together with Swiss Post and it was launched in 2011 in some of the canton's municipalities. Back then, Geneva's EHR represented the first Swiss attempt to link all healthcare professionals in the treatment chain. Today, it serves more than 6,000 patients and 400 physicians. This number is growing regularly, as well as the health care institutions (private hospitals, labs) joining the community. The project fits into the national strategy of Switzerland in establishing a national EHR by linking regional implementations like MonDossierMedical.

**Keywords.** MonDossierMedical.ch, Electronic Health Record EHR, e-health, Geneva, Shared Care Plan, Shared Medication List

## 1. Introduction

"MonDossierMedical.ch" project, originally named e-Toile, was born in Geneva in a context of public health costs higher than the national average and development of information technologies. Following issues initiated a thorough reflection:

- Placing the patient at the center of his medical care ("patient empowerment")
- Ensuring the quality of care and avoiding errors
- Ensuring data security
- Improving the efficiency and thus meeting up with the challenges of an aging population.

This project started in 1998. In 2001, the foundation IRIS-GENEVA was created to enable the networking of all health partners. This foundation is now in charge of monitoring the network and promotes its use. This pioneering project required a legal basis, then non-existent in Switzerland. In 2008, the law on the EHR community network was adopted in Geneva, entering into force in 2009. The Swiss federal law on the patient's EHR is forecast to be ready nearly by 2018.

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To realize the sharing of medical information according to the patient's will, a concept of technical architecture and access rules has been developed. It is now being implemented throughout the canton as "MonDossierMedical.ch". The project is conducted by the Directorate General for Health of the Canton of Geneva.

Access to online medical record is free of charge. Patients have then an easy access to medical documents from the University Hospitals of Geneva (HUG), home care, connected pharmacies and laboratories. The patient gives access rights to his attending physicians, pharmacist or specialists.

## **2. Obstacles and opportunities**

Geneva is pioneering this approach in Switzerland that allows physicians and other stakeholders to access, with the patient's permission, to essential information for its management. Conducting this type of project requires overcoming technical and "business" obstacles.

From a technical point of view, after a pilot phase, the system was stabilized to allow wider deployment with improved access times to medical documents.

It was also necessary to simplify the connection process for all users by replacing smart card connection with more modern technologies. It is now possible to connect to MonDossierMedical.ch with a user name, a password and a single-use code received via SMS, known as mTan. The records can now securely be accessed from any computer without any specific hard or software installation.

From a business point of view, the challenge is now to implement greater use of MonDossierMedical.ch for information sharing in the Geneva care network. For this purpose we are working on the management of complex patients with the implementation of a shared care plan and a shared medication list. Those issues require interoperability between the tools and avoiding double data entries.

We will also target more precisely population groups, according to age, conditions, interests, and provide services that are of particular interest to develop connections.

## **3. Present and perspectives**

Registration of patients and professionals to MonDossierMedical.ch is no longer an anecdote. The platform use is today concrete and registrations increase regularly with more than 600 new patients per month - a total of more than 8,000 active records - and over 450 physicians connected.

We also work with various structures such as associations, municipalities, etc. to promote the use of "MonDossierMedical.ch". Public sessions are held to present "MonDossierMedical.ch" and to register interested citizens. All information is available on our website.

Targeted actions are also conducted in various locations among HUG: enrollment is proposed at the main hospital, at the pediatric and geriatric hospitals, and at the emergency room, while patients are waiting, to help them pass the time. Patients doing administrative admission at the hospital have the possibility to be registered in MonDossierMedical.ch at the same time.

As the network of involved partners is extending, we now hope family physicians, private clinics, and laboratories to join the community.

The 2016 outlook is the improvement of complex patients care in the care network with the commissioning of a shared medication list, the upload of documents by the patient himself, and the pilot project of the shared care plan in partnership with PRISM<sup>2</sup> and imad<sup>3</sup>.

#### 4. Added value tools

The **shared care plan** is a dashboard showing on one side the medical information provided by doctors and on the other side observations made by nurses who take care of the patient at home. This tool is primarily intended for complex patients still living at home, with polymorbidities and several health professionals taking care of. The need of regular information transmission between all those professionals is today mainly fulfilled by numerous faxes. An interactive dashboard will allow all players to share information and to access up-to-date data structured according to their activity and needs.

The objective of the **shared medication list** is to perform medication reconciliation in order to get a picture as comprehensive as possible of the drugs taken by the patient. This view allows the physician to have full vision and to avoid prescribing dual or interfering drugs.

Detection tools to prevent adverse effects in connection with other drugs or the patient's condition (weight, age, pregnancy, allergies, etc.) will also be introduced gradually.

The **shared medication list** also allows to easily produce and print a treatment card, sort of "menu" for the patient showing him which dose to take, at what time, and with the reason of the treatment. An image of the tablet will be added for people having difficulties to recognize the different drugs.

This essential tool in the continuity of care is currently only available in "MonDossierMedical.ch". There are however many other prescription systems: HUG, a number of private doctors, clinics and pharmacies all have their own prescribing tools. A priority task in 2016 is to allow those different software's to communicate in order to have a complete shared medication list while avoiding dual entries. Among other things, pharmacists will be able to reprint the patient's treatment card with updated information, which may be different, i.e. in case of a generic substitution.

The project in Geneva is the most advanced implementation of its kind in Switzerland. It is also in line with recommendations that are the basis for the future national EHR. In 2016 the Swiss parliament passed a national law that will make it possible to link regional implementations like MonDossierMedical with similar projects in other cantons. Starting in 2017 every regional EHR that will be part of the future Swiss "circle of trust" has to pass a process of certification to guarantee common rules and interoperability. By this stepwise approach Switzerland wants to establish a nationwide EHR-network that makes it possible for patients to give their health professionals access to relevant health information – regardless of time or location in Switzerland.

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<sup>2</sup> PRISM: Promotion des réseaux intégrés des soins aux malades - [www.prism-ge.ch](http://www.prism-ge.ch)

<sup>3</sup> imad: Institution genevoise de maintien à domicile - [www.imad-ge.ch](http://www.imad-ge.ch)

# How to Prepare a Nursing Informatics Conference Submission

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**Abstract** This workshop aims to demystify the process of submitting papers to Nursing Informatics and MEDINFO Congresses for international authors. During the workshop the authors of this proposal will focus on the characteristics of NI and MEDINFO congresses, principles of scientific writing, requirements of submission formats, and criteria used for assessing submissions. The workshop will be of special interest to those who are planning on submitting a paper, poster, or workshop to future Nursing Informatics and MEDINFO conferences. As part of this the workshop, authors and participants will discuss and share their experiences in submitting papers to NI and MEDINFO conferences and the workshop authors will provide suggestions on how to improve the papers.

**Keywords.** Scientific writing, publication, health and nursing informatics

## Introduction

The aim of the Nursing Informatics (NI) and MEDINFO congresses is to share knowledge and analyze how nursing informatics research is addressing some of the most challenging problems in health care, public health, consumer health, as well as in research and development. The strength of the NI and MEDINFO congress programs are their international, multidisciplinary, and timely input into advances in the field. The overall theme of the conference defines an overarching topic, and the categorial program content covers descriptions of specific approaches that leverage informatics approaches in alignment with the chosen topic. Researchers, clinicians, technologists, managers, and educators around the world contribute to and share experiences on the use of information methods, systems and technologies to promote patient-centered care, improve patient safety, enhance care outcomes, facilitate translational research, enable precision medicine, and improve education and skills in health informatics.

Over the years, submissions for NI and MEDINFO congresses have followed standardized guidelines and formats to ensure the high quality academic contributions

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to the evolving field. The number of submissions for the conferences has varied from year to year, with the category of paper submissions consistently receiving the most. With each year, there is increased interest in NI and MEDINFO congresses and the desire to get papers or posters accepted. There are some essential points that should be addressed in a typical submission. It is the intent of the authors of this workshop to help others improve the quality of their submissions and therefore enhance their ability to be accepted to the conference.

### **Aim of the workshop**

The aim of this workshop is to provide instruction and insights for participants who wish to submit contributions to future NI congresses, with a particular emphasis on papers and posters. The workshop will focus on the characteristics of NI congresses, principles of scientific writing, requirements of submission formats, and criteria used for reviewers assessing conference submissions.

### **Educational Goals**

The workshop has the following learning objectives. Participants will:

1. Learn how to structure a typical paper, poster, panel and workshop proposal, including how to write research questions, a literature review, methods section, results and conclusions.
2. Review key aspects of previously accepted paper, poster, panel, and workshop submissions.
3. Learn about the submission guidelines and the format of conference paper, poster, panel, and workshop publications.

After the workshop, participants will have developed advanced abilities to write and submit papers, posters, workshops and panels for future NI and MEDINFO congresses. The target audience for the workshop is international attendees for future NI and MEDINFO congresses.

### **Workshop structure**

The workshop (90 minutes) will consist of presentations with examples and exercises of scientific writing as well as discussion of criteria for writing high quality submissions. Dr. Saranto will act as the workshop facilitator and will give an introduction of the characteristics of NI congress topics and themes over the years as well as focus on the submission and evaluation processes for the papers and abstracts. Dr. Borycki will discuss the similarities and differences between the differing types of submissions and the key aspects of those submissions that need to be attended to. Prior accepted submissions will be used as illustrative examples. Dr. Sarkar will provide guidance from the perspective of editing and share experiences from the process used for reviewing and editing the submissions for scientific conferences.

# Nursing and eHealth: Are We Preparing Our Future Nurses as Automatons or Informaticians?

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<sup>a</sup>University of Auckland, New Zealand. <sup>b</sup>Sheffield Hallam University, UK. <sup>c</sup>University of Alabama at Birmingham School of Nursing, USA. <sup>d</sup>University of Oslo, Norway. <sup>e</sup>Federal University of Santa Catarina, Brazil.

**Abstract.** The Education Working Group of IMIA NI present this thought provoking panel where the changing and challenging role of nursing will be explored within the information intensive eHealth arena. The session will be of interest to any nurse as the discussion will be driven by the objective of trying to understand how best to prepare nurses to be actively engaged in information and communication technology (ICT) developments that enhance care assessment, delivery, evaluation and audit. As a balance, the discussion will consider the increasing emergence of 'nursing by numbers' where risk assessment tools are used in an automatic way leaving little room for individual evidenced based care.

**Keywords.** Education, competencies, risk assessment, care, ICT

## 1. Description

The World Health Organisation (WHO) defines eHealth as "... the use of information and communication technologies (ICT) for health. Examples include treating patients, conducting research, educating the health workforce, tracking diseases and monitoring public health." [1] Nursing is more difficult to define: according to the International Council for Nursing [2] "Nursing encompasses autonomous and collaborative care of individuals of all ages, families, groups and communities, sick or well and in all settings. Nursing includes the promotion of health, prevention of illness, and the care of ill, disabled and dying people. Advocacy, promotion of a safe environment, research, participation in shaping health policy and in patient and health systems management, and education are also key nursing roles." Certainly this definition gives an indication of the diverse range of nursing roles, and it is this diversity that causes some difficulties in determining collectivity amongst nurses and in maintaining a strong nursing voice in eHealth initiatives.

Part of the reason for the lack of volume of the nursing voice in eHealth must be the massive and regular changes in nursing and healthcare provision over the past ten to twenty years. Job titles have changed, job roles have changed, the way healthcare is delivered has and continues to change, professional dilution has occurred and nursing has perhaps been the greatest net loss group.

Concentration over recent years has been on reducing the costs of care whilst at the same time the drivers for nursing care have compounded. These drivers include the increased intensity of care delivery, increased care outside of hospitals and increasing reliance upon risk assessment, all of which has placed massive pressure upon the point of contact for care.

The barriers preventing nursing engaging further in eHealth include the employer's financial attitude where investment in nursing is seen as a cost rather than a saving; system applications being tactical rather than strategic; limited expert impact to a few members of staff showing an interest rather than creating a pervasive approach; organisations still seeing the technology as computers rather than considering multiple technologies; and management tending towards delegation rather than taking a leadership role. To overcome these barriers it is widely acknowledged that nurses need to be involved in the design, development, implementation and evaluation [3] of clinical computer systems. Sadly according to Dowding [4] there is little evidence to suggest that healthcare organisations are incorporating the knowledge and skills required for effective eHealth development amongst nurses. This view is supported by Mandirola Brioux et al [5] when writing about eHealth in developing countries.

The question is how has nursing education risen to these challenges? The panel will provide perspectives informed by nursing informatics developments within their respective countries before engaging the audience in discussion on how to best prepare nurses for the future and whether that will be as automaton or informatician.

## References

- [1] World Health Organisation, *e-Health*, 2015, <http://www.who.int/topics/ehealth/en/>. Accessed September 10, 2015.
- [2] International Council of Nurses, *Definition of nursing*, 2015, <http://www.icn.ch/definition.htm>. Accessed September 10, 2015.
- [3] L. Ting-Ting, Nurses' experiences using a nursing information system: early stage of technology implementation, *CIN: Computers, Informatics, Nursing* 25, (2007), 294-300.
- [4] D.W. Dowding, Are nurses expected to have information technology skills?, *Nursing Management* 20, (2013), 31-37.
- [5] H.F. Mandirola Brioux, J.H. Bhuiyan Masud, S. Kumar Meher, et al., Challenges and hurdles of ehealth implementation in developing countries, *Studies in Health Technology and Informatics* 216, (2015), 434-437.



# Patient Engagement: Opportunities and Challenges for Nursing and Health Care Professionals

Mervat Abdelhak, PhD, RHIA, FAHIMA

Department Chairman and Associate Professor, University of Pittsburgh, School of Health and Rehabilitation Sciences, Pittsburgh, Pennsylvania, USA  
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**Abstract** Patient (citizen) engagement argued as a critical initiative for the transformation of health care and improving health outcomes. Health care is experiencing patients that have expectations for value, transparency, choice, and engagement. However, meaningfully engaging patients in their own health care has often proven to be difficult. This panel will present commentary, research and educational initiatives, representing multiple and global perspectives on patient engagement. Global efforts in education to prepare the needed workforce will also be addressed. The audience will have an opportunity to share multiple perspectives and experiences within the panel framework.

**Keywords:** Patient (citizen) engagement, e-health, mobile health, technology and data enablers, research results, competencies, roles for nursing and health care professionals

## 1. Panel Organization

The proposed panelists are:

**Dr. Mervat Abdelhak** is an internationally recognized educator and leader in health informatics (HI) and health information management (HIM). She has provided numerous consultancies in several countries including the Middle East. Recipient of AHIMA's and Pennsylvania's Distinguished Member Award, the Edna K. Huffman Literary Award, and the University of Pittsburgh's Distinguished Alumnus Award. Served as president of AHIMA. Served as immediate past-chair of the Commission on Accreditation for Health Informatics and Information Management Education (CAHIIM), inducting AMIA as a second Organization Member of CAHIIM. Developed one of the first Masters and Doctoral programs for HIM. Has 100+ publications in the field of HI and HIM including *Health Information: Management of a Strategic Resource*, 2015; 5<sup>th</sup> edition.

**Marion Ball, Ed.D, FAAN, FCHIME, FHIMSS, FACMI, FAHIMA, FMLA**, Senior Advisor, Research Industry Specialist, Healthcare Informatics, IBM Research; Professor Emerita, Johns Hopkins University School of Nursing; Affiliate Professor, Division of Health Sciences Informatics, Johns Hopkins School of Medicine, Member of the Institute of Medicine, [marionball@us.ibm.com](mailto:marionball@us.ibm.com),

Dr. Ball is an international leader with significant contributions to health and nursing informatics (NI). Dedicated her career to NI and is a founding member of TIGER initiative integrating enabling technologies into the nursing profession. Served as president of IMIA, Board member of AMIA, AHIMA, and NLM. Widely published with 27 books and 200+ journal publications and book chapters, including the (2015; 4<sup>th</sup> edition) textbook on NI. Recipient of coveted awards; Morris F. Collen Lifetime Achievement Award from ACMI/AMIA, Lifetime Achievement Award from IMIA, and inducted as an honorary Fellow into the American Academy of Nursing.

**Angelika Haendel**, DRG Controlling, University Hospital of Erlangen, Nuremberg, Germany; President, International Federation of Health Information Management Associations (IFHIMA), [angelika.haendel@uk-erlangen.de](mailto:angelika.haendel@uk-erlangen.de)

Angelika's responsibilities in her current position include HIM, Quality Management, DRG Controlling, and Integrated Care. As president of IFHIMA, she brings together HIM associations from Europe, Middle East, Asia, and the Americas. Co-chair of the European Federation for Medical Informatics (EFMI), working group (HIME), and is serving on AHIMA's Global Health Workforce.

**Bonnie Cassidy, MPA, RHIA, FAHIMA, FHIMSS**, Senior Director of HIM Innovation Healthcare, Nuance Communications, Inc., Burlington, Massachusetts, USA; Chair of the Commission on Accreditation for Informatics and Information Management Education (CAHIIM), Chicago, Illinois, USA, [bonnie.cassidy@nuance.com](mailto:bonnie.cassidy@nuance.com)

Bonnie is responsible for advancing clinical documentation and information governance. Served as past president of AHIMA and received AHIMA's and Georgia's Distinguished Member Award. An AHIMA Academy ICD-10 CM/PCS certificate holder, Fellow of HIMSS, AHIMA, and an advanced member of HFMA.

**Dr. Bjoern Sellemann**, Head of Nursing Informatics, Institute for Medical Informatics, University of Gottingen, Georg-August Universitat Gottingen, Germany [bjoern.sellemann@med.uni-goettingen.de](mailto:bjoern.sellemann@med.uni-goettingen.de)

Dr. Sellemann is a registered nurse and a nursing and medical informatics scientist. His research focuses on data mining in nursing and identifying competencies in nursing and medical informatics. He is co-chair of the German Society of Medical Informatics Biometry and Epidemiology Nursing Informatics workgroup.

## 2. Panel Description

### 2.1. Format

#### Timeline of activities

- Dr. Abdelhak, panel moderator, introduces the panel members and discussion guidelines. An overview of the topic including the dynamics that are driving patient engagement globally will be addressed.
- Dr. Ball will present research results of using technologies: Kiosk, mobile devices, wearables, and web technology by patients. The role of technology in supporting patients and providers to realize this aim will be discussed.
- Angelika Haendel will discuss patient engagement initiatives in Germany, leveraging the EHR, and the PHR to allow for data to move freely bi-directionally between patient and providers.

- Bonnie Cassidy will present clinical documentation and data governance practices enabling patients and providers to share data seamlessly, a requisite for patient engagement.
- Dr. Sellemann will present global efforts in nursing informatics education discussing new roles and competencies in the workforce.

Sample list of debatable questions

- Can patient engagement improve health outcomes and lower costs?
- What competencies are needed by nursing and health professionals to realize patient engagement?

## 2.2. Description

Patient (citizen) engagement argued as a critical initiative in the transformation of health care and improving health outcomes. In fact, patient engagement has been hailed as the health care breakthrough of the 21<sup>st</sup> century with patients charting the course of their own health care.

The birth of the health care consumer, and the recognition by health care organizations that achieving patient engagement can indeed improve one's health, reduce cost and readmissions, increase patient satisfaction, and enrich health care data, has served as a driving force for a patient-centric framework creating opportunities and challenges not only for the patient but also for health care providers, policy makers, and systems developers.

Health care is experiencing patients that have expectations for value, transparency, choice, quality, and engagement. Today's citizens are accustomed to making informed decisions and have experience with digital markets. The expectation is that the health care industry affords patients the same value added services of accessible information, connectivity, transparency, and choice. The expectation is that patients become well-informed with actionable data so as to be able to choose treatment options wisely and become an active participant in self-management of their own health. However, meaningfully engaging patients in their own health care has often proven to be difficult.

This panel will present commentary, educational, and research initiatives representing multiple perspectives and global practices of the methods in place and being developed for achieving patient engagement. The role of technology, portals, mobile devices, wearables, and hearables will be discussed as supporting patients in achieving engagement. The use of well-designed, well-implemented enabling technologies have been shown to overcome many of the challenges in engaging patients in their health care. Clinical documentation and data governance practices ensuring data integrity, meaningful use, privacy, and security will also be presented. Leveraging the EHR and the PHR to allow for data to move freely bi-directionally between patient and providers will be explored.

The challenges and opportunities surrounding the fundamental transformation of the role of both the patient and providers will be discussed. New roles for nursing and health professionals coupled with new competencies are needed in order to realize patient engagement. Furthermore, the audience will have ample opportunity to share experiences and tested solutions representing global and multiple perspectives within the panel framework.

# Nursing Informatics Competencies: Psychometric Validation, Dissemination, and Maintenance of Self-Assessment Tool for Nurse Leaders

Sarah Collins

*Partners Healthcare; Brigham and Women's Hospital; Harvard Medical School*

[sacollins@partners.org](mailto:sacollins@partners.org)

**Abstract:** Due to rapid advances in technology, HIT competencies for nursing leaders require frequent attention and updating from experts in the field to ensure relevance to nursing leaders' work. This workshop will target nursing informatics researchers and leaders to: 1) learn methods and findings from a study validating a Self-Assessment Scale for Nursing Informatics Competencies for Nurse Leaders, 2) generate awareness of the Self-Assessment scale, 3) discuss strategies for maintenance of competencies overtime and 4) identify strategies to engage nursing leaders in this pursuit.

**Keywords:** Informatics competencies, self-evaluation tool, psychometric testing, factor analysis

## 1. Workshop Organization

The proposed speakers are:

Andy Phillips, MGH Institute of Health Professions, Massachusetts General Hospital, Partners Healthcare System, [aphillips@mghihp.edu](mailto:aphillips@mghihp.edu)

Andrew B. Phillips, RN, PhD is Assistant Professor at the MGH Institute of Health Professions, School of Nursing, teaching nursing informatics and an adjunct Assistant Professor of Clinical Nursing at Columbia University School of Nursing teaching health policy. Dr. Phillips studies HIT policy and technology transformations in complex adaptive systems. Mr. Phillips has a background as an actuarial consultant, pediatric critical care nurse, and founded a company developing process management software for institutional pension and health funds.

Po-Yin Yen, The Ohio State University, [po-yin.yen@osumc.edu](mailto:po-yin.yen@osumc.edu),

Dr. Yen is a Research Assistant Professor in the Department of Biomedical Informatics (BMI), an adjunct faculty member in College of Nursing at The Ohio State University, and a Nurse Scientist at OSUWMC Health System. She is an expert in HIT usability evaluation, human computer interaction, workflow analysis, time motion study, data visualization, and systematic reviews process improvement.

Mary Kennedy, Organization for Nursing Leaders MA and RI, [kennm1@aol.com](mailto:kennm1@aol.com)

Ms. Kennedy is a Nurse and Board Certified in Nursing Informatics. She is currently a Clinical Instructor at Northeastern University. Her past positions

include Director of Clinical Informatics (The Miriam Hospital), North American Product Manager (Deio), Product Manager (Datex-Ohmeda) and project leadership experience implementing various point of care clinical applications.

Sarah Collins, RN PhD, Partners Healthcare System, Brigham and Women's Hospital, Harvard Medical School, [sacollins@partners.org](mailto:sacollins@partners.org)

Sarah Collins, RN, PhD is a Senior Clinical and Nurse Informatician in Clinical Informatics Partners eCare at Partners Healthcare System and an Instructor in Medicine at Harvard Medical School and Brigham and Women's Hospital. Her research, as well as her applied clinical informatics work, is focused on modeling, developing, and evaluating standards-based, patient-centered collaborative informatics tools to further patient safety, decision-support, and coordinated care.

## 2. Workshop Description

### 2.1. Format

Agenda & Timeline for breakout group discussion: 1) Welcome and opening remarks: Motivation, Opportunities, Progress (15 minutes, Sarah Collins); 2) Nursing Informatics Competencies Factor Analysis (20 minutes, Andy Phillips & Po-Yin Yen); 3) Self introductions by Workshop Participants [if less than 25 participants] (15 minutes, Mary Kennedy); 4) Focus Areas for Breakout group discussion organized by Foundations and Applications for Nursing Informatics Competencies (30 minutes): a) Foundations Path: i. Review of Factor Analysis and outstanding items (Po-Yin), ii. Self-Assessment Tool Implementation and Evaluation (Sarah Collins); b) Applications Path: i. Strategies for maintenance of competencies overtime (Andy Phillips), ii. Strategies to engage nursing leaders, outside the traditional informatics community, in this pursuit (Mary Kennedy); 5) Summation and Next Steps (10 minutes)

### 2.2. Description

#### 2.2.1. Foundations Path: Nursing Informatics Competencies and Factor Analysis

Our team conducted a 2 year, multi-method study to define and validate Nursing Informatics Competencies for Nurse Leaders. This was done in partnership with the Organization of Nurse leaders MA, RI and NH (ONL) Nursing Informatics and Technology sub-committee. The deliverable from this study is a short, validated self-assessment tool that can be used by Nurse Leaders at healthcare organizations to evaluate their levels of nursing informatics competencies and target learning and professional development opportunities. Phase 1 included a Delphi Survey to capture expert opinion on the relevance and description of each competency. Phase 2 included psychometric testing and factor analysis to validate the competencies.

The Delphi Survey consisted of three rounds with the ONL leadership and members. Based on Westra and Delaney, 108 competencies were included in the first version[1]. Content Validity Index (CVI) was used to analyze survey results[2]. Kruskai-Wallis ANOVA was used to analyze differences among groups of participants. Participants' comments were qualitatively analyzed for items with a CVI <.80 to determine if they should be retained. This process resulted in 74 items. A multi-voting method [3] was utilized to reduce the 74 items from the Delphi process to a 45 item

instrument for testing and feasibility. 539 responses were collected through a survey of nursing leaders (357 valid responses with < 20% missing values). An exploratory factor analysis was performed [3]–[5] including: 1) PA and Velicer’s MAP to determine the number of components; 2) Maximum Likelihood (ML)[6]; 3) orthogonal (varimax) and oblique rotations (promax) to assess stability of factor solution across rotation types; and 4) item reductions based upon item loadings and affect on Cronbach’s alpha reliabilities[7], [8]. Following item reductions, we repeated procedures until final solution was reached. Preliminary analysis resulted in 5 factors across 26 items. Final results will be presented and discussed during the workshop.

### 2.2.2. Applications Path: Maintenance, On-going Engagement with Stakeholders, and Use of a Nursing Informatics Competency Tool in the Field

Foundational instrument development is advanced by applying a system lifecycle approach for competency implementation and maintenance and ongoing value- and outcomes-based evaluations that are relevant to stakeholders and their organizations. The mission, vision, purpose, and measurable short and long-term goals of Nursing Informatics Competency Tool implementation will be identified. These concepts will be applied to define a business case for healthcare organizations to adopt tools that support informatics competency attainment for nurse leaders. Rogers Diffusion of Innovation model will be used to frame the discussion of specific activities such as: stakeholder engagement, adoption, integration into practice, and value demonstration[9]. Successful strategies and lessons learned from will be shared.

## References

- [1] B. L. Westra and C. W. Delaney, “Informatics Competencies for Nursing and Healthcare Leaders,” in *AMIA Annual Symposium Proceedings*, 2008, pp. 804–808.
- [2] D. F. Polit and C. T. Beck, “The content validity index: are you sure you know what’s being reported? Critique and recommendations.,” *Res. Nurs. Health*, vol. 29, no. 5, pp. 489–97, Oct. 2006.
- [3] W. Zwick and W. Velicer, “Comparison of 5 Rules for Determining the Number of Components to Retain,” *Psychol. Bull.*, vol. 99, no. 3, pp. 432–442, 1986.
- [4] B. O’Connor, “SPSS and SAS programs for determining the number of components using parallel analysis and Velicer’s MAP test,” *Behav. Res. Methods Instruments Comput.*, vol. 32, no. 3, pp. 396–402, 2000.
- [5] N. Turner, “The effect of common variance and structure pattern on random data eigenvalues: Implications for the accuracy of parallel analysis,” *Educ. Psychol. Meas.*, vol. 58, no. 4, pp. 541–568, 1998.
- [6] A. Satorra and P. Bentler, “A scaled difference chi-square test statistic for moment structure analysis.,” *Psychometrika*, vol. 66, no. 4, pp. 507–514, 2001.
- [7] A. Costello and J. Osborne, “Best Practices in Exploratory Factor Analysis: Four Recommendations for Getting the Most From Your Analysis,” *Pract. Assessment, Res. Eval.*, vol. 10, no. 7, 2005.
- [8] R. Worthington and T. Whittaker, “Scale Development Research: A Content Analysis and Recommendations for Best Practices,” *Couns. Psychol.*, vol. 34, no. 6, pp. 806–838, Nov. 2006.
- [9] E. Rogers, *Diffusion of innovations*, 5th ed. New York: Free Press, 2003.

# Continuity of Care: Sharing the Medication Treatment Plan

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**Abstract** The shared medication treatment plan is a key element for supporting the continuity of care. Indeed a substantial amount of emergency hospitalization is linked to medication – 5% to 10% according to some studies. Methods and tools helping all healthcare providers to have a better knowledge of the complete medication plan are therefore required in order to limit side effects linked to an insufficient knowledge of what the patient is taking. The workshop intends to present various initiatives and open the discussion about the limits, pros and cons of various initiatives.

**Keywords.** Continuity of care, medication, shared treatment plan

## 1. Workshop Organization

The proposed speakers are:

Stéphane Spahni, University Hospitals of Geneva, stephane.spahni@hcuge.ch  
*Stephane Spahni, Dr. Sc., is working at the University Hospitals of Geneva since 1996. He worked on several European projects aiming at exchanging medical data between healthcare providers. Since several years he is working on the regional healthcare platform, leading in particular the shared medication treatment plan development. He is also involved in the standardization process (IHE Pharmacy) and on international activities (epSOS & Expand projects, healthcare national contact point).*

To be defined. Many groups are working on medication reconciliation (University of Toronto, Massachusetts General Hospital, John Hopkins Hospital, University of Arizona, Mayo Clinic, ...).

## 2. Workshop Description

### 2.1. Format

Type of format: roundtable or flash session  
Timeline

## *2.2. Description*

The workshop intends to present different initiatives related to the management of the medication list of a patient. At least two projects will be presented – the shared medication treatment plan implemented in Geneva (Vivates platform, also used in other parts of Switzerland) and a national project aiming at updating the list of medication of every patient each time the patient has an encounter.

Geneva's project aims at implementing a true continuity of care by enabling various healthcare providers to access and update a shared medication treatment plan: private physicians as well as hospital's one will be able to get and update the medication plan, pharmacists will be able to document dispenses – including over the counter and self-medication reporter by the patient, nurses will be able to retrieve the treatment plan and to report patient's information.

The PROGRESS study aims at establishing a better documentation of which medications the patient is currently taking. This study is led by the organization "patient safety switzerland" and will take place from 2015 to 2018.

Other initiatives in the domain of medication plan communication like national projects related to medication in Austria or Saudi Arabia, other projects in Switzerland or in other countries will be encouraged to join and present their work. Openings toward international exchange of medication plans with other countries – as foreseen within the Connecting Europe Facility – will also be presented by stakeholders involved in epSOS / EXPAND / CEF projects.

The workshop will start with a series of presentations on various aspects of the continuity of the medication treatment plan followed by discussion on the main technical / organizational / ethical / security challenges.

The list of contributors is not yet established but we expect to have 4 to 6 contributions:

- One or two from the Geneva's projet;
- One from the PROGRESS project;
- 2 to 4 from leading groups in the domain of medication reconciliation in relation with nursing care.



# Advancing Nursing Informatics in the Next 5-10 Years: What Are the Next Steps?

Panel moderator: Charlene Ronquillo  
University of British Columbia School of Nursing  
[cronquillo@alumni.ubc.ca](mailto:cronquillo@alumni.ubc.ca)

**Abstract** Objective: This panel will explore expert perspectives on what is needed to advance nursing informatics (NI) based on results of an international survey conducted by the IMIA-NISIG Student Group in 2015. This panel will build on results of the survey's thematic analysis findings, highlighting: research, practice, education, collaboration, and visibility, as key areas needing action. Scope: Each expert panelist will speak to one of the identified themes in the context of the survey results. Each panelist will then provide perspectives on additional areas of opportunities, potential challenges, and offer actionable recommendations. Target audience: nursing informatics leaders, educators, policymakers, researchers, clinicians, students.

**Keywords.** Nursing informatics trends, research, practice, education, leadership

## 1. Panel Organization

The proposed panelists are:

**Connie White Delaney**, University of Minnesota, [delaney@umn.edu](mailto:delaney@umn.edu),

Dr. Delaney is Professor & Dean at the School of Nursing in the University of Minnesota. She also served as Associate Director of the Clinical Translational Science Institute – Biomedical Informatics, and Acting Director of the Institute for Health Informatics (IHI) in the Academic Health Center from 2010-2015. She is an active researcher and writer in the areas of national standards development for essential nursing and health care, outcomes/safety, and data science.

**Joyce Sensmeier**, HIMSS, IHE USA [JSensmeier@himss.org](mailto:JSensmeier@himss.org),

Joyce Sensmeier is Vice President of Informatics for HIMSS, a global, cause-based, not-for-profit organization focused on better health through information technology (IT). In her current role she is responsible for the areas of clinical informatics, standards and interoperability programs and initiatives. She is co-founder and ex-officio chair of the Alliance for Nursing Informatics, a global collaboration of 30 distinct nursing informatics groups that represents a unified voice for nursing informatics professionals.

**Heimar de Fátima Marin**, Federal University of Sao Paulo (UNIFESP), [hfmalin@unifesp.br](mailto:hfmalin@unifesp.br)

Heimar de Fátima Marin is a nurse who has devoted her professional career to improving patient care using information and communication technologies. She is Full Professor and Coordinator of the Graduate Program in Health Informatics at the

Federal University of São Paulo (UNIFESP). Dr. Marin has over 250 publications and has mentored over 20 Ph.D. students, 32 master students, and 85 specialists in health and nursing informatics.

**Hyeoun-Ae Park**, Seoul National University College of Nursing, President, International Medical Informatics Association (IMIA) South Korea, [hapark@snu.ac.kr](mailto:hapark@snu.ac.kr).

Professor Park has been teaching nursing and health informatics since the early 1990's. Prof. Park's research interests include use of nursing and health terminology and classifications and detailed clinical models in electronic health records to promote interoperability. Prof. Park's is currently working on a health avatar project developing and using intelligent virtual agents and quantified self for health promotion.

**Patti Abbott**, University of Michigan School of Nursing, [pabbott@umich.edu](mailto:pabbott@umich.edu)

Patricia Abbott is a formally trained informatician and an Associate Professor at the University of Michigan School of Nursing. Dr. Abbott is a member of the Biomedical Computing and Health Informatics Study Section at the US National Institutes of Health. In 2014, she was appointed to the WHO e-Health Technical Advisory Group (TAG). Dr. Abbott is focused on e-Health applications and solutions for low-resource settings.

## 2. Panel Description

### 2.1. Format

Timeline of activities

- Moderator introduces panelists and discussion guidelines (5 minutes)
- Panelists give presentations (5 panelists x 10 minutes each)
- Questions & answers (30 minutes)
- Closing (5 minutes)

Sample list of debatable questions

- What actionable recommendations can you make to advance NI (research/ practice/ education/ visibility/ collaboration) across various roles (e.g., students, staff nurses, nurse informaticians, educators, etc).
- For places where NI is not well established, what are some “lessons learned” that might be especially useful from places where NI is relatively advanced?

### 2.2. Description

In summer 2015, the IMIA-NISIG Student Working group developed and distributed an international survey exploring the perspectives of nurse informaticians on current and future trends in nursing informatics. The survey was translated into six languages and distributed through the student groups' professional channels. Out of 402 total survey participants, 272 (response rate=67.7%) responded to the question regarding recommendations on the advancement of NI. The focus of the panel is to build on one of the open-ended survey questions that asked: “What should be done (at a country or organizational level) to advance nursing informatics in the next 5-10 years?” A

thematic analysis of survey responses identified five key areas for action: research, practice, education, collaboration, and visibility.

This panel brings together nursing informatics experts representing each of the five areas for action, who will share their insight as to the next steps that need to be taken within each of these key areas. Further, the panel discussion of debatable questions aims to begin the broader dialogue on additional areas of opportunities, potential challenges, and actionable recommendations.

### **Visibility**

Dr. Park will introduce national and international organizations such as professional organizations, academic organizations and standard development organizations for us as nursing informatics experts to represent nurse informatics and discuss how we can get involved as in these organizations.

### **Practice**

Ms. Sensmeier will describe [HIMSS Position Statement](#) on Transforming Nursing Practice through Technology & Informatics which identifies specific recommendations for eliminating barriers and addressing nursing's role in transforming healthcare through the use of IT. The discussion will emphasize that technology will continue to be a fundamental enabler of future care delivery models and nursing informatics leaders are essential to transforming nursing practice through technology.

### **Research**

The research focus portion of this panel will highlight research priorities, including nursing's engagement in big data science-based research and personalized health. The importance of driving electronic data capture to represent the expanse of nursing and interprofessional care across the continuum of care will be discussed. Advancing interprofessional collaboration and team research are discussed. Within these research topics emphasis will be directed to opportunities and challenges.

### **Education**

Nurses and allied professionals need to be prepared for leading and managing, or to assume new roles and positions in the global health sector. This preparation requires programs in Nursing and Health informatics in several levels and degrees (certificate, master, doctoral, specialization) - one type does not replace the other. Dr. Marin will discuss a number of priorities in education that cover aspects such as shortages of mid-career academicians, availability of resources and infrastructure, and defining curriculum and competencies for training programs, among others.

### **Collaboration**

Dr. Abbott will discuss ways that nurse informaticians can take the lead in creating and participating in opportunities to collaborate with other health and informatics disciplines, approaches towards strengthening existing relationships, and ways that we can potentially capitalize on shared goals and resources to build stronger health informatics systems and communities.

# Accessing Quality Online Health Information: What Is the Solution?

Célia Boyer

*Health on the Net Foundation, Geneva, Switzerland*

[celia.boyer@healthonnet.org](mailto:celia.boyer@healthonnet.org)

**Abstract** The majority of the adult population in both Europe and North America have access to the internet. Over 70% state that they have used the internet to look for health information and the majority started their search at a search engine. Given that search engines list sites according to popularity and not quality, it is imperative that users have a means of discerning trustworthy and honest information from non-reliable health information. The HONcode, a set of eight quality guidelines, ensures access to standardized trustworthy health information which can be used as a tool to guide consumers.

**Keywords:** Patient education, Ethics, Quality, Health information technology, Information privacy. Trust, HONcode

## 1. Workshop Organization

The proposed speakers are:

Célia Boyer, Director of Health On the Net Foundation, [celia.boyer@healthonnet.org](mailto:celia.boyer@healthonnet.org)

Célia has been with HON since its inception 20 years ago. Célia is widely recognized as an expert in the quality assessment of medical information on the Internet. She has taken part in multiple projects at both European and international levels. Her latest achievement is her involvement in the European Commission funded project KConnect (<http://www.kconnect.eu/>) started in 2015, which aims to develop a targeted health search engine for health professionals and general public. She has authored or co-authored more than 90 original scientific publications in peer-reviewed scientific journals and contributed to several books, including the published “eHealth: Legal, Ethical and Governance challenges” - The Internet and Health : international approaches to evaluating the quality of web-based health information.

Allan Hanbury, TU Wien, Austria, [hanbury@ifs.tuwien.ac.at](mailto:hanbury@ifs.tuwien.ac.at)

Allan Hanbury is Senior Researcher and Privatdozent at the TU Wien, Austria. He is coordinator of the EU-funded KConnect Innovation Action on technology for analysing medical text, and coordinator of the CHIST-ERA project MUCKE on credibility of and search in multimodal data and social networks. He was scientific coordinator of the EU-funded Khresmoi Integrated Project on medical and health information search and analysis. His research interests include information

retrieval, multimodal information retrieval, and the evaluation of information retrieval systems and algorithms. He is author or co-author of over 100 publications in refereed journals and refereed international conferences.

Sanna Salanterä, University of Turku, Finland, sansala@utu.fi

Sanna Salanterä is a registered nurse and public health nurse by basic education. She received her PhD in Health Sciences (nursing) in 1999 and became Docent (Assistant Professor) of Health Sciences in 2002. In 2007, she was appointed full time Professor in Clinical Nursing Science at the University of Turku and Joint Nurse Director at the Turku University Hospital. Her main tasks consist of leading a research group of about 10 full time and 15 part time researchers, teaching in master and doctoral programs and, as appointed vice head of the department, being responsible for certain managerial duties. She leads a research program called “Clinical Decision-Making Research Program”. Its focus is on clinical patient care, its management and documentation supported by smart technology. She also leads two research and development projects: “Health Producing Basic Care with Smart Technology” and “Health Producing Health Promotion with Smart Technology”.

## 2. Workshop Description

### 2.1. Format

Type of format: Demos, slide-based lecture presentations and debate discussion

Timeline: The workshop will take 90 minutes divided into: 15 minutes demos, 45 minutes slide-based lecture presentation and 30 minutes debate discussion.

### 2.2. Description

#### 2.2.1. Learning Objectives:

Better understand the challenges and limitations of finding trustworthy information on the Internet. Inform the audience about the eight principles of the HONcode and how each contributes to improving the transparency and reliability of health information. Better understand how search engines find and rank web pages. Learn from practical experience in educating patients about online health and medical information.

#### 2.2.2. Intended Audience:

The workshop is targeted mainly towards health professionals (nurses, doctors and other healthcare professionals) who can help their patients find trustworthy health information using the HONcode certification.

#### 2.2.3. Equipment required:

Data projector and an Internet connection.

#### 2.2.4. Introduction:

The workshop will have three talks followed by a discussion. The first talk will present the challenges in access to high quality health and medical content on the internet, and the solution in the form of the HON code. The second talk will cover some basics of

how a web search engine finds and ranks web pages, and show some demos of solutions to find high quality health and medical information on the internet. The third talk will cover practical aspects of educating patients about accessing high quality information.

#### 2.2.5. *Accessing high quality health and medical information on the internet*

This talk, presented by Célia Boyer, will outline challenges and pitfalls in accessing high quality health and medical information on the Internet. One approach to meeting the challenges is the HONcode certification, the longest standing and most respected quality guideline for online health information [1, 2]. It consists of eight quality factors that health websites should comply with [3]. All aspects of certifying websites and the effect of the certification will be covered.

#### 2.2.6. *Searching the web for health and medical information*

This talk, by Allan Hanbury, will cover, in an intuitive way, how a web search engine finds and ranks pages in response to a query, and how this can lead to poor quality information being ranked highly on a result list. Demos of search engines that aim to rank high quality health information highly will be presented. This will include a demo of Khresmoi for Everyone (K4E, <http://everyone.khresmoi.eu>) [4]. It enables citizens and healthcare professionals to find the most recent and relevant medical information through state-of-the-art semantic search. However, specialized medical search engines have not always been shown to be better than the general search engines [5].

#### 2.2.7. *Practical experience in educating patients about internet search*

This talk, by Sanna Salanterä, will cover practical aspects of educating patients on accessing high quality health and medical information on the internet. It will also cover research on evaluating health information quality and search engines, in particular as part of the CLEF eHealth campaign.

#### 2.2.8. *Discussion*

The last part of the workshop will be devoted to structured discussion between presenters and the attendees about various aspects of finding quality health information on the internet and educating patients about relevant approaches. An outcome of the discussion will be a plan for a study to quantify how patients access health and medical information.

- [1] Boyer C., Selby M., Appel R.D. The Health On the Net Code of Conduct for medical and health Websites 9th World Congress on Medical Informatics, *Proceedings, IOS Press* vol 2 (1998); , 1163-1166
- [2] Wilson, Petra. "How to find the good and avoid the bad or ugly: a short guide to tools for rating quality of health information on the internet." *BMJ: British Medical Journal* 324.7337 (2002): 598.
- [3] HONcode and guidelines: [hon.ch/Conduct.html](http://hon.ch/Conduct.html) [hon.ch/HONcode/Guidelines/](http://hon.ch/HONcode/Guidelines/), (Sep. 2015)
- [4] Pletneva, N, Degoulet, P. et al. "Observations and lessons learnt from non-health professionals evaluating a health search engine." *Studies in health technology and informatics* 205 (2013): 940-944.
- [5] Ilic, Dragan, et al. "Specialized medical search-engines are no better than general search-engines in sourcing consumer information about androgen deficiency." *Human Reproduction* 18.3 (2003): 557-561.

# Health Information Technologies for Geriatrics: The Big Picture

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**Abstract:** Nearly five decades ago in 1970, Simone de Beauvoir's "The Coming of Age" painted a broad-strokes picture of urgent issues affecting the welfare of elders in many cultures. Using her agenda and others, this panel will attempt to sketch what specific technological advances and applications offer to older citizens, clients and patients – over these 50 years and into the future. Rapid aging societies warrants the need to transform health systems to be focused on preventions and patient engagement rather than the curative care. .

**Keywords:** Geriatric nursing, eHealth, Simone de Beauvoir, "The Coming of Age," mHealth, mobile apps for health, active aging, assisted living.

## 1. Panel Organization

The proposed panelists are:

**Dave deBronkart**, noted activist for healthcare transformation, priority@epatientdave.com

Frist panelist's brief biography: Cancer survivor "e-Patient Dave" is an international keynote speaker on healthcare who consistently earns extraordinary ratings by understanding each audience and working closely with each client to define their unique "home run." Audiences have ranged from the Institute for Healthcare Improvement to the Danish Patient Safety Association and the Israel Internet Society. His compelling TEDx Talk "Let Patients Help" was for years in the top half of most-watched TED talks of all time.

**Yu-Chuan Li**, International Center for Health Information Technology, Taipei Medical University, jack@tmu.edu.tw,

Second panelist brief biography: Prof. Dr. Yu-Chuan (Jack) Li has been a pioneer of Medical Informatics research in Asia. He has been Principle Investigator of many national and international projects in the domain of Electronic Health Record, Patient Safety Informatics and Medical e-learning. He is also author of 130 scientific papers and 3 college-level textbooks. He became an elective fellow of American College of Medical Informatics (FACMI), (2010), Australian College of Health Informatics (FACHI), (2010) and also the President of Asia Pacific Association for Medical Informatics (APAMI) from 2006 to 2009. Currently, he is the Editor-in-Chief of two internationally renowned journals - Computer Methods and Programs in Biomedicine and International Journal for Quality in Health Care.

**Luis Fernandez Luque**, Norut, Norway, and University of Sevilla, Spain. [luis@salumedia.com](mailto:luis@salumedia.com)

Third panelist brief biography: Dr. Luis is a co-founder in Salumedia a spin-off from the University of Sevilla (Spain) focused on technologies for the healthcare domain, especially mobile apps and health games. He is also the elected chairman of the Health Social Media Working Group of the International Medical Informatics Association.

**Dr. Shabbir Syed-Abdul** is an assistant professor of Health Informatics at the Graduate Institute of Biomedical Informatics, College of Medical Science and Technology, Taipei Medical University, Taiwan. He is a leading researcher and a principal investigator of Health IT projects in areas including Biosensors, TrEHRT, PWAS, DzMap, big-data analytics and visualization.

His research interests are Telemedicine, mHealth, geriatric medicine, Personal Health Records and Social Media. He wants to focus on the management and flow of the medical information among health care providers and patients. Ultimately his goal is to find efficient methods of providing the right information to the right person at the right time and at the right price.

## 2. Panel Description

### 2.1. Format

Timeline of activities

- Moderator gives brief introduction of panelists and discussion guidelines – 5 minutes
- Panelist position presentations (5-10 minutes each)
- Questions & answers (30 minutes)

Sample list of debatable questions

- How has technology improved the lives of elderly nursing patients and elders in general since 1970?
- Which technologies will be most influential and beneficial in serving the same groups in the future?

What business models will be most effective?

### 2.2. Description

WHO recently estimated that the over-65 population will triple from 524 million in 2010 to nearly 1.5 billion in 2050, with most of this increase in developing countries (1). Clearly health systems must transform to focus on prevention and patient engagement rather than curative care.

This panel will discuss the uses of and problems and benefits associated with various health information technologies that can support geriatric health and functional capabilities. The speakers will note milestones of the past 50 years of digitization and computerization, and show how technologies can promote healthier lifestyles for individuals at risk.



For example, various hardware and applications can enhance elders' security and prevent them from being socially isolated. Still other advances support caregivers and families, or help institutions to increase efficiency and productivity and care for more people with limited funds.

Much has changed in the five decades since Simone de Beauvoir wrote "The Coming of Age" to protest the neglect of elders. In Asia and elsewhere, eldercare has since shifted from being entirely family-managed to include hired workers and institutional support. This professionalized care can include the full range of innovative medical tools and technologies, as well as social media and other outreach for public information and health literacy education.

In some societies, such as the United States, the disproportionate power of elderly voters has led to many new public services and demands for changes. Yet in massive humanitarian crises such as the 2004 tsunami, the needs of older adults are not considered by aid planners; for example, elders cannot use temporary latrines with steep stairs. Older survivors were often vision challenged by lost eyeglasses, and mobility limited for lack of walking sticks, canes, walkers and wheelchairs. mHealth and other real-time information systems can help distribute such scarce items when normal communication systems are not working.

This panel will discuss different technologies impacting on older adults over the past fifty years, with the goal of generating interest and enlisting collaborators for a major conference on the occasion of the book's 50<sup>th</sup> year in print on a very similar topic: how have the lives of elders changed in fifty years? Naturally geriatric nursing specialists and scholars are critical in telling this story, so this panel's organizers hope that the topic can spark much useful collaboration.

## **Reference**

[1] [http://www.who.int/ageing/publications/global\\_health.pdf](http://www.who.int/ageing/publications/global_health.pdf)

# Information Challenges in Patient Transition

Ragnhild HELLESØ

*Institute of Health and Sciences at the University of Oslo, Norway; Centre for Care Research, Gjøvik University College, Gjøvik, Norway*  
ragnhild.helleso@medisin.uio.no

**Abstract** The aim of this workshop is to address challenges in access to accurate and relevant information for both patients and their clinicians during patient transitions. Successful exchange of information across transitions relies on clinicians' use of the electronic health record, information systems that support workflow and communication and access to actionable information to facilitate information exchange. In this workshop the speakers will illustrate the above mentioned challenges. The chairman will initially make a short statement of the purpose and the organization of the workshops.

**Keywords.** Home health care, information needs, point-of-care information, aged, clinical information systems

## 1. Workshop Organization

The proposed speakers are:

Kathryn H. Bowles, Visiting Nurse Service of New York Center for Home Care Policy and Research and van Ameringen Professor in Nursing Excellence, University of Pennsylvania School of Nursing. Email: bowles@nursing.upenn.edu

For more than 20 years, Dr. Bowles has conducted research using information technology to improve care for older adults. The focus of her work is on transitions in care and clinical decision support

Kavita Radhakrishnan, School of Nursing, University of Texas, Austin, TX, USA.

Email: kradhakrishnan@mail.nur.utexas.edu

Radhakrishnan is an Assistant Professor. Her research focuses on the use of technology to support clinicians' home health care service delivery in her research. In particular she investigates potential HIS solution of using standardized nursing data to visualize associations of patients' behavioral context on health outcomes and its potential for effective information exchange among clinicians from community care settings.

Paulina Sockolow, Drexel University College of Nursing and Health Professions, Philadelphia, PA, USA. Email: pss44@drexel.edu

Dr. Sockolow is an Associate Professor of Informatics. She uses mixed methods to identify barriers and facilitators to nurses using health information technology as intended, as well as to discern the impact of health information technology on work and clinical process.

Ragnhild Hellesø, Institute of Health and Sciences at the University of Oslo, Norway; Centre for Care Research, Gjøvik University College, Gjøvik, Norway  
ragnhild.helleso@medisin.uio.no

Hellesø is a Professor in Nursing Sciences. Over the last ten years, Dr. Hellesø has investigated the experiences about facilitators and barriers from a broad spectrum of information processes both within and across healthcare settings and the clinicians' use of information systems.

## 2. Workshop Description

### 2.1. Format

Each speaker will initially give a 10 minute presentation on the topic. Thereafter we will pose questions for the debate which will be discussed in groups and summed up in plenary.

### 2.2. Description

The aim of this workshop is to address the implication of gaps in exchange of information for both patients and their clinicians during patient transitions. Providing high quality and safe health care for patients who are increasingly living at home and receive health care across different health care settings and from multiple clinicians, is challenging. Access to accurate and relevant information is imperative and relies on several important features [1], successful exchange of information across transitions relies on clinicians' accurate use of the electronic health record (EHR) [2], having information systems that support workflow and communication, and [3] having access to actionable information to facilitate information exchange [4]. In this workshop the speakers will illustrate the mentioned challenges based on relevant studies. The chairman will initially make a short statement of the purpose and the organization of the workshops.

The first speaker **Dr. Bowles** will share findings from her research regarding the information needs of patients as they make the decision to accept or refuse home care services [1]. In addition, she will discuss the information needs of the hospital and home care agency personnel as they attempt to track and understand the reasons for refusal and determine patients' needs. Technology solutions to improve decision making are needed.

How data is presented can impact clinician decision-making on quality of care, by influencing not only how quickly they interpret information, but also how they interpret information. **Dr. Radhakrishnan** will as the second speaker provide an overview of a potential HIS solution of using standardized nursing data to visualize associations between patients' contextual information on health outcomes and its potential for effective information exchange among clinicians from community care settings.

The third speaker, **Dr. Sockolow**, will start with an overview of two evaluations of point-of-care EHR use by multidisciplinary teams in community settings. Use of EHR systems in community care settings "not as intended" impacts both information capture as well as clinical process. Dr. Sockolow will summarize barriers and facilitators to EHR use that were identified in her geriatric medical day care study and her home care study [2]. She will highlight key findings including the mismatch between EHR functionality and workflow; impact of EHR use on team communication; organizational use of EHR data to manage efficiency and health outcome goals.

Before opening up the workshop debate, **Dr. Hellesø** will share lessons learned from a study in which nurses were introduced to electronic tools to communicate and exchange information of patients in transition from hospital to home health care. The shift from predominantly oral to electronic communication stimulated the nurses to reflect on the information quality, but also make the transition more efficient.

## References

- [1] J.Sefcik, R. Nock, E. Flores, S. Potashnik, K.H. Bowles, (under review) Patient preferences for information on post-acute care services, *Research in Gerontological Nursing*.
- [2] P. Sockolow, J. Weiner, K. Bowles, P. Abbott, H. Lehmann, Advice for decision makers based on an electronic health record evaluation at a program for all-inclusive care for elders site, *Applied clinical informatic*, 2011;2(1):18-38.
- [3] L. Melby, B.J. Brattheim, R. Hellesø, Patients in transition – improving hospital–home care collaboration through electronic messaging: providers' perspectives, *J Clin Nurs*. 2015:n/a-n/a.
- [4] K. Radhakrishnan, K. Bowles, A. Hanlon, M. Topaz, J.A. Chittams, Retrospective Study on Patient Characteristics and Telehealth Alerts Indicative of Key Medical Events for Heart Failure Patients at a Home Health Agency, *Telemedicine and e-Health*, 2013;19(9):664-70.

# Intelligent Re-Use of Nursing Routine Data: Opportunities and Challenges

Werner O HACKL

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**Abstract** Secondary use of structured nursing routine data receives an increasing attention in healthcare and is supposed to bear huge potential for different purposes. However, building and analyzing such integrated nursing routine data repositories are nontrivial, challenging tasks. The workshop gives an insight in the state of the art of secondary data analysis in nursing and addresses possible opportunities as well as the main challenges when re-using nursing data for secondary analyses. The target audience of the workshop comprises all stakeholders who are interested in the intelligent re-use of nursing data (e.g. decision-makers, public health officials, nursing managers, nursing informatics/IT staff, scientists, data analysts as well as industry representatives).

**Keywords.** nursing informatics, routine nursing data, data collection, data analysis, re-use, secondary use, data warehousing

## 1. Workshop Organization

The proposed speakers are:

Dr. Dieter Baumberger, LEP AG, St. Gallen, Switzerland

- Head of Research and Development at LEP AG, [dieter.baumberger@lep.ch](mailto:dieter.baumberger@lep.ch)

Thomas Jucker, Nursing Management Board University Hospital Zürich, Switzerland, [thomas.jucker@usz.ch](mailto:thomas.jucker@usz.ch)

- Head of Data Analysis, Nursing and Allied Health Professions Office

Dr. Werner O Hackl, Institute of Biomedical Informatics, University of Health Sciences, Medical Informatics and Technology, Hall in Tirol, Austria, [werner.hackl@umit.at](mailto:werner.hackl@umit.at)

- Assistant Professor at Institute of Biomedical Informatics, President of the Austrian Nursing Informatics Society

## 2. Workshop Description

### 2.1. Format

Introductory presentations and moderated group discussion

#### Timeline

- Introductory presentation “Opportunities” (20 min incl. discussion) (D Baumberger):  
*Opportunities of secondary use for whom?*
- Introductory presentation “Hands-on Experience” (20 min incl. discussion) (T Jucker):  
*Secondary use of nursing routine data at the University Hospitals of Zurich*
- Introductory presentation “Challenges and strategies against failure” (20 min incl. discussion) (WO Hackl):  
*Failing to plan is planning to fail: Strategies against failure when re-using routine nursing data for multiple purposes.*
- Involvement of participants “Synopsis” (30 min) (WO Hackl + participants):  
*Synopsis of the introductory presentations and discussion of further opportunities and possible solutions for the different challenges.*

### 2.2. Description

As in most evolving fields, recognized standards, well-proven methodological frameworks or accurately described best practice approaches for the systematic planning and intelligent use of solutions for secondary use of routine nursing data are missing.

Three widely acknowledged experts in the field of secondary use of nursing routine data will give insights in their field of expertise from different viewpoints.

In a first introductory presentation, different opportunities and possible application areas for secondary data analyses in the nursing domain will be presented and critically reflected (D Baumberger). The following introductory presentation (T Jucker) will give interesting and illuminative insights into the state of the art of intelligent data analysis in nursing. The last introductory presentation (W Hackl) will then carve out the major challenges when designing, building and using solutions for secondary use of routine nursing data and propose strategies against failure for nursing data re-use projects.

Finally, the participants will be involved in a moderated group discussion to recapitulate the introductory presentations and to identify further opportunities as well as additional challenges.

The target audience of the workshop comprises all stakeholders who are interested in the intelligent re-use of nursing data (e.g. decision-makers, public health officials, nursing managers, nursing informatics/IT staff, scientists, data analysts as well as industry representatives.)

# Nursing Informatics Education: Latino America & Caribe

Carol HULLIN

Project Leader: Internationalization

[chullin@duoc.cl](mailto:chullin@duoc.cl)

**Abstract:** The objective of this panel is to share the current status of Nursing Informatics education at the national (Chile) and regional level. All the panelists are involved in different educational programs by face to face, online and small workshops. The scope is to anyone who is interested in the education in nursing informatics in Spanish, since the entire panelists participate in the design & development of educational programs from certificate, diploma, bachelor, master and PhD curriculums.

**Keywords:** Nursing Informatics Education, Nursing Informatics, Students, Curriculum

## 1. Panel Organization

The proposed panelists are:

Carol Hullin [chullin@duoc.cl](mailto:chullin@duoc.cl) School of Health Chile

PhD Hullin is a eHealth Leader for over twenty years that currently work with International Entities that aim to reduce poverty by using Information Communication Technologies . At present she is the part of the IMIA LAC directive, and she founded more than five country societies of health Informatics in Latino America & Caribbean Region.

She has worked in numerous countries (54). Carol has been able to educate public & private contexts in organizational behavior and change management, health systems evaluation, quality improvement, research methods and biomedical fundamentals in the vocational, undergraduate and graduate programs. Her research interests include eHealth & mHealth, clinical informatics, organizational change management, health information system implementations, patient safety, project management and information seeking involving health information systems. She authored & several papers examining health information systems upon Patient Safety. More recently, she has edited two books in Health Informatics in English & Spanish. She publishes extensively, such as books in Spanish and English about Nursing Informatics and Policy Development.

Erika Caballero Muñoz,  
Universidad Finis Terrae, UVISA, Chile  
[ecaballe@gmail.com](mailto:ecaballe@gmail.com),

Ms Caballero is a nursing informatics leader in Latin America & Caribbean region. She has worked in academic program to the nursing informatics in Chile. Erika leads a

nursing informatics project to de clinical management nursing and home care systems. Her research in mhealth and nursing informatics, and she has edited over seven books in nursing care and two in Health informatics. Now she is one of the leader in IMIA-LAC.

Tatiana Astengo , Director of Nursing

DuocUC, Maipu Campus, School of Health Chile

Registered Nurse in Chile, and Director of Nursing Education, including clinical technical careers including, nursing & laboratory with blood bank. Her educational background include: Nurse/Midwife, Pontificia Universidad Catolica de Chile, Clinical Simulation Trainer, Diploma of Curricula Development, Subject Instructional Design, Designer of Competencies Tool Certification at DuocUC, including current Clinical teacher of 750 students.

Alejandra Escobar , Director of Nursing

DuocUC, San Carlos Campus School of Health Chile

Registered Nurse in Chile, and Director of Nursing Education, including clinical technical carrers including, nursing & laboratory with blood bank. Nursing at the Universidad de Chile, Diploma of High Education Management (Pontificia Universidad Católica de Chile), ACLS Licenced Trainer , Diploma Vocational Education and Teacher Development (Duoc UC)

## **2. Panel Description**

Sample list of debatable questions

- Question 1

What are factors in LAC for designing and developing special techniques that are appropriate for the region?

- Questions 2

Which are the challenges for the region in nursing informatics education?

## **3. Description**

This panel is to share all the level of Nursing Informatics education in the Spanish speaking world, specifically using the country development of Chile and within the Latino American & Caribbean region.

According the current literature the justification of this panel is based on the following arguments from nursing literature:

David Benton, ICN 2011, states that nurses around the world are at the forefront of many innovative developments and continue to actively improve their practice for the benefit of individuals, communities and society (1). There is no doubt that all nurses use ICT in their practice of care and changing , which is why today it requires empowering nurses in the world in advancing eHealth policies and practices (ICN, 2015) (2)



The panel consists of educators in nursing informatics within the Latino American & Caribbean regions. The formal training for this type of specialist did not exist for the last decade; therefore, lots of developments were commenced for the clinical care needs. Each speaker outlined their own academic experience gained in vocational, undergraduate programs & graduate studies, sharing level of satisfaction with the content and methodology of their program. Also the experience of the development of training in nursing informatics in the region such as designing and developing workshop face to face for nurses, semi , and virtual conferences and symposium . All the panelists believe that is the essence of nursing professionals to update their knowledge and specialization in Latin America to develop, is to provide a safe, efficient, effective, timely, equitable and excellent care to their people, family and community, using international standards based on evidence and science of caring, innovation and use of information and communication technologies to optimize care. Consequently, the power to use in nursing science evidence and using information, let our profession is visible and tangible to the community. (Caballero, E; Hullin C. 2014) (3)

## References

- [1] Benton David. eSalud Launch Program, 7 mayo 2011. ICN.
- [2] ICN. eHealth Program. Extraído Junio 2015, On line disponible en <http://www.icn.ch/es/que-hacemos/ehealth>
- [3] Caballero E. Hullin C. Introducción a la Informática en salud. Editorial Mediterráneo. 2014

# Integrating a Proposed Population Health Model with Nursing Informatics Research

Dawn DOWDING <sup>a,b</sup>, Adriana ARCIA <sup>a</sup>, Ragnhildur Ingibjargardottir BJARNADOTTIR <sup>a</sup>, Sarah IRIBARREN <sup>a</sup>, Sunmoo YOON <sup>a</sup>

<sup>a</sup> *Columbia University School of Nursing*

<sup>b</sup> *Visiting Nurse Service of New York, New York, USA*

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**Abstract.** In this panel we discuss how nursing informatics can provide a framework for carrying out population health nursing research, using a conceptual model for nursing and population health; the Conceptual Model of Nursing and Population Health (CMNPH). The panel will provide an overview of the CMNPH and then each presenter will present findings from ongoing informatics research that provides insights to different levels of the CNMPH model. The panel is targeted towards informatics researchers who wish to use novel informatics approaches to carry out population health research.

**Keywords:** Population Health, Nursing Informatics, Text Mining, Data Visualization, Health Disparities

## 1. Panel Organization

The panel will be moderated by Dawn Dowding, Professor of Nursing at Columbia University School of Nursing and the Visiting Nurse Service of New York. Dr Dowding's research focus is the use of technology to support decision making. The proposed panelists are:

Adriana Arcia, Columbia University School of Nursing, [aa2594@columbia.edu](mailto:aa2594@columbia.edu).

Dr. Arcia researches informatics-based approaches to health communication with a focus on meeting the information needs of childbearing women and individuals with low health literacy.

Ragnhildur Ingibjargardottir Bjarnadottir, Columbia University School of Nursing, [rb2898@columbia.edu](mailto:rb2898@columbia.edu).

Ms. Bjarnadottir's research focuses on improving healthcare for underserved populations using informatics-based approaches. Her current work focuses on nurse documentation and data mining in electronic health records.

Sarah Iribarren, Columbia University School of Nursing, [si2277@columbia.edu](mailto:si2277@columbia.edu)

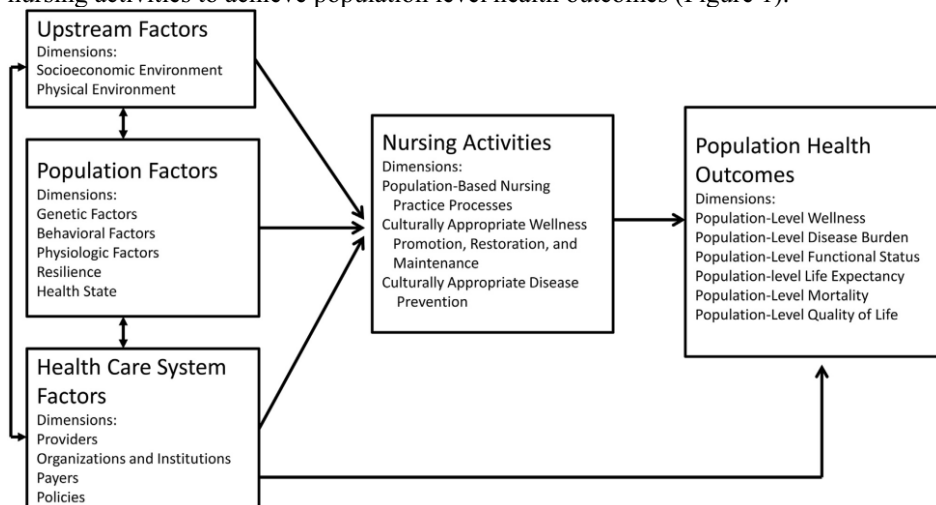
Dr. Iribarren's research focus is in global health, infectious diseases, and mobile health (mHealth) tools to support patients and healthcare teams in low-resource setting with challenging diagnoses/long course treatments, such as tuberculosis (TB).

Sunmoo Yoon, Columbia University School of Nursing, [sy2102@columbia.edu](mailto:sy2102@columbia.edu),

Dr Yoon's research focus is on using data science to improve self-managed health behavior. Her recent work on Twitter mining has been recognized as a ground breaking finding by other disciplines such as business and pharmacology.

## 2. Panel Description

Fawcett and Hall Ellenbecker [1] have proposed a conceptual model for nursing and population health; the Conceptual Model of Nursing and Population Health (CMNPH). The model emphasizes the need for nurses to consider upstream factors (e.g. socioeconomic and physical environment), population factors (e.g. genetic, behavioral, physiologic) and health care system factors (e.g. providers, payers) when carrying out nursing activities to achieve population level health outcomes (Figure 1).



**Figure 1: the Conceptual Model of Nursing and Population Health [1]**

In this panel we discuss how nursing informatics can provide a framework for carrying out population health nursing research, using the CNMPH model as the basis for enquiry. Population health is defined as “life span wellness and disease experiences of aggregate groups of people residing in local, state, national, or international geographic regions or those populations with common characteristics. Population health includes aspects of public health, health care delivery systems, and determinants of wellness and illness, emphasizing promotion, restoration, and maintenance of wellness and prevention of disease.” [1] pp. 290.

Each of the panelists will briefly describe their research and highlight how it fits with the CNMPH. We will then discuss the utility of using the model to frame nursing informatics research that considers populations of patients, rather than focusing on individual patients and diseases.

### 3. Panel Overview

Dr Dowding (moderator) will provide a brief introduction to the panelists and provide an overview of the CNMPH model (5 minutes). Each of the four panelists will then provide an overview of their research (10 minutes each) as follows:

**Adriana Arcia:** Dr Arcia will present findings from her ongoing work which explores how to support comprehension of personal health status through tailored information visualizations (infographics) and insuring the feasibility and acceptability of an online maternity education platform among women at risk for poor health outcomes. This work articulates with the CMNPH as follows: web-based visualization-enhanced health communication (nursing activities) are implemented in response to populations' health literacy and health self-management behaviors (population factors) with the goal of improving population health outcomes.

**Ragnhildur Ingibjargardottir Bjarnadottir:** Ms Bjarnadottir will present findings from a study exploring nurses' experiences, attitudes, and perceptions related to collecting information about sexual orientation, gender identity and expression in the home health care setting. With relation to the CNMPH model, the study highlights how population and health care system factors interrelate to impact on nurse activities related to the routine collection of sensitive data.

**Sarah Iribarren** will present finding from an mHealth based pilot study conducted in Argentina to improve TB treatment outcomes in a setting with historically low treatment success. Finding include an evaluation of upstream factors (e.g., low socio-economic status, geographic isolation/long distances to healthcare facilities); population factors (e.g., medication adherence behavior); and healthcare system factors (e.g., healthcare system organizational structures contributing to low treatment success). These findings are being used to inform plans for intervention scale up and evaluation.

**Sunmoo Yoon:** Dr Yoon will discuss how the CMNPH guided the process for a study using social media mining to gain insights about culturally appropriate nursing activities to manage an emerging global disease from Twitter. It will explore how three fundamental factors (upstream, population and health care system) were molding nursing activities (culturally appropriate disease prevention), which ultimately influenced population health outcomes (population-level disease burden and mortality).

The panel will then be open for audience questions and discussion. Potential questions for debate include:

- What barriers or difficulties did you encounter in framing your research from a population perspective?
- Have you experienced difficulty in acquiring support for such research? For example in reviewers comments, or grant summary statements, have you perceived an lack of understanding or acceptance of this perspective?
- In what generalizable way has your work in informatics contributed to a better understanding of factors that affect the health of individuals and communities?

### References

- [1] J. Fawcett, C.H. Ellenbecker, A proposed conceptual model of nursing and population health, *Nursing Outlook* **63** (2015), 288-298

# Strategies for Leveraging Interoperable Health Information Exchange Systems Among Healthcare Communities

Gregory L. ALEXANDER<sup>a</sup>, Joyce SENSMEIER<sup>b</sup>, Joe MCDONALD<sup>c</sup>, William GOOSSEN<sup>d</sup>, and Mary M. ALEXANDER<sup>e</sup>

<sup>a</sup>University of Missouri, Sinclair School of Nursing, United States; <sup>b</sup>Health Information Management Systems Society, North America, United States; <sup>c</sup>Consultant Psychiatrist & Deputy Medical Director NHS Trust, England; <sup>d</sup>Results4Care, Principal, Netherlands; <sup>e</sup>St. Mary's Health System, United States

**Abstract:** The panel will share international Health Information Exchange (HIE) projects to improve quality and lower costs in healthcare communities (i.e. hospitals, clinician practices, and aged care facilities). HIE allows healthcare professionals and patients to appropriately access and securely share a patient's vital medical information electronically within and across organizations. Intended audience: Researchers, consumers, practitioners, vendors, care providers, and policy makers with interests in technology design, development, implementation, and management, particularly focused on HIE.

**Keywords:** Health systems, Health Information Exchange, Health Information Technology, Patient Care, Electronic Health Records

## 1. Panel Description

A major component of current healthcare practices internationally is to promote widespread HIT adoption, to improve quality and lower costs(1). An emerging area of technology internationally is HIE, used to enhance communication within healthcare organizations. Implementation of technological tools, such as HIE, can be reproduced internationally, so an interactive discussion about international HIE projects to improve quality of patient care is timely to current practice. In our panel, we propose three learning objectives. Participant learning objectives include: 1) Review international models of care incorporating IT with HIE in healthcare organizations, 2) Assemble a real-world view of how to prepare healthcare facilities with health IT, including preparation for HIE adoption through Readiness Assessment, Evaluating Clinical Workflows, Creating and Validating Use Cases, 3) Interactively discover opportunities to advance interoperable HIE in healthcare facilities, with a variety of stakeholders as senders and receivers of key clinical information, 4) Create, use and reuse Detailed Clinical Models, which consist of clinically relevant concepts, data element specification, appropriate code binding, and linkage to the evidence base supporting its use(2).

Following presentations 3-5 discussion groups will be formed, depending on the number of attendees. Each group, composed of 6-8 people, will be facilitated by one

(or more) workshop organizers for 10 minutes using discussion questions. The final 20 minutes will be used for each discussion group to report back and discussion by workshop participants. This is followed by a brief closing summary of the workshop by the moderator. The action items will be elicited and circulated to the attendees interested in following-up after the conclusion of the workshop.

## 2. Panelists and Moderator

**Gregory L Alexander** has specialized education in health systems, human factors, informatics, gerontology, patient safety and quality improvement. He is a lead on a national demonstration project in the US funded by Center's for Medicaid and Medicare to develop Health Information Exchange (HIE) implementation models in health systems.

**Joyce Sensmeier** is a global, cause-based, not-for-profit organization focused on better health through IT. Sensmeier is president of Integrating the Healthcare Enterprise (IHE) USA which serves as a voice representing national health IT efforts fostering national adoption of a consistent set of standards to enable interoperability of health IT systems.

**Joe McDonald** is Consultant Psychiatrist and Quality and Safety Lead Clinician. Chairman CCIO Network. Sunderland, United Kingdom. Dr. McDonald is a practicing Consultant Psychiatrist & Deputy Medical Director of Quality and Patient Safety at Northumberland, Tyne, and Wear NHS Trust, England's largest Mental Health Trust. Dr. McDonald has been campaigning and trying to measure better quality mental health services for 20 years. He is the former NHS Trust Medical Director and national Clinical Lead for IT. McDonald is a clinical engagement specialist with a track record of engaging clinicians in difficult circumstances.

**William Goossen** is Results4Care, Principal, Netherlands. Goossen is a consultant and researcher. His core work is related to information analysis, system analysis and design, requirements gathering, consensus building, terminology evaluation and development. He has published over 200 articles in international and national scientific journals and has acted as a speaker at dozens of conferences.

**Mary M Alexander** is a clinical nurse with nearly 30 years of bedside nursing experience in a variety of areas including intensive care, hospice, school health, ambulatory and outpatient surgical care.

## 3. Timeline of panel activities

**M. Alexander** briefly introduces the topic, panelist's introductions, and discussion guidelines – (5 minutes)

**G. Alexander** presents a 4 year national demonstration project called the Missouri Quality Improvement Initiative (MOQI) funded by the U.S. Centers for Medicare and Medicaid. He will highlight models preparing nursing homes and hospitals for the future of HIE(3). He will outline 6 use cases including, Scheduling patient appointments, Laboratory specimen drawing, Pharmacy orders and reconciliation, Social Work discharge planning, Admissions and pre-admissions, and Pharmacy medication reconciliation. (10 minutes)

**J. Sensmeier** presents results of the 2015 HIMSS HIE and Direct Messaging National Survey which solicited input on the use of Direct messaging to facilitate HIE(4). The survey was open to all healthcare IT stakeholders including those representing Accountable Care Organizations, HIEs, Health Information Service Providers, hospitals, government and vendors. Key themes indicate there is: Substantial use of Direct in support of care coordination; broad availability of a provider directory but great variability in the method of access; challenges incorporating structured data into the EHR; some knowledge of Direct messaging among the clinician community; participating organizations support Direct as a method for data exchange. (10 minutes)

**J. McDonald** will present work being done in the NHS Trust including a high level strategy regarding Quality and Safety, in particular the assessment and shaping of the Safety Culture of the organisation against the backdrop of the "Nicholson Challenge" and the Francis Report. McDonald will discuss a very successful clinical engagement strategy using the National Patient Safety Agency 7 steps approach. (10 minutes)

**W. Goossen** will present an overview of 15 years development of HIE in the Netherlands, starting with the policy decision in 1999 to start a national project. Three areas of concern identified for the Dutch HIE included realization of 1] security measures and policies, 2] a national infrastructure, called the national switchboard: landelijk schakelpunt or LSP) and 3] the infostructure. The security involves national identifiers, authentication and authorization services, the infrastructure is based on the exchange via query and response of clinical content messages through the national index at the LSP. The infostructure consists of HL7 version 3 messaging (medication, gp-to-gp, juvenile care, perinatology, trauma, and CDA (perinatology). New CDA plans are ongoing, including for hospital discharge and nursing discharge. Beside the HL7 v3 standard, terminology is used, such as SNOMED-CT, LOINC, and ICF. For each domain the clinical content is specified in data sets, and more recently in Detailed Clinical Models that are more easily reused from one domain to the other. (10 minutes)

**Discussion forum (30 minutes)**

## Reference List

- [1] R. Bollinger, L. Chang, R. Jafari, T. O Callaghan, P. Nagatia, D. Settle, J. Mackenzie-White, K. Patel, A. Dossil, N. Shorbaji. Leveraging information technology to bridge the health workforce gap. Bulletin of the World Health Organization 2013;91:797-896. Available from: URL: <http://www.who.int/bulletin/volumes/91/11/13-118737/en/>
- [2] W. Goossen, L. Heerman. Exchanging Care Records using HL7 v3 Care Provision Messages. Journal of the American Medical Informatics Association 2014;21:e363-e368.
- [3] G.L. Alexander, M. Rantz, C. Galambos, A. Vogelsmeier, M. Flesner, L.L. Popejoy, J. Mueller, S. Shumate, M. Elvin. Preparing nursing homes for the future of health information exchange. Applied Clinical Informatics 2015;6(2):248-66.
- [4] HIMSS. 2015 HIMSS HIE and Direct Messaging Survey: Current market view of the usage, value and future of Direct Messaging. HIMSS 2015; Available from: URL: [http://s3.amazonaws.com/rdcms-himss/files/production/public/FileDownloads/HIE%20and%20Direct%20Survey%20Results-%202015%2006%2012\\_FINAL.pdf](http://s3.amazonaws.com/rdcms-himss/files/production/public/FileDownloads/HIE%20and%20Direct%20Survey%20Results-%202015%2006%2012_FINAL.pdf)

# Twenty Years of Health On the Net: Committed to Reliable Information

Marion J. BALL, co-founder and member, Health On the Net Foundation Council

**Abstract.** In 1996, at the beginning of the World Wide Web, a group of health specialists anticipated the need for trustworthy health information online. Thus the Health On the Net Foundation (HON) was born. HON was created to promote the deployment of useful and reliable health information online and to enable its appropriate and efficient use. Two decades on, HON is the oldest and most valued quality marker for health information online. For a number of years under the guidance of the late Jean-Raoul Scherrer, the foundation has established its reputation through dynamic measures, innovative endeavors and a dedication to upholding key values and goals. This panel discussion provides an overview of the HON Foundation, its activities, challenges and achievements over the years.

**Keywords.** quality standard, ethics, e-health, health information technology, certification

## 1. Panel Organization

The proposed speakers are:

- Antoine GEISSBÜHLER, President, Health On the Net Foundation Council
- Célia BOYER, Executive Director, Health On the Net Foundation

## 2. Panel Description

**Format.** This panel discussion gets into the nitty-gritty aspects of the HON Foundation's work, and most importantly the challenges and opportunities inherent in both providing trustworthy health information online and its appropriate and efficient use. It will also explore how certification motivates behavioural changes in the production process of health websites, gradually influencing the website's transparency and trustworthiness

- Introduction to HON and the HONcode certification, and the challenges and opportunities of providing trustworthy health information online and its appropriate and efficient use – 30 minutes
- Panelists position presentation (30 minutes)
- Questions & answers (30 minutes)

Sample debatable questions


- Discuss the possibility of worldwide access to HONcode.
- Sustainability of HON into the future.



### 3. Description

The majority of the adult population in both Europe and North America has access to the Internet. More than 70% state that they have used the Internet to look for health information and the majority started their search at a search engine. Given that search engines list sites according to popularity and not quality, it is imperative that users have a means of separating trustworthy and honest information from non-reliable health information. The abundance of content (1 billion websites in 2014, according to internetlivestats.com) suggests that the problem does not lie in finding health information, but in evaluating its trustworthiness.<sup>1</sup>

Numerous challenges and pitfalls are inherent in accessing high-quality health and medical information on the Internet. One approach to meeting the challenges is through HONcode certification, the longest standing and respected quality guideline for health information online. It consists of eight quality factors that health websites should comply with, ensuring access to standardized, trustworthy health information that can be used as a tool to guide consumers.

HONcode seal	Criteria	Detail	
	HC1	Authoritative	Indicates the qualifications of the authors
	HC2	Complementarity	Information supports, does not replace, the doctor-patient relationship
	HC3	Privacy policy	Discloses and respects the privacy and confidentiality of personal data submitted to the site by the visitor
	HC4	Reference and date	Cites the source(s) of published information Dates medical and health pages
	HC5	Justifiability	Backs up claims relating to benefits and performance
	HC6	Transparency	Presentation is accessible; email contact is accurate
	HC7	Financial disclosure	Identifies funding sources
	HC8	Advertising policy	Clearly distinguishes advertising from editorial content

The HONcode is a process metric that determines if a website's construction and maintenance conform to standards of excellence. The HONcode standards help webmasters and information providers adhere to quality information provision practices through simple, broadly accepted rules. The presence of the dated, dynamic and unique HONcode symbol on a website helps users make a decision when faced with multiple, contradicting and sometimes questionable information.

The HON Foundation does not evaluate the reliability or quality of website information content directly. Websites voluntarily apply for the HONcode seal and are evaluated manually by an expert medical team according to the eight HON principles and associated published guidelines. As the result of the audit, an evaluation report helps health website editors render content HONcode compliant and transparent.

Methodologies for certification have evolved over time. The measures for internal and external quality assurance were updated in 2007, improving the system by incorporating standards such as the ISO/IEC 17065 norm and by requiring inspection by independent accrediting organizations. To improve its services, HON set up procedures to monitor certification, complaint management, re-evaluation, and internal audits. When a website is granted certification, HON monitors and adapts the website's status. Because health content on the Internet evolves constantly, the HONcode relies on three mechanisms for this monitoring: the complaint mechanism; automatic surveillance; and manual surveillance. Thus, HON has furthered the reproducibility of

certification independently of revisers by more than 74% according to the principles.<sup>2</sup>

Not all websites achieve certification: 20% are rejected after initial inspection. Increasing rejection rates may reflect stricter, more binding guideline criteria. The reasons for exclusion vary: site outside the scope of certification, inappropriate content, inability to respect the HONcode, or non-certifiable content. A comparative study found that only 0.6% of randomly chosen health websites that did not apply for HON certification conformed to the eight ethical standards, while 89% of certified websites did.<sup>3</sup> Certification motivates behavioural changes in the production process of health websites, gradually influencing the website's transparency and trustworthiness.

Through Khresmoi for Everyone (K4E, <http://everyone.khresmoi.eu>), a HON-related project funded by the European Union, HON has targeted the general public by developing a search engine that identifies high-quality online health information. It enables the public and healthcare professionals in the European Union to find the most recent and relevant medical information through a state-of-the-art semantic search. Within K4E, HON provides access to a database of trustworthy health information consisting of over 8,000 certified and manually selected Web portals in some 27 European languages.

A website can be completely reliable and conform to HONcode criteria without being HON certified. The number of such sites that gain certification is limited due to a lack of manual resources. Therefore, HON has also developed an automated system to detect health website HONcode criteria conformance. This tool was implemented in the K4E search engine as a feasibility test and will become a general search engine plugin. It will assist in detecting uncertified health websites as HONcode candidates.

Over the past 20 years, HON has evaluated more than 20,000 websites. Some 30% of websites in general disappear over a 10-year period. Nevertheless, 13% of HON-certified websites have re-qualified for over 10 years. Some 12,000 users now access the HONcode certificate daily through these certified health websites. This demonstrates the demand for reliable information. Thanks to public funds, the certification procedure was initially a free service. In 2014, HON sought greater financial sustainability and implemented an annual fee for recertification. The recertification payment scheme considers the type of website, its visibility, and its usage. Fees range from 50€ to 325€. So far, 50% of previously certified websites have been contacted and asked to pay; 32% have done so.

## References

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- [1] Straten, A. van, P. Cuijpers, N. Smits (2008). Effectiveness of a Web-Based Self-Help Intervention for Symptoms of Depression, Anxiety, and Stress, *J Med Internet Res.* 10(1):e7.
  - [2] Boyer, C., L. Dolamic (2015). Automated Detection of HONcode Website Conformity Compared to Manual Detection: An Evaluation, *J Med Internet Res.* 17(6)e135. URL: <http://www.jmir.org/2015/6/e135>.
  - [3] Laversin, S. et al. (2011). Improving the transparency of health information found on the internet through the HONcode: a comparative study. *Stud Health Technol Inform.* 169:654-8.

# Reducing Technology-Induced Errors: Organizational and Health Systems Approaches

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**Abstract.** Technology-induced errors are a growing concern for health care organizations. Such errors arise from the interaction between healthcare and information technology deployed in complex settings and contexts. As the number of health information technologies that are used to provide patient care rises so will the need to develop ways to improve the quality and safety of the technology that we use. The objective of the panel is to describe varying approaches to improving software safety from an organizational and health systems perspective. We define what a technology-induced error is. Then, we discuss how software design and testing can be used to improve health information technologies. This discussion is followed by work in the area of monitoring and reporting at a health district and national level. Lastly, we draw on the quality, safety and resilience literature. The target audience for this work are nursing and health informatics researchers, practitioners, administrators, policy makers and students.

**Keywords.** Technology induced errors, patient safety, monitoring, quality improvement, software quality

## 1. Introduction

Technology-induced errors are a growing issue as health care modernizes. With the increased number of health information systems that health professionals are currently using, there is an expectation that the use of these technologies will extend to other types of mobile devices and software applications. Experts in the field of nursing and health informatics expect that the number of incidents of technology-induced errors will rise over time, and research is beginning to show that this is occurring. There are several key points at which we can improve the quality and safety of health information technology, and a comprehensive systematic approach to addressing these errors is needed [1]. Nursing and health informatics research has shown how we can improve the safety of technology at these key points in time. More specifically, research has

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shown that organizational strategies aimed at improving the design of health information technologies, the testing of these technologies and monitoring for incidents are important to improving patient safety and the quality of the technology itself.

## **2. Overview of Organizational and Health Systems Approaches**

In this panel we plan to present on and stimulate discussion about evidence-based strategies for reducing technology-induced errors, improving the quality of health information technology, and incorporating these approaches into organizational quality improvement activities and initiatives (i.e. vendor and health care organizational). The panel will be moderated by Dr. Elizabeth Borycki who will introduce the topic of technology-induced errors from a conceptual, theoretical, healthcare industry and technology perspective [1,2].

Dr. Yalini Senthriajah, an expert in novel design of systems for safety, will describe work currently being done in the United States of America focused on learning more about designs that fit individual health professionals' cognition and work flow early in the development of new healthcare software to be used by clinicians at point of care [3].

Dr. Kushniruk, a methodologist, will discuss the methods developed in Canada that are being used to detect technology-induced errors, as they can be applied to evaluating prototypes, designing new systems, in organizational procurements and in implemented systems. This work will be discussed in terms of how and when these methods can be applied [4].

Sari Palojoki is a leader in the area of patient safety research and development work at the Helsinki University Hospital District. She will discuss how monitoring can be used to effectively identify and learn more about safety incidents involving health information technology. She will describe the innovative methods that have been used to collect, analyze and use monitoring data to understand the nature of safety issues and how they can be used by organizations to advance the safety of technology.

Dr. Kaija Saranto will present on the current state of the research and health care systems' approaches to managing technology-induced errors as an expert in national, systems approaches to managing technology safety. Finland will be presented as an example of national level monitoring and feedback approaches.

Lastly, Dr. Takeda will discuss technology-induced errors in the context of the quality improvement literature and the use of methods from the resilience literature to address these technology quality issues effectively in mature technology settings (i.e. where technology is used for documentation and process improvement in Japan). Japan will be used as an illustrative example. We will conclude our panel discussion with the ways that this work has been integrated to improve the safety of health care [5].

## **3. Conclusion**

Technology-induced errors are an important patient safety issue that needs to be addressed in modern health care organizations as the rate of health information technology usage increases. The research evidence has identified several theoretical, conceptual, design, methodological, monitoring, quality and resilience approaches that can be used to improve organizational strategies and quality improvement initiatives

aimed at improving the safety of health information technologies. Vendor, physician, hospital and regional health authority organizations need to create organizational structures and incorporate evidence-based approaches from the nursing and health informatics literature to improve the safety of health information technologies.

## References

- [1] E. Borycki, E. Keay. Methods to assess the safety of health information systems. *Healthcare quarterly (Toronto, Ont.)* 13 (2009): 47-52.
- [2] E. M. Borycki, A. W. Kushniruk Where do technology-induced errors come from? Towards a model for conceptualizing and diagnosing errors caused by technology. *Human, Social and Organizational Aspects of Health Information Systems*, 2008; 148-165.
- [3] Y. Senathirajah. Safer design: Compostable EHRs and mechanisms for safety. *Stud Health Technol Inform*, 2015; 218:86-92.
- [4] A. Kushniruk, E. Borycki, M. H.Kuo, S. Kuwata, S. Integrating technology-centric and user-centric testing methods: Ensuring healthcare system usability and safety. *Studies in Health Technology and Informatics*, 2010, 157:181-186.
- [5] K. Saranto, D. W. Bates, M. Mykkanen, M. Harkonen, M Miettinen. Whose voices are heard in patient safety incident reports? *NI* 2012: 356.
- [6] H. Takeda, Y. Matsumura, K. Nakajima, S. Kuwata, Y. Zhenjun, K. Nakajima, S. Kuwata, Y. Zhenjun, J. Shanmai, Z. Qiyang, C. Yufen, H. Kusuoka, M. Inoue. Health care quality management by means of an incident report system and an electronic patient record system. *Int J Med Inform*, 2003, 69, 285-293.

# Harmonising ICNP and SNOMED CT: A Model for Effective Collaboration

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**Abstract:** The purpose of this panel was to demonstrate an approach to collaborative working within nursing and health informatics. The panel took as an example an initiative to harmonise between two large-scale terminologies, namely the International Classification for Nursing Practice (ICNP) and SNOMED Clinical Terms (SNOMED CT). A number of practical topics were framed within a context of collaboration, including semi-automated and manual approaches to mapping, consensus working, clinical validation, formal concept modelling, etc. Those attending the panel, nurses and informatics professional alike, came away with an increased understanding of a range of approaches to collaborative working within nursing and health informatics.

**Keywords.** Collaboration, standards, terminologies, harmonization, mapping

## 1. Panel Organization

Members of this panel included:

**Nicholas R. Hardiker** (moderator), International Council of Nurses (ICN) and University of Salford, UK, [n.r.hardiker@salford.ac.uk](mailto:n.r.hardiker@salford.ac.uk)

**Jane Millar**, International Health Terminology Standards Development Organisation (IHTSDO), UK, [jmi@ihtsdo.org](mailto:jmi@ihtsdo.org)

**Tae Youn Kim**, ICN and University of California-Davis, USA, [tynkim@ucdavis.edu](mailto:tynkim@ucdavis.edu)

**Kay Jansen**, ICN and University of Wisconsin-Milwaukee, USA, [kjansen@uwm.edu](mailto:kjansen@uwm.edu)

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## 2. Panel Description

The International Classification for Nursing Practice (ICNP), a product of the International Council of Nurses (ICN), is a standardized terminology that is used by nurses in a number of countries to describe and report their practice in a systematic way. SNOMED Clinical Terms (SNOMED CT), which is owned and distributed by the International Health Terminology Standards Development Organisation (IHTSDO), is the world's most comprehensive multi-disciplinary health terminology. ICNP has been developed for use by and for nurses. As a result ICN has been able to focus the development of ICNP on nursing practice. While there are obvious benefits to being able to capture nursing practice in a consistent way, it is important to recognize that nurses do not practice in isolation. With this in mind, ICN has made a commitment to ensure that nurse users of ICNP, who practice alongside other disciplines, also remain connected to the broader global informatics landscape. Part of this commitment has manifested in the form of a formal collaboration between ICN and IHTSDO that seeks to ensure alignment between ICNP and SNOMED CT [1,2]. A recent piece of work has involved the identification (or creation) of equivalencies between terms or concepts within ICNP and SNOMED CT. An equivalency table for nursing diagnoses or 'problems' has been released [3] and a similar table for nursing interventions is in development. The potential benefits of these tables are far-reaching. For example, they provide a vehicle for transforming ICNP-encoded data into SNOMED CT and vice versa (e.g. an ICNP concept in a local system can be converted via the table to the equivalent SNOMED CT concept for use in a multidisciplinary record). Added value of the work has included enhancements to both terminologies and significant additional nursing content (including 120 new Clinical Findings) for SNOMED CT. Work on the equivalency tables has involved a number of collaborative activities: rating the reliability of semi-automated mappings, augmenting manually the initial set of mappings, validating from a clinical perspective the draft mappings, agreeing new content for SNOMED CT, and concept modeling within both ICNP and SNOMED CT. Each of the activities required teams of people from both organizations to work effectively together, resolving disagreements, reaching consensus, and setting aside any differences in pursuit of a common goal: to deliver to nurses and to nursing the tools they need to perform their role most effectively. Members of this panel described the various phases of the work, highlighting and generalizing lessons learned. Those attending the panel took away concrete advice and practical tips to apply within their own collaborative activities.

## References

- [1] ICN and IHTSDO Team-up to Ensure a Common Health Terminology (2010). Accessed: 18/9/2015 at: [http://www.icn.ch/images/stories/documents/news/press\\_releases/2010\\_PR\\_04\\_AC-ICNP\\_IHTSDO.pdf](http://www.icn.ch/images/stories/documents/news/press_releases/2010_PR_04_AC-ICNP_IHTSDO.pdf) and: [www.ihtsdo.org/resource/resource/72](http://www.ihtsdo.org/resource/resource/72)
- [2] ICN and IHTSDO extend collaboration to advance harmonisation of health terminology (2014). Accessed: 18/9/2015 at: [http://www.icn.ch/images/stories/documents/news/press\\_releases/2014\\_PR\\_17\\_ICN-IHTSDO.pdf](http://www.icn.ch/images/stories/documents/news/press_releases/2014_PR_17_ICN-IHTSDO.pdf) and: [www.ihtsdo.org/resource/resource/86](http://www.ihtsdo.org/resource/resource/86)
- [3] International Council of Nurses (ICN) and International Health Terminology Standards Development Organisation (IHTSDO) deliver collaborative product (2015). Accessed: 18/9/2015 at: [http://www.icn.ch/images/stories/documents/news/press\\_releases/2015\\_PR\\_22\\_ICNP\\_SNOMED\\_equivalency.pdf](http://www.icn.ch/images/stories/documents/news/press_releases/2015_PR_22_ICNP_SNOMED_equivalency.pdf) and: <http://www.ihtsdo.org/resource/resource/206>

# Update: NI Scope and Standards of Practice, Competencies, and Certification

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**Abstract.** The new 2015 ANA Nursing Informatics: Scope and Standards of Practice, Second Edition, includes a slightly revised definition of nursing informatics, totally revised scope of practice statement, and updated standards and accompanying competencies. The competencies are now leveled for informatics nurses and informatics nurse specialists. This professional resource informs practice, education, research, administration, and the certification process. The presenters will provide details about the development of the latest NI scope and standards of practice and the contemporary ANCC certification process to stimulate group discussion and promote development of a personal action plan to integrate such content into nursing and informatics practice. The target audience includes all registered nurses, informatics nurses, informatics nurse specialists, faculty, and administrators.

**Keywords.** Nursing informatics, scope and standards of practice, certification

## 1. Panelists

Carol J. BICKFORD, American Nurses Association, [carol.bickford@ana.org](mailto:carol.bickford@ana.org). Dr. Carol Bickford completed a 22 year US Navy Nurse Corps career, completed her doctorate in nursing informatics, and has served as an American Nurses Association senior policy fellow/advisor for over 18 years. She has published both nationally and internationally. Dr. Bickford was one of the creators of the Weekend/Weekday Immersion in Nursing Informatics (WINI) and continues in her faculty role for this innovative and very successful continuing education program that builds on the framework of the nursing informatics scope and standards of practice.

Nadia SULTANA, New York University (NYU) College of Nursing, [ns56@nyu.edu](mailto:ns56@nyu.edu). Dr. Nadia Sultana, is a Clinical Assistant Professor and Program Director for the Nursing Informatics Master's and Advanced Certificate Programs at the NYU College of Nursing. Before joining the NYU College of Nursing as the Program Director, she was an adjunct professor and she worked in the healthcare information technology department in both the private and public sector. Dr. Sultana has more than twenty-five years of experience developing, implementing and supporting financial and clinical information systems in a variety of health care delivery settings including Correctional Health. Recently, Dr. Sultana served as a member of the ANA workgroup to revise the nursing informatics scope and standards of practice.

Luann WHITTENBURG, Medicomp, [lwhittenburg@medicomp.com](mailto:lwhittenburg@medicomp.com). Dr. Luann Whittenburg is Chief Nursing Informatics Officer at a major international clinical



information company preparing the future vision of nursing information technology. Dr. Whittenburg uses her clinical commitment to nursing to promote the inclusion of nursing practice data in legislated EHR systems while serving on national and international healthcare data standards committees, including the International Organization for Standardization (ISO) and federal committees established by the US Department of Health and Human Services. Dr. Whittenburg is involved in several NI organizations, authored numerous papers for national and international NI conferences and contributed several chapters in NI textbooks.

## 2. Workshop Format.

This workshop will begin with welcome announcements and introductions of presenters and participants, each of whom will identify personal goals targeted for completion upon return to home.

During the presentation about the development the 2015 edition, workshop participants will have ample opportunity to engage in discussion about the selection of the scope and standards revision workgroup members, the thoughtful and deliberative work process, and decisions about the need for revisions of the definition of nursing informatics. The workgoup's new definition received minimal comment during the public comment period and was finalized as:

*Nursing informatics (NI)* is the specialty that integrates nursing science with multiple information and analytical sciences\* to identify, define, manage, and communicate data, information, knowledge, and wisdom in nursing practice. NI supports nurses, consumers, patients, the interprofessional healthcare team, and other stakeholders in their decision-making in all roles and settings to achieve desired outcomes. This support is accomplished through the use of information structures, information processes, and information technology. [1]

Discussion of the scope of practice statement will address several models depicting the integration of data, information, knowledge, and wisdom as core components of nursing informatics practice. Because of the significant diversity of NI practice roles, the scope statement construction included detailing of functional areas of practice of the informatics nurse and informatics nurse specialist. Participants will be invited to identify opportunities for further career development in such functional areas. Similarly, examination of ethical issues and requisite informatics competencies for all registered nurses and competencies for informatics nurses and informatics specialists will set the stage for a discussion of the standards of practice and professional performance and the accompanying competency statements.

The final segment of the workshop will address the American Nurses Credentialing Center (ANCC) specialty certification in nursing informatics. This certification became available in 1995 and has now been expanded to include acceptance of international applicants. The presenters will provide details about the most recent role delineation study informing development of the current test form and content outline, as well as the application process. Again, extensive opportunities for questions and discussion are included.

## References.

- [1] American Nurses Association. (2015). *Nursing Informatics: Scope and Standards of Practice, Second Edition*. Silver Spring, MD: Nursesbooks.org.

# Milestones and Experiences of Standardized Documentation

Kaija SARANTO<sup>a1</sup>, Virginia SABA<sup>b</sup>, Patricia DYKES<sup>c</sup>, Ulla-Mari KINNUNEN<sup>a</sup>,  
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**Abstract** The purpose of this panel is to discuss milestones and experiences of a standardized nursing terminology for the documentation of nursing practice using Clinical Care Classification as an example. The aim is to describe the value of using the CCC as the standardized nursing terminology and framework for the multidisciplinary care plans and how its interoperability with SNOMED CT, LOINC, and other required terminologies can be used for the electronic health record systems. Further the aim is to discuss the advantages a multidisciplinary documentation system and how it impacts on nursing practice, management, and research as well as highlight the monitoring of nursing documentation. The target audience will enrich their understanding about the possibilities that a standardized multidisciplinary documentation is critical for future data analyses and datamining highlighting nursing practices.

**Keywords.** Standards, Documentation, Nursing, Clinical Care Classification System

## 1. Introduction

The purpose of this panel is to discuss milestones and experiences of a standardized nursing terminology using Clinical Care Classification as an example. The aim is to describe the value of using the CCC as the standardized nursing terminology and framework for the multidisciplinary care plans and how its interoperability with SNOMED CT, LOINC, and other required terminologies can be used for the electronic health record systems. The panelists will highlight the values of the CCC as the nursing care aspect for the multidisciplinary team's documentation strategies and how it can provide the basis for tracking the continuity of care for a patient's episode of care.

### *Panel Description*

Each panelist will then give their presentations and impulses for joint discussion with the audience. The presentations will lead to debatable questions:

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<sup>1</sup> Kaija Saranto University of Eastern Finland, P.O.Box 1627, FI 70211 Kuopio, Finland

- What is the value of standardized terminologies for nursing practice and management?
- What could be the leading strategies for incorporating a standardized terminology into clinical documentation system?
- What are the challenges associated with implementation of standardized terminology with nurses?

### *Panelists*

Dr. Kaija Saranto as the moderator of the panel will focus on the challenges in using standardized nursing documentation and especially on the importance of data re-use in nursing.

Dr. Virginia Saba will provide a brief overview of the Clinical Care Classification (CCC) System. She will describe how the CCC System is being used for the documentation of nursing practice in the electronic health record (EHR) or healthcare information technology HIT systems.

Dr. Patricia Dykes will demonstrate how CCC was used as the terminology platform for a patient-centered plan of care in an acute care hospital in the United States.

Dr. Ulla-Mari Kinnunen will describe shortly how CCC was selected, to be used in Finland, the development process of the FinCC (Finnish Care Classification), the structure and content of the classification, and the validation process nationally in the form of surveys to the end users. Dr. Kinnunen will tell about the ongoing development process of Finnish nursing documentation model including the FinCC.

Nursing Manager Minna Mykkänen will describe how we can take advantage of structural information in evidence based nursing management. She will present the current electronic nursing documentation model with the FinCC and how information is used to improve nursing documentation as well as share some data examples retrieved from the nursing databases.

## **2. Panel Organization**

The moderator of the panel: **Kaija Saranto, PhD, RN, FACMI, FAAN**, Professor in Health and Human Services Informatics, Department of Health and Social Management, University of Eastern Finland. The panelists are:

- **Virginia K. Saba, EdD, RN, FACMI, FAAN**, Adjunct Professor, Uniformed Services University, Bethesda, MD, USA, and developer of the Clinical Care Classification (CCC) System.
- **Patricia Dykes PhD, RN, FAAN, FACMI** Program Director for Research, Center for Patient Safety Research and Practice and the Center for Nursing Excellence at Brigham and Women's Hospital, Boston, MA, US
- **Ulla-Mari Kinnunen, PhD, RN**, Senior lecturer, University of Eastern Finland, Department of Health and Social Management, Kuopio, Finland
- **Minna Mykkänen, MHSc, RN**, PhD candidate, Nursing Manager, Kuopio University Hospital and Department of Health and Social Management, University of Eastern Finland, Kuopio Finland.

# Health Informatics Competencies, Workforce and the DNP: Why Connect These ‘Dots’?

Juliana J. BRIXEY

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**Abstract.** This panel will provide the perspectives of nurse informatics experts on the development of informatics education integrating health information technology (HIT) and immersive simulation. The panel will also address student and provider access to the electronic health record (EHR) for educational purposes. This panel examines the education and preparation of students and practicing nurses to meaningfully use EHRs. The target audience is clinicians, educators, trainers, students and those interested in the meaningful use of EHRs and achievement of the Informatics competencies defined by AACN and TIGER.

**Keywords.** Electronic health records (EHRs), simulation, ethics, nursing education, health informatics education, doctor of nursing practice (DNP)

## 1. Panelists

Marge Benham-Hutchins, PhD, RN [Mbenhamhutchins@austin.utexas.edu](mailto:Mbenhamhutchins@austin.utexas.edu)

University of Texas at Austin, School of Nursing

Benham-Hutchins completed her PhD at the University of Arizona. Her research focuses on health informatics and nursing systems. She has extensive experience teaching informatics content at the graduate and doctoral level.

Juliana J. Brixey, PhD, MPH, MSN, RN [Juliana.J.Brixey@uth.tmc.edu](mailto:Juliana.J.Brixey@uth.tmc.edu)

University of Texas Health Science Center at Houston

Brixey completed a PhD in Health Informatics from the School of Health Information Sciences, University of Texas Health Science Center in Houston. Brixey holds a joint teaching appointment between UTHealth School of Biomedical Informatics and School of Nursing. She is responsible for teaching graduate level informatics courses.

William Scott Erdley, PhD, RN [erdley@buffalo.edu](mailto:erdley@buffalo.edu)

Behling Simulation Center, University at Buffalo, SUNY

Erdley has been active in nursing and health informatics since the early 1990's. His area of expertise for the past 5 years is in immersive high-fidelity patient simulation. He is the Simulation Education specialist at the Behling Simulation Center working with health students from medicine, nursing, dentistry, pharmacy and physical therapy.

Kay Sackett Fitzgerald, EdD, RN, [kay.sackett@gmail.com](mailto:kay.sackett@gmail.com)

Kay Sackett Fitzgerald Consulting

Fitzgerald completed her EdD at Temple University. She is a fellow of the NLM/MBL informatics group. She has experience teaching nationally and internationally at the undergraduate and graduate areas of interest including healthcare informatics and technology, online education, and evidence-based practice.

Angela M. Ross, DNP, MPH, PMP, PHCNS-BC [AngelaM.Ross@uth.tmc.edu](mailto:AngelaM.Ross@uth.tmc.edu)  
University of Texas Health Science Center at Houston

Ross served over 20 years in the U.S. Army Medical Department. Her most recent positions were Chief Medical Information Officer and IT Project Manager. Ross earned her MS in informatics and DNP from the University of Maryland at Baltimore. Ross holds a teaching appointment at UTHealth School of Biomedical Informatics

## **2. Panel Description**

Introduction: J. J. Brixey, Moderator (10 minutes)

The use of the EHR in nursing curriculum has been influenced by the AACN Essentials [1], which specifically identifies that nursing students develop informatics skills involving the use and understanding of the EHR. This panel discussion presents different perspectives regarding the educational use of the EHR.

Meaningful “Educational” use of the EHR. M. Benham-Hutchins (10 minutes)  
HIT, specifically the EHR, provides tools for nursing students to incorporate the data, information, knowledge and wisdom (DIKW) model [2] into their learning activities. To optimize this, nursing students and practicing clinicians should have the ability to track a former patient in the EHR to learn about the results of their interventions and the patient’s progression. This requires development of policies and guidelines that incorporate patient consent and confidentiality [3].

To “ehr” or not to “ehr”: This is the question. W. S. Erdley (10 minutes)

Many human-patient immersive simulation labs and centers integrate electronic health records (EHRs) into the learning experience. This presentation will provide a short literature review, as well as an argument for careful planning and consideration of organizational and instructional goals / direction as determinants of investing in a simulated EHR for immersive simulation experiences.

Healthcare informatics competencies and nursing workforce: An educational intervention. K. Sackett Fitzgerald (10 minutes)

Improvement of healthcare informatics competencies is a nursing workforce issue and a medium for doctorate in nursing practice (DNP) students’ scholarly inquiry. The author describes online experiential learning activities that incorporate evidence-based strategies, the AACN Essentials of Doctoral Education [1] and TIGER recommendations for integrating technology into practice and education [4].

EHR workforce Education: Teaching 24/7, N=1. Dr. Ross (10 minutes)

Health Care is a 24/7 operation and staff education is required to support the continuity of care through all shifts. EHR education may consist of classroom instruction targeted at user types, identification and training of super users (peer trainers), and one-on-one (over-the-shoulder) training to support users through the new

system implementation. One-on-one/over-the-shoulder training is vital to the success of a system implementation. Over-the-shoulder trainers should be available on all shifts in the early weeks of system implementation. Trainers and IT staff collaborate to assess user issues and aim to provide quick system updates.

Summarize panelist presentations – Dr. Brixey (moderator) 10 minutes

Questions & answers (30 minutes)

Sample list of debatable questions

1. Which is more important in the creation of a DNP HIT course, the DNP Essentials or the TIGER Informatics Competencies?
2. What are the ethical and competing concerns which influence the ability of nursing students and practicing clinicians to use the EHR to track previously cared for patients?
3. Is one-on-one training in the clinical environment worth the cost?

## References

- [1] American Association of Colleges of Nursing, *The essentials of doctoral education for advanced nursing practice*, 2006. Available at <http://www.aacn.nche.edu/publications/position/DNPEssentials.pdf>.
- [2] G.E. Brisson, K.J. Neely, P.D. Tyler, & C. Barnard, Should medical students track former patients in the electronic health record? An emerging ethical conflict, *Academic Medicine* **90** (2015), 1020-1024.
- [3] S.M. Matney, P.J. Brewster, K.A. Sward, K.G. Cloyes, & N. Stagers, Philosophical approaches to the nursing informatics Data-Information-Knowledge-Wisdom Framework, *Advances in Nursing Science* **34** (2011), 6-18.
- [4] TIGER Initiative Foundation, *The leadership imperative: TIGER's recommendations for integrating technology to transform practice and education*, 2014. Available at: <http://www.thetigerinitiative.org/docs/TIGERInitiativeFoundationReportTheLeadershipImperative.pdf>

# Urgent Call for Nursing Big Data

Connie W. Delaney, PhD, RN, FAAN, FACMI  
University of Minnesota, School of Nursing  
[Delaney@umn.edu](mailto:Delaney@umn.edu)

**Abstract.** The purpose of this panel is to expand internationally a National Action Plan for sharable and comparable nursing data for quality improvement and big data science. There is an urgent need to assure that nursing has sharable and comparable data for quality improvement and big data science. A national collaborative – Nursing Knowledge and Big Data Science includes multi-stakeholder groups focused on a National Action Plan toward implementing and using sharable and comparable nursing big data. Panelists will share accomplishments and future plans with an eye toward international collaboration. This presentation is suitable for any audience attending the NI2016 conference.

**Keywords:** Standardized nursing data, big data, data science, big data, data science, workflow processes, health policy, nursing informatics

## 1. Panel Organization

The proposed panelists are:

**Joyce Sensmeier, MS, RN-BC, CPHIMS, FHIMSS, FAAN;** Vice President of Informatics for HIMSS ([jsensmeier@himss.org](mailto:jsensmeier@himss.org))

**Charlotte Weaver, PhD, RN, FAAN;** Health Care Executive ([caweaver2011@gmail.com](mailto:caweaver2011@gmail.com))

**Lisiane Pruinelli, PhD-C, RN;** Doctoral Student at University of Minnesota (UMN) in the School of Nursing ([pruin021@umn.edu](mailto:pruin021@umn.edu))

**Asta Thoroddsen, PhD, RN, FAAN;** Professor at University of Iceland in Faculty of Nursing within the School of Health Sciences ([astat@hi.is](mailto:astat@hi.is))

## 2. Panel Description

### Timeline of Activities

5 min - Introduction of panelists, their topics, and discussion guidelines  
Moderator – Connie W. Delaney, PhD, RN, FAAN, FACMI

10 min - Vision of Big Data for Quality Improvement and Big Data Science  
Connie W. Delaney, PhD, RN, FAAN, FACMI

10 min - Working Groups to Achieve the Vision

Lisiane Pruinelli, PhD-C, RN

10 min - Informatics and Leadership – Key to Success

Joyce Sensmeier, MS, RN-BC, CPHIMS, FHIMSS, FAAN

10 min - Engaging Vendors to Support Standard Data and Processes

Charlotte Weaver, PhD, RN, FAAN

10 min – Opportunities and Challenges for an International Community

Asta Thoroddsen, PhD, RN, FAAN

30 Minutes Questions and Answers – sample questions

1. What are the challenges for contributing sharable and comparable nursing data for big data science?
2. What activities and resources already exist for conducting nursing big data science?
3. Where is there congruence for conducting comparative effectiveness research across health systems and countries?
4. What health policies and leadership strategies have been successful for standardizing data and process for comparative data?

### *2.1. Description*

There is an urgent need to assure that nursing has sharable and comparable data for quality improvement and big data science. Over the past three years, the University of Minnesota hosted a national collaborative and conference – Nursing Knowledge and Big Data Science which includes multi-stakeholder groups focused on a National Action Plan toward implementing and using sharable and comparable nursing big data.

For more than 40 years, nursing developed standardized terminologies, however, these are seldom integrated within electronic health records (EHRs), other information systems, and clinical data repositories. The time is now to move beyond naming nursing phenomenon and effectively use consistent terminologies for documentation and continuing use for continuity of care, quality reporting, and big data science. A consensus conference was convened to develop a national action plan and harmonize existing and new efforts of multiple individuals and organizations to expedite integration of standardized nursing data within EHRs and ensure their availability in clinical data repositories for secondary use. This harmonization addresses implementing standardized nursing terminologies and subsequent access to and use of the clinical nursing data. There are many diverse activities that exist to implement standardized nursing languages in EHRs; however, these activities are not coordinated resulting in duplicate efforts rather than building a shared learning environment and resources. The ongoing work of the Big Data Science conference occurs between events through virtual workgroups. In 2015, there are 12 workgroups who are moving the effort forward toward implementing and effectively using nursing data.



There were a number of transformative recommendations from the Nursing Knowledge: Big Data Science conference pertinent to the goal of having “big data” available to nursing clinicians, managers, and executives. One is to leverage expertise in best practices for nursing information systems by providing a mechanism for collecting, posting and housing clinical documentation workflows, clinical decision system (CDS) support tools, maps of nursing documentation and terminologies to national standards, and data queries and reports. Another recommendation is for nurse leaders to sponsor, support, and require nursing informaticians doing clinical system builds and maintenance to have the knowledge and skills to integrate standard terminologies and to map to SNOMED-CT and LOINC. Together with the first recommendation, these form the building blocks to enable current EHR systems to provide structured, standardized data in support of aggregating, querying and reporting key nursing data for outcomes, while generating new best practice knowledge.

A number of resources were developed by workgroups listed in references below. One is the work of the HIMSS CNO-CNIO Vendor Roundtable, Big Data Principles Workgroup. This Workgroup developed Guiding Principles for Big Data in Nursing which include four key principles that underscore big data: privacy and security of health information, data standards, interoperability and immutability. Recommendations to advance these principles derive from the following key areas: promotion of standards and interoperability; advancement of quality eMeasures; and leveraging nursing informatics experts. Each of these emergent efforts accentuates that big data offers the potential to accelerate the synthesis of new knowledge to make a positive impact on nursing as well as the individuals and populations we serve.

## References

- Brennan PF, Bakken S. Nursing needs big data and big data needs nursing. *J Nurs Scholarsh.* 2015. doi: 10.1111/jnu.12159 [doi].
- Clancy TR, Bowles KH, Gelas L, et al. A call to action: Engage in big data science. *Nursing Outlook.* 2014;62(1):64-65.
- HIMSS. (2015). Guiding Principles for Big Data in Nursing: Using Big Data to Improve the Quality of Care and Outcomes. <http://www.himss.org/big10>.
- Simpson, Roy L., R.N., et al. "NIMS: Nursing Information Systems - An Urgent Need", *Research in Nursing and Health*, Volume 6, No.3, September, 1983.
- Westra BL, Latimer GE, Matney SA, et al. A national action plan for sharable and comparable nursing data to support practice and translational research for transforming health care. *J Am Med Inform Assoc.* 2015;22(3):600-607. doi: 10.1093/jamia/ocu011 [doi].
- Westra BL, Clancy TR, Sensmeier J, Warren JJ, Weaver C, Delaney CW. Nursing knowledge: Big data science-implications for nurse leaders. *Nurs Adm Q.* 2015;39(4):304-310. doi: 10.1097/NAQ.000000000000130 [doi].

# Documentation and Reporting of Nutrition – Interoperability, Standards, Practice and Procedures

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**Abstract.** Interoperability, fragmentation, standardization and data integrity are key challenges in efforts to improve documentation, streamline reporting and ensure quality of care. This workshop aims at demonstrating and discussing health politics and solutions aimed to improve nutritional status in elderly.

**Keywords.** Nutrition, evidence based nursing procedures, standardization, Electronic Health Records

## 1. Workshop Organization

The proposed speakers are:

Jannie M. de Grijis, The Norwegian Directorate of Health,

[Jannie.De.Grijis@helsedir.no](mailto:Jannie.De.Grijis@helsedir.no). Jannie is a Senior Advisor, eHealth (National quality indicators and statistics) and is the leader of NorHiT- Norwegian computer society- eHealth. She will speak about the health authorities' requirements of standards for quality and share results from a pilot study of documentation of nutrition practices and medication.

Elisabeth Østensen, University of Oslo, Norway.

[elisabeth.ostensen@medisin.uio.no](mailto:elisabeth.ostensen@medisin.uio.no). Elisabeth is a PhD-student at the University of Oslo. She will share findings from her studies on how nurses in community health care use and evaluate the usefulness of Standardized Care Plans for prevention of malnutrition.

Ann Kristin Rotegård, Cappelen Damm, Norway

[ann.kristin.rotegard@cappelendamm.no](mailto:ann.kristin.rotegard@cappelendamm.no). Ann Kristin will describe and demonstrate a digital knowledgebase for nurses, integrated with an electronic patient record for high quality nursing care and evidence based quality indicators. Ann Kristin has a PhD and heads the PPN (Practical Procedures in Nursing).

Caroline Farsjø, University of Oslo, Norway

[caroline.farsjo@medisin.uio.no](mailto:caroline.farsjo@medisin.uio.no). Caroline is a PhD student at the University of Oslo. Her workshop contribution draws from design and deployment of functionality to have patients report their food.

## 2. Workshop Description

### 2.1. Format:

Following short introduction of key concerns and perspectives by the contributors, we will organize for *breakout group discussion* to engage the participants, and develop recommendations to further progress

#### 2.1.1. Timeline

- 20 min: This workshop will have four short presentations (10 min. each) about needs and solutions so far, in order to support nurses and patient / elderly in preventing malnutrition and promoting nutritional status.
- 40 min discussion

### 2.2. Description

#### 2.2.1. Background

Nutrition is a core Public health concern amendable to nursing interventions [1]. Unfortunately, malnutrition and risk for undernutrition are significant problems among patients in healthcare institutions and home dwelling elders [2]. Systematic screening of risks, clear, written procedures to assess the residents' nutritional status at admission and for follow up care has been suggested [2]. However, lack of integrated tools, lack of help [3] inadequate care during meal situations [4] or underdeveloped nutritional procedures and appropriate intervention in clinical practice [5] complicates the situation. In addition, changes due to illness or aging, adds to the problem and calls for new solutions [6]. Even though nurses document assessment and interventions in their nutritional practice, systematic analysis is cumbersome due to poorly developed structures and lack of systems and technology support for standardized extraction of information from nursing documentation [7]. The Government wants better and more accurate data on the services delivered in order to measure equality, even distribution and quality of the services delivered in primary care [7].

From a nursing informatics perspective, key e-health challenges, captured in *interoperability*, *fragmentation*, *standardization* and *data integrity*, pinpoints challenges and comes with opportunities to improve documentation, streamline reporting and contribute to quality care. An ultimate contribution to patient care would be better risk management and less frequent health problems (falls, isolation, depression) following undernutrition. Our overall question is; how can these important e-health challenges lead to solutions available for nurses and contribute to enhance the quality of care, exemplified as patients' improved nutritional status?

The panelist will frame their contributions from the perspectives of health authority's recommendations; digital evidence based nursing procedures and standardized care plans, and opportunities in patient engagement using new communication technologies. We will engage the audience in discussions on recommendations to balance standardization and interoperability in these systems to ensure data integrity and reduce fragmentation.

### 2.2.2. Goal and expected outcomes of the workshop

This workshop will take some solutions aimed to improve nutritional status in elderly as a starting point, to discuss international significance of such solutions, and point to future needs and opportunity for innovation. Participants are expected to engage in discussions, share experiences and ask questions to establish broader understanding of the challenges involved.

### 2.2.3. Statement of participation

All presenters in the workshop agree to be present and contribute in the workshop, should this proposal be accepted at NI'2016.

## References

- [1] Meld. St.34 (2012-2013). *Folkehelsemeldingen, God helse - felles ansvar. Helse- og omsorgsdepartementet. 2013.* [White paper 34 (2012-2013). *Public health report, Good health - common responsibility.* Ministry of Health and Care Services]
- [2] U. Soderhamn, B. Dale, K. Sundsli, O. Soderhamn. Nutritional screening of older home-dwelling Norwegians: a comparison between two instruments. *Clin Interv Aging* 2012;7:383-391. <http://www.dovepress.com/nutritional-screening-of-older-home-dwelling-norwegians-a-comparison-b-a11028> (09.12.2014).
- [3] U. Johansson, I. Bosaeus, J. Larsson, E. Rothenberg, C. Stene, M. Unosson. Nutritionsbehandling i äldrevård - ett bortglömt perspektiv. *Läkartidningen.* 2009;106(40):2538-42. [Nutrition treatment in geriatric care - a hidden perspective].
- [4] LK. Larsen, L. Uhrenfeldt. Patients' lived experiences of a reduced intake of food and drinks during illness: a literature review. *Scand J Caring Sci* 2013;27(1):184-194.
- [5] H. Aagaard, VA. Grøndahl. Mat og måltider i hjemmesykepleien: undersøkelse utført for Helsedirektoratet. Høgskolen i Østfold - Oppdragsrapport 2013;(4):1-58.[Food and meals in home health care: a study conducted for the Ministry of Health and Care Services. Østfold University College- A report carry out an assignment]
- [6] A. Moen, Small Eaters – diet as a challenge for Independent Living. *NI'2012; 2012;* Montreal, Canada: IOS Press.
- [7] *Helsedirektoratet.* Forprosjekt innen kvalitetsindikatorer for ernæring og legemiddelgjennomgang. Helsedirektoratet, 2015. [Ministry of Health and Care Services. A pilot project of quality indicators in nutrition and medication].

# Deep Dive: Evaluation Methods for Electronic Health Records

Panel Moderator: Sarah Collins

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*sacollins@partners.org*

**Abstract:** Clinicians currently use electronic health records (EHR) which have often not been designed with the user in mind. Participatory design requires a thorough evaluation of the system using mixed methods. When different methods yield conflicting results, synthesis is challenging. This panel will present four cases of triangulation approaches to evaluate EHR usability and usage in multiple institutions. The audience will have a better idea how to triangulate results from multiple innovative methods such as the use of eye-tracking techniques and mixed methods approaches to evaluation.

## 1. Panel Organization

The proposed panelists are:

**Sarah Collins<sup>a</sup>**, RN, PhD, Partners Healthcare Systems, [sacollins@partners.org](mailto:sacollins@partners.org)

Dr. Collins's research focus is on evaluation of electronic health records in the context of usage and downstream data needs for optimization of content.

**Yalini Senathirajah<sup>b</sup>**, PhD, Medical Informatics, State University of New York Downstate, NY, NYC, USA, [yalini@zoho.com](mailto:yalini@zoho.com)

Dr. Senathirajah's research focus is on user-centric design and evaluation of EHR.

**Sarah Iribarren<sup>c</sup>**, RN, PhD, Columbia University School of Nursing, New York, NY, USA, [si2277@columbia.edu](mailto:si2277@columbia.edu)

Dr. Iribarren's research focus is in global health, infectious diseases, and evaluation of mobile health (mHealth) tools to support patients/health care professionals.

**Sunmoo Yoon<sup>d</sup>**, RN, PhD, Columbia University School of Nursing, New York, NY, USA, [sy2102@columbia.edu](mailto:sy2102@columbia.edu),

Dr. Yoon's focus is on usability using eye tracking techniques and data science.

**Dawn Dowding<sup>e</sup>**, RN, PhD, Columbia University School of Nursing, Visiting Nurse Service of New York, New York, NY, [dd2724@columbia.edu](mailto:dd2724@columbia.edu)

Dr. Dowding's research focus is on using mixed methods to evaluate HIT.

## 2. Panel Description

### 2.1. Format

Timeline of activities



Potential questions for debate include:

- What barriers or difficulties conducting a mixed-methods for EHR?
- Have you experienced difficulty in triangulating conflicting results from qualitative and quantitative methods?
- Are eye-tracking techniques essential for usability test?
- Is concurrent think-aloud better than retrospective think-aloud?

## 2.2. Description

Clinicians spend approximately half of their work time interacting with electronic health records (EHR). However, in most clinical settings, clinicians' voices have rarely been heard during the design of EHR and the efficiency of human-computer interaction behavior has seldom been observed. EHRs are increasingly relied on for reporting mechanisms and reuse of data for downstream purposes, including data driven improvements to patient safety and quality of care. Meanwhile, EHRs with poor usability may compromise patient safety and quality care. Although Yen and Bakken identified more than sixteen different methods for the evaluation of EHR technology<sup>1</sup>, there are many challenges including institutional and methodological barriers. Triangulation method uses more than one approach (e.g., methods, data, theoretical, investigator) to ensure valid findings.<sup>2</sup> This presentation aims to discuss triangulation approaches when findings from the use of different methods 1) confirm, 2) complement or 3) conflict by presenting evaluation use cases from a set of independent informatics research projects.

### 2.2.1. Evaluation Techniques to Optimize Relevance and Usefulness of EHR Content

Dr. Collins<sup>a</sup> will present findings from a study at Partners Healthcare Systems is focused on optimizing content presented to clinicians within the EHR by evaluating EHR usage data and downstream data needs (e.g., reports, compliance measures, reuse in clinical decision support, billing). Data recorded within structured data elements are extracted from the EHR to evaluate frequency in which each data element is used and analyze the consistency and usefulness of the data stored for downstream data needs. Content areas with high usage rates are prioritized for in-depth analysis of data definitions, display of documentation forms, and downstream data needs. Clinical Subject Matter Expert (SME) panels with end users are convened for prioritized content areas to define a data element reference model for implementation on documentation forms. Content areas with low usage rates are analyzed for relevance to end-users and to identify if usability issues are a barrier to use of structure data fields. Iterative evaluation of usage rates and downstream data needs, combined with SME input, are useful methods to optimize EHR content that is relevant and useful to end-users of the system.

### 2.2.2. Interaction Design for Safety

Dr. Senathirajah<sup>b</sup> will present findings from studies using user-composable approaches to mitigate safety risks arising from conventional interaction design approaches. These use eye-tracking, user composition patterns, and thinkaloud protocols to detect design features which may increase or decrease cognitive load. Current interaction design can pose several specific risks to safety. These include display fragmentation fostering errors and inefficiencies.

### 2.2.3. Evaluation of a BCMA's Electronic Medication Administration Record

Dr. Iribarren<sup>c</sup> will present findings from a study to identify usability problems in the Veterans Administration's eMAR/BCMA system and explore how they might affect nurses' situational awareness. Heuristic evaluation techniques and an overall situational awareness perspective were used to assess 10 nursing tasks/elements. The study illustrates important areas for improvement for nurses and patient safety.

### 2.2.4. Evaluation of Visualization of Inpatient EHR Applying Eye Tracking Techniques

Dr. Yoon<sup>d</sup> will present findings from evaluation of visualizations of a healthcare-associated infection (HAI) in EHR using eye-tracking techniques. Hospital infection data were extracted from EHR in a local institution, and visualized as traditional line graphs and infographics using a user participatory approach for EHR. A mixed method was applied to evaluate nurses' perceptions on the ease of use and usefulness.

### 2.2.5. Using Mixed Methods to Evaluate EHR Use in an Acute Hospital Setting

Dr. Dowding<sup>e</sup> will present findings from a study evaluating how nurses' used EHR technology and its impact on patient outcomes. An interrupted time series design, together with observation and interviews with nurses was utilized to explore EHR use. The study illustrates how combining evaluation methods can provide useful insights into the integration of EHR into clinician workflow and impact on outcomes.

These studies will provide triangulation approaches of synthesizing results from multiple methods. Based on our case studies, understanding an evaluation framework allows for deeper understanding of user needs and behavior in order to improve EHR.

## 3. Acknowledgement

- a. Collins thanks to all members of the Structured Data Element Workgroup at Partners eCare and all members of Partners eCare project and subject matter experts that contributed to this work.
- b. The study was supported by a federally-funded project (AHRQ R01HS023708-01A1, Senathirajah).
- c. The study was supported by Dept. of Veterans Affairs, Veterans Health Administration, Health Services Research and Development Service (#CR12-321, Weir), and a training grant (NIH T32NR014205, Stone).
- d. The study was supported by a federally-funded project (NIH 2R01NR010822-06, Larson).
- e. The study undertook whilst Dr Dowding was a Harkness Fellow in Healthcare Policy and Practice funded by the Commonwealth Fund of New York.

## References

- [1] P.Y. Yen, S. Bakken, Review of health information technology usability study methodologies. *Journal of the American Medical Informatics Association: JAMIA* **19** (2012), 413-22.
- [2] N.K. Denzin, *The Research Act in Sociology*, Chicago, Aldine, 1970.

# Towards Implementing a Global Competency-Based Nursing and Clinical Informatics Curriculum: Applying the TIGER Initiative

Ursula HÜBNER<sup>a1</sup>, Marion BALL<sup>b</sup>, Heimar de Fátima MARIN<sup>c</sup>, Polun CHANG<sup>d</sup>,  
Marisa WILSON<sup>e</sup>, Christel ANDERSON<sup>f</sup>

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**Abstract.** This workshop will review the history of the TIGER initiative in order to set the framework for an understanding of international informatics competencies. We will include a description of clinical nursing informatics programs in 37 countries as well as the results of a recent survey of nursing competencies in order to further discussions of internationally agreed-upon competency definitions. These two surveys will provide the basis for developing a consensus regarding the integration of core competencies into informatics curriculum developments. Expected outcomes include building consensus on core competencies and developing plans toward implementing intra- and inter-professional informatics competencies across disciplines globally.

**Keywords.** Education, Nurses, Clinicians, Competencies, Informatics, Innovation

## 1. Introduction

The TIGER Initiative (Technology Informatics Guiding Education Reform) was founded in 2004 to develop a shared vision, strategies, and specific actions for improving nursing practice, education, and the delivery of patient care through the use of health information technology. It has emerged as a grass roots effort in 2006 in the U.S. to allow informatics tools, principles, theories and practices to be used by interdisciplinary providers and consumers; interweave enabling technologies into practice, education and research to improve outcomes, patient safety and reduce costs; and prepare workforce to use technology and informatics for improvement of patient care [1]. Effective September 22, 2014, TIGER officially transitioned from a standalone foundation to Healthcare Information and Management Systems Society (HIMSS).

Providing patient care has moved towards employing methods that target optimized processes and measurable health outcomes. Professional silos and single provid-

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er approaches have thus become obsolete while team based and inter-professional care promise to lead the way towards coordinated processes and better outcomes. This change in the perspective entails the need for informatics competencies that focus on the processes and the patient outcomes.

TIGER has recognized the role of education as a powerful enabler and change agent. It thus has adopted the education approach from its onset to leverage better patient care and to pave the way towards greater awareness, acceptance and better design and use of innovations in clinical informatics.

Given this extraordinary importance of education a series of national and international recommendations have been published in medical and health informatics education [e.g. 2]. This includes paper and digital content provided by TIGER members [3]. Recent recommendations make use of a competencies based approach, some with very detailed and highly granular descriptions [4]. The challenge of providing recommendations from a global perspective is to give meaningful advice while still leaving enough space for teachers and students to tailor educational measures according to their individual needs.

The goal of this workshop is thus to draw on these experiences, propose a competencies based framework for nursing and clinical informatics, present best practice examples and a practical mechanism to derive curricula and courses from this framework. This workshop will provide a platform for participant engagement to discuss the TIGER proposals and together, develop new insights into this demanding field. The results from this workshop are incorporated into the TIGER body of knowledge, also as a source for shaping the TIGER Virtual Learning Environment (VLE), and will be published as TIGER recommendations.

## 2. Materials and Methods

The objectives of the workshop focus on:

- **To review** the international informatics competency definitions.
- **To evaluate** the global competency set for nursing and clinical direct-care providers.
- **To build** consensus regarding core competencies for integration into curriculum development.
- **To plan** towards implementing intra- and inter-professional informatics competencies across disciplines.

The following list shows the timeline of the workshop.

- Introductory presentation (Marion J Ball): History of the TIGER Initiative - grassroots approach and methodology for gathering people, compiling their knowledge via the Virtual Learning Environment (VLE) and building consensus (10 minutes).
- Review process: First round of moderated discussion. (Moderators are: Heimar Marin, Polun Chang, Marion J Ball, Marisa Wilson, Ursula Hübner and Christel Anderson); participants form groups of up to 5 people, introduce themselves shortly (e.g. affiliation, professional experience) and discuss the question "What are the top 5 informatics competencies for nurses according to your experience?" (30 Minutes)

- Evaluate process - second presentation (Ursula Hübner): An international overview of the nursing and clinical informatics competencies framework: methodology and results (10 minutes)
- Build process: Second round of moderated discussion (Moderators are: Heimar Marin, Polun Chang, Marion J Ball, Marisa Wilson, Ursula Hübner and Christel Anderson); participants discuss the questions “What is your opinion about the competencies framework just presented?” and “Do you think that the core competencies differ between the various health professions and what are inter-professional competencies?” (30 minutes)
- Plan process: Group summary and conclusions (10 minutes)

### 3. Conclusion

We expect the following outcomes of the workshop:

- Attendees will engage as future TIGER members in educational, nursing/inter-professional and learning opportunities utilizing in the VLE.
- Attendees will be able to recognise the importance of nursing/clinical informatics competencies and contribute to the TIGER initiated global discussion building an intra- and inter-professional global curriculum.
- Develop recommendations for implementation of a world-wide informatics curriculum

### References

- [1] MJ Ball, JV Douglas et.al., *Nursing Informatics: Where Technology and Caring Meet*, 4th Edition, London: Springer-Verlag, January 2011.
- [2] Global Health Workforce Council (GHWC). *Global Academic Curricula Competencies for Health Information Professionals*. Draft for public comment. [Internet]. Chicago: The AHIMA Foundation; 2015
- [3] TIGER Initiative. *Informatics Competencies for Every Practicing Nurse: Recommendations from the TIGER Collaborative*. [Internet]. Chicago: Healthcare Information and Management Systems Society (HIMSS); 2015
- [4] HITCOMP – Health IT Competencies. <http://hitcomp.siframework.org/>

# Engaging Nurses in the Design and Adoption of mHealth Tools for Care Coordination

Judy Murphy  
IBM [murphyja@us.ibm.com](mailto:murphyja@us.ibm.com)

**Abstract:** This panel will share ideas for the Nursing Informatics Specialists in the audience on how mHealth tools are being designed and used for clinical practice, education and research. They will describe specific mHealth projects they are involved in, give practical examples, and provide tangible tactics for nurses to make a difference. They will provide insight into new technology and standards developments that make it easy to connect the mobile app ecosystem - from open application program interfaces (APIs), to traditional health information technology tools like Electronic Health Records (EHRs).

**Keywords.** mHealth, Mobile Health, Mobile Technology, Care Coordination, Clinical Decision Support, Workflow

## 1. Panel Organization

The proposed panelists are:

Judy Murphy, IBM, [murphyja@us.ibm.com](mailto:murphyja@us.ibm.com)

Ms. Murphy is Chief Nursing Officer (CNO) with IBM Healthcare. Prior to this she was CNO and Deputy National Coordinator for Programs and Policy at the Office of the National Coordinator for Health IT (ONC) in Washington D.C. In these roles she advanced the vision of using health IT to improve health care, lower costs, and promote consumers' use of health IT for their own health. She has published and lectured nationally and internationally and has won numerous awards, including the AMIA 2014 Don Eugene Detmer Award for Health Policy Contributions in Informatics and the HIMSS 2014 Federal Health IT Leadership Award. Before working at the ONC, she had more than 25 years of health informatics experience at Aurora Health Care in Wisconsin where she was VP-Applications and led their EHR program since 1995.

Susan Hull, Cincinnati Children Hospital Medical Center, [hull.susan.c@gmail.com](mailto:hull.susan.c@gmail.com)

Ms. Hull is Chief Nursing Informatics Officer for Cincinnati Children's Hospital Medical Center in Ohio, USA. She previously was Chief Health Informatics Officer for Diversinet and VP for Elsevier's CPM Resource Center. Her background includes nursing, health system, and healthy community partnership/ community health information network (CHIN) executive. She is an author and speaker, advocating for design and delivery of healthcare solutions that are mobile, personally connected, interoperable, personalized and mass customized, with special interest integrating patient and device generated data. She co-leads the Alliance for Nursing Informatics

Consumer e-Health task force, serves on the Learning Health System Policy and Governance task force and advisory groups for consumer e-health technology standards.

Olivia Velez, HealthEnabled, [olivia@healthenabled.org](mailto:olivia@healthenabled.org)

Dr. Velez is currently Executive Director for HealthEnabled, a South Africa-based organization accelerating the integration of life-saving digital health solutions into the national health systems of low/middle-income countries. Prior to this, she served as Senior Technical Specialist with ICF International and eHealth Team Lead for USAID's Maternal and Child Survival Program. A 2010 Jonas Nurse Leaders Scholar and a 2014 Alliance for Nursing Informatics Emerging Leader, Dr Velez has authored over a dozen peer reviewed papers on health informatics and has presented her work on mHealth at international events including the mHealth Summit, the UN Economic & Social Council Partnership Clinic on Mobiles for Midwives, and numerous informatics conferences. She maintains a research scientist role with Columbia University, advising the Biomedical Informatics Department on the implementation of mobile point-of-care applications for midwives and nurses working in public health settings in Ghana.

Robin Austin, School of Nursing-Univ of Minnesota, [robin.austin12@gmail.com](mailto:robin.austin12@gmail.com)

Dr. Austin is currently Clinical Assistant Professor in the School of Nursing, University of Minnesota, USA. Her teaching areas include Consumer Health Informatics for master's level students, and also teaching for Pre-Licensure Nursing. Her specialties include Nursing Informatics, Mobile Health, Consumer Engagement, Big Data Analytics, Integrative Health and Wellness. She is an author and frequent presenter, and recently served as the President of the Minnesota Informatics Nursing Interest Group (MINING).

## **2. Panel Description**

### *2.1. Format*

Judy Murphy will moderate the panel and begin by citing some of the recent studies and statistics demonstrating why mobile health for nursing care and care coordination is making a difference in how care is delivered and what outcomes are being seen across care settings internationally. She will describe the broad range of mHealth tools supporting this movement, as well as some of the issues and barriers to design, development and adoption. She will feature use cases where mHealth tools are improving clinical workflow for nurses and complementing tools already existing within electronic health records.

Next, Dr. Olivia Velez will discuss her work enhancing the role of nurses in Zambia through the use of mHealth. The use of mHealth in developing African countries has increased rapidly in the past decade. The majority of mHealth tools have focused on community health workers or on aggregate information systems. Dr. Velez will report on a recent scoping assessment, and its follow-up, to understand how nurses and nursing leaders could benefit from mHealth and other health information tools. This assessment was part of a Primary Health Care to Communities Initiative (PHC2C), led by IntraHealth International and partially funded by Johnson & Johnson.

Robin Austin will then describe how mHealth is the foundation for a university-based master and doctoral education program for nurses who are advancing their training in nursing informatics. She will give examples of mHealth solutions for education, practice and research as well as describe the competency roadmap to support

this evolution. Special emphasis will be on field experiences nurses are having in community settings, where mHealth tools are supporting care collaboration and coordination.

Last, Susan Hull will discuss the evolution of mHealth application development and adoption in healthcare settings in the US and Canada. Susan will describe technical advances in embedding mHealth apps within clinical workflow and EHRs, enabled with new innovation such as the Substitutable Medical Apps (Smart) and Fast Healthcare Interoperability Resources (FHIR®) ecosystem, which provide a set of data models with understandable terminology that speeds development of mHealth apps and their connection to EHRs.

The panel will wrap-up with time for interaction through Q & A with the audience, as well as encouragement to share other examples of mHealth projects that participants are involved in that help make a difference to nursing and health care around the world. Sample list of debatable questions:

- What mHealth tool has made a difference in your practice – and why?
- What are important design elements important in mHealth tools?
- How can we encourage nurses to adopt the use of mHealth tools?

## *2.2. Description*

The use of mobile technology is pervasive in our daily lives and essential for our mobile lifestyles. This smart computer in our pocket is making a profound difference in the way we work, learn and interact with each other, as well as how we provide and obtain health care. Mobile Health (mHealth) is a wide-ranging term most commonly used to describe a variety of therapeutic interventions for patients - from something as straight forward as text messaging reminders for prenatal visits, to video visits, to stand alone point of care vital signs with and automated clinical decision support. mHealth tools are also being designed and developed by nurses, for nurses, to simplify clinical workflows and improve care coordination in care settings across the continuum and community. Some industry experts are predicting the rapid advance of an mHealth ecosystem with a variety of solutions for nurses, and for patients and consumers at large. New skills and competencies for designing and deploying these tools to support patient care, education and research are needed.

MHealth tools are beginning to transform the patient experience, including the ways in which patients and providers interact and how nurses care for patients. mHealth is also a strategy in health systems, health plans, developing countries and low resource areas, to extend the reach of nurses to enhance the delivery and coordination of care. Nurses have a significant need for assistance with health information management, clinical workflow, care supervision and care coordination, in a variety of settings where mHealth tools can be of great benefit. Leveraging many functions familiar to nurses that already exist in smart phones, mHealth solutions and data streams coming from these solutions can easily track movement, time and location to understand the impact of new workflow interventions to improve nursing care.

Yet, nurses have little exposure to the design, development and deployment of these mHealth solutions. New skills and competencies are needed for advancing these tools to support patient care, education and research. As nurses gain more experience with mHealth tools, they will become increasingly involved in developing and adopting solutions to optimize the way they work, as well as complementary health and care coordination solutions for patients and families.

# Not Lost in Translation: Changing Intervention Delivery Mechanisms in e-Health

Karen L. Courtney  
University of Victoria  
[Court009@uvic.ca](mailto:Court009@uvic.ca)

**Abstract** This workshop will explore the challenges in translating existing health interventions to new e-health delivery mechanisms. Challenges to be covered include: identifying and retaining the active ingredients of an intervention; and measurement and validation of newly translated interventions. This session will appeal to health researchers and e-health developers. Participants will have an opportunity to work on cases in small groups to foster in-depth discussion and sharing. Following this session, participants will be able to articulate critical issues to be addressed in translating interventions to a new delivery mechanism and share potential solutions to various translation challenges.

**Keywords.** e-Health; telemedicine; community-based interventions; psychometric testing; theory testing; research methods

## 1. Workshop Organization

The proposed speakers are:

Karen Courtney  
University of Victoria  
[Court009@uvic.ca](mailto:Court009@uvic.ca)

Dr. Courtney is an Associate Professor in the School of Health Information Science at the University of Victoria in Victoria, British Columbia. Her research has been on the evaluation of community-based e-health interventions with a focus on low-resource older adults and palliative care patients and their family members. She has evaluated telehealth, smart home and web-based technologies.

Judith T. Matthews  
University of Pittsburgh  
[jtmatt@pitt.edu](mailto:jtmatt@pitt.edu)

Dr. Matthews is the Associate Director of Gerontology at the University Center for Social and Urban Research and a Research Associate Professor of Nursing at the University of Pittsburgh. She is the PI of an AHRQ grant focused on using a multi-

user telehealth kiosk in congregate settings that serve older adults to support healthier lifestyles and self-management of chronic disease. She has also led other novel technology intervention research with a focus on visual systems and robotics.

Marcy Antonio  
University of Victoria  
[mantonio@uvic.ca](mailto:mantonio@uvic.ca)

Marcy Antonio is a PhD student at the University of Victoria in Interdisciplinary Studies with an emphasis on Nursing and Health Informatics. Ms. Antonio is developing a research program focused on eliciting patients' perspectives on chronic disease management via information technologies. She has been investigating the use of theoretical behavior change models across disciplines in the building of health interventions.

## **2. Workshop Description**

### *2.1. Format*

Breakout group discussion

Timeline

- Introduction of topic and speakers (10 min)
- Group background sharing (15-20 min), each group moderated by one of the speakers
- Key issues Part 1 – Active Ingredients (10 min)
- Small group case discussions Part 1 (15 min)
- Key issues Part 2 - Measurements (10 min)
- Small group case discussions Part 2 (15 min)
- Summarizing group ideas (10 min)

### *2.2. Description*

With the proliferation of information sharing mediums, there has been concurrent interest in “translating” or making existing health interventions available to new audiences via different information sharing platforms. Information sharing platforms may include applications on the internet, mobile devices, telehealth devices, or purpose-specific devices such as a Garmin Vivoactive. Translation of an intervention, whether to an alternative delivery mechanism or a new language, requires careful attention to ensure faithful replication or simulation of the active ingredients of the original intervention.

Active ingredients may be intertwined with the intended behavioral outcomes of an intervention. For example, in a face-to-face communication skills intervention, participants may be asked to role play a scenario. The role playing is an active ingredient that engages participants in applying concepts they have learned while also practicing desired skills. In contrast, asking participants to critique a video depicting an exchange of communication would merely result in them applying learned concepts

without skills practice. The intent of the original intervention must also be considered when redesigning it for a new delivery modality. Identifying and translating active ingredients for a new delivery mechanism can be a significant challenge for researchers and often involve decisions which may alter the effectiveness of an active ingredient.

The first part of this workshop will focus on the most common design challenges faced by researchers translating the active ingredients of an existing intervention to an intervention delivered by a different information sharing platform. Participants will have the opportunity to discuss and solve design challenges with cases presented in small groups facilitated by the workshop presenters.

Once an intervention has been translated for a new delivery mechanism, it must be re-assessed for similarity and predictability in results to the original intervention. If measurement components of the intervention have also been altered for a new delivery medium, they must also be re-validated and re-tested for reliability. For example, if recommendations for participant action are based on the results of an assessment tool such as the Rand SF-36 and the data collection method has changed to an electronic self-report from face-to-face interview, it must be determined that this ingredient in the overall intervention has maintained its original reliability and validity properties. In the second part of the workshop, key re-assessment outcome measurements; and reliability and validity issues will be presented with recommendations for psychometric testing of newly translated instruments. Participants will again work within their small groups to discuss and develop a psychometric testing plan for a case with a newly translated intervention.

Solutions arising from the small group discussions will be shared with the larger group and participants will share their experience with other challenges or solutions they have encountered in this domain. Following this session, participants will be able to articulate critical issues to be addressed in translating interventions to a new delivery mechanism and share potential solutions to various translation challenges. This workshop is designed to be highly interactive with a high level of collaboration among participants.



# Nursing Informatics Beyond 2020; An Interactive Workshop Exploring Our Futures

Peter J. MURRAY

*Centre for Health Informatics Research and Development (CHIRAD);  
IMIA Honorary Fellow, IMIA-NI Honorary Member  
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**Abstract** This interactive workshop will reflect on and update participants' views on possible future scenarios for the development of health and nursing informatics. The NI2006 Post Congress Conference discussed the future nature and scope of nursing informatics, nursing and healthcare, as viewed from likely developments between 2006 and 2020 [1]. Brief synopses from the NI2006 conference will be presented, with summaries of speakers' views on changes and progress since. Workshop participants will discuss major themes and changes, with a view to updating views on possible futures for nursing, healthcare and informatics.

**Keywords.** Nursing informatics, future, digital health, ubiquitous computing

## 1. Workshop Organization

The proposed speakers and discussion facilitators are:

Dr. W Scott Erdley, Simulation Education Specialist, Behling Simulation Center, University at Buffalo, SUNY, USA. Email: [erdley@buffalo.edu](mailto:erdley@buffalo.edu) Dr. Erdley has published and presented on health care high fidelity simulations for health care students from professions such as medicine, nursing, pharmacy and physical therapy.

Prof. Margaret Hansen, University of San Francisco, USA. Email: [mhansen@usfca.edu](mailto:mhansen@usfca.edu) Prof. Hansen's research interests include the use of mobile technologies in promoting health and well-being for adult surgical patients and the use of technology in enhancing higher education students' learning.

Prof. Hyeoun-Ae Park, Professor of Biostatistics and Health Informatics, College of Nursing Seoul National University, Seoul, Korea. Email: [hapark@snu.ac.kr](mailto:hapark@snu.ac.kr) Past Chair of IMIA-NI; President, International Medical Informatics Association (IMIA). Professor Park's research interests include use of nursing and health terminology and classifications and detailed clinical models in electronic health records to promote interoperability. Prof. Park is currently working on a health avatar project developing and using intelligent virtual agents and quantified self for health promotion.

Dr. Susan K Newbold, Director, Nursing Informatics Boot Camp, Franklin, TN USA. Email: [sknewbold@comcast.net](mailto:sknewbold@comcast.net) Dr Newbold has extensive experience in nursing informatics education and practice, and is IMIA-NI Vice Chair Communications.

Dr. Karl Øyri, Senior Project Manager, Section for Method Development and Industry Collaboration, The Intervention Centre, Clinic for Diagnostics and Intervention, Oslo University Hospital, Norway. Email: karl@oyri.no Dr. Oyri has 15 years clinical practice and manager as a CCRN, and participation in projects.

Prof. Graham Wright, Adjunct Professor, School of Health Sciences, University of Fort Hare, South Africa. Email: profwright@gmail.com Prof. Wright has taught nursing and health informatics in the UK and South Africa, and is chair of the newly formed HELINA Education Working Group.

## **2. Workshop Description**

### *2.1. Format*

The workshop will focus on breakout group discussions of topics raised in the original 2006 conference and proceedings, and as identified by workshop participants.

#### Timeline

- Introduction: main outputs of NI2006 Post Conference [10 mins.]
- Brief overviews from speakers on what has been achieved (or not), and what has changed in the 10 years since the conference [20 mins.]
- Discussion (breakout groups) on key topics arising from the original 2006 meeting, and identified by workshop participants [30 mins.]
- Feedback from breakout groups; group discussion of how to anticipate or influence the future [20 mins.]
- Concluding 'next steps' discussion [10 mins.]

### *2.2. Description*

Organisers and participants (the proposed speakers) from the NI2006 Post Congress Conference will present brief synopses of the future vision for nursing, healthcare and informatics as identified in the 2006 proceedings [1]. This will provide the context for workshop participants to identify key topics for discussion. The focus of the workshop is on participant interaction, and widespread exploration of a range of opinion. Topics to be discussed will include technological and societal changes that are impacting health and nursing, and the changing expectations of citizens and patients.

A website of resources will allow for curation of a range of materials, and to encourage discussion of issues by potential workshop participants, identification of key issues before, during and after the event, and sharing of resources (<https://ni2020futures.wordpress.com/>). Other existing work exploring health and nursing futures, including Medical Futurist Dr Bertalan Mesko's publications [2] (<http://www.medicalfuturist.com>), will be used to inform the workshop discussions; Dr Mesko has also agreed to provide Skype/video input to the workshop. Participants will be invited to continue discussions online after the workshop, and outputs of the workshop will form the basis for further activity at Medinfo2017 and NI2018.

## References

- [1] P.J. Murray , H.A Park ,W.S Erdley, J Kim (eds). *Nursing Informatics 2020: towards defining our own future. Proceedings of NI2006 Post Congress Conference*. IOS Press, Amsterdam. 2007.
- [2] Mesko, B. *The guide to the future of medicine. Technology and the human touch*. Webicina Kft., Budapest. 2014.

# Nursing Informatics Competencies for Emerging Professionals: International Leaders Panel

Lisiane PRUINELLI

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**Abstract** To achieve a cursory review of the competencies necessary for acquire a successful career in a competitive job market, the panel will bring together leaders from renowned academic, successful health corporations, and international leaders in nursing informatics to the table for discussion, dialogue, and make recommendations. Panelists will reflect on their experiences within the different types of informatics organizations and present some of the current challenges when educating skillful professionals. The panel will provide personal experiences, thoughts, and advice on the competencies development in nursing informatics from their lens.

**Keywords.** Nursing informatics, Competencies, Leadership, Academia, Industry, Education

## 1. Panel Organization

Panel Organizers: Lisiane PRUINELLI<sup>1</sup>; Maxim TOPAZ<sup>2</sup>, Charlene RONQUILLO<sup>3</sup>, Laura-Maria PELTONEN<sup>4</sup>

The proposed panelists are:

**Suzanne Bakken**, RN, PhD, FAAN, FACMI, is the Alumni Professor of Nursing and Professor of Biomedical Informatics at Columbia University. She currently directs the Center for Evidence-based Practice in the Underserved and the Reducing Health Disparities Through Informatics (RHeaDI) pre- and post-doctoral training program. Dr. Bakken has published more than 250 peer-reviewed papers. She is Fellow of the American Academy of Nursing, and President of the American College of Medical Informatics. Dr. Bakken is currently the AAN/ANA/ANF Distinguished Nurse Scholar-in-Residence at the Institute of Medicine where she is focusing on the intersection of data science and health equity.

**Ellen Harper**, DNP, RN-BC, MBA, is Vice President and Chief Nursing Officer (CNO) at Cerner Corporation. She has more than 30 years of experience in healthcare, of which 20 plus years have been focused on using technology and informatics to automate evidence based, interdisciplinary, patient centered workflows. As a nurse informatician, Dr Harper demonstrates that although nursing informatics is still a relatively new field, it is critical to healthcare in the new millennium. Her work is

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centered on transforming healthcare by reducing error, variance and waste. An accomplished writer and international speaker Dr Harper's solutions/models optimize processes for healthcare organizations ranging in size from single-doctor practices, to health systems, to entire countries. She is a fellow of the American Academy of Nursing.

**Polun Chang**, PhD, Professor, Institute of BioMedical Informatics and School of Nursing. Director, Integrated Health Care Research Center, National Yang-Ming University. polun@ym.edu.tw, polunchang@gmail.com. Dr. Chang has been one of few active medical informatics leaders in Taiwan since late 1990s. He used a successful strategy of End-User Computing with the tool of Excel and embedded VBA to promote the informatics training. He started the Taiwan Nursing Informatics Initiative in 2003, and then led to establish the national NI association in 2006. Under his leadership, the nursing informatics practice, research and activities in Taiwan has become active and popular and most of the NI specialists in Taiwan are program graduates. In 2013, he was the first non-US scholar picked as the Face of AMIA. Dr. Chang is currently working with the nursing colleagues and leaders in China and internationally countries to promote the NI and ideas and visions set in TIGER globally. For his achievements, Dr. Chang was honored with the position of Distinguished Professor in the Capital Medical University in Beijing and awarded as the 2015 Hundred-Talent Program Laureate by the ShanXi Province in China.

**Maxim Topaz**, Postdoctoral Research Fellow, PhD, RN, MA. Harvard Medical School & Brigham Women's Health Hospital, Boston, MA, USA. mtopaz80@gmail.com. Dr. Topaz is a postdoctoral research fellow at the Harvard Medical School & Brigham Women's Health Hospital. He received his PhD from the University of Pennsylvania School of Nursing focusing on clinical decision support and standardized terminologies. Maxim was involved in diverse range of professional activities including membership in a student editorial board of bioinformatics journals (e.g., the Journal of American Medical Informatics Association) and policy development with the Office of National Coordinator for Health Information Technology, USA (Internship). He also co-founded, and is currently chairing, the IMIA-NISIG Students working group. Maxim has over 30 publications in peer-reviewed journals (including the Journal of American Medical Informatics Association, Computers Informatics Nursing, etc.) and a record of over 50 presentations at national and international conferences.

## 2. Panel Description

### 2.1. Format

**Timeline of activities:** 1) Moderator introduces panelists and discussion guidelines (5 minutes); 2) Panelist position presentations (10-12 minutes each); 3) Questions & answers (30 minutes); 4) Moderator thanks all participants and closes panel (5 minutes).

**Sample list of debatable questions:** Describe the main requirements of different informatics competencies (academia, practice, professional organizations)?; How should informaticians prepare themselves in lifelong learning for diverse professional and leadership roles in nursing informatics?; What are some of the effective strategies for finding training in different skillset necessary for the job market?

## *2.2. Description*

In academic settings, nursing informatics (NI) education developed significantly during the last decades. Several sets of criteria for NI education developed, for example the Technology Informatics Guiding Education Reform [TIGER] initiative in the United States. TIGER created a three parts model for NI competencies: basic computer competencies, information literacy, and information management. Many new informatics educational programs were established across the world, and NI students are increasing in number. On the international level, NI is a growing field with many research and applied opportunities. Legislative agendas and policies have been driving NI into the public policy arena. For example, the United States Congress mandated the Health Information Technology for Economic and Clinical Health Act. This legislative action involves using the Electronic Health Record and related technology to improve quality, safety and efficiency of patient care; engage patients and families; improve care coordination; and ensures adequate privacy and security for people's personal health information. Other governments adopted similar legislative trends facilitating the adoption of health information technology by healthcare providers mandated including the United Kingdom, Jordan, and Austria.

In the light of an increasing demand for informatics professionals, it is imperative that nursing informatics students understand educational requirements, skillsets, and networking strategies needed to align educational development and future career and opportunities. To address this need, the IMIA-NISIG Students Working Group proposes a panel of nursing informatics leaders. The panelists will provide insights and recommendations on career development, educational requirements and skillsets needed, to be competitive for opportunities available for nursing informatics emerging professionals. The aim of the panel is to provide a view through the lens of their experiences on career development and to focus on how to prepare for the future. Panel members will reflect on advantages and disadvantages of each of the professional paths, the different educational requirements, and skillsets needed. This will provide the audience with actionable insights on the possible career choices, how to plan during the student's development, and opportunities for the emerging nurse informaticians in the areas of practice, research and leadership.

# Facilitating eHealth for All Through Connecting Nurses and the Women Observatory for eHealth

Veronique Ines THOUVENOT<sup>a</sup>, Nicholas HARDIKER<sup>b</sup> RN PhD FACMI

<sup>a</sup>Millennia2025 Foundation, Namur, Belgium

<sup>b</sup>International Council of Nurses, Switzerland and University of Salford, UK

**Abstract:** Nurses are at the forefront of health care delivery and are key to health improvements across populations worldwide. They play vital role in the treatment of communicable diseases and in maintaining optimal quality of life for those living with long-term conditions. A number of factors such as an ageing population, a shrinking nursing workforce, inequity and variable access to health services naturally point towards technology-focused solutions. However the uptake of eHealth tools and techniques by nurses and their integration with nursing practice remain patchy, not least because of nurses simply 'not knowing' that good solutions exist. The purpose of this panel is to describe initiatives that seek to identify and showcase good practice in the use of eHealth in nursing.

**Keywords.** eHealth, technology, nursing

## 1. Panel Organization

Members of this panel will include:

**Veronique Ines Thouvenot**, Millennia2025 Foundation, Namur, Belgium, [thouvenot.veronique@millennia2025-foundation.org](mailto:thouvenot.veronique@millennia2025-foundation.org)

**Nicholas R. Hardiker**, International Council of Nurses (ICN) and University of Salford, UK, [n.r.hardiker@salford.ac.uk](mailto:n.r.hardiker@salford.ac.uk)

## 2. Panel Description

Innovative digital tools and services are fast expanding, and the Connecting Nurses ([www.connecting-nurses.com](http://www.connecting-nurses.com)) programme is a worldwide patient-centric programme for nurses supported by Sanofi Patient Centricity Unit and developed in collaboration with international nursing organisations such as the International Council of Nurses (ICN). ICN is a federation of over 130 national nurses organisations which indirectly represents the interests of over 16 million nurses worldwide. The ICN eHealth Programme has as its strategic aim to transform nursing and improve health through the visionary application of information and communication technologies. The ICN eHealth Programme takes as one of its workstreams Connecting Nurses.

Connecting Nurses intends to provide a forum for nurses from around the world to share their ideas, advice and innovations, and contribute to patient empowerment. The aim is simply to bring nurses together. Connecting Nurses provides an online forum for nurses from around the world to share ideas, advice and innovations, both among themselves and with other health care professionals (HCP), patients, caregivers, and the general public.

As an integrated part of Connecting Nurses, Care Challenge (<http://www.care-challenge.com>) has been created to celebrate the important role the nursing community plays in healthcare provision around the world, while addressing the challenges which arise within modern healthcare systems. Nurses are able to submit, on an ongoing basis, a summary of their initiative i.e. the problem, the solution and the anticipated results, either under a general nursing category or under more specific chronic disease like diabetes, cardiovascular, or renal care. The programme is focused on identifying nursing innovations related to: Education (resources promoting patient self-management or raising community awareness of a disease); Practice (nursing services, procedures, techniques or tools promoting patient self-management of disease or new ways to support families and caregivers); and, Research (studies of outcomes of innovative approaches to nursing, patient care, and patient education). Submissions are showcased via the Care Challenge platform for users to discover, "like", or share through social media. Best projects are supported for example through the production of high-quality video showcasing the nurse and how her/his project benefits to patients.

To improve the focus on eHealth, mHealth and Telemedicine initiatives, the Millennium2025 Foundation "Women Observatory for eHealth" (WeObservatory) (<http://www.millennia2015.org/WeObservatory>) has partnered with Connecting Nurses since 2013. The overall objective of the WeObservatory is to serve as an Innovation Resource Center to promote women's empowerment through the access and use of advanced technologies for health, combined with innovative integrated collaborative leadership programs within the Global Framework of the UN SDGs 3 and 5 (<http://www.un.org/sustainabledevelopment/sustainable-development-goals/>). eHealth nursing projects address women's health needs, scaling up programmes to full realization and a vision of the future by 2025. By end of 2015, the WeObservatory had provided support to 13 innovative nursing projects in Africa, America, Asia and Europe. The projects ([http://www.millennia2015.org/WeObs\\_Selected\\_Projects](http://www.millennia2015.org/WeObs_Selected_Projects)) cover Mental Health (Canada and Congo DR), HIV (Canada), ePrevention (Peru), Wound Care (France), Diabetes and young children and FootCare (Spain, Kosovo), Maternal Health (Spain, Nigeria, Philippines), Older people and Telehealth (Philippines), Telemedicine (USA) and Emergencies during disasters (Philippines). Multilingualism, highlighted as a crucial need for women, is addressed with UniversalNurse Speaker (<http://www.u-nurses.com/>), a new translation tool that facilitates multilingual healthcare communication across language boundaries between nurses and patients. UniversalNurse Speaker is tailored to support nurses in communicating with patients, and vice versa, in multiple languages. This empowers nurses to deliver care to patients in diverse multicultural settings. UniversalNurse Speaker is powered by UniversalDoctor translation technology used by hospitals and patients worldwide (<http://www.universaldocor.com/>). Nurses also benefit from a selection of Massive Open Online Courses (MOOCs) to improve their education on digital tools and services, in English, French and Spanish. In 2015, 340 Moocs were available at the Intelligence MOOCs Commons for Women and eHealth (WeMOOCs : <http://www.millennia2015.org/moocs>).



Connecting Nurses and the WeObservatory will continue showcasing eHealth nursing projects all over the world to ensure that eHealth for all becomes a reality and benefits the populations that need it most.

# The Future of Informatics in Aged Care: An International Perspective

Gregory L. ALEXANDER<sup>a</sup>, Patti ABBOTT<sup>b</sup>, Mariann FOSSUM<sup>c</sup>, Ryan J. SHAW<sup>d</sup>,  
Ping YU<sup>e</sup> and Mary M. ALEXANDER<sup>f</sup>

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**Abstract:** The panel will share global technology research initiatives in aged care. Panel objectives: 1) Describe international informatics research initiatives by experts addressing health needs of the aged, 2) Contrast health technologies used to manage aging patients, and 3) Explain challenges and opportunities to improve healthcare informatics for aging patients. Intended audience: researchers, consumers, practitioners, vendors, care providers, and policy makers with interests in aged care technology design, development, implementation and management.

**Keywords:** Aging, Health Information Technology, IT adoption, Quality of Care

## 1. Panel Description

The panel includes five interdisciplinary experts with backgrounds in aging, engineering, informatics, health systems, quality improvement, mobile health, and patient engagement from three continents, including Australia, Norway, and the U.S. The expert panelists are all leading novel research efforts in aging with an emphasis on informatics or technology to improve quality of care and health of older citizens.

During the presentation we will introduce a variety of interdisciplinary projects to illustrate the breadth and depth of aging research globally. Dr. Abbott will first present a discussion about disruptive innovations in aged care, which includes an extensive and futuristic plan to facilitate patient-engagement. Dr. Alexander and Dr. Fossum will contrast the use of IT in resident care activities, clinical support, and administrative activities in nursing home settings in two countries including the U.S. and Norway. Dr. Yu will report the results of an evaluation project about the implementation, adoption, usage and impact of electronic nursing documentation systems in 17 residential aged care homes in three states in Australia. Lastly, Dr. Shaw will present innovative mobile health technology investigations using social media and social networks to improve health of older adults’.

Following presentations, 3-5 discussion groups will be formed. Each group, will be facilitated by one (or more) workshop organizers for 10 minutes using discussion questions. The final 20 minutes will be used for each discussion group to report back and discussion by workshop participants. This is followed by a brief closing summary of the workshop by the moderator. The action items will be elicited and circulated to the attendees interested in following-up after the conclusion of the workshop.

## 2. Panelist and Moderator

**Patti Abbott**, Associate Professor, University of Michigan School of Nursing, USA [pabbott@umich.edu](mailto:pabbott@umich.edu). Dr. Abbott is focused on e-Health/mHealth applications for low-resource settings and vulnerable populations, with a primary focus on non-communicable diseases and digital education.

**Gregory L. Alexander**, Professor, University of Missouri Sinclair School of Nursing, USA, [alexanderg@missouri.edu](mailto:alexanderg@missouri.edu). Dr. Alexander has a broad research background in human factors, informatics, gerontology, patient safety and quality improvement.

**Mariann Fossum**, Associate Professor, University of Agder, Norway, [mariann.fossum@uia.no](mailto:mariann.fossum@uia.no). Dr Fossum's research is focused in the area of decision-making and information technology used in healthcare. Dr Fossum has experience in many care environments including hospitals, nursing homes, and home health care services in Norway.

**Ryan J. Shaw**, Assistant Professor, Duke University School of Nursing, USA [ryan.shaw@duke.edu](mailto:ryan.shaw@duke.edu). Dr. Shaw has interdisciplinary training in nursing, health informatics, and computer science. Dr. Shaw's research focuses on the science of patient-generated data, specifically, how to improve health outcomes and care delivery through the use of real-time data from wearable technologies, embedded environmental sensors, and electronic health records.

**Ping Yu**, Associate Professor, University of Wollongong, Wollongong, NSW, Australia, [ping@uow.edu.au](mailto:ping@uow.edu.au). Dr. Yu is Director Centre for IT-enabled Transformation in School of Computing and IT. She is a pioneer researcher on Australian nursing home's adoption of IT. She leads research projects on the impact of technology on residential aged care quality, chronic disease management with mobile technology and exploring impact of technology on dementia care.

**Mary M. Alexander** is a clinical nurse with nearly 30 years of bedside nursing experience in a variety of areas including intensive care, hospice, school health, ambulatory and outpatient surgical care.

## 3. Timeline of Panel Activities

**M. Alexander** will provide brief introductions of panel topics, panelist introductions, and discussion guidelines – (10 minutes).

**P. Abbott** will present the results of one-year project, "Care at Home". A team of 15 cross-disciplinary experts from University of Michigan schools and health system was formed and tasked with analysis of current and future state projections to address challenges for an aging and chronically ill population. The task force, specifically named the "Disruptive Innovations Group" developed an extensive and futuristic plan centering on facilitating patient-engagement, patient-driven and patient-facing gerotechnology, the creation of intergenerational campus housing affiliated with the UM senior-care community to support embedded "Gero-preneurs in Residence", and other inter-professional efforts. The results of the analysis will be shared with the expectation that the overall findings and plans will be generalizable to others. (10 minutes)

**G. Alexander** will provide Year 1 results of a federally funded national study about IT adoption in US nursing homes. The goals of the 4-year study are to recruit

nursing homes from across the US to determine level of IT sophistication. IT sophistication is defined as IT capabilities, extent of IT use, and degree of internal/external IT integration. Additionally, the results will be correlated with nationally reported quality measures using Nursing Home Compare data to provide insights into how IT sophistication, including health information exchange systems, influence quality in these facilities. Drawing on findings from other published studies we will draw some international comparisons of IT sophistication with our US study. (10 minutes)

**M. Fossum** will present a study describing the level of diversity in IT tools and software used in a purposive sample of four Norwegian municipalities. The healthcare services in the Norwegian municipalities, including nursing homes and home healthcare services have used electronic healthcare record (EHR) systems since the end of 1990. However, highly sophisticated computerized systems and opportunities to transferring information between different stakeholders have been limited. After an overview of the level of IT sophistication identified, the perceived enablers and barriers identified by participants will be reported and compared with findings of other international studies. Specific issues regarding the need for standardization; the lack of interoperability of systems; and poor user-interface features will be discussed with examples from usability studies conducted of EHR systems used in the municipalities. (10 minutes).

**R. Shaw** will describe the development, testing, and study results from a one year dissemination and implementation study evaluating how communication channels including social media and social networks lead older adults' to use mobile health technology—e.g. The Sixth Vital Sign mobile ResearchKit application (app)—for evaluating gait speed as an indicator of health. The Sixth Vital Sign mobile app developed at Duke University enrolls older adults using their social network to evaluate walking speed and health status. The participating older adult immediately receives assessment feedback, a summary of personalized health risk for negative health events, population based comparisons, recommendations and action steps for preventing falls and dependence, and an individualized report that can be shared with health care providers and family. (10 minutes).

**P. Yu** will report the findings of an evaluation project about the implementation, adoption, use and impact of electronic nursing documentation systems in 17 residential aged care homes in three states in Australia. She will present an overview of the project and major findings about the implementation, adoption, usage and impact of electronic nursing documentation on nursing care processes and quality of nursing records. The strategies and pitfalls in implementing technology in aged care nursing, the benefits and unintended consequences and the challenges for technology evolution will be discussed. The impact of electronic nursing documentation on quality of nursing care will be further validated through the evidence extracted from the official aged care accreditation reports all over Australia. (10 minutes).

- **Example Discussion Forum Questions (30 minutes)**

1. What are strategies to engage older adults in the use of innovative technologies?
2. How do we ensure the long term sustainability of technology in aged care settings (i.e. nursing homes, assisted living, home health, etc.)?
3. Is nursing practice keeping pace with evolving and existing technologies, which are being used to care for the aged?
4. What are opportunities and challenges for technology use in aged care?

# Developing a Framework for Teaching Nursing Informatics Internationally

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**Abstract.** Information technology systems in healthcare have resulted in transformation of work practices. Nurses need knowledge, skills, judgment and understanding of the importance of informatics from the commencement of their training. This interactive workshop will look at developing a framework for common core content, teaching methodologies and program structures in the integration of nursing informatics in undergraduate programs. The workshop format will provide a forum for international discussion on this serious challenge faced by nursing schools everywhere. The outcome of this workshop will be the development of a framework that may be applied in teaching nursing informatics internationally.

**Keywords.** Nursing informatics, ICT, health information system, curriculum, undergraduate education

## 1. Introduction

Healthcare delivery is increasingly dependent on information technology for timely information and effective decision-making. In 2003 McNeil et al conducted a survey of 266 baccalaureate and higher nursing programs in the United States and found approximately half of the programs reported they only require students to have basic computer word processing and email skills, while less than one third of the programs addressed core nursing competencies such as standardized terminologies and telehealth applications. [1] In this workshop we report on the findings of a survey that show less than one third of program faculty was rated competent to teach nursing informatics skills. Nearly 50% of the schools had no future plans or did not know of any plans to offer nursing informatics.

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## 2. Review of the Literature

In 2015 Madsen, Cummings and Borycki compared bachelor nursing informatics programs in Denmark, Canada and Australia, and reported significant variability in the development, evolution and integration of nursing informatics into undergraduate education. [2] While the informatics curriculum in Denmark is well established at the undergrad level, the comparison showed Canada and Australia are still in early stages. This inquiry was broadened with an informal unpublished survey in the fall of 2015 that included representative universities in 20 countries. As shown in Table 1, of the twelve participants (60%) who responded 10 had a Bachelor of Nursing program but only 3 of those programs had nursing informatics content. When asked if they preferred a stand-alone informatics program to integrating informatics curriculum within an undergraduate nursing program, 55% indicated they preferred integration. Findings of the survey served to further confirm wide differences exist in nursing informatics curriculum development, delivery methodology and integration into basic nursing competencies.

**Table 1.**

Country	Bachelor of Nursing	Nursing Informatics Program (Bachelor)	Integrated or Stand Alone Informatics program
Australia	Yes	No	Integrated
Canada	Yes	Yes	Stand Alone
China	Yes	Yes	Integrated
Denmark	Yes	Yes	Integrated
Finland	No	No	N/A
Iceland	Yes	No	No
Netherlands	Yes	No	No
Norway	No	No	N/A
Switzerland	Yes	No	No
UK	Yes	No	Integrated
USA - 1	No	No	N/A
USA - 2	Yes	No	Integrated

## 3. Methods

The workshop will feature roundtable discussions and is organized around specific topics relevant to the expected outcome, for example: nursing informatics content, program structure, challenges/opportunities for implementation, faculty training requirements, etc. Target participants are nursing faculty, clinicians and administrators.

The workshop will be 90-minutes in length and will be organized as follows:

- 2 speakers x 15 minutes each to present workshop objectives, current status findings from the international survey and a discussion framework. (30 minutes)
- 3 Roundtable discussions with first topic areas x 20 minutes (specific questions and responses recorded) (20 minutes)
- 3 Roundtable discussions with second topic areas x 20 minutes (total of 6 topic areas covered) (20 minutes)

- Summary of findings presented by leaders at each table (12 minutes i.e. 6 topics x 2 minutes reporting each) (12 minutes)
  - Acknowledgements and determining next steps (5 minutes)
- Total 87 minutes with 3 minutes for Roundtable reset

#### 4. Conclusion

In summary, the international survey substantiated nursing informatics has become a core competency for nurses who are soon to be left behind in today's digital reality. Healthcare records all over the world are being digitalized. This explosion of information technology systems has transformed how nurses will practice in the new workplace. Therefore nurses need knowledge, skills, judgment and understanding of the importance of informatics from the commencement of their training.

Nursing informatics as part of the basic nursing curricula has evolved differently in each country, and even in jurisdictions within those countries. It is apparent nursing generally has not developed a common framework, core content guidelines and core competencies in healthcare informatics. This workshop will serve to explore, on an international level, core content and competencies in an undergraduate nursing informatics program. Participants will assist in the development of a common framework for integrating nursing informatics into existing programs. Important collateral information from the workshop will include lessons learned in overcoming barriers and identifying opportunities for implementation. The workshop will also help identify faculty informatics training requirements and available resources.

#### References

- [1] B. J. McNeil, V. L. Elfrink, S. T. Pierce, Preparing student nurses, faculty and clinicians for 21<sup>st</sup> century informatics practice: Findings from a national survey of nursing education programs in the United States. *MedInfo* (2004), 903-907.
- [2] I. Madsen, E. Cummings, E. Borycki, Current status for teaching information in Denmark, Canada, and Australia, *Stud Health Technol Info* (2015), 216, 856–890.

# Healthcare Informatics Schemata: A Paradigm Shift over Time

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**Abstract:** The schemata “A paradigm shift over time©” (Sackett & Erdley, 2006) a graphic model, visualizes development and progression of informatics in health over time. The model portrays information technology trends, from computers as resource through computational ubiquity, and the shift to social networking and e-Health. The discrepancy between “real” and “proposed” suggests gaps involving issues such as value, interoperability and ontology requiring attention, development and ultimately adoption, hinging on a universal standards framework. The workshop objective is to review previous and current models of healthcare informatics to springboard revisions of the schemata for current and future use.

**Keywords.** Model (theoretical), healthcare, informatics, nursing

## 1. Workshop Organization

The proposed speakers are:

Dr. W. Scott Erdley, Behling Simulation Center, UB, [erdley@buffalo.edu](mailto:erdley@buffalo.edu),

Dr. Erdley has been involved with nurse and health informatics education since the early 1990’s. The last 5 years his focus shifted to immersive human patient simulations. He has published and presented on topics related to high fidelity simulations for health care students (nursing, medicine, dentistry to physical therapy).

Dr. Kay Sackett Fitzgerald, Frontier Nursing University, [kay.sackett@gmail.com](mailto:kay.sackett@gmail.com),

Dr. Fitzgerald has been involved with nursing since the mid-1970s and healthcare informatics since the mid-1990s. The last several years were spent focused on healthcare informatics, evidence-based practice and online education. She has numerous papers, presentations and book chapters related to her areas of interest.

## 2. Workshop Description

### 2.1. Format

Type of format: Breakout group discussion

Timeline

- Introduction and setting the stage – 10 minutes
- Historical review of schemata – 10 minutes
- Breakout group discussions – 45 minutes



- Breakout group summation presentation to others – 15 minutes
- Wrap up and Q&A – 10 minutes

## 2.2. Description

Visual models historically provide graphical representation of items and processes, concepts and relationships, otherwise not easily contemplated. Nursing informatics is well represented with models such as those by Schwirian [1], Graves & Corcoran [2] and Turley [3]. Each of these models provided representation of difficult concepts and relationships, thereby aiding intellectual digestion and subsequent discussion by users within and without nursing.

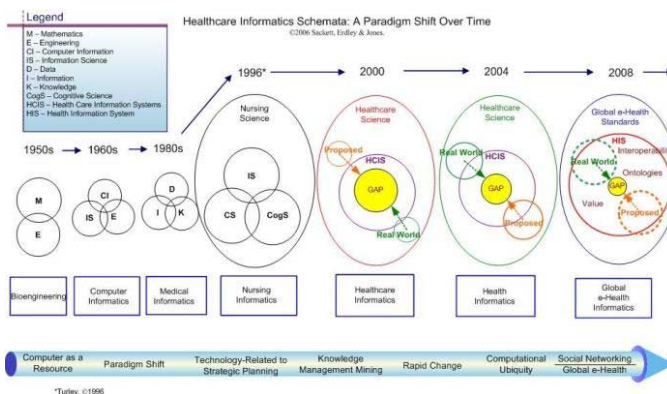


Figure 1 [4]

The healthcare informatics schemata “A paradigm shift over time©” (Sackett & Erdley) provides broader insights into the development and progression of healthcare informatics over time. Beginning with the early 1950s through 2008, this graphical representation conveys past and current trends, from computers as resource through computational ubiquity, and the shift to social networking and online health records. Parallel growth is depicted by the shift from discipline-specific applications to global, or universal, e-Health concept. The speed of changes accelerated the narrowing gap between the “proposed” and “real” world of working health informatics.

The discrepancy between the “real world” and “proposed” suggests a gap where issues of standards, interoperability, affordability, interface and modularity diagnostics and health information technology related to patient safety may be addressed from both national (US) and global perspectives. Singh and Sittig [5] developed the Health IT Safety (HITS) framework as a mechanism to measure and improve patient safety through information technology. The “sociotechnical work system” was articulated and safety domains identified. The need for shared responsibility between all stakeholders; healthcare providers, patient safety professionals and EHR vendors are considered from the US perspective. A global perspective to develop health technology standards using exemplars from industry is articulated by Masum, Lackman and Bartleson [6]. This global perspective is not bound by national boundaries. The goal is to improve healthcare for all. Identified are comparisons between healthcare and other industries economic and technological viewpoints, intellectual property, regulations and a global health business module. Emphasis on “point of care diagnostics” as one global health

technology with lesson learned from other industries that has potential to narrow the “real-world” to “proposed” gap is elucidated and complimented by best practice standards.

This workshop is designed to stretch attendees’ thinking and perspectives of healthcare and nursing informatics global impact, both now and in the future. Visual representations of concepts and ideas have a long-standing history in health care in general. This workshop will explore how this current model might be improved using past history along with participants’ life experiences and knowledge. The workshop will include two short presentations, one related to review of models in nursing and the second to include background information about the model. The bulk of the session will incorporate moderator-led active discussion with the participants. Recording comments will be accomplished via hard copy, computer-aided, pen and paper, and audio recording with participant permission will also be employed to document discussions. Ultimately all suggestions will be reviewed and incorporated into the schemata with a subsequent publication in a peer-reviewed journal.

## References

- [1] P Schwirian. (1986). The NI pyramid: a model for research in nursing informatics. *Comput Nurs.* 4:134–136.
- [2] JR Graves & S Corcoran. (1996). The study of nursing informatics. *Image J Nurs Sch.* 21:227–231.
- [3] JP Turley. (1996). Toward a model for nursing informatics. *Image J Nurs Sch.* 28:309–313
- [4] KM Sackett, WS Erdley, & J Jones. (2006). The Western New York regional electronic health record initiative: Healthcare informatics use from the registered nurse perspective. *Stud Health Technol Inform.* 122: 2485
- [5] H Singh and D Sittig. (September 14, 2015). Measuring and improving patient safety through health information technology: The Health IT Safety Safety Framework. *BMJ Quality & Safety Online* as 10.1136/bmjqs-2015-004486. Downloaded from <http://qualitysafety.bmj.com> on September 15, 2015. Published by group.bmj.com
- [6] H Masum, R Lackman, and K Bartleson. (October 17, 2013). Developing global health technology standards: what can other industries teach us? *Globalization and Health* 2013, 9:49 doi:10.1186/1744-8603-9-49 Retrieved from <http://www.globalizationandhealth.com/content/9/1/49>

# Demonstration

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# POLESAT an Innovative e-Geoplatform in Health Management

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**Abstract.** Health geography and geomatics have become major disciplines in the last few years and are the source of attractive concepts for medical informatics. POLESAT's e-geoplatform was built to present information and support decision-making during medical consultation. We have improved its usability with innovative and modern methodology. Results show five steps of the process. **1:** we select one of three hospitals. **2:** thanks to PiNoKio's anatomy, the related activity segments are displayed. **3:** the activity segment "AB-Orthopedics, Rheumatology" is displayed. **4:** click on "AB02-Amputations" product line and **5:** go to hospital activity choropleth map. Conclusion: This third e-geoplatform version is a showcase for advanced open-source geomatics via web-mapping possibilities. Health management based on geography concepts, geomatics, an amusing avatar for children, health and/or geographic open data represent the technology of tomorrow. This e-geoplatform concept presents an opportunity for the serious games industry, education and will reduce health access inequalities.

**Keywords.** geomatics, e-geoplatform, decision-making, medical visualization knowledge, serious games, programmed medical choice, education.

## 1. Introduction

Health geography and geomatics (Geographic information and GIS) have become major disciplines in the last few years and are the source of attractive concepts for medical informatics. POLESAT's e-geoplatform was built to present information and support decision-making for professionals and the general public. Our e-geoplatform proposes to guide a programmed medical choice during a consultation.

To optimize e-geoplatform usability, we have incorporated geographical and medical knowledge visualization approaches (VCM), dynamic and interactive web pages [1]. For e-geoplatform3, the challenge is to test an open-source web-mapping service for atlases and to pursue our communications on POLESAT.

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## 2. Methods

The architecture of the dynamic website, the VCM medical iconic language (PiNoKio©) and the security and state of the servers has remained unchanged from e-geoplatform2 [1].

We have tested the GIS environment and web-mapping servers "QGis – Lizmap®". The map data and geocoded PMSI fictive data are stored in the QGis© for map processing. Choropleth mapping outcomes are provided thanks to QGis and *LizMap Plugin*, sent and stored in the *QGis server* and *Lizmap client* until a "request client" displays the requested maps thanks to HTTP, HTTPS, WMS protocols [2, 3].

## 3. Results

The webpage1 prototype represents an interactive map of the Nord-Pas-de-Calais region. By clicking on the circle, we select one of three hospitals: Dunkerque, Lille and Valenciennes. Webpage2 shows an attractive and amusing dynamic avatar: PiNoKio. Click on one of PiNoKio's legs and the table of related activity segments is displayed on webpage3.

Once the administrative and statistical information has been observed and analyzed, click on the activity segment: "AB-Orthopedics, Rheumatology". Webpage4: Click on the product line "AB02-Amputations" and go to web-mapping choropleth map Step 5.

## 4. Discussion

This regional e-Atlas is a showcase for advanced open-source geomatic possibilities [1]. Health management based on geography concepts, an amusing avatar for children, geomatics, health and geographic open data represent the technology of tomorrow.

This e-geoplatform concept [4] presents an opportunity for the serious games industry, education and will reduce health access inequalities owing to the fact that e-Atlas and PiNoKio provide a better and easier guide for health care units according to the cultural aspects of patients (mobility, habits, languages, etc.).

## 5. Acknowledgments

The authors wish to thank all those who contributed to this research.

## References

- [1] A. Quesnel, J. Soula, F. Dufosse, N. Sharma, A. Ruhela, R. Beuscart: POLESAT, an innovative e-health geomatic platform in decision-making based on: Geographical approach, medical knowledge visualization & geographic information system & web-mapping architecture. *IRBM*, **34** (2013), 267-273.
- [2] Development Team: Quantum GIS Geographic Information System: Open Source Geospatial Foundation Project, <http://qgis.osgeo.org/fr/site/>, 2014.
- [3] R.L. D'Hont, M. Douchin: Lizmap software, <http://www.3liz.com/lizmap.html>, 2014.
- [4] A. Quesnel-Barbet, F. Dufosse, A. Hansske, M. Souris, D. Delerue: Géomatique en Santé et applications dans le nord de la France. *Techniques de l'Ingénieur*, (in press) 2016.

# Posters

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# Understanding Nurses' Perceptions of Electronic Health Record Use in an Acute Care Hospital Setting

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**Abstract.** Electronic health records (EHRs) are being implemented in health care environments in an effort to improve the safety, quality and efficiency of care. However, not all of these potential benefits have been demonstrated in empirical research. One of the reasons for this may be a number of barriers that prevent nurses from being able to incorporate EHRs into their professional practice. A review of the literature revealed a number of barriers to, and facilitators of EHR use by nurses. Among these, EHR usability, organizational context, and individual nurse characteristics were found to be concepts that influence use. It is currently unknown how these concepts together might influence nurses' perceptions of their ability to use the technology to support the nursing process. In this poster, the authors will describe a study aimed at achieving a better understanding of nurses' perceptions of their EHR use by investigating the concepts of EHR usability, organizational context and select individual nurse characteristics.

**Keywords.** Electronic health records, nursing informatics, health information systems, technology, nursing, adoption

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# Improving EMR Usability: Critical Elements When Designing Perioperative Emergencies Template

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**Abstract.** Perianesthesia nursing care involves monitoring of unexpected outcomes before and after surgical and anesthetic procedures. When adverse events occur, reviewing patient data is critical to provide appropriate intervention. Current EMR software systems are limited in structure and are not cohesive in recording adverse events. Users tend to develop workarounds when systems fail to capture workflow. Analysis of adverse incident is incomplete because data entered is not retrievable. Narrative data, while sometimes necessary, cannot easily be analyzed or linked to the structured portion of the record. Designing templates to capture essential data during emergency situations improves usability and compliance. The presentation of information in terms of layout and structure is important because it can influence data retrieval, interpretation and clinical decision making in fundamental ways.

**Keywords.** usability, design, elements, perioperative emergencies, documentation

## 1. Introduction

Adverse events occur in preoperative, intraoperative and postanesthesia care units (PACU). Some examples of these conditions are acute myocardial discomfort, airway obstruction, breathing dysfunction and hemodynamic instability. Resuscitations are often chaotic and stressful with decisions needing to be made quickly [1]. Accuracy in documentation is crucial in order to provide timely intervention and for analysis and review. Current clinical documentation software systems are limited in design. Users enter data in multiple areas for their assessment and interventions which is time consuming and cumbersome.

When EMR systems fail to capture specialty practice workflow, users tend to develop workarounds i.e., free text entry. A 2014 Black Book EHR Loyalty survey reported “89% of nurses developed creative workarounds to deal with shortcomings and system deficiencies” [2].

Designing templates to capture essential data in perioperative emergency situations improves usability and promotes compliance. Cues serve as reminders and prompt

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users on how to proceed and complete documentation requirements in a stressful environment.

## **2. Methods**

A pre-implementation survey was used to gather data on users concerns on current design of clinical documentation system. Staff expressed concerns they had to visit multiple screens to enter patient's initial and ongoing assessment and intervention. A perioperative adverse event template was designed, created and pilot tested. Post-implementation feedback from users is encouraged for ongoing systems improvement.

## **3. Results**

Survey results indicated that the template met the following criteria (a) Cohesiveness-patient data is captured and viewed in one screen, (b) Comprehensive-captures all the essential details when managing crisis events, (c) Convenient-prompts users to enter essential information, (d) Accessibility-data can be viewed by all departments and services, (e) Reportable- data elements are standardized and are retrieval for audit reports.

## **4. Discussion**

When adverse events occur in the perioperative setting and provision of intervention is critical. Clinical data should be accessible and reflective of patient's condition. Efficiency in entering data should be taken into consideration. Templates for electronic documentation should be designed to capture departmental workflow improving usability and compliance.

## **5. Acknowledgments**

Members of P4G Optime Task Force University of Colorado Health System (North, Central and South).

## **References**

- [1] J. BOEHM. Making Code Documentation Work for You-The Electronic Way. Retrieved from <http://tinyurl.com/zgt6jh4> (2010)
- [2] D. BROWN. Hospital Nurses Forced to Develop Creative Workarounds to Deal with EHR System Flaws; Outdated Technologies and Lack of Interoperability, Reveals Black Book, Black Book Market Research, Newswire. Retrieved from <http://tinyurl.com/hdav8ty> (2014)

# User Experience-Take Multimedia Registration Panel as an Example

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**Abstract.** Follow the transfer method that the popular technology products users share new item online, to encourage nursing staffs express their real experience, attract them involve the clinical IT development. Help the Technology Products more useful to improve clinical provider quality.

**Keywords.** User experience Interface Instant feedback TAM Clinical IT

## Introduction

Today smartphone has become popular in Taiwan, almost every person own. Because the internet is easy to grain, such as public Wi-Fi that is the point to allow mobile devices been acceptable for user.

New technology make many place more convenient include hospital, in the past without any assisted systems in outpatient department for patient to forecast their time of arrival which they usually come to clinical very early to wait ,for nurse so many patient waiting out of the door that makes them feel lot of stress. But now, this situation has been changed, cause via multiple registration panel, patient can realize when should they start to hospital, for nurse, when patient check in their ID number, that is more clearly and easy to management all waiting situation.

Sometimes the IT products may have something wrong or any bug in workflow, if user can instant feedback as soon as better, so try to let them have an easy way to point the problem is this paper's main idea.

## Methods

This article describes an user testing report. A new technology to be implemented successfully, concludes with the platform all user's feedbacks is necessary.

Promote the easy computer skill, such as "Print Screen" button, while error showed, users can grab the wrong situation moment computer page to save the interface. Encourage staff use their blog writing experience to share any new technology products to point how they feel in it .then make the clinical IT get better.

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In this case the product combine hardware and software, if there is any problem in hardware staffs can use the blog writing style to describe the item, if the error come from software such as webpage, just use the fast button to save the interface.

## **Results**

Modern people already used to share any news, stuffs...by Facebook, blog...,just use the same skill to convey their ideas in the clinical IT using experiences is piece of cake, so find easy way for staffs to express their opinion would help us more efficiency in clinical IT research project.

## **Discussion**

Not only in clinical IT research project but also other project, it must involve user's experience. Offer an ease of use's program to collect users' opinions, trying to design a friendly interactive pipeline. It can development process as well.

## **References**

- [1] P.F.LEE, A study of the usage of clinical scheduling board for outpatients, Unpublished master's thesis, Taipei,Taiwan, 2013.

# Evaluation of a Fall Risk Prediction Tool Using Large-Scale Data

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**Abstract.** To support nursing care for the prevention of falls among inpatients at our institution, we developed and implemented a fall risk prediction tool. To evaluate its effectiveness, we compared the number of falls among inpatients before and after its implementation. The odds ratio for the probability of falling was 0.79 (95% confidence interval: 0.69-0.91) ( $p < 0.001$ ), which was adjusted based on institutional data comprising 573,216 records from 25,039 patients in 24 general wards. Although whether nurses used the tool completely or whether the dissemination of fall prevention measures led to behavioral changes among the nurses in relation to their care remained unclear, the fall risk of inpatients appeared to be reduced after implementation of the prediction tool.

**Keywords.** Accidental Falls, Accident Prevention, Nursing Care, Risk Management, Electronic Health Records

## 1. Introduction

Falls can cause serious injuries, including fractures and brain contusions [1]. Therefore, it is important that medical institutions take adequate fall prevention measures. One such example is a fall risk prediction tool. We developed a fall risk prediction tool in our electronic medical record system and implemented it in March 2014 [2].

The aim of this study was to evaluate the effects of our fall risk prediction tool in the clinical setting.

## 2. Methods

We analyzed whether a reduction in fall occurrence, in accordance with the Japanese Ministry of Health, Labour and Welfare guidelines [3], was evident. We investigated two periods: the period before the tool was implemented (before period), defined as April 2013 to February 2014; and the period after the tool was implemented (after period), defined as April 2014 to February 2015. This study was reviewed and approved by the research ethics committee of the authors' institution (number 10520). We analyzed the number of falls with fall reports stored in an incident reporting system

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during the before and after periods. We used institutional data on the patients' "Intensity of Nursing Care Needs", which refers to patients' nursing care, medical treatment, and activities of daily living [4]. We targeted 24 wards (excluding pediatrics, maternity, ICU, emergency, and psychiatric wards) in which nurses are required to record these data according to medical service fee-based rules in Japan. For statistical analysis, we used R 3.2.0 [5].

### 3. Results

There were 287,273 (14,430 patients) Intensity of Nursing Care Needs records during the before period and 285,943 (14,183 patients) during the after period, for a total of 573,216 (25,039 patients). Some patients were hospitalized during both periods. The number of falls was adjusted according to the number of patient-days to account for days in which a patient fell more than once. The adjusted number of falls was 495 (422 patients) during the before period, and 407 (352 patients) during the after period, for a total of 902 (762 patients). As a result of multilevel logistic regression analysis, in which the response variable was the logit of the probability of falling; the explanatory variables were period of hospitalization, sex, age and Intensity of Nursing Care Needs items, the odds ratio for the probability of falling was 0.79 (95% confidence interval: 0.69-0.91) ( $p < 0.001$ ).

### 4. Discussion

The fall risk prediction tool appeared to result in a 21% reduction in fall risk among inpatients in target wards at our institution; however, whether nurses used the tool properly or whether the dissemination of fall prevention measures led to behavioral changes among the nurses in how they provide patient care remains unclear.

### 5. Acknowledgments

This work was supported by JSPS KAKENHI (Grant Number 26870134).

### References

- [1] M.J. Krauss, B. Evanoff, E. Hitcho, K.E. Ngugi, W.C. Dunagan, I. Fischer, S. Birge, S. Johnson, E. Constantinou, V.J. Fraser, A case-control study of patient, medication, and care-related risk factors for inpatient falls, *J Gen Intern Med* 20 (2005), 116–122.
- [2] S. Yokota, M. Endo, T. Hiramatsu, T. Noguchi, K. Miyo, K. Ohe, Construction, evaluation, and implementation of a formula predicting a patient's fall risk based on a historical cohort study using electronic medical records (EMR) data, *Jpn J Med Inform* 34 (2014), 119–128. In Japanese.
- [3] Ministry of Health, Labour and Welfare. Evaluation system for IT introduction in hospital, 2009. Available at: <http://www.mhlw.go.jp/shingi/2010/01/dl/s0125-8m.pdf>. Accessed: 3 July 2015. In Japanese.
- [4] K. Iwasawa, T. Tsutsui, Intensity of Nursing Care Needs. First ed. Japanese Nursing Association Publishing Company, Tokyo, 2014. In Japanese.
- [5] R Core Team, R: A language and environment for statistical computing, 2014. Available at: <http://www.R-project.org>. Accessed: 3 July 2015.

# Nurses' Experiences of an Initial and Re-Implemented Electronic Health Record Use

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**Abstract.** The Electronic Health Record (EHR) is a key component of healthcare information systems (HISs). In EHR implementation, smooth adoption can streamline nursing activities. In order to explore the adoption process, a qualitative study design and focus group interviews were conducted 3-month post and two years after EHR system implementation (system aborted one year in between) in one hospital located in Taiwan. Content analysis was performed to analyze the interview data and six main themes were derived, in the first stage: 1) liability, work stress and anticipation for EHR, 2) slow network speed and user unfriendly design, 3) insufficient information technology/organization support; on the second stage: 4) getting used to EHR and further system requirements 5) benefits of EHR in time saving and documentation 6) unrealistic IT competence expectation and future use. It concluded that user friendly design and support by information technology and manpower backup would facilitate this adoption process.

**Keywords:** electronic health record; focus group interviews; information technology; qualitative study; system implementation

## 1. Introduction

In recent years, numerous hospitals worldwide have invested money and manpower into developing healthcare information systems (HISs), and the Electronic Health Record (EHR) is a key component of HIS. Developing HIS requires carefully considering numerous complex dimensions, such as the type of healthcare organization, currently used ISs, consumers, and increasing healthcare needs. The transition to EHRs is best implemented with strong support from within the hospital administration and IT support staff, and with training modules designed for the nursing staff.<sup>1</sup>

The purpose of the present study was to examine the perspective of nurses from paper to EHR use and to explore their adoption process of EHR system in different implementation stages: the initial implementation stage, and post implementation stage (with one-year aborted system). It is hoped that the findings can act as a reference for further system design and developmental processes to smooth users' transition stages.

## 2. Methods

This qualitative study was designed to explore nurses' perspectives on the impact of EHR on their daily practice in the transition stage from paper to EHR. A focus group of

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nurses was used to provide insights about their adoption experiences in the different implementation stages. The study was conducted in 3 general medical or surgical wards of a 1,200-bed teaching hospital employing 700 nurses in southern Taiwan. A mobile nursing station was created by installing an EHR on a conventional nursing cart. The EHR comprised a 19-inch notebook computer with a touchscreen. The system weighed approximately 165 pounds and could operate for as long as 6 hours on a single charge. The nursing cart (including the computer) weighed approximately 165 pounds. The original mobile nursing station was designed to allow nurses to perform operations while sitting down.

Data was collected in two stages: the first was from August to September 2010; and the second was from August to September 2012. Four focus groups comprising three to seven nurses who had volunteered to participate met in a conference room after their day shift. Guided interviews were conducted which included the following questions regarding using HER for care routines, the impact on daily practice, expectations, problems, difficulties and suggestions.

### **3. Results**

The interview data resulted in 6 main themes as the following: Stage I – 1) increased work stress, liability, and anticipation for EHR systems, 2) slow network speed, unfriendly design for logical thinking and learning process, 3) insufficient IT/organization support for problem solving and manpower backup; Stage II - 4) getting used to EHR and requirements for further system functions, 5) learning the benefits of EHR in time saving and easy-reading documentation, 6) concerns of unrealistic IT competence expectation and future barcode use.

### **4. Discussion**

The initial expectation of the research participants was that the EHR would streamline record keeping and facilitate patient care activities. Nonetheless, users were required to adapt to the hardware design, network speed, and system's design logic for documentation. If these adjustments overwhelmed the nurses and interfered with their daily tasks, the implementation process had to be terminated. Nonetheless, once the system had been revised and redesigned, nurses could benefit from the EHR use and provide constructive comments. Additionally, nurses would be more prepared for the next technology implementation stage. In other words, nurses not only adopted the technology, they also evolved with the technology; and the EHR features needed to be more comprehensive, integrative and less repetitive. Finally, IT support, manpower assistance, and in-service training courses could be better served if shortened to enhance nurses' competency in adopting EHR during the adoption process .

### **References**

- [1] J. Lammintakanen, K. Saranto, T. Kivinen. Use of electronic information systems in nursing management. *Int J Med Inform.* 2010;79(5):324-331.

# A Customized Workflow-Driven Instant Messaging System Support Team Communication in the Hospital

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**Abstract.** Effective communication among the healthcare team is a very important skill to support team resource management (TRM). However, we take too much effort to connect with other team members by using traditional telephone communication. In this study, we developed an instant messaging system embedded in the original hospital information system and evaluated the preliminary outcome and the usage of the system.

**Keywords.** Instant messaging system, Team resource management

## 1. Introduction

During the clinical nursing daily tasks, nurses spent 19-24% of their time in professional communication [1]. Telephone communication is the traditional method to connect and communicate with different healthcare team members. However, the telephone communication often leads to interruption of current work, long waiting for the right person to answer the phone, and communication errors. The communication errors may be due to listening errors, transcription errors or misremembered. To simplify the communication workflow and maintain the patients' privacy, we aimed to develop a customized workflow-driven instant messaging system embedded in the original hospital information system to facilitate the communication among all team members.

## 2. Methods

We conducted several multidisciplinary focus group interviews to summarize the common interdepartmental communication scenarios. Then we simplified original workflow and planned new processes to address these different communication scenarios with the users. And we also allowed the users to maintain their own text messages for a variety of communication scenarios, as reference templates for sending messages from our new instant message system. An instant messaging system which was nicknamed Link to Team (L2T) system was developed by applying the rapid

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application development model (RAD). After several iterative corrections, the official version was implemented in all wards, operation room, central sterile supply department, cath room and special examination laboratories. In order to evaluate the preliminary outcome, we conducted interviews, system operation tests and a satisfaction survey with the users from each ward by purposive sampling after 3 months of implementation. To explore the usage of the system we also applied quantitative content analysis after 6 months of implementation.

### 3. Results

In preliminary outcome evaluation, we interviewed 15 nurses. The respondents indicated that they have replaced most telephone communication by the L2T system. It's very convenient to transmit a message to a number of recipients simultaneously. It saved lots of time in team members connecting. Besides, the content of the text messages was more correct and clear. Users can also query history information in the system to avoid forgetting messages. We also randomly sampled 29 nurses and conducted a questionnaire survey for primary users' experience. Most users were satisfied with the color scheme and the design of the interface, easy to learn and easy to use the system. 86.2% users were familiar with the system function. After 6 months of implementation, we analyzed the history records of the system from January 1 to January 31, 2015. The total number of records was 20,781. 51.21% messages were related to notifying another nursing station about patient transfer information. 31.32% messages were communicated between the ward and operating room about the patient surgery preparation. 13.38% were used for communication between colleagues of the same nursing station. The outpatient clinic nursing staffs have the highest utilization rate in requesting support. 68.42% of messages were received and processed within three minutes.

### 4. Discussion

This project was satisfied the users' expectation in rapidly, easily and correctly operative. Meanwhile, it also improved the timeliness and coordination between the healthcare team. The L2T system was designed as a communication tool to meet the workflows of various departments. Next, we would like to integrate the workflows of those departments that have not been included in this project. It is expected that wider adoption of the current L2T system will help to improve clinical and administrative work processes in the future.

### References

- [1] J.I. Westbrook, C. Duffield, L. Li and N.J. Creswick, How much time do nurses have for patients? A longitudinal study quantifying hospital nurses' patterns of task time distribution and interactions with health professionals, *BMC Health Serv Res*, **11** (2011), 319. doi: 10.1186/1472-6963-11-319.

# The Austrian Nursing Minimum Data Set (NMDS-AT)

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**Background.** In order to be able to follow the predicted changes in healthcare systems, there has long been a need for a unified database that could transparently compare nursing care data from different service providers. Data, which currently can be found in medical data sets and/or medical registers, give no information to describe nursing care in different populations and a variety of settings, about the costs of nursing care or the quality of nursing care. To assess and improve nursing care topics in future, healthcare decision makers need a solid database and a good overview of the care situation in Austria. The international development of Nursing Minimum Data Sets (NMDS) has demonstrated that nursing care data can be sufficiently compared.

**Objectives.** To identify the data elements for an Austrian NMDS and test the feasibility of using this NMDS-AT by assessing the availability of data needed for the NMDS-AT in routine nursing documentation, and to assess its reliability and usefulness.

**Methods.** A three-round Delphi survey was conducted, based on a review of available NMDS. The NMDS-AT were tested in a general hospital from patient records of 20 patients representing 457 patient days. Availability of needed data was assessed by two raters. The interrater reliability and intrarater reliability was assessed using Cohen's kappa coefficient and intraclass correlation coefficient (ICC). Usefulness was assessed by verifying whether typical analysis questions can be answered by the documented NMDS-AT data.

**Results.** 116 data elements were rated as relevant for an NMDS-AT: data elements concerning the institution, patient demographics, and medical condition; 33 data elements concerning nursing problems by using nursing diagnosis; five data elements concerning nursing outcomes, and 78 data elements concerning nursing interventions. In the 20 patient records, thirteen nursing diagnoses, 50 nursing interventions, and all five nursing outcomes occurred, representing 59% of the data elements of the NMDS-AT. The data were found at different data sources (e.g. electronic nursing record or paper-based fever chart) and in various forms (e.g. standardized or free text). The reliability of the data extraction was good, whereby the main challenges for data availability were overlapping and/or inconsistent information, different data sources and free text notes in the patient record. Performing typical analysis questions showed that the extracted NMDS-AT data are able to answer questions of clinical management, of policy makers, and of nursing science.

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**Conclusion.** The NMDS-AT was found to be feasible: needed data was available in the analysed patient records, data extraction showed good reliability, and typical analysis could be performed and showed interesting results. Before the NMDS-AT can be introduced in healthcare institutions, the following challenges need to be addressed: 1. improve the quality of nursing documentation; 2. reduce fragmentation of documentation; 3. use a standardized nursing classification system; and 4. establish mappings between nursing classification systems and the NMDS-AT.

**Keywords.** Nursing care, nursing process, nursing informatics, nursing records, classification, data collection, nursing minimum data set, Austria

# Evaluation of an Allergy Documentation System Adopted by Hong Kong's Private Hospitals – A Pilot Study

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**Keywords.** Adverse drug reaction, allergy, electronic health record system, quality, usefulness, satisfaction, patient safety, medication error

## 1. Introduction

Under the development of the electronic health record sharing system (eHRSS) in Hong Kong, a new sub-system called the Structured Alert Adaptation Module (SAAM) was introduced for the electronic documentation of allergy, adverse drug reaction (ADR) and clinical alerts for private hospitals in December 2012. This study aims to evaluate the quality, usefulness and satisfaction level of SAAM from the views of different healthcare professions.

## 2. Methods

A cross-sectional descriptive study with quantitative design was used. A self-reporting evaluation questionnaire was developed with reference to the DeLone and McLean model of information systems success. SAAM users in 7 private hospitals, including doctors, nurses and pharmacy staffs, were recruited by convenience sampling to complete the questionnaire.

## 3. Results

A total of 145 SAAM users responded. They generally perceived good quality and usefulness of SAAM, and were also satisfied with the system. Pharmacy staffs had the highest expectation and satisfaction than doctors and nurses. Constructive comments were collected regarding information presentation and user interface.

#### **4. Conclusion**

SAAM, as a system implemented to ensure patient safety and prevent medication errors by clear documentation of patients' allergy, ADR and clinical alert, received positive feedback from users in Hong Kong's private hospitals. Enhancement will be made to further facilitate the workflow and increase the usability.

# A Standard for Nursing Process - Clinical Decision Support Systems (NP-CDSS)

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**Abstract.** A Nursing Process-Clinical Decision Support System (NP-CDSS) Standard with 25 criteria to guide future developments of Nursing Process-Clinical Decision Support Systems was developed. The NP-CDSS Standards' content validity was established in qualitative interviews yielding fourteen categories that demonstrate international expert consensus. All experts judged the Advanced Nursing Process being the centerpiece for Nursing Process-Clinical Decision Support System that should suggest research-based, pre-defined nursing diagnoses and correct linkages between diagnoses, evidence-based interventions and patient outcomes.

**Keywords.** Decision support, Electronic Health Report, Nursing Process - Clinical Decision Support Systems (NP-CDSS), Standard, Consensus Validation

## 1. Introduction

Nursing documentation is essential for safe patient care<sup>2</sup> as missing documentation and the lack of Standardized Nursing Language (SNL) endangers care continuity[1]. Most Electronic Health Records (EHRs) don't contain *Advanced Nursing Process* decision-support. The *Advanced Nursing Process*[2] "consists of defined, validated concepts. It includes assessments, nursing diagnoses, nursing interventions, and nursing outcomes that are rooted in scientifically based nursing classifications" [3]<sup>(p.13)</sup>.

Second Nursing specific Clinical Decision Support Systems (CDSS) do not exist and no "gold standard" is available for accurate nursing process documentation[4]. Nursing Process - Clinical Decision Support Systems (NP-CDSS) aim to support nurses in diagnostic reasoning in the *Advanced Nursing Process*. The study aim was to develop a standard for NP-CDSS.

## 2. Methods

In a literature review previous instruments[5, 6] and criteria were derived to develop the NP-CDSS Standard. Next, it was pilot validated and last, qualitative interviews



were performed with eight international experts to reveal categories[7] establishing the NP-CDSS Standards' content validity.

### 3. Results

The NP-CDSS Standard includes 25 criteria supported by expert consensus that revealed fourteen categories. The eight main categories are: 1) The Nursing Process is key to support the nurse in a NP-CDSS. A NP-CDSS has to contain: 2) SNL, 3) evidence-based nursing diagnoses and 4) evidence-based interventions, 5) standardized, knowledge based outcome-indicators, 6) connections between measurement instrument results and nursing diagnoses, interventions and outcomes, 7) it must support holistic nursing, and 8) it must contain coded, standardized concepts for data gathering and research.

### 4. Discussion

All experts were positive about the NP-CDSS Standard and considered it a necessity, and judged the *Advanced Nursing Process* to be the centerpiece for a NP-CDSS[8].

Second All experts agreed that a NP-CDSS must contain research-based assessment cues, pre-defined nursing diagnoses and correct linkages between diagnoses, interventions and patient outcomes, and that such a system can enhance nursing care quality. This finding is supported by the literature [2, 3, 9]. The experts also indicated that a NP-CDSS offers chances for future “big data” research were interoperable data are key for future meta-analyses and to compare outcomes across-settings and countries[9, 10]. The new NP-CDSS Standard is suggested for application and testing in EHRs.

### References

- [1] N.Wang, D. Hailey and P. Yu, *Quality of nursing documentation and approaches to its evaluation: a mixed-method systematic review*. Journal of Advanced Nursing, 2011. **67**(9): p. 1858-75.
- [2] B.J. Ackley and G.B. Ladwig, *Nursing diagnosis handbook: An evidence-based guide to planning care*. 10 ed. 2014, St. Louis: Mosby/Elsevier.
- [3] M. Müller-Staub et al., *Expert report on nurses' responsibility*. 2015, Bern: Swiss Nursing Science Association (ANS).
- [4] M. Müller Staub, H. de Graaf-Waar and W. Paans, *Standard for Nursing Process Clinical Decision Support Systems (NP-CDSS) in EHRs*, in *ACENDIO*. 2015, Association for Common European Nursing Diagnoses, Intervention and Outcomes: Bern.
- [5] M. Müller-Staub et al., *Testing the Q-DIO as an instrument to measure the documented quality of nursing diagnoses, interventions, and outcomes*. International journal of nursing terminologies and classifications : the official journal of NANDA International, 2008. **19**(1): p. 20-7.
- [6] W. Paans et al., *D-Catch instrument: development and psychometric testing of a measurement instrument for nursing documentation in hospitals*. Journal of Advanced Nursing, 2010. **66**(6): p. 1388-400.
- [7] P. Mayring, *Qualitative Inhaltsanalyse: Grundlagen und Techniken*. 11 ed. 2010, Weinheim: Beltz.
- [8] American Nurses Association. *Nursing: Scope and Standards of Practice*. 2015.
- [9] D. Jones et al., *Standardized nursing languages: essential for the nursing workforce*. Annual review of nursing research, 2010. **28**: p. 253-94.
- [10] G. Keenan et al., *Challenges to nurses' efforts of retrieving, documenting, and communicating patient care information*. J Am Med Inform Assoc, 2013. **20**(2): p. 245-51.

# Shifting Tasks from Nurses to Physicians: CDS Needed After Introduction of CPOE?

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**Keywords.** Electronic prescribing, medication errors, intravenous injections,  
parenteral infusions, clinical decision support systems

## 1. Introduction

Unintended effects can occur by introducing computerized physician order entry (CPOE) if responsibilities are shifted from nurses to physicians, e.g. regarding the specification of the duration of intravenous (IV) administrations. The purpose of this quality assessment was to determine the rate of IV prescriptions with too short durations, when the prescribers were not assisted by clinical decision support (CDS).

## 2. Methods

All IV drug prescriptions for inpatients at the University Hospital Zurich (tertiary care, 850 beds) were included over a 25 month period following the introduction of CPOE. The prescribed durations of IV administrations were compared to the minimal duration defined by the Swiss drug knowledge base.

## 3. Results

Analysis of the 100 most frequently ordered IV drugs showed that the duration of IV administrations was not defined in 112,594 of 247,255 orders (45.5%) and prescribed with too short durations in 13,640 orders (5.5%).

## 4. Discussion

Introduction of CPOE accompanied by a shift of tasks from nurses to physicians resulted in a high number of incomplete or erroneous IV medication orders. Patient safety might be improved by physicians' training complemented by CDS ensuring drug-specific default values for minimal durations of IV administration.

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# Using a Text-Mining Approach to Evaluate the Quality of Nursing Records

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**Abstract.** Nursing records in Taiwan have been computerized, but their quality has rarely been discussed. Therefore, this study employed a text-mining approach and a cross-sectional retrospective research design to evaluate the quality of electronic nursing records at a medical center in Northern Taiwan. SAS Text Miner software Version 13.2 was employed to analyze unstructured nursing event records. The results show that SAS Text Miner is suitable for developing a text-mining model for validating nursing records. The sensitivity of SAS Text Miner was approximately 0.94, and the specificity and accuracy were 0.99. Thus, SAS Text Miner software is an effective tool for auditing unstructured electronic nursing records.

**Keywords.** nursing record; record quality; text mining

## 1. Introduction

Nursing records are critical legal documents representing the process of nursing care. Recently, most nursing records in Taiwan have been computerized, resulting in a large number of nonstructural text data; however, the quality of these records has rarely been discussed. Therefore, this study used a text-mining method to evaluate the quality of nursing records.

## 2. Methods

A cross-sectional retrospective research design was adopted to investigate the electronic nursing records at a medical center in Northern Taiwan. A research sample of 27,356 electronic records of nursing events involving patients discharged from the department of internal medicine between January and June in 2014 was selected through a purposive sampling approach. SAS Text Miner software Version 13.2 was employed to analyze the unstructured nursing event records.

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The efficiency of a text-mining benchmark established by nursing experts was compared with that of text mining using SAS Text Miner to determine the sensitivity, specificity, and accuracy of SAS Text Miner software.

### 3. Results

The nursing records were divided into two types of nursing event: system-formulated events and nurse-formulated events. The results show that there was an 8.08% similarity between the nurse-formulated and system-formulated nursing events. Among the nurse-formulated nursing events, 29.72% were necessary and appropriately worded, and should be considered for inclusion as new system-formulated nursing events. Additionally, 17.53% of nursing events were written appropriately and should be retained as nurse-formulated nursing events, 10.15% involved irrelevant or incorrect terms in the event name or content, and 34.52% were named inappropriately.

In the text data mining of nurse-formulated nursing events, the sensitivity of SAS Text Miner software was approximately 0.94, and the specificity and accuracy were 0.99.

### 4. Discussion

The results show that 47.25% of nurse-formulated records were accurate, 34.52% contained appropriate content but an inappropriate event name, and 18.23% were erroneous. We recommend that future research assist hospitals through developing continuing education for nurses on how to use appropriate system-formulated nursing events.

The research results also show that using SAS Text Miner software to develop a text-mining model for nursing records is an effective approach for filtering and validating record content. Thus, SAS Text Miner software is an effective auditing tool for ensuring nursing record quality. We recommend applying SAS Text Miner software as a tool for such records in the future. In addition, applying the text-mining model to audit unstructured electronic nursing records may enhance their quality.

### 5. Acknowledgments

This research was supported by the National Taiwan University Hospital, Taiwan, R.O.C.

### References

- [1] M. Kushima, K. Araki, M. Suzuki, S. Araki, and T. Nikama, Text data mining of in-patient nursing records within electronic medical records using keygraph. *IAENG International Journal of Computer Science* **38** (2011), 215-224.
- [2] T. Yee, J. Needleman, M. Pearson, P. Parkerton, M. Parkerton, and J. Wolstein, The influence of integrated electronic medical records and computerized nursing notes on nurses' time spent in documentation, *Comput Inform Nurs* **30** (2012), 287-292.

# Electronic Health Record Messaging and Quality of Care for Type 2 Diabetes Patients in Primary Care

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## 1. Introduction

Delivering high-quality care for patients with diabetes is a challenging public health issue. While emerging consensus shows that primary care teams play an important role in providing the best quality of care to patients with diabetes, little evidence is available on how communication and coordination (e.g., frequent, timely, accurate communication; shared knowledge; and problem solving) contribute to the team's capacity to deliver high quality care for patients with diabetes. We used administrative data from the Electronic Health Record (EHR) system to investigate how patterns of primary care team EHR communication relate to quality of care process outcomes for patients with Type 2 diabetes.

## 2. Methods

A search of administrative data identified messages sent and received between care team members through the clinic's EHR system. EHR messages routed between any 2 care team members were totaled over a 6-month period. Message counts were dichotomized to indicate pairs of team members who communicated through the EHR at least a once a week. *Betweenness centrality*, the number of times an individual communicated with two other individuals who themselves did not communicate, was computed. Hierarchical modeling related average care team *betweenness centrality* with quality of care process outcomes (HbA1c and LDL cholesterol testing), while adjusting for patient-level covariates, team size, and clinic-level covariates.

## 3. Results

The study sample included 155 health professionals in 31 care teams at 6 US primary care clinics and 2071 diabetes patients seen by the teams. *Betweenness centrality* averaged 5.82 (sd 1.66). Diabetes patients were 13% (OR=1.13, 95% CI: 1.06, 1.20) more likely to receive a HbA1c test and 12% (OR=1.12, 95% CI: 1.04, 1.20) more likely to receive a LDL cholesterol test with every one sd increase in team *betweenness*

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*centrality*. Team *betweenness centrality* remained statistically significant after adjusting for team size.

#### **4. Discussion**

Primary care teams which rely on densely connected EHR communication among team members have better quality of care process outcomes for their Type 2 diabetes patients. Interventions targeting primary care team interactions may improve care for patients with Type 2 diabetes.

# Nursing Informatics in Turkey

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**Abstract.** We reviewed the studies investigating nursing Informatics (NI) in Turkey. Our review showed that previous NI studies in Turkey heavily focused on the attitudes of clinicians towards technology. Our literature review allows for developing policies and strategies to motivate NI studies in similar countries.

**Keywords.** Nursing Informatics, Turkey, computer literacy, computer use.

## 1. Introduction

The use of nursing information technology systems varying from associated with the documentation of the medical records of patients to the analysis of data concerning patient care guide in all domains for a nurse. The purpose of this study is to identify review the studies investigating nursing Informatics in Turkey.

## 2. Methods

The search was performed using the databases of Medline, Pubmed and Cumulative Index to Nursing and Allied Health Literature (CINAHL). The studies about the nursing Informatics in Turkey were published in the national and international journals were evaluated. A literature research was undertaken until September 2015.

## 3. Results

A total of fifteen national and international publications were identified and of them; ten were evaluated as part of the study according to inclusion criteria. All of the studies included in this paper were descriptive cross-sectional studies investigating nursing Informatics. Our review showed that previous nursing informatics studies in Turkey heavily focused on the attitudes of clinicians towards technology.

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#### **4. Discussion**

Literature reviews of nursing informatics studies in Turkey can allow us to develop policies and strategies to motivate these studies in similar countries.



# Development Needs of Electronic Nursing Discharge Summaries in Finland

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**Abstract.** In this study the development needs of Electronic Nursing Discharge summaries (ENDS) mentioned by nursing professionals are classified and addressed using the FITT model (“Fit between Individuals, Task and Technology”) framework.

**Keywords.** Electronic Nursing Discharge summary, FITT-model

## 1. Introduction

In Finland the starting point of ENDS is that information content is structured and follows up the nursing process model. ENDS can support information exchange and continuity of patient care. However their use has not been established, documenting habits vary and their content is not up to date. The purpose of this study was to describe how ENDS should be developed.

## 2. Material and methods

Cross-sectional study data were collected electronically using a previously tested questionnaire in 2012 in one hospital district in Finland where ENDS has been used since 2005. In this presentation the focus is on one open-ended question “*How would you develop the ENDS?*” FITT model framework was used in analysis of the question.

## 3. Results

A total of 180 nursing professionals working in primary care participated in the study. The developing needs in the FITT model framework (individual, task and technology) mentioned by 37 professionals will be available in conference.

## 4. Discussion

Respondents were aware of usefulness of ENDS and there’s a need to further develop it.

# Reporting Patient Safety Events: A Cross-Cultural Trial

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<sup>b</sup>The University of Texas Health Science Center at Houston, USA

## 1. Introduction

Incident reporting is one of the major contributions to perinatal safety since communication and teamwork related issues are identified as leading causes of perinatal incidents. To maintain a high level of perinatal safety, it is critical to recognize problems and to prevent them from recurring. The challenges of reporting perinatal incidents remain in incompleteness in terms of reported data and substantial analytical bias. This study aims to utilize the Common Formats to report perinatal incidents. A cross-cultural study was performed by (1) translating relevant Common Formats into Chinese; (2) utilizing translated forms to report perinatal incident in a Chinese hospital; (3) employing a cross-cultural discussion.

## 2. Methods

### 2.1. Cross-cultural translation and adaptation of the Common Formats

Seven independent health care professionals were involved in the cross-cultural translation and adaptation of the Common Formats. The task includes translation, back-translation, and reconciliation [1]. (1) Five perinatal related forms were translated to Chinese, which comprise of healthcare event reporting form, patient information form, summary of initial report, Perinatal Form, and Perinatal Event Description. Translators A and B performed the translation. (2) Translators C and D performed the back-translation. (3) In the reconciliation, translators E, F, and G compared the original text with the back-translated text for issues. A reconciliation report with notes of these issues and the recommended edits and adjustments was sent to the panel of seven translators (A, B, C, D, E, F, and G) for discussion. A consolidated version of Chinese translation is formed once all issues are addressed.

### 2.2. Reporting and Data Collection

The Perinatal Form and Perinatal Event Description were utilized to report a perinatal incident from a Chinese hospital. Twenty-one graduate students in a School of Nursing participated in the reporting. Each participant provided general information including education, degree, specialty, and clinical training prior to the reporting.

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### 3. Results

The demographic characteristics of the participants are shown in Table 1. The Perinatal Form comprises of 20 items directly related to perinatal incident. For a complete form, please direct to [https://www.psoppc.org/web/patientsafety/version-1.2\\_documents](https://www.psoppc.org/web/patientsafety/version-1.2_documents), and access Perinatal Form. The discrepant responses were found in five items (25 %): Item 5, Item 6, Item 11, Item 16 and Item 19.

In Item 5, four participants accounted only the neonate was affected by the event, while the rest accounted both of mother and neonate. In Item 6, 16 participants identified the outcomes to mother as 'injury to body part or organ', whereas the rest specified 'psychological influence'. In Item 11, 19 participants chose 'Birth trauma/injury as listed under ICD-9-CM 767 or ICD-10-CM P10-P15', whereas one chose 'Five-minute Apgar < 7 and birthweight > 2500 grams' and the other one chose both. In Item 16, 15 participants identified an induced labor, while five other participants identified an augmented labor, and one specified 'unknown'. In Item 19, 14 participants identified there was no instrumentation used to assist vaginal delivery, whereas the rest identified 'unknown'.

**Table 1.** Demographic characteristics of the participants.

Characteristics	n	%	Characteristics	n	%
School grade			Area of research		
1 <sup>st</sup> year	11	52.3	Nursing management	4	19.0
2 <sup>nd</sup> year	6	28.5	Surgical nursing	1	4.7
3 <sup>rd</sup> year	4	19.0	Nosocomial infection management	1	4.7
Previous clinical training			Nursing ethics	1	4.7
Urinary surgery	2	9.5	Psychiatric nursing	4	19.0
ICU	1	4.7	Aged nursing	1	4.7
Pediatrics	1	4.7	Nursing of gynecology and obstetrics	1	4.7
Gynecology and obstetrics	2	9.5	Nursing education	4	19.0
Surgery	1	4.7	Nursing psychology	4	19.0
Endocrinology	1	4.7			
No previous clinical training	13	61.9			

The percentage is rounded to tenths.

### 4. Discussion

The results demonstrate the validity of the cross-cultural translation and diversity in a typical perinatal incident reported by Chinese clinicians. These findings suggest (1) an imperative need of cross-cultural study on incident reporting; (2) the significant role an incident reporter can play; (3) future direction of incident reporting and patient safety culture.

### 5. Acknowledgments

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### References

- [1] J.A. Harkness, F.J.R. de Vijver, P.P. Mohler fur Umfragen Z, *Cross-cultural survey methods*. Wiley-Interscience Hoboken; 2003.

# Using Hospital Information System Data to Capture Nurse Workload

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**Abstract.** **Aim** Using hospital information system (HIS) data to capture nurse workload. **Method** Direct and indirect nursing items were included by survey and group discussion, workload of nurses is calculated by the work hour measurement of nursing item. Nursing items were matching with HIS index. An ETL (Extract, Transform, Load) tool, Microsoft SSIS, is to capture all HIS index if it happened in a day. **Results** The workload of a ward can be calculated automatically the day before. **Discussion** This study provides a new approach to achieve nursing workload. However, a confirmatory study should be implemented in the future to verify the reliability of workload.

**Keywords.** Nursing workload, Hospital information system, Nursing item

## 1. Introduction

Nursing human resources allocation can affect the patient outcomes, work experience of nursing staff and hospital operational efficiency directly or indirectly [1-2]. Traditional nursing allocation methods cannot resolve the unbalanced nurses wandering between work overload and redundancy completely [3]. The Hospital Information System (HIS) includes big data about patient healthcare and nursing care activities from admission to discharge. However, only 5% to 10% are used for analysis [4]. Using HIS data is a promising method to calculate the workload of nurse. Therefore, this study used HIS data to capture nurse workload.

## 2. Methods

This study firstly established nursing items through the method of survey and group discussion. Then work hour of each nursing item were measured by stopwatch time measurement method and individual written 24h recording in West China Hospital, Sichuan University, a tertiary hospital for medical, teaching, scientific research, and prevention in the west of China.

Based on HIS index which already had, nursing item contain “order” item and “non-order” item. “Non-order” items will synthesize a HIS index. “Order” item have two situations: if they are same context, nursing item is equal to HIS index; if HIS is a

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part of nursing activity, several nursing item will synthesize a HIS index. This progress is prepared for the system parameters to calculate the nursing workload automatically, rather than daily manual statistics. This study use an ETL (Extract, Transform, Load) tool, Microsoft SSIS to import the work hour of each HIS index into HIS.

### 3. Results

Measured direct nursing items have 92 items. Total number of times is 7954. Recorded indirect nursing items have 21 items. After this synthesize process have been done, Microsoft SSIS import the work hour of each HIS index into HIS (Table 1). Therefore, total work hour of a ward everyday can be calculated automatically from HIS.

**Table 1.** HIS items with work hour and constraint rule (part)

HIS item	Work hour (min)	Order code	Order	Constraint rule
Admission	41.09			Data come from HIS
Discharge/transfer	46.07			
Blood pressure measurement	2.59	7289  1	Blood measurement	Based on frequency of orders
... (76 indexes omit)	.....	.....	.....	.....

### 4. Discussion

This study capture the nursing workload based on the HIS index the day before. This method provides a new approach to achieve nursing workload. Moreover, the work hour of nursing item should be adjusted at regular intervals, and confirmatory study should be implemented in the future to verify the reliability of workload.

### 5. Acknowledgments

This is a part of program from Science & Technology Department of Sichuan University (Program number: 2103ZR0007). Thanks for all for this project.

### References

- [1] Xw .Zhu, Lm. You, J. Zheng, K. Liu, Jb Fang, Sx. Hou, et al. Nurse staffing levels make a difference on patient outcomes: A multisite study in chinese hospitals, *Journal of Nursing Scholarship* **44** (2012),266-273.
- [2] L.H. Aiken, S.P. Clarke, D.M. Sloane, J. Sochalski, J.H. Silber. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction, *Jama* **288** (2002),1987-1993.
- [3] Y.J. Wang, Nursing human resource allocation research in a large general hospital, *The Fourth Military Medical University* (2012)
- [4] L. Kong, The application of data mining in hospital information system, *Journal of Medical Informatics* **32**(2011),37-39.

# A Study on the Effect on Scheduling and Management of Surgeries with the Introduction of Excellent Medical Information

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**Abstract.** The services of OR play an important role in the medical business for department of surgery. The most important issue for OR is about the scheduling and management of surgeries. Good surgery schedule could elevate the utilization efficiency of OR. Therefore, the introduction of excellent medical information can both dramatically elevate the work efficiency of health care employees and reduce workload to reach win-win benefits in both management and performance.

**Keywords.** operation room, scheduling, first operation, planning, performances.

## 1. Introduction

Operation Room is the best representative for the combination of artificial intelligence and technology in the medical profession. In the past, the scheduling of surgeries is usually determined by the rule of thumb and the constraints of resources and thus resulting in the derivative problems including overtime services of staff, inefficient usage of existing services, long waiting time of patients, and etc. Taking advantage of the development of information technology such as multiplex of information and fast computer power, OR resources could be allocated efficiently and fairly under the premise that the safety of patients and the quality of medical care are not affected. Establishment of an effective planning system for surgery scheduling could ensure the provision of accurate surgical scheduling and the elevation of both use efficiency of OR and performances[1].

## 2. Methods

### Method and Object of Study

Retrospective approaches are adopted in this study with the research objects as one OR in the university hospital in central and southern Taiwan. Data about the medical information systems about surgeries before and after alteration are collected to undergo investigation and analyses. Both data using old scheduling operation system in 2013 and new introduced medical information scheduling system for surgeries in 2014 are

compared to analyze the differences before and after the introduction of OR to investigate the service effectiveness of Operation Room.

### 3. Results

- (1) The completion rate for the surgeries scheduled elevates from 93.8% to 96.5%.
- (2) The time rate for the first surgery is elevated from 95.4% to 98.1%.
- (3) The cancellation rate for the surgeries is lowered from 6.4% to 4.2%.
- (4) The accumulated leave hours is lowered from 726 hours to 128 hours, which is the best improvement.

### 4. Discussion

From the above we know that Operation Room plays an absolutely important role in the services provided by the hospital. Since reaching best interests with limited resources to allow the best benefits of resource allocation is the main appeal of effective OR, the effective planning and management of OR thus become very vital. Effectiveness-oriented surgical scheduling can provide fast and effective aids with the help of advanced technology to elevate the performance of services and business[2].

### 5. Acknowledgments

Thanks for the effort of working partners pay all the medical information system conversion process.

### References

- [1] Fei, H.; Meskens, N. and Chu, C. (2010). A planning and scheduling problem for an operating theatre using an open scheduling strategy. *Journal of Computer & Industrial Engineering*, 58: 221-230.
- [2] Cardoen, B.; Demeulemeester, E. and Beliën, J. (2010), Operating room planning and scheduling: A literature review. *European Journal of Operational Research*. 201(3), 921-932.

# Emergency Information Systems for Performance Assessment Value Before and After the Child Abuse and Sexual Assault of Time After Medical Intervention

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**Abstract.** This study was designed to investigate child abuse and sexual assault in the emergency medical treatment process, child abuse and sexual assault a total of 2014 years of the city informed of 82 accounted for 23 hospital. The use of teamwork and information systems intervention before and after, child abuse and sexual assault for the time required for medical treatment, the effectiveness of valuation step. Project object for child abuse and sexual abuse of patients in the emergency room. Data were collected using direct observation and retrospective chart review method. The results show medical record was reduced from 11 to 4 step step; time from 1 hour 52 minutes to 46 minutes, greatly enhance emergency service satisfaction.

**Keywords.** Emergency, Information Systems, child abuse, sexual assault, work flow

## 1. Introduction

This study was designed to investigate child abuse and sexual assault in the emergency medical treatment process, child abuse and sexual assault a total of 2014 years of the city informed of 82 accounted for 23 hospital.

## 2. Methods

The use of teamwork and information systems intervention before and after, child abuse and sexual assault for the time required for medical treatment, the effectiveness of valuation step. Project object for child abuse and sexual abuse of patients in the emergency room. Data were collected using direct observation and retrospective chart review method.

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<sup>1</sup> full contact information for the corresponding author.



### **3. Results**

The results show medical record was reduced from 11 to 4 step step; time from 1 hour 52 minutes to 46 minutes

### **4. Discussion**

Greatly enhance emergency service satisfaction.

### **5. Acknowledgments**

Thanks for all the members of the full cooperation and support.

# Effect of Automatic Inpatient Fall Prediction Using Routinely Captured EMR Data: Preliminary Results

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**Abstract.** The increasing adoption of electronic medical record (EMR) systems including nursing documentation worldwide provides opportunities for improving patient safety by the automatic prediction of adverse events using EMR data. An inpatient fall is a preventable adverse event that can be managed more effectively and efficiently through a data-driven predictive approach. This study implemented a new approach and explored its effects in neurologic inpatient units. The results suggest that integrating an automatic fall prediction system with the EMR system could reduce inpatient falls.

**Keywords.** Falls, inpatient setting, electronic medical records, prediction

## 1. Introduction

Falls reportedly account for up to 70% of accidents among hospital inpatients. Reducing falls has been a frequent target of strategies for improving the quality of patient care.(1) This study explored the feasibility of automatically predicting falls using routinely captured electronic medical record (EMR) data.

## 2. Methods:

We retrospectively developed a Bayesian network prediction model using the EMR data of a tertiary teaching hospital in Korea, and implemented this model as an alert system integrated into the EMR system. We compared the prevalence of falls in a 32-bed neurologic medical unit (intervention group) and in a 32-bed neurologic surgical unit (control group) over a 6-month postimplementation period. We also compared the performance of the system with that of the hospital STRATIFY tool.

## 3. Results:

We reviewed 1,848 patient charts. There were 20 falls among 1,105 patients in the intervention group; this rate of 1.81% was similar to that of 1.78% during the preimplementation period. The prevalence in the control group increased from 0.89% to 1.62% (12 falls among 743 patients). The new system showed better performance than the STRATIFY tool (sensitivity: 0.65 vs. 0.55; specificity: 0.67 vs. 0.54).

#### **4. Discussion:**

Integrating an automatic fall prediction system with the EMR system could reduce inpatient falls. Future studies should attempt to improve the predictive ability.

#### **5. Acknowledgement:**

This study was supported by a grant of the Korea Healthcare Technology R&D Project, Ministry for Health, Welfare & Family Affairs, Republic of Korea (No. HI15C1089).

#### **Reference:**

- [1] World Health Organization (WHO). A World Alliance for Safer Health Care. More Than Words: Conceptual Framework for the International Classification for Patient Safety. Version 1.1. Final Technical Report. Geneva (Switzerland): World Health Organization; 2009 Jan.

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# Design of an Electronic Reminder System for Supporting the Integrity of Nursing Records

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**Abstract.** The integrity of electronic nursing records (ENRs) stands for the quality of medical records. But patients' conditions are varied (e.g. not every patient had wound or need fall prevention), to achieve the integrity of ENRs depends much on clinical nurses' attention. Our study site, an one 2,300-bed hospital in northern Taiwan, there are a total of 20 ENRs including nursing assessments, nursing care plan, discharge planning etc. implemented in the whole hospital before 2014. It become important to help clinical nurses to decrease their human recall burden to complete these records. Thus, the purpose of this study was to design an ENRs reminder system (NRS) to facilitate nursing recording process. The research team consisted of an ENR engineer, a clinical head nurse and a nursing informatics specialist began to investigate NRS through three phases (e.g. information requirements; design and implementation). In early 2014, a qualitative research method was used to identify NRS information requirements through both groups (e.g. clinical nurses and their head nurses) focus interviews. According to the their requirements, one prototype was created by the nursing informatics specialist. Then the engineer used Microsoft Visual Studio 2012, C#, and Oracle to designed a web-based NRS (Figure 1). Then the integrity reminder system which including a total of twelve electronic nursing records was designed and the preliminary accuracy validation of the system was 100%. NRS could be used to support nursing recording process and prepared for implementing in the following phase.

**Keywords.** Nurse Care Records, Decision Support, Integrity, Nursing Informatics

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資料擷取完畢!

範圍:  個人  病房 時間:  班別  區間 起: 2015/09/24 00:00 迄: 2015/09/25 00:00

院區: 總院區 病房: 07A 病床狀態:  住院中  已清床 4天 查詢

### 護理紀錄完整性檢核清單

姓名	病房	床號	TPR	BP	疼痛	疼痛	入院	族譜	身評	壓危	跌倒	出現	導管	計劃	過程	指導	功能	LO	壓瘡	約束	出漏
賴	07A	01-01	3	4	0	0	0	0	2	0	0	0	3	3	3	1	0	10	0	0	0
林	07A	01-02	2	2	0	0	0	2	0	1	1	1	2	8	2	3	0	3	0	0	0
廖	07A	01-03	4	4	1	3	0	0	1	0	0	0	1	3	3	2	0	20	0	0	0
鄭	07A	02-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
張	07A	02-02	7	7	0	0	0	0	1	0	0	0	1	4	3	4	0	13	0	0	0
林	07A	02-03	7	7	0	0	0	0	1	0	0	0	3	3	3	5	0	14	0	0	0
葉	07A	03-01	3	3	0	0	0	0	1	0	0	0	1	3	3	2	0	0	0	0	0
雷	07A	05-01	3	4	0	0	0	0	1	0	0	0	3	4	3	4	0	17	0	0	0
陳	07A	06-01	7	7	0	0	0	0	0	0	0	0	4	5	3	4	0	19	0	0	0
謝	07A	07-01	6	4	0	0	0	0	1	0	0	0	4	3	3	1	0	14	0	0	0
黃	07A	07-02	8	3	0	0	0	0	1	0	0	0	1	1	4	3	0	18	0	0	0

Figure 1. The snapshot of Nursing Reminder System

# Discussion on the Initial Use of Nursing Information Systems Related Factors of Satisfaction

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**Abstract.** Information technological advances to develop health care-related systems, Improve clinical efficiency through introducing information technology, Simplify processes to enhance the quality of nursing care. Study investigated the regional hospital nurses after initial information system the use of satisfaction surveys, Study for unit 50-bit nurse the use questionnaires collection, not satisfied is 30%, For analysis in found to be not satisfied.1. Aged between 38-50 years old.2.The operating practices are not familiar.3. Typing is siow the fee time is more long.4. The slow operation of the system.5. Information ability is low. For the above reasons and after improvement and guidance dissatisfaction reduced to 5%, multi-enhancing information related to education and training in future, Increase nurses information literacy competency.

**Keywords.** Information,Nurse,Age,Education,Satisfaction

## 1. Introduction

Study investigated the regional hospital nurses after initial information system .

## 2. Methods

50 nurses using questionnaire collection.

## 3. Results

After improvement dissatisfied 30% reduced to 5%

## 4. Discussion

Increasing information education and training in future.

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<sup>1</sup> full contact information for the corresponding author.

## **5. Acknowledgments**

Thank unit nurses involved in the questionnaire and Information scholar teaching.

# Classification of Patient Care Complexity: Cloud Technology

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**Abstract.** Presentation of the computerized structure to implement, in a university hospital in the South of Brazil, the Patients Classification System of Perroca, which categorizes patients according to the care complexity. This solution also aims to corroborate a recent study at the hospital, which evidenced that the increasing workload presents a direct relation with the institutional quality indicators. The tools used were the Google applications with high productivity interconnecting the topic knowledge on behalf of the nursing professionals and information technology professionals.

**Keywords.** Patient classification systems, Patient safety, Workload, Cloud.

## 1. Introduction

The patient classification system (PCS) of Perroca [1] is an important tool for Nursing in the Brazilian scenario to sort the care complexity or patient acuity. This tool, in addition to providing a better care planning, allows the adequate staff sizing, with direct repercussion in workload control. Previous studies in the institution indicate an increased dependency degree of hospitalized patients [2,3]. The computerization of a validated instrument as the PCS makes the data collection more effective and dynamic, and allows monitoring the professional actions. This study objective is to present the computerized structure that enables the use of the PCS in cloud technology in the hospital.

## 2. Methods

This technological production development project was based on software engineering, which comprises seven phases (Problem Acknowledgement, Feasibility Study, Analysis, Project, Testing and Maintenance) [4]. Development of a computerized solution of PCS using Google Apps. The electronic form is filled out by the nurse via mobile device or on computers. For every inclusion of a form a row is generated in

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Google spreadsheet, the sheets implemented containing tabs that group by bed, date and patient dependence degree, according to the care classification level (minimum, intermediate, semi-intensive and intensive). This computerized solution is on a website hosted in the cloud that was also developed with the Google tool with access profile controls to the information through the use of Google Groups and sharing rules.

### 3. Results

The patient classification system (PCS) of Perroca allows evaluating the nursing workload and adjusting human resources (Figure 1). The tool use on Google platform provided the development, interconnecting the topic knowledge on behalf of the nursing and information technology professionals. The computerized solution was constructed to allow other forms, in addition to the PCS tool, to be included in the future.

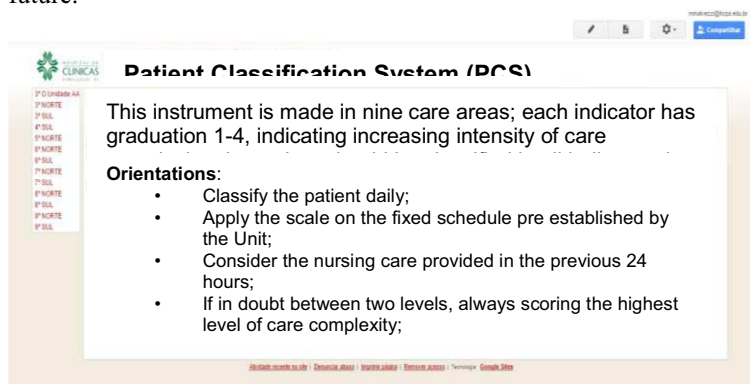


Figure 1. Layout of the PCS homepage

### 4. Discussion

The application of this technological solution optimizes the nurses' time and contributes in the qualification of information and care records. The project is in the implementation phase and requires systematic reviews and updates.

### References

- [1] M.G. Perroca. Development and content validity of the new version of a patient classification instrument. *Rev. Latino-Am. Enfermagem*, 19:1 (2011), 58-66. Available on: <http://dx.doi.org/10.1590/S0104-11692011000100009>.
- [2] A.B.T. Macedo. *Avaliação da carga de trabalho, estresse psicossocial e resiliência nos profissionais de enfermagem em uma unidade de internação para adultos portadores de germes multirresistentes*. Universidade Federal do Rio Grande do Sul, Porto Alegre, 2013. 87 p. Available on: <http://www.lume.ufrgs.br/handle/10183/90196>.
- [3] A.M.M. Magalhães et al. Nursing workload and patient safety: a mixed method study with an ecological restorative approach. *Rev. Latino-Am. Enfermagem*, 21:Spec (2013), 146-54. Available on: <http://dx.doi.org/10.1590/S0104-11692013000700019>.
- [4] P. Laudon, K.C. Laudon. *Sistemas de Informação Gerenciais*. Pearson Prentice Hall, São Paulo, 2007.

# Nursing Activities Score: Cloud Computerized Structure

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**Abstract.** This study objective to describe the cloud Nursing Activities Score implementation process in the Intensive Care Unit of the Post-Anesthesia Recovery Room. It is a case study. The tools used were the Google applications with high productivity interconnecting the topic knowledge on behalf of the nursing professionals and information technology professionals. As partial results, it was determined that the average nursing staff workload in the ICU/PARR during the first 24 hours, according to the score on the scale, was  $91.75 \pm 18.2$ . Each point of NAS is converted into 14.4 minutes, which is equivalent to an average of 22 working hours. Currently the instrument is implemented in the institution, reinforcing the need to update and raise awareness concerning the need to maintain the new routine.

**Keywords.** Nursing Informatics, Cloud, Patient safety, Workload, Nursing care, Intensive care units

## 1. Introduction

Given the increasing complexity that involves health care, the nurse has been occupying an indispensable role in the services management, in order to ensure the safety and quality of the provided care. The Nursing Activities Score (NAS) is an instrument developed by Miranda et al [1], which contributes in this respect to the classification of patients and evaluation of nursing staff workload in intensive care units [1,2]. The post-operative care to patients undergoing large surgeries that require intensive care is provided in the Intensive Care Unit (ICU) of the Post-Anesthesia Recovery Room (ICU/PARR). In this unit, the nurses began to use the NAS in 2011, with the purpose of improving the nursing care management regarding the existing nursing human resources. Therefore, this study aims to describe the cloud NAS implementation process in the ICU/PARR of Hospital de Clínicas de Porto Alegre (HCPA), teaching hospital of Federal University.

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## 2. Methods

It is a case study. This is the development of a computerized solution of NAS using Google Apps (Google Forms, Google Spreadsheets, Google Groups and Google sites). The NAS system is composed of two modules. The first module is managerial and is intended for NAS electronic form construction, which will be used in the data collection field in the intensive care units of HCPA. The second module is operational and will be used in mobiles, i.e. for handhelds or fixed computers that allow the module use on a wireless network. The access is done through the Wi-Fi (Wireless Fidelity) system that offers wireless access to the Internet of the HCPA through a broadband connection. This system was designed to run on the internet, through the site hosted on Google sites, with cloud storage, and access profile controls to information through the use of Google Groups with sharing rules. On line tabs present a panorama of that UTI situation, enabling actions in order to ensure the care quality and safety.

## 3. Partial Results and Discussion

The NAS implementation process started in 2010, after the disclosure of the Collegiate Board Resolution of the National Agency of Sanitary Surveillance (RDC 7), which defines the obligation of UTIs usage of an instrument that quantifies the need for the patients nursing care. The pilot project was implemented in the critical patients' areas (adult and pediatric UTIs, Post-Anesthesia Recovery Unit and Coronary Care Unit). In this process, some obstacles had to be overcome, such as the lack of knowledge regarding the instrument, the instrument's adequacy with the unit reality, the valorization trend according to the increased demand, time, and completion criteria standardization. As partial results, it was determined that the average nursing staff workload in the ICU/PARR during the first 24 hours, according to the score on the scale, was  $91.75 \pm 18.2$ . Each point of NAS is converted into 14.4 minutes, which is equivalent to an average of 22 working hours. Currently the instrument is implemented in the institution, reinforcing the need to update and raise awareness concerning the need to maintain the new routine.

## 4. Conclusion

The tool use on Google platform provided a high productivity in the development by interconnecting the topic knowledge on behalf of the nursing and information technology professionals. In addition to allowing the approximation of nurses with the results and as a care and administrative tool, targeting and qualifying the care to critical patients.

## References

- [1] D.R. Miranda et al. Nursing Activities Score. *Crit Care Med.* 31:2 (2003), 374-82.
- [2] R.M.Y. Conishi, R.R. Gaidzinski. Nursing Activities Score (NAS) como instrumento para medir carga de trabalho de enfermagem em UTI adulto. *Rev. esc. enferm. USP*, 41: 3 (2007), 346-354. Available on: <http://dx.doi.org/10.1590/S0080-62342007000300002>.

# Using a System Science Strategy to Measure Teamwork in an Urban Hospital

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## 1. Introduction

Approximately 2.9 million inpatients and outpatients are treated by a national university hospital per year by approximately 6000 employees in Korea. Healthy work cultures are crucial for patient-centered care. The purpose of this study is to test feasibility of network analysis to measure degree of teamwork in a national hospital.

## 2. Methods

Survey was used to measure the degree of collaboration among staffs before and after a teamwork intervention. Questions were developed based on the social exchange theory<sup>1</sup> by the authors. Online survey have been collected via e-mail after obtaining the written informed consent. Latent groups were identified and network measures were calculated.

## 3. Results

The study is in progress. Teamwork network structure (pre) were visualized (Figure 1).

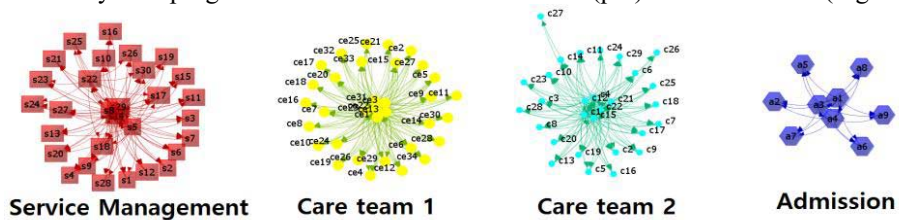


Figure 1. Collaboration networks among staffs in an urban hospital

## 4. Discussion and Conclusion

Network measures can be useful for capturing degree of teamwork over time. An innovative network analysis were applicable for hospital administrators to measure efficiently the degree of teamwork among staffs. Most staffs were willing to be identified their names when they are identified as an important leader. Network

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analysis applying social exchange theory was useful in understanding staffs' collaboration behaviors in an acute care setting.

**5. Acknowledgments:** Wonhee Shim, RN, Meehyun Yun, RN for data collection

## **References**

[1] E. Griffin. A first look at communication theory. (8th edition). New York: McGraw-Hill. 2011

# From a Suspect Victim to the Holmes: The Unexpected Value of a Home-Made Mobile Chemotherapy Medication Administration System

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**Abstract.** Nurse used to be the first one to be investigated in a drug adverse event. Our newly hospital-wide implemented home-made mobile chemotherapy medication support system, which has released our nurses from the traditional heavy 2-nurse-double-checking loading, was unexpectedly used to protect our nurses from being suspected in a recent event of over delivery of infusion. The outcome turned us to reexamine the device maintenance and test protocols.

**Keywords.** Mobile Nursing, Chemotherapy Medication, Adverse Event, Medical Device

## 1. Introduction

A home-made intelligent mobile chemotherapy medication administration support system was put online hospital-wide to take care of all in-hospital patients with chemotherapy prescriptions, about 4000-5000 annually, in our 805-bed medical center in Taipei in April, 2015 [1]. The system has been very welcomed by our nurses not only because it removed our nurses from the traditional heavy 2-nurse double checking loading, but also it successfully prevents all related adverse events so far. In early July, one serious adverse event of over delivery of infusion was reported in which the patient felt the infusion ran too fast and called the nurse. The pumping rate showed 260 cc/hr. instead, not the correct 52 cc/hr. The situation was well taken care of and no harm was made to the patient. The investigation began immediately and the caring nurse suffered a great pressure because she could not remember what she has exactly done with the pumper.

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## 2. Process

The investigation was initiated right after the event with three plausible scenarios: (1) the nurse failed to enter the right pumping rate, (2) the patient or his family mistakenly made the change, and (3) the medical device error. Nurse and patients were interviewed, system logs were examined, and the device was sent back to the maintenance company for checking.

## 3. Results

At the first run of investigation, the patient/family scenario was first ruled out because there was no reason for them to do so and they were incapable of doing it. The nurse replied that she did follow the protocol to set the pumping rates but she could not exactly remember the details. Then, the device test report showed 100% normal which left the investigation team seriously considered the possibility that the nurse might make the mistake. However, when the system logs, which the pumping parameters set by nurses were all transformed into image format for double checking, were retrieved and showed what rate nurse exactly set (Figure 1), nurse and the nursing department felt totally relieved. Our nurse did set the correct rate. To prove our nurses' innocence was never the reason why we developed the mobile system!



Figure 1. The image files, saved as logs, showed that nurse correctly set the pumping rate to 52 cc/hr.

## 4. Current Direction of Investigation

It appears that neither patient nor nurse should be blamed for the adverse event. Though the test report showed 100% normal for the device, the nursing department tested the pumping speed for all pumper and found one was abnormal. We were curious about the device quality and studied whether the normal test protocol could be sensitive to find the technical defect happening to us. There is still no answer why the pumping rate mysteriously changed from 52 to 260 and this error cannot be prevented by any checking mechanism, not even the traditional 2 nurse model, because it happened afterwards. We keep working on with the device test technicians for the reasons and independently test the devices on our own.

## References

- [1] M.C. Kuo, P. Chang, A total design and implementation of an intelligent mobile chemotherapy medication administration. *Studies in Health Technology and Informatics* **201** (2014), 441-446.

# Nursing Documentation: An Evaluation of an Action Research Project

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**Abstract.** This abstract describes an evaluation of an action research project conducted to improve nursing documentation practice in four municipalities in Norway. In an explorative design, four focus group interviews and two individual interviews were conducted. The interview data were analyzed using content analysis. Three themes emerged: healthcare professionals perceived the documentation process as complicated; they experienced competing interests; and they highlighted a clear and visible leader as important for success. This study provides knowledge about the importance of collaboration and involvement of stakeholders when developing electronic health record systems.

**Keywords.** evaluation, nursing process, electronic healthcare record, usability issues.

## 1. Introduction

Documentation of individualized patient care is important for improving quality and continuity of healthcare in transition between different healthcare services and in daily patient care [1,2]. The documentation must contain planned and performed care to ensure patient safety and to serve as a tool for communication among healthcare professionals [3]. High-quality documentation is demanded by law [4,5]. A care plan should be an integrated part of the patient record. The lack of opportunity to create care plans is a challenge for healthcare professionals [6]. Electronic health record (EHR) systems have been implemented and used for over fifteen years in Norwegian municipalities. However, a lack of accuracy and quality is still identified in the nursing documentation.

## 2. Methods

With an explorative design, four focus groups and two individual interviews were conducted. The interview questions focused on the intervention implemented into the EHR system during this action research project. The aim of this study was to describe healthcare professional's experiences and perceptions of an action research project conducted to improve nursing documentation practices in four municipalities in Norway. Qualitative content analysis was used [7].



### 3. Results

The documentation process was experienced as complicated, healthcare professionals perceived competing interests. A clear and visible leader was perceived as important for success. The participants described their situation as complicated, with regards to nursing, continuity, and documentation, including EHR functionalities and knowledge about documentation. They highlighted the importance of a positive attitude and a supportive culture of the organization. About competing interests, they referred to three subthemes: holistic care and use of EHR system, time required, and use of the evidence-based guideline.

### 4. Discussion

With a complicated documentation process, the healthcare professionals felt lack of time. They expressed that they wanted to be bedside and did not manage to follow-up the care plans. This challenge highlighted continuity. A clear and visible manager may include that employees know what to do. Findings from this study showed that healthcare professionals wanted a leader to assume responsibility for processes and continuity. Involving healthcare professionals in all phases of the project was a key to success. Lack of functionalities in the EHR system used in this study and usability issues caused a vulnerable situation. The healthcare professionals felt that the intervention was complicated; however, at the same time important for patients safety. Strategies for a stronger collaboration between policy-makers, EHR-vendors, and healthcare professionals are recommended.

### 5. Acknowledgments

We would like to give a special thanks to the healthcare managers in the four municipalities for their support and their involvement in the project.

### 6. References

- [1] G.Castledine, Updating the nursing process. *Br J Nurs* **20** (2011), 131-131.
- [2] TD.Sequist, Clinical Documentation to Improve Patient Care. *Ann Intern Med* **162** (2015), 315-316.
- [3] Y.Teytelman. Effective nursing documentation and communication *Semin Oncol Nurs* **18** (2002), 121-127.
- [4] Departement for Health and Care N. Act 1999-07-02-64. Act relating to health personnel etc. Available at: <https://lovdata.no/dokument/NL/lov/1999-07-02-64>, (1999.)
- [5] Departement for Health and Care Journal Regulations, Oslo. Available at: <https://lovdata.no/dokument/SF/forskrift/2000-12-21-1385>, (2000).
- [6] A.Thoroddsen M.Ehnfors & A.Ehrenberg Content and Completeness of Care Plans After Implementation of Standardized Nursing Terminologies and Computerized Records. *Comput Inform Nurs* **29** (2011), 599-607.
- [7] UH.Graneheim & B.Lundman Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Educ Today* **24** (2004) 105-112.

# Enhancing a Blood Transfusion Platform with Clinic Decision Support Component to Better Assure Patient Safety

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**Abstract.** Blood transfusion is an important but complex and high-risky clinical procedure. Any error could cause serious injuries to patients. To better assure the procedure safety, we enhancing our home-made blood transfusion platform with new clinic decision support components to assure patient's identity and to inform clinicians of any event in time. So far, our transfusion incidence case has been reduced to 0 from 9 before the system implemented.

**Keywords.** Blood Transfusion, Patient Safety, Decision Support, Transfusion Incidence

## 1. Introduction

Blood transfusion has been a complicated and high-risky clinical procedure. Therefore it will not be a surprise that error will occur in some places by someone at some time and some of these errors might be deadly<sup>1</sup>. An effective support system to assure the safety appears urgently needed. We enhanced and built a new blood transfusion platform with decision support module to better guarantee the safety.

## 2. Methods

The platform was designed in a 2,400-bed medical center in Taipei. A new module was added to the current CPOE, LIS and NIS systems. Seven new features of the platform were designed: (1) assuring the patient identification with barcode techniques; (2) designing a structured order entry; (3) proactively reminding the physicians with patient's previous blood transfusion reaction with related precautions including the use of leukoreduction filter; (4) automatically reminding physicians the happening of reaction and suggesting relevant test; (5) automatically saving the vital signs and blood pressure data to nursing records (Figure 1); (6) building a complete traceability log system as shown in Figure 2; and (7) supporting data analysis.

### 3. Results

The new blood transfusion platform integrated the workflow and reduced the time of blood component preparation. Cost saving was about NT\$12,900 per year. The barcode correctly identified patients and monitored the entire transfusion process. The rate of blood transfusion reaction report is raised from 0.39% to 0.77%, and transfusion incident was reduce from 9 to 0.

### 4. Conclusion

A better design of clinical decision support module with barcode technology could improve the safety of the blood transmission procedure.



Figure 1. Transfusion record system

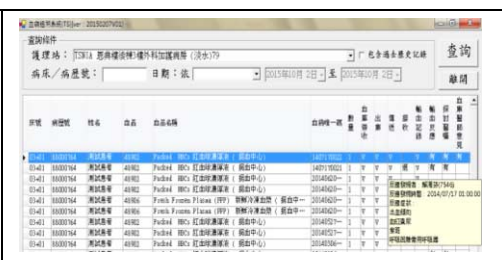


Figure 2. A complete traceability log system

### References

[1] C.J. Chen, P.L. Tsung, S.M. Kao, W.C. Uen, J.N. Cheng, T.J. Chen. (2015). *The Journal of Medical Informatics*, Promoting Transfusion Safety by Failure Mode and Effects Analysis, 19(2).170-177.

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# An Empirical Study on the Successful Implementation of Nursing Information System

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**Abstract.** This study investigated the major NIS implementation factors and their capability of predicting the effectiveness of NIS implementation by using the clinical information systems success model. The triangulation method was employed in this study. A total of 348 nurses were recruited from regional hospitals in two districts of Taipei through purposive sampling. Research data were collected through questionnaires and focus group interviews 3 and 6 months after an NIS was implemented at their hospital. The result show the explanatory power of use dependence, use satisfaction, and net benefits in predicting NIS effectiveness was approximately 64.5%–89.4%. The explanatory power of net benefits in predicting NIS effectiveness after 3 and 6 months exceeded 80%. The nurses reported that NIS implementation changed their workflow and positively influenced medication administration safety. This study empirically identified the critical factors that affect the successful implementation of NISs and reported the nurses' experience of NIS use.

**Keywords.** Nursing information systems; Clinical information systems success model; System user satisfaction; Use dependence

## 1. Introduction

In the current era of rapidly advancing information technology, information systems are increasingly being adopted in clinical nursing care to improve the quality of nursing care and the efficiency of nursing administration. In this regard, domestic hospitals are increasingly implementing nursing information systems (NISs). Most studies investigating the effectiveness of these systems have evaluated NIS acceptance according to satisfaction among nurses, whereas few studies have focused on their quality and functionality. Therefore, this study investigated the major NIS implementation factors and their capability of predicting the effectiveness of NIS implementation by using the clinical information systems success model.

## **2. Methods**

The triangulation method was employed in this study. A total of 348 nurses were recruited from regional hospitals in two districts of Taipei through purposive sampling

Research data were collected through questionnaires and focus group interviews 3 and 6 months after an NIS was implemented at their hospital. The questionnaire comprised four dimensions: system performance, information quality, social influence, and facilitating conditions. In addition, use dependence, use satisfaction, and net benefits of the NIS were recorded. The nurses' subjective opinions regarding the NIS implementation process were obtained through focus group interviews.

## **3. Results**

The results of this study are as follows: (a) The mean scores of various NIS implementation factors, the nurses' use dependence and use satisfaction, and the net benefits of NIS 6 months after NIS implementation were higher than the mean scores 3 months after the implementation. (b) Various factors of NIS implementation were positively correlated with the nurses' use dependence and use satisfaction and the net benefits of NIS. (c) The explanatory power of use dependence, use satisfaction, and net benefits in predicting NIS effectiveness was approximately 64.5%–89.4%. The explanatory power of net benefits in predicting NIS effectiveness after 3 and 6 months exceeded 80%. Among all nurses, medical nurses exhibited the highest NIS use satisfaction, whereas elderly and nonmedical nurses exhibited lowest use dependence. In addition, the higher the use dependence and use satisfaction, the higher the net benefits of implementing NIS.

## **4. Discussion**

The nurses reported that NIS implementation changed their workflow and positively influenced medication administration safety. However, they also reported that the NIS hardware and software require further improvement. This study empirically identified the critical factors that affect the successful implementation of NISs and reported the nurses' experience of NIS use. The identified factors can predict the success of implementing NISs in the future.

## **5. Acknowledgments**

This research was supported from Taipei City Hospital, Zhongxing Branch, Taiwan, R.O.C

## **References**

- [1] Garcia-Smith, D., & Effken, J. A. Development and initial evaluation of the Clinical Information Systems Success Model (CISSM). *Int J Med Inform.* 2013;82(6):539-552.

# Leading the Development of Our New Nursing Information System with the TIGER-Based Taiwan Model

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**Abstract.** Our nursing information system has been incomplete and not very reliable. The situation is not changed because our IT department is seriously understaffed and the HIS vendor is weak. We decided to take the responsibility to lead the development of our NIS using the Taiwan model to develop our TIGER-based new strategies.

**Keywords.** nursing information system, Task Force, informatics competency, TIGER, Taiwan Model

## 1. Introduction

The development of hospital information systems (HISs) in Central China lags behind than those in the coastal cities in terms of quality and scope. We are from one of leading medical centers in central China and started the HIS project in early 2000s and our “nursing information system (NIS)” went on line in 2008. However, the NIS is still incomplete, not reliable, and bothering our nurses. The current NIS was composed of TPR, execution of orders from EPOC, and very limited nursing assessment only. The situation has not been resolved because of small IT group, only 4, in our 1500-bed medical center and lack of nursing domain knowledge for our HIS vendor. We are determined to build our NIS with new strategies after we learned the successful stories from Taiwan in which clinical nurses build up their informatics competency and lead the design and development of NIS.

## 2. Process

Taiwan model [1][2] was used to plan our new NIS development strategies, which are composed of (1) promoting the informatics competency, (2) setting up and educating the core Task Force, (3) training professional informatics nurses, (4) redesigning the

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usability of current NIS, and (5) building the leadership team composed of stakeholders and consultants from Taiwan.

### 3. Results

The director of nursing department is strongly determined to put the NIS in right track in coming three years. A WeChat NIS user group was established in 2014 to start collecting the usability problems and to serve as the communication and discussion platform. One experienced head nurse was assigned to serve as the full time coordinator, who was expected to be trained as an informatics nurse. As many as 53 nurses, out of 1,159 as a total in my hospital, were interested, voluntarily, and determined to join the NIS Task Force. The work experience of the group ranges from 1 to 27 years, with an average of 8.9 years. Their first assignment was to report the current NIS problems, as shown in Table 1. There are still many errors and redundancy. System is still not efficient.

Table 1. The current problems with the nursing informatin system

Problem	Work		Total
	System	Paper	
Data Inconsistency	8 (9%)	0 (0%)	8 (6%)
Error	16 (18%)	5 (10%)	21 (15%)
Need Decision Support	2 (2%)	0 (0%)	2 (1%)
Redundancy	6 (7%)	16 (33%)	22 (16%)
Time Consuming	6 (7%)	16 (33%)	22 (16%)
Non-sharable	24 (27%)	7 (15%)	31 (23%)
Lack of Data	10 (11%)	0 (0%)	10 (7%)
Difficult to Use	10 (11%)	1 (2%)	11 (8%)
Data Missing	6 (7%)	3 (6%)	9 (7%)
Total	88	48	136

### 4. Competency Training

The competency training for the Task Force started in November, 2015 and two, out of four, runs of all-day-long courses were given. After-class discussion group meetings were made to enhance the learning effectiveness. Group members were highly motivated and some demo projects were successfully completed, such the intelligent bed-sore assessment support system. We are setting up the NI committee and the way to operate.

### References

- [1] *Nursing Informatics: Where Technology and Caring Meet*. M.J. Ball, J.V. Douglas, P. Hinton Walker, D. DuLong, B. Gugerty, K.J. Hannah, J.M. Kiel, S.K. Newbold, J.E. Sensmeier, D.J. Skiba, and Troseth, M.R. Forth ed. Springer-Verlag, 2011.
- [2] *Nursing and Nursing Informatics the 21<sup>st</sup> Century: An International Look at Practice, Trends, and the Future*. C.A. Weaver, C.W. Delaney, P. Weber, and R.L. Carr. Second ed. HIMSS, 2010

# Clinical Knowledgebase Integration of Nursing Terminology

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**Abstract.** Medicomp Point of Care Clinical Knowledgebase, MEDCIN<sup>®</sup> is designed to support integrated care documentation and the care planning functions of nurses and allied health professional. In electronic medical records (EMRs) starting with one or more clinical diagnoses and/or patient signs and symptoms, the capabilities of the MEDCIN<sup>®</sup> knowledgebase are used to prompt nursing terminology concepts following the American Nurses Association (ANA) nursing process [1]. The MEDCIN<sup>®</sup> diagnostic index dynamically constructs Interactive Plans of Care (PoC) using the six standards of the nursing process and allows aggregated data analysis. MEDCIN<sup>®</sup> is widely used in the US by EMR clients and health information technology systems around the world.

**Keywords:** Nursing Care Plan, Clinical Care Classification, CCC, Nursing Documentation

## 1. Introduction

The project began with the documentation of nursing requirements for a health information system using a standardized nursing terminology. The Clinical Care Classification (CCC) System was selected for data modeling [2]. The project purpose was to index the CCC nursing terminology to the full array of terminology standards and concepts in MEDCIN<sup>®</sup> with intelligent prompting allowing for the presentation and documentation of relevant clinical symptoms, history, physical findings, and diagnoses to the CCC from the CPT<sup>®</sup>, DSM, ICD, LOINC<sup>®</sup>, RxNorm, Snomed CT<sup>®</sup> and others for virtually any clinical condition [3].

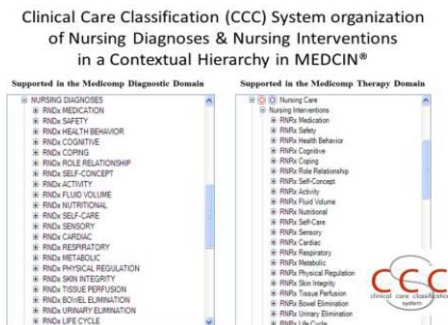
## 2. Methods

The methodology used the MEDCIN<sup>®</sup> diagnostic index to provide intelligence linking of signs and symptoms, as well as clinical diagnoses to nursing diagnoses. The diagnostic index is used at the point of care via MEDCIN<sup>®</sup> intelligent prompting engine<sup>™</sup> to suggest relevant nursing diagnoses using the clinical diagnoses or other signs and symptoms in a patient encounter. At the point of care, the diagnostic index focuses on nursing interventions relevant to CCC nursing diagnosis and carries the proper CCC code allowing for aggregate data analysis.

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**Figure 1:** Clinical Care Classification (CCC) System Nursing Terminology in MEDCIN® Clinical Knowledgebase (© 2014 Medcomp).

### 3. Results

A new systematic methodology was developed to integrate a structured nursing terminology, the CCC System, as a contextual hierarchical tree into a clinical knowledgebase hierarchy: MEDCIN®. This methodology has populated the MEDCIN® clinical database with CCC nursing terminology and demonstrates that the contextual hierarchy is the appropriate method for integrating the CCC terminology in the clinical databases.

### 4. Discussion

This innovative methodology of a contextual hierarchy versus typical knowledgebase hierarchy supports the design of an electronic Plan of Care (PoC) following the nursing process. The sixth standard of the nursing process (evaluation) is used to measure the outcomes of nursing care and provide aggregated information benefiting patient care.

### 5. Acknowledgments

Special thank you to Dr. James Vail for his project support; Marco Johnson, Director, eBusiness, Policy & Standards, Information Management, Office of the Assistant Secretary of Defense (Health Affairs) for his guidance; and Dr. Virginia K. Saba who made the integration possible with her willingness to help along the way.

### References

- [1] American Nurses Association. Nursing Process: A common thread amongst all nurses. (Internet). 2015 Oct. (cited 2015 Dec 31). Available from: <http://www.nursingworld.org/EspeciallyForYou/StudentNurses/Thenursingprocess.aspx>
- [2] V.K. Saba. Clinical Care Classification (CCC) System, Version 2.5: User's Guide. New York: Springer Publishing; 2012 (cited 2015 Dec 31).
- [3] P.S. Goltra. MEDCIN®: a new nomenclature for clinical medicine. New York: Springer-Verlag Publishing; 1978.

# The Automated Alert System for the Hospital Infection Control and the Safety of Medical Staff Based on EMR Data

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**Abstract.** This report is about planning, developing, and implementing the automated alert system for the Hospital infection control and the safety of medical staffs about information on patients exposed to infection based on EMR Data in a tertiary hospital in Korea.

**Keywords.** Alert system, Infection control

## 1. Introduction

Sharing information of patients who became exposed to infection is important to reduce further occurrence of infection in the hospital as well as to protect patients and medical staff from infection. There is an Electronic Medical Record (EMR) system for this purpose in Seoul National University Hospital (SNUH). Previously, in this EMR system, there was an alert system that shares information of infected patients, but medical staff had to manage the system manually by registering patients in the watch list or releasing them from the list after checking each of individual's lab result, that required significant time and efforts among medical staff. As a result, this alert system was not widely used and information in the system became unreliable. That's why we needed to develop an automated infection alert system that is highly accurate and easy to use.

## 2. Methods

We have formed a task force team for a new infection alert program, and developed and implemented the program from February 2014 to July 2014. We defined data rules for the system, designed user interface for infection control and considered usability of the system. We defined 1) infectious disease items to be displayed on the screen, 2) automation rules of updating a list of infected patients corresponding to the lab result in EMR, and 3) rules of data migration for the past data record. The use interface includes a published guideline for infection control as well as patient's infection record. We considered 1) how to increase the usability of the system and 2) how to enhance the quality of data in the system.

### 3. Results

We defined 17 infections disease items to be displayed on alert system. Which include 3 types of blood transmission, 7 types of contact transmission, 3 types of droplet transmission, and 4 types of airborne transmission. Among patients with infections, one with any of 10 items (e.g. HIV, MRSA h and VRE) is automatically registered based on the lab test result in EMR, and one with any of 12 items (e.g. MRSA and Influenza) is automatically released from the system based on a lab test result or upon discharge.

Data update is scheduled to process not in real time, but only once every night to avoid system overload. Data update history is logged. Infection registration or release can be done manually. There is information page regarding data update history and data rule in the user interface. Users can also view all of seven guidelines of contact transmission at any time. One infection information is registered in the system, users can identify the information in a several different ways (e.g. icon blink, popup message, notification on various printouts) without checking alert system. In order to improve the quality of data in the alert system, all the lab results of patients who have had hepatitis B,C or HIV since 2000 are kept in the alert system, because recovery from these blood transmission diseases is difficult, we made a separate screen for administrators and unit managers. )

### 4. Discussion

We were able to a highly accurate and convenient automated alert system that shares information of patients who got exposed to infection in Seoul National University Hospital. We expect not only to enhance the hospital infection control but also to increase the safety of medical staff from infection. Also we are planning to build this system in other branch hospitals.

### References

- [1] P. R. Dexter, S. Perkins, J. M. Overhage, K. Maharry, R. B. Kohler. A computerized reminder system to increase the use of preventive care for hospitalized patients. *New England Journal of Medicine*, 345.13(2001): 965-970.

# Development and Appraisal of Multiple Accounting Record System (Mars)

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**Abstract.** The aim of the system is to achieve simplification of workflow, reduction of recording time, and increase the income for the study hospital. **Methods:** The project team decided to develop a multiple accounting record system that generates the account records based on the nursing records automatically, reduces the time and effort for nurses to review the procedure and provide another note of material consumption. Three configuration files were identified to demonstrate the relationship of treatments and reimbursement items. **Results:** The workflow was simplified. The nurses averagely reduced 10 minutes of daily recording time, and the reimbursement points have been increased by 7.49%. **Conclusion:** The project streamlined the workflow and provides the institute a better way in financial management.

**Keywords.** Multiple Accounting information system, workflow, burden.

## 1. Introduction

The National Health Insurance (NHI) in Taiwan reimburses the healthcare services through fee for services. The nursing specialists were responsible to take care of the physical, mental, and social requirements of patients. While supporting the treatment procedures, it is also important to accurately record the treatments that had been provided and the use of medical materials and devices that the treatments consumed. It can be observed that recording the accounts has become a burden for nurses and a factor that caused their overtime duty. Using the information technology to support account recording has the potential in saving time and costs, and also provides a more effective way to do finance management [1]. The principle was not to change the nursing recording process and not to increase the burden of nurses, the project team analysis the workflow and aimed to develop a system that achieved simplification of workflow, reduction of recording time for nurses, and increase the income of the study hospital.

## 2. Methods

This study took place in hospital in northern Taiwan, which consists of 2,328 beds and employed 2,800 nurses. A nursing information system are 22 sub-systems in nursing information systems and the nursing workflow has managed to not to use paper records. Figure 1 shows the overview of the sub-systems.

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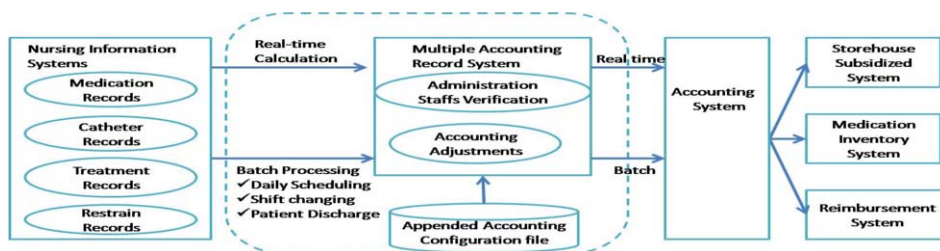


Figure 1.

The team evaluated the workflows of wards and intensive care units and discussed with the administration staffs. Through discussion, 17 NHI reimbursement rules were clarified and 223 NHI reimbursement items were defined. The discussion also found that 76% of the NHI reimbursement items were already included in NIS. When a nursing record was noted down, the system the compare the items with the configuration files, and real-time computing were used to send out a notification to the storehouse subsidized system and the reimbursement system to do storage management and calculation management. A web-based system that was developed with C#, JavaScript, jQuery, AJAX, CSS, and using Oracle as database.

### 3. Results

The workflows of before and after the implementation of MARS were illustrated, the process of nurses to record the consumption of treatments has been simplified and the accounting information were generated automatically when the nursing records were done. The nursing specialists averagely reduced 10 minutes of daily recording time, and the NHI points have been increased by 7.49%.

### 4. Discussion

The development of accounting systems requires accurate logics and complies with the existed workflow. During the process, it has become clear that there is no consistency among the ward in how to records the consumed materials. In order to make the system verified the accounts automatically, the project team put great effort in verified the NHI rules and regulatory to insure the accuracy of the account information. The clarification streamlined the workflow and provides the institute a better way in finical management.

### 5. Acknowledgments

The authors express great gratitude to the support and cooperation of the partners.

### References

- [1] C.C. Chang, Improvement of Medical Bill Charges through the Accurate Use of a Computer Charging System. *Leadership Nursing*, 2013; 14:94-104.

# Mining Clinicians' Electronic Documentation to Identify Heart Failure Patients with Ineffective Self-Management: A Pilot Text-Mining Study

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**Abstract.** Effective self-management can decrease up to 50% of heart failure hospitalizations. Unfortunately, self-management by patients with heart failure remains poor. This pilot study aimed to explore the use of text-mining to identify heart failure patients with ineffective self-management. We first built a comprehensive self-management vocabulary based on the literature and clinical notes review. We then randomly selected 545 heart failure patients treated within Partners Healthcare hospitals (Boston, MA, USA) and conducted a regular expression search with the compiled vocabulary within 43,107 interdisciplinary clinical notes of these patients. We found that 38.2% (n= 208) patients had documentation of ineffective heart failure self-management in the domains of poor diet adherence (28.4%), missed medical encounters (26.4%) poor medication adherence (20.2%) and non-specified self-management issues (e.g., "compliance issues", 34.6%). We showed the feasibility of using text-mining to identify patients with ineffective self-management. More natural language processing algorithms are needed to help busy clinicians identify these patients.

**Keywords.** Heart failure, self-management, adherence, text mining, data mining

## 1. Introduction

Between one-third to half of all heart failure (HF) hospitalizations could be prevented if individuals with this condition were able to follow their self-management routines more effectively. Unfortunately, studies continue to show that self-management by patients with HF is generally poor. This pilot study aimed to explore the use of text-mining to identify HF patients with ineffective self-management.

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## 2. Methods

For this pilot study, we randomly selected 2% (n=545) of all HF patients treated within hospitals of the Partners Healthcare System in Massachusetts (US) between 01/01/2011 and 12/31/2013. Patient data was extracted from our electronic health record (EHR) systems that included structured patient data (e.g., age, gender, co-morbidities) and diverse types of clinical notes (inpatient and outpatient notes written by physicians, nurses, therapists, social workers and others). The study received institutional review board approval from the Partners Healthcare System.

The text mining approach consisted of first developing a thorough vocabulary of terms describing ineffective HF self-management in the domains of diet, physical activity, medication adherence, self-monitoring and adherence to clinician appointments. To construct the vocabulary, we used 1) the relevant literature, 2) our multidisciplinary team's clinical expertise (nursing, medicine and pharmacy) and 3) full text review of a random sample of 200 clinical notes. We then conducted a regular expression search of medical notes with the compiled vocabulary using an open-source computer program (Textcrawler). Each word or expression match what the software identified in the notes was manually reviewed in the clinical note context by two research team members to identify false positives (e.g., negated terms such as "no diet indiscretions were reported or observed"). .

## 3. Results

For these 545 patients, 43,107 notes were extracted. On average, each patient had 79.1 notes in their EHR over about a 3-year period. 38.2% (n= 208) patients in this sample had documentation of ineffective HF self-management. The false positive rate was about 7.4% and they were excluded after full text review. The prevalence of notes reflective of ineffective HF self-management was 2.5% (1,053 notes out of 43,107).

The most common type of ineffective HF self-management was "non-specified" (where specific domain was not indicated, e.g., "compliance issues" 34.6%), with expressions like "difficulties with outpatient adherence" or "compliance issues", followed by ineffective diet adherence (28.4% e.g., "dietary indiscretion" or "excessive fluid intake"), missed medical encounters (26.4% e.g., "misses follow-up appointment") and poor medication adherence (20.2% e.g., "poor medication compliance" or "skips medicines").

## 4. Discussion

Our approach shows the feasibility of using text mining to identify patients with ineffective HF self-management. Documentation of ineffective HF self-management is very scarce (2.5% of clinical notes) which highlights the critical need to develop automated, more sophisticated natural language processing algorithms (e.g., considering contextual information) to identify these patients. In addition, similar work is needed to identify whether and how ineffective HF self-management was addressed by the clinicians.

# Nurses' Actual Usage of EMRs: An Access Log-Based Analysis

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**Abstract.** Access logs for electronic medical records (EMRs) are a useful source of data for understanding how nurses' perform their duties. The purpose of this study was to understand how nurses' used an EMR system, by inspecting and analyzing from one week EMR access logs (394,708) of accessing 'outcome Input' screen. Anytime day and night, nurses accessed 'outcome Input' screen. Viewing and information input obtained from observations, in order to monitor patients' conditions over tasks such as keeping nursing records.

**Keywords.** Access log, Electric Medical Records, Nursing task

## 1. Introduction

Access logs for electronic medical records (EMRs) are a useful source of data for understanding how nurses' perform their duties [1] [2]. The purpose of this study was to better understand how nurses' used an EMR system, by inspecting and analysing EMR access logs.

## 2. Methods

### 2.1. Study Data

One week of EMR access logs (394,708) was obtained for 30 nurses in the B Ward at A Hospital. The data were rendered anonymous at the time of collection to prevent individual patients and nurses from being identified.

### 2.2. Analysis

Access logs for the 'Outcomes Input' screen and other screens with assigned names, which were accessed by nurses, were used to explore nurses' actual EMR usage.

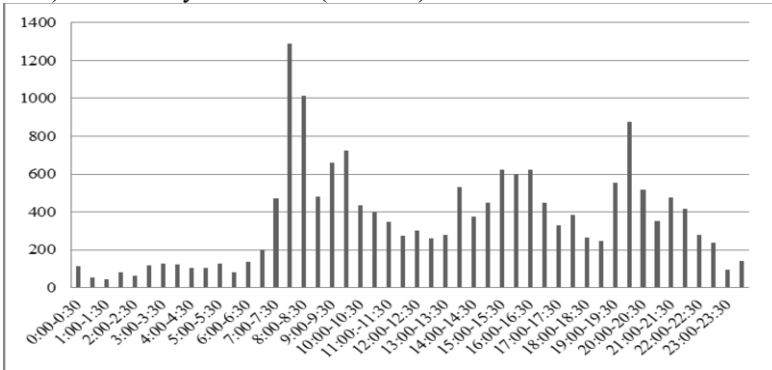
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### 3. Results

There were 17,211 logs for access to the EMR screen 'Outcomes Input', making it the sixth most frequently accessed screens. Access was most frequent between 7:30 and 8:00 (1,288 times), followed by 8:00–8:30 (1,015 times). The screen was accessed continuously throughout the day with access being least frequent between 1:00 and 1:30 (45 times) followed by 0:30–1:00 (54 times).



**Figure 1.** Logs for access to the EMR screen 'Outcomes Input'.

### 4. Discussion

Analysis of the logs of nurses' actual accessing of the Outcomes Input screen, which is mainly used to view and input details such as observation outcomes and time, showed that they used it continually throughout the day. Further, that they prioritized the viewing and information input obtained from observations, in order to monitor patients' conditions over tasks such as keeping nursing records. Thus, it has been suggested that while performing their nursing duties, nurses input or view some of the patient information.

The time slot of 7:30–8:00, during which access was most frequent, was 30 minutes before the start of the day shift. Night shift nurses entering records before the end of their duty can be considered one of the factors for the frequent access of the Outcomes Input screen during this time slot. However, since the number of accesses before the start of the day shift was higher than the number of accesses before the start of the night shift, which had almost the same number of nurses, screen access by day shift nurses before the start of their duty for information collection can also be considered a factor in the increased number of accesses. From the above, it appears that nurses prefer to evaluate the condition of their patient from the information obtained through observation rather than from the nursing records.

### References

- [1] Kajimura Ayako, Takemura Tadamas, Fujita Kenichiro *et al.*, Analysis of the relationship of screen transition and the nursing service in Electric Medical Records, *Japan Journal of Medical Informatics* 34 (2014), 470-471.
- [2] Kajimura Ayako, Takemura Tadamas, Hikita Tomoko *et al.*, Analysis of actual electronic-medical-record-use before nurses start day-shifts. , *Japan Journal of Medical Informatics* (2015), 438-439.

# Outcomes of Medication Administration Information System for Nurses

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**Abstract.** The purpose of this study is to survey nurses' use of the new information system (IS) and to compare the outcomes of the medication errors (MEs) due to the use of this technology. A questionnaire with the system successful model was distributed from October to November 2014 (n=210). Additionally, medication errors due to workflow design in patient assessment, MA regulations, MA standard of operation procedure (SOP), double checks, and others were collected before and after the MAIS implementation. The highest scored category is the charting time and the lowest is the screen speed. Nurses are unsatisfied on downtime and intranet speed. Three main MEs factors are: not following MA SOP, no MA regulations, and others based on 275 (before) and 124 (after) incident reports. While nurses valued the MAIS use, network speed has been raised. ME incidents are decreased but the workflow factors are different for both before-after implementation stages.

**Keywords.** incident reports, information systems success model, medication administration errors, patient safety, workflow design

## 1. Introduction

Medication safety has been one of the main themes of healthcare. It is because when a medication administration error (MAE) occurs, this negative effect not only influences but also could endanger patient safety [1].

The main purpose of this study is to evaluate the outcomes of the medication administration information system (MAIS) use. The outcomes are evaluated in two perspectives: nurses' comments toward this MAIS use were collected, and incident reports related to MAEs were also analyzed for comparison purpose on before-and-after MAIS implementation.

## 2. Methods

The study adopted a descriptive and correlational research design. The research subjects were nurses in general wards of a medical center in Taiwan. A structured questionnaire based on DeLone and McLean's information systems of successful

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models was applied [2]. Furthermore, the questionnaire also contained an open-ended question to collect users' suggestions of the MAIS use.

Evaluate the differences between pre- and post- of MAIS adoption. Events occurred before (January 2010 to June 2012) and after (January 2013 to June 2014) MAIS use were collected. The classified workflow categories related to MEs are as the following: no completed patient assessment, no specific MA SOP, not following the designated MA SOP, no MA double check, and other factors.

### 3. Results

The survey results showed that the average score of user satisfaction was the highest and the users' benefits of using the system was the lowest. Moreover, the quality of information was the most critical factor related to user satisfaction ( $r=0.83$ ,  $p < 0.01$ ). As to the users' comments on the MAIS, the positive ones lied in clear and clean screen on MA, user friendly interface design, and convenient integration to the website of the pharmacy department. On the other hand, the negative ones were in time-consuming for screen change, slow network speed, and computer crashes.

Analysis of the MA incident reported related workflow classifications revealed that the percentage of "not following the designated MA SOP" decreased from 63.27% to 45.97% while the percentages of "no specific MA SOP" and "no MA double checks" increased from 5.9% to 13.71% and 4.1% to 9.17% , respectively. The statistical results indicated that use of MAIS did reveal a MA classification differences ( $\chi^2=18.042$ ,  $p = .001$ ). Other factors related to workflow are as following: wrong medication orders, system operation errors ...etc.

### 4. Discussion

Nurses generally have positive attitude toward the MAIS, which could due to the system functions for MA documentation and available drug information upon requests. Furthermore, it helps nurses spend less time on charting MA processes and enhance patient safety in providing correct medication and education.

Although the incident reports related to "not following the designated MA SOP" decreased, other categories increased in "no specific MA SOP" "no MA double check" and "other factors". New workflow procedures may have to be created and whether "MA double check" would be indispensable could be take into consideration. While is technology is created to solve human problems, it may not be an elixir, human and organization elements are important in this adoption process [3].

### References

- [1] J. Kim, & D. Bates, Medication administration errors by nurses: adherence to guidelines. *Journal Of Clinical Nursing*, 2013,22(3/4), 590-598.
- [2] W. H. DeLone, & E. R. McLean, The DeLone and McLean Model of information System Success: A Ten-Year Update. *Journal of Management Information Systems*, 2003, 19(4), 9-30.
- [3] P. F. Cipriano, & J. Murphy, Nursing Informatics. The Future of Nursing and Health IT: The Quality Elixir. *Nursing Economic*, 2011, 29(5), 286-282.

# The Application of an Integrated IHCA Information System to Analysis the Related Indicators

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**Abstract.** In-Hospital cardiac arrest (IHCA) is a high risk of patient's safety issue in medical institutions, the incidence and patient's outcome of IHCA is an important indicator of ability of medical treatment and emergency medical quality of hospital. By building up the IHCA information system, we can save the time of typing and statistical data, save the consumption of paper and storage space, managers can view immediately data, track progress and confirm the correctness of the information, and Index values can be rendered immediately.

**Keywords.** IHCA, TCPI, Patient Safety, Information System

## 1. Introduction

Usually, the data collection is manual method in our hospital, it took a lot of time and can't make sure the correctness of these data, therefore we hope through the IHCA information system is built up, it can automatically provide the indicator data and patient list, allow the managers can get all information of IHCA immediately.

## 2. Methods

Base on the document of "Cause analysis of IHCA" to build up information system, the major parts of system as follows: (1) Provide the indicator data and patient list automatically; (2) Permissions were set according to the different responsibilities, the unit manager of Index can only see their own; (3) Managers, physicians and arbitrator can understand IHCA events through the reporting system and confirm the correctness of data, only the arbitrator can be modified and send back; (4) Managers, physicians and arbitrator can follow the progress of IHCA events through the reporting system; (5) Integration the "cause analysis of IHCA", IHCA systems and patient safety reporting system; (6) Automatically analyze and statistic data of IHCA and results are automatically aggregated and compared with hospital patient safety systems and TCPI quality index system.

3. Results

- (1) Save the time of typing and statistical data;
- (2) Save the consumption of paper and storage space;
- (3) Managers can view immediately data, track progress and confirm the correctness of the information;
- (4) Index values can be rendered immediately.

4. Discussion

In the initial of implementation of IHCA information platform system, data collection were both manual and information system to make sure the correctness of data. Therefore, it may increase the time and burden on staff daily work, and because of not familiar with information system, the staffs refuse to use it. When the system is stable, it can provide these data more quickly and correct. It is suggested that in the initial of implementation of information technology, should pay attention to the burden on staff, and phased implementation. Through this information platform system of IHCA, allow medical institutions to become an efficient and highly competitive organization, and better to promote quality of care and maintenance of patient safety.

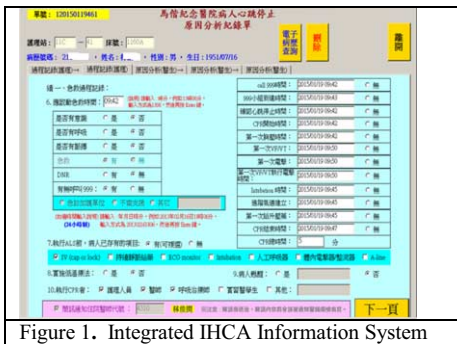


Figure 1. Integrated IHCA Information System

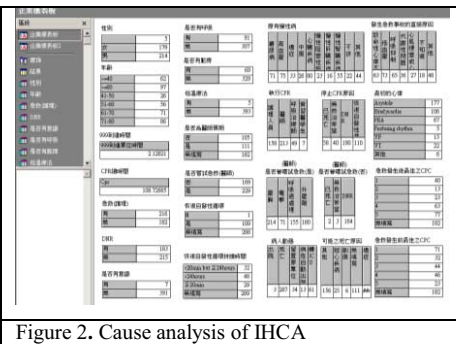


Figure 2. Cause analysis of IHCA

References

[1] M. Christ, W. Dierschke, K.I. von Auenmueller, M. van Bracht, M. Grett, H.J. Trappe. (2014) Cardiac Arrest Teams and Time of Day: Effects on Surviving In-Hospital Resuscitation. Journal of International Journal of General Medicine, 30(7), 319-23.

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# Decision-Making to Support Smooth Daily Unit Operation in Perioperative Settings

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**Abstract.** Decision-making in daily unit operation in perioperative settings needs to be smooth. Decision support systems are mainly used as help in this situation. These systems reduce the possibility of risks caused by poor communication. But the decisions and dimensions of the decisions made by nurse manager are still unsolved. The aim of our study was to describe the timeframe of the decisions made by nurse managers in the daily unit operation in perioperative settings. The results indicated that nurse managers made operational and tactical decisions. These operational and tactical decisions happened coincide during the nurse managers shift. The nurse managers were repeatedly interrupted in decision-making.

**Keywords.** Decision-making, Information need, Nurse manager, Perioperative settings

## 1. Introduction

The number of surgical processes is increasing in Europe while nursing resources are decreasing due to e.g. retirements. Hence, the daily unit operation in perioperative settings needs to be developed. The nurse manager is an essential person in perioperative settings when smooth daily unit operations are organized. The nurse managers' decisions have an impact on flow of tasks, care coordination, patient safety, and nurses' daily wellbeing <sup>[1]</sup> amongst other. But, the decisions and timeframe of the decisions made by nurse manager are still unsolved. Information systems that are currently available for managerial decision-making do not support the daily decision-making in the best possible way. The aim of our study was to describe the timeframe of the decisions made by nurse managers in the daily unit operation in perioperative settings. The nurse manager in our study is defined as a person who is responsible for the daily unit operation. The title of this person differs between units and organizations and they are for example nurse managers, assistant nurse managers and charge nurses.

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## 2. Methods

We used the think aloud method in data collection and the first author of this study conducted the think aloud sessions. The data consisted of 20 nurse managers talking out loud their thoughts in real life situations. The sessions were carried out during the morning shifts (8 a.m. to 4 p.m.), for four hours per participant in spring 2011 and in spring 2013. Operating departments, day surgery units and one anesthesia unit were included from two university hospitals. The participants thinking aloud was recorded with a MP3 recorder. The data were analyzed with thematic analysis.

## 3. Results

During the data collection the nurse managers made altogether more than 700 decisions. Nurse managers made both operational and tactical decisions because their responsibilities were different according to their position in the unit. The decisions were divided into three timeframes: decisions regarding the direct ad hoc daily unit operation, such as confirming the equipment to the operation; decisions that focused to the near future, such as planning the equipment to operation; and long term decisions, such as procurement of the equipment. The ad hoc decisions and the decisions for the near future were more operational whereas the long term decisions were more tactical. The decision-making concerning these three timeframes was coincide and nurse managers faced many interruptions while managing the daily unit operation.

## 4. Discussion

The target of the nurse managers' decision-making was the same but the timeframe differed between situations. Nurse managers were interrupted several times during the daily unit operation and this was stressful for them. Frequent interruptions may increase the possibility of errors. The think aloud method can be recommended to be used in real life situations in managerial studies and acute care settings. The results of this study can be used to develop decision support systems for perioperative nurse managers with the right type of content and accurate information to support decision-making.

## 5. Acknowledgements

This work was supported by the Finnish Foundation of Nursing Education and Research funds from specified government transfers in Finland.

## References

- [1] L.H. Aiken, W. Sermeus, K. Van den Heede, D. M. Sloane, R. Busse, M. McKee, L. Bruyneel, A.M. Rafferty, P. Griffiths, M.T. Moreno-Casbas, C. Tishelman, A. Scott, T. Brzostek, J. Kinnunen, R. Schwendimann, M. Heinen, D. Zikos, I.S. Sjetne, H.L. Smith, A. Kutney-Lee, *Patient safety, satisfaction, and quality of hospital care: cross sectional surveys of nurses and patients in 12 countries in Europe and the United States*. British Medical Journal 344 e1717. 2012.

# Using a Call Centre for Data Mining and Data Capturing – Pilot Study Using Glasgow Coma Outcome Scale in Head Injured Patients

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**Abstract:** Trauma healthcare delivery is limited in rural areas of India. **Aim:** The aim of the study was to assess the Glasgow coma outcome scale via a call centre for head injured patients who were discharged after head injury. **Methods:** Glasgow coma scales were assessed by call-center staff using a set of standard questions in Hindi language. **Results:** 484 patients were admitted during the study period. Of these, 63% ( $n=305$ ) were from rural areas. After patients were discharged, call centre staff were able to reach 84% of patients on their phones and elicit GOS in all cases. **Conclusions:** Call centers have the potential to revolutionize delivery of trauma healthcare to rural areas.

**Keywords:** Call center, head Injury, healthcare delivery, rural, glasgow coma outcome scale, trauma

## 1. Introduction

Worldwide, head injury is the single largest cause of death and disability following injury. The burden of head injury is greatest in low- and middle income countries (LAMIC), where 85% of the world's population live.<sup>[1]</sup> The aim of the study was to assess the Glasgow coma outcome scale in head injured patients treated at our centre using an integrated call centre.

## 2. Methods

In this prospective observational study carried out over a six month period a telephonic survey was used to assess the Glasgow coma outcome scale of the patients who were admitted in the trauma centre was assessed with the help of trained staff of an integrated call centre. A set of standard questions were made in Hindi language to assess the GOS. The questions were kept deliberately simple so that call-center staff could administer them in the patient's language and document the response accurately.

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**Setting** The JPN Apex Trauma Centre All India Institute of Medical Sciences is a 152-bed level I trauma centre in New Delhi, India. A nine-seated call-center was outsourced to a private company in January 2010. The call center was located in a different state of India (Noida, Uttar Pradesh) and the hospital's electronic medical records were integrated with the call-center operations so that all patient data was accessible by the call-center staff with necessary privileges. After the integration of the hospitals EMR call centre was assigned to telephonically assess the outcome of the patients who were admitted in the centre during the last six months (January –June 2014). The response was noted in the EMR.

**Role of nursing informatics specialist** The nursing informatics specialist were responsible for giving training to the call centre staff regarding how to access electronic medical records, administration of GOS questionnaire and documentation of patients response in the EMR. Nursing informatics specialists were also responsible to supervise the work done by the call centre staff.

### 3. Results

A total of 484 patients were admitted in Neurosurgery department during the study period. Of these, 63% ( $n=305$ ) were from rural areas. Call centre could reach 84% of all patients on their phones and elicit GOS in all cases.

### 4. Discussion

This study shows that call centers have the potential to revolutionize delivery of trauma healthcare in an extremely cost-effective manner. This model is ideal for developing countries like India.

### 5. Acknowledgments

We express our sincere gratitude to the call centre team who helped us in conducting the study.

### References

- [1] M.J.De Silva , I.Roberts , P.Perel , P. Edwards , M.G.Kenward , *et al.* Patient outcome after traumatic brain injury in high-, middle- and low-income countries: Analysis of data on 8927 patients in 46 countries. *Int J Epidemiol* 2009;38:452-8
- [2] Batt, L. Moynihan. The viability of alternative call centre production models. *Hum Resour Manage J* 2002; 12:14-34.
- [3] P. Bain, A. Watson, G. Mulvey , P.Taylor . Taylorism, targets and the pursuit of quantity and quality by call centre management. *New Technology, Work and Employment* 2002; 17:170-85.
- [4] D. Knights, D. McCabe. Governing through Teamwork: Reconstituting Subjectivity in a call centre. *J Manag Stud* 2003; 40:1587- 619.
- [5] R. Dandona, G.A.Kumar, M.A. Ameer, G.M. Ahmed, L. Dandona. Incidence and burden of road traffic injuries in urban India. *Inj Prev* 2008; 14:354-9.

# A Model for Risk Assessment in Health Care

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**Abstract.** The purpose of our research is to reduce risks and hence prevent errors in the health care process. The aim is to design an organizational information model using error prevention methods for risk assessment in a clinical setting. The model is based on selected indicators of quality nursing care, resulting from the world-known theoretical and practical models combined with experience in the Slovenian health care. The proposed organizational information model and software solution has a significant impact on the professional attention, communication and information, critical thinking, experience and knowledge.

**Keywords.** health care, patient safety, errors, information communication technology

## 1. Introduction

Patient safety is the reduction of the risk of unnecessary harm associated with healthcare to an acceptable minimum with is fundamental to ensuring quality of health care [1]. The reducing of risk is an important topic in the field of health care, not only for the public but also for politicians, administrators and economy as a whole [2,3,4].

Each organization must decide which tool is best suited to what product or service. In itself, a single method is not a panacea, but should be used in combination with other methods and tools for problem solving to eliminate or reduce risks [4].

## 2. Methods

The risk assessment model was developed by combination of four methods: the Health care Failure Mode and Effect Analysis (HFMEA) in order to assess the risk of errors; the Root Cause Analysis (RCA) in order to determine the causes of the errors; the Method of Structured Analysis for the analysis of work processes and information system design; Dynamic systems development method (DSDM) for the development of software prototype.

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### 3. Results

Results of the process analysis following corrective measures shows that the risk assessment of individual error causes reduced for 73.6 percent. Re-evaluation of the risks to the whole process shows that the overall risk score was decreased by 45.5 percent. The average impact of information communication technology on the reduction of medications administration errors is 56 percent.

The proposed organizational information model and software solution has a significant impact on the professional attention, communication and information, critical thinking, experience and knowledge.

### 4. Discussion

The combination of using ICT and a new way of organizing information prevents loss of data between health care staff. It has a positive impact on the flow of information and communication, which is a fundamental characteristic of the process of care. Electronic support is a utility for recording a large number of important information, integration of distributed resources and support decision-making, planning and evaluation of health care process.

### References

- [1] World Health Organization, Conceptual Framework for the International Classification for Patient Safety Version 1.1, 2009, Available Sep 10, 2015 from: [http://www.who.int/patientsafety/taxonomy/icps\\_full\\_report.pdf](http://www.who.int/patientsafety/taxonomy/icps_full_report.pdf)
- [2] Council of Europe. Recommendation Rec(2006)7 of the Committee of Ministers to member states on management of patient safety and prevention of adverse events in health care, Available Sep 10, 2015 from: <https://wd.coe.int/ViewDoc.jsp?id=1005439&Site=CM>.
- [3] L.T. Kohn, J.M. Corrigan, M.S. Donaldson., *To Err Is Human: Building a Safer Health System*, Washington DC: National Academy Press, 2000.
- [4] J. De Rosier, E. Stalhandske, J.P. Bagian, T. Nudell. Using Health Care Failure: Mode and Effect Analysis., *The VA National Center for Patient Safety's Prospective Risk Analysis System*, *JCJQI* 2002; 27(5): 248-267.

# Improving EHR Usability Using LEAN Methodology

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**Abstract.** Electronic health record (EHR) usability concerns continue to reduce EHR effectiveness. LEAN methodology, which focuses on waste elimination, may provide an effective method to address efficiency related usability deficiencies. We aimed to improve the usability of an inpatient seclusion and restraint (SR) EHR module using LEAN methodology. A multidisciplinary team convened to evaluate and redesign clinical and technological SR workflows using LEAN techniques, including process mapping and time-series analyses. SR module modifications addressed 40 of the 60 efficiency related usability deficiencies identified in the initial SR module. Usability enhancements included elimination of 10 nonessential inputs, 21 redundancies, and nine overhead functions. Process steps were reduced from 74 to 47. Improving EHR usability is critical to assure safe, effective, and efficient care<sup>1</sup>. We demonstrated that LEAN methodology is an effective method to address efficiency related EHR usability deficiencies. More research is needed to determine how these improvements impact care quality.

**Keywords.** Usability, EHRs, problems in EHRs, simplifying workflow, quality improvement

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# The Relationship Between Nursing Workload, Quality of Care and Nursing Payment in Intensive Care Units

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**Abstract.** Nursing workload adversely affects patient safety in intensive care units, the higher nursing care hours were lower incidence rate of bedsores.

**Keywords.** Nursing workload, quality of care, nursing payment, patient classification

## 1. Introduction

The heavy nursing workload seems to be related to patient care quality. Research shows that a heavy nursing workload adversely affects patient safety<sup>1,2</sup>. This study aimed to explore the relationship between nursing workload, patient safety and nursing fee in intensive care units (ICUs).

## 2. Methods

We retrieve data to analysis from patient classification systems (PCS) and nursing quality monitoring system (NQMS) for six ICUs of a medical center in Taiwan. Data retrieve from January 2013 to November 2014. We built up a structure PCS that includes therapeutic intervention scoring system-28(TISS-28) and direct patient care activities in ICU which is linked with computerized physician order entry (CPOE) system. We collect the nursing care hours and nursing manpower utilization as nursing workload, nursing fee data retrieved also from PCS. The adverse incidence of patient safety-related indicators includes bedsores, restraint, falls, self-extraction of tubing, infection rate, and mortality rate.

## 3. Results

The daily classification of patient's data retrieved total 92442 data set the average of daily nursing care hours was 12.5 hours per-patient. There was no statistically significant correlation between nursing workload and patient safety; but the results showed the higher nursing care hours were lower incidence rate of bedsores.. We compare the nursing fee items from PCS and national health insurance (NIH), the

records showed that the PCS more than NIH. The nursing fee only accounted for 4.77 percent of total ICU medical expenses.

#### **4. Discussion**

The lower nursing care hours were more adverse events. We compared the nursing payments items between PCS and NIH, the NIH program covers too little nursing care payments.

We retrieve data from patient classification systems and nursing quality monitoring system, even translation to nursing workload and patient safety information, we expect increase the nursing manpower, and add the useful and valuable of informatics system.

#### **5. Acknowledgments**

Thank financial assistance of Taiwan Nurses Association.

#### **References**

- [1] S. H. Cho, J. H. Hwang, & J. Kim, Nurse staffing and patient mortality in intensive care units. *Nursing Research*, *57*(2008), 322-330.
- [2] S. H. Cho, & S. C. Yun, Bed-to-nurse ratios, provision of basic nursing care, and in-hospital and 30-day mortality among acute stroke patients admitted to an intensive care unit: cross-sectional analysis of survey and administrative data. *International Journal of Nursing Studies*, *46*(2009), 1092-1101.

# Nursing Informatics Pioneers Continue to Influence the Profession: A Sustainable Impact

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**Abstract.** The American Medical Informatics Association (AMIA) established the Nursing Informatics History Project to recognize the pioneers of nursing informatics. Fundamental to the pioneers was dissemination of knowledge. The purpose of this review was to identify contributions to the field of nursing informatics as peer-reviewed manuscripts for the years 2010-2015 and indexed in PubMed. Results indicate that many of the pioneers continue to have manuscripts indexed in PubMed. It is anticipated this project will be extended to identify other types of contributions made by the pioneers in the advancement of nursing informatics.

**Keywords.** Nursing informatics, informatics, nursing, history project

## 1. Introduction

The AMIA Nursing Informatics History Project was established to record and maintain the history of nursing informatics [1]. As part of the History Project 143 individuals were designated as pioneers in the field. By convenience, thirty three were interviewed. Pioneers were defined as people who were innovators, trailblazers, or groundbreakers in some aspect of nursing informatics, first to open a new area and prepare a way for other nurses to follow [2, 3].

The designated pioneers advanced nursing informatics through innovation in health information technology (HIT), education, administration, and research. Central to their work was dissemination so that others could utilize their findings and technology to advance nursing and nursing informatics. The purpose of this review was to identify contributions to the field of nursing informatics as peer-reviewed manuscripts for the years 2010-2015 and indexed in PubMed.

## 2. Methods

A systematic review of the published literature was conducted to identify manuscripts published by the pioneers in PubMed for the years 2010-2015.

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Each of the thirty three pioneer's last name, initial(s), as well as the term "informatics" was entered in PubMed. The publication was included if the pioneer was listed as an author and was within the specified timeframe.

### 3. Results

Of the thirty-three pioneers, twenty-five (75.8%) have published one or more journal articles in the last five years and the manuscript was indexed in PubMed. See Figure 1 PubMed Articles 2010-2015. Six of the pioneers had authored at least one manuscript. One pioneer was identified as an author on fifty-seven publications.

### 4. Discussion

The pioneers in nursing informatics continue to contribute to the dissemination of new knowledge in the form of peer-reviewed indexed manuscripts in PubMed. The lack of publications in the last five years for some pioneers could be attributed to changes in employer, funding for research, or retirement. It is anticipated this project will be extended to research other types of new knowledge or technology credited to the pioneers.

### References

- [1] AMIA. Nursing Informatics History Project [Website]; 2016. Available from <https://www.amia.org/working-groups/nursing-informatics/history-project>
- [2] B. L. Westra and S. K. Newbold, American Medical Informatics Association Nursing Informatics History Committee, CIN March/April 2006 pp 113-115, 2006.
- [3] S. K. Newbold and B. L. Westra American Medical Informatics Association Nursing Informatics History Committee Update. CIN July/August 2009 pp 263-265, 2009.

Pioneer	PubMed	Book		Pioneer	PubMed	Book	
Patricia Abbott	14	0		Susan K. Newbold	1	1	
Ida M. Androwich	3	0		Judy G. Ozbolt	1	0	
Jean M. Arnold	0	0		Carole Romano	0	0	
Suzanne Bakken	57	0		Virginia K. Saba	1	7	
Marion Ball	4	2		Patricia M. Schwirian	2	1	
Patricia Brennan	12	2		Joyce E. Sensmeier	20	1	
Patricia Button	0	0		Roy L. Simpson	8	0	
Betty L. Chang	0	0		Diane J. Skiba	11	1	
Connie Delaney	8	1		Nancy Staggers	21	1	
Carole A. Gassert	1	1		Linda Q. Thede	8	1	
Susan J. Grobe	0	0		James P. Turley	4	0	
Rosemary Kennedy	1	0		Judith J. Warren	4	0	
Debra Konicek	1	0		Charlotte Weaver	4	0	
Norma Lang	0	0		Elizabeth E. Weiner	4	0	
Karen S. Martin	8	0		Rita Zielstorff	0	0	
Susan Matney	6	0		<b>Totals –</b>			
Kathleen McCormick	0	4		<b>No publications</b>	8 – No	20 – No	
Judy Murphy	14	1		<b>Publications</b>	25 – Yes	13 – Yes	

Figure 1 PubMed Articles 2010-2015



# Impact of an Emergency Nurse Coordinator on Work Flow Optimization in an Emergency Department in Delhi, India

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**Abstract:** The aim of this study was to assess the effect of the emergency nurse coordinator in optimization of workflow of the emergency department. A retrospective analysis of all patient encounters in the emergency department between Aug 1 to Sept 31 of 2014 (n=6,189) and Aug 1 to September 31 of 2015 (n=8,626) was conducted. There was a statistically significant decrease in the admission time, length of stay, transfer time, and review time of the patients after the introduction of the emergency nurse coordinator in the emergency department.(p<0.05).

**Keywords:** emergency nurse coordinator, emergency department, workflow

## 1. Introduction

In October 2014, an emergency nurse coordinator (ENC) was created as a liaison between the inpatient department, other hospital facilities and the emergency department. This was a new role undertaken by the nursing informatics specialist. A total of four nursing informatics specialist are posted in emergency and one assumes the role of emergency nurse coordinator every shift. The goal of the new role was to improve the patient workflow in the emergency department. The aim of this study was to assess the effect of an ENC in optimization of workflow of the emergency department.

## 2. Methods

AIIMS New Delhi is an academic tertiary referral centre that provides a breadth of specialized care for patients with complex, critical and life threatening conditions. The emergency department of our hospital consists of a screening room, main surgical emergency, pediatric emergency, and medical emergency with total patient registrations of 132,095 in 2015 up to September 30th. A retrospective analysis of all patient encounters in the emergency department between Aug 1 to Sept 31 of 2014 and Aug 1 to Sept 31 of 2015 were selected. We examined the average admission time, the average length of stay, transfer time, and review time.

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### 3. Results

**Table1. Demographic data of patients**

Variables	Before ENC	After ENC
Average age	46.27	41.43
Sex	Male-4,246 (68.6%) Females-1,943 (31.4%)	Male-5,785 (67.1%) Females-2,843 (32.9%)
Triage category	red -143 yellow – 6,040 green -6	red-265 yellow -8,408 green-5

Red – high risk; Yellow- medium risk; Green – low risk

**Table 2. Pre and post ENC for parameters studied**

Parameters	Before ENC	After ENC	Difference	*p value
Admission time	43.6hrs	20.33hrs	23.27hrs	0.04
Length of stay in ED	70.6hrs	32.29hrs	38.31 hrs	0.01
Transfer time	32.51hrs	25.79hrs	6.72hrs	0.04
Review time	99.47min	43.38 min	56.09min	0.01

\*independent samples t-test; *Average admission time*: the difference between admission time and emergency registration time of the patient with total number of admission within study period. *Length of stay in ED*: average time between the patient's first presentation to the ED and his/her departure from the emergency department. *Average transfer time*: is calculated by dividing the difference between transfer time and emergency registration time of the patient with total number of transfers within the study period. *Review time*: difference between the time of call to the physician and the physician sees the patient.

### 4. Discussion

From the study it could be inferred that the emergency nurse coordinator has significantly improved patient flow in the emergency department which is in congruence with the findings of a study done by Asha et al.<sup>3</sup>. Although this is not a traditional nursing informatics role, having the emergency nurse coordinator be part of the nurse informatics initiative was important because the ENC needs to be computer literate and help others in using technology during their work.

### 5. Acknowledgement

We express our sincere gratitude to all the emergency staff for their contribution and special thanks to Mr.Vishal programmer of the computer facility for his help in data retrieval.

### References

- [1] R.Y. Hsia, A.L.Kellerman , Y.C.Shen. Factors associated with closures of emergency departments in the United States. JAMA. 2011; 305(19):1978-85.
- [2] 58th AIIMS annual report of 2013 -2014, [www.aiims.edu](http://www.aiims.edu)
- [3] S.E. Asha. Improvement in emergency department length of stay using a nurse lead emergency journey coordinator.EMA.2014; 26:158-164

# An Interview and an Observation Study of Nurses and Student Nurses' Electronic Clinical Documentation Behaviors in a OB/GYN Nursing Ward

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**Abstract.** This research was conducted to understand clinical nurses' and nursing students' current use of a clinical nursing information system to document their patient care activities in an OB/GYN nursing ward at a medical center in central Taiwan. A semi-structure interview and participant observation methods were used to gather the data. The results showed that the majority of participants regarded the clinical nursing information system as a useful system in terms of saving documentation time and improving communication among healthcare providers. This study provided some empirical evidence of the attitudes/behaviors of nurses and student nurses about electronic documentation. However, more studies were recommended to evaluate the impact of electronic nursing documentation on the quality of care delivered to patients.

**Keywords.** Nursing documentation, clinical information system, electronic medical record

## 1. Introduction

Electronic nursing documentation systems are expected to improve the quality of nursing care provided to patients. In Taiwan, nurses spend significant time documenting various nursing care activities including nursing processes, it was anticipated that the introduction of an electronic nursing documentation system would ease nurses' documentation workload and improve their communication among care providers. Although nursing documentation is required by governmental and institutional regulations and policies, electronic nursing documentation is not the norm in majority Taiwan hospitals.

The study hospital was a 1000-bed medical center in central Taiwan. There were approximately 1000 nurses worked at more than 30 nursing wards and outpatient units and about 400 student nurses were placed for their clinical practicum experience at the hospital annually. An electronic nursing documentation system were implemented at the study hospital since 2008 and currently more than 60 common nursing activities and 24 patient-safety related functions were in place for nurses to use on a daily basis. Therefore, nurses and student nurses at the study hospital

## **2. Methods**

A semi-structure interview and participant observation methods were used to gather the data. A total of 16 nurses and senior nursing students were interviewed and observed during a 4-week study period in 2015. Interviews and observational data were recorded, transcribed and analyzed.

## **3. Results**

The preliminary results showed that the majority of participants regarded the clinical nursing information system as a useful system in terms of saving documentation time when comparing with paper-based method. They also reported that using electronic nursing documentation system improved communication among healthcare providers.

## **4. Discussion**

These preliminary results of the study provided some empirical evidence of the attitudes/behaviors of nurses and student nurses about electronic nursing documentation system. More studies were recommended to evaluate the impact of electronic nursing documentation on the quality of care delivered to patients.

# Design of a Recommendation System for Adding Support in the Treatment of Chronic Patients

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**Abstract.** Rapid growth of chronic disease cases around the world is adding pressure on healthcare providers to ensure a structured patient follow-up during chronic disease management process. In response to the increasing demand for better chronic disease management and improved health care efficiency, nursing roles have been specialized or enhanced in the primary health care setting. Nurses become key players in chronic disease management process. Study describes a system to help nurses manage the care process of patient with chronic disease. It supports focusing nurse's attention on those resources/solutions that are likely to be most relevant to their particular situation/problem in nursing domain. System is based on multi-relational property graph representing a flexible modeling construct. Graph allows modeling a nursing ontology and the indices that partition domain into an efficient, searchable space where the solution to a problem is seen as abstractly defined traversals through its vertices and edges.

**Keywords.** Chronic disease, ontology, nursing, nursing process, recommendation system, electronic health record, e-documentation

## 1. Introduction

Due to increases in obesity, heart diseases, and diabetes (both types 1 and 2) great pressure is being put on healthcare providers when trying to ensure a structured patient follow-up during chronic disease management process [1]. Nurses working in specialized or enhanced roles (working collaboratively with physicians) may be a viable option to improve the management, efficiency (by reducing physician demand) and quality of chronic disease care in the primary health care setting [1,2].

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## 2. Methods

Viewing the chronic disease management process as a structured, problem-solving approach provides a framework for process-oriented chronic disease management documentation using nursing care plans [2]. The foundation of the chronic disease recommendation system is a rich model of nursing domains related to chronic disease management in the form of semantic network (ontology) as a multi-relational property graph structure (a set of vertices and edge) [4]. Ontology defines the knowledge needed to make recommendations in the process of building a nursing care plan by applying different algorithms to achieve a solution to specific problem in chronic disease management process [3,4].

## 3. Results

Chronic disease ontology and recommendation system in primary health care setting in Slovenia is primary result of our study. Recommendation system depends on a set of patients' health history to build a model that is able to predict and recommend disease risk and disease risk status for the future cases of chronic patients. System also provides decision support in assessment process of patient's health characteristics (covering all aspect of patient health information) and nursing care plan execution process.

## 4. Conclusion

The use of the multi-relational property graph structure allowed us to model chronic disease ontology and the indices that partition the domain into an efficient, searchable space, where the solutions to a nursing problem are abstractly defined recommendation traversals through its domain concepts, instances, and relationships. We have found a proposed model efficient in saving documenting time in practice. The model will have to be further tested in practice. The extended work aims to provide medical advices and treatments recommendation along with the disease risk status. Love is in the air

## References

- [1] E. Andrès, S. Talha, A. Ahmed Benyahia, O. Keller, M. Hajjam, A. Moukadem, M. Hajjamc, A. Moukademd, A. Dieterlend, J. Hajjame, S. Ervée, A. Hajjamf, e-Health: A promising solution for optimizing management of chronic diseases. Example of the national e-Health project E-care based on an e-platform in the context of chronic heart failure. *Eur Res Telemed Rech Eur En Télémedecine* (2012)
- [2] Health Quality Ontario, Specialized Nursing Practice for Chronic Disease Management in the Primary Care Setting: An Evidence-Based Analysis. *Ontario Health Technology Assessment Series* 10(2013), 1-66.
- [3] R.C. Chen, Y.H. Huang, C.T. Bau, S.M. Chen, A Recommendation System Based on Domain Ontology and SWRL for Anti-diabetic Drugs Selection. *Expert Syst Appl.* 4(2012), 3995–4006.
- [4] M.A. Rodriguez, P. Neubauer, The Graph Traversal Pattern. Retrieved September 2, 2015, from <http://arxiv.org/abs/1004.1001>.

# The Impact of Nursing Students' Cultural Diversity on the Intention and Attitudes Towards the Use of Information Technology (IT)

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**Abstract:** This research highlights the challenge for nursing educators in understanding, developing awareness, and preparing strategies to manage the impact of nursing students' cultural diversity on the relationship between the intention to use computer and attitudes, self-efficacy, innovativeness, and threat and challenge.

**Keywords:** Cultural diversity, Attitudes, Information Technology, Nursing students, Innovativeness, Self-efficacy, Threat

## 1. The purpose of this study:

Examining some cultural characteristics amongst nursing students in an Israeli academic center, concerning the use of Information Technology (IT).

## 2. Methods:

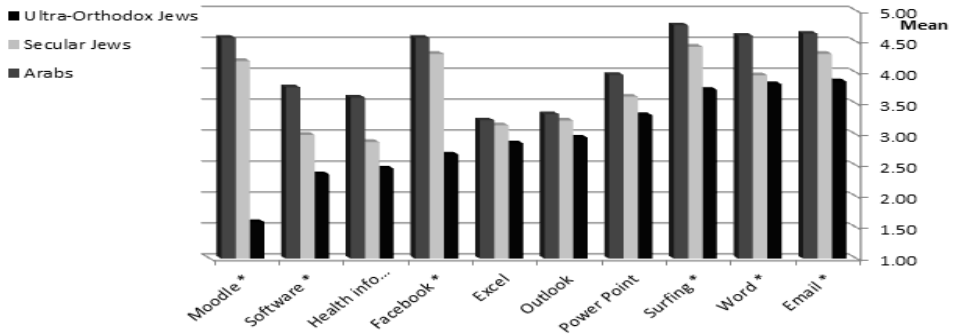
This is a quantitative study, with the sample of 102 nursing students. We assessed the difference between three groups of students: Ultra-orthodox Jewish, Secular Jewish and Arabs students, on their subjective perceived knowledge and expertise in using a multitude of software programs.

## 3. Results and discussion

Ultra-orthodox Jewish students felt more threatened by using IT. Arab and Secular Jewish students reported overall software knowledge on a high level, and were mostly willing to assimilate innovations. They also had more positive attitudes and self-efficacy. This study provides some valuable insights about how culture, religion, and education may influence nursing students' attitudes toward Information Technology.

**4. Summary**

Nursing education today is facing new challenges with the emergence of the Internet and other information and communication technologies. The call for the transformation of nursing education is imperative. The learning environment extends beyond the classroom and establishing a learning culture is essential to the future of nursing education and the facilitation of lifelong learning. This research highlights the challenge for nursing educators in identifying the factors, understanding, developing awareness and preparing strategies to manage the impact of nursing students' cultural diversity on the relationship between the intention to use computer and attitudes, self-efficacy, innovativeness, and threat and challenge.



**Figure 1:** Differences between the groups pertaining to perceived knowledge of different software programs

**References:**

[1] I. Ajzen, & M. Fishbein. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.

[2] A. Freund, & T.B. Winterstein, (2013). Between tradition and modernity: Social work-related change processes in the Jewish ultra-orthodox society in Israel. *International Journal of Intercultural Relations*, 37, 422-433.

[3] A. Gonen, D., L., Sharon, Lev-Ari, E., Strauss, & R. Segev, (2015). The Impact of Nursing Students' Cultural Diversity on the Intention and Attitudes toward the Use of Information Technology. *Journal of Transcultural Nursing*, 1043659615581558.

[4] A. Zisberg, M., Topaz, & T.Band-Wintershtein, (2014). Cultural-and Educational-Level Differences in Students Knowledge, Attitudes, and Preferences for Working with Older Adults An Israeli Perspective. *Journal of Transcultural Nursing*, 1043659614526252.



# The Effect of Tele-Consultation Between a Hospital-Based Nurse and a COPD Patient

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**Abstract.** Patients admitted with exacerbation COPD (AECOPD) were at hospital discharge randomly assigned (1:1) to either daily teleconsultation for one week between hospital-based telenurses and patients with severe COPD or conventional treatment. Addition of one week of teleconsultations was as safe and effective as conventional treatment, but it did not significantly reduce readmissions or affect mortality

**Keywords.** Telemedicine, nurse video-consultation, Tele-consultation, COPD consultation, readmission

## 1. Introduction

Hospitalization with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) causes a major burden for the COPD patients and is a common cause for admissions and readmissions to medical wards (1, 2). The objectives was to investigate the effect of one week of daily real-time telemedicine video consultations (teleconsultation) between hospital-based nurses specialized in respiratory diseases (telenurses) and patients with severe COPD discharged after AECOPD in addition to conventional treatment compared to the effect of conventional treatment. Primary outcome consisted of the total number of readmissions within 26 weeks after discharge.

## 2. Methods

Patients admitted with AECOPD at two different locations were recruited at hospital discharge and randomly assigned (1:1) to either daily teleconsultation for one week in addition to conventional treatment, the TVC group or to conventional treatment, the CT group. The patients' telemedicine equipment consisted of a briefcase with built-in computer including a web camera, microphone and measurement equipment.

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### 3. Results

A total of 266 patients (mean age 71.5 years, SD 9.5 years) were allocated to either TVC (n=132) or CT (n=134). There were no differences within the two groups according to baseline characteristic

No significant difference in readmission was noted between the groups ( $p = 0.62$ ).

Table 1: Readmission

Outcome	Teleconsultation (n=121)	Conventional treatment (n=121)	Difference between groups	p-values
<b>Primary outcome</b>	<b>Mean (SD)</b>		<b>Mean (95% CI mean)</b>	
Number of readmissions after 26 weeks	1.42 (2.07)	1.56 (2.40)	0.14 (-0.40- 0.68)	0.62
<b>Secondary outcome</b>	<b>Mean (SD)</b>		<b>Mean (95% CI mean)</b>	
Number of readmissions with AECOPD: 26 weeks	1.22 (1.92) (n=121)	1.28 (2.10) (n=121)	0.06 (-0.43- 0.54)	0.82
Number of days readmitted for any cause: 26 weeks	4.94 (8.24) (n=121)	6.37 (11.44) (n=121)	1.43 (-0.97- 3.84)	0.24
Number of days readmitted for AECOPD: 26 weeks	3.88 (7.39) (n=121)	5.16 (9.73) (n=121)	1.29 (-0.80- 3.37)	0.23

### 4. Discussion

The duration of the intervention was only a week, which is much shorter than other telemedicine trials. It were the frailest COPD patients. They were elderly, the majority had severe or very severe COPD, they had previously been admitted with AECOPD, they had multiple comorbidities, they were current or previous smokers and 10 % used LTOT. These are all factors, which are known to relate to increased mortality and morbidity with increased readmissions

### References

- [1] Dansk register for Kronisk Obstruktiv Lungesygdom/Danish Register for COPD, *Regionernes Kliniske Kvalitetsudviklingsprogram/Database*, Denmark, 2012.
- [2] Global Initiative for Chronic Obstructive Lung Disease (GOLD), *Global Strategy for the diagnosis, management and prevention of COPD*. NHLBI/WHO Global Initiative for Chronic Obstructive Lung Disease (GOLD), 2011.
- [3] Sorknaes AD, Bech M, Madsen H, Titlestad IL, Hounsgaard L, Hansen-Nord M, et al. *The effect of real-time teleconsultations between hospital-based nurses and patients with severe COPD discharged after an exacerbation*, J Telemed Telecare, 2013;19(8):466-74.

# Nurses' and Patients' Experiences of Tele-Consultations

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**Abstract.** The study focused on real-time video consultations (tele-consultations) as experienced by Danish hospital-based, respiratory nurses (tele-nurses) and patients with chronic obstructive pulmonary disease, COPD, discharged after hospitalization with acute exacerbation (tele-patients). Tele-patients and tele-nurses consider tele-consultations as distinct, but qualified care, enabling close relationships between patient and nurse. The nurses' performance and their professional identity changed. The patients become active, participants in their treatment and care.

**Keywords.** Telemedicine, nurse video-consultation, Tele-consultation, COPD consultation, Postphenomenolgi

## 1. Introduction

Currently telemedicine is introduced with the expectation that it can solve basic challenges faced by the health system regarding an increasing number of patients with chronic service needs (1). The effects of tele-consultations, however, on the embodied, experiential and perceptual dimension of the relationship between nurses and patients are little known. This study focused on real-time video consultations (tele-consultations) as experienced by Danish hospital-based, respiratory nurses (tele-nurses) and patients with chronic obstructive pulmonary disease, COPD, discharged after hospitalization with acute exacerbation (tele-patients). The purpose was to explore how telepatients and telenurses use and develop sensual perceptions during teleconsultations; and how teleconsultations affect communication and interaction between patient and nurse, and to inform the implementation process in clinical practice. The study was carried out at OUH, Odense University Hospital & Svendborg Hospital, Denmark. The telemedicine service consisted of daily consultations during a week. The teleconsultations were conducted between telenurses and telepatients. The patients' tele-equipment consisted of a dedicated computer with built-in web camera, microphone, speaker and external measurement devices.

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## 2. Methods

Post-phenomenological (2) analyses of empirical data from fieldwork. Post-phenomenology is a practice-oriented, philosophical approach to understand how our sense of the body and our perceptual orientation in the world is affected by technological mediation. Participant observations and video recordings were carried out twice with eight patients, three relatives and eight tele-nurses; within the first two tele-consultations (un-experienced patient) and after five tele-consultations (experienced patient). Afterwards, individual semi-structured interviews were conducted with the same participants. Interviews were structured around tele-patients' and tele-nurses' general experience of tele-consultations, their use of tele-devices, and tele-nurses' experience of the significance of technology on tele-consultations and caring. A semi-structured focus-group interview, themed around their experiences of treatment and care for tele-patients at home, use of tele-devices, the tele-devices' influence on patient consultation, the care that can be performed, and which nursing skills are required. The analyses were carried out using meaning-condensation. The interviews were examined, natural meaning units were categorized and central themes were identified. The themes were analyzed in a post-phenomenological framework with a focus on technology-mediated perception, transformation and transparency.

## 3. Results

Tele-patients and tele-nurses alike consider tele-consultations as distinct, but qualified care, enabling close relationships between patient and nurse (3). Technological mediation of nursing actions changed the nurses' performance and their professional identity (3). The nurses amplified their audio-visual perceptions and their communicative skills and they relied on their patients as assistants. Correspondingly, the patients took on active roles in observation and measurement of their condition, and their self-image changed accordingly for them to become active, participants in their treatment and care (3). Less conclusively, it appeared that patients would take ownership of their own data and perhaps gain better insight into their illness and treatment (3). Occasionally, some tele-nurses experienced digital interactions as inadequate (3). Furthermore, tele-consultation was not appropriate for all patients (3).

## 4. Discussion

The findings indicate that a more individualized process is needed to decide on the right technology for each patient in the future.

## References

- [1] Danish Regions - Danske Regioner, *Telemedicine strategy*, The Regions health-ICT, 2011.
- [2] D.Ihde, *Technology and the lifeworld*, Blomington and Indianapolis, USA: Indiana University 1990.
- [3] A.D.Sorknæs, *The effect of real-time telemedicine video consultations between nurses and patients with severe Chronic Obstructive Pulmonary Disease (COPD)*, PhD Thesis. Unit for Nursing Research, Clinical Institut, University of Southern Denmark (Serietitel 2013, Rapport nr. 2, ISSN 2244-9302).

# Developing Evidence-Based Care Standards and a Decision-Making Support System for Pain Management

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**Abstract.** Pain is a crucial sign and symptom in hospitalised patients. This paper describes how a medical centre created a knowledge-based, computerised pain management decision-making process to support nurses in personalising preventive interventions based on patient requirements.

**Keywords:** pain control, evidence-based care standards, decision making support system

## 1. Introduction

A pilot ‘nursing care plan decision support system’ was developed in this study. All relevant factors and characteristics regarding nursing interventions in pain management were retrieved from a data set, and a content analysis method was applied to determine the major indicators in the nursing care decision-making process. Nursing care plans are structured plans of action for patient care. In 1992, a 2900-bed medical centre in northern Taiwan implemented a computerised nursing care plan (CNCP) system in all its in-patient units. Although the CNCP system provides standardised nursing knowledge and care procedure alerts, it lacks a decision support function. In this study, a nursing care plan decision support system was developed to act as a guide for nurses when identifying patients’ pain problems and to enhance nursing care and pain management.

## 2. Methods

The study data set included all relevant factors, defined characteristics, and nursing interventions regarding pain management in the CNCP system from 01 January, 2010, to 30 September, 2011. The research group members analysed the pain care plan, employed knowledge generation and data-mining process, and applied the content analysis method to identify major indicators in the nursing care plan decision-making process.

### 3. Results

The CNCP data set included a total of 324,412 care plans related to pain management. Analysis of pain assessment records from the nursing information system showed that 44.46% of all hospitalised patients experienced pain problems: 10.13% had a pain score of 1, 13.14% had 2, 8.86% had 3, 4.34% had 4, and 8% had >5. Regarding pain emergence, 27.94% occurred in the abdominal part, 17.59% in the lower limbs, 8.3% in the chest, and nearly 7% in the head and mouth. In addition, the results showed that the major factors of pain were injury, therapeutic procedure, musculoskeletal pain, psychological factor, and pressure pain. The defined characteristics included self-report of pain, suffering facial expression, neurohumoral responses, crying and emotional expression, and pale appearance.

Furthermore, the total number of nursing interventions for pain management in the data set was 2,315,667. All interventions were classified into 24 interventions on the basis of the CCC categories. The five major categories represented approximately 71% of all interventions performed, including 'comfort care' (25.93%), 'pain control' (22.52%), 'medication care' (11.70%), 'emotional support' (9.30%), and wound care (1.51%). Five types of interventions were identified, and 34.27% of these nursing action types were related to assess or monitor actions, 52.66% to care or perform actions, 12.38% to teach or instruct actions, and 0.69% to manage or refer actions.

In addition, the pilot decision-making support system (DDS), which covered all elements from assessment to evaluation, was designed according to the nursing process.

### 4. Discussion

According to the CNCP data set, the characteristics were classified in nursing diagnosis and nursing actions in nursing interventions. When transforming the CCC system, the researchers added a sixth digit for nursing actions.

The major five relevant factors, defined characteristics, and intervention categories in this study were used as indicators to develop a pilot nursing care plan decision support system for aiding nurses in choosing the accurate nursing diagnosis. The study results are expected to help nurses in documentation, and the desired clinical information fields can be created to facilitate data retrieval for research and related tasks.

### 5. References

- [1] R. Barker , A. Kober , K. Hoerauf, D. Latzke, , S. Adel , Z. N. Kain, , et al. (2006). Out-of-hospital auricular acupressure in elder patients with
- [2] hip fracture: A randomized double-blinded trial. *Academic Emergency Medicine: Official Journal of the Society for Academic Emergency Medicine*, 13(1), 19-23.
- [3] E. de Jong , E. Middelkoop , A. W. Faber , & N. E. van Loey (2007). Non-pharmacological nursing interventions for procedural pain relief in adults with burns: A systemic literature review. *Burns*, 33, 811-827.
- [4] J. Dunwoody , D. A. Krenzischek, C. Pasero, J. P. Rathmell, & R. C. Polomano (2008). Assessment, physiological monitoring, and consequences of inadequately treated acute pain. *Journal of PeriAnesthesia Nursing*, 9(1), S11-S21.
- [5] Krenzischek, C. J. Dunwood., R. C. Polomano , & J. P. Rathmell (2008). Pharmacotherapy for acute pain: Implications for practice. *Pain Management Nursing*, 9(1), 22-32.

# Chinese Nurses' Acceptance of PDA: A Cross-Sectional Survey Using a Technology Acceptance Model

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**Abstract.** This study explores Chinese nurses' acceptance of PDA, using a questionnaire based on the framework of Technology Acceptance Model (TAM). 357 nurses were involved in the study. The results reveal the scores of the nurses' acceptance of PDA were means 3.18–3.36 in four dimensions. The younger of nurses, the higher nurses' title, the longer previous usage time, the more experienced using PDA, and the more acceptance of PDA. Therefore, the hospital administrators may change strategies to enhance nurses' acceptance of PDA, and promote the wide application of PDA.

**Keywords.** Personal digital assistants, Mobile health, Nurse, Technology Acceptance Model, Cross-sectional survey

## 1. Introduction

The use of the personal digital assistant (PDA) in clinical nursing is increasing dramatically in the last 5 years in China, although it has been used widely in western countries. However, data is limited with regard to Chinese nurses PDA usage. The purpose of this study aimed to investigate Chinese nurses' acceptance of PDAs, through the use of the Technology Acceptance Model (TAM) [1].

## 2. Methods

A cross-sectional survey questionnaire was developed by the researchers based on the TAM framework. 357 nurses who used PDA in clinical practice for at least one month in the previous year, in nine tertiary hospitals in Beijing China completed the questionnaire. Data for total and domains were expressed as means with SDs and analyzed. Each items scores 1 to 5, higher score indicates higher degree of acceptance. Analyzed data with t test to identify the mean difference. Correlation analysis was used determine the relationship between different domains based of TAM framework.

## 3. Results

The most respondents were female (97.8%), with an average age of 30.3 (SD, 6.9) years, 72.3% of nurses has more than 6 months working experiences of PDA, 82.4%

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of nurses stating that they has already mastering the skills of using PDAs. Figure1 shows the four domains of TAM in the Chinese nurses' acceptance of using PDA. "Perceived ease of use" was scored the highest, while "attitude to use" was the lowest. Figure 2 illustrates the correlations between the different variables related to the nurses' acceptance of PDA.The perceived usefulness and ease to use was related to the nurses' attitude to use of PDA( $r=0.683$ ), the intentions to continuing use was highly related the nurses' attitude to use of PDA ( $r=0.814$ ).The younger of nurses, the longer previous usage time, the higher nurses' title, the more experienced using PDA, were related to the more acceptance of PDA.

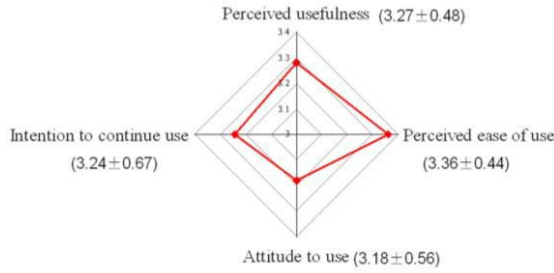


Figure 1.Nurses acceptance of using PDA in the four domains of TAM

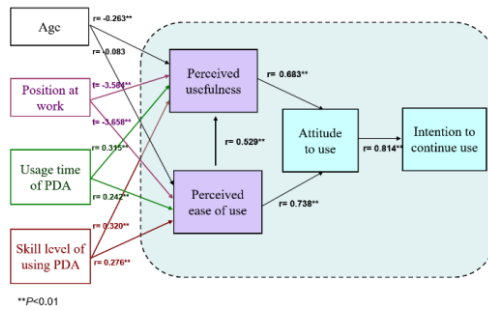


Figure 2.The correlative factors based on the frame work of TAM

#### 4. Discussion

The usage of PDA by nurses is important to patient safety. Our result shows more than eighty percent of nurses have already experienced in using PDA. Overall, the respondents perceived PDA useful and easy to use. When the hospital administrators train and support to promote the wide application of PDA could consider the correlative factors revealed in this study.

#### References

[1] Gillian Strudwick. Predicting Nurses' Use of healthcare technology using the technology acceptance Model CIN: Computers, Informatics, Nursing, 2015, 33(5):189-198.



# User's Satisfaction of Multiple Accounting Record System

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**Abstract.** The study hospital had developed a multiple account recording system that generates the accounting information of the consumed materials based on daily nursing records. A questionnaire survey was delivered to further investigate the impact of the system. Methods: Four concepts of the system were investigated. (1) Supportive and time saving; (2) impact on workflows and job satisfactions; (3) ease of use; and (4) overall satisfactions. Results: The system scored 4.03 out of 5 as the highest for helpfulness for daily practices, 3.98 for decrease the time for recording material consumptions, 3.98 for actually changed the way they work. Discussion: Users mostly expressed positive attitude towards the system.

**Keywords.** Satisfaction, multiple account recording system, simplifying workflow.

## 1. Introduction

The National Health Insurance (NHI) in Taiwan reimburses the healthcare services through fee for services [1]. The NHI reimbursement is a primary income for the medical institutes, which is based on the healthcare service that was provided, and the records of the materials and device consumed. The nursing specialists were to review all the procedure after the treatment and note down all the materials and devices consumed on a piece of paper and hand it to the administration staff to input it to the accounting system. Using the computer to assists accounting records not only has the potential in saving time and costs, but also improves the efficiency of finance management. The healthcare industry has applied all kind of information technology in simplifying workflow, reducing the opportunity of manual transcription and message transmission, increasing healthcare quality and patient satisfaction, and reducing the burden of medical staffs. In January 2011, the study hospital, which is an educational medical center in northern Taiwan that consisted of 2,328 beds, decided to develop a multiple account recording system (MARS) to support nurses and generate the consumed accounts through daily nursing records.

## 2. Methods

The questionnaire consists of 13 questions. It was designed to investigate 4 concepts, (1) whether the nursing staffs considered MARS as supportive and time saving, (2)

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whether the nursing staffs considered MARS had an impact on workflows and job satisfactions, (3) whether MARS is easy to use, and (4) overall satisfactions towards MARS. The questionnaire had gone through expert reviews, involving 5 clinical specialists. The questionnaire is based on Likert scale, ranking from 1 to 5 points for highly disagree to highly agree, and the overall user satisfaction were scored from 0 to 100, the higher score the better.

### 3. Results

112 users were invited to do the survey and 96 replied, achieving 80.7% response rate.

Table 1. Questionnaire survey of the impact of MARS

Questionnaires	N=112	Mean value
Time saving and supportive		
I think that MARS decreased the time for recording material consumption		3.98
I think that MARS decreased the time to teach new staff in recording material consumption		3.67
Impact on workload		
I think that MARS changes the way we work		3.98
I think that MARS changes the habits of recording accounts		3.97
I think that MARS is helpful for work		4.03
I think that MARS increase more burden for me		2.82
I think that MARS simplified the workflow for recording accounts		3.89
I think that MARS increases job satisfaction		3.82
Do you agreed that MARS increase the accuracy of accountings		3.93
Do you think that MARS is capable in increasing incomes?		3.79
Operation and interface		
I think that MARS is easy to use		3.67
I think that the functions of MARS is easily understandable		3.67
Overall satisfaction		
Overall satisfaction for MARS, ranking from 0 to 100		83.34

### 4. Discussion

While implementing information systems into clinical practices, it is important to analyze the workflow and implement the system without causing more efforts for the staffs. MARS was designed to generate the accounting records while the nurses are done with nursing records charting, it integrated with existed information systems and simply the work for staffs. The users mostly expressed positive attitude towards the system. It has its' impact on simplifying workflows and increasing job satisfaction.

### 5. Acknowledgments

The authors express great gratitude to the support and cooperation of the Information Systems Office, the Medical Affairs Office, National Taiwan University Hospital.

### References

- [1] Chang, M., Lin, J. S., Chang, Y. M., Lee, T. T. (2008). Applications of nursing information systems: sharing the experience of implementation in a hospital. *The Journal of Nursing*. 55(3).75-80.

# Early Assessment of Patient's Medical Condition in Ambulance Care Affects the Level of Care of Non Urgent Patients

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**Abstract.** The Rapid Emergency Triage and Treatment System (RETTS) is used by the Swedish ambulance care organization for assessment of patients medical condition. The aim of the present study was to evaluate prehospital assessment in collaboration with the ambulance nurse and primary health care physicians. If the patient's condition was priority GREEN by RETTS then the ambulance nurse decided to contact the primary care physicians for a dialogue and together they decided which level of care was the most appropriate for the patient's condition.

**Keywords:** Triage Classification (RETTS), emergency nursing, prospective cohort study

## 1. Introduction

The Ambulance organization provides qualified medical assessments and treatments. Several studies describe problems regarding to patient's medical condition and unnecessary ambulance transports to accident and emergency departments (A&E) (1). A new model for prehospital care for patients with non urgent medical conditions has been introduced.

The majority of all patients in ambulance care are assessed by RETTS (2). The patients are assessed at the scene by an ambulance nurse in collaboration with primary health care physicians for appropriate level of care. There are three levels of care; 1. The patient is ready to stay at home with supervision from the primary health care. 2. The ambulance transports the patient to the primary health care unit for assessment. 3. The ambulance transports the patient to the emergency ward. The main objective of the study was to examine patient outcomes with prehospital assessment in collaboration with the ambulance and primary health care.

## 2. Methods

The study design was a 1 year prospective study involving one ambulance district in the south west of Sweden with a population of 78 000 inhabitants. The study patients were consecutively included by an ambulance nurse. Eligible patients were adult patients 18 years of age and assessed as priority GREEN by RETTS. Data was

collected from all patient's Electronic Health Records during august 2014 – august 2015. Only patients who were priority GREEN by RETTS were included. The expected sample size was 200 patients to detect a reduction from 80 % to 50 % of patients transported to A&E. Statistical power of 80% with type I error of 5%. A control group was recruited from retrospective patients 14 months before start of the study. The patients were assessed and decision was made of ambulance nurse regarding appropriate level of care. No contact was taken with any physicians. The patients met the same inclusion and exclusion criteria as the study group.

### 3. Results

The study group and control group did not differ significantly in gender, age, time of day of admission, reason for calling ambulance and accommodation. Regarding staying at home, transport to emergency ward and admission to hospital ward there were statistically significant differences in favor of the study group ( $p < 0.001$ ). There was also a statistically significant difference regarding mean time of ambulance admission.

### 4. Discussion

The results indicate that it is possible to implement a prehospital assessment system in collaboration with the ambulance nurse and primary health care physicians. An early assessment of the patient's actual medical condition is important in order to decide the most appropriate level of care, to avoid unnecessary ambulance transport of patients to A&E.

### References

- [1] Hagiwara, M. A., Suserud, B. O., Jonsson, A., & Henricson, M. (2013b). Exclusion of context knowledge in the development of prehospital guidelines: Results produced by realistic evaluation. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, 21, 46-7241-21-46. doi:10.1186/1757-7241-21-46 [doi]
- [2] Widgren, B. R., & Jourak, M. (2011). Medical emergency triage and treatment system (METTS): A new protocol in primary triage and secondary priority decision in emergency medicine. *The Journal of Emergency Medicine*, 40(6), 623-628. doi:10.1016/j.jemermed.2008.04.003 [doi]

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# Health Consumers eHealth Literacy to Decrease Disparities in Accessing eHealth Information

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**Abstract.** The purpose of this study was to assess the perceived eHealth literacy of a general health consumer population so that health care professionals can effectively address skills gaps in health consumers' ability to access and use high quality online health information. Participants were recruited from three public library branches in a Northeast Florida community. The eHealth literacy scale (eHEALS) was used. The majority of participants (n=108) reported they knew how and where to find health information and how to use it to make health decisions; knowledge of what health resources were available and confidence in the ability to distinguish high from low quality information was considerably less. The findings suggest the need for eHealth education and support to health consumers from health care professionals, in particular, how to access and evaluate the quality of health information.

**Keywords.** eHealth literacy; Online health information; Health literacy; Internet

## 1. Introduction

An understanding of the deficits in current consumers' eHealth literacy skills is needed to enable health care providers to effectively address and remedy skills gaps in the context of eHealth service delivery. The purpose of this study was to assess the eHealth literacy skills of a general health consumer population so that health care professionals can effectively address skills gaps in health consumers' ability to access and use high quality online health information. The specific aims were: 1) to assess participants' eHealth literacy, and 2) determine if there are relationships between eHealth literacy skills and individual characteristics of participants.

## 2. Methods

After receiving approval from the Institutional Review Board at the researcher's institution, permission was obtained from library directors in three public library branches in a Northeast Florida community. The researchers visited the public libraries weekly to recruit participants and collect data for two months. The purpose of the study was explained to participants before obtaining consent from those willing to fill out the questionnaires. A total of 111 questionnaires were returned at three public libraries;

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three were incomplete. The remaining 108 questionnaires were analyzed for this study. Participants included men and women over 18 years old, of all ethnic groups, with the ability to read and write English. Participants' eHealth literacy was measured using the eHealth literacy scale (eHEALS) [1].

### 3. Results

Of the 108 library users who participated, 51.9% (n=56) were female and 48.1% (n=52) were male. Approximately half were Caucasian (n=56, 51.9%); slightly more than one-third were Black or African American (n=40, 37.0%). The majority had at least some college education (n=25, 21%), followed by a BA/BS (n=18, 16.7%) or Master's (n=18, 16.7%), a high school diploma or GED (n=16, 14.8%) and a Doctorate (n=13, 12.0%). Most of the respondents reported that they knew what health related resources were available on the Internet (n=62, 57.4%), where to find them (n=75, 69.4%), how to find helpful health resources (n=81, 75%), how to use the Internet to answer questions about health (n=78, 72.3%) and how to use the health information they find on the Internet to help themselves (n=73, 77%). However, while 69.5% (n=75) indicated that they had the skills needed to evaluate health resources found on the Internet and 60% (n=66) reported they felt confident in using this information to make health decisions, only 54.9% (n=59) reported they could distinguish high quality health resources from low quality resources. In relation to demographic characteristics, eHealth literacy was significantly associated with gender (p=0.01), employment status (p=0.005), hours per day of Internet use (p<0.001), and years of Internet use (p=0.002).

### 4. Discussion

A majority of participants in this study indicated they did not feel confident in their ability to differentiate between high quality and low quality health-related websites on the Internet. This self-perception suggests a potential limitation in health consumers' ability to identify key criteria that could help them discern which health information websites on the Internet can be trusted. Previous studies of health literacy confirm that of those who have access to health information online in the US report that they have difficulty evaluating if that information is credible [2, 3]. In this study, eHealth literacy skills were significantly associated with gender, employment status, health status, hours per day of Internet use, and years of Internet use while others, such as age, race, education level, marital status, and income level, were not. This is not surprising since eHealth literacy skills are connected to operational Internet usage skills, which co-occur with Internet use experience.

### References

- [1] C.D. Norman, H.A. Skinner, eHealth Literacy: Essential Skills for Consumer Health in a Networked World. *J Med Internet Res*. 2006; 8(2):e9
- [2] Manhattan Research. "Credibility, Accuracy, and Readability: Consumer expectations regarding online health information" 2003, Manhattan RESEARCH, Available at <http://www.manhattanresearch.com/Credibility,%20Accuracy,%20and%20Readability> Neoliberal Recovery Subject 23
- [3] H. Park, E. Lee, Self-reported eHealth literacy among undergraduate nursing students in South Korea: A pilot study 2015;35 (2):408-413

# User Expectations: Nurses' Perspective

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**Abstract.** Healthcare is a technology-intensive industry. Although all healthcare staff needs qualified computer support, physicians and nurses need more. As nursing practice is an information intensive issue, understanding nurses' expectations from healthcare information systems (HCIS) is a must issue to meet their needs and help them in a better way. In this study perceived importance of nurses' expectations from HCIS is investigated, and two HCIS is evaluated for meeting the expectations of nurses by using fuzzy logic methodologies.

**Keywords.** Healthcare Information System, Evaluation, User expectation, Ranking, Fuzzy Logic

## 1. Introduction

Healthcare Information System (HCIS), is the system composed of data, workflows, users, and technology; used to collect, store, process, and provide the needed information to support healthcare institutions and professionals [1].

Nursing Informatics is "A specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge, and wisdom in nursing practice." [2]. User expectations are stated as one of the success factors as well as the failure reasons of information systems (IS) in the literature [3-6]. The aim of the study is to examine the HCIS user expectations from the nurse's perspective.

## 2. Methods

$$RF_j = \sum_{i=1}^k W_i R_i / n \quad (1)$$

$$EMR = \sum_{k=1}^n W_k R_k / \sum_{k=1}^n W_k \quad (2)$$

In the previous work [7], "Expectation Questionnaire" was formed. For each expectation variable, an importance question was asked to capture the relative importance weight of the variable to the user. Also some questions for each variable were asked for expectations. Answers are expressed by 5-point Likert scale.

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In the study, part of the data (related to the nurses) captured in the previous study [7] by the Expectation Questionnaire is used. In hospital A, 170 of 504 questionnaires belong to the nurses. In hospital B, 26 of 96 questionnaires belong to the nurses. To examine the perceived importance of nurses' expectations from HCIS, expectations are rank ordered by (1). The second part of the study is conducted by measuring the EMRs of nurses, by (2).

### 3. Results

Ranking of HCIS expectations of nurses' and general users' are; Availability, Speed, Decreasing Work Load, Ease of Use, User Support, Need for Training, Improve Service Quality, Function Sufficiency, Consistency, Bringing Positive Change, Interoperability, Report Facilities, Decision Support, Research Facilities, Security, Help Manuals, Privacy.

In the results of the second part of the study, Hospital A has considerably lower ratios than hospital B. The HCIS in hospital A has been used for five months (newly deployed) when the measured was performed. Consistent with the difficulties in implementing a new HCIS [8] the expectations of the nurses were poorly met.

### 4. Discussion

The surprising finding in the first part of the study is, the second topmost ranked dimension, System and Data Expectations. The second ranked dimension in all users is Improvement expectations. The nurses have priority on data quality over improvement.

System and Data expectations are the highest met expectations in A and second in B. When the perceived importance ranking is considered, these expectations are ranked as the second by nurses; this part is also compatible and good values for both HCIS.

In this study an analysis from the nurses' perspective is done. To deploy, design, perform and improve HCISs to meet the needs better, this kind of analysis should be done; users should be kept in touch all the time trying to understand their preferences.

### References

- [1] K. A. Wager, F. W. Lee, and J. P. Glaser, *Managing Healthcare Information Systems: A Practical Approach for Healthcare Executives*, Wiley, San Francisco, 2005, 92.
- [2] American Nurses Association, *Nursing informatics: Scope and standards of practice*, Silver Springs, MD, American Nurses Association. (2008), 65.
- [3] Project Management Institute, *A guide to the project management body of knowledge (PMBOK guide)*, fourth Ed., Newtown Square, PA: Project Management Institute, 2004.
- [4] A.R. Montazemi, Factors Affecting Information Satisfaction in the Context of the Small Business Environment, *MIS Quarterly*, 12 (1988), 239-256.
- [5] Y.Li Eldon, Perceived Importance of Information System Success Factors: A Meta Analysis of Group Differences, *Information & Management*, 32 (1997), 15-28.
- [6] D.W. Conrath, and O.P. Mignen, What is Being Done to Measure User Satisfaction with EDP/MIS, *Information & Management*, 19 (1990), 7-19.
- [7] G. Gürsel, N. Zayim, K. H. Gülkesen, A. Arifoğlu, and O. Saka, A new approach in the evaluation of hospital information systems, *Turk. J. Electr. Eng. Co.*, 22(1)(2014), 214-222.
- [8] M. Berg, Implementing information systems in health care organizations: myths and challenges, *Int J Med Inf*, 64 (2001), 143-156.



# eHealth Literacy Skills Among Undergraduate Nursing Students in the U.S. and South Korea

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**Abstract.** Online health information is a critical resource for health consumers. Nursing professionals need to be eHealth literate to support patients and their families. The purpose of the study was to explore eHealth literacy skills among undergraduate nursing students in the U.S. and South Korea. One hundred and sixty-nine undergraduate nursing students in two universities, one in the southern area of the U.S. and one in the eastern area of South Korea, participated. Participants were asked to complete the eHealth Literacy Scale. The majority of participants perceived that the Internet is a useful or very useful tool in helping them make health-related decisions. The participants either agreed or strongly agreed with the 7 items of the eHealth literacy scale except an item such as they can call high to low quality of online health information. The U.S students have higher mean scores of all eHealth literacy items than students of South Korea.

**Keywords.** eHealth literacy; Internet; Undergraduate Nursing students, Online Health Information

## 1. Introduction

As Internet health information becomes increasingly accessible, health professionals are expected to engage in information sharing with the public and to assist them with finding, understanding, and evaluating health information. For this, health professionals should be eHealth literate. Moreover, a plentitude of Internet health information exists, but the quality of online health information varies. Some Internet sites even provide low quality information. It is, therefore, important that patients be taught to identify health information sites and to discriminate between high and low quality health information so that they avoid making health decisions using low quality information. eHealth literacy is defined as the ability to seek, find, understand, and appraise health information from electronic resources and apply such knowledge to address or solve a health problem [1]. Gilmour [2] described that nurses, especially, must have eHealth literacy skills since they are necessary to assess patients' use of eHealth information and correct patients' misconceptions about their illness due to incorrect interpretations of online information. There were only few studies about eHealth literacy skills among undergraduate nursing students. The purpose of the study

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was to assess eHealth literacy among undergraduate nursing students in the U.S. and South Korea.

## 2. Methods

The 169 participants were undergraduate nursing students from two universities, one in the Southern area of the U.S. and one in the Eastern area of South Korea. eHealth literacy was measured by 8 items of eHealth literacy scales (eHEALS) [3]. After Institutional Review Board (IRB) approval, an invitation email was sent to students enrolled in the nursing program in two universities, one in the U.S. and one in South Korea. An explanation of the study's purposes and an embedded link to the Internet survey packages, which included the questionnaire and an online consent form, was emailed to students. The data collection period was one semester, about 4 months. The total response rate was 61% (169 out of 276).

## 3. Results

The composite mean score for eHealth literacy (as measured by 8 items) was 31.95 (SD=5.4) out of the possible 40 with a score range from 17 to 40. Of the 169 participants, 88 participants (52.1 %) had high eHealth literacy. Over 30 % participants strongly agreed that they could find helpful information (n=52, 30.8%), use the Internet to answer their questions about health (n=57, 33.7%), use health information they found (n=54, 32%), and evaluate health resources (n=51, 30.2%). However, regarding having confidence to use information from the Internet to make health decisions (n=44, 26%) and having the ability to tell high quality health resources from low quality health resources on the Internet (n=39, 23.1%), only 23 to 26% participants strongly agreed that they have these skills. In comparison of two countries' undergraduate students' eHealth literacy skills, the U.S students have higher mean scores for all items than Korean students

## 4. Discussion

In this study, we found that there are areas in need of improvement. Based on the area need to improve, we suggest that educators should address the weakness in developing curriculum. For example, one weakness from this study, distinguish information quality is need to improve among undergraduate students.

## References

- [1] C.D. Norman, H.A. Skinner, eHEALS: The eHealth Literacy Scale. *J Med Internet Res.* 2006; 8(4):e27.
- [2] J.A. Gilmour, Reading disparities in the access and use of Internet health information. A discussion paper. *International Journal of Nursing Studies*,2007; 44, 1270-1278.
- [3] C.D. Norman, H.A. Skinner, eHealth literacy: Essential skills for consumer health in a networked world. *J Med Internet Res.* 2006;8(2), e9.

# Telerehabilitation Services in Pakistan: A Rehabilitation Professional's Perspective

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**Abstract.** Disabled community spending a miserable life and having no or very less access to basic health and rehabilitation care across Pakistan. WHO developed objectives for the provision of standard health and rehabilitation care to disables and emphasizes to achieve them till 2021. The Purpose of this study was to assess the future of tele-rehabilitation services in Pakistan. It was quantitative study with Sample size of 100 rehabilitation professionals across the country. Result showed that Telerehabilitation Services are strongly needed in Pakistan and professionals rated it as a best alternate of facility based rehabilitation services. We can provide a wide range of services through Telerehabilitation Services ranging from simple consultation to delivery of different therapeutic sessions and online monitoring.

## 1. Introduction

Rehabilitation can be generally understood as a goal or objective, a process or a set of practices. Rehabilitation is closely associated with the term “restoration” that denotes as a return to a former or desirable state or position. About 110-190 million (2.2%-3.8%). people are older than 14 years and are experiencing signification limitation in their functioning. The World Health Organization is working hard for the rehabilitation of those physically and mentally handicapped persons. WHO defined three main objectives for the provision of equality based health care and other services to all disabled community of the world and especially in the developing countries. Due to certain issues WHO revised its guidelines and proposed new timeframe to achieve these goals till 2021.

Telerehabilitation can be defined as an emerging method of delivering rehabilitation services with the help of ICT's for the provision of rehabilitation services to the targeted population. It allows clinicians with an efficient, quick and cost effective access to their patients living in remote areas. Shortage of Rehabilitation services particularly in developing countries served stimulus for the development of tele-rehabilitation Services for the provision of standard, face to face and cost effective rehabilitation services regardless of time and space.

## 2. Methods

It was a survey based quantitative study with the sample size of 100 rehabilitation professionals.

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### **3. Results**

There were 56% female and 44% male participants in this study. A great majority of participants (84%) were using smart phones and were using different communication tools. Participants had good knowledge about telemedicine and tele-rehabilitation and more than 50% recommended telerehabilitation services for rehabilitation services at door steps. Among the participants (26%) rated tele-rehabilitation as an extremely useful and 36% as a very useful for rehabilitation services at community level.

Tele-rehabilitation services were rated as extremely acceptable by 18% of the participants and very acceptable by 32% and somewhat acceptable by 40% of participants. A merge count of 8% participants said that lack of ICT knowledge may limit the success of tele-rehabilitation and 09% said that high cost of technology while 03% said it could be rapidly changing technology may limit its usefulness. Among the participants 26 % rehabilitation professionals said that they can provide consultation, prescriptions and required therapy to the patients through telerehabilitation. However, 10% said only monitoring and 2% said that nursing care can also be provided and 62% chooses all of these options.

### **4. Discussion**

There is huge scope and gape of telerehabilitation services because of shortage of qualified professionals and lack of resources. Telerehabilitation services will be very useful and successful in Pakistan because 70% of the total population belongs to rural areas where the infrastructure and health facilities are very poor. Mobile based telerehabilitation programs will be more successful and acceptable in Pakistan because most area of the country have mobile phone coverage. We can offer almost all kind of services to the patient including consultation, assessment, prescription, management, monitoring and follow ups cost effectively and efficiently.

### **References**

- [1] WHO Disability and Health Fact sheet N°352, Reviewed December 2014.
- [2] WHO global disability action plan 2014-2021, 2014
- [3] S. B. O'Sullivan, T. J. Schmitz, and G. Fulk, *Physical rehabilitation*: FA Davis, pp. 38-41 2013.
- [4] D. Kairy, P. Lehoux, C. Vincent, and M. Visintin, "A systematic review of clinical outcomes, clinical process, healthcare utilization and costs associated with telerehabilitation," *Disability & Rehabilitation*, vol. 31, pp. 427-447, 2009.
- [5] S. B. O'Sullivan, T. J. Schmitz, and G. Fulk, *Physical rehabilitation*: FA Davis, pp. 38-41 2013.
- [6] M. McCue, A. Fairman, and M. Pramuka, "Enhancing quality of life through telerehabilitation," *Physical medicine and rehabilitation clinics of North America*, vol. 21, pp. 195-205, 2010.
- [7] M. T. dos Santos, S. C. Moura, L. M. Gomes, A. H. Lima, R. S. Moreira, C. D. Silva, et al., "Telehealth application on the rehabilitation of children and adolescents," *Rev Paul Pediatr*, vol. 32, pp. 136-43, Mar 2014

# Organizational Benefits of Computerized Physician Order Entry (CPOE) System in Pakistan

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**Abstract.** Electronic prescribing is also known as Computerized Physician Order Entry (CPOE). It is a computer-aided system which offers the health professionals a robust platform for entering the prescription electronically. Due to paucity of facilities in Pakistan which are available around the world, there is an observable overburden on the health professionals and practitioners. CPOE system has shown to be very effective in minimizing medication errors. CPOE is beneficial for both patient and health organizations. There is great deal of interest in the adoption of this system in our healthcare system. The results state clearly that this system is equally beneficial for organizations who want to adopt this system as perceived by the health professionals. It supports the idea of adoption and implementation of CPOE in healthcare facilities healthcare institutes. CPOE must be adopted to ease and optimize nursing services in Pakistani healthcare system.

**Keywords.** Organizational benefits; CPOE; health professionals; adoption; implementation

## 1. Introduction

Electronic prescribing or e-prescribing is system of electronic entry of medication orders. These instructions are shared over a network which is accessible to every medical department. This system not only saves time but also reduces chances of medication errors due to legibility problems and transcription of medication orders and reduces delays in order completion [1]. It also aids in error checking and duplicate entry for doses and laboratory tests.

CPOE systems became more popular and important after the publication of findings of the “Committee on Quality on Health Care in America on Medical Errors and Improvement of the Quality of the Health System”. The findings recommended and suggested that the extensive introduction of CPOE would significantly reduce the medication errors. Bates et.al, [2, 3] have reported that CPOE aids in reducing medication errors up to 84% in US. Literature witnesses that CPOE offers more advantages over paper based system of prescribing, the old one [4].

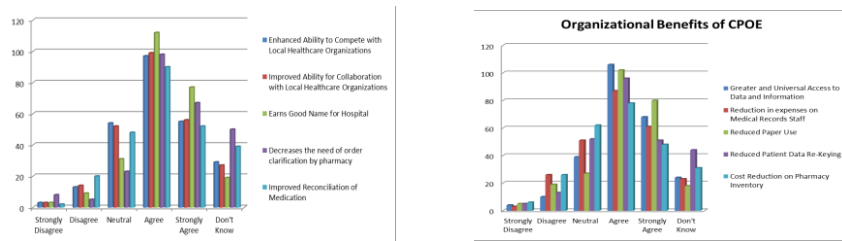
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## 2. Methods

We used a questionnaire as data collection tool. It is a part of larger study conducted to find perceptions regarding overall benefits of CPOE, while this paper only aims to find organizational benefits of CPOE. Data was collected from four major cities of Punjab province. 251 participants responded out of 500 distributed questionnaires and response rate was 50%.

## 3. Results



## 4. Discussion

The results call for an action to implementation of CPOE in healthcare system of Pakistan. Lack of infrastructure as well as political will might be the major factors impeding the adoption and implementation in Pakistan. It was found that majority of the population has a useful knowledge of computer and its application in health sector. As evidenced by the literature review CPOE is not only supportive to health professionals in proper care delivery but also is an important tool to save the expenses incurred on the healthcare delivery.

CPOE has been implemented in developed world showing its potential benefits. There is need to implement this system in our healthcare system. Now it is proper time to implement this system in our healthcare system as IT industry is rapidly expanding in Pakistan. In future further studies must be conducted to establish the evidence among other health professionals including the Pharmacists and nurses.

## References

- [1] P. Sengstack, B. Gugerty. CPOE systems: success factors and implementation issues. *Journal of healthcare information management: JHIM*. 2003;18(1):36-45.
- [2] E.M. Campbell, D.F. Sittig, J.S. Ash, K.P. Guappone, R.H. Dykstra. Types of unintended consequences related to computerized provider order entry. *Journal of the American Medical Informatics Association*. 2006;13(5):547-56.
- [3] G.J. Kuperman, R.F. Gibson. Computer physician order entry: benefits, costs, and issues. *Annals of internal medicine*. 2003;139(1):31-9.
- [4] D.W. Bates, J.M. Teich, J. Lee, D. Seger, G.J. Kuperman, N. Ma'Luf et al. The impact of computerized physician order entry on medication error prevention. *Journal of the American Medical Informatics Association*. 1999;6(4):313-21.

# A Serious Game for Teaching Nursing Students Clinical Reasoning and Decision-Making Skills

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**Abstract.** The aim of this study was to design and pilot-test a serious game for teaching nursing students clinical reasoning and decision-making skills in caring for patients with chronic obstructive pulmonary disease. A video-based serious game prototype was developed. A purposeful sample of six participants tested and evaluated the prototype. Usability issues were identified regarding functionality and user-computer interface. However, overall the serious game was perceived to be useful, usable and likable to use.

**Keywords.** community health nursing, computer simulation, education, problem-based learning, serious games, user-computer interface

## 1. Introduction

Simulation technologies embedded in ‘serious games’ have appeared in the educational games market [1]. Serious games (SGs) combine knowledge and skills development with video game playing aspects. SGs enable active, experiential, situated and problem-based learning. In nursing education, SGs provide nursing students with an opportunity to practice clinical reasoning and decision-making in a realistic and safe environment [2].

Despite a growing number of serious games developed for healthcare professionals, few serious games are video-based or address the domain of home health nursing.

## 2. Methods

A video-based SG prototype was developed. The project employed a unified framework of usability named TURF [3] and theory in SGs design [4] to ensure a user-centered design. The educational content and quiz-based tasks were based on the Clinical Decision-Making Model [5], Blooms taxonomy [6] and the curricula in the bachelor program in nursing at University of Agder. The objective of our SG was to increase nursing students clinical reasoning and decision-making skills in clinical

situations related to patients with chronic obstructive pulmonary disease (COPD) living at home. To provide realistic situations from clinical practice, a registered nurse (RN) from home healthcare and a person with COPD participated as actors in the video-based scenarios.

A purposeful sample of six participants tested and evaluated the SG prototype in a usability laboratory. The usability evaluation methods included a cognitive walkthrough, a questionnaire and individual interviews. Content analysis was used.

### 3. Results

Our SG was perceived as realistic, clinically relevant, and easy to learn. However, several usability issues were identified such as: lack of demonstration of how to use embedded links and solve drag-and-drop tasks, desired functionality to view both wrong and right answers, and a limited range of navigation options to go back and forth in the game.

### 4. Discussion

A combination of different theoretical approaches in the design of our SG was experienced as an advantage. Issues identified regarding functionality and user-computer interface emphasize the importance of usability evaluation during the process of development of a SG before implementation.

### 5. Acknowledgments

We would like to give a special thanks to faculty members at University of Agder, students, actors and healthcare professionals involved in the development and testing of the SG.

### References

- [1] C. Girard, J. Ecalte and A. Magnan. Serious games as new educational tools: how effective are they? A meta-analysis of recent studies. *J Comput Assist Learn* **29** (2013) 207-219.
- [2] R. P. Cant and S. J Cooper. Simulation in the Internet age: The place of Web-based simulation in nursing education. An integrative review. *Nurse Educ Today* **34** (2014), 1435-1442.
- [3] J. Zhang and M. F. Walji. TURF: Toward a unified framework of EHR usability. *J Biomed Inform* **44** (2011), 1056-1067.
- [4] L. A. Annetta. The "I's" have it: A framework for serious educational game design. *Rev Gen Psychol* **14** (2010), 105-112.
- [5] E. S. O'Neill, N. M. Dluhy and E. Chin. Modelling novice clinical reasoning for a computerized decision support system. *J Adv Nurs* **49** (2015), 68-77.
- [6] S. Whei Ming, S. and P. J. Osisek. The Revised Bloom's Taxonomy: Implications for Educating Nurses. *J Contin Educ Nurs* **42** (2011), 321-327.

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# POLESAT an Innovative e-Geoplatform in Health Management

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**Abstract.** Health geography and geomatics have become major disciplines in the last few years and are the source of attractive concepts for medical informatics. POLESAT's e-geoplatform was built to present information and support decision-making during medical consultation. We have improved its usability with innovative and modern methodology. Results show five steps of the process. **1:** we select one of three hospitals. **2:** thanks to PiNoKio's anatomy, the related activity segments are displayed. **3:** the activity segment "AB-Orthopedics, Rheumatology" is displayed. **4:** click on "AB02-Amputations" product line and **5:** go to hospital activity choropleth map. Conclusion: This third e-geoplatform version is a showcase for advanced open-source geomatics via web-mapping possibilities. Health management based on geography concepts, geomatics, an amusing avatar for children, health and/or geographic open data represent the technology of tomorrow. This e-geoplatform concept presents an opportunity for the serious games industry, education and will reduce health access inequalities.

**Keywords.** geomatics, e-geoplatform, decision-making, medical visualization knowledge, serious games, programmed medical choice, education.

## 1. Introduction

Health geography and geomatics (Geographic information and GIS) have become major disciplines in the last few years and are the source of attractive concepts for medical informatics. POLESAT's e-geoplatform was built to present information and support decision-making for professionals and the general public. Our e-geoplatform proposes to guide a programmed medical choice during a consultation.

To optimize e-geoplatform usability, we have incorporated geographical and medical knowledge visualization approaches (VCM), dynamic and interactive web pages [1]. For e-geoplatform3, the challenge is to test an open-source web-mapping service for atlases and to pursue our communications on POLESAT.

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## 2. Methods

The architecture of the dynamic website, the VCM medical iconic language (PiNoKio©) and the security and state of the servers has remained unchanged from e-geoplatform2 [1].

We have tested the GIS environment and web-mapping servers "QGis – Lizmap®". The map data and geocoded PMSI fictive data are stored in the QGis© for map processing. Choropleth mapping outcomes are provided thanks to QGis and *LizMap Plugin*, sent and stored in the *QGis server* and *Lizmap client* until a "request client" displays the requested maps thanks to HTTP, HTTPS, WMS protocols [2, 3].

## 3. Results

The webpage1 prototype represents an interactive map of the Nord-Pas-de-Calais region. By clicking on the circle, we select one of three hospitals: Dunkerque, Lille and Valenciennes. Webpage2 shows an attractive and amusing dynamic avatar: PiNoKio. Click on one of PiNoKio's legs and the table of related activity segments is displayed on webpage3.

Once the administrative and statistical information has been observed and analyzed, click on the activity segment: "AB-Orthopedics, Rheumatology". Webpage4: Click on the product line "AB02-Amputations" and go to web-mapping choropleth map Step 5.

## 4. Discussion

This regional e-Atlas is a showcase for advanced open-source geomatic possibilities [1]. Health management based on geography concepts, an amusing avatar for children, geomatics, health and geographic open data represent the technology of tomorrow.

This e-geoplatform concept [4] presents an opportunity for the serious games industry, education and will reduce health access inequalities owing to the fact that e-Atlas and PiNoKio provide a better and easier guide for health care units according to the cultural aspects of patients (mobility, habits, languages, etc.).

## 5. Acknowledgments

The authors wish to thank all those who contributed to this research.

## References

- [1] A. Quesnel, J. Soula, F. Dufosse, N. Sharma, A. Ruhela, R. Beuscart: POLESAT, an innovative e-health geomatic platform in decision-making based on: Geographical approach, medical knowledge visualization & geographic information system & web-mapping architecture. *IRBM*, **34** (2013), 267-273.
- [2] Development Team: Quantum GIS Geographic Information System: Open Source Geospatial Foundation Project, <http://qgis.osgeo.org/fr/site/>, 2014.
- [3] R.L. D'Hont, M. Douchin: Lizmap software, <http://www.3liz.com/lizmap.html>, 2014.
- [4] A. Quesnel-Barbet, F. Dufosse, A. Hansske, M. Souris, D. Delerue: Géomatique en Santé et applications dans le nord de la France. *Techniques de l'Ingénieur*, (in press) 2016.

# Decision Support System in the Nursing Instruction Information System

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**Abstract.** The purpose of this study is to explore the usage frequency of the decision support instruction in the nursing information system, and to survey the technology acceptance among nurses in one hospital. The results indicated that the usage frequency of the care instruction was increased from 191.3 to 1308.5 per month. Nurses also rated the "perceived usefulness" the highest score, followed by "perceived ease of use" in the survey.

**Keywords.** Decision Support System, nursing instruction, nursing information system, Technology Acceptance Model.

The integration of Decision Support System (DSS) with nursing instruction information systems not only provides more alternatives for nursing use, but also produces individualized nursing instructions for patient care needs [1][2][3]. Analysis of the type nursing instruction, almost is disease cognition, health care, medicine cognition, notes of physical or lab examination, care of post-operative and skill of home care. So, using 9th International Classification of Diseases (ICD9), code of drugs and lab...etc.. To establishment of database. (table1)

This study applied the Technology Acceptance Model (perceived usefulness, perceived ease of use, use attitude, use intention) as a framework (Figure 1) to design a questionnaire to survey the technology acceptance of nurses toward the nursing instruction information system [4][5]. Furthermore, this study explored the outcome of technology use both with and without an embedded DSS.

Table1 Analysis of the type nursing instruction to establishment of database

types of nursing instruction	corresponding standard.	example
disease cognition, health care, care of post-operative	ICD9	Understanding of hypertension
medicine cognition	code of drugs	Understanding of diuretics
notes of physical or lab examination	code of physical or lab examination	Colonoscopy Information
skill of home care	code of medical material	Foley for home Care

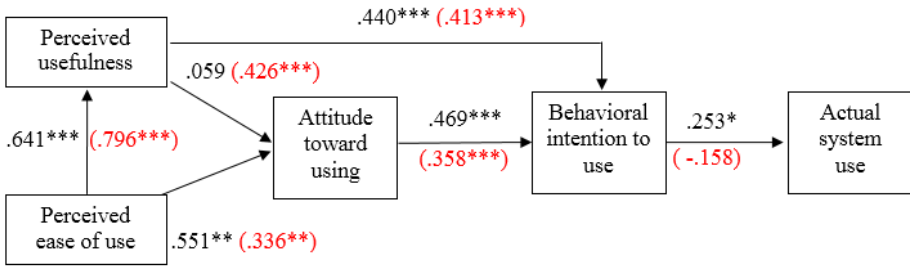
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**1. Methods**

Nurses working in an outpatient department of a medical center at which a DSS was embedded into the nursing instruction information system were recruited to complete a questionnaire survey on technology acceptance. Data downloaded from the database for 4-month pre-and-post results were analyzed to compare the differences in usage.

**2. Results**

Results indicate that perceived usefulness was rated higher than perceived ease of use, with actual use increasing significantly from 191.3 to 1308.5 times per month ( $Z = -3.72, p < .001$ ). Usage in different categories increased significantly as well ( $Z = -3.52, p < .001$ ). Variables of the technology acceptance model did not affect actual use. (Figure 1.)



**Figure 1.** DSS intervene before and after, the path of the analysis coefficient comparison TAM (Brackets mean after intervention)

**3. Discussion**

Although DSS implementation increased actual usage, the variables did not increase usage. This may be attributable to the features of the DSS, interface design, workflow, and print speed.

**References**

- [1] B.M. Gunnarsson and M. Warrén Stomberg, Factors influencing decision making among ambulance nurses in emergency care situations. *International Emergency Nursing*. 17 (2009), 83–89.
- [2] R.B. Haynes and NL. Wilczynski, Effects of computerized clinical decision support systems on practitioner performance and patient outcomes: Methods of a decision-maker-researcher partnership systematic review. *Implementation Science* 5 (2010), 12.
- [3] I. Cho, N Stagers, I.Park, Nurses’ responses to differing amounts and information content in a diagnostic computer-based decision support application. *CIN: Computers, Informatics, Nursing*. 28 (2010), 95–102.
- [4] CC. Chou, CP Chang, TT. Lee, HF Chou, ME Mills, Technology acceptance and quality of life of the elderly in a Telecare program. *CIN: Computers, Informatics, Nursing* 31 (2013), 335–342.
- [5] FD. Davis, Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*.13 (1989), 319-340.

# An Efficient User Interface Design for Nursing Information System Based on Integrated Patient Order Information

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**Abstract.** A user friendly interface can enhance the efficiency of data entry, which is crucial for building a complete database. In this study, two user interfaces (traditional pull-down menu vs. check boxes) are proposed and evaluated based on medical records with fewer medication orders by measuring the time for data entry, steps for each data entry record, and the complete rate of each medical record. The result revealed that the time for data entry is reduced from 22.8 sec/record to 3.2 sec/record. The data entry procedures also have reduced from 9 steps in the traditional one to 3 steps in the new one. In addition, the completeness of medical records is increased from 20.2% to 98%. All these results indicate that the new user interface provides a more user friendly and efficient approach for data entry than the traditional interface.

**Keywords:** Nursing information system, User interface design, Usability

## 1. Introduction

Nursing information system is extremely important in a hospital, especially for recording patient treatments, nursing interventions, and physician orders. A userfriendly interface can enhance the efficiency of data entry, which is crucial for a complete database establishment. In this study, a new user-friendly interface is proposed and evaluated by medical record documentation instead of traditional questionnaire that investigates users' satisfaction. Since traditional questionnaire investigation provides users' subjective perception while documentation evaluation - a more objective approach - can verify the outcome of new interface design.

## 2. Methods

Records of antipyretic medication are used as indicators in this study. The proposed new user interface incorporated a pre-filtered list of antipyretic medication corresponding to patients' physical information and physicians' previous prescriptions. The traditional user interface only lists pull-down menu, which contains no patients'

past information and required nursing staff to use scroll down bar to select physician's prescription.

For comparison, a 3-month chart review on antipyretic medication prescription was analyzed on three perspectives. First, the time spent on data entry. We recorded the time when user select this function(Create time), and the time when user save the date(Recorded time). "Recorded time" minus "Create time" was the time on data entry. Second, the steps required for data entry. Third, the completeness of the medical records.

### 3. Results

The time for data input is reduced from 22.8 seconds per record for the traditional user interface to 3.2 seconds per record for the new user interface. As for the operation steps, data entry has been reduced from 9 steps for the traditional interface to 3 steps for the new interface. In addition, the completeness of medical records increases from 20.2% to 98%. All these results indicate that the new user interface provides a more userfriendly and efficient approach for data entry than the traditional one.

### 4. Discussion

The new user interface has adopted a pre-filtered listed menu in nursing information system, which can dramatically reduce the time and steps for data entry. It increases nursing staff's working efficiency as well. In addition, the completeness of medical record is also significantly improved. All of these show that the new proposed user interface with integrated patient medication orders can lead to a major improvement in design of nursing information system. In the future, the proposed user interface can be further developed with all the drug prescriptions, instead of being limited to antipyretic medication.

### References

- [1] P.A. Hortman and C.B. Thompson, Evaluation of user interface satisfaction of a clinical outcomes database, *Comput Inform Nurs*, **23** (2005), 301-307.

# Utilization of Communication Robot in Patient Education

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**Abstract.** In Japan, the population is expected to decrease. Moreover, the proportion of elderly people living alone among the elderly population is expected to increase for both men and women. Therefore, the demand for elderly care is increasing year by year. In this paper, we aim at making environment in which elderly people can receive interactive guidance, and reducing the burden on medical staff such as caregivers and nurses. So, we design a patient education by ARCS model which classifies concepts related to learning motivation, and consider to utilize a communication robot "Pepper".

**Keywords.** Patient education, ARCS model, Communication robot, Pepper, Learning motivation

## 1. Introduction

Japan is facing problems such as shortage personnel in care and nursing field due to advancement of aging society with falling child birthrates and decline of population of people in production ages<sup>[1]</sup>. This study aims at making environment in which elderly people can receive an interactive guidance even if they are at home and reducing the burden on medical staff such as caregivers and nurses. For that purpose, we consider utilization of communication robots.

## 2. Communication Robots

Communication robots aim to live associated with the human being unlike industrial robots which improve work efficiency. A Danish communication robot named "Alice" is reported. Alice is approximate 60cm tall and Alice is good at communication with elderly. Alice can speak human language, and inform a medical staff of the records<sup>[2]</sup>. In addition, Paro, a fur covered robotic seal, was specifically designed for therapeutic uses with the elderly<sup>[3]</sup>.

In Japan, People have a high affinity to robots. The main reasons are robots which help people such as "Astro Boy" and "Doraemon" are well known. We therefore try to utilize communication robots for patient education in Japan. In this study, we use



Figure 1: Pepper  
(Aldebaran/ SoftBank Robotics)

“Pepper” (Figure 1). Pepper is approximately 120cm tall and Pepper has a tablet terminal mounted with a touch panel. Pepper as well as Alice can communicate with people, however, Pepper is different from Alice in that Pepper's speaking words are displayed on tablet terminal and also users can play games such as card game with this tablet terminal.

### 3. Developing Applications

We try to make environment in which elderly people can receive interactive guidance even if they are at home and reducing the burden on medical staff such as caregivers and nurses, and we have developed the application for medication advice and diet support until now. These are designed by ARCS model <sup>[4]</sup> which classifies concepts related to learning motivation into four categories: "attention," "relevance," "confidence," and "satisfaction".

The application for medication advice is evaluated between medical staff from 30 to 89 years old in Japan. The result shows “Pepper’s impression”, “attachment to Pepper”, “motivation to learn”, “comprehension”, and “attention” are highly valued <sup>[5]</sup>. We consider Pepper’s looks and behavior are like children, so Pepper is highly acceptable to users especially elderly. The personal robot “Alice” is similar in this point, but Japanese people prefer Pepper to Alice culturally. Because Alice looks like human beings too much, many Japanese people feel somewhat weird.

In this time, we developed a new application. It is used to prevent hypertension. The points that we thought and worked out are as follow: Pepper shows the statistical graph of user’s blood pressure value with a comment to explain the data visually. Moreover, all of our applications have the function that the medical staff and family can get to know the user’s medical data by e-mail.

### 4. Conclusion

We developed the new application for elderly people to prevent hypertension by communication robot “Pepper”. In the future, we will enrich not only the education contents but also Pepper’s conversation pattern and amusement application.

### References

- [1] Japan’s Ministry of Economy, Trade and Industry, Japan’s Robot Strategy, 2015
- [2] M A. M. van Kemenade, E. A. Konijn and J. F. Hoorn, Robots Humanize Care Moral Concerns Versus Witnessed Benefits for the Elderly, HEALTHINF2015 8<sup>th</sup> International Conference on Health Informatics, Lisbon, Portugal, 12-15 January, 648-653, 2016
- [3] A. Sharkey, N. Sharkey, Granny and the robots: ethical issues in robot care for the elderly, *Ethics Inf Technol*, pp.27-40, 2012
- [4] J.M.Keller, An integrative theory of motivation, volition, and performance, *Technology, Instruction, Cognition, and Learning*, 6(2), 79-104, 2008
- [5] K. Ishiguro, Y. Majima and N. Sakata, 2015. Deployment of ARCS Model and Utilization of Communication Robot in Patient Education, HEALTHINF2016 9<sup>th</sup> International Conference on Health Informatics, Rome, Italy, 21-23 February, 2016



# The Effectiveness of Peritoneal Dialysis System Implementation on Case Management

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**Abstract.** Peritoneal dialysis management system (PDS) is special design system to integrate all dialysis-related information for PD case managers. This study aims to investigate the impact of peritoneal dialysis system (PDS) implementation on the work efficacy of PD case managers. This study carried out in the PD unit of medical center in northern Taiwan. We utilized work sampling and chart reviews to compare the changes of work efficacy of PD case managers before and 3 months after PDS implementation.

The results of this study showed direct care increased to 38.3% while indirect care decreased to 18% and unit-related care to 6.2%. The time spent on the five category activities has statistically significant difference before and after implementation of PDS. The completion rate of records has no statistically significant difference before and after the implementation of PDS. This study demonstrated that PDS implementation significantly affected the care patterns of PD for case managers.

**Keywords.** peritoneal dialysis system; work sampling; chart review; system evaluation

## 1. Introduction

Globally, Taiwan ranks first in the prevalence of end-stage renal disease (ESRD). Peritoneal dialysis (PD) is a major and important renal replacement therapy, therefore the government decided to promote PD case management in order to improve the quality of medical care for patients with ESRD.

Peritoneal Dialysis System (PDS) is an information system that integrates laboratory data, medical management and health care records for every patient receiving PD. By connecting with the web-based hospital information system, PDS could automatically retrieve a patient's profile, doctor's orders and laboratory data and integrate it into a single electronic medical record. This study aims to investigate the impact of PDS implementation on the work efficacy of PD case managers.

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## 2. Methods

This study were 11 registered nurses served as PD case managers in this unit and PDS was introduced in June 2015. During the study period, 435 patients received maintenance PD. We utilized work sampling to record the time the PD case manager spent on each domain of care service. We also performed chart reviews to collect the completion rate of recording within 24 hours of a patient's visit. All observations were gathered before PDS and 3 months after its implementation to compare the changes in work efficacy. We were approved by the IRB201507094RIND of the study hospital.

## 3. Results

1,252 work observations were Before and after PDS implementation, the percentages of time PD case managers spent on direct care (such as dialysate exchange and patient education) were 26.9% and 38.3%, respectively. On the other hand, the time spent on indirect care (such as case discussions), changed from 19.0% to 18.0%. Furthermore, case managers went from spending 17.3% of their time on administrative work and prescription checkups to only 6.2% after PDS implementation. These results indicate that PDS significantly affected the care pattern of PD for case managers.

We also performed chart reviews (N=68) to investigate the immediate completion rate of care recordings within 24 hours of patients' visit was 73.0% before PDS implementation. After PDS implementation, the completion rate of electronic medical recordings was 75.0%. These results indicate that completion rate of records have no statistically significant difference before and after the implementation of PDS.

## 4. Discussion

Our results revealed that after PDS implementation, PD case managers spent more time on direct care of patients. They saved time on integrating assessments into medical records, indirect care and administrative work. This indicates that PDS significantly affects the pattern of medical care in PD case managers. On the other hand, the completion rate of medical recording within 24 hours had not improved 3 months after implementation. We inferred this might be due to the unfamiliarity of the new working system to case managers. Many studies suggested that effectiveness of an information system should be evaluated 6 months after its implementation or even later. Further investigations at a later time will be necessary to evaluate its effectiveness on PDS.

## 5. Acknowledgments

Thank all members of National Taiwan University Hospital that contributed to us.

## References

- [1] E.C. Hunt, S.B. Sproat, and R.R. Kitzmiller *The Nursing Informatics Implementation Guide..* Springer-Verlag, 2013.

# Study on Synchronization of the Heart in a Nursing Art

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**Abstract.** Compared to rookie nurses, it is often said that a skilled nurse's injection is less degree of pain. The authors believe that the reason why the pain is reduced is because skilled nurses can make themselves relaxed and synchronize their state to the patients. So, if we can make people relaxed and synchronized intentionally by giving artificial stimulation, the technique will be so valuable not only in the inheritance of injection skills but also in various medical situations including the care of aged, nursing of infant and so on. In this paper, we focused on the synchronization of brain waves, and examined the method of inducing the relaxed state and the synchronization in brain waves of subjects by giving a vibratory stimulation.

**Keywords.** Synchronization, Brain wave, Alpha wave band content, vibratory stimulation, Correlation coefficient.

## 1. Introduction

In this paper, we focus on the synchronization in brain wave. Brain wave is in close contact with mental condition of human. And there is the paper which reported that the synchronization in brain waves between nurse and patient occurs more strongly when the injection was successful than it failed<sup>[1]</sup>. Therefore, we think the synchronization of brain waves creates the so-called breath-matched situation in which it is easy for people to do collaborative work, communicate and understand each other.

## 2. Method

We gave the vibratory stimulation which imitates the man's heartbeat and breathing rhythm to five pairs of subjects simultaneously and analyzed whether the stimulation is effective in increase of  $\alpha$  wave band content and brain wave synchronization inducing.

In the heartbeat-model stimulation (HS), we attached two vibrating motors to the chest of subjects and gave 8 kinds of continuous pulse vibration being different in the interval (100, 90, ..., 30 times per minute) for one minute. In the breathing-model stimulation (BS), we attached one vibrating motor to the chest and another to the stomach of subjects. We reflected the quantity of lung air in the breathing action (IN, HOLDING, OUT) to the strength of vibration. And we gave 5 kinds of 2 minutes BS which the time configuration (IN, HOLDING, OUT) is differ from each other .To

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evaluate the relaxed state, we calculated the  $\alpha$  band content in the brain wave. And to evaluate the degree of synchronization between each pair of subjects, we calculated the absolute value of correlation coefficient between the 1 minute time series of  $\alpha$  band content in each pair which is smoothed by secondary Butterworth filtering (Cut-off frequency is 0.1 [Hz]).

### 3. Results

We show the results below. In Table1, A represents the average of all subjects'  $\alpha$  band content and the types which show the highest two of the absolute value of correlation coefficient in each pair are painted darkly.

**Table 1,**  $\alpha$  band content and the absolute value of correlation coefficient

Type		A [%]	Correlation coefficient					
			Pair 1	Pair 2	Pair 3	Pair 4	Pair 5	Average
HS [times/min]	100	36.4	0.00	0.10	0.14	0.03	0.10	0.08
	90	33.8	0.04	0.00	0.07	0.07	0.14	0.07
	80	35.2	0.05	0.20	0.00	0.12	0.09	0.09
	70	37.8	0.13	0.05	0.02	0.27	0.00	0.09
	60	35.9	0.02	0.01	0.06	0.08	0.05	0.04
	50	35.0	0.06	0.07	0.05	0.33	0.07	0.12
	40	35.2	0.33	0.03	0.23	0.02	0.03	0.13
	30	33.6	0.10	0.07	0.23	0.01	0.31	0.14
BS	1	35.7	0.04	0.04	0.10	0.03	0.13	0.07
	2	37.2	0.25	0.35	0.10	0.36	0.16	0.24
	3	39.0	0.24	0.23	0.11	0.42	0.11	0.22
	4	37.4	0.04	0.07	0.15	0.24	0.10	0.12
	5	36.2	0.10	0.13	0.02	0.47	0.03	0.15
<b>No stimulation</b>		31.2	0.10	0.19	0.07	0.20	0.08	0.13

### 4. Discussion

At the view of increase of  $\alpha$  wave band content, we can see the general rise of  $\alpha$  band content both in HS and BS. So we can say that the vibratory stimulation itself is effective in rising the  $\alpha$  band content in brain wave and making people relaxed. At the view of inducing brain wave synchronization, we can see the tendency that higher value of correlation coefficient in each pair is gathered at Type 30 ~ 50 [minute] in HS and Type 2 and 3 in BS. We think this tendency is relevant to usual biological rhythm of subjects.

### 5. Acknowledgments

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### References

- [1] K. Tsuneo, "Synchronization in EEG Data between Nurse and Patient during Needle Operation for Blood Collection", the Conference of Japan Ergonomic Society, Japan, 2014

# CarerSupport – An Innovative Approach to Informal Carers’ Training and Collaboration

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**Abstract.** EU and national policies for long-term care acknowledge the role of informal carers. However, there is still little adequate support to prepare or ease informal carers in terms of training to allow them improve their skills, alleviate psychosocial stress and maintain their own health and well-being. In the CarerSupport project, we seek to integrate services, deploy and test an integrated ICT platform enabling participation and collaboration of informal carers, psychologists and health professionals to collaborate, facilitate training and orientation, offer tele-consulting services and psychosocial support to carers. Based on this platform and its content, we will deploy and report on informal carers’ experiences with the wide range of offered service. The poster will present the first experiences and suggest potentials for a service like CarerSupport.

**Keywords.** AAL, informal carers, caregiver burden, support services, assessment

## 1. Introduction

The success of active ageing and social inclusion policies has always depended on the ever-important human care factor. Support provided by formal and informal carers to vulnerable individuals, i.e. individuals who cannot function without the practical help of others, is a prime example of human care. The informal carers’ role is challenging, given that they have to deal with a variety of symptoms and treatments, interact with care services spanning a wide range of illnesses, diseases, chronic conditions and health problems. Specifically, informal carers need to understand various conditions, while also possessing relevant knowledge and acquiring required skills to provide support. At the same time, carers need psychosocial support to cope with challenges of their role, i.e. emotional labor [1], and perform their tasks in sustainable way.

New, innovative tools and efficient services can help and give support to informal carers’ significant responsibilities in care for vulnerable persons who depend on practical help to sustain life and maintain health. CarerSupport is an internet-based platform with tailored learning-material, tele-consultation, access to information that can enhance coping, and opportunities to communicate with other informal caregivers. The goals are to offer practical support and contribute to alleviate experienced stress coming from their demanding caregiving responsibilities [2]. The selection of information and learning resources, opportunities to exchange experiences and knowledge with peers (other informal carers), and consult with health professionals,

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can help attending to questions, providing answers and coaching for the carers. In this poster, we will share the first experiences with CarerSupport and discuss opportunities for learning and reported benefit of participation in a peer-support network.

## 2. Methods

Informal carers will be recruited to use the CarerSupport platform in a pilot test fall 2015 – spring 2016. We will evaluate the CarerSupport platform and services from the informal carers' perspective, using questionnaires to elicit 1) informal carers' experience of usefulness, 2) informal carers' perceptions of their caring responsibility, and 3) experience/ usefulness of the CarerSupport platform.

## 3. Results and discussion

In the poster we will present informal carers' perspective, accounts and experiences of usefulness and suggestions for improvements, and how or if the CarerSupport services' alleviate burden or support care giving.

## 4. Acknowledgments

The CarerSupport project is funded under the AAL Joint Program, AAL-2012-5, call5's theme: ICT-based Solutions for (Self-) Management of Daily Life Activities of Older Adults at Home, specific application areas: Secondary end-users / informal carers. We acknowledge the contributions of consortium members, and in particular Birgitte Holmene, Ellen Andersen and Solfrid R. Lyngroth.

## References

- [1] S. Payne, Resilient carers and caregivers, in: *Resilience in palliative care: achievement in adversity.*, B. Monroe and D. Oliviere, eds., Oxford University Press, Oxford, 2007.
- [2] B. Candy, L. Jones, R. Drake, B. Leurent, and M. King, Interventions for supporting informal caregivers of patients in the terminal phase of a disease, *Cochrane Database Syst Rev* (2011), CD007617.

# My Cancer Care Plan as a Web-Solution

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**Abstract.** The Swedish National Cancerplan states that patients should be offered an Individual Care Plan (ICP) for the treatment and survivorship care and rehabilitation planning. As there is no web-solution for ICP available, the project aim is to develop a non-commercial web-solution based on communication between the contact nurse and the patient.

**Keywords.** Cancer care plan, web-solution, contact nurse, patient communication

## 1. Introduction

The Swedish National Cancer Plan states that patients should be offered both oral and written information regarding treatment and care. The National Cancer Plan also requires that patients with cancer should be offered an individual written plan for treatment including survivorship care planning. This document should be initiated at diagnosis, follow the treatment trajectory and be updated accordingly.

The Individual Care Plan (ICP) should include:

- Contact information
- Information on medical procedures and treatments
- Time schedule for medical procedures and treatments
- Plan for cancer rehabilitation.

In Sweden today there is no available web-solution for ICP.

## 2. Methods

In this project we develop a non-commercial web-solution for ICP, based on communication between the contact nurse and the patient. The solution will have information transferred from the electronic health record (EHR) such as contact information and appointments.

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Together with contact nurses and breast cancer patients the web-solution will be tested in order to find a working solution. The solution will after tests with breast cancer patients be adapted for other cancer patient groups.

### **3. Results**

The web-solution includes an option for the contact nurse to individualize patient information (choosing different items from a list) and send it to the patient. The contact nurse can also send questionnaires for systematic symptom reporting to be able to initiate and tailor an early rehabilitation process. The patient can read the information and/or fill in the questionnaires on a mobile device and the contact nurse can respond and take actions directly. The web-solution include an alarm system (high scores on a symptom give a direct signal in the contact nurses phone with the message to contact the patient. In order to improve evidence based nursing care, the solution will include an option to link to manuals or clinical guidelines for decision making. The web-solution will also offer self-care advice for cancer-related symptoms.

During the whole treatment and survivorship trajectory, the contact nurse can respond to and then send back relevant advice and add new information. In the web-solution it will also be possible for the patients, as well as the contact nurse, to follow reported symptoms in graphs. This will make it much easier to follow the symptoms over time.

The web-solution will follow the regulations in Sweden concerning patient and data integrity. The web-solution will be tested, and further developed, together with patients and contact nurses and results from the project will be presented at the conference.



# What if It Was Like a Departure Lounge at an Airport?

-eHealth for Healthcare Staff in a Swedish Healthcare Organization, a Participatory Design Study

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**Abstract.** eHealth is implemented in everyday work practice as a tool to improve accessibility and patient participation as well as healthcare efficiency. The aim of this study was to explore healthcare staff's experiences and ideas about how eHealth ought to be designed to be a useful tool in everyday work practice in a Swedish healthcare organization. Healthcare staff (n= 7) at the micro level in a Swedish healthcare organization, participated in four Participatory Design workshops about eHealth design. eHealth could be a more useful and efficient tool in everyday work practice if it were designed more purposefully for its local setting and intended users, like the information system in 'a departure lounge of an airport'. Including healthcare staff in design discussions concerning eHealth tools for everyday work practice may improve the efficiency of eHealth as an everyday tool and support for healthcare staff.

**Keywords.** eHealth, healthcare staff, Participatory design, Swedish healthcare organization

## 1. Introduction

In Swedish healthcare organizations, eHealth is implemented in everyday work practice as a tool to improve accessibility and patient participation as well as healthcare efficiency [1-3]. Often, however, healthcare staff are not invited to the design process of eHealth. The aim of this study was to explore healthcare staff's experiences and ideas about how eHealth ought to be designed to be a useful tool in everyday work practice in a Swedish healthcare organization. This study is a part of the project Health in Hand (Blekinge Institute of Technology).

## 2. Methods

This study was inspired by Participatory Design (PD) [4] and Computer Supported Collaborative Work [5]. Healthcare staff (n= 7) at the micro level [5] in a Swedish healthcare organization in the south of Sweden, participated in four workshops about how eHealth ought to be designed to be a useful tool in their everyday work practice.

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### 3. Results

Healthcare staff participating in the workshops suggested that eHealth could be a more useful and efficient tool in everyday work practice if it were designed more purposefully for its local setting and intended users, like the information system in 'a departure lounge of an airport'. Using a single, individual log-in, each user would, they suggested, access a startup page with information about patients, staff, planned activities for that day, links to relevant patient records, and to administrative tools and support. With one comprehensive and shared start up page, the staff agreed that they could work efficiently, be more accessible, and improve patient participation.

### 4. Discussion

Including healthcare staff in design discussions concerning eHealth tools for everyday work practice led to a focus on shared work spaces and purposeful structuring and highlighting of timely information for planned activities during the day. eHealth tools ought to be easily adaptable to suit local needs and contexts of use. Improving the efficiency of eHealth as an everyday tool and support for healthcare staff will in turn most probably also improve accessibility and patient safety.

### 5. Acknowledgements

We would like to acknowledge the inspiration and design ideas contributed by the healthcare staff who participated in this study. Without their innovative ideas, devotion and engagement during the workshops, this study could not have been accomplished. The Health in Hand project is funded by the Swedish Governmental Agency for Innovation Systems [VINNOVA Reg.No.2013-04660].

### References

- [1] L. Nilsson, M. Hofflander, S. Eriksen, C. Borg, The importance of interaction in the implementation of information technology in health care: A symbolic interactionism study on the meaning of accessibility. *Inform Health Soc Care*. 2012;37:277-90.
- [2] M. Hofflander, L. Nilsson, S. Eriksen, C. Borg, Discharge planning: Narrated by nursing staff in primary healthcare and their concerns about using video conferencing in the planning session – An interview study. *Journal of Nursing Education and Practice*. 2013;3:88-98.
- [3] A.J. Mahmud, Designing ICT-supported health promoting communication in primary health care. [Doctoral dissertation] Karlskrona: Blekinge Institute of Technology; 2013.
- [4] R.L. Baskerville, A.T. Wood-Harper, A critical perspective on action research as a method for information systems research. *J Inf Technol*. 1996;11:235-46.
- [5] E. Balka, Getting the big picture: the macro-politics of information system development (and failure) in a Canadian hospital. *Methods of information in medicine*. 2003;42:324-30.



# Living with Chronic Obstructive Pulmonary Disease and Being Followed Up Through Telemedicine – A Phenomenological Approach

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**Abstract.** Chronic obstructive pulmonary disease (COPD) provides substantially reduced health related quality of life (HQoL). Telemonitoring on COPD patients appears to have a positive effect on improving HQoL. This study has a phenomenological approach, and ten informants, who were followed-up between 1 and 3 months in their own homes through telemonitoring of COPD symptoms, narrated their lived experiences of HQoL. The results show that the informants experienced safety and increased knowledge through the digital dialog (telemedicine) with expertise nurses, which indirectly improved their HQoL, and in term lead to increased mastery and control in managing their disease. Several studies show an increased HQoL, but the benefits are still limited and there is a need for further research.

**Keywords.** COPD patient, telemedicine, health related quality of life, phenomenology

## 1. Introduction

Chronic obstructive pulmonary disease (COPD) is a serious, progressive, chronic disease, which provides substantially reduced quality of life [1]. To have had increased dyspnea [2] and exacerbations [2,3] have been found to impair health related quality of life (HQoL) in COPD patients. These results show that in order to improve HQoL, effective management of exacerbations are needed [2,3].

Telemonitoring in COPD patients appears to have a positive effect in improving HQoL [4]. The aim of the study is to describe the lived experiences of HQoL among a group of COPD patients who were included in a telemedical intervention after a hospital stay.

## 2. Methods

The study has a phenomenological research approach, and is based on narratives of lived experiences of HQoL among patients with COPD that have been included in a

telemedical intervention between one and three months. Ten informants were interviewed, and the interviews consisted of two open questions that would enhance the informants to narrate their own lived experience.

The data were analyzed through a descriptive phenomenological research method designed by Giorgi [5]. The results are based on an analysis of five out of ten interviews. The research design is approved by the Norwegian Social Science Data Services (project number: 41146).

### 3. Results

The results from the analysis showed that the informants' experienced increased knowledge and safety concerning their chronic disease through digital dialog and monitoring (telemedicine) by nurses with expertise on COPD. Improved knowledge gave patient increased mastery and control over their disease. Furthermore, the digital dialog affected their health related quality of life indirectly; as the patient experienced personal presence from their nurses, direct clinical information followed by confirmation and treatment in the comforts of their own homes.

### 4. Discussion

For patients with COPD, safety is a distinct experience which all of the participants acknowledged. This experience had a positive impact on HQoL, and affected the life of each informant in managing the disease. Several studies show an increased HQoL when patients with COPD are monitored through telemedicine, however, the benefits are still limited and there is a need of further research in order to test telemedicine solutions on a larger scale.

### 5. Acknowledgments

We want to acknowledge the University of Agder, United4Health, the eHealth center and the Uglund-foundation for the opportunity to conduct this research.

### References

- [1] WHO. Chronic respiratory disease. COPD management. Retrieved from: <http://www.who.int/respiratory/copd/management/en/>
- [2] L. Lirong L. Yingxiang Y. Ting. Z. Hong. L. Jie. W. Chen. Determinants of health-related quality of lifeworsening in patients with chronic obstructive pulmonary disease at one year. *Chinese Medical Journal*, 2014; 127: 4-10.
- [3] C.T. Solem. S. X. Sun. L. Sudharshan. C. Macahilig. M. Katyal. X.Gao. Exacerbation-related impairment of quality of life and work productivity in severe and very severe chronic obstructive pulmonary disease. *International Journal of COPD*, 2013; 8: 641-652.
- [4] J. Cruz. D. Brooks. A. Marques. Home telemonitoring effectiveness in COPD: a systematic review. *The International Journal of Clinical Practice*, 2014, doi: 10.1111/ijcp.12345
- [5] A. Giorgi. *The Descriptive Phenomenological Method in Psychology: A Modified Husserlian Approach*. Pittsburgh (PA); Duquesne University Press: 2009.

# An eNursing Solution for Patients with Home-Ventilation – The eVent@home-Tool

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**Keywords.** eNursing, home-ventilation, HL7 CDA, SNOMED CT, ICNP, LOINC

## 1. Introduction

In the spreading field of home-ventilation, a lack of interoperability exists in the documentation and communication of nursing measures between the various stakeholders in the German healthcare system.

Above that, the acute shortage of well-trained nurses, with appropriate experience in the care of that particular patient clientele and the necessary know-how for the safe handling of complex medical devices, aggravates the problematic circumstances [1].

## 2. Methods

With the eVent@home-tool, a new kind of standardized and web-based eNursing software solution shall be implemented in home-ventilation care. The IT foundation will be an HL7 CDA document, using the standards SNOMED CT, ICNP and LOINC.

## 3. Results

The software solution will be developed, tested and rolled-out in a 3-year-period research- and development project sponsored by the local Ministry of Health (MGEPA).

## 4. Discussion

The eVent@home-tool offers an optimized holistic approach on eNursing, which considers the individual, gender, cultural and social needs of home-ventilated patients.

It may improve the specific nursing education via an embedded eLearning tool.

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## **References**

- [1] S.J. Lloyd-Owen, G.C. Donaldson et al. Patterns of home mechanical ventilation use in Europe: Results from the Eurovent survey. *Eur Respir J.* 25: 1025-1031. 2005

# Application of Text Mining in Cancer Symptom Management

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**Abstract.** Fatigue continues to be one of the main symptoms that afflict ovarian cancer patients and negatively affects their functional status and quality of life. To manage fatigue effectively, the symptom must be understood from the perspective of patients. We utilized text mining to understand the symptom experiences and strategies that were associated with fatigue among ovarian cancer patients. Through text analysis, we determined that descriptors such as energetic, challenging, frustrating, struggling, unmanageable, and agony were associated with fatigue. Descriptors such as decadron, encourager, grocery, massage, relaxing, shower, sleep, zoloft, and church were associated with strategies to ameliorate fatigue. This study demonstrates the potential of applying text mining in cancer research to understand patients' perspective on symptom management. Future study will consider various factors to refine the results.

**Keywords.** Text mining, cancer care, symptom management, eHealth, data mining

## 1. Introduction

Ovarian cancer is the fourth leading cause of cancer related deaths in women in the United States<sup>1,2</sup>. Patients with ovarian cancer often experience multiple symptoms, which decrease functional status and quality-of-life (QOL)<sup>3</sup>. Fatigue has been identified as one of the most common symptoms of ovarian cancer patients<sup>1</sup>; however, management strategies for fatigue have come from the perspective of providers. The concerns of patients and their strategies for symptom management need to be identified for more effective care. The aim of this study was to understand the symptom experiences and strategies that were associated with fatigue management among women with ovarian cancer through the use of text mining.

## 2. Methods

We used data collected from a previous web-based ovarian cancer symptom management intervention. We extracted patients' qualitative responses to two prompts: (1) Please describe your fatigue; (2) What things have you done to try to manage your fatigue? First, patient responses were cleaned because user-generated documents feature noise created by nonstandard characters, numbers, and frequently used

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abbreviations and contractions (e.g. I'm, isn't). These features were removed or edited to render the English commensurate with the R Project for Statistical Computing program (R program). Additionally, common punctuation marks (e.g., quotes, commas, and colons), symbols (e.g., \$, #, and @), and stop words (i.e., of, a, an, the, and to) were removed<sup>4</sup>. After preprocessing the data, we calculated correlations between words, a quantitative measure of the co-occurrence of words in the corpus, to identify which descriptors were associated with the word fatigue in each questionnaire.

### 3. Results

Among 165 participants, 70 wrote about fatigue as one of their three primary symptoms of concern. From the first question, we found that the descriptors energetic ( $r=0.54$ ), challenging, frustrating, struggling, unmanageable ( $r=0.48$ ), and agony ( $r=0.40$ ) were associated with fatigue. For the second question, decatron, encourager, grocery, massage, relaxing, shower, sleep, zoloft, and church ( $r=0.55$ ) were associated with fatigue.

### 4. Discussion

Text mining has shed new light on health research by identifying useful information from unstructured text. Since the methodology only focused on co-occurrence of words, it may have limitation to reflect contextual factors. However, we learned patients' needs and perspective from the patient reported outcome through the text mining. This result provides us insights what we need to consider to develop for a symptom management intervention. Our next study will address various factors (e.g., age, cancer stage) to refine our text analysis approach to improve QOL in cancer patients.

### 5. Acknowledgments

This study was supported by the Ruth Perkins Kuehn Research Award (University of Pittsburgh; Lee, PI) and the National Institute of Nursing Research (R01NR010735; Donovan, PI).

### References

- [1] S.W. Fox, D. Lyon. Symptom clusters and quality of life in survivors of ovarian cancer. *Cancer Nurs* 30 (2007), 354-61.
- [2] American Cancer Society. What are the key statistics about ovarian cancer?  
<http://www.cancer.org/cancer/ovariancancer/detailedguide/ovarian-cancer-key-statistics>.
- [3] B.C. Thomas, A. Waller, R.L. Malhi, T. Fung, L.E. Carlson, S.L. Groff, B.D. Bultz. A longitudinal analysis of symptom clusters in cancer patients and their sociodemographic predictors. *J Pain Symptom Manage* 47(2014), 566-78.
- [4] B. Liu B, M.J.. Carey, S. Ceri. *Web data mining: exploring hyperlinks, contents and usage data*. Springer, Berlin, 2006.
- [5] P.B. Jensen, L.J. Jensen, S. Brunak. Mining electronic health records: towards better research applications and clinical care. *Nat Rev Genet* 13(2012), 395-405.

# VIH-TAVIE™ Relational Model of Engagement: Creating Meaningful Connections to Empower People Living with HIV via a Virtual Nursing Intervention

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**Abstract.** The use of information and communication technologies for designing web-based nursing interventions is growing exponentially. Despite the interest devoted to such approaches, little is known about their foundational principles and the way they translate into virtual nursing practice to generate meaningful engagement with patients. VIH-TAVIE™ is a virtual nursing intervention aiming to empower people living with HIV to help them in managing their antiretroviral therapy. Here we present VIH-TAVIE™ relational model of engagement – its core components informed by interview data with patients and a virtual nurse: building a virtual presence founded on caring relational principles and values; creating a caring environment where patients feel safe, supported and respected; stimulating patients' engagement by offering supportive and tailored messages; transposing nursing communication skills into a virtual practice to build trust and reciprocal relationships. This study suggests that empowering connections can develop between a nurse and a patient within a caring virtual environment.

**Keywords.** virtual nursing intervention, people living with HIV, engagement, caring interactions, qualitative research, information and communication technologies

## 1. Introduction

The use of Information and communication technologies (ICTs) for designing web-based nursing interventions is growing exponentially. This involves the development of new relational approaches and abilities for nurses to meaningfully engage with patients. Despite the interest devoted to such approaches, little is known about their foundational relational principles and the way they translate into virtual nursing practice to generate meaningful engagement with patients. VIH-TAVIE™ is a virtual nursing intervention aiming to empower people living with HIV (PLHIV) to help them in managing their antiretroviral therapy. This consists of four virtual interactive computer sessions delivered by a nurse who guides PLHIV through a learning process in an asynchronous way, through video. The intervention was developed [1, 2] and evaluated using a mixed

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methods research design to test its effectiveness in optimizing treatment adherence for PLHIV [3] and to describe the experience of patients who participated in the intervention [4]. The aim of this work is to present VIH-TAVIE<sup>TM</sup> relational model of engagement – its core components and principles informed by a patient and nurse perspective.

## 2. Methods

We report on a secondary data analysis undertaken as part of VIH-TAVIE<sup>TM</sup> qualitative research stream. Interview data with patients (n=26) are used to further explore one of the five themes identified in the primary qualitative research [4] (i.e. virtual nurse humanizes experience of the computer-delivered intervention) to pinpoint key components of meaningful interactions between PLHIV and the virtual nurse. Informal discussions with the nurse who participated in delivering the intervention helped to better understand how these components translate into virtual nursing practice. Data is subjected to qualitative thematic analysis. Findings are articulated in the form of a model which incorporates the patients' and virtual nurse's perspectives.

## 3. Results

Core inter-related components characterize VIH-TAVIE<sup>TM</sup> relational model of engagement: building a virtual presence that is founded on caring relational principles and values; creating a caring environment where patients feel safe, supported and respected; placing patients' needs at the centre of the interactions by providing educational messages adapted with regards to unique responses from participants; stimulating patients' engagement by offering supportive messages aimed at developing a positive vision of themselves and reinforcing their current abilities at managing their treatment; transposing nursing communication skills into a virtual practice to build trust and reciprocal relationships with patients (e.g. eye contact with the camera, tone of the voice, language adapted to patients' health literacy).

## 4. Discussion

This study sheds light on key components of a relational model of engagement informed by a patient and nurse perspective to generate caring interactions in the context of a virtual nursing intervention dedicated to PLHIV. VIH-TAVIE<sup>TM</sup> relational model of engagement suggests that empowering connections can develop between a nurse and a patient within a positive virtual environment.

## 5. Acknowledgments

The study is funded by the Canadian Institutes of Health Research (CIHR, 2007-2012).

## References

- [1] J. Côté, et al.: Program development for enhancing adherence to antiretroviral therapy among persons living with HIV. *AIDS Patient Care STDs*, 2008, 22(12): p. 965-975.
- [2] J. Côté, et al.: A nursing virtual intervention: Real-time support for managing antiretroviral therapy. *Comput Inform Nurs*, 2011, 29(1): p. 43-51.
- [3] J. Côté, et al: Virtual intervention to support self-management of antiretroviral therapy among people living with HIV. *JMIR*, 2015, 17(1), e6.
- [4] J. Côté, G. Rouleau, et al.: Virtual nursing intervention adjunctive to conventional care: The experience of persons living with HIV, *JMIR Research Protocol*, 4(4), e124.

# How Do Information and Communication Technologies Influence Nursing Care?

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**Abstract** Despite the well-known advantages of information and communication technologies (ICTs), their overall impact on nursing care has not been synthesized. The objective of this overview of systematic reviews is to summarize the best evidence regarding the effects of ICTs on nursing care. We considered quantitative, qualitative and mixed-method reviews published since January 1995. Two reviewers independently screened the title and abstract of 5515 papers to assess their eligibility. From these, 72 full-text papers were evaluated and 28 publications met the inclusion criteria. Three reviewers extracted and compared their data. Preliminary results show that the following dimensions of nursing care are the most frequently reported: assessment, care planning and evaluation, documentation time, quality of care and patient safety. This overview provides a starting point from which to compare and contrast findings of separate reviews regarding the positive, neutral and negative effects of ICTs on nursing care.

**Keywords.** information and communication technology, e-health, telehealth, nursing practice, nursing care, nursing sensitive outcomes, overview.

## 1. Introduction

The implementation of information and communications technologies (ICT) in practice is difficult and involves changes at different levels: patients, healthcare providers and healthcare organizations [1]. Nurses constitute the largest health provider group of the healthcare workforce [2]. They are compelled to deal with the introduction of ICTs within nursing care, which can have impacts on their practice [4]. The lack of an integrated body of knowledge led to the creation of an overview of systematic reviews aimed at systematically summarizing the best evidence that comes from systematic reviews regarding the positive, neutral and negative effects of ICTs on nursing care.

## 2. Methods

We included all types of reviews (quantitative, qualitative and mixed) published in English from January 1995. Registered nurses and nurses in training were included as long as they provided direct care to patients. These types of ICTs were targeted: management systems, communication systems, computerized decision support systems, and information systems [1]. The Nursing Care Performance Framework [4] was used

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as a logic model to target the dimensions of nursing activities [5] that have the potential to be influenced by ICTs. This model was also used as an extraction grid. Two reviewers independently screened the title and abstract of the reviews to assess their eligibility. Three reviewers summarized the characteristics of included reviews, performed the data extraction and assessed their methodological quality. A narrative synthesis was done to summarize the data.

### 3. Results

A total of 5515 titles/abstracts were assessed for eligibility; full-text papers of 72 articles were retrieved for detailed evaluation. Twenty-eight publications met the eligibility criteria. Eighteen reviews used a mixed method research approach, nine used a quantitative approach and only one used a qualitative approach. The AMSTAR tool [6] was used to assess the methodological quality of the quantitative reviews (n=9). Three had high quality and six had medium quality. We found no tool to evaluate the quality of qualitative and mixed systematic reviews.

More than one third of reviews documented changes in assessment, care planning and evaluation. Seven reviews reported impacts of ICT on nursing documentation time associated with management systems (ex: electronic health record). Quality of care and patient safety was also an outcome largely influenced by ICTs. Documentation quality was another outcome, frequently reported in association with quality of care. In seven reviews, ICT used by nurses had a positive impact on patient outcomes.

### 4. Discussion

The methodological quality was not assessed for qualitative and mixed method research approach, which is a limit of the current overview. For now, there is no tool to appraise the different types of reviews that could allow uniform evaluation. In this overview, we aimed to include different types of systematic reviews to document the effects of ICTs on nursing care. The conceptualisation of nursing care using a macroscopic model was useful to explain different components of the nursing care system.

### 5. Acknowledgments

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### References

- [1] F. Mair, et al: Factors that promote or inhibit the implementation of e-health systems: an explanatory systematic review. *Bull World Health Organ*, 2012. 90: p. 357 - 364.
- [2] *Institute of Medicine: Keeping Patients Safe: Transforming the Work Environments of Nurses*. Washington, DC: National Academic Press; 2004.
- [3] A.J.E. de Veer, et al.: Successful implementation of new technologies in nursing care: a questionnaire survey of nurse-users. *BMC Med Inform Decis Mak* 2011, 11.
- [4] C.-A. Dubois, D. D'Amour, et al.: Conceptualizing performance of nursing care as a prerequisite for better measurement: a systematic and interpretive review. *BMC Nurs* 2013, 12:7-7.
- [5] D. D'Amour, C.-A. Dubois, et al.: Measuring Actual Scope of Nursing Practice: A New Tool for Nurse Leaders. *J Nurs Adm* 2012, 42:248-255.
- [6] B.J Shea, et al.: AMSTAR is a reliable and valid measurement tool to assess the methodological quality of systematic reviews. *J Clin Epidemiol*, 2009. 62(10): p. 1013-1020.

# Call for Increased Patient Support Focus: Review and Evaluation of Mobile Apps for Tuberculosis Prevention and Treatment

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**Abstract.** Tuberculosis (TB) remains a major global public health problem and is a leading killer due to an infectious disease. Mobile applications (apps) could support TB prevention and treatment. App stores were searched and of the 1332 reviewed 24 met our inclusion criteria. For each app 11 functionalities were assessed. The majority were targeted towards clinicians (n=17), few patient focused (n=4). Most had fewer than 4 functions out of 11, *inform* and *record* being the highest. Peer reviewed publications were identified for 2 of the apps and 3 apps in testing stage were found in the grey literature. Apps for TB prevention and treatment had minimal functionality, primarily targeted clinicians, and focused on information or data collection. None were for patient self-management of care and treatment or to improve patient-provider interactions. Identifying TB patient needs and involving them in the design phase is recommended.

**Keywords.** mHealth, mobile applications, review, treatment support

## 1. Introduction

The World Health Organization recently reported Tuberculosis (TB) as now rivaling HIV/AIDS as a leading cause of death.[1] In 2014, TB killed 1.5 million people while the estimated death toll of HIV was 1.2 million people which included 0.4 million TB deaths among HIV positive people.[1] Given that most deaths from TB are preventable and nearly all cases can be cured, this death toll is recognized as unacceptably high. Mobile health (mHealth)-based tools, such as smartphone applications (apps), are reported to be an ideal platform for improving health outcomes because of their popularity, connectivity, and increased sophistication.[2] Apps have the potential to support TB prevention and treatment efforts by, for example, supporting healthcare providers in diagnosing TB, and monitoring patient progress as well as providing support to patients to successfully complete treatment.[3]

## 2. Methods

We conducted searches in 3 mobile app stores from within the US during June 2015: Apple iTunes Store, Android Google play Store, and Amazon Appstore. We used the search terms tuberculosis, TB, phthisis, and tuberculose in each of the app stores. Apps were eligible for inclusion if they focused on TB control efforts and excluded if they focused on other infectious diseases, were games, or unrelated, and not in English,

Spanish or Portuguese. For each app 11 functionalities were assessed by two reviewers. Searches were conducted in peer review publications for TB app evaluations and in the grey literature for apps in development or testing.

### 3. Results

1332 potentially relevant apps were identified, with 24 meeting our inclusion criteria. All were free to download, 7 required login/password and were developed for specific clinics or research studies. Targeted users were mainly clinicians (n = 17); few (n = 4) were patient focused. Most apps (n=17) had a total of 4 or fewer functions out of 11 (range 1-6). The most common functionalities were *inform* and *record* (n=15). Some had issues, such as incorrect spelling and grammar, inconsistent responses to data entry, problems with crashing, or links to features that had no data. Eight apps had not been updated for more than a year. Peer reviewed publications were identified for two of the included apps and 3 in the grey literature (not found in the app stores) as in progress, being launched, or tested.

### 4. Discussion

Even though the app market is huge, apps as a potential solution to support TB prevention and treatment are limited in scope and functionality. Almost all of the identified apps targeted healthcare providers as end users, and the majority provided access to a broad spectrum of TB information or to tools aimed to support frontline healthcare workers in monitoring, detecting, and documenting visits. Few TB related apps targeted patients as end-users which limits the potential of these apps to facilitate patient-centered care. None were developed to support TB patients' involvement and management in their care (e.g., follow-up alerts/reminders, side effects monitoring) or to improve interaction with their healthcare providers. Our evaluation shows that more refined work needs to be done in the area of apps for TB. Involving TB patients in treatment in the design of these apps is recommended.

### 5. Acknowledgments

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### References

- [1] World Health Organization, Global Tuberculosis Report 2015. 2015.
- [2] Hale, K., S. Capra, and J. Bauer, A Framework to Assist Health Professionals in Recommending High-Quality Apps for Supporting Chronic Disease Self-Management: Illustrative Assessment of Type 2 Diabetes Apps. *JMIR Mhealth Uhealth*, 2015. 3(3): p. e87.
- [3] Denking, C.M., et al., Mobile health to improve tuberculosis care and control: a call worth making. *Int Journal of Tuberculosis and Lung Disease*, 2013. 17(6): p. 719-27.

# Current Trends in Nursing Informatics: Results of an International Survey

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**Abstract.** Nursing informatics (NI) can help provide effective and safe healthcare. This study aimed to describe current research trends in NI. In the summer 2015, the IMIA–NI Students Working Group created and distributed an online international survey of the current NI trends. A total of 402 responses were submitted from 44 countries. We identified a top five NI research areas: standardized terminologies, mobile health, clinical decision support, patient safety and big data research. NI research funding was considered to be difficult to acquire by the respondents. Overall, current NI research on education, clinical practice, administration and theory is still scarce, with theory being the least common. Further research is needed to explain the impact of these trends and the needs from clinical practice.

**Keywords.** nursing, informatics, research trends, research priorities, international survey.

## 1. Introduction

Nursing informatics (NI) can help provide effective and safe healthcare. Currently, NI is a fast evolving discipline. Unfortunately, little is known about the current trends in NI research. We conducted an international survey to describe current NI research trends.

## 2. Methods

We designed an online questionnaire based on major themes from NI literature [1-2]. The questionnaire was translated into six languages (Arabic, English, Korean,

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Portuguese, Spanish and Swedish). Nurses and other allied health professionals with experience in NI from academia and practice were eligible to participate. Snowball sampling technique was used to reach as many respondents as possible internationally. Questions were broad in scope, in attempt to provide an overview of overall trends. Questions asked centered on participants' perspectives of NI within their respective countries. Topics included perceptions of NI national policies and standards and research, satisfaction with state of health information systems development, state of resources and infrastructure, potential future trends, and efforts that should be taken to advance NI.

### 3. Results

A total of 402 responses were submitted from 44 countries in Asia, Africa, North and Central America, South America, Europe, and Australia. The top five reported (n=376, 93.5%) research areas were: standardized terminologies (n=151, 40.2%); mobile health (n=128, 34%); clinical decision support (n=127, 33.8%); patient safety (n=123, 32.7%); and big data research (n=103, 27.4%). Respondents reported (n=289) that the possibility to get funding for NI research in their own country was difficult. On a scale from 1 (very easy) to 10 (extremely difficult), the mean response score was 6.8 (SD 2.5). Participants felt that only little NI research is conducted in their countries (on a scale from 1-very little to 10-very much) in the area of NI theory (mean 3.6, SD 2.1, n=281) while administration (mean 4.3, SD 2.1, n=290), clinical practice (mean 4.5, SD 2.2, n=304) and education (mean 4.5, SD 2.1, n=295) received slightly higher scores.

### 4. Discussion

The findings provide a snapshot of current trends in NI research and can be used to direct future research efforts. Respondents reported that NI research focusing on education, clinical practice, administration, and theory was limited in their countries. Yet, current research seems to focus on education and clinical practice when compared to research on administration and theory. These findings should be interpreted with caution as the sampling technique may result in skewed results. Further research is needed to explain the impact of these trends and the needs from clinical practice.

### 5. Acknowledgments

We thank the IMIA-NI group leadership and NI experts for their support and feedback on the survey and all who helped us to distribute the survey.

### References

- [1] M. Topaz, C. Ronquillo, L. Pruinelli, et al. Central trends in nursing informatics: students' reflections from International Congress on Nursing Informatics 2014 (Taipei, Taiwan) *CIN*, **33**(3) (2015), 85–89.
- [2] V.K. Saba, K. McCormick. *Essentials of Nursing Informatics*, 6th Edition, McGraw-Hill Education, USA, 2015.

# Using Rapid Prototyping to Design a Smoking Cessation Website with End-Users

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**Abstract** Rapid prototyping is an iterative approach to design involving cycles of prototype building, review by end-users and refinement, and can be a valuable tool in user-centered website design. Informed by various user-centered approaches, we used rapid prototyping as a tool to collaborate with users in building a peer-support focused smoking-cessation website for gay men living with HIV. Rapid prototyping was effective in eliciting feedback on the needs of this group of potential end-users from a smoking cessation website.

**Keywords.** rapid prototyping, website development, participatory approaches

## 1. Introduction

This study employed rapid prototyping as a tool to facilitate user-centered design - "a philosophy based on the needs and interests of the user...on making products usable and understandable" (p. 188) [1], and concepts of user sensitive inclusive design, which emphasizes incorporation of empathy and relationship-building between researchers/developers and users as a key component of the design process [2]. This poster presents one component of a larger study aiming to build a peer-support, smoking-cessation website with gay men living with HIV.

## 2. Methods

One aim of the study was to explore rapid prototyping as a user-centered approach to design and data collection. We conducted two participatory website design sessions with potential end-users (n=9; n=15). Promoting user-centered and user sensitive inclusive design approaches, researcher-participants began with naming the website as *Pierre Support*. They were then presented with an initial website design mockup created by the research team with Balsamiq wireframing software. Through various iterations, researcher-participants were guided to provide feedback on specific features of the website mockups. After the first cycle of feedback, minimally functioning website mockups were created using Axure RP Pro 7.0 to allow users to interact with website features, run through use cases, and provide feedback. Data were collected via observation of participants, various versions of the website mock ups, and field notes gathered by the research team.

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### 3. Results

Qualitative feedback from participants revealed that the ability to see and interact with various iterations of the website, and almost instantaneously refine the website according to feedback were viewed positively. The participants’ perceived needs from a peer-support smoking cessation website led to the preliminary website design.

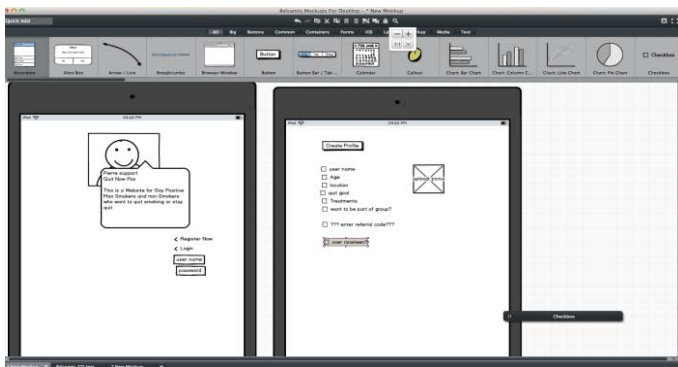


Figure 1. Pierre Support website landing and signup page wireframe in Balsamiq.

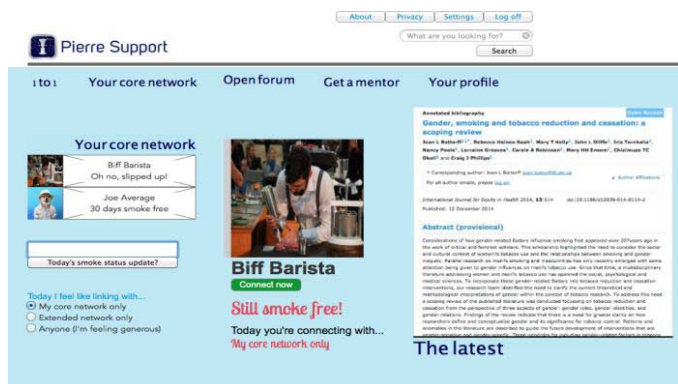


Figure 2. Pierre Support website minimally functioning profile page mockup in Axure.

### 4. Discussion

This study illustrated the potential advantages of using a prevalent approach in user-centered design - rapid prototyping - in health care, an area where it has not previously been explored [3]. Rapid prototyping was effective in engaging participants in collaborative design because it provided tangible opportunities for participants to see and interact with a prototype as part of the design process, providing rich information and highlighting the practical needs of potential end-users.

### References

- [1] D.A. Norman, *The design of everyday things*, Basic Books, New York, NY, 1988.
- [2] A.F. Newell, P. Gregor, M. Morgan, G. Pullin, C. Macaulay, User-sensitive inclusive design, *Universal Access in the Information Society*, **10**(3): 235-243, 2011.
- [3] HIMSS Usability Task Force, Promoting Usability in Health Organizations: initial steps and progress toward a healthcare usability maturity model, *Health Information and Management Systems Society*, 2011.

# Developing Customer Oriented eHealth Services to High Schools in City of Espoo

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**Abstract.** The purpose of this research was to study the hopes and needs of high school first grade students and student healthcare nurses about development of eServices for student healthcare mainly by improving existing ITC solutions and planning new eHealth services. The secondary purpose was to innovate how to share general knowledge about health to students. Four (n=4) high school nurses were group interviewed and an electronic questionnaire was made for high school first grade students. Nearly 15% (n=247) of the target group answered the questionnaire. Preventive eHealth solutions need improvements in student health care in Finland.

**Keywords.** School health services, customer-oriented approach, eHealth Service

## 1. Introduction

The development of eHealth services has not been a priority in student health care in Finland due to scarce resources and lack of responsible national unit. New Student Health 2014 - 2018 -project by National Institute for Health and Welfare aims to create an eService platform for health care professionals for them to be able to share knowledge, information and recommendations with each other. This would only be beneficial solution for professionals. Students and student healthcare nurses require also new innovative eHealth solutions by which they can effortlessly communicate with each other and share personalized and private information and advice in secure environment.

This action research shows that accurately timed, accessible and reliable information is important and can lead to more cost-effective preventive health care.

## 2. Methods

Qualitative and quantitative methods were used in data collection of this action research. Quantitative data was analyzed with PAWS-SPSS Statistics program and qualitative data from group interview with content analysis. Lean-strategies [1], Service Blueprinting-method [2], Gap-analysis [3] and Service Oriented Architecture were used and make student health service concept visual and easily understandable and also to identify the problem areas and solutions.

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### 3. Results

Service Blueprinting method [2] helped to visualize the multiple problems in the student health service process and showed where improvements and new eHealth solutions were needed. Student healthcare nurses and students commented on these problem areas in their interview and questionnaire.

Results showed that majority of the students aged 16 - 19 years wished for new interactive eHealth services. 74,9 % (n=185) of the students hoped for a customer oriented do-it-yourself appointment booking and 72,9 % (n=180) pre-fill-in inquiries and others forms. Access to read own patient records was wished by 77,7% (n=192) students. 63,6 % (n=157) wished that school nurses would have their own eService platform for sharing information about student healthcare. Free to use health coaching - programs and health tests were hoped by 64,8% (n=160) students.

The analysis of the current solutions showed that only 44,9 % (n=111) of the students had answered to the existing eHealth survey, which student healthcare nurse had sent to them as a e-mail link. The main reason for the low answering rate was the problem of accessing the survey through the provided link (35 %, n= >40) even when the link was sent more than once (45,9 %, n=51 of cases). Regardless of the problems, students thought that the current eHealth survey was easy and fast to use, although they wished for more than ten days to answer. Those who did not answer to the eHealth survey criticized the lack of general information about when and where to find it.

Student health nurses are ready to offer new eHealth solutions to students but they also have reservations about them. If electronic solutions were to be introduced to student healthcare they have to add value to nurses' workflow by transferring customer generated information automatically to patient records and by giving automated notices to nurses if fast treatment is required based on this information. Student health care nurses also want to have access to the information about student's health related absences, which are currently not provided to them by the school systems.

### 4. Discussion

This study discovered that the entire health check process, existing ITC software and other eHealth services would benefit from further development in national level. By improving and generating a new easily accessible eService platform for students, time used by student healthcare nurses on secondary tasks (making appointments, filling student eHealth records and transferring data from one source to another) could be allocated to the primary tasks. This would most likely heighten the experienced quality and cost-efficacy of student health care in general.

### References

- [1] N. Modig & P. Åhlström. This is Lean. Rheologica publishing. Stockholm., 2012
- [2] M. Bitner, A. Ostrom & F. Morgas. Service Blueprinting: A practical Technique for service innovation, Arizona State University, 2007
- [3] A. Parasuranam, V. Zeithaml & L. Berry, A Conceptual Model of Service Quality and Its Implications for future research. The Journal of Marketing, Vol.49, No 4. American Marketing Association, 1985. 41 -50.

# Use and Acceptance of Mobile Technology by Hospital Nurses in Germany

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**Abstract.** *Introduction:* The aim of the study was to measure and describe user behavior, information and communication technology (ICT) competence and technology acceptance of hospital nurses. *Methods:* 36 nurses received for six weeks a mobile phone or a tablet pc with mobile application and answered one questionnaire before and after the six weeks. *Results:* The participating nurses show a high technology acceptance and private daily use of technologies. Younger participants judge their ICT competency higher than older nurses. The perceived ease of use is significantly higher in younger participants. The perceived usefulness was evaluated heterogeneously. *Discussion:* Despite the barriers mobile technology is perceived as useful for nurses in their daily work. Factors influencing personal, institutional and device acceptance were determined in this study and can be helpful to facilitate the process of implementation of mobile technology.

**Keywords:** mobile device, technology acceptance, hospital, nurses

## 1. Introduction

The use of mobile technology at the point of care in hospitals is increasing [1]. Nurses play a key role because they are constantly at the point of care, and a lot of the patient data are gathered by them. Support through mobile technology is seen as chance for minimising the workload of nurses [2]. Nevertheless little is known about the technology acceptance of mobile devices by nurses in German hospitals. Therefore the aim of the study is to measure and describe user behavior, competence and technology acceptance of hospital nurses.

## 2. Methods

Tablets or smartphones with applications for evidence based practice and education were provided for six weeks. Two questionnaires were used. The first questionnaire was used to determine experience and usage of technology, computer anxiety and ICT competency. The second questionnaire was distributed after the use of the mobile

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devices and measured the technology acceptance according to the Model of Venkatesh & Bala [2]. This model concentrated on the perceived usefulness and ease of use as essential aspects. The items of the questionnaires were distributed on a 7 point Likert scale (1=totally disagree, 7=totally agree). Descriptive statistics (frequency, mean, median, percentage) were used to analyse the data. The Mann-Whitney-U test was applied to compare attributes of participants. Ethical approval was obtained.

36 nurses completed both questionnaires and used the mobile devices.

### 3. Results

24 nurses aged 18-35 years and 12 aged 36-55 years took part. Nearly 90% of the participants were female. 63.9% of the participants reported daily private use of information and communication technologies. The mean of the ICT competency was good. Younger participants judge their ICT competency higher than older nurses.

The perceived ease of use of the devices was rated 6.5 on a Likert scale of 7. The perceived ease of use is significantly higher in younger participants ( $p=0.02$ ).

The perceived usefulness was evaluated heterogeneously. Nurses who used mobile devices for more than 120 minutes within the six weeks rated the importance of the mobile device higher than those who used it for less than 120 minutes.

### 4. Discussion

The participating nurses report a high level of private daily use of information and communication technologies and ICT competency. A high technology acceptance is seen and is influenced by age. The perceived usefulness seems crucial for the successful implementation. It seems to be important to support the workflows and to involve experienced nurses in the development of technological innovations.

Limitations are the small number of participants and the restricted applications of the mobile device. Therefore the results need to be confirmed in further studies.

### 5. Acknowledgments

Some of the data has been collected in the project *Witru Care*. This project was carried out on behalf of the German Federal Ministry for Education and Research (*BMBF*) under grant number 16SV6380. Responsibility for the contents of this publication lies with the authors.

### References

- [1] World Health Organisation, *MHealth. New horizons for health through mobile technologies*. 2011. [http://www.who.int/goe/publications/goe\\_mhealth\\_web.pdf](http://www.who.int/goe/publications/goe_mhealth_web.pdf). Accessed 30.9.2015.
- [2] U. Hübner, J.-D. Liebe, N. Egbert, A. Frey, *IT Report Gesundheitswesen. Schwerpunkt IT im Krankenhaus*. Niedersächsisches Ministerium für Wirtschaft, Hannover, 2012. <http://dnb.ddb.de>. Accessed: 01.10.2015.
- [3] V. Venkatesh, H. Bala, *Technology Acceptance Model 3 and a Research Agenda on Interventions*, Decision Sciences. 2008. 39, 273-315.

# What Facilitates the Use of Telehealth Applications Among Nurses?

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**Abstract.** This presentation describes the preliminary results of the facilitators of the use of telehealth applications from nurses' point of view based on a qualitative systematic literature review synthesizing 25 previously published papers. The study brought out two main categories that facilitate the use of telehealth among nurses: 1) Nurses' skills and attitudes, and 3) Changes in nurses' work and operations.

**Keywords.** telehealth, eHealth, nursing professionals, systematic review, qualitative study

## 1. Introduction

Today, telehealth and electronic communication are an essential component of patient care, and in future, health information technology (HIT) will be increasingly used by nurses in their work. Telehealth provides opportunities to address social and geographical inequalities, reduce costs and save working time in health care [1, 2].

The integration of telehealth services into nursing practice is not always easy. Nursing staff may have insufficient knowledge about computers and difficulties in handling telehealth applications [3]. Concerns about confidentiality and security related to communication using telehealth are also common [4]. Literature also reveals claims about poorly designed HIT applications [5].

The aim of the review was to synthesize the best available evidence on nursing professionals' experiences of the facilitators and barriers to the use of telehealth applications in nursing practice.

## 2. Methods

The steps in the review included defining the focus of the review, searching all relevant studies, selecting studies using inclusion and exclusion criteria, quality assessment, abstraction of data and results and thematic synthesis.

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The search strategy was defined using PICO elements. International electronic databases PubMed, CINAHL, Eric, Web of Science and Scopus, and the Finnish databases Medic and Ohtanen were searched using suitable phrases.

The full text of 317 articles was reviewed and a total of 25 articles were included in the study.

### 3. Results

The studies were published between the years 1998 and 2015. We found two main categories facilitating the use of telehealth among nurses and related to their work: 1) Nurses' skills and attitudes, 2) Changes in nurses' work and operations.

The first category contains three sub-categories: Adequate skills; Positive attitudes and Positive learning experiences. The results of some single studies described dimensions in all three subcategories. The second main category contains four sub-categories: Communication; Patient-nurse relationship; Job satisfaction and Actual nursing. Many studies described results related to communication, and this was the largest of the subcategories.

### 4. Discussion and conclusions

The introduction of telehealth applications requires systematic education and training of nursing staff. Constructive discussion about the possible changes related to nurses' work is also needed.

The best possible benefits will be obtained when nurses have adequate skills, the functionality of the applications is ensured and nurses have the possibility to work with technology without stress.

### 5. Acknowledgments

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### References

- [1] G. Paré, M. Jaana & C. Sicotte. Telehealth provides opportunities for addressing social and geographical inequalities in health care. *The Journal of the American Medical Informatics Association* 14 (3), 269-277. 2007.
- [2] A-M. Jönsson & A. Willman. Implementation of telenursing within home healthcare. *Telemedicine Journal and eHealth* 14 (10), 1057-1062. 2008.
- [3] M. Engström, R. Lindqvist, B. Ljunggren & M. Carlsson. Staff members' perceptions of a ICT support package in dementia care during the process of implementation. *Journal of Nursing Management* 17 (7), 781-789. 2009.
- [4] J. Ye, G. Rust, Y. Fry-Johnson & H. Strothers. E-mail in patient-provider communication: A systematic review. *Patient Education and Counseling* 80 (2), 266-273. 2010.
- [5] L. Alpay, O Henkemans, W Otten, T Rövekamp & A Dumay A.C. E-health applications and services for patient empowerment: directions for best practices in The Netherlands. *Telemedicine Journal and eHealth* 16 (7), 787-791. 2010.

# Textual Analysis and Data Mining: An Interpreting Research on Nursing

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**Abstract.** Every day there is a data explosion on the web. In 2013, 5 exabytes of content were created each day. Every hour internet networks carries a quantity of texts equivalent to twenty billion books. For idea lit is a huge mass of information on the linguistic behavior of people and society that was unthinkable until a few years ago. It is an opportunity for valuable analysis for understanding social phenomena, also in nursing and health care sector. This poster shows the the steps of an idealy strategy for textual statistical analysis and the process of extracting useful information about health care, referring expecially nursing care from journal and web information. We show the potential of web tools of Text Mining applications (DTM, Wordle, Voyant Tools, Taltac 2.10, Treecloud and other web 2.0 app) analyzing text data and information extraction about sentiment, perception, scientific activites and visibility of nursing. This specific analysis is conduct analyzing "Repubblica", first newspaper in Italy (years of analisys: 2012-14) and one italian scientific nursing journal (years: 2012-14).

# eHealth Literacy Scale: An Nursing Analysis and Italian Validation

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**Abstract.** Background One of the scales most used to measure quickly and easily eHealth Literacy is the eHealth LiteracyScale (eHEALS); however, there was no validation of this scale in Italian. Therefore, the aim of this study was to adapt and validate the eHealth Literacy Scale (eHEALS) to the Italian context. Methods: Italian translation of eHEALS was administered along with another two scales for measuring lifestyle habits, self-esteem, and life satisfaction. A sample of 650 university students aged between 18 and 45 years was selected. An exploratory factor analysis, confirmatory factor analysis, analysis of invariance, reliability, stability, and bivariate correlations were performed. Results: Exploratory factor analysis revealed a unifactorial structure that explained 67% of the variance. Reliability of 0.87 and test-retest correlation of 0.78 were obtained. The questionnaire was invariant by gender. Regarding criterion validity, statistically significant and positive correlations between 0.05 and 0.15 with three indicators were obtained (self-esteem, lifestyle habits, and life satisfaction). The Italian version of the eHEALS tested in this work has shown to be a valid and reliable scale to measure eHealth competence in university students.

# Co-Operation and Co-Funding Networks in eHealth Research

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**Abstract.** In our bibliometric study we were interested in development and global trends in information and communication technology resulted in the emergence of cooperation and co-funding networks in eHealth research. The corpus was formed from the Web of Science Core Collection using the search keyword string “eHealth” in information source titles, abstracts, and keywords for the time period 2005 – 2014. The study results show that the research in eHealth is globally dispersed, however most co-operation is performed on the local continent or country level. Most co-funding is done among pharmaceutical firms themselves, however Sanofi, Merck and Abbot also co-fund the same projects as funding agencies.

**Keywords.** eHealth, bibliometric mapping, co-operation, funding, networks

## 1. Introduction

In last two decades eHealth with a promise to improve health and the health care systems, become the focus of global initiatives. It forms a component of healthcare strategy and policy, and is represented in funding initiatives, and research projects, resulting in holistic clinical process improvements [1]. The International Council of Nurses is also part of these initiatives [2]. Our study was aimed to analyze these initiatives from the viewpoint of cooperation between organization and funding bodies. In our study we were interested first if these global trends resulted in the emergence of cooperation networks between organization and funding bodies and second in the nature of these networks.

## 2. Methods

Bibliometric mapping is a more recent method in the arsenal of bibliometric tools. A popular bibliometric mapping open license software tool is VOSviewer [3]. In our study VOSviewer was used to generate cooperation networks based on co-authorship and co-funding. The corpus was formed from the Web of Science Core Collection (WoS, Thomson Reuters) bibliographical database. The search was made on September 18<sup>th</sup>, 2015 using the search keyword string “eHealth” in information source titles, abstracts, and keywords for the time period 2005 – 2014.

## 3. Results and discussion

The search in the WoS bibliographical database resulted in 1848 papers. The paper production was spread between 500 institutions located in 78 countries. The top

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productive organizations are coming from five different countries most of them from United States of America ( $n = 5$ ) and Netherlands ( $n = 3$ ). Large number of institutions dispersed through many countries shows that the research in eHealth is globally distributed. However, notable cooperation between organizations, revealed through a co – authorship network can be observed (Figure 1). The co – authorship network shows that the most co – operation is performed on the local continent or country level. Consequently, sub – networks emerged indicating the cooperation between USA organizations, Australian, Canadian and Dutch organizations, and EU organizations. USA organizations sub – network is the largest and the most connected.

The most productive funding bodies (Figure 1) were Robert Wood Johnson Foundation ( $n = 3$ ), National cancer institute ( $n = 3$ ), Sanofi ( $n = 2$ ) and Merck ( $n = 2$ ). The co – funding network shows a strong collaboration between funding bodies. Despite the fact that pharmaceutical funding of eHealth is a bit surprising due to ethical reasons and possible conflict of interests, most funding is done by pharmaceutical industry. However as seen above, the two most productive funders are funding agencies. This might show that pharmaceutical industry is focusing on single eHealth projects, while funding agencies have more general interests, expressed in funding multiple projects. Most co – funding is done among pharmaceutical firms themselves. However Sanofi, Merck and Abbot also co – funds some same projects as funding agencies. Interestingly, there is a very limited co – funding among funding agencies themselves. This might indicate the specialisation of funding by agencies to specific eHealth themes.



Figure 1. eHealth research co - funding network.

#### 4. References

- [1] H.R. Oh, C. Rizo, M. Enkin, A. Jadad A. What is eHealth (3): A systematic review of published definitions. *Journal of Medical Internet Research* 7/1 (2005).
- [2] ICN, International Council of Nurses. eHealth. [cited 2015 9 27. Available from: <http://www.icn.ch/what-we-do/ehealth>].
- [3] N.J. Van Eck, L. Waltman L. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84/2 (2010), 523 - 538.

# Improving Patient Safety with a Mobile Application for Patients with Peripherally Inserted Central Venous Catheters (PICC)

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**Abstract.** Peripherally inserted central venous catheters (PICCs) are of growing interest because they allow intravenous therapies up to several months. The appropriate management of the PICCs is crucial to minimize complications and largely depends on the right information for everyone who cares for the patient. To reach this goal we develop the mobile application “PICC App” to provide the necessary information for all involved persons in the outpatient setting. We expect to be able to report about the PICC App and the results of the usability evaluation with pilot users.

**Keywords.** Catheter management, CDSS, PICC, Supportive decision making

## 1. Introduction

Peripherally inserted central venous catheters (PICCs) are inserted for intravenous therapies up to several months. Only with diligent care and holistic knowhow an ideal exposure time with minimal complications can be reached [1]. Are we able to improve PICC care with computerized clinical decision support systems (CDSS)? It is known that CDSSs can improve practitioner performance and therefore patient safety [2]. The purpose of our project is to develop a CDSS to improve patient safety by providing evidence based information at the right time to everyone who works with the patient.

## 2. Methods

Students of the Bern University of Applied Sciences develop in collaboration with the University Hospital of Zürich the mobile application “PICC App”. The App provides the necessary information for an appropriate PICC management for all involved persons in the outpatient setting.

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### 3. Results

We expect to be able to report not only about the PICC App, but also results of the usability evaluation with pilot users.

### 4. Discussion

Whereas typical CDSS are geared towards one user group, we plan our “PICC App” with several facets to train as well health care providers and the patient himself. In the next phase of the project we plan to collect data with the “PICC App” at the point of care to learn more about the significant factors influencing the achievable dwelling time and the incidence of complications.

### References

- [1] Chopra V., et al., The Michigan Appropriateness Guide for Intravenous Catheters (MAGIC): Results From a Multispecialty Panel Using the RAND/UCLA Appropriateness Method, *Annals of Internal Medicine* **163**(6 Suppl) (2015), S1-S40.
- [2] Garg A.X., et al., Effects of Computerized Clinical Decision Support Systems on Practitioner Performance and Patient Outcomes: a systematic review, *JAMA* **293**(10) (2005), 1223-1238.

# e-Health Interventions for Healthy Aging: A Systematic Review Protocol

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**Abstract** e-Health interventions could contribute to healthy aging (HA) but their effectiveness has not been synthesised. This study aims to systematically review the effectiveness of e-health interventions for supporting HA. We will perform standardized searches to identify experimental and quasi-experimental studies evaluating the effectiveness of e-health interventions for HA. Outcomes of interest are: wellbeing, quality of life, activities of daily living, leisure activities, knowledge, evaluation of care, social support, skill acquisition and healthy behaviours. We will also consider adverse effects such as social isolation, anxiety, and burden on informal caregivers. Two reviewers will independently assess studies for inclusion and extract data using a standardised tool. We will calculate effect sizes related to e-health interventions. If not possible, we will present the findings in a narrative form. This systematic review will provide unique knowledge on the effectiveness of e-health interventions for supporting HA.

**Keywords.** e-health, healthy aging, intervention, systematic review.

## 1. Introduction

It is expected that 2 billion people will be 65 years and over by 2050 [1], which has profound implications on the planning and delivery of health and social care. Healthy aging (HA) is defined as the process of optimizing opportunities for physical, social and mental health to support older adults' participation in society without discrimination [2]. e-Health refers to the various uses of ICT in the health sphere and offers older adults the opportunity to access health information and receive health and social care in their homes. Interactive interventions could empower, engage, and educate older adults [3]. Although previous reviews on specific e-health applications found some support of their effectiveness for improving health in older adults [4-5], there are no systematic reviews that currently address the effectiveness of a wide range of e-health interventions for supporting HA in its various dimensions.

## 2. Methods

We will conduct a systematic review based on the Cochrane Collaboration methods [6]. The following types of studies will be considered: randomized controlled trials, non-randomized controlled trials before and after studies and interrupted time series.



Studies in English, Dutch, French, German or Spanish, published from 2000 up to the date of the search, will be considered for inclusion.

Targeted participants are adults aged 50 or more, which is considered as the beginning of young old age [2], living in the community or in institutional arrangement. Interventions will include telehealth and telemedicine, remote monitoring, internet, smart phones, mobile applications, interactive digital games, electronic information systems. Primary outcomes will consider: wellbeing, quality of life, activities of daily living, leisure activities, biological measures, physical measures, health-enhancing lifestyle, and self-efficacy. Secondary outcomes will include: knowledge; decision-making; evaluation of care; social support; skills acquisition; and health behaviors. We will also consider adverse effects related to e-health interventions on HA in the targeted population, such as social isolation, anxiety, and burden on informal caregivers.

### 3. Results

Two reviewers will independently assess studies for methodological quality using the Cochrane Risk of Bias tool [6]. Any disagreements that arise between the reviewers will be resolved through discussion, or with a third reviewer. Data will be extracted using a standardized data extraction tool. The data extracted will include details about the interventions, populations, study methods and outcomes of significance. Where possible, data will be pooled in statistical meta-analysis. Effect sizes expressed as odds ratio (for categorical data) and weighted mean differences (for continuous data) and their 95% confidence intervals will be calculated for analysis. Heterogeneity will be assessed statistically using the standard Chi-square and also explored using subgroup analyses based on the different study designs included in the review. If statistical pooling is not possible, we will present the findings in a narrative form.

### 4. Discussion

This review will provide some insight regarding the role of e-health to answer the increasing needs of an aging population.

### References

- [1] K. Kinsella, D. Phillips, Global Aging: The Challenge of Success. Population Reference Bureau (Population Bulletin 60, no.1), Washington, DC, 2005.
- [2] Swedish National Institute of Public Health. *Healthy aging: a challenge for Europe*. Huskvarna: The Swedish National Institute of Public Health, 2006.
- [3] A.K. Hall, M. Stollefson, J.M. Bernhardt, Healthy Aging 2.0: the potential of new media and technology. *Preventing Chronic Disease*, **9**, (2012).
- [4] M. Stollefson, B. Chaney, A.E. Barry, E. Chavarria, B. Tennant, K. Walsh-Childers, P.S. Sriram, J. Zagora, Web 2.0 chronic disease self-management for older adults: a systematic review. *Journal of Medical Internet Research*, **15**, (2013).
- [5] L.H. Larsen, L. Schou, H.H. Lund, H. Langberg, The physical effect of exergames in healthy elderly: a systematic review. *Games for Health: Research, Development, and Clinical Applications*, **2**, (2013) 205-212.
- [6] J.P.T Higgins, S. Green, *Cochrane handbook for systematic reviews of interventions*, Version 5.1. 0 [updated March 2011]. The Cochrane Collaboration, 2011.

# The Research and Application of Information Platform About Community Support Intervention for Patients with Alcohol Dependence

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**Abstract** Objectives Through the establishment of electronic health records, health education and measures such as regional information sharing platform , we explored the management of patients with alcohol dependence living in communities and established a medical information resource sharing model between mental hospital -community to strengthen the supportive intervention management of patients with alcohol dependence, improve the effect of intervention and reduce the rate of compound drink.

Methods. To design the questionnaire of health state for patients with alcohol dependence, After data collection, We should establish electronic health records and community support intervention , make medical health card with terminal configuration card reader in both mental hospitals and community, develop information platform, establish a variety of supporting interventions and the service function modules , unblock information sharing between hospitals and community to make full use of the platform to carry out health education and health intervention management.

Results. The effectiveness of community supportive intervention are improved, rehabilitation rate of patients is reduced greatly , bad ways of life behavior are better.

Conclusions. Establishing electronic health records is an important mean of community supportive interventions which is good for Real-time, dynamic management and promoting self-management skills making the dream of medical information resource between hospital-community sharing come true.

**Keywords:** Patients with alcohol dependence ; Electronic health records; Health education; Information platform

# Relationship Between Organizational Culture and Organizational Effectiveness- A Study of Nurses in Taiwan

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**Abstract.** Organizational culture refers to the beliefs and values that have existed in an organization for a long time, and to the beliefs of the staff and the foreseen value of their work that will influence their attitudes and behavior. It is therefore essential to understand the relationship between organizational cultures and organizational effectiveness. **Methods.** A cross-sectional study was undertaken that focused on hospital nurses in Taiwan. Data was collected using a structured questionnaire; 900 questionnaires were distributed and 473 valid questionnaires were returned. **Results.** Organizational cultures were significantly (positively) correlated with organizational effectiveness ( $p < 0.001$ ). **Conclusions.** When the interaction between the leadership and employees is good, the latter will make a greater contribution to team communication and will also be encouraged to accomplish the mission and objectives assigned by the organization, thereby enhancing organizational effectiveness.

**Keywords.** Organizational culture, Organizational effectiveness, Teamwork, Leadership vision

## 1. Introduction

Organisational artefacts consist of styles of behaviour, physical items, symbols and ceremonies, and anything else that is seen, heard or felt by persons external to the organisation; they represent the tangible, physical and behavioural manifestations of organisational culture. Organisational cultures exist along a continuum, from a strong culture shared by the various subgroups in the organisation [1] to a weak culture, in which the declared aims of management may be at odds with workers' norms and values and how firms effectively use multiple cultural representations to enable innovation [2]. Since cultural research within the nursing field is not common, it is necessary to explore the way the Organisational culture influences the behavior of the nursing staff, and in turn how the behavior of the staff influences the organizational outcome.

## 2. Methods

A cross-sectional study was conducted in Taiwan hospitals. There were 900

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questionnaires were distributed, and 473 valid questionnaires were returned (total return rate 52.5%). Of the subjects, 98.1% were female, 48.8% were age <30, 48.8% had a tenure at the hospital of 5 years, and 39.1% had had a college-level education. The majority of employees at the hospitals were general nurses (86.5%). All data were analyzed using the SPSS 18.0 software package. Cronbach's  $\alpha$  coefficient was used to assess the internal consistency reliability of scales. Correlation analysis was used to test for the relationships between subscales of organizational culture and organizational effectiveness. Finally, a series of regression analysis were used to identify the proposed hypotheses. For three sets of simple linear regression were used to assess the association between independent variable and dependent variable. Partial R<sup>2</sup> ( $\Delta R^2$ ), F test and standardized regression coefficient ( $\beta$ ) and their test statistics (t value) were reported in all regression analysis.

### 3. Results

Results of several regression analyses. As organizational culture was positively associated with learning ( $F = 11.872$ ,  $p < .001$ ). Organizational culture was positively related to Innovations ( $F = 26.186$ ,  $p < .001$ ). Finally, As the partial regression coefficient of job satisfaction reached statistically significant ( $F = 22.759$ ,  $p < .001$ )

### 4. Discussion

Currently, there is a shortage of nurses in clinical care, and good leaders can help any attrition. Furthermore, the leadership skills of nurse administrators can contribute to the success of their organization. Studied nurses in determining the relationship between different leadership styles and organizational cultures, and showed a correlation between leadership and organizational culture, consistent with the findings of our research. However, by adopting regression analysis, we also found that organizational effectiveness impacts on organizational culture [3]. Believed that a satisfactory work environment can be created by the employees when an organisation possesses a healthy culture and thus has a positive attitude towards employee work [4]. Therefore the relationship between organisational culture and employee behaviour/attitude has been emphasised by different academics from various fields. A positive correlation between organisational culture and employee job satisfaction that is consistent with the findings of our research [5].

### References

- [1]. G. S. Saffold, Culture traits, strength and organizational performance: Moving beyond "strong" culture', *Academy of Management Review*, **13**(1988), 546-558.
- [2]. V. P. Seidel, S. O'Mahony. Managing the repertoire: Stories, metaphors, prototypes, and concept coherence in product innovation. *Organization Science*, **25**(2014), 691-712.
- [3]. P. Bamberger, M. Biron. Group norms and excessive absenteeism: The role of peer referent others. *Organizational Behavior and Human Decision Processes*, **103**(2007), 179-196.
- [4]. A. Cooke, B. Green. Developing the research capacity of departments of nursing and midwifery based in higher education: A review of the literature. *Journal of Advanced Nursing*, **32**(2000), 57-65.
- [5]. M. L. Santos-Vijande, L. I. Álvarez-González. Innovativeness and organizational innovation in total quality oriented firms: The moderating role of market turbulence. *Technovation*, **27**(2007), 514-532.

# An Assessment of the Application of Pharma Cloud System to the National Health Insurance Program of Taiwan and the Result in Hospitals

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**Abstract.** National Health Insurance Administration established Pharma Cloud System in July 2014. The purpose is to decrease therapeutic duplications and enhance public medication safety. Comparison will be made among individual hospitals and the administering branches of National Health Insurance Bureau (NHIB) on the statistical data on the inquiry of the cloud medication history record system to understand the result of the installation and advocacy of this system. The results show (1) there were 2,329,846 entries of data collected from the branches of the NHIB from 2015 on cloud medication history record and 50,224 entries of data from individual hospitals. (2) The inquiry rate at the branches of the NHIB was 43.2% from January to April, 2015 and at individual hospitals was 18.8%. (3) The improvement rate at the branches of the NHIB was 32.5% and at the individual hospitals was 47.0% from January to April, 2015.

**Keywords.** Pharma cloud system, therapeutic duplications, medication safety

## 1. Introduction

The IC card for the National Health Insurance (NHI) program of Taiwan allows medical personnel to consult the history of the last 6 medical visits and 60 entries of prescription information. The physicians or pharmacists may access to the content of the national health program IC card but they may have difficulty in making timely judgment concerning possible repeated prescription and medication and effective reduction of the problem of repeated prescriptions. For this reason, the National Health Insurance Administration installed the “National Health Insurance Pharma cloud system” in July 2013. This system allows for the inquiry of the record of medical prescriptions in the last 3 months of the insured, including the source of the prescription, the pharmaceutical classification of medications, the name, the national health insurance number, the daily dosage and method of intake and the remainder of the days for medication of each prescription [1].

Hospitals and clinics can make improvements in repeated prescriptions and medication just by making inquiries on the cloud medication history record. They can avoid multiple medication that may cause interactive reactions of drugs and avoid side effects of surgery under the effect of medication [2-3]. For the cases of special medication, they can

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intensify health education and eventually provide the physicians reference for treating the patients and give prescription for the recent visit. Through the real-time inquiry of the information on the medical attention and medication history of the patients, physicians can avoid repeated prescription and the repeated medication of the patients. These help to upgrade medication safety and quality.

## 2. Methods

This study is conducted mainly by the gathering of information on the function of the prescription information system of the outpatient ward of hospitals direct linking to the cloud medication history record function. Education of this system will be given on each day before giving outpatient treatment. The ultimate goal is the incremental and compulsory linkage to the cloud medication history record system. Comparison will be made among individual hospitals and the administering branches of National Health Insurance Bureau on the statistical data on the inquiry of the cloud medication history record system to understand the result of the installation and advocacy of this system. The data period covers January 1 to April 30, 2015, a total of 4 months.

## 3. Results

The results show (1) there were 2,329,846 entries of data collected from the branches of the National Health Insurance Bureau (NHIB) from January to April, 2015 on cloud medication history record and 50,224 entries of data from individual hospitals. (2) The inquiry rate at the branches of the NHIB was 43.2% from January to April, 2015 and at individual hospitals was 18.8%. (3) The improvement rate at the branches of the NHIB was 32.5% and at the individual hospitals was 47.0% from January to April, 2015.

## 4. Discussion

The introduction of the cloud medication history record to healthcare can help to remove the constraints of resources, place, and time for data sharing, speed up the decision of diagnosis and treatment for the patients, upgrade the quality of medical and healthcare, improve patient safety, reduce waste in medical resources, reinforce the communications among hospitals. The findings from this study indicated sustained improvement of the advocacy of this program.

Finally, the reduction of repeated medication and the waste of medical resources rely on the efforts and responsibilities of the patients, hospitals, and the National Health Insurance Administration. Through the complete presentation of cloud medication history information, the abnormal behaviors of the people in seeking medical attention could be reduced. People shall be responsible for taking care of themselves and appropriate act of seeking medical attention. Through the proper concept of seeking medication attention, the people can enjoy a healthy and happy life.

## References

- [1]. C. C. Chen, H. J. Wang., Y. L. Lin. Promoting NHI On-line Medication Record Inquiring System in Hypertension, Diabetes and Dyslipidemia. *The Journal of Taiwan Pharmacy*, **30**(2014), 120-124.
- [2]. Y. Y. Fang, J. S. Wu., C. C. Hsu. The Effectiveness of Medication Safety for Using Pharma Cloud System. *The Journal of Taiwan Pharmacy*, **30**(2014), 107-112.
- [3]. C. F. Yen, J. C. Lee, C. L. Tang., Pharma Cloud System Improving Patient Medication Safety. *The Journal of Taiwan Pharmacy*, **30**(2014), 133-136.

# Exploring the Flexibility of Challenge Based Learning in Health Promotion Training

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## 1. Introduction

Challenge based learning (CBL) encourages nursing students to leverage the technology to analyze, collaborate and publish the solution in response to health problems in the real world.

Nursing students work in collaborative approach and use technology to identify and tackle the global health issues in the context of the school, family, or local community. Through the CBL framework which begins with a big idea, cascades to essential question; the challenge; guiding activities and the implementation of solution, students have to use the technology to access the related information and create solution video to improve the health worldwide. While health promotion demands social and environment interventions, CBL required students to connect with all stakeholders by using an online collaborative workspaces.

## 2. Methods

SWOT (Strengths, Weaknesses, Opportunities, and Threats) is used to as a framework to explore the feasibility of CBL in health promotion training.

## 3. Results

*Strength:* Students learnt the survival technology skills for 21th century throughout the use of Web 2.0 tools for organizing, collaborating, and sharing. CBL using ubiquitous access connects schoolwork with real life. It connects and engages all students, teachers and community stakeholders to motivate the health promotion. CBL allows students to publish innovative solutions to influence the global health challenge worldwide.

*Weakness:* New technology adds demands and workload to students and academics. The digital divide create inferiority and disparities across students. Students who are good at technology show superior performance in CBL.

*Opportunities:* Academics receive new technology training. IT Resources are equipped to prepare the CBL teaching. Academics develop intersectoral collaboration with CBL IT professionals. Students build up a strong, long-term community partnership through the use of technology, contributing to positive transition from school to further education and employment opportunities.

*Threats:* New academics are not experienced in CBL and relevant technology. Some academics show resistance to integrate technology into the class.

#### **4. Discussion**

Strengths and opportunities outweigh weaknesses. CBL with relevant technology should be integrated in the health promotion training systematically.

#### **References**

- [1] Apple Inc. (2011). Challenge based learning. Take action and make a difference. Apple Inc.
- [2] World Health Organization. (2015). Health Promotion. Geneva: world Health Organization.



# Co-Designing Mobile Apps to Assist in Clinical Nursing Education: A Study Protocol

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**Abstract.** Mobile applications (apps) to train health professionals is gaining momentum as the benefits of mobile learning (mLearning) are becoming apparent in complex clinical environments. However, most educational apps are generic, off-the-shelf pieces of software that do not take into consideration the unique needs of nursing students. The proposed study will apply a user-centred design process to create a tailored mobile app for nursing students to learn and apply clinical skills in practice. The app will be piloted and evaluated to understand how nursing students use mobile technology in clinical settings to support their learning and educational needs.

**Keywords.** Nursing student; Mobile technology; Smartphone application; Mobile app; Co-design; Co-creation; End-user design

## 1. Introduction

Nursing students often find clinical practice a challenging learning environment [1]. Nurse educators have looked at a range of mobile platforms as a way to provide better access to quality educational material for nursing students in clinical settings [2]. However, barriers exist to using of mobile technology in clinical nursing education such as a lack of tailored educational resources for nursing students [3].

## 2. Methods

The research will adopt a mixed methods design as it aims to 1) explore the co-design process when creating a clinical skills based smartphone app in collaboration with nursing students, and 2) conduct a pilot study to examine the experiences of nursing students who use the personalized mobile app to improve learning in clinical environments. Ethical approval has been sought and granted by the appropriate institutional ethics committees.

This study will adapt a co-design approach [4] by conducting a series of interactive co-creation workshops with final year nursing students. These will use a variety of methods to generate ideas and consensus on what educational content and

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functionality a clinical skills based smartphone app should have. This will feed into the subsequent software development of a personalized educational app. A twelve week pilot study will then be run with nursing students to evaluate the app in clinical settings. Google analytics will be embedded in the mobile app to track usage patterns. Interviews with nursing students will explore their experiences of using the educational app.

Quantitative results from Google analytics will be analysed on SPSS using descriptive statistics. This will give insights into the number of times and areas of the app that were accessed. Qualitative data from the co-design workshops and post-study interviews will be analysed using a framework approach [5] which will be underpinned by a theory of mobile learning [6]. NVivo will be used to facilitate qualitative analysis.

### 3. Discussion

Mobile apps could help nursing students learn and apply knowledge and skills in clinical settings. This study will examine a collaborative design process where nursing students are involved in shaping the design, function and educational content of an app. This novel way of creating mobile technology for nursing students has not been explored in detail and could radically improve the design of educational applications. The pilot study will also reveal how nursing students use a mobile app in clinical practice to provide better insights into how mobile learning works in a clinical setting.

### 4. Acknowledgments

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### References

- [1] M.G. Landers, The theory–practice gap in nursing: the role of the nurse teacher, *Journal of Advanced Nursing* **32**(2000),1550-1556.
- [2] S. O'Connor, T. Andrews, Mobile Technology and Its Use in Clinical Nursing Education: A Literature Review. *Journal of Nursing Education* **54**(2015),137.
- [3] P.E. Johansson, G.I. Petersson, G.C. Nilsson, Nursing students' experience of using a personal digital assistant (PDA) in clinical practice - An intervention study, *Nurse Education Today* **33**(2013),1246-1251.
- [4] D. Millard, Y. Howard, L. Gilbert, G. Wills, Co-design and co-deployment methodologies for innovative m-learning systems. *Multiplatform E-Learning Systems and Technologies: Mobile Devices for Ubiquitous ICT-Based Education: Mobile Devices for Ubiquitous ICT-Based Education*, (2009), 147. [http://eprints.soton.ac.uk/267555/1/Co-design\\_and\\_deployment\\_chapter-preprint.pdf](http://eprints.soton.ac.uk/267555/1/Co-design_and_deployment_chapter-preprint.pdf)
- [5] R. Ritchie, L. Spencer, Qualitative Data Analysis for Applied Policy Research, In: M. Hubermann, M. Miles, *The Qualitative Researcher's Companion*, Sage Publications, California, 2002.
- [6] M. Sharples, J. Taylor, G. Vavoula, A theory of learning for the mobile age. In: R. Andrews, C. Haythornthwaite, *The Sage Handbook of Elearning Research*, Sage Publications, 2006.

# Design of a Program to Learn the Nursing Process by Introducing Digital Stories- For The Promotion of Patient Understanding-

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**Abstract.** Nursing students have a problem to develop real images of patients by using paper patient-based learning as the initial program to learn the process of nursing care. This paper presents a learning program for the promotion of patient understanding, designed by focusing on digital stories and workshops held in classes.

**Keywords.** Digital story, nursing process, workshop, a learning program, basic nursing education

## 1. Introduction

In basic nursing education, students usually undergo paper patient-based learning as the initial program to learn the process of nursing care. However, this method has a problem in that nursing students have difficulty developing real images of patients. Since an understanding of patients is the key to the implementation of the nursing process, it is important to address this problem. This paper presents a learning program for the promotion of patient understanding, designed by focusing on digital stories and workshops held in classes.

## 2. Methods

### 1) Definition of the problem

Paper patient-based learning allows nursing students to formulate an overall picture of patients only superficially, and the students have difficulty developing real images of patients, including their lifestyles.

### 2) Objective

It is necessary to implement paper patient-based classes in which student nurses understand the psychological aspects of patients and experience their perspectives of the world to develop a clear overall picture of patients.

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### 3) Development

**Introduction of digital stories:** Digital stories, which reflect patients' views of health and their psychological changes, are introduced as image-based materials to encourage students to understand patients multilaterally, "become able to think as a person involved in nursing care" and develop more real images of patients.

**Introduction of workshops in classes:** Teachers serve as facilitators to help their students learn independently, which encourages them to integrate images of patients that they have developed to recognize the overall images, and implement each step of the nursing process in training.

**Sharing the results of the e-learning program:** In the program, students review what they have learned, take quizzes to confirm it, develop case examples as advanced learning, and share the learning results of workshops.

### 3. Results

A summary of the developed learning program is shown Figure 1.

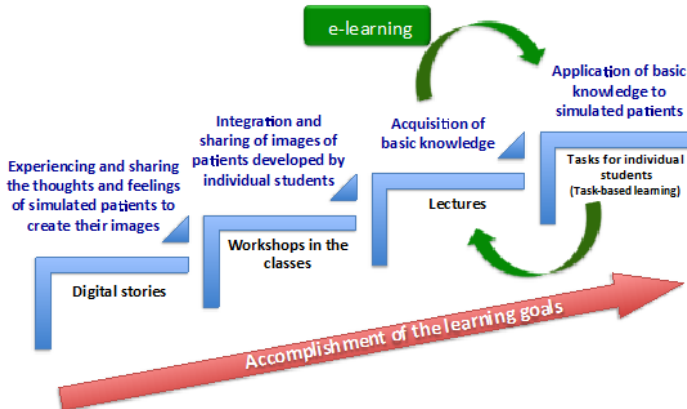


Figure 1. A summary of the developed learning program on the nursing process

### 4. Discussion

Digital stories, a type of learning material, are approximately three-minute videos that use images and music associated with specific persons as well as digital synthesis technologies to visually express their life stories. The program, in which students experience and share the thoughts and feelings of simulated patients as those of real ones, promotes their better understanding of patients.

Since workshop-based classes develop the skills of students required for independent learning, including their interests, motivations, and attitudes, the program is expected to motivate them to continue to learn independently.

The e-learning materials should be available to students even after the completion of the classes, so that they will be able to learn using the materials at any time and they can brush up their knowledge.

On the next stage, evaluation of this learning program is managed to clarify the education effect.

# Patients' Opinions on Display Methods to Protect Privacy

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**Abstract.** The purpose of this study is to ascertain if patients will accept an electronic patient record system that temporarily conceals their private information. We interviewed 11 outpatients at a core hospital in Shizuoka prefecture of Japan. Most patients agree with our idea using temporary mosaic on the screen to protect their privacy.

**Keywords.** Display Methods, Electronic Patient Records System, Information Privacy, Medical Records, Patient

## 1. Introduction

Patient privacy concerns have arisen because health care professionals (HCPs) can access most patient information through electronic patient records. Patients may demand that certain HCPs are not given access to some information. Previous research indicates that privacy needs can grow depending on the nature of information [1]. Therefore, we created a privacy protection display for the electronic medical record screen by using a temporary mosaic to hide various sections of patient information. This study examined patients' feedback on this display.

## 2. Methods

We conducted 30-minute face-to-face interviews with 11 outpatients who were visiting the hospital for the first time post-discharge. Participants were presented a 24-item list of patient information based on the four categories of the Patient Information Privacy Scale (PIPS) [2]: treatment, identification, everyday behaviours, and personal life. They then had to state whether they wanted the item to be present on the information display screen. Subsequently, participants received an explanation of the display designed for privacy protection, and their opinions regarding the display were obtained. After obtaining participants' permissions, all interviews were audiotaped and transcribed. A content analysis of data was performed. The relevant research ethics committees approved the study protocol. Data were collected in August 2015.

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### 3. Results

All participants had been discharged from the orthopaedic ward with an average of 29.6 days of hospitalization (range: 2–150 days); most participants were 40–59 years old. Six participants requested that information sharing by HCPs be limited for identifying information (e.g. address, phone number, occupation, family members) and personal life (e.g. family's health history, family financial issues). Only a few participants requested that treatment-related information be limited (e.g. excretion behaviours).

The interview results indicated that eight participants did not want to be identified by HCPs, and eight participants felt that the display method effectively concealed confidential information with the mosaic-blur. Most participants agreed that HCPs should view this private information when necessary for practice.

### 4. Discussion

Most patients regarded the proposed display method as effective and appropriate, and expected it to help privacy protection. However, their demands differed according to information categories. For example, they were less concerned about the confidentiality of treatment-related information because they regarded information sharing as necessary for safe treatment. This finding is consistent with previous studies conducted with HCPs, such as nurses, physicians, pharmacists, radiologists, and physiotherapists [3]. We believe that a display that meets the patient's privacy needs would improve privacy protection and reduce patients' concerns about privacy violations.

### 5. Acknowledgments

We thank the outpatients who participated in this study. This work was supported by the Japan Society for the Promotion of Science Grants-in-Aid for Scientific Research(C) Grant Number 26463224.

### References

- [1] P Clerkin, B S Buckley, A W Murphy, A E MacFarlane. Patients' views about the use of their personal information from general practice medical records in health research: a qualitative study in Ireland. *Fam Pract* 30(1) (2013), 105-12.
- [2] H Iguchi, K Ota. Development of an instrument to measure patient perception of information privacy: patients' information privacy scale (PIPS) and convenient privacy checklist (CPC). *Jpn J Med Inform* 26(6) (2007), 367-75.
- [3] Y Niimi, K Ota. Display methods of electronic patient record screens: patient privacy concerns. *Stud Health Technol Inform* 192 (2013), 1029.

# Using ADDIE Model to Develop a Nursing Information System Training Program for New Graduate Nurse

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**Abstract.** This study is to develop a nursing information system (NIS) training program, and takes a local community teaching hospital in Taiwan for example. We adopt the ADDIE model to develop our NIS training program. We preliminaries followed the framework of the model to design a NIS training program, and implement it for the newcomers' training of nursing information system. After training course, the self-efficacy report has a significant ( $p < .000$ ) improved compare to pre-test, and 88% of participants passed the pragmatic exam.

**Keywords.** ADDIE model, training program develop, nursing education, nursing information system

## 1. Introduction

Although more and more hospitals implement the nursing information system (NIS) to help nurses to deliver health care services, but many researchers point out that nurses are lack of suitable NIS usage training generally.[1][2] However. It's difficult to provide adequate training for primary nurses. There are many obstructions including nonexistent or inadequate training program, lack of interest in computer technologies, negative attitudes toward computer systems, and hard to identify the training needs. [2] Although some studies mention some good characteristics of a training program for nurses, or make a training methods comparison to find out the best teaching model, but few study focus on the process of developing a NIS training program. Therefore, the aim of this study is to develop a NIS training program, and takes a local community teaching hospital in Taiwan for example..

## 2. Methods

We adopt ADDIE model, which consists of five stages, analysis, design, development, implement, and evaluation, to develop our NIS training program. The NIS training program development project team was consisted of two nursing informatics specialists, and a nursing supervisor. By following the framework of the

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ADDIE model, we analyzed the newcomers' learning needs and goals, design the content of the course unit, teaching strategies, and evaluation methods, and develop teaching materials. After all works done, we implement this program for the NIS training of new graduate nurses, and exam the effectiveness of the program by a 5-point likert scale self-efficacy questionnaire where "one" represents fully unacquainted and "five" represents fully acquainted and pragmatic test. All study occurred in a local community teaching hospital in Taiwan, and all participants joined the study with informed consent.

### **3. Results**

We listed out 47 functions of NIS as learning needs, and identified learning goal of this training program as new graduate nurses could adopt all of 47 basic functions and utilize it when delivering care services after finish all courses. There are three parts in our program, a 60 minutes instructor-led course, a 240 minutes small group hand-on practice course and online self-study materials. Teaching materials include a NIS overview slide for instructor-led course; six scenarios contain all 47 functions for hand-on practice course, and eight operating manuals.

Twenty-five new nurses have completed the courses. The self-efficacy reports show average  $3.95 \pm 0.59$  among all functions and have significant improvement ( $p < 0.00$ ) compare with pre-test. 88% of participants can also make way for the pragmatic test.

### **4. Discussion**

Lacking a suitable training program has grown up to be a major issue of nursing informatics. The ADDIE model offers a task-oriented framework for the training course development. It allows program designer focus on the learners' needs and goals, and reducing the redundant procedurals. And the result shows that our training program which developed under ADDIE framework can train new graduate nurses to use NIS expeditiously.

### **5. Acknowledgments**

This research was supported by En Chu Kong Hospital. The authors would like to thank all colleagues who contributed to this study and institute.

### **References**

- [1] G. Edwards, R. R. Kitzmiller, and S. Breckenridge-Sproat. Innovative health information technology training: exploring blended learning. *CIN: Computers, Informatics, Nursing*, Publisher Location. 2012; 30(2):104-109.
- [2] L. Alpay, and A. Russel. Information Technology Training in Primary Care: The Nurses' Voice, *CIN: Computers, Informatics, Nursing*. 2002; 20(4):136-142.



# Factors Affecting Participation in the eRedBook: A Personal Child Health Record

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**Abstract.** A personal child health record called the eRedBook was recently piloted in the United Kingdom. A qualitative exploratory case study was used to examine how public health nurses engaged or recruited parents and what factors hindered participation. Interviews and focus groups were conducted with those implementing the eRedBook and those taking part in the pilot study. A range of project documentation was also reviewed. Thematic analysis using the framework approach was applied to draw out themes. Numerous socio-technical factors such as the usability of the software, concerns over data protection and costs, poor digital literacy skills and a lack of Internet connectivity emerged. These barriers need to be addressed before the eRedBook is implemented nationwide.

**Keywords.** personal health record, eHealth, digital health, child, pediatric, public health nurse, implementation

## 1. Introduction

The 'Red Book' is a paper based child health record in the United Kingdom (UK) where infant health, growth and development milestones from birth are documented. A digitized version called the 'eRedBook', which takes the form of a personal health record (PHR), was piloted in two National Health Service (NHS) trusts [1]. Public health nurses, known as Health Visitors (HVs), helped promote the platform to parents, sign them up to use it and document in it as they would the paper based version. This study seeks to illuminate the factors that hindered HVs in engaging and recruiting parents to the eRedBook. If these can be identified and addressed it will improve how the personal child health record is implemented nationwide [2].

## 2. Methods

A qualitative exploratory case study design was adopted. Ethical approval for the study was obtained from the University of Glasgow. Secondary analysis of interviews done

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with implementation staff (n=11) between October 2012 and August 2015 was performed. Two mixed focus groups were also conducted in April 2015 with parents (n=12) and HVs (n=10) involved in the pilot of the eRedBook. Project documentation including quarterly technical reports, recruitment reports and evaluation updates were also reviewed (n=32). Thematic analysis using the framework approach [3] was undertaken to draw out themes that specifically affected participation in the eRedBook.

### 3. Results

Several factors emerged which affected HVs ability to engage and recruit parents to the eRedBook, which are grouped into technological, social and health service.

1. *Technological*: The usability of some aspects of the eRedBook platform, especially the complexity of registering and setting up a new profile, made it difficult for HVs to enroll parents on the PHR. Another barrier to participation was the concern HVs and parents had over the security of children's health data if it was going to be held by a private multinational company and not governed by the NHS.

2. *Social*: The lack of high-speed broadband in some rural areas was a major stumbling block as were the hidden costs associated with the PHR, which meant some families couldn't afford the technical equipment or Internet service to access online tool. The digital divide was clearly evident in certain economically deprived communities where some HVs work.

3. *Health Service*: Poor digital literacy skills among HVs also hindered engagement with parents around the eRedBook. Both electronic and paper versions were run in parallel which doubled HVs workload, and the PHR was not integrated with IT systems in the NHS which made it difficult for HVs to prioritize the eRedBook with parents during busy clinical appointments and sign them up to use it.

### 4. Discussion

HVs had to adapt to numerous challenges when rolling out a personal child health record in community settings. These digital health engagement issues need to be addressed before the eRedBook can be implemented nationwide.

### References

- [1] Royal College of Pediatricians and Child Health, Introduction to the Electronic Personal Child Health Record (ePCHR). ePCHR Briefing, RCPCH (2013). Available at: <http://www.rcpch.ac.uk/PCHR>, accessed September 2015.
- [2] S. O'Connor, F.S. Mair, M. McGee-Lennon, M. Bouamrane, C.A. O'Donnell, Engaging in large scale digital health technologies and services. What factors hinder recruitment?, *Proceedings of the 26<sup>th</sup> Medical Informatics Europe Conference*, Madrid, Spain, (2015), May 27-29<sup>th</sup>.
- [3] R. Ritchie, L. Spencer, Qualitative Data Analysis for Applied Policy Research, In: M. Hubermann, M. Miles, *The Qualitative Researcher's Companion*, Sage Publications, California, (2002).

# Effects of Reflection Using the iPad on Students' Motivation to Learn Nursing Techniques

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**Abstract.** In technical nursing training, it is necessary for students to adopt extensive perspectives, focusing on not only the accuracy of manual procedures, but also surrounding environments, in order to appropriately evaluate their own practices. Therefore, based on the idea that students need opportunities to objectively evaluate their own practices and improve their learning levels, a method of reflection using videos recorded by themselves with the iPad was developed. These results highlight the importance of providing students with learning materials that will promote discussions, as well as opportunities for successful learning experiences.

**Keywords.** nursing Techniques, learning strategy, iPad, reflections, basic nursing education

## 1. [Background]

In technical nursing training, it is necessary for students to adopt extensive perspectives, focusing on not only the accuracy of manual procedures, but also surrounding environments, in order to appropriately evaluate their own practices. For example, when performing urinary catheterization as a nursing technique requiring catheter insertion under aseptic conditions, in principle, students tend to concentrate only on part of the procedure, leading to difficulty in maintaining a broad visual field to ensure sufficient cleanliness while performing it. Therefore, based on the idea that students need opportunities to objectively evaluate their own practices and improve their learning levels, a method of reflection using videos recorded by themselves with the iPad was developed. This paper discusses its effects based on the results of a questionnaire survey for students, conducted after a training session.

## 2. Methods

The following training session was held for 187 second-year nursing students taking undergraduate courses:

1) The students were divided into practitioners and observers; while the former practiced a nursing technique, the latter recorded it with the iPad.

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2) When recording, a broad field was maintained until urinary catheter insertion. On insertion, the practitioner's hands were focused on.

3) Recorded videos were used for evaluation among the students to extract: generally favorable aspects; processes during which the aseptic technique was not appropriately performed; and points of improvement.

In a self-administered questionnaire survey conducted after the session, the students freely described their impressions of reflection using the iPad, and content analysis of such descriptions was performed. Participation in this survey was voluntary.

### **3. Results**

The following storyline and extracted categories outline the effects of learning using the iPad:

Reflection using the iPad enabled nursing students to <newly and more realistically recognize themselves>. <Timely reviewing their own skills>, they could clearly confirm each process and method of implementation, and this helped them <develop patient-based perspectives>. Furthermore, reflection with other group members facilitated <the integration of knowledge and practice to enhance awareness>, and <mutual evaluations> guided them toward the development of more detailed improvement plans. By <objectively evaluating their own nursing skills>, they realized their <difficulties>, and identified <further learning challenges>, while developing a sense of satisfaction, regarding their experience as <useful>. They also favorably evaluated watching videos and discussing with other group members, as these approaches enhanced their <understanding of the technique> which had previously been unclear.

### **4. Discussion**

Reflection using videos enabled students to comprehensively examine their own skills. It also helped them integrate their knowledge and practice, and enhance their awareness. Such awareness facilitated the identification of further learning challenges, consequently increasing their motivation to learn. These results highlight the importance of providing students with learning materials that will promote discussions, as well as opportunities for successful learning experiences. In line with this, it may be necessary to design courses that will enhance their self-esteem and create appropriate environments to maintain their motivation to learn.

# Social Media and Population Health Virtual Exchange for Senior Nursing Students: An International Collaboration

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**Abstract.** The authors have all engaged in using social media with students as a means for collaboration across national and international boundaries for various educational purposes. Following the explosion of big data in health the authors are now moving this concept forward within undergraduate and postgraduate nursing curricula for the development of population health virtual exchanges. Nursing has a global presence and yet it appears as though students have little knowledge of the health and social care needs and provision outside their local environment. This development will allow for explorative exchange amongst students in three countries, enhancing their understanding of their own and the selected international population health needs and solutions through asking and responding to questions amongst the learning community involved. The connection of the students will be recorded for their use in reflection; of particular interest will be the use of information included by the students to answer questions about their locality.

**Keywords.** Virtual electives, big data, population health, information resourcing, education

## 1. Introduction

The move towards more citizen engagement with technology shows no sign of slowing down. The internet of things [1], big data [2] and social media [3] are three examples of information and communications technology regularly used across all age ranges of people, with nursing students being no different. Undergraduate students starting their course at the time of NI2016 will register as nurses in 2019 or 2020 and become practitioners in a world reliant upon managing, recording and using information to support care. This project is designed to help prepare nurses for their professional career in a global environment where collaboration will be valuable to resolve population health issues.

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## **2. Methods**

The project is planned to run for three months. Ten undergraduate nursing students in New Zealand will be joined by 10 students from the United States and 20 students from the United Kingdom through a closed Facebook site where they will be directed towards exploring the similarities and differences of public/population health across the three countries involved. For example ‘What is the impact of wearable devices?’ or ‘What happens if there is a chickenpox outbreak in your community?’ or ‘What does the health community look like in your country?’ The students will drive the content on the site through questions and answers linked to their course work. In addition, they will be supported by Faculty and encouraged to use a diverse range of media and sources of information to gain a comprehensive appreciation of different population needs and outcomes. At the conclusion of the project assessment of the metrics/analytics of the site and Faculty led focus groups with the students involved will take place and the results made available to each participating University along with dissemination of the findings.

## **3. Results**

The preliminary findings of the project will be included in the poster presentation as the first release of results to the nursing informatics community. Additionally the experience of faculty will be shared, in terms of practical considerations for others considering a virtual student exchange.

## **4. Discussion**

The ever increasing cost of health care provision for public, personal and privately funded health care requires us all to find new ways of working. As educators we are able to help students to understand how population health is assessed, delivered and managed through this explorative study using social media so that they can take such knowledge forward in their careers. Should our expectations be met with the project then we propose to expand the number of students taking part both in terms of the participating Universities and new institutions wishing to join this exciting venture.

## **References**

- [1] N Kobie, What is the internet of things? The Guardian, 6<sup>th</sup> May, Accessed through <http://www.theguardian.com/technology/2015/may/06/what-is-the-internet-of-things-google> 2015
- [2] E Dumbill, What is big data?: An introduction to the big data landscape, O'Reilly Media Inc. Accessed through <https://www.oreilly.com/ideas/what-is-big-data?log-in> 2012
- [3] D Nations, What is Social Media? Accessed through <http://webtrends.about.com/od/web20/a/social-media.htm> 2015

# A 2-Year Study on the Use of NursingNAVI with the Partogram by Midwifery Students

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**Keywords.** NursingNAVI, partogram, labor

## Introduction

We have identified three foci of the nursing observation and nursing action respectively. Using these frameworks, we have developed the structured knowledge model for a number of diseases and medical interventions. We developed “NursingNAVI<sup>1)2)</sup>” for the intrapartum period, and explained to midwifery students during a lecture on the intrapartum period, how to use it with the partogram—the device that records the patients’ conditions during the intrapartum period—in practical training for conduct of labor. The records kept by the midwifery students were analyzed to study whether necessary observations and records were conducted at every stage of labor. Reports suggest that NursingNAVI was useful in such situations.

## Method

Each midwifery student (first-year student) experienced 10 cases of conduct of labor using the partogram. The intrapartum period was divided into 4 stages from the 1st to the 4th according to partogram, to collect the number of observation items.

## Results

The rate of use of the observation items of NursingNAVI during the intrapartum period in 2013 and 2014 was 70–84% in 70 records by 7 midwifery students and 74–83% in 100 records by 10 students, respectively (Table 1).

**Table 1. Observation terms in the partogram of labors by midwifery students in 2013 and 2014**

Each period for labor	Observation terms 70 cases by 7 midwifery students in 2013 (n=70)	Observation terms 100 cases by 10 midwifery students in 2014 (n=100)	p	Number of observation terms in NursingNAVI for labor
the first-stage of labor	58±3 (70)	61±2 (74)	ns	82
the second-stage of labor	59±3 (78)	62±3 (83)	ns	75
the third-stage of labor	27±2 (71)	28±2 (74)	ns	38
during the first 2 hours after labor	27±3 (84)	28±3 (83)	ns	32

Data are mean ±SD or(%). ns: not significant, p<0.05, t- test

## Conclusion

NursingNAVI was used as educational material for the intrapartum period in the lecture and practical training on midwifery. Results indicated that many observation items were used for the records, which suggested that the observation items of NursingNAVI were useful during the intrapartum period. Future studies should evaluate the items for delivery interventions.

## Reference:

- [1] S. Tsuru, F. Wako, M. Omori et al.; Developing the Structured Knowledge Model to Navigate the Nurses' Thinking Process in their Professional Judgment and Action, *Nursing Informatics. Stud Health Technol Inform.*, 188-95, 2014
- [2] S. Tsuru, F. Wako, M. Omori, K. Sudo. [Problem Solving for Volatilizing Situation in Nursing: Developing Thinking Process Supporting System using NursingNAVI® Contents.](#) *Stud Health Technol Inform.*, 541-5. 2015



# Development of an Open Source Educational Resource: “Clinical Procedures for Safer Patient Care”

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**Abstract.** An Open Education Resource (OER) has been developed by two nurse educators to address inconsistencies in how clinical health care skills are taught and practiced in the clinical setting, and to ensure best practice and quality care based on the latest evidence. A checklist approach aims to provide clear steps and rationale for procedures, standardized processes for clinical skills and to assist nursing schools and clinical practice partners in teaching clinical skills, and keeping procedural practice current. The format is logical, organized and focused on patient safety, and will provide information retrieval opportunities at the point of care to support decisions and plan patient care. This poster discusses the development of this resource, the framework used, and the process from conception to distribution.

**Keywords.** Open Education Resource, clinical skills, patient safety, interprofessional, evidence-based practice, nursing education

## 1. Introduction

In response to a call-out for open source textbook applications by BC Campus ([www.bccampus.ca](http://www.bccampus.ca)) in British Columbia, Canada, the authors applied and successfully obtained funding to develop an Open Education Resource (OER) to address inconsistencies and lack of standardization within the teaching and practice of nursing procedures and clinical techniques, and to ensure best practice and quality and safety of patient care. This OER has since been developed and is in press, for publication this year. This resource has a strong focus on patient safety and will provide guidance in procedures, and decision support for nurses and other healthcare professionals at the point of care.

## 2. Methods

This OER was based on the research and review of current and credible resources to ensure that all processes are based on a strong foundation of evidence with patient safety and quality of care being the priority of all procedures. The intention was to not only have consistency based on evidence in the way procedures are performed, but to ensure that students understand the associated clinical reasoning of the skill

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underscored by the need to provide safe patient care. Patient safety and quality of care should be focused on creating robust safety systems and among these, the point-of-care checklist has been proven to be a safe strategy, that is now becoming more common in health care<sup>[1]</sup>.

Checklists are used as the predominant format in this resource, following the work by Dr. Atul Gawande and described in his book *The Checklist Manifesto: How to get things right*<sup>[2]</sup>. Gawande posits that the reason for many medical errors is simple: the volume and complexity of healthcare today has exceeded our ability as individuals to properly deliver it in caring for people consistently, correctly, and safely. He argues that we can do better by using the simplest of methods: the checklist. Each skill/procedure is evidence-based and adapted based on research and reputable resources such as current textbooks, local health authority policies, and Canadian healthcare associations and organizations. Each checklist includes rationale for steps and additional information, with images, videos and/or diagrams to guide practice.

### 3. Results

The authors developed this OER in collaboration with BC Campus and it is due for publication by the end of the year. The OER consists of ten chapters of procedures and clinical skills for healthcare professionals, each chapter consists of an introduction, learning objectives, background to each procedure, the procedure checklist which includes rationale, additional information and relevant images/diagrams/videos, a chapter summary, key takeaways, online resources and references. Instructors using this resource will have the ability to reuse, revise, remix, and redistribute the material as per a Creative Commons License.

### 4. Discussion

We propose that the development of this open education resource will support the standardization of clinical patient care skills across BC to improve the safety and quality of care received by patients in healthcare facilities across BC. This poster presentation will outline the process of developing an OER and plans for distribution and adaptation for other healthcare educators.

### 5. Acknowledgments

We acknowledge funding from BC Campus and support for this work through BCIT.

### References

- [1] Canadian Patient Safety Institute. Frank J.R., Brien, S. (Editors) on behalf of The Safety Competencies Steering Committee. *The Safety Competencies: Enhancing Patient Safety Across the Health Professions*. Ottawa, ON. 2008
- [2] A. Gawande. *The Checklist Manifesto: How to get things right*. New York: Metropolitan Books. 2010

# Diffusing Innovations in Nursing Education: From PDAs to OERs

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**Abstract.** The Canadian educational and healthcare practice landscapes are ever-evolving technologically. In response to these changes, the British Columbia Institute of Technology (BCIT) has integrated various educational technologies using Rogers Diffusion of Innovation model as a guiding framework for this integration with considerable success. This poster describes BCIT's journey with diffusing innovations, discusses examples of these technological integrations in accordance with Roger's model, and outlines several implications for educational practice.

**Keywords.** Diffusion of Innovation, mobile technology, nursing education, teaching strategies, open education resource

## 1. Introduction

In response to evolving educational and health care technologies, the British Columbia Institute of Technology (BCIT)'s Bachelor of Science (BSN) Program began an exploration into adopting the use of mobile devices (Personal Digital Assistants [PDAs], smartphones, tablet computers) in nursing education and nursing student practice at the point of care in 2008. The introduction of these devices were the result of requests from nursing leaders to integrate technology in nursing education so as to best prepare nursing students for a technologically evolving clinical practice environment<sup>[1,2]</sup>. In the last seven years, the initial exploration into mobile devices has led faculty and students at BCIT to explore other innovative technologies.

## 2. Methods

Rogers Diffusion of Innovation<sup>[3]</sup> was used as a framework to guide the integration of technologies to support student-centered learning, faculty adoption, and the desire for the development of new teaching strategies in the BSN and Specialty Nursing programs<sup>[4]</sup>. Innovators and early adopters initiated pilot projects, moving through the five stages of innovation diffusion (the knowledge, persuasion, decision, implementation and confirmation phases) and utilizing the influencing characteristics of *relative advantage*, *compatibility*, *complexity*, *trialability*, and *observability*<sup>[3]</sup>.

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The initial exploration of integrating mobile devices in nursing student education developed into a decision to support student access to reputable software and databases rather than hardware (e.g. smartphones, tablets). The Specialty Nursing program progressed from an iBook authoring pilot to full implementation of the Critical Care program using iPads laden with all course materials. Other innovative technologies, such as the exploration of social networks, e-portfolios and Open Education Resources (OERs) were adopted and integrated using Rogers DoI framework.

### 3. Results

Reported benefits of technology integration included positive student feedback related to decreased stress levels, increased confidence, and improved feelings of self-efficacy as evidenced by Research Ethics Board approved research studies<sup>[5]</sup>. Challenges were faced with outdated Practice Education Site (PES) policies, and inconsistent acceptance or denial of mobile device use across sites. BCIT developed a social media policy for students and expanded that to include practice, sharing this policy with local Health Authorities and taking the lead in the use of mobile technology to support education for clinical practice and other post secondary institutions. A need for access to BCIT and other Canadian resources was recommended anecdotally by students and faculty and with a BC Campus ([www.bccampus.ca](http://www.bccampus.ca)) callout for textbook applications for the development of Open Source textbooks, BCIT is currently developing an Open Education Resource (OER) related to Clinical Skills for students and faculty to access via mobile devices. BCIT is also leading a project to develop an educational EHR to prepare students for practice.

### 4. Discussion

Work is in progress to explore other relevant resources that could be accessed by mobile device. Several research studies related to the development of these resources and the impact of mobile devices, social networks and e-portfolios are currently being shared with nursing communities through presentations and publications. Further research is anticipated related to the impact of technology on student's learning.

### References

- [1] Canadian Nurses Association *Position Statement*. Canadian Nurses Association: <http://www.cna-aiic.ca/CNA/documents/pdf/publications/PS87-Nursing-info-knowledge-e.pdf>. 2006
- [2] National League for Nursing Board of Governors. *Preparing the next generation of nurses to practice in a technology-rich environment: an informatics agenda*. National League for Nursing: [http://www.nln.org/aboutnln/PositionStatements/informatics\\_052808.pdf](http://www.nln.org/aboutnln/PositionStatements/informatics_052808.pdf). 2008
- [3] E.M. Rogers. *Diffusion of Innovations* (5th Edition ed.). New York: Free Press. 2003
- [4] G.J. Doyle, B. Garrett, B., & L.M. Currie. Integrating mobile devices into nursing curricula: Opportunities for implementation using Rogers' Diffusion of Innovation model. *Nurse Education Today*, 34(5), 775-782. 2014
- [5] G. Doyle, L. Secco, K. Furlong, J. Bailey, B. Jamieson, W. Hansen, R. Pafford. *Exploring student and faculty perceptions on access to and use of information: Responding to a call to reframe nursing competence*. e-Health 2015 Conference. Toronto, ON. 2015.

# Geo-Spatial Informatics in International Public Health Nursing Education

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**Abstract.** This poster describes results of an undergraduate nursing informatics experience. Students applied geo-spatial methods to community assessments in two urban regions of New Zealand and the United States. Students used the Omaha System standardized language to code their observations during a brief community assessment activity and entered their data into a mapping program developed in Esri ArcGIS Online, a geographic information system. Results will be displayed in tables and maps to allow comparison among the communities. The next generation of nurses can employ geo-spatial informatics methods to contribute to innovative community assessment, planning and policy development.

**Keywords.** Community assessment, geo-spatial science, geographic information system, nursing education, Omaha System, public health informatics

## 1. Introduction

Population health research increasingly associates health with where people live, work and play. Geo-spatial science can enhance public health informatics methods by including variables related to place and revealing important factors influencing health. This poster describes international student-generated community assessment data using the Omaha System to display community strengths and problems in a geographic information system. The Omaha System is a standardized terminology frequently used by public health nurses within public health informatics systems [1].

## 2. Methods

Esri ArcGIS Online was used to create a mapping tool to record community observations. Undergraduate nursing students in the United States and New Zealand

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used a checklist of 11 concepts from the Omaha System Problem Classification Scheme to code their observations during a brief community assessment activity. Students drew a polygon around the geographic boundaries of their community and entered their community assessment results into the mapping program. Descriptive statistics were used to summarize the results. Symbology was used to visualize results on the interactive online map.

### **3. Results**

A table of results will summarize problems and strengths for 20 communities surrounding the participating universities, 10 each from the United States and New Zealand. Map displays will be presented to allow comparison among communities.

### **4. Discussion**

Public health nursing students can transform observations into geo-spatial data to contribute to innovative community assessment, planning and policy development.

### **5. Acknowledgments**

Development of the mapping tool in ArcGIS Online was supported by a University of Minnesota Office of Information Technology faculty fellowship to M. Kerr, 2012-2013.

### **References**

- [1] K.S. Martin, *The Omaha System: A key to practice, documentation, and information management (reprinted 2<sup>nd</sup> ed.)*, Health Connections Press, Omaha, NE, 2005.

# Problems Faced by Nurses in Use of Electronic Health Records During Clinical Practice

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**Abstract.** The use of Electronic Health Record system still remains new to Indian health care settings. **Objective:** This study aimed to assess use of computer system by the nurses, to identify their problems and perception about EHR system. **Methods:** A cross-sectional study was conducted among 33 nurses working in a tertiary care hospital. A questionnaire was used to gather the data. **Results:** Most nurses were using computer systems but were not sure that EHR helped in efficient patient care. All nurses were in consensus that EHR system is a good method to improve documentation. **Conclusions:** Nurses under study were not so comfortable using EHR system but suggested the need of training in EHR system. The study has implications for health administrators to ensure rigorous training on EHR system for nurses.

**Keywords:** Problems in EHR, Health Informatics, Nursing Informatics, Electronic Health Record

## 1. Introduction

Nurses being the key link in patient care connecting many professionals have an important role in successful implementation of EHR systems. Studies conducted in many setting suggest that nurses understand that EHR enhances nursing work by increasing access to information but also help in quality control still it requires guidelines for consistent documentation, quality management, more efficient software and systems availability.<sup>1</sup> Nurse leaders will play important role in enhancing global perspective, technology skills, creating organization cultures, team building and to envision healthcare system characterized by rapid changes.<sup>2</sup> Current study focuses on assessing use of EHR by nurses, problems faced and attitude towards EHR.

## 2. Methods

A cross-sectional quantitative descriptive study was conducted among 33 nurses, selected by convenient sampling and after taking consent were enrolled for the study.

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### 2.1 Data Collection

Structured questionnaire was used for data collection. First part consisted of demographic profile and second part included questions on use of EHR, problem faced and attitude of nurses towards use of EHR system.

### 3. Observations

The mean age of nurses was 29 years. Mean years of experience with computer system were three years. About half of the nurses were diploma holders (54.5%). Majority of nurses (63.6%) were using computer for health informatics. More than half of the nurses were comfortable using EHR system (60.6%). Most nurses agreed that adequate computer systems were available to enter data (63.6%), most of them faced problems due to system breakdown (93.9%) and technical problems (69.7%). About 90.9% nurses reported that help was available. 63.6% agreed that entering data in system was duplication of work, though 51.5 % of the nurses agreed that using EHR instead of written documentation will save nursing time. All the nurses said that computerized system is a good method to improve documentation. Around 63.6% preferred using computerized system if given a choice.

### 4. Discussion

Most nurses were using EHR system and found it user friendly. Nurses suggested need for more training. The reason of difference in opinion and practice could be many such as previous use of computers, training issues, system design and support available during orientation. Problems mentioned by nurses were not enough time, no appreciation, no incentives and more rivalry among colleagues although, most reported that help was available whenever they faced problem. Technical factors included nurse's computer skill level, their pre-existing knowledge, and availability of EHR program. The attitude of nurses reflected that most of the nurses were unsure how the system helped. The opinion reflects that nurses are aware of the importance of more organized systems in clinical setting but limitations being the correct execution with involvement in designing, implementation, considering training aspects and analyzing relevance of written and computerized documentation.

### References:

- [1] Kossman SP, Scheidenhelm SL. Nurses' Perceptions of the Impact of Electronic Health Records on Work and Patient Outcome. *Comput Inform Nurs*. 2008 Mar-April; 26(2): 69-77.
- [2] Huston C. Preparing nurse leaders for 2020. *Journal of Nursing Management*. 2008 Nov; 16(8): 905–911.



# Distance Education Programs: The Technical Support to Be Successful

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**Abstract.** Academic success requires support on a variety of levels as well as access to contemporary tools and services. Supporting students enrolled in a successful higher education distance learning program, requires a strong, properly trained IT support staff in addition to a stable IT environment. Our distance education program began with a regional market but has grown significantly over the past few years. This is primarily due to the success of our distance education tools and support which have contributed to achieving a ranking of eleventh of best graduate schools in nursing according to the U.S. News and World Report. The entire student population is “Bring Your Own Devices” (BYOD). Critical to this support is the initial configuration and loading of needed software during the first week of orientation. All of this success requires a robust team of members prepared in a range of skill sets from networking to instructional design.

**Keywords.** Nursing Education, Distance Education, Technology Support, Nursing Students, Staff Development

## 1. Introduction

Supporting nursing education is rapidly changing as students are preferentially selecting programs that support distance education and online learning. Distance education necessitates more support on a larger scale than the traditional classrooms once required. Successfully supporting a distance education program is a multi-faceted undertaking. It requires a flexible, properly trained support staff as well as a litany of tools and services operating over a robust yet stable infrastructure that can handle the load these students place on the network, equipment, and staff.

## 2. Student population

In the 1990s, the Vanderbilt School of Nursing (VUSN) was a relatively small, high quality, boutique program solely aimed at students within commuting distance of the campus. Growing the program required steps to accommodate a different type of student, (the distance learner), who in turn brought about a completely new set of support challenges. “Because of competing priorities of work, home, and school, adult

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learners desire a higher degree of flexibility” [1]. Attracting distance learners required a change in how courses were taught, an increase in equipment and staff to support the undertaking.

### 3. Staffing, Tools and Systems

It is no longer sufficient to run a distance academic nursing program with skeleton support staff. “Support for distance learners should not be overlooked when planning distance programs” [1]. A properly staffed program contains specialists such as onsite audio/video (AV) staff, information technology (IT) technical staff, developers, and academic instructional designer(s), and even faculty who can model distance teaching behavior. Network bandwidth at the institution and at the students’ end must be robust enough to handle the load that distance education students place on the network infrastructure. Another requirement for a successful distance education program is a Learning Management System (LMS), which is essential for administering, tracking and reporting not only course materials and data but also student enrollment and communication. With the vast majority of students taking courses at a distance, exam security becomes an issue and will require a proctoring software integrated into the LMS.

### 4. Challenges

One challenge that occurs when supporting distance students is that technical support must be available across different time zones. Students bring their own devices which significantly increases this can be reduced by creating a list of minimum hardware and software requirements the students must abide by. Supporting students’ technological needs has become much more difficult as technology changes constantly.

### 5. Conclusion

As students look to further their careers they seek solutions that maximize their already hectic schedules. Distance education allows for participation from students residing around the world who did not have such options prior to its use. Successful distance education programs take a strong and robust infrastructure, a skilled team of support staff, and a solid set of tools to guarantee an excellent educational experience. Challenges are many but can be overcome. Providing this type of support is a major investment for the educational institution but essential and non-negotiable. Having only one to two individuals supporting a large distance program is a mindset that must be changed.

### References

- [1] Gallusha, J.M. (1998). *Barriers to Learning in Distance Education*. Retrieved from <http://files.eric.ed.gov/fulltext/ED416377.pdf>

# An Innovative Use of Telepresence Robots for Educating Healthcare Professional

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**Abstract.** Telehealth enhances communication across distances, facilitates teamwork, and increases access to care, particularly in rural areas. As the use of telehealth technology assimilates into clinical practice, its integration is also needed in clinical curricula. Students participated in 2 pediatric scenarios in teams of 3 to 4 prelicensure nursing students, with one nurse practitioner student participating via a telepresence robot. Forty-eight prelicensure and 5 nurse practitioner students completed surveys following the clinical simulations. We found that it was feasible to use a telepresence robot as a tool in clinical simulation, to introduce telehealth, and students reported high mean scores on the acceptability of using the robot. While there are challenges, incorporating telepresence technology into simulations opens up many opportunities to both engage students in telehealth with patients and other clinicians, and to engage students in their education when they are learning at a distance.

**Keywords.** Telehealth, distance based education, telepresence, simulation

## 1. Introduction

The adoption of telehealth technologies eliminates location as a barrier to accessing quality health care. This opens up new possibilities for clinicians to engage with patients and other clinicians with an internet connection across the world and in real-time. Realizing the benefits of telehealth requires care teams to engage with patients and each other in new ways. Telehealth enhances communication across distances, facilitates teamwork, and increases access to care [1]. As the use of telehealth technology assimilates into clinical practice, its integration is also needed in clinical curricula.

Implementing telehealth through the use of a telepresence robot can potentially enhance interprofessional education, promote role development of students, and enable them to improve their communication and teamwork skills. A telepresence robot is a remote-controlled, wheeled device with a display to enable video chat and video conferencing, among other purposes. This project assessed the feasibility and acceptability of a telepresence robot as a tool to introduce telehealth and to engage distance-based students in clinical simulations.

## 2. Methods

Students participated in pediatric scenarios in teams of prelicensure nursing students, with one nurse practitioner student participating via a telepresence robot. Forty-eight prelicensure and 5 nurse practitioner students completed surveys and feasibility and acceptability following the clinical simulations.<sup>9</sup>

## 3. Results

It was feasible to use the telepresence robot in this project, and both groups of students reported high mean scores on the acceptability of using the robot. Telepresence technology provided students the opportunity to participate in simulations without distance being a barrier. This provided the nurse practitioner student with the opportunity to be the clinical provider at a distance.

Table. Acceptability of the Telepresence Robot in the Clinical Simulation

	Prelicensure students <sup>a</sup> M (SD)	NP students <sup>b</sup> M (SD)
Teaching methods were helpful and effective.	4.16 (0.62)	4.2 (0.45)
The simulation provided me with a variety of learning materials and activities to promote my learning the class objectives.	4.39 (0.72)	4.4 (0.55)
I am confident that I am mastering the content of the simulation presented to me.	3.72 (1.08)	4.4 (0.55)
I am confident that I am developing skill & required knowledge to perform necessary tasks in a clinical setting.	4.21 (0.75)	4.6 (0.55)
I am confident this simulation covered critical content necessary for mastery of class learning objectives.	4.25 (0.84)	4.6 (0.55)

<sup>a</sup>n=45 <sup>b</sup>n=5

## 4. Discussion

We found that it was feasible to use a telepresence robot as a tool in clinical simulation, to introduce telehealth, and students reported high mean scores on the acceptability of using the robot. While there are challenges, incorporating telepresence technology into simulations opens up many opportunities to both engage students in telehealth with patients and other clinicians, and to engage students in their education when they are learning at a distance [2,3].

## References

- [1] C. Henderson, M. Knapp, J.L. Fernández, et al., Cost effectiveness of telehealth for patients with long term conditions (Whole Systems Demonstrator telehealth questionnaire study): nested economic evaluation in a pragmatic, cluster randomised controlled trial. *BMJ*. (2013), 346:f1035.
- [2] S.B. Issenberg, W.C. McGaghie, I.R. Hart, et al., Simulation technology for health care professional skills training and assessment, *JAMA* **282**(9) (1999), 861-866.
- [3] M. Enlow, L. Shanks, J. Guhde, M. Perkins, Incorporating interprofessional communication skills (ISBARR) into an undergraduate nursing curriculum, *Nurse Educator* **35**(4) (2010), 176-180.

# Design and Development of Learning Objects for Health Professionals

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**Abstract.** Infectious diseases have been re-emerging in developed and underdeveloped countries. In Brazil, the increasing incidence of communicable diseases is ongoing. This new reality generates the need to update the professionals of the sector, in order to make them capable of dealing with such important problem of public health. Educational actions through the usage of the learning objects can contribute to a review and an adoption of effective and safer public health practices. Thus, this scenario leads to the proposal to disseminate knowledge based on the development of learning objects concerning surveillance and prevention of communicable diseases to primary care providers, specifically community health agents. Learning Objects are interactive tools based on web which support specific learning conceptions enhancing, expanding and guiding the learners cognitive process, and when they are combined with other objects may create an efficient and flexible learning environment.

**Keywords.** primary health care, epidemiological surveillance, communicable diseases, health education, learning objects

## 1. Introduction

Brazilian society has suffered constantly structural transformations, along with significantly demographic profile changes due to the rise in life expectancy and in the epidemiological profile, with the increase of the communicable diseases rates [1] [2].

Considering this context, it is necessary to improve healthcare providers' quality and performance, mainly community health agents, as they represent an interface between the community and the health services

While educational resources have been used to promote the learning process of the primary care providers, learning objects can be seen as a cognitive learning enhancer for those who are involved in users care, including community health agents (CHA).

## 2. Methods

This is a qualitative and exploratory research, with an interventionist approach [3] [4] [5]. The scenario is the Assistance Teaching Integration (ATIC) from Federal

University of Health Sciences of Porto Alegre (UFCSPA), Brazil. Forty CHA were involved in the process.

Respondents answered a questionnaire about previous knowledge on information technologies, and transmissible diseases, the relevance of a serious game in their training for work, and the intention on using the app. Based on the Bardin's content analysis methodology [5], the findings served as the basis for design and development of a prototype of a Learning Object (LO) [6], which aims to address the needs of the participants.

### 3. Results

A mobile friendly web app prototype was created, using Android, and running both on/offline. Through this LO, it is possible to improve the actions of CHA, in terms of quality and productivity. The app run in mobile devices, allowing the agents to use it in their daily work, clarifying their doubts whenever needed.

### 4. Discussion

This project makes an important contribution to health, because of its uniqueness and innovation aspects. Also, the use of a LO enhance dynamism and interactivity to Health Care Workers' education.

The application software has the potential to qualify the health measures adopted by these professionals, and therefore outlines a new epidemiological approach about the Basic Attention.

### 5. Acknowledgments

The researchers would like to thank the respondents and the areas surveyed for the collaboration and availability.

### References

- [1] Beltrão, K.; Sugahara, S., Brazilian population and the social security system: reform alternatives. (IPEA), Rio de Janeiro, 2005.
- [2] Brasil. Secretaria de Vigilância em Saúde – Departamento de DST, AIDS, e hepatites virais. Boletim Epidemiológico, HIV/AIDS, Brasília, 2013. [Portuguese]
- [3] Yin, R. K., Case Study Research: Design and methods. Second Edition. Sage, 2003.
- [4] Baxter, P., & Jack, S., Qualitative case study methodology: Study design and implementation for novice researchers. The Qualitative Report, 13), 544-559. 2008
- [5] Bardin L. Análise de conteúdo. Lisboa: Edições 70; 1993. [Portuguese]
- [6] Barros, D. M. Pedagogical features of learning styles in virtual for evaluation of virtual learning environments. Lisbon, 2011.

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# Education Methods for Improving the Ability to Use Nursing Information, with a Focus on Issues Related to the Role of the Head Nurse: A Post-Workshop Evaluation

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**Abstract.** The use of information technology in medical setting is becoming increasingly prevalent; therefore, it is necessary to examine education methods that promote improvements among nursing professionals in the ability to use nursing information. With a focus on the role of the head nurse, the aim of this study, which consisted of two separately organized workshops, was to examine the effectiveness of behavior modification to resolve workplace issues identified by nursing professionals. After participating in these workshops, all nursing professionals demonstrated an increased ability to use nursing information and effectively resolve issues through behavior modification

**Keywords.** Head nurse, improved ability to use nursing information, workshop

## 1. Introduction

The use of information technology such as electronic medical records has become increasingly common in medical setting in Japan. In practice, many head nurses are part of a generation that has not received IT education, and therefore are somewhat uncomfortable with information and communication technology (ICT) equipment and may not fully understand the appropriate methods for collecting information <sup>[1]</sup>. The aim of this study, which consisted of two separately organized workshops, was to examine the effectiveness of behavior modification in relation to improving the use of nursing information among nursing professionals, with a focus on issues related to the role of the head nurse.

## 2. Methods

Two workshops were conducted involving nine head nurses. Workshop methods were (1) Divide nurses into two groups and hold discussions.

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(2) Make notes of discussion content on small slips of paper, and then affix these small slips to a large sheet of paper.(3) Classify workplace issues and information use skills. In Workshop 1, head nurses identified their own issues in “Types of nursing information dealt with by individuals on a daily basis and specific actions in the use of this information.” In Workshop 2, they reported and shared information on “achievements in resolving issues”.

### **3. Results**

In Workshop 1, almost all head nurses instigated concrete actions proactively, but head nurses in pediatrics and obstetrics, where the level of nursing requirements is not reflected, wondered how to analyze and express “busyness,” establishing this as an individual issue that needed to be addressed in the future. In Workshop 2, all head nurses consciously took “action regarding individual issues”. The head nurse in pediatrics, where the level of nursing requirements is not reflected, collected and analyzed data from previous hospital stays, and promoted information sharing across the entire ward, encouraging staff to complete incident and near-miss incident reports.

### **4. Discussion**

The results suggest that the workshops provided head nurses with the opportunity to clarify their own role issues, and through proactive participation and discussion, share their experiences of improvements in the work process and activities that resolved workplace problems. As a result, they were able to make observations and generate measures that otherwise may not have been possible. Furthermore, establishing a second workshop to report on results seems to have given rise to behavior modification, as participants set their own goals to be achieved for the measures they planned at the first workshop and needed to achieve by the time of the second workshop.

### **5. Acknowledgments**

We would like to thank the head nurses, who assisted with this study. This work was supported by JSPS KAKENHI Grant Number 25463382.

### **References**

- [1] T. Izumi, Y. Majima: Present Situation and Problems in Information Utilization by Head Nurses, *International Journal of Innovation, Management and Technology*, Vol.6, No.1, pp52-56, 2015.
- [2] M. Matsuo: *The Experiential Learning Process of Managers*, Toyo Keizai, 2013.
- [3] M. Matsuo: *Learning from Experience*, Doubunkan-syuppan, 2008



# Design of a Hospital Simulation Software for Nursing Education

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**Abstract.** This work aims to describe the inception and design for a hospital simulator based on data and cases provided by teachers and other randomized data. The main goal is to develop a computer software tool that simulates a hospital as a tool for nursing student. The system is based on a multi-agent model and multi threaded parallel processing. Other parts includes the interfaces for teacher and student, reports and fixed constraints like Laws and other rules. This is a work in progress project and will be released as open source software after the final validation.

**Keywords.** Nursing, Hospital, Simulator, Learning tool, Software, Design.

## 1. Introduction

People management on a hospital may be all things but simple, the main distribution of a hospital nurses depends on the rules of each country. In some cases, like in the United States, it can be divided in two main categories: Registered Nurses (RN) with associate degree and Licensed Practical Nurses (LPN) with a post-secondary non-degree award, the last one works under the direction of RN and Physicians [1].

This project aims to create a computer software that simulates the workflow at a model hospital, based on common cases (inpatients, illness types, employees jobs, etc.) and serving as a tool for nurse teachers and students, proposing situations from the simple normal operations to the challenging ones, like work overload or other non-normal circumstances.

## 2. Methods

The construction of the simulator is based on a multi-agent system (MAS) [3] [4] over a running timeline. At presentation level, the HTML5 standards was chosen for the deployment easiness. At backend level, the Python programming language [5] was chosen because this is the most known language by the developer at research team. For persistence, the PostgreSQL [6] database server was chosen for the same reason.

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### 3. Results

At this point, two user interface was defined: student and teacher. The student interface module permits all interactions between the simulator and the student. The teacher interface permits administrative tasks like reports, case insertions and students monitoring. The student module provides access to students interface where they may interact with the inpatients, staffand the hospital equipment.

Inside the main kernel, all processes works together handling the databases connections, events and communications with other modules like the interfaces and intelligent agents.

### 4. Discussion

This model aims to mimic the real situations encountered in a common hospital, where each patient are different from others and may request assistance at any time, in unpredictable order [2].

One of the challenging situations is that, depending on patient request, the service performed by some professional will lock the worker in that job for the time necessary to do the job (programmed by the teacher). Other important factor to student manage is the complexity of the procedure requested by the patient, the student must allocate the correct professional/time to the duty. In more critical situations the physician must be called to attend the patient [1].

Once that all simulations are performed with a teacher supervision, the validation will be executed in a determined period in the pre-release phase by the teachers itself in partnership with the project.

### 5. Acknowledgments

This project is a work-in-progress and aims to produce a most real possible simulation of the challenges encountered by nurses at a common hospital, although it's not fully concluded, the main structure will be released in open source model to attract other programmers focused in nursing technology.

### References

- [1] BLS, Bureau of Labor Statistics. United States Department of Labor. 2015.
- [2] S. M. Nascimento. As funções gerenciais do enfermeiro no cotidiano da assistência hospitalar. Master Degree Dissertation.Federal University of Rio de Janeiro,2012.
- [3] R. Lagatie et al, P. Negotiation Protocols for Distributed Nurse Rostering. Proceedings of the 21<sup>st</sup> Benelux Conference on Artificial Intelligence, 29-30 October 2009 Eindhoven, Netherlands (2009). 145-152.
- [4] E. Kaplansky et al. Distributed personnel scheduling -negotiation among scheduling agents. Annals of Operations Research, 155 (2007) ,227-255.
- [5] Python Software Foundation, available from: [www.python.org](http://www.python.org).
- [6] The PostgreSQL, available from: [www.postgresql.org](http://www.postgresql.org).

# Evaluation of Knowledge, Attitude, Practise and Adoption Among Health Care Professionals for Informatics/Computerised Technology Systems

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**Abstract:** This proposed study will be conducted in Telangana and Tamil Nadu states in India. Mapping of Health care Professionals by a web-based Delphi technique followed by Focus Group Discussion and Evaluation of Knowledge, Attitude, Practise and Adoption among Health Care Professionals for informatics/ computerised technology systems by using structured questionnaire for knowledge and practice and for Attitudes toward Computers in Healthcare (P.A.T.C.H.) Scale will be used to collect the data. This study results will create evidence on present and relevant informatics/ computerized technology systems needs and help the research team to develop informatics competencies list and design an online or offline skill up gradation programs for health professionals in India according to their diverse roles in the health care system. The researcher team believes these results will have National relevance to the current focus areas of Government of India and to strengthen the Health Informatics Program offered in IIPH, Hyderabad.

**Keywords:** Informatics/computerized technology systems, P.AT.C.H Scale, Delphi technique, Focus group discussion, Mapping of the Health Professional.

## 1. Introduction

Advances in global health are increasingly driven by new ideas that emerge at the interface of computers, informatics and technology based systems (1). The promise of Health Informatics can be realised in countries like India, only if health care professionals are trained in basic computing skills and information technologies (IT). Beyond health care literacy, Health Informatics Systems requires the users to understand and develop proficiency in the use of informatics and technology based systems that are not always taught in a formal method as part of the health care academic curriculum or thru standardised training programs (5).

The importance of evaluating knowledge, attitudes and beliefs for learning to use new technologies is widely acknowledged (DeYoung & Spence, 2004; Loyd & Gressard, 1984; Ray, Sormunen, & Harris, 1999; Saade & Galloway, 2005).

## 2. Methods

To date, very little research based evidence is available from India, related to Knowledge, Attitude, present Practise and present Adoption among health care professionals towards health informatics. A mixed methods approach would be

selected to address the aims of this study. This study will be done in states of Telengana and Tamil Nadu in India.

Mapping of Health care Professionals by a web-based Delphi technique followed by Focus Group Discussion and Evaluation of Knowledge, Attitude, Practise and Adoption among Health Care Professionals for informatics/ computerised technology systems by using structured questionnaire for knowledge and practice and for Attitudes toward Computers in Healthcare (P.A.T.C.H.) Scale will be used to collect the data.

### 3. Results

The data analysis plan is by using SPSS and R and results will be presented in narratives and tables. Descriptive (frequency and percentage) and inferential statistics (Chi-square test) to test hypothesis of association will be used to interpret the data. Regression methods will be used to evaluate the strength of association, in an adjusted and Un-adjusted format. The results will be considered statistically significant if the p value was < 0.05.

### 4. Discussion

Evaluation Knowledge, Attitude, Practise and Adoption among Health Care Professionals for informatics/ computerised technology systems will help in contributing to a pool of evidence that could be used to understand the present and relevant needs among health care professionals across wide variations in education, practice, experience, skills and socio demographics. The project results would be helpful to design and develop informatics competencies list and an online or offline skill up gradation programs, in line with the present focus areas of the Government of India. Also it would help to strengthen the health informatics program being offered by Indian Institute of Public Health – Hyderabad to offer relevant skills in various formats.

### References

- [1] R.M. Mary , Telemedicine: an emerging health care technology, *Health Care Manag (Frederick)*, 22(3):219–23, 2003.
- [2] S.M.Edworthy , Telemedicine in developing countries.,*BMJ*, 8;323(7312):524–5, 2001 Sep, doi: 10.1136/bmj.323.7312.524, <http://bmj.com/cgi/pmidlookup?view=long&pmid=11546681>.
- [3] F. Francesco, Medical care from space: Telemedicine, *ESA Bull*, 114:54-59, 2003.
- [4] O. O. Taiwo , A.O. Wellington , Use of CD-ROM MEDLINE by medical students of the College of Medicine, University of Lagos, Nigeria. *J Med Internet Res*, 31;5(1):e7, Mar 2003 .
- [5] O.O. Odusanya , O.A.Bamgbala , Computing and information technology skills of final year medical and dental students at the College of Medicine University of Lagos, *Niger Postgrad Med J*, 9(4):189–93, Dec 2002.
- [6] M. Azeem, Ten ways to improve information technology in the NHS, *BMJ*, 326(7382):202–6, Jan 2003.
- [7] T. Jeanine Warisse, R.D. James, A. Adil, W. James, N. Alan, L.A. Betty, C. Jeff, K.M. Seong , Media attitudes vs. use: the contribution of context to the communication environment in telemedicine, *Health Care Manage Rev*, 28(2):95–106, Apr2003 .
- [8] A. Grace Ada, Computer and internet use by first year clinical and nursing students in a Nigerian teaching hospital, *BMC Med Inform Decis Mak*, 2003.

# Information Sharing and the Nursing Practice for the Certified Nurse in Radiation Therapy Nursing

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**Abstract.** This study is conducted in order to clarify, however practice and get or sharing information in the Radiation Therapy Nursing of Certified Nurses. We have the group interviews from the four members the Certified Nurses in Radiation Therapy Nursing. It was found that Certified Nurses in Radiation Therapy Nursing felt that don't have the information about the patients who receives radiation therapy. In addition, they thought not able to even determine about whether time required, and not provide the professional nursing care practice. They say that we need the time, place and information. They were determined to be there to be necessary in for exhibiting their abilities. In particular, the most important problems that there aren't systematic information of the patients who receives radiation therapy. It's mean that, not have described the information for Radiation Therapy Nursing, and not obviously structure of nursing process or important assessment's, yet.

**Keywords.** Radiation Therapy Nursing, Certified Nurse, Nursing Informatics, thinking process, professional judgment

## 1. Introduction

In Japan, "Certified Nurse in Radiation Therapy Nursing" was born in July, 2010.

But the members were very limited only 177 in 2015. Facilities of training to the Certified Nurses in Radiation Therapy Nursing is only 3 in the Japan, one training facility suspends recruitment now. This study is conducted in order to clarify, however practice and get or sharing information in the Radiation Therapy Nursing of Certified Nurses.

## 2. Methods

We have the group interviews from the four members the Certified Nurses in Radiation Therapy Nursing.

The four members are whole members in one prefecture. They talk about their nursing practices and Information sharing with other nurses. All the contents of the

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group interview were recorded by IC recorder with permission of the member's. Create a verbatim record from the IC recorder data were analyzed.

### 3. Results

All members were only the specialist nurse in radiotherapy nursing and institution.

They are thinking to need the professional judgment for the patients in Radiation Therapy. In addition the patients and families must be get the self-care skills and keep the Quality of Life (QOL). However, they thought not able to even determine about whether time required, and not provide the professional nursing care practice. They were feeling a lot of issues that lack of the time, information's and feedback to the activity themselves etc.

In particular, the most important problems that there aren't systematic information of the patients who receives radiation therapy.

### 4. Discussion

The Certified Nurse in Radiation Therapy Nursing said that we need the information systems to grasp the all patients in hospital. It's mean that, not have described the information for Radiation Therapy Nursing, and not obviously structure of nursing process or important assessment's, yet.

### 5. Acknowledgments

It was found that Certified Nurses in Radiation Therapy Nursing needed the information about the patients who receives radiation therapy. They thought not able to even determine about whether time required, and not provide the professional nursing care practice. It's mean that, not have described the information for Radiation Therapy Nursing, yet. In the other side, not obviously structure of nursing process or important assessment's for the Radiation Therapy Nursing.

The importance of information to support the activities of the certified nurse is a small number of people have been suggested.

### References

- [1] Tsuru S, Nakanishi M, Ohta K, et al. *The problem of nursing common language for the information sharing in clinical practice: The fact-finding in regard to the correspondence between name and contents of nursing action*. Japan J Med Informatics. 2002; 22 (1): 59-70.
- [2] S. Tsuru, F. Wako, M. Inoue, et al. *Issues in terminology for describing nursing practice in Japan: Development of standardized terminology for nursing observation and action*. Proc. of the AMIA 2012 11th International Congress on Nursing Informatics (2012), 665
- [3] Tsuru S, Watanabe C. *The navigator for thinking process in nursing*, (eds.) Standard Association, Tokyo, [in Japanese], 2011. Japan

# Designing an Internet-Based Intervention Tailored to Psychological Factors for CVD Risk Reduction: Role of Stress and Anger

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**Abstract.** Purpose: To examine the mediating role of occupational stress on the relationship of anger expression to cardiovascular disease (CVD) risk using Framingham risk score equation in Korean adults with metabolic syndrome. Methods: This cross-sectional study was a secondary analysis of baseline data from a longitudinal study conducted in 91 Korean male workers. Psychological variables were assessed using structured questionnaires. Results: Occupational stress was significantly predictive of CVD risk ( $\beta = .278, p = .008$ ). The inclusion of occupational stress non-significantly decreased the standardized beta by 33.6% for anger expression as a predictor of CVD risk ( $\beta = .152, p = .163$ ). The Sobel test showed a significant mediating effect between occupational stress and CVD risk ( $p < 0.01$ ). Conclusion: This mediating role of occupational stress has important clinical implications as interventions designed to manage anger expression to reduce CVD risk in this population.

**Keywords.** metabolic syndrome X, cardiovascular risk, stress, anger

## 1. Introduction

Metabolic syndrome is an emerging global health problem; it appears as combination of cardiovascular diseases (CVD) risk factors [1]. Negative psychological conditions, such as anger and stress, are known to be associated with CVD risks [2]. The parent study examined the effects of an internet-based program on CVD risk reduction and details of the parent study are described elsewhere [3]. The ultimate goal of this study was to provide a foundation for designing an intervention corresponding to workers' current stage of change for lifestyle behaviors including anger and stress for prevention/reduction of CVD risk [3]. Thus, we examined the role of occupational stress on the relationship of anger expression to CVD risk.

## 2. Methods

This cross-sectional study was a secondary analysis of baseline data from a longitudinal study conducted in 91 Korean male workers who had one or more of metabolic syndrome risk factors. The 10-year absolute CVD risk was calculated using the Framingham 10-year general cardiovascular risk equation [4]. Occupational stress was measured with 24 items from the Korean Occupational Stress Scale, a self-reported

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questionnaire for estimating unique and specific occupational stressors among Korean workers [5]. Anger expression were measured by a previously developed the 24-item State-Trait Anger Expression Inventory (STAXI) adapted for use with Korean (STAXI-K) [6]. The hypotheses were all tested using multiple regression analyses; the Sobel test was used to determine whether the mediating role of occupational stress was statistically significant. Statistical significance was set at  $\alpha = 0.05$  (two-tailed).

### 3. Results

The mean age was 38.4 years ( $SD$  7.14) and the most prevalent metabolic risk factor was elevated blood pressure (73.6), followed by elevated triglyceride (69.2%), abdominal obesity (52.7%). The mean score of 10-year CVD risk was 10.04 % ( $SD$  6.01). The percentage of moderate and high risk ( $\geq 10$  % of FRS) was 50.6% ( $n=46$ ). Anger expression significantly predicted both occupational stress ( $\beta = .342, p = .001$ ) and CVD risk ( $\beta = .229, p = .029$ ). In addition, occupational stress was significantly predictive of CVD risk ( $\beta = .278, p = .008$ ). The inclusion of occupational stress in the model non-significantly decreased the standardized beta by 33.6% for anger expression as a predictor of CVD risk ( $\beta = .152, p = .163$ ), consistent with the finding that occupational stress fully mediated the relationship between anger expression and CVD risk. The Sobel test for this mediation model showed a significant mediating effect between occupational stress and CVD risk ( $z = 2.136, p = .033$ ).

### 4. Discussion

We observed occupational stress mediates the relationships between anger expression and CVD risk. Our findings suggest supporting management of occupational stress may help individuals with worse anger expression. Identifying anger expression categories may help identifying risk groups who are more vulnerable to have worse CVD under similar occupational stress.

### 5. Acknowledgments

This research was supported by Basic Science Research Program through the National Research Foundation of Korea funded by the Ministry of Education, Science and Technology (grant number: 2009-0067981) and partly supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (grant number: 2013R1A1A2059806).

### References

- [1] S.M. Grundy, Metabolic syndrome pandemic, *Arterioscler Thromb Vasc Biol*, **28** (2008), 629-636.
- [2] E. Diene, A. Fouquet, Y. Esquirol, Cardiovascular diseases and psychosocial factors at work, *Arch Cardiovasc Dis*, **105** (2012), 33–39.
- [3] C.J. Kim, S. Kang, Development and a pilot test of an internet-based cardiovascular risk reduction program for Korean male workers with metabolic syndrome, *Comput Inform Nurs*, **31** (2013), 157-166.
- [4] R.B. D'Agostino, R. Vasan, M.J. Pencina et al., General cardiovascular risk profile for use in primary care: the Framingham heart study. *Circulation*, **117** (2008), 743-753.
- [5] S.J. Chang, S.B. Koh, D. Kang et al., [Developing an Occupational Stress Scale for Korean Employees], *Korean J Occup Environ Med*, **17** (2005), 297-317.
- [6] K.K. Chon, D.W. Hahn, C.H. Lee, & C.D. Spielberger, Korean adaptation of the state-trait anger expression inventory: anger and blood pressure. *Korean J Health Psycho*, **2** (1997), 60-78.



# Attitude Towards Health Information Privacy and Electronic Health Records Among Urban Sri Lankan Adults

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**Abstract.** Sri Lanka is planning to move towards an Electronic Health Record (EHR) system. This research argues that the public preparedness should be considered in order to implement a functioning and an effective EHR system in a country. When asked about how concerned the participants were about the security of their health records, 40.5% stated they were concerned and 38.8% were very concerned. They were asked to rate the 'level of trust' they have on health institutes in Sri Lanka on a scale from 1 to 10 (1 lowest level of trust and 10 highest), 66.1% rated at level 5 or less.

**Keywords.** Health Information Technology, Electronic Health Records, developing countries, Manual Health Records, concerns, security, Health Information Exchange

## 1. Introduction

The Ministry of Health Sri Lanka has formulated the National e-Health plan draft document to improve the quality, efficiency, patient safety, and cost effectiveness of health care thus contributing to achieve the six goals set out in the National Health Policy. [1] It is important to assess the 'preparedness' of the public for the upcoming changes leading towards e-health. A framework that defines such key aspects is Health Insurance Portability and Accountability Act 1996 of USA, which is a collection of many components called HIPAA rules. They protect the privacy health information, sets national standards for the security of electronic protected health information and improves patient safety [2] This study is done to describe the attitudes towards EHRs among Sri Lankan Adults and their perception on health data privacy and IT related security practices based on the standards prescribed under HIPAA rules.

## 2. Method

A descriptive cross sectional study was done on Sri Lankan urban and sub-urban adults using convenient sampling from Males and Females of over 18 years using an online data collection form, based on a questionnaire.

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### **3. Results**

Out of the received 234 responses, 227 were selected as adequately complete for analysis. Among them only 27.3% were either satisfied or very satisfied on the existing health document maintenance systems in Sri Lanka. 40.5% respondents stated as that they are concerned and 38.8% as very concerned about the security of their health records. 66.1% rated at 5 or less as their 'level of trust' they have on health institutes in Sri Lanka on a given scale from 1 to 10 (1 lowest level of trust and 10 highest). A majority of 98 subjects (43.2%) thought that the patient, the family and the doctor should share the ownership of their Health records. The others either had concerns or said they wouldn't share it. 60.8% thought computerization would improve errors in handling health records. 42.7% thought electronic records are more secure and 40.1% thought it would be equally secured as the current manual system. The respondents were asked about their usual IT related practices and 47 (20.7%) said they never use password protection even for their important documents. When asked about electronic transferring of health information 45.4% were very concerned on unauthorized persons having access to it and 41% were somewhat concerned about the same matter. It was interesting to note that even the ones who were not using password protection on their documents were concerned about unauthorized access during data transferring. 83.3% said electronic health record systems would prevent the loss of data. 92.1% thought exchanging health information electronically would improve the quality of care. 63.9% said they would want their entire health record to be made available on an electronic system while the others were in favor of doing so only for a part of their record.

### **4. Discussion**

The overall preparedness for a future electronic health records based framework is encouraging and positive especially when public awareness campaigns and advertising on such a system is yet to be started. Most of the subjects were quite used to computers and IT; which was an expected finding since this research was done online. But since it is a research on the urban and suburban populations, the methodological approach can be justified. However it does not reflect the true picture of the Sri Lankan society which is largely not IT literate. However, since the digitalization of the health system is supposed to commence in the urban settings, this research does create a valid background to understand the 'preparedness' of the local people; which seems satisfactory.

### **5. Acknowledgments**

I acknowledge the support given by IIHS - Sri Lanka.

### **References**

- [1] National eHealth Policy of Sri Lanka (DRAFT) Version 1.6.0, 2011.
- [2] HHS.gov. Health Information Privacy. <http://www.hhs.gov/ocr/privacy/> (accessed 18 September 2015).

# Nursing Students' Satisfaction with Mobile Academic Electronic Medical Records for Undergraduate Clinical Practicum

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**Abstract.** The purpose of study was to evaluate satisfaction with and usability of mobile academic electronic medical records (AEMR) for undergraduate nursing students' clinical practicum. After an AEMR application on mobile devices was applied to the experimental group while a PC-based EMR system was used for the control group as usual in the fall semester, 2014. Two items of practicum satisfaction such as preparation of lab test and understanding of the results, and nursing intervention and documentation were significantly higher in the experiment group. The findings of usability survey showed that students in the experiment group consider the use of mobile AEMR in their job would increase their productivity.

**Keywords.** Nursing Education, Electronic Medical Records, Mobile Technology, Electronic Nursing Documentation, Satisfaction

## 1. Introduction

Electronic medical records (EMRs) systems were broadly used in the clinical settings, and opportunities for undergraduate nursing students to use EMRs were also increased for their clinical practicum. It was, however, reported that nursing students have had limited and inconsistent access to EMRs [1]. This may be caused by the fact that EMR terminals were provided in the fixed sites only, and other users occupied them [2]. One of the solution for this issue could be the use of academic EMRs on mobile devices. Therefore, the present study aimed to investigate nursing students' satisfaction with and usability of a mobile AEMR application for their clinical practicum.

## 2. Methods

The study design was a quasi-experimental study. All the participants were third year students of a 4-year nursing school in Seoul, South Korea, with 28 in the experiment

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group and 30 in the control group. Nursing students in the experiment group were assigned to two experimental practicum sites of adult health nursing. The students in the experiment group used a mobile AEMR application on iPads [3] for 4 weeks in the fall semester of 2014, whereas the control group used a PC-based EMR system as usual. The mobile AEMR has all features of the EMR and added features, such as documentation and frequently used scales (e.g., fatigue, sleep quality, etc.). Both groups had pre- and post-tests of the clinical practice satisfaction of 12 items with 5-point Likert scale and the usability scale of 22 items with 7-point Likert scale. To analyze the effect between the experimental and control groups, t-test was utilized.

### 3. Results

Two items of the practicum satisfaction, "Preparation of diagnostic test or laboratory test and Understanding of results" ( $t=2.217$ ,  $p=0.031$ ) and "Nursing intervention and documentation" ( $t=2.217$ ,  $t=.031$ ), showed significantly higher scores in the experiment group than the control group. For the usability of a mobile AEMR, three items with high scores were "The display color is appropriate" ( $5.57\pm 1.10$ ), "Using AEMR system with mobile device in my job would increase my productivity" ( $5.54\pm 1.07$ ), and "I would intend to use AEMR system with mobile device in the future" ( $5.46\pm 1.00$ ).

### 4. Discussion

The experimental group using the AEMR application showed generally positive satisfaction and usability. The students who used the AEMR application were more satisfied with understanding the diagnostic and laboratory tests as well as nursing intervention and documentation. The AEMR application seem to enable students to practice their own nursing documentation based on the patient's clinical information. These advantages made them to expect that their job productivity would be increased by using mobile AEMR.

### 5. Acknowledgments

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT & Future Planning (NRF-2013R1A1A3011136).

### References

- [1] A.D. Hanberg & C. Madden, Tech-Know-Logy: Using Multimodal Simulation Strategies to Bring Data Management and Patient Care Technologies to Life, *Clinical Simulation In Nursing* 7(4) (2010), e133-e139.
- [2] C.Y. Lai & C.C. Wu, Supporting nursing students' critical thinking with a mobile web learning environment, *Nurse Educator* 37(6) (2012), 235-236.
- [3]. M. Choi, H.S. Lee & J.H. Park, Usability of Academic Electronic Medical Record Application for Nursing Students' Clinical Practicum, *Healthcare Informatics Research* 21(3) (2015), 191-195.

# Linking Nurses with Evidence-Based Information via Social Media Tools: An Analysis of the Literature

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**Abstract.** Many health professional believe that social media tools can play a pivotal role in sharing and facilitating the use of evidence-based information with patients and other healthcare providers. By understanding how social media tools function, healthcare professionals can capitalize on these interactive platforms to improve the health of others. However, limited information exists to guide nurse educators in preparing healthcare professionals to engage patients or share evidence-based information among peers. The purpose of this literature review was to determine the extent to which professional development programs using social media for sharing evidence-based information have reported their research and/or experience in the published literature.

**Keywords.** Social media, information literacy, informatics, Web 2.0

## 1. Introduction

The use of social media platforms continue to become more widespread in today's society. Many believe that these social media tools can play a pivotal role in facilitating the sharing of health information with patients and among healthcare professionals. However, limited information is available to guide nursing educators in explaining or demonstrating how healthcare professionals might best engage patients or share evidence-based information via social media platforms. This research reviewed the published literature to determine what information currently exists in this resource.

## 2. Methods

A literature search for potentially useful articles was conducted by searching healthcare related electronic databases, (CINAHL, PubMed/Medline, Cochrane, Joanna Briggs Institute, Ovid LWW, and Proquest Dissertation and Thesis) using the search terms "social media," "nursing" and "evidence-based practice." A total of 34 articles were retrieved and then reviewed using inclusion criteria established prior to the search. Eleven articles met the inclusion criteria and were retained for analysis.

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### 3. Results

All of the articles <sup>[1-12]</sup> discussed nurses' use of social media. The two most obvious differences among the articles related to the particular level of nurses targeted and in some cases the incorporation of participants from other healthcare related disciplines and the approach and use of various Web 2.0 tools in the reported studies. Further, all authors acknowledge the need for such learning experiences and the need for research as a basis for the development of a framework to guide for nursing education. However, only one of the articles used a scientific method with valid instruments to measure change in the participants understanding and use of evidence-based information. <sup>[11]</sup>

### 4. Discussion

Social media platforms and tools hold vast potential for augmenting professional networks and supplying valuable evidence-based information to health care providers and consumers. A careful and thoughtful approach to preparing both patients and nurses for using social media platforms can provide significant professional benefits. However, at this point limited evidenced based information exists for guiding nurse educators in preparing healthcare professionals for engaging with patients or sharing evidence-based information with peers and other health professionals.

### References

- [1] S. Okun, & C. Caligan, The evolving ePatient, in *Health informatics: An interprofessional approach*, R. Editor. 2014, Elsevier, St. Louis. 212-224.
- [2] J. Berger, H. Hardin, & R. Topp, Implementing a virtual journal club in a clinical nursing setting. *Journal for Nurses in Staff Development* (2011) **27**(3): 116-120.
- [3] C. Ferguson, S. C. Inglis, P. J. Newton, P. J. S. Cripps, P.S. Macdonald, & P. M. Davidson, Social media: A tool to spread information: A case study analysis of Twitter conversation at the Cardiac Society of Australia & New Zealand 61st Annual Scientific Meeting 2013 *Collegian*, (2014) **21**: 89-93.
- [4] K. Hew, & H. Noriko, An online listserv for nurse practitioners: A viable venue for continuous nursing professional development. *Nurse Education Today* (2008) **28**: 450-457.
- [5] D. Jackson, M. L. Waine, & M. Hutchinson, Blogs as a way to elicit feedback on research and engage stockholders. *Nurse Researcher* (2014) **22**(3): 41-47.
- [6] E. Kean, Creating an online journal club using Wordpress.com. *American Journal of Nursing* (2013) **113**(3) 61-65.
- [7] C. Lehna, J. Berger, J., & A. Truman, Virtual journal club connects evidence to practice. *Journal of Advanced Nursing* (2010) **40**(12) 522-528.
- [8] V. Mistry, Critical care training: Using Twitter as a teaching tool. *British Journal of Nursing* (2011) **20**(20) 1292-1296.
- [9] C. R. Moorley, & T. Chinn, Nursing and Twitter: Creating an online community using hashtags. *Collegian* (2014) **21**:103-109.
- [10] K. Rolls, M. Hansen, D. Jackson, & D. Elliot, Analysis of the social network development of a virtual community for Australian intensive care professionals. *CIN: Computers, Informatics, Nursing* (2014) **32**(11): 536-544.
- [11] C. Sortedahl, Effect of online journal club on evidence-based practice knowledge, intent, and utilization in school nurses. *Worldviews on Evidence-Based Nursing*, (2012) **9**(2): 117-125.
- [12] M. Wilson, S. Ice, C.Y. Nakahima, L.A. Cox, E. C. Morse, G. Philip, & E. Vuong, Striving for evidence-based practice innovations through a hybrid model journal club: A pilot study. *Nurse Education Today* (2015) **35**: 657-662.

# The Creation of Simulation for the Development of Competencies in Nurses

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**Abstract.** Distance Learning, among other advantages, encourages the development of autonomy and social construction of knowledge, both essential in continuing health education. For the development of competencies needed at work, the use of simulation can be an alternative so that knowledge, skills and attitudes are put into practice through simulated situations with a pedagogical and educational structure. Therefore, it has been proposed the creation of simulation with the aim of promoting competencies related to the leading role played by nurses of a hospital. The present study briefly describes its creation process with this purpose, which was developed as part of a Master's Thesis of one of the authors. It is expected to highlight the improvement of skills associated with leadership practices through this methodology.

**Keywords.** Distance Education; Simulation; Nursing; Leadership; Competencies; Conflict Management; Continuing Health Education.

## 1. Introduction

Distance learning has been increasingly used in healthcare education, in line with the advances of technology and the internet. Literature has shown advantages regarding economic aspects, the reduction of barriers related to time and space, content, and the encouragement of autonomy [1]. The use of simulations arises as an alternative, given the possibility to simulate real situations in a planned, controlled and protected environment, in which applied knowledge could be assessed [2]. Thus, the aim of the present study was to build a simulation to promote conflict management behavioral competencies as well as to generate feedback, through designing critical situations based on real situations.

## 2. Methods

The simulation is part of a Master's Thesis of one of the authors. It was created using SIACC (Interdisciplinary Analysis System of Clinical Cases) [2], introducing cases designed with fictitious critical situations, similar to those faced on hospital practice.

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For evaluation and validation of the situations' constructs it was noticed the need to look for a tool that could be applied prior to performing the simulation to compare the results shown in the simulation. The Questionnaire of leadership dimensions and styles, based on the theory of Managerial Grid was chosen [3]. The situation storyboard was submitted to evaluation by three expert judges in order to check the compatibility of situations and the answers created with the management styles theory and the questionnaire, as well as work reality. They agreed 100%.

### **3. Results**

The simulation for the development of conflict management skills and feedback aligned to the theory of Managerial Grid is initially available to be used by nurses who work in hospitals.

Some examples of questions used in the simulations are “About two weeks after the argument between Mary and Peter, the mood in the sector remains heavy. You realize that the exchange of harsh words between professionals still happens. You?” and “A few days later, you are passing by the nursing station and see Claudia typing on her phone while a person is standing at the counter unobserved. After a few moments, Claudia finally drops her phone and answers the customer. You?”. In both cases, nurses had to choose what would be their attitude, and it was compared with management styles [3].

### **4. Discussion**

Continuing Health Education is increasingly necessary in the practice of professionals working in health assistance. The hospital nurse usually plays the staff leadership role in the unit where he/she works, in addition to care processes, and thus presenting direct relationship between patient care and team management.

It is expected, in this way, to contribute to the development of continuing education in health and the enhancement of development processes of behavioral competencies related to the exercise of leadership in nurses. Such processes have great relevance since they are the basis for carrying out proper care to patients.

### **References**

- [1] H. Mouaheb, A. Fahli, M. Moussetad, S. Eljamalic, The serious game: what educational benefits? *Procedia Soc Behav Sci.*, 46 (2012), 502-08.
- [2] R.L. Sebastiani, M.K. Zago, A. Montovani, M.R.R. Bez, M. Bruno, A. Dahmer, C.D. Flores, Ferramenta de Autoria para Construção de Casos Clínicos Interativos para Educação Médica, XII Workshop de Informática Médica, Porto Alegre: Sociedade Brasileira de Computação (2012), 1-10.
- [3] R. Blake, J. Mouton, *The managerial grid III: the key to leadership excellence*, Houston: Gulf Publishing Co, 1985.



# Iranian Novice Nursing Faculty Experiences on Their New Roles in Relation to IT Literacy

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**Abstract.** In recent years, there has been a fast spread of using new technologies and software in health management areas. Nursing education should be accommodated with this change to provide qualified nurses. There are little studies on novice nursing faculty challenges to perform their new roles in relation to IT literacy, specifically in Iran. Qualitative approach may provide first hand data to understand novice nursing faculty perceptions on their new roles that can be used to develop an actual empowerment program. A qualitative design was applied to explore novice nursing faculty experiences to perform their new roles in Mashhad nursing school (Iran). Data were gathered by in depth unstructured interviews from nine eligible participants. Two main themes related to IT competencies emerged from data as: “Efficiency concern” and “Importance of support”. Findings support that novice faculty should be familiarized with new systems and software in health management.

**Keywords.** Nursing Education, IT Education

## 1. Introduction

Nurse educators are expected to play multiple roles competently (1). One of their roles is training qualified nurses to be competent in using IT in care and acquiring nursing knowledge (2). Better perception of novice teachers' experiences in their professional roles is essential to design more efficient empowerment programs for them (3).

The important point is to plan appropriately any educational program based on needs assessment research findings. This qualitative study were carried out to explore lived experiences of Iranian novice nursing faculty in their professional roles, specially related to their IT literacy and competency in nursing education fields to plan empowering programs more efficient in Mashhad nursing school (Iran).

## 2. Methods

The current study endeavors to explain the meaning of “novice nursing faculty” experiences based on phenomenological approach. The study population was faculty

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members of selected schools of nursing at the northern east of Iran. Participants were nine faculty members (Seven females and two males) from four nursing schools. Of the participants, two had PhD and the rest had M.S. degree in nursing.

Data were gathered by in depth unstructured. Each recorded interview was transcribed to a text and then coded using MAXQDA software to manage the data. van Manen method was used to analyze the data.

### 3. Results

The emerged themes and subthemes of participants' experiences on "being novice nursing faculty" were as a) "Efficiency concern", and b) "Importance of support". Many of participants stated that they had experienced inefficiency sense especially on new caring technologies, and health informatics systems and soft wares in clinical education fields.

Most of them believed that they had not been prepared well to teach their students on new health informatics systems, and standards. Also they stressed that it is needed to be familiar by evidence based practice and its necessities.

### 4. Discussion

Grant insists on doing needs assessment for each career and perceiving expressed needs (4). Shortage of time and too much work do not let them to adapt appropriately and gain enough knowledge and experience. Another study has mentioned similar problem on IT literacy and barriers to gain proficiency in this area (3).

Many M.S. degree programs in nursing in Iran have focused more on training practitioners than teachers. Although, due to faculty shortage and replacing retired ones, many of these graduates are employed as teachers with little or even no preparation for their roles especially in newly established schools. It seems that some courses on evidence based care and using health informatics should be included in M.S. degree programs in Iran.

### 5. Acknowledgments

The authors appreciate all of nursing faculty that participated in this study.

### References

1. NLN. Core competencies of nurse educators with task statements. National League for Nursing, 2005.
2. Hsiao J-L, Chang L-H, Hung W-F, editors. Research on the Informatics Literacy of Clinical Nursing Personnel. The 10th Annual Conference of Asia-Pacific Decision Sciences Institute; 2005; Taipei, Taiwan.
3. Carter-Templeton HD, Patterson RB, Mackey STN. Nursing faculty and student experiences with information literacy: A pilot study. *Journal of Nursing Education and Practice*. 2013;4(1):208-17.
4. Grant J. Learning needs assessment: assessing the need. *BMJ*. 2002;324:156-9.

# Establishing Long-Term Nursing Informatics Capacity in Malawi, Africa

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**Abstract.** The capacity of developing countries to implement nursing informatics education, research and practice is limited. Therefore, an international partnership was established to provide teaching and research opportunities in the field of eHealth for nursing faculty at Mzuzu University, Malawi. This resulted in staff development and capacity building with nursing faculty undertaking mHealth research and beginning doctoral studies as well as the creation of an online repository of educational resources to teach nursing informatics to undergraduate students. Collaborative international partnerships can assist in building nursing informatics capacity in low resource settings.

**Keywords.** nursing informatics, eHealth, digital health, Malawi, Africa, international partnership, capacity building

## 1. Introduction

Nursing informatics, which is the use of information and communication technology (ICT) by nurses to improve health outcomes and the delivery of nursing-led health services, has been identified as one way to improve healthcare quality, extend access to affordable care and reduce healthcare costs in low resources settings [1]. However the capacity for many developing countries to implement nursing informatics is low.

## 2. Methods

A collaborative partnership between academic institutions in Malawi, the United Kingdom, Ireland and the United States was established. A number of initiatives were run including educational workshops on nursing informatics at Mzuzu University, a

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mobile health research project which provided learning opportunities in the field of eHealth for nursing faculty and global education workshops for international participants delivered by a Fulbright scholar [2,3].

### 3. Results

The international partnership resulted in several significant developments. Firstly, capacity building came to the forefront with a number of junior and senior faculty members at Mzuzu University gaining expertise in nursing informatics. This help to spur a novel initiative i.e. the building of a dedicated eHealth research and education centre on campus which is currently underway. An online repository of educational material to teach nursing informatics to students was also created. Furthermore, research opportunities to examine the use of mobile devices in primary care settings of Malawi has helped nursing faculty begin masters and doctoral studies. The international partnership is now looking towards the national agenda and plans to liaise with the Nurses and Midwives Council of Malawi to integrate nursing informatics into the national undergraduate and postgraduate curriculum.

### 4. Discussion

Important lessons were learned when establishing this international partnership which can be used as a model for others to follow. Setting out clear goals for each stakeholder and putting in place a robust governance framework is essential for the partnership to work effectively. It is also vital to integrate initiatives with relevant local and national agendas to support the partnerships and advocate for change. Finally, building long-term capacity in nursing informatics in low resource settings also requires a significant investment in human, financial and infrastructural resources to be successful.

### 5. Acknowledgments

We gratefully acknowledge funding from staff at the Irish Health Service Executive (HSE), Musgrave Charitable Trust, the Strategic Research Fund at University College Cork, Ireland, and the Irish Fulbright Commission who have supported this global nursing informatics education & research partnership at Mzuzu University, Malawi.

### References

- [1] World Health Organisation (WHO). Building Standard-Based Nursing Information Systems. Division of Health Systems and Services Development. Washington DC: PAHO. (2001).
- [2] L. Kenny, J. O'Donoghue, J. Gallagher, S. Woodworth, F. Adam, S. O'Connor, Supporting LIFE in Malawi. *Centre for Global Development (CGD) Annual Report 2012*, Cork University Press (2012), 12. Available at: [http://epublications.snap.com.au/centre\\_for\\_global\\_development\\_2012\\_annual\\_report/10029374#](http://epublications.snap.com.au/centre_for_global_development_2012_annual_report/10029374#) (accessed 24 November 2015)
- [3] S. O'Connor, From New York to Cork (and Malawi). *UCC News Archive*, (2014). Available at: <http://www.ucc.ie/en/about/uccnews/fullstory-488639-en.html> (accessed 24 November 2015)

# Personalised Multi-Criterial Online Decision Support for Siblings Considering Stem Cell Donation: An Interactive Aid

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**Abstract.** Person-centred decision support combines the best available information on the considerations that matter to the individual, with the importance the person attaches to those considerations. Nurses and other health professionals can benefit from being able to draw on this support within a clinical conversation. A case study and storyline on four siblings facing a transplant coordinator's call to donate stem cells to their brother [1] is 'translated' and used to demonstrate how an interactive multi-criteria aid can be developed for each within a conversational mode. The personalized dialogue and decision aid are accessible online for interaction. Each sibling's decision exemplifies the communication including physical and psychosocial complexities within any decision cascade from call-to-test and to donate, if compatible. A shared template can embrace the informational and ethical aspects of a decision. By interactive decision support within a clinical conversation, each stakeholder can gain a personalised opinion, as well as increased generic health decision literacy [2].

**Keywords** person-centred, multi-criteria, decision support, ethics, donation, stem cells, decision literacy

## References

- [1] A. Begley, S. Piggott, Exploring moral distress in potential sibling stem cell donors. *Nursing Ethics* **20** (2013):178-88.
- [2] M.K.Kaltoft, Towards improved decision quality in person-centred healthcare: exploring the implications of decision support via Multi-Criteria Decision Analysis. PhD thesis. University of Southern Denmark, Odense, 2015.

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# Cross-Mapping Diagnostic Nursing Concepts Between the ICNP and the ICF for Expressing Nursing in the Health Care Record

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**Keywords.** Nursing standardized language, ICNP, ICF, mapping

## 1. Introduction

Standardized terminologies in the Electronic Health Record (EHR) need to address all relevant professional perspectives. In Sweden, the International Classification of Functioning Disability and Health (ICF) is proposed as a standardized terminology representing nursing in the EHR. The aim was to investigate completeness and granularity regarding diagnostic concepts in International Classification of Nursing Practice (ICNP) compared to ICF.

## 2. Methods

Cross-mapping pre-coordinated diagnostic concepts in ICNP with ICF terms, identifying exact match, partial match or no match between concepts.

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### **3. Results**

Preliminary findings indicate a rather large mismatch between concepts in the two terminologies, which will be presented in further details.

### **4. Discussion**

The use of standardized language is beneficial for patient care, strengthening patient safety issues and communication. However, it needs to have enough coverage and depth, including nursing, to be able to represent all aspects of patient care.

# Real-Time MFER Monitoring Using Interval-Saving of Health Signals

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**Abstract.** This study proposes MFER design, an international standard for saving measured vital signs while simultaneously monitoring, for health care. The proposed method does not record vital signs as a single file, but rather, after setting header information on vital signs, it reads the measured signs in regular intervals, which are shown in a screen and saved along with header information. Shorter the interval of saving, more similar it becomes to real time monitoring. After measurement is complete, the file fragments are aggregated into a single file, including the header information. MFER constructed in this study in real time monitoring design shows that it can be efficiently used in monitoring and saving of vital signs for health care.

**Keywords.** Healthcare, MFER, Vital sign, EMR, ECG

## 1. Introduction

Vital signs including blood pressure, blood glucose level, and ECG measured for health care are being used in various fields such as health care, telemedicine, and health monitoring system. There is ISO11073-90201 MFER (Medical Waveform Format Encoding Rules) as an international standard to store or transfer the measured vital signs in forms of files for health care. The MFER cannot be used in situations that require real time monitoring. This study proposes a design that enables real time monitoring while following traits of MFER, the international standard for saving such vital signs.

## 2. Methods

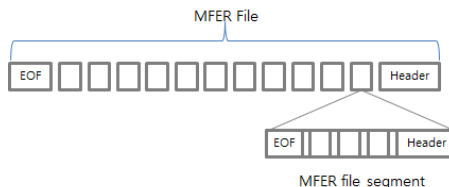
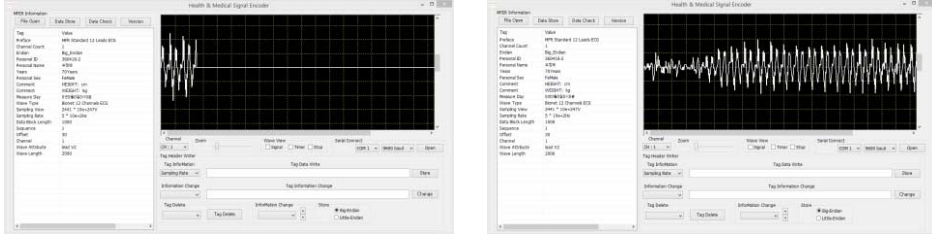


Fig. 1. The modified MFER structure

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We propose the following structure while maintaining compatibility with international standards as like Fig. 1. The entire data divided into smaller units when saving files, than, it made up of small file blocks with fixed size. If the storage time is sufficiently small, it may be directly monitored during storage in short time. When the measurement is completed, it is organized into a single file with file fragments attached.



(a) A fragmented file

(b) A regenerated file

Fig. 2. Real-time MFER monitoring system

### 3. Discussion

As the proposed real time vital sign encoder has the design to transfer and save data in real time without significant increase of data size by classifying the whole measurement data in regular intervals into header information and data, it is expected to be used efficiently in areas such as U-health and telemedicine

### 4. Acknowledgments

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- 2) The research was supported by the 2015 Economic Cooperation Business Project(Business Cooperative R & D) under the Ministry of Trade, Industry & Energy, Korea.

### References

- [1] M Hirai, K Kawamoto. MFER -a Japanese Approach for Medical Wave Form Encoding Rules for Viewer Design. OpenECG Workshop 2004, Berlin, Germany(2004)
- [2] Y Lee, Soon, S Kim, C. H. Choi ,J. H. Park, Encoder design for healthcare signals”, Personal and ubiquitous computing, Springer,(2012)

# Exploring Community Planning Thinking as a Model for Use Case Development

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**Abstract.** There are many vetted technical and semantic standards promulgated within the United States and the United Kingdom to operationalize eHealth interoperability in order to improve care outcomes, manage population health, and provide efficient information exchange between providers, services, patients and consumers. However, consideration must be given to the complex real world use cases in which the data and information will be exchanged between a wide variety of interested parties, including the consumer or patient. In many instances, community based use cases need development in order to serve as the model. These use cases can only be accurately described and created by using a wide lens viewpoint such as community-planning engages, which requires that all interested parties be actively involved. This poster will introduce models of community planning that can be developed and led by the Nurse Informatician.

**Keywords.** interoperability, community planning, use case development, participatory planning, population health

## 1. Introduction

Interoperability has been defined as the ability of different information technology systems and software applications to communicate, exchange data, and use the information [1]. The Department of Health and Human Services (DHHS) Office of the National Coordinator (ONC) in the US through the Interoperability Roadmap and the Academy of Medical Royal Colleges (AoMRC) through the Transfer of Care Initiative have both established guidelines and document architectures for the technical and structural exchange of data between providers and organizations in order to optimize health, support better decision making, and to create more opportunities for efficiencies. The ONC has offered the Standards and Interoperability Framework (S&I) that contains multiple document templates while the AoMRC Transfer of Care Initiative offers eDischarge guidance [3,4] for a variety of situations and between different providers. In the UK developments towards the sharing of health records started in 2002 with the launch of the individual National Health Service (NHS) number [5] and

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continues through interoperability initiatives and toolkits from the NHS Health and Social Care Information Centre [6].

## 2. Methods

A review of community planning models and a synthesis of the evidence of best practice offer multiple models from which to choose will be presented. Each of the models presented support the inclusion of the data from the health determinants that do not come from the medical care sectors. These sources include social, economic, environmental, agricultural, and physical determinants [3].

## 3. Results

Synthesis of the evidence supporting the community planning models will provide Nurse Informaticians with a best practice for engaging a wide range of partners to positively impact outcomes, and to provide needed data and information to providers through broader use case development. The community planning process will also support the development of needed use cases through which the technical standards of the ONC and the AoMRC can be operationalized.

## 4. Discussion

Nurse Informaticians can lead the way in using a community planning processes for use case development. Nurse Informaticians can create use cases that will allow for the appropriate sending and receiving of data and information across disparate information systems. Nurse Informaticians, case managers, community nurses, home health nurses, visiting nurses, public health nurses, long term care and acute care nurses will all be able to practice safe and effective care at the highest level of their training when community level use cases are developed using a planning process.

## References

- [1] HIMSS *Dictionary of Healthcare Information Technology Terms, Acronyms, and Organizations*, 2<sup>nd</sup> Edition, Appendix B. p 190. 2013
- [2] National Committee on Vital and Health Statistics (NCVHS). *Report on Uniform Data Standards for Patient Medical Record Information*, pp 21-22. 2000
- [3] The Office of the National Coordinator (ONC). *Connecting Health and Care for the Nation: A Shared Nationwide Interoperability Roadmap*. Accessed 12/2015 at: <https://www.healthit.gov/sites/default/files/ONC10yearInteroperabilityConceptPaper.pdf>.
- [4] NHS Health and Social Care Information Centre (HSCIC). eDischarge Supporting Guidance. Accessed 12/2015 at: <http://systems.hscic.gov.uk/interop/tci/edischarge>.
- [5] NHS Health and Social Care Information Centre (HSCIC), NHS Number, Accessed 12/2015 at: <http://systems.hscic.gov.uk/nhsnumber>.
- [6] NHS Health and Social Care Information Centre (HSCIC), Interoperability, Accessed 12/2015 at: <http://systems.hscic.gov.uk/interop>.

# Is the ISO Reference Terminology Model for Nursing Actions Enough to Describe Nursing Actions?

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**Abstract.** The aim of this study is to test the applicability of the International Standards Organization (ISO) Reference terminology model (RTM) for nursing action to describe Detailed Clinical Models (DCMs) for nursing action. All verb and target terms were mapped to 'Action' and 'Target' category of RTM for nursing actions. Among 72 attributes qualifying the verb terms, 50 attributes were mapped to Means, Route, Timing, or Site categories of the nursing action model. Among 142 attributes qualifying the target terms, 20 attributes were mapped to Means, Timing, or Site categories of the nursing action model and 6 attributes were mapped to Degree or Judgment categories of the nursing diagnosis model. The findings suggest the need for an integrated RTM for nursing.

**Keywords.** Nursing action; Nursing diagnosis; Terminology; Reference standard; Concept formation; Documentation

## 1. Introduction

Reference terminology model (RTM) established by International Standards Organization (ISO) provides conceptual structure of concepts to represent nursing diagnoses and actions[1]. Applicability of the ISO RTM for nursing diagnoses was tested for existing nursing terminologies such as Home Health Care Classification and the Omaha System[2], and Detailed Clinical Models (DCMs) for nursing assessment results[3]. Applicability of the ISO RTM for nursing actions was tested for narratives describing nursing actions[4], and nursing practice patterns[5]. DCMs for nursing actions were newly developed by the authors of this study to generate nursing narratives describing nursing actions in a more detailed and consistent manner. Developed DCMs include entity-attribute-value triplets needed to describe direct nursing care, assessment, teaching, and managing. This study is to examine the applicability of the ISO RTM for nursing actions to DCMs for nursing action by mapping components of the DCMs to the categories of the RTM for nursing actions.

## 2. Methods

Source of mapping is the verb and target terms as well as attribute terms qualifying the verb and target terms of the DCMs for nursing actions in perinatal care. Target of the

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mapping is 7 categories of the ISO RTM for nursing actions. We did not attempt to map value terms of the attributes since values represent uniquely identifiable instances. Verb terms were mapped to 'Action' category and Target terms were mapped to 'Target' category of RTM for nursing actions. Attributes qualifying the verb and target terms were mapped to 'Means', 'Route', 'Timing', or 'Site' categories of the RTM for nursing actions. Since DCMs for assessing action have attributes describing degree or judgment of the entities being assessed, these attributes were mapped to categories of the ISO RTM for nursing diagnoses. The first author mapped source terms to target categories. If verb, target, or attribute terms belong to any category of RTM for nursing actions or nursing diagnoses, it is classified as mapped. Otherwise, it is classified as not mapped. Second author verified the mapping.

### 3. Results

All 32 verb terms were mapped to 'Action' category and all 145 target terms were mapped to 'Target' category of the RTM for nursing actions. Among 72 attributes qualifying the verb terms, 50 attributes were mapped to 'Means', 'Route', 'Timing', or 'Site' categories of nursing actions. Among 142 attributes qualifying the target terms, 20 attributes were mapped to 'Means', 'Timing', or 'Site' categories of nursing actions and 6 attributes describing degree or judgment were mapped to 'Degree' or 'Judgment' categories of nursing diagnoses. In total, 253 verb, target, and attribute terms were mapped.

### 4. Discussion

It was found that in order to map DCMs for nursing action to RTM, we need not only RTM for nursing actions, but also RTM for nursing diagnoses. The findings suggest the need for an integrated RTM for nursing. This was also suggested by Hwang [4].

### 5. Acknowledgments

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### References

- [1] International Organization Standardization. Health Informatics: Categorial structures for representation of nursing diagnoses and nursing actions in terminological systems. ISO 18104. Geneva, Switzerland 2014.
- [2]. J.I.Hwang, J.J.Cimino, S.Bakken. Integrating nursing diagnostic concepts into the medical entities dictionary using the ISO Reference Terminology Model for Nursing Diagnosis. Journal of the American Medical Informatics Association : JAMIA. 2003;10(4):382-8.
- [3]. Y.H.Min, H.A.Park. Applicability of the ISO Reference Terminology Model for Nursing to the Detailed Clinical Models of Perinatal Care Nursing Assessments. Healthcare informatics research. 2011;17(4):199-204.
- [4]. J.I.Hwang, H.A.Park. Exploring the usability of the ISO reference terminology model for nursing actions in representing oriental nursing actions. International journal of medical informatics. 2009;78(10):656-62. Epub 2009/06/02. doi: 10.1016/j.ijmedinf.2009.04.009. PubMed PMID: 19482511.
- [5]. M.Andison, J.Moss. What nurses do: use of the ISO Reference Terminology Model for Nursing Action as a framework for analyzing MICU nursing practice patterns. AMIA Annual Symposium proceedings / AMIA Symposium AMIA Symposium. 2007:21-5. Epub 2008/08/13. PubMed PMID: 18693790; PubMed Central PMCID: PMC2942066.

# Nursing Students' Opinion on the Use of Smartphone Applications (Apps) in Clinical Education and Training: A Study Protocol

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**Abstract.** Nurse educators are exploring different mobile technologies to provide additional support to nursing students in clinical practice. However, the view of nursing students on the use of smartphone applications (apps) to enhance clinical education has not been explored. This proposed study will use a self-reported questionnaire to examine the opinions of nursing students on the current and potential use of smartphone apps when training in clinical settings. Descriptive and inferential statistics will be performed on the quantitative data. Qualitative data from open ended questions will be thematically analysed using the framework approach. This will be the first study to examine the use of smartphone apps as a support in clinical teaching from a students' perspective. Their opinion is vital if the right mobile technology is to be designed and implemented.

**Keywords.** Nursing student; Education; Clinical practice; Mobile technology; Smartphone; Mobile application; App

## 1. Introduction

Nursing students encounter many challenges when learning in clinical practice as they apply theoretical knowledge and practical skills gained in academic settings in real-world complex healthcare settings [1]. Nurse educators are exploring the use of mobile technologies to support nursing students in clinical training as they provide easy access to quality educational material at the point of care [2]. The perspective of all stakeholders needs to be taken into account to ensure that mobile devices and applications are designed, developed and implemented appropriately [3].

## 2. Methods

The aim of this study is to understand the perspectives of nursing students in relation to using mobile technology, in particular smartphone apps, to enhance their education and training in clinical environments. It was informed by an extensive literature review

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undertaken on the use of mobile technology in clinical nursing education [2]. The study will adopt a descriptive cross-sectional design and use a self-reported questionnaire that will be distributed to undergraduate nursing students. Ethical approval has been sought and granted from the appropriate institutional ethics committees.

### 2.1. Recruitment & Data Collection

Convenience sampling will be used to reach groups of students from a Bachelor of Science (B.Sc.) Nursing programme. Paper-based surveys will be distributed at the end of well-attended teaching sessions to gain the maximum number of respondents.

### 2.2. Data Analysis

The quantitative results will be analysed using 1) descriptive statistics, to describe the number and type of students and the kinds of mobile platforms and apps they currently use, and 2) inferential statistics, to derive meaningful interpretations between different student groups for example the educational content they would like included in future smartphone apps. Qualitative data from open ended questions will be thematically analysed using the framework approach [4].

## 3. Discussion

As mobile technology advances and its use continues to proliferate, the boundaries are beginning to blur between traditional approaches to learning and those emerging through electronic learning (eLearning) and mobile learning (mLearning). This study will lead to a more in-depth understanding of what mobile technologies and applications nursing students currently employ during clinical placements to support their learning needs. It will also reveal students' opinions about what educational resources would be useful in a smartphone app, and the factors that affect how they use mobile devices in clinical settings. The findings of this study could be used to improve how mobile applications are designed and delivered in future nursing education.

## 4. Acknowledgments

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## References

- [1] M.G. Landers, The theory-practice gap in nursing: the role of the nurse teacher, *Journal of Advanced Nursing* **32**(2000),1550-1556.
- [2] S. O'Connor, T. Andrews, Mobile Technology and Its Use in Clinical Nursing Education: A Literature Review, *Journal of Nursing Education* **54**(2015),137.
- [3] J.C. Phillippi, T.H. Wyatt, Smartphones in nursing education, *Computers Informatics Nursing*, **29**(2011),449-454.
- [4] J. Ritchie, L. Spencer, Qualitative Data Analysis for Applied Policy Research, In: M. Hubermann, M. Miles, editors. *The Qualitative Researcher's Companion*. Thousand Oaks, Sage Publications, 2002.

# Perceptions of Older Adults with Heart Failure on Playing an Interactive Digital e-Health Game (IDEG) for Learning About Heart Failure (HF): Prototype Development and Usability Testing

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**Abstract.** Effective self-management can decrease up to 50% of heart failure (HF) hospitalizations. However, self-management by patients with HF remains poor. We describe the development and usability testing of an interactive digital e-health game (IDEG) for older patients with HF in Central Texas, USA. Majority of the participants (5 out of 6) who participated in the usability testing found the game interesting, enjoyable and helpful to play. Developing an IDEG that is satisfying and acceptable to older adults with HF is feasible.

**Keywords.** Digital Game, Heart failure, knowledge, self-management, usability

## 1. Introduction

Heart failure (HF) is a major health issue with an estimated worldwide prevalence of over 23 to 41 million<sup>1</sup>. Effective HF self-management is associated with lower mortality and hospitalization rates<sup>2</sup>. We will present the development and usability testing of an IDEG prototype for improving HF self-management knowledge and efficacy. Digital game playing has been associated with significant positive effects on physical health outcomes of older adults.<sup>3</sup> However, to our knowledge, currently no IDEGs help cultivate HF self-care knowledge and self-efficacy, and no IDEGs target an older audience.

## 2. Methods

An inter-disciplinary team from nursing science, computer game programming, usability science and communication collaborated to develop a digital serious game prototype for HF self-management. The game genre of casino slot game was selected based on a survey of 34 community based HF nurses on their and their patients' preferences for playing digital games. HF education content adapted from the Heart Failure Society of America (HFSA)<sup>4</sup> evidence-based guidelines and tailored to low literacy levels<sup>5</sup> was placed strategically throughout the game using game-based learning strategies. Participants 55 years or older and admitted with a HF diagnosis were recruited from an out-patient HF clinic and a safety-net community care clinic based in central Texas. Usability of the digital game was tested on 6 HF individuals through guided observations by a trained Research Assistant, video-taped user observations as well as participant completion of a usability survey influenced by the

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Serious Game Usability Evaluation<sup>6</sup> and the interest / enjoyment subscale of the Intrinsic Motivation Inventory (IMI)<sup>7</sup> questionnaires. Two rounds of usability evaluations were conducted to iteratively improve the usability of the IDEG. Beta-testing of the game was conducted with 19 participants. The study received institutional review board approval from the University of Texas – Austin.

### 3. Results

Of the six community-residing older adults (50% females) with HF who participated in the usability testing of the digital game, 100% found the game easy to play, 100% found it enjoyable and 83% found it helpful to learn about HF. Comments included: “Interesting way to learn about HF”; “HF serious subject..not a game” & “Useful for patients with low education”. Of the 19 community-residing older adults who participated in the beta-testing of the game (90% were males, 84% were Caucasian), majority of the participants were older than 70 years age (58%) and diagnosed with heart failure for more than 10 years (58%). Regarding the participants’ education level, majority did not have a degree (72%) and over 42% were educated at the high school level or less. 90% of the 19 participants found the game interesting, enjoyable and easy to play. Participants with lower education levels preferred games to any other medium for receiving information (p= 0.02).

### 4. Discussion

Developing an IDEG that is satisfying and acceptable to older adults with HF is feasible. Moreover, gamification was established as an effective manner to impart knowledge on chronic diseases such as heart failure, especially for participants with lower education levels. This project is truly innovative, because evidence-based HF guidelines was combined with contemporary advances in game technology to cultivate patient-centered HF self-management knowledge, and self-efficacy.

### 5. Acknowledgements

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### References

- [1] M. H. Forouzanfar, A. Moran, D. Phillips, G. Mensah, M. Ezzati, M. Naghavi, C.J.L.Murray. Prevalence of heart failure by cause in 21 regions: Global burden of diseases, injuries and risk factors - 2010 study. *Journal of American College of Cardiology* 2013; 61(10\_S): doi:10.1016/S0735-1097(13)60786-X
- [2] C.S.Lee, D.K.Moser, T.A.Lennie, B.Riege. Event-free survival in adults with heart failure who engage in self-care management. *Heart Lung*. Jan-Feb 2011;40(1):12-20.
- [3] A.K.Hall, E.Chavarria, V.Maneeratana, B.H.Chaney, & J.M.Bernhardt (2012). Health benefits of digital videogames for older adults: A systematic review of the literature. *Games for Health Journal*, 1(6), 402-410. doi:10.1089/g4h.2012.0046
- [4] Heart Failure Society of America, et al. HFSA 2010 Comprehensive Heart Failure Practice Guideline. *J Card Fail*. 2010;16(6):e1-194. doi: 10.1016/j.cardfail.2010.04.004.
- [5] D.A.DeWalt, R.M.Malone, M.E.Bryant, M.C.Kosnar, K.E.Corr, R.L.Rothman, C.A.Sueta, M.P.Pignone. A heart failure self-management program for patients of all literacy levels: a randomized, controlled trial [ISRCTN11535170]. *BMC Health Serv Res*. 2006;6:30.
- [6] P.Moreno-Ger, J.Torrente, Y.G.Hsieh, & W.T.Lester (2012). Usability testing for serious games: Making informed design decisions with user data. *Advances in Human-Computer Interaction*, 2012, Article ID 369637. doi:10.1155/2012/369637.
- [7] E.McAuley, T.Duncan, & V.V.Tammen (1987). Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: A confirmatory factor analysis. *Research Quarterly for Exercise and Sport*, 60, 48-58.

# Barriers to Co-Designing Mobile Technology with Persons with Dementia and Their Carers

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**Abstract.** Mobile applications can be used to help manage different aspects of long-term illnesses but many are not designed to meet the specific needs of people with dementia or their carers. This case study explores the barriers experienced when co-producing a memory and reminiscence app. A focus group and interviews were conducted with patient/carer dyads, an occupational therapist, project manager and software engineer involved in the design of the app. Data was analysed thematically using the framework approach. Several limitations such as poor technical knowledge and skills, negative attitudes and inaccurate perceptions of people with dementia slowed down or changed how the mobile app was developed. Compromises also had to be made over the final design of the app. More research to explore how mobile apps are co-designed with patients is needed.

**Keywords.** Dementia; Alzheimer's disease; mobile technology; mobile app; co-design; co-creation; co-production; engagement

## 1. Introduction

Dementia is becoming an important public health priority due to growing numbers of older adults and degenerative diseases related to ageing. The Department of Health in the United Kingdom (UK) has set out a national strategy to address the needs of people with dementia and their carers. One of its key aims is to develop a range of services that meet the needs of patients and their family over time as the illness progresses [1].

To help implement this national dementia strategy, a digital initiative called 'My House of Memories' was launched to involve people with dementia and their carers in the design of a mobile application that would allow them to share memories together [2]. It is hoped that this form of reminiscence therapy will help improve patients' mood, cognition and functional ability as well as reduce caregiver strain. The aim of this study is to explore the barriers experienced by all participants during the co-design of the 'My House of Memories' app, to ensure that the future co-production of mobile technology is more effective.

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## 2. Methods

The study adopted a qualitative exploratory case study design. An in-depth focus (n=10) and interviews (n=6) with people involved in the co-design of the 'My House of Memories' app was held between March and September 2015. This included four dementia patient-carer dyads, an occupational therapist, a project manager and a software engineer. Data was thematically analysed using the framework approach [3].

## 3. Results

The lack of digital literacy knowledge and skills among people with dementia and their carers was the first factor that changed how the mobile application was co-designed. It took time for these individuals to become familiar with using tablet computers as well as grasping the technical language the software development team. Other issues that affected co-production were inaccurate perceptions of how people with dementia or carers would use mobile technology which meant many initial design ideas had to be scrapped or significantly changed. Some patients with dementia and their carers also held negative attitudes towards technology which limited their participation in designing the mobile app. Furthermore, people who were in the later stages of dementia struggled to take part in the workshops and compromises also had to be made to the design and functionality of the mobile app as it was impossible to incorporate everyone's ideas.

## 4. Discussion

While co-designing technology can help create tailored mobile apps that meet the specific needs of patients and carers, certain barriers can slow down and change the process. Developing digital applications with people with dementia and their carers needs to be well thought out, planned and executed to address poor attitudes, inaccurate perceptions, lack of digital literacy knowledge and skills and to ensure any compromises made in the design are justified and add value for the majority of users. More research into designing digital services with patients and carers should be done to uncover the complexities involved and to help develop a robust methodology that is theoretically grounded.

## References

- [1] Department of Health, *Living well with dementia: A National Dementia Strategy*, London, DOH, (2009).
- [2] National Museums of Liverpool, *My House of Memories app*, 2015. Available at: <http://www.liverpoolmuseums.org.uk/learning/projects/house-of-memories/my-house-of-memories-app.aspx> (accessed 24 November 2015)
- [3] R. Ritchie, L. Spencer, *Qualitative Data Analysis for Applied Policy Research*, In: M. Hubermann, M. Miles, *The Qualitative Researcher's Companion*, Sage Publications, California, 2002.

# Current Status and Quality Assessment of Cardiovascular Diseases Related Smartphone Apps in China

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**Abstract.** To examine current status and quality of CVD related apps available for download in China, a total of 151 apps from the top popular six app stores were analyzed. Data analysis uncovered a range of issues including missing of key variables in the pre-formatted daily records, no platform for interaction with relevant healthcare professionals and undesirable user-interface design. More importantly, these apps had low levels of adherence to internationally recognized guidelines in CVD management. Overall quality score of these apps was below the average (8.08/20). This study identified areas for improvement concerning the existing CVD related apps. Information may guide the further advancement of CVD related apps and benefit CVD management in China.

**Keywords.** Application, Cardiovascular disease, Quality assessment, Mobile health

## 1. Introduction

Smartphone apps have become useful tools to support self-management of chronic diseases including cardiovascular diseases (CVD). While reliability and coverage are considered as the key parameters for the quality of apps, no relevant information is available concerning current status and the quality of current CVD related apps in China. Hence, this study aimed to examine the current status and quality of current CVD apps in China.

## 2. Methods

The top six most popular app stores were searched using CVD related key words in both Chinese and English languages in September 2015. The frequency of the download was recorded. The functions and contents of the top 5 downloaded CVD related apps were further compared against what are recommended by international CVD related guidelines. The selected apps were also assessed with a seven-dimension quality assessment scale with 20 items derived from the modified Silberg scale<sup>[1]</sup> (for four quality categories: Authorship, Attribution, Disclosure and Currency) and Technology Acceptance Model<sup>[2]</sup> (for three quality categories: Ease to Use, Usefulness

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and Privacy). One point is awarded for the presence of each item, and the maximum possible quality score is 20 points with a higher score indicating a better quality.

### 3. Results

151 apps were selected and the majority of them (82.1%) had been downloaded for less than 500 times (Figure 1). Take the top 5 downloaded apps as an example, most of them did not have the function for friends sharing and online Q&A(Figure 2). None of the apps had ‘regular medical follow-up’ and ‘smoking cessation’ listed in their preformatted daily records despite both were recommended by CVD guideline [3] (Table 1). The interface of most of these apps did not have the features that cater the needs of elderly patients. Overall quality score of the apps was only 8.08 of a possible 20(ranged from 1 to 12). Of the seven quality dimensions, the average scores of authorship, attribution, disclosure and currency were lower than that of the other three dimensions (Figure 3).

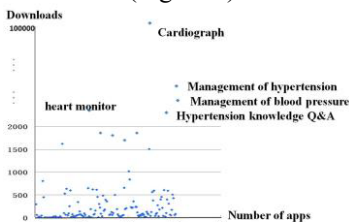


Figure 1- Downloads of the CVD related apps in China

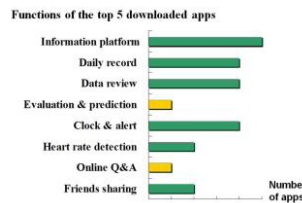


Figure 2- Analysis of functions among the top 5 downloaded CVD related apps in China

Table 1-Comparison of the top 5 downloaded apps with internationally recognized CVD guideline

Items recommended by the guidelines	Top 5 downloaded CVD related apps				
	Top1	Top2	Top3	Top 4	Top5
Vital signs	Yes	Yes	Yes	Yes	Yes
Symptoms	No	Yes	Yes	No	No
Medication taking	No	Yes	Yes	No	No
Diet	No	No	Yes	No	No
Exercise	No	No	Yes	No	No
Psychological states	No	No	Yes	No	No
Medical follow-up	No	No	No	No	No
Smoking cessation	No	No	No	No	No

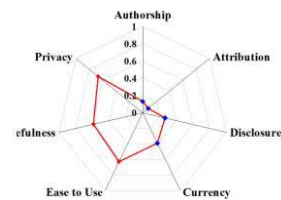


Figure 3- The quality of the CVD related apps in China

### 4. Discussion

The findings of this study showed a range of drawbacks of these CVD apps, which may result in limited usage of these apps. The quality of the existing apps could be further improved by more efforts made to address issues related to the coverage and reliability and by better integration with the needs of patients and guidelines of clinical practice.

### References

[1] Eunjoo Jeon, Hyeoun-Ae Park, Yul Ha Min, et al. Analysis of the Information Quality of Korean Obesity-Management Smartphone Applications. *Healthcare Informatics Research*, 20(2014), 23-29.  
 [2] Viswanath Venkatesh , Fred D Davis. A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies[J] . *Management Science*, 46 (2000), 186-204.  
 [3] European Association for Cardiovascular Prevention & Rehabilitation (EACPR). European Guidelines on cardiovascular disease prevention in clinical practice (version 2012). *European Heart Journal*, 33 (2012), 1635–1701.

# A Survey on the Willingness to Use Physical Activity Smartphone Applications(Apps) in Patients with Chronic Diseases

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**Abstract.** This study aimed to explore the willingness of using physical activity smartphone apps among patients with chronic diseases. 218 outpatients from a tertiary hospital in Beijing were involved using a questionnaire. Over half of the patients(53.7%)were willing to use smartphone apps to promote physical activities. The individuals more likely to use physical activity apps tended to be younger( $\leq 44$  years), be more educated, perceiving their disease need exercise instruction or professional support, current smartphone user, having previous experience of using physical activity apps, and accepting paid apps ( $P < 0.05$ ). The results could help health educator suggest chronic disease patients to use apps to do more exercises. Further research could be focus on evaluate the effects of using physical activity apps in chronic disease patients.

**Keywords.** Mobile phone , Chronic Diseases , Physical Activities , Apps, Exercise

## 1. Introduction

With the growth of smartphone netizens and the increasing downloads of smartphone apps in mainland China, utilizing physical activity apps may be a new tool to encourage doing exercise and a healthy lifestyle change as these apps applied some behavior change techniques<sup>[1]</sup>. This study aimed to describe the willingness of using physical activity smartphone Apps and its relative factors in patients with chronic diseases.

## 2. Methods

During a two months period in 2015, 218 outpatients with chronic diseases were involved using an anonymous questionnaire. Patients' sociodemographic characteristics, the history of and current usage, and their willingness to use were investigated. A Chi-squared test was conducted to analyze differences between users who are willing to use apps and reluctance /uncertain to use apps.

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### 3. Results

34.9% of the participants has history of physical activity app use, 18.8% of the participants are current users. 53.7% of the patients were willing to use physical activity apps, and the patients' willingness was statistically different among the following factors, see table1.

**Table 1.** The willingness to use physical activity Apps in chronic disease patients among different factors

Items	The willingness to use physical activity Apps		$\chi^2$	P
	Yes(n=117)n,%	No/Uncertain(n=101) n,%		
Sex				
Male(85)	41 (35.0)	44 (43.6)	1.65	0.21
Female(133)	76 (65.0)	57 (56.4)		
Age (years)				
$\leq 44$ (89)	60 (51.3)	29 (28.7)	11.42	0.001
$\geq 45$ (129)	57 (48.7)	72 (71.3)		
Education				
Primary(73)	32 (27.4)	41 (40.6)	4.26	0.045
Diploma/degree(145)	85 (72.6)	60 (59.4)		
Perceiving their chronic disease need doing exercises				
Yes(159)	93 (79.5)	66 (65.3)	5.49	0.019
No(59)	24 (20.5)	35 (34.7)		
Perceiving their chronic disease need exercise instructions				
Yes(113)	75 (64.1)	38 (37.6)	15.22	<0.001
No(105)	42 (35.9)	63 (62.4)		
Perceiving their chronic disease need professional support				
Yes(156)	96 (82.1)	60 (59.4)	16.60	<0.001
No(62)	21 (17.9)	41 (40.6)		
Smartphone user				
Yes(202)	113 (96.6)	89 (88.1)	5.70	0.02
No(16)	4 (3.4)	12 (11.9)		
History of physical activity apps users				
Yes(76)	55 (47.0)	21 (20.8)	16.40	<0.001
No(142)	62 (53.0)	80 (79.2)		
Accepted paid Apps				
Yes(157)	96 (82.1)	61 (60.4)	12.61	<0.001
No (61)	21 (17.9)	40 (39.6)		

### 4. Discussion

Smartphone apps may now seem to be ubiquitous, yet much remains unknown with regard to their usage. The findings showed more than half of the patients are willing to use physical activity apps to promote their physical activities, and health educator could suggest chronic disease patients to use physical activity apps as it promotes health and physical activity.

### Reference

- [1] A. Middelweerd, J. S. Mollee, C N. van der Wal, J. Brug & S. J. te Velde. Apps to promote physical activity among adults: a review and content analysis. *International Journal of Behavioral Nutrition and Physical Activity* 2014, 11:97

# Preliminary Findings of the Delivery of the National Diabetes Prevention Program via a Mobile Application

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**Abstract.** NewYork-Presbyterian Hospital partnered with Noom Health to pilot the virtual delivery of the proven National Diabetes Prevention Program (NDPP) to prediabetic patients. Goals were to understand if the patients can use a mobile device to receive the NDPP content, perform tasks and communicate with a virtual health coach. This poster describes our preliminary findings and responses from patients and staff.

**Keywords.** Mobile Health, mHealth, Nursing Informatics, Health Promotion/Disease Prevention, Health Coach

## 1. Introduction

Patient engagement using mobile technology is a relatively new concept for healthcare. In 2013, Ricciardi outlined a federal strategy for consumer engagement via e-health as a way to achieve better health and health care<sup>1</sup>. There is evidence to show that the use of disease specific mobile technologies can make a difference in patient outcomes.<sup>2</sup> Since the dissemination of mobile applications is a new workflow for most healthcare institutions, it is important to understand not only the impact on patients but the operational processes for providers and any challenges or barriers.

As part of a local healthcare accelerator program, NewYork-Presbyterian Hospital (NYP) partnered with Noom Health to perform a small feasibility study to evaluate the use of the National Diabetes Prevention Program (NDPP) via a mobile application by evaluating the number of tasks performed and the satisfaction level of patients and staff.

## 2. Methods

Registered dietitians at the 5 NYP Ambulatory Care practices in the Washington Heights area of NY, NY recruited up to 50 patients with a smartphone between the ages of 18-75 with any of the following criteria: diagnosis of impaired fasting glucose, BMI>30, A1c>5.6, prior history of gestational diabetes, and/or family history of diabetes. Patient's primary language could be English or Spanish. At the conclusion of the program, satisfaction survey data were quantitatively analyzed and free text responses were summarized using descriptive statistics. The participant use of the



application was quantitatively analyzed by examining the number of tasks that were completed in the application. This study was approved by the Columbia University Institutional Review Board.

### **3. Results**

The first cohort of 11 patients, ranging in age from 24-57, had 959 interactions with the application in the 12 weeks. On average, 46 meals were logged and 19 articles read per patient. Overall, patients reported to be satisfied with the application. Results from the second cohort will be available within 12 weeks of this submission.

From a programmatic perspective, manual point of care recruitment was challenging in a busy ambulatory practice environment. Extra time was needed to technically assist patients in downloading the application and not all mobile devices had the same functions enabled. Step-by-step instructions, an increase in contact points and online help features were added to the program for the second cohort. The findings from these analyses will inform the future rollout of mobile application based programs to NewYork-Presbyterian Hospital patients.

### **References**

- [1] L. Ricciardi, F. Mostashari, J. Murphy, J.G. Daniel, & E.P. Siminerio, (2013). A national action plan to support consumer engagement via e-health. *Health Affairs*, 32(2), 376-384.
- [2] P.J. Cunningham, J. Hibbard, C.B. Gibbons. Raising low "patient activation" rates among Hispanic immigrants may equal expanded coverage in reducing access disparities. *Health Aff (Millwood)*. 2012;30(10): 1888-94.

# Quality of Chinese CVD Medication Apps

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**Abstract.** The quality of Chinese cardiovascular disease medication apps was evaluated and compared to those in the Google Play Store. Only 21% of 257 CVD medication apps covered medication issues, but the quality is in question. The quality of top 10 CVD medication apps from China was inferior to international apps. An app quality assurance mechanism is needed to ensure patient safety.

**Keywords.** Application, Cardiovascular Disease, mHealth, Medication

## 1. Introduction

Cardiovascular disease (CVD) is the leading cause of death in China. Patient medication compliance is an important factor in disease management. We measured the quality of Chinese CVD medication applications (apps) in helping patients manage their medication and compared them to top international apps.

## 2. Methods

Wandoujia, one of the leading Android app stores in China, was used to find the apps using Chinese keywords, “Medication”, “Medication + Cardiovascular Disease” or “Medication + Heart”. The popularity of contents of apps was analyzed by 10 categories of functions (Figure 1). The quality of apps with more than 10,000 downloads was evaluated with the modified Silberg Scale (mS Scale)[1], composed of 7 categories of 20 indicators (Figure 2). The top 10 most frequently downloaded CVD medication apps from the Google store were compared with the top 10 Chinese apps. Two experienced CVD nurses, familiar with mobile health and quality evaluation, conducted the evaluation. A third nurse was consulted to resolve disagreements.

## 3. Results

A total of 257 apps were found. Only 53 (21%) focused on medications. Among those 53 apps, the top 3 features were Searching Medicines (68%), Medication Information

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(42%), On-line Shopping (30%) (Figure 1). The quality is not consistently good. For example, only one app found all popular CVD medicines on the market, and some apps recommended medications based only on symptoms.

Among the 26 most frequently downloaded apps, the mean mS-scale score was only 7.8, out of 20 (Figure 2). The two best apps, with scores of 13, were developed by professional medical teams. The quality of top 10 CVD medication apps from China was inferior to those from globally ( $10.00 \pm 2.26$  vs  $14.80 \pm 4.02, P=0.004$ ) (Figure 3).

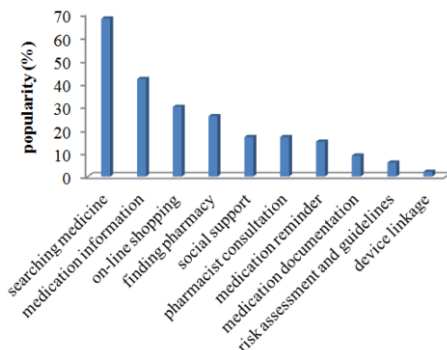


Figure 1. Contents' popularity of CVD medication apps in China.

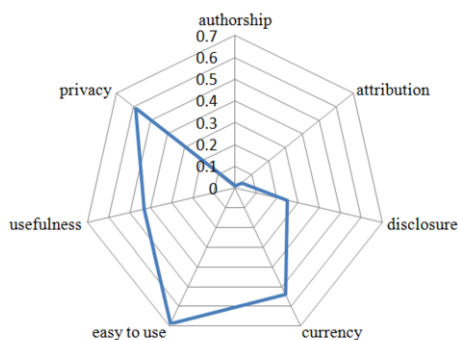


Figure 2. The average quality of CVD medication apps in China.

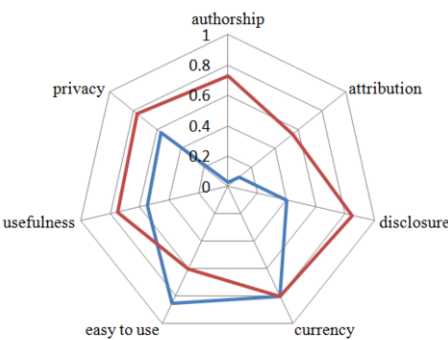


Figure 3. Comparison of quality between top 10 Chinese (blue) and International CVD (red) medication apps.

#### 4. Discussion

The quality of Chinese CVD apps requires improvement and averages worse than the international ones. An app quality assurance mechanism should be in place to ensure patient safety.

#### References

[1] E. Jeon, H.A. Park, Y.H. Min, H.Y. Kim, Analysis of the information quality of Korean obesity-management smartphone applications, *Healthcare Informatics Research* 20(2014) ,23-29.

# The Usefulness of the Electric Textbooks at Nursing Practicum by Analyzing the Usage Logs of the Terminal Tablet

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**Abstract.** We conducted assessment tests for clinical training, analyzing the usage of the electronic textbooks and the tablet functions from the log information of the terminal tablets. Results revealed that usage of the terminal tablet and digital nursing dictionary (ver. 2), by which users can enjoy free access to electric textbooks during clinical training, was effective as learning support.

**Keywords.** electric textbooks, terminal tablet, nursing Practicums

## 1. Introduction

This study developed a digital nursing dictionary (ver. 2) to conduct proving tests. It includes educational material contents of examples for nursing learning support systems and electric textbooks mounted on a terminal tablet. This report describes the usefulness of the electric textbooks and terminal tablet functions by analyzing the usage logs of the terminal tablets.

## 2. Methods

Of the 127 third year students of O University's nursing department in 2012, this study examined 76 students. This study was conducted using quasi-experiments during October 2012 – July 2013. To analyze the data, basic descriptive statistics and correlation analyses were conducted using Excel (Microsoft Corp.). The research was approved by this university's research ethical committee.

Contents of the terminal tablet: Electric textbooks, nursing simulation examples, nursing skill video. Functions of the terminal tablet: Handwriting, bookmark, note, dictionary search.



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### 3. Results

In terms of the number of content users, 66 students (88.0%) respectively used text of the electric textbooks (medical). Results show that 38 (50.7%), 47 (62.7%) contents were devoted, respectively, to text of the electric textbooks (nursing) and training gist. In addition, regarding contents, 47 students (62.7%), 55 (73.3%), 39 (52.0%), and 57 (76.0%) respectively used skill learning, knowledge learning, question learning, and example learning.

In terms of average open times per capita, the text and index of the textbooks (medical) were 17.2 and 14.0, respectively. The text, index of the textbook (nursing), and training gist were 42.9, 14.0, and 4.8, respectively. Furthermore, average open times were 6.2 for skill learning, 6.2 for knowledge learning, 3.5 for question learning, and 6.6 for example learning. The average usage times of handwriting function per capita were 45.6 for nursing textbooks, 8.7 for medical textbooks, and 4.3 of the training gist. The average usage times per capita for respective titles were 14.5 for nursing textbooks, 1.2 for textbooks medical, and 0.6 for the training gist. The average usage times per capita for the jump operation function across contents were 7.7 for the index of the nursing textbooks, 8.5 for the index of the medical textbooks, 3.5 for skill learning, and 3.4 for example learning. The average usage days of the tablet were  $6.9 \pm 5.37$  days. The average usage time per day was  $38.4 \pm 26.1$  min. The coefficient of correlation between usage days and average usage time per day was 0.4.

### 4. Discussion

Regarding contents used in this research, the electronic textbooks were often used. The usage rates of research, handwriting (marker), and jump functions were also high, suggesting that many were used effectively. In contents, skill learning and example learning of nursing technology were used frequently. Because the nursing technology must be confirmed in advance before helping to care for patients in clinical training, nursing technology video that was available at any time was extremely useful and should therefore contribute to boosting of learning effects. In addition, because the example learning contents used were of the patient nursing process, they are thought to be effective. For users to become accustomed with the new instrument of the tablet and to use it as a learning tool, it is necessary to support users to improve the basic ability to manipulate it and to improve the usability of the functions itself.

### 5. Acknowledgments

We express our sincere gratitude to all people who participated in our study.

### References

- [1] Yumiko Nakamura, Yukie Majima, Kaori Fukayama., Terminal Tablet as Electric Textbooks for Nursing Practicum. *HCI 2013*. Las Vegas Nevada, USA, 2013, .
- [2] Yumiko Nakamura, Yukie Majima, Kaori Fukayama, Effectiveness and Utility of Terminal Tablet as Electric Textbooks for Nursing Practicum, ML2015, Madeira Portugal.

# Could People Get Quality Apps They Intend to Get? Taking Finding Stroke Apps for Example

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**Abstract.** We conducted a study to evaluate what apps could people get and what quality these apps were when different searching keywords were used to search in different platforms. We took Stroke apps as an example with “Stroke” “Cerebrovascular Disease” and “Zhongfeng” (in Chinese) as the keywords. Two reviewers evaluated apps independently with revised MARS scale. It was interesting to see that people would get different apps from different platforms with different keywords. The results show that a good mechanism is needed to safeguard people obtain right apps from any source with any term in China.

**Keywords.** Quality Evaluation, App Quality, Stroke, Mobile App

## 1. Introduction

Using health apps has been believed to be an important and effective approach to manage health. However, when the quantity of health apps keeping increased rapidly, there is no easy way to assure people get the right apps [1]. We were interested in knowing whether layman could easily get the right apps with good quality.

## 2. Methods

Two mobile app stores, Apple Store and 360 Android Assistant, in China were used for searching the free Chinese apps related to Stroke. “Cerebrovascular Disease,” “Stroke,” and “Zhongfeng” (all in Chinese) were used as the keywords. The first two were more academic and the last one, more commonly used by layman. Apps found were evaluated by two researchers independently. Five technical quality indicators, such as *Privacy*, *Currency*, *Easy to use*, *Usefulness* and *Reliability*, extracted from literature reviews and assessed by specialist panel were used to assess the quality of the apps [2]. The five indicators were made up of 19 items, each item used a 5-point scale (1-Inadequate, 2-Poor, 3-Acceptable, 4-Good, 5-Excellent), each indicator were calculated the mean score, and the overall score added up by five mean scores was stand for one

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app's quality. The reliability of the scale was tested by Cronbach alpha, which is .90. Data were processed and analyzed using Excel 2007 and SPSS16.0.

### 3. Results

A total of 239 apps were found: 181 from the Apple Store and 58 from the other. However, only 45 (24.9%) Apple apps and 12 (20.7%) Android ones, with only 3 in common, were related to stroke. Different keywords also generated different searching outcomes: Out of the total 54 apps, 5 (9.2%), 22 (40.7%), and 26 (48.1%) were found by keyword Zhongfeng, Stroke, and CVD. Only 1 from Android store could be found by both Stroke and CVD terms. Among the five categories quality evaluation items, both Apple and Android apps had similar scores, except the Apple apps performed better in Currency category, shown in Figure 1. The average score of the all related apps were  $(15.7 \pm 3.1)$  out of 25.

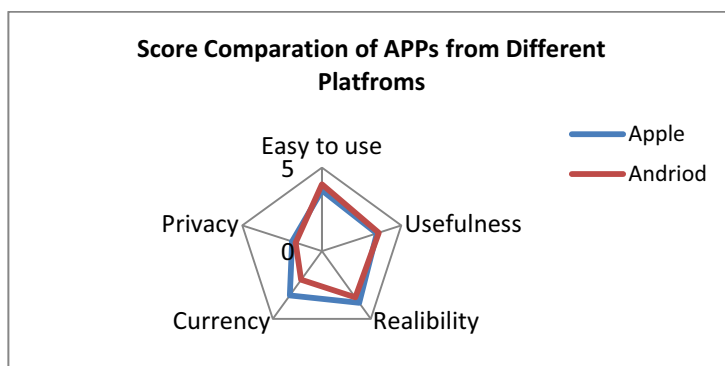


Figure 1. Quality scores of apps by platforms in five quality categories

### 4. Discussion

Our study found that there are different vendor/developer ecosystems between Apple and Android platforms. Interestingly, people would get different apps when they used different keywords for searching and the common term generated the least apps. The app quality from two platforms was similar but the Apple apps were better in Currency. A good mechanism is needed to safeguard people obtain right apps from any source with any term.

### References

- [1] K. Huckvale, C. Morrison, J. Ouyang, A. Ghaghda, J. Car, The evolution of mobile apps for asthma: an updated systematic assessment of content and tools, *BMC Medicine* **13** (2015), 58-73.
- [2] N.F. BinDhim, A. Hawkey, L.Trevena, A Systematic Review of Quality Assessment Methods for Smartphone Health Apps, *Telemedicine and e-Health* **21** (2015), 97-104.

# Evaluation of Efficiency Improvement in Vital Documentation Using RFID Devices

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**Abstract.** We introduced medical devices with RFID tags and the terminal with RFID reader in our hospital. Time study was conducted in two phases. In phase I, nurses round as usual, and in phase II, the nurse round the ward with a terminal installed on a cart. This study concluded that RFID system shortens the time for vital sign documentation. However, deploying the terminals at every bedside did not contribute the more time reduction.

**Keywords.** Vital sign, time study, RFID, EMR

## 1. Introduction

The previous studies show that measuring vital sign and its documentation occupies a great deal of time in nursing care. This study was conducted on the idea of effective improvement in checking vital sign and its documentation using RFID technology.

## 2. Methods

We introduced thermometer, pulse oximeter, and manometer equipped with RFID tags to every patient and the terminal with RFID reader in our university hospital. The terminal reads the data of BT, SpO<sub>2</sub>, HR, and BP with RFID reader and automatically transfers them to the EMR. Time study was conducted under two scenarios. The nurses round the ward with the cart installed the terminal (Phase 1), and the nurses used terminals deployed side of every patients' beds without using the cart. (Phase 2).

## 3. Results

In phase 1, the one-way layout variance analysis has no significant difference in the measuring time between clinical ladders except SpO<sub>2</sub> and no difference in phase 2. VS measuring time was 88.13 (sd 33.12) secs per person in phase 1 and 75.96 (sd: 37.31) in phase 2. There is a significant difference in VS measuring and documentation time between phase 1 and 2 (ladder I, II:  $p < 0.01$ , III:  $p < 0.05$ ).

## 4. Discussion

This study shows the RFID system shortens the VS documentation time. We will try to delegate vital sign measurement to patients to realize more time utilization, cause RFID-enabled medical devices are user-friendly to be a little cost of patient education.



# Structural Equation Model of Health Promoting Behaviors for Health Information Seekers with Mobile

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**Abstract.** This study was conducted on verifying whether variables such as prior health related behaviors, health literacy, interpersonal influence, perceived ease of use and usefulness of health information, and behavioral intention could predict actual health promoting behaviors of consumers using health information with mobile in the future. The research model was based on Technology Acceptance Model. Data were collected from 199 mobile health information seekers. Participants' actual health promoting behaviors were checked after 3 months from pre-data collection. The final modified model had good fit indices.

**Keywords.** mHealth, Health promoting behaviors, Consumer, Seeking health information, Structural Equation Modeling (SEM)

## 1. Introduction

With the development of information technology, using websites with mobile devices such as laptops, smartphones, and smart pads has been generalized and its usage and dependency has expanded as essential matters of life (Fox & Duggan, 2013). However, with the increased accessibility, it is the current state to be cautious about quality evaluation and self-explored health information by consumers in a flood of information. Nevertheless, previous studies had limitations of predicting consumers' behaviors of seeking health information and behavioral intention. Therefore, this study verifies a theoretical model which includes all the related consumers' actual health promoting behavior factors further from intention of action.

## 2. Methods

Data collection was conducted in June, 2015 to 20~70-year-old adults, male and female, regardless of regions, who had experiences of looking up the health information related to health promotion using smartphone applications. A total of 199 people were divided by top five groups according to distribution of Organization for Standardization in South Korea (2007). The research tool is about prior health related behaviors, health literacy, perceived information usefulness and ease of use, and intention of action based on Technology Acceptance Model (Davis, 1989). Collected data were analyzed using Amos and SPSS program.

### 3. Results

#### Characteristics of Participants

Average age of participants was 31.8 years old for mobile users. There were 104 twenties (52.3%), 59 thirties (29.6%), 15 forties (7.5%), and 14 fifties (7.0%), so the twenties and the thirties took the majority of the study population. Also, 54 men (27.1%) and 145 women (72.9%) participated. As of occupations, there were 74 students (36.7%), 42 medical-related professionals (21.2%), 30 non-medical-related professionals (15.1%), and 24 office workers (12.1%). Among the participants, 91 people were university graduates (45.7%).

#### Descriptive statistics of measured variables

Scores for the study are as follows: prior health related behaviors was 15.2. The score for health literacy was 9.7 and interpersonal influence was 11.2. 11.7 for perceived ease of use and 13.8 for perceived usefulness. The score for behavioral intention was 21.7 and health promoting behaviors such as Health responsibility 10.16, fitness 11.65, nutrition 11.66, spiritual growth 10.39, and stress management 9.89.

#### Analysis for structural model

Bivariate normality was checked to identify the normality of the sample. As a result, mobile group (-.36~.29) showed the absolute value of less than 2 for all the skewness and less than 7 for kurtosis (-.38~.76), so the hypothesis of bivariate normality was satisfied. The absolute value of mobile group showed from .01 to .63 and it is considered that there is no problem in multi-correlation. Model fit indices for the hypothetical model fitted to the recommended level,  $\chi^2 = 66.57$ , GFI= .95, Normed  $\chi^2 = 1.80$ , RMSEA=.06, NFI= .90, CFI= .95, and IFI= .95. Variables accounted for 20.8% of health promoting behaviors. Out of 12 paths, 9 were statistically significant.

### 4. Discussion

The results of this study did not include exploring behaviors of intervention applications which provide contents related to obesity or chronic diseases which require continuous usage from consumers who look for health information about health promotion. However, prior to self-management by a patient, in a preventive level, consumers' actual health promoting behaviors were influenced by prior health related behaviors, health information literacy, perceived usefulness, and interpersonal influence. This study support that factors affecting actual health promoting behaviors of consumers who prefer mobile more over personal computer of health information portal. It would be used as the basis for health promotion for mobile users of health information.

### References

- [1] S.Fox, & M. Duggan, (2013). Health online 2013: Pew Internet & American Life Project Washington, DC.
- [2] F.D. Davis, (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340.
- [3] Korea National Statistical Office (2007). *6th Standard Occupational Classification in Korea*. Seoul, Korea.

# The Educational and Supportive Mobile Application for Caregivers of Dementia People

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**Abstract.** This paper presents a healthcare mobile app for caregivers of dementia patients. The app had been implemented to run on wearable and mobile devices, and it helps caregivers to take dementia test, review dementia test history, and search location of public health centers in the vicinity. The collective purpose of these features is to provide meaningful healthcare services to elderly at risk of dementia. The app uses the time and change (T&C) test for screening for dementia. The app was tried for its validity and usability for the intended purpose, and participating users were surveyed to evaluate its usefulness.

**Keywords.** Dementia, Smartphone application, Dementia caregiver, Wearable mobile device, Cognitive testing function

## 1. Introduction

About 7.7 million people have being observed with dementia each year. According to “Dementia Prevalence Rate Report, 2012” from the Ministry of Health and Welfare in South Korea, the dementia prevalence rate has been on a steady rise as South Korean society is aging quickly; there were 54 thousand confirmed cases of dementia in the country as of 2012. It is expected that the number of patients would double every twenty years, so the number of patients with dementia would reach 1.27 million by 2030 and 2.71 million by 2050 [1, 2]. Early diagnosis can help slow down the progress of the condition, however, the majority of the public have incorrect ideas of dementia, harming/hindering the chances of adequate response, and there are often lots of cases that the patient is sent to hospital for diagnosis when it is too late. The overarching goal of the app is helping the elderly at high risk of dementia by educating them on the status of severity level, performing screen tests to detect those with deteriorating cognition, and providing relevant information to the caregivers. Additionally, the app allows the user to view the time test and cognition (T&C) test result history and find public healthcare centers in the vicinity.

## 2. Methods

The app was developed on the Android platform. The development environment involved Android Studio and Java SE Development Kit for coding, LG G2 for smartphone, and LG G watch for smartwatch. These two devices communicate through Bluetooth to perform screen test.

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### 3. Results

The app fetches the GPS coordinates and locates public healthcare centers in the vicinity, and provides with the mini-mental state examination (MMSE) as well as an assortment of reliable cognition tests, including voice recognition test. Within the context of the time and change test for dementia screening test, the app measures user's response time and suggests test results.

The time and change (T&C) test is easy to use, reliable, and quick to administer to screen test for dementia [5]. In the time test of our app, the user sees an analog clock with an hour hand and a minute hand and tells to his/her caregiver the time with precision within 60 seconds. In the change test, the user receives/takes coins - 3 quarters, 7 dimes, and 7 nickels - and makes a combination of the coins to the sum of one dollar within 180 seconds. Time to completion is recorded in each test, and the user can retry the test when failing to achieve test goals.

Next, a poll was conducted to find out the overall usefulness of the app by experienced users. We polled 17 users in ages between their 40s and 70s, and recorded their age, gender, occupation, as well as user satisfaction after using the app. The Likert-type scale was used between 1 and 5, with 5 being most satisfied and 1 not satisfied at all. None of the poll participants had tried a dementia screening test service previously. The majority of them indicated the app is easy to use so that we found little difficulty of the app's comfort. In a while, a few pointed to the small font on the smartwatch and thought the questions were not readily understandable. The participants indicated that this type of dementia screening test is more convenient than the traditional pen-and-paper type.

### 4. Discussion

The app is limited only to Android platform and it needs to be converted to web-based service to support various platforms. The majority of the conventional dementia screening tests are pen-and-paper-based, thus they are not tailored for testing on a digital device. More work should be done to devise tests suitable on digital device platforms. The data used in the app needs to comply with existing standards in order to ensure interoperability among devices because the app transfers personal health data via digital devices. FHIR(Fast Healthcare Interoperability REsources) of HL7(Health Level 7) can be adopted for standardization of the web app platform. The current work used only a simple dementia screening test, however, the user's vital signs, language, behavioral characteristics could be exploited to enhance accuracy of screening test.

### Acknowledgement

This research was supported and funded by a ezCaretech, Seoul, Republic of Korea about 'FHIR based PHR Service Implement' project; a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI); the Ministry of Health & Welfare, Republic of Korea (grant number : H114C2756).

### References

- [1] Health Quality Ontario. "Caregiver-and patient-directed interventions for dementia: an evidence-based analysis." *Ontario health technology assessment series* 8.4 (2008): 1
- [2] Statistics Korea, Population Projections for Korea: 2010~2060 (Based on the 2010 Census), 2011
- [3] Ministry of Health and Welfare, 2012 dementia prevalence rate investigation, 2013 Kim Tae Hyeun,
- [4] A study on the Development of educational program for families with demented elderly persons, Korea Home Management Association, 1996
- [5] Inouye, The Time and Change Test: A Simple Screening Test for Dementia, *biomed gerontology oxford journals*, 1998

# Modeling a Mobile Health Management Business Model for Chronic Kidney Disease

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**Abstract.** In these decades, chronic kidney disease (CKD) has become a global public health problem. Information technology (IT) tools have been used widely to empower the patients with chronic disease (eg, diabetes and hypertension). It is also a potential application to advance the CKD care. In this project, we analyzed the requirements of a mobile health management system for healthcare workers, patients and their families to design a health management business model for CKD patients.

**Keywords.** Mobile health management, Business model, Chronic kidney disease

## 1. Introduction

Chronic kidney disease (CKD) is a global public health problem. It is the tenth causes of death and largest burden of the National Health Insurance in Taiwan. Self-management is one of the popular chronic kidney disease care program [1]. In recent years, there were many business models which were applying the information technology (IT) to empower patients with chronic diseases (eg, diabetes or hypertension). It is also seen as a potential application to advance the CKD care [2]. In this project, we aimed to find a business model to enhance the CKD patient health management by integrating the information technology and medical service.

## 2. Methods

We conduct literature review, expert interview and focus group discussions to confirm the system requirements. During the literature review, we focus on some issues: the guidelines for CKD management, current status of CKD care and existing regulations for CKD care. During the expert interviews and focus group discussions, we firstly came to understand the current model of CKD care and clarified the restrictions under the current model of care. Furthermore, we analyzed the needs of healthcare workers, patients and their families. Then we also surveyed the potential devices and business model innovation methodology to match the demands of the mobile health management of CKD patients.

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### 3. Results

We integrated the requirements for CKD care workers, patients and their families into several components. 11 key components for CKD mobile health management system were defined: physiological monitoring, medical laboratory reports, self-assessment, exercise recording, food and drink recording, medication reminders, medical appointment reminders, health education, instant messaging, ranking report and social community or family share. According these requirements, we designed a business model (Figure 1) and planned to develop a self-management application and a multidisciplinary case management platform for CKD management.

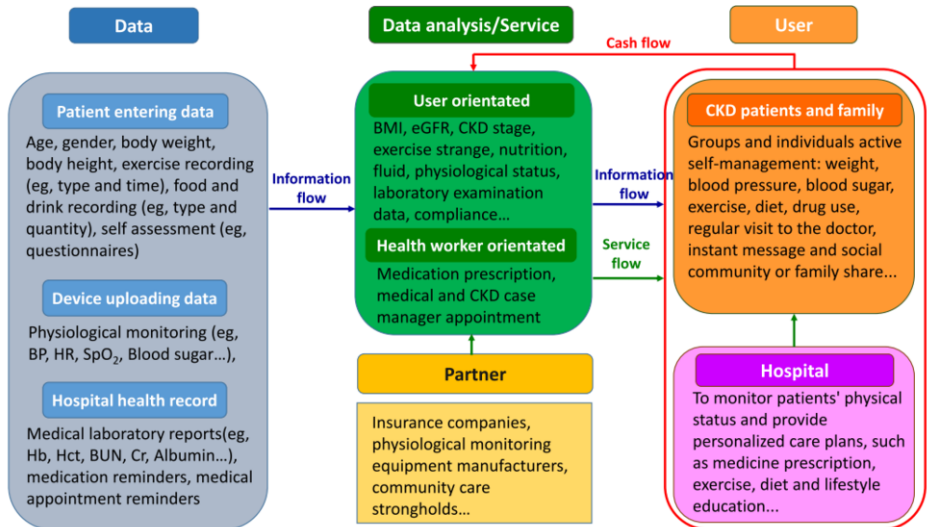


Figure 1. Mobile health management business model for chronic kidney disease

### 4. Discussion

An approach to integrate mobile patient self-management application and decision support for healthcare workers in a multidisciplinary case management platform will be designed and implemented for CKD patients. We would like to provide a cheap, convenient and professional disease management supported platform for patient, family and healthcare workers. We are going to further verify the effectiveness of this business model of CKD mobile health management in different settings.

### References

- [1] A. Bonner, K. Havas, C. Douglas, T. Thepha, P. Bennett and R. Clark, Self-management programmes in stages 1-4 chronic kidney disease: a literature review, *J Ren Care*, **40** (2014), 194-204. doi:10.1111/jorc.12058.
- [2] C.J. Diamantidis and S. Becker, Health information technology (IT) to improve the care of patients with chronic kidney disease (CKD), *BMC Nephrol*, **15** (2014), 7. doi:10.1186/1471-2369-15-7.

# Understanding the Learning Needs of New Graduate Nurses at a Surgical Ward to Develop a Smartphone/Table Based Training System

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**Abstract.** Taiwan government and health officials had made the new graduate nurses training program a mandatory requirement for all teaching hospitals in order to train new graduate nurse staffs to prepare them for the clinical practice. Mobile devices may provide a feasible and useful tool for the new graduate nurses to learn knowledge/skills, thus, the study researchers proposed to develop a smartphone/tablet based learning system to assist the new graduate nurses in the study hospital ease their transition into the RN roles. Prior to developing this electronic training system, learning needs assessment was carried out. A focus group research method was used to help the researchers better understand the learning needs of new graduate nurses. The data is still under analysis, results and discussed will be reported as soon as the analysis is completed.

**Keywords.** smartphones, tablets, new graduate nurses training program, need assessment

## 1. Introduction

In Taiwan, completion of a nursing educational program and the passing the National Nursing Board Examination are required for nurses to begin nursing practice. However, even those newly licensed nurses have passed the board examination and meet the minimal competence required to enter clinical nursing practice, their abilities to provide safe and competent care to patients were limited. Therefore, Taiwan government and health officials had made the new graduate nurses training program a mandatory requirement for all teaching hospitals in order to train new graduate nurse staffs to prepare them for the clinical practice.

In recent years, the popularity of mobile devices (including smartphones and tablet computers) and their multimedia capabilities make the enthusiastic nurse educators and experts believe that those mobile devices may benefit students by providing constant access to learning materials and tools. Therefore, the study researchers proposed to develop a smartphone/tablet based learning system to assist the new graduate nurses in the study hospital ease their transition into the RN roles. Prior to developing this electronic training system, learning needs assessment was carried out.

## **2. Methods**

A focus group research method was used to help the researchers better understand the learning needs of new graduate nurses. The Institutional Review Board approval was obtained prior the initiation of the study. Focus group participants were asked a set of semi- structured questions and the study were audiotaped and transcribed.

## **3. Results & Discussion**

The data is still under analysis, results and discussed will be reported as soon as the analysis is completed.



# Specialty Task Force: A Strategic Component to Electronic Health Record (EHR) Optimization

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**Abstract.** Post-implementation stage comes after an electronic health record (EHR) deployment. Analyst and end users deal with the reality that some of the concepts and designs initially planned and created may not be complementary to the workflow; creating anxiety, dissatisfaction, and failure with early adoption of system. Problems encountered during deployment are numerous and can vary from simple to complex. Redundant ticket submission creates backlog for Information Technology personnel resulting in delays in resolving concerns with EHR system.

The process of optimization allows for evaluation of system and reassessment of users' needs. A solid and well executed optimization infrastructure can help minimize unexpected end-user disruptions and help tailor the system to meet regulatory agency goals and practice standards. A well device plan to resolve problems during post implementation is necessary for cost containment and to streamline communication efforts. Creating a specialty specific collaborative task force is efficacious and expedites resolution of users' concerns through a more structured process.

**Keywords.** optimization, task force, specialty, collaborative

## 1. Introduction

Post-implementation stage comes after an electronic health record (EHR) deployment. This phase addresses the challenging tasks of resolving concerns encountered with the newly implemented system. Optimization is the process of evaluating and enhancing a system after users' feedback and to keep the system compliant with regulatory agency requirements and practice standards.

Problems encountered during and after an EHR deployment are numerous and can vary from simple to complex. Redundant ticket submission creates backlog for Information Technology (IT) personnel resulting in delays in resolving concerns with electronic health record system. Resolution of submitted tickets and request for upgrades is dependent upon availability of IT personnel and an organized processing system. During optimization, one of the most common concerns expressed by end users is the rate of response in improving functionality. Analysts are restricted from deploying enhancement without authorization by managerial or administrative staff. Ineffective decision making process creates inefficiency during the optimization period.

### Aim/Purpose

- Develop a systematic approach to expedite resolution of problems encountered with documentation system
- Streamline system wide decision making process, avoiding delays in approving changes

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<sup>1</sup> full contact information for the corresponding author.

## 2. Method

The University of Colorado Health System Perianesthesia Department created a specialty specific task force to address issues and concerns encountered with software application. A charter was drawn that defined goals, role expectation and task force guidelines. Membership was open to analysts, managers, educators, clinical experts and end users. Other services such as pharmacy and risk management were invited if the topic of concern needed some clarification.

A 90 minute monthly meeting was held utilizing audio and video conferencing to accommodate institutions that were remotely located. Members were responsible for disseminating information to end users.

## 3. Results

A survey was conducted to determine if the P4G Task Force met the set goals. The results indicated that having a specialty specific task force during optimization was beneficial. An analyst involvement in the task force helped in streamlining the process of addressing problems. A 90 minute meeting is complimentary to the members' schedule. The task force improved communication process from administrative level to clinicians. Patient safety is addressed through rapid resolution of EHR concerns.

## 4. Discussion

EMR optimization is a continuous and important process for any EHR systems. Creation of an specialty specific optimization task force ensures efficiency in dealing with end users problems, regulatory agency requirements and practice standards. Team members must come from various departmental roles to expedite decision making support. This enables prompt deployment of enhancements improving patient safety and users' satisfaction.

## 5. Acknowledgments

Members of P4G Optime Task Force University of Colorado Health System (North, Central and South)

## References

- [1] The Joint Commission. Sentinel Event Alert: Safely implementing health information and converging technologies. Dec. 2008.
- [2] Ash JS, Stavri Z, Kuperman GJ, et al. Consensus Statement on Considerations for a Successful CPOE Implementation. *J Am Med Inform Assoc.* 2003; 10: 229-234. 66 (1993), 856-890
- [3] S.S. Jones, R. Koppel, M.S. Ridgely, T.E. Palen, S. Wu, and M.I. Harrison. Guide to Reducing Unintended Consequences of Electronic Health Records Prepared by RAND Corporation under Contract No. HHSA290200600017I, Task Order #5. Agency for Healthcare Research and Quality (AHRQ). Rockville, MD. August, 2011.
- [4] T. Smith. Strategies for Optimization Success, *HIMSS News*, retrieved from <http://www.himss.org/news/newsdetail.aspx?itemnumber=4904> (2012)

# Wearable Technology Surveillance Data for the Personal Health Record using the Omaha System: Noise Exposure, Cardiovascular and Stress Biomarkers

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**Abstract.** This poster describes a method to prepare noise and health data from wearable technology for standardized representation in the electronic personal health record thus enabling individuals to identify noise-related health risks. Using a case study approach, the authors demonstrate transformation of data to the Omaha System standardized terminology in order to depict the data graphically in a personal health record.

**Keywords.** Noise exposure, cardiovascular biomarker, salivary cortisol, wearable technology, Omaha System, personal health record, population health

## 1. Introduction

Science increasingly links cardiovascular diseases to noise exposures in communities and workplaces. Methods are needed to examine simultaneous noise, cardiovascular, and stress data. Incorporating wearable technology data in personal health records may reveal patterns in noise exposure relative to psycho-biological data.

## 2. Methods

Noise exposure, heart rate, systolic and diastolic blood pressure, and salivary cortisol data from simulated and secondary data sources were transformed using the Omaha System [1]; leveled across problems; normalized from baseline; and depicted graphically.

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### **3. Results**

Graphic displays of the case study results will be presented in the context of other personal health data.

### **4. Discussion**

Integrating noise exposures and psycho-biological responses may help individuals identify noise-related health risks. There is potential to aggregate such data for public health surveillance and to study the cardiovascular and stress effects of noise pollution using standardized data and visualization techniques.

### **5. Acknowledgments**

The coauthors are members of the Omaha System Partnership for Knowledge Discovery and Health Care Quality <<http://omahasystempartnership.org/>>.

### **References**

- [1] K.S. Martin, *The Omaha System: A key to practice, documentation, and information management (reprinted 2<sup>nd</sup> ed.)*, Health Connections Press, Omaha, NE, 2005.

# Proposal of Comprehensive Model of Teaching Basic Nursing Skills Under Goal-Based Scenario Theory

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<sup>c</sup>*Jikei University Hospital*

**Abstract.** The purpose of this study is to design and develop a comprehensive model of teaching basic nursing skills on GBS theory and Four-Stage Performance Cycle. We designed a basic nursing skill program that consists of three courses: basic, application and multi-tasking. The program will be offered as blended study, utilizing e-learning.

**Keywords.** Basic nursing skills, Goal-Based Scenario Theory, Blended study

## 1. Introduction

Japan's basic nursing curriculum emphasizes clinical practicum, and is yet to achieve a paradigm shift to replace clinical practicum with simulation education. In this study, we designed scenario-based curriculum, and evaluated the implementation. The ultimate goal of the study is to elucidate how simulation education should be implemented in the teaching of basic nursing skills. As a first step, we follow the instructional design process to analyze, design and develop a comprehensive model of teaching basic nursing skills, which we present in this article.

## 2. Methods

Our objective was to design courses tailored to the levels of nursing students. First, we analyzed information that we collected from teachers in order to help revealing learning processes that enable students to provide systematic nursing care in clinical practicum. Next, we verified students' attainment targets and attainment levels of nursing skills upon graduation in order to carefully select basic nursing skills to be covered. We then used an ID (Instructional Design) theory called GBS (Goal-based scenarios) theory as a broad framework to apply the Four-Stage Performance Cycle<sup>[1]</sup> in the actual course design.

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### 3. Results and Discussion

We reaffirm the importance of the following points in campus training for students to provide systematic nursing care in clinical practicum: 1. To perform sufficient task training; 2. To focus on standardized protocols and to give opportunities to practice them; and 3. To make plans as to what nursing practice should be given for patients under certain conditions and in certain situations.

Based on the results, we designed a basic nursing skill program to teach livelihood support. The program consists of three courses: basic, application and multi-tasking. Students read cover stories presented, and advance their learning in the three courses step-wise to fulfill their roles and duties. They take necessary actions of the following four as each course requires: 1. To acquire basic knowledge; 2. To repeat practicing skills based on standardized protocols; 3. To discuss care plans suitable for the patients; and 4. To implement. Upon completion of the courses, students reflect their learning achievements. The program is offered based on such cycle model (Fig.1). The three courses will be offered as blended study, utilizing e-learning. The program also uses LMS to deliver cover story videos, multi-tasking and time urgency simulation materials, and quiz materials to check students' basic knowledge.

Through the implementation of such comprehensive model of teaching basic nursing skills as a broad framework, we would like to evaluate the implementation and study micro designs of the teaching materials to present in future.

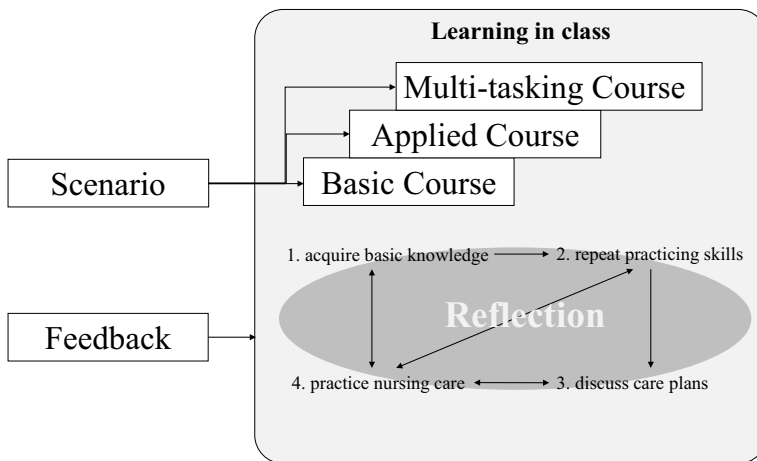


Figure.1 Course Design

### References

[1] Alexander Romiszowski, *Fostering Skill Development Outcomes, Instructional-Design Theories and Models Volume III Building a Common Knowledge Base*, Routledge, New York, 2009.

# Collaboration in the Hospital-Situations

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**Keywords.** Collaboration, novice nurse, assertiveness, co-medical staff

## 1. Introduction

This study describes “the situations where novice nurses felt they could not be sufficiently assertive in the workplace” for the collaboration with co-medical staff.

## 2. Methods

A self-administered questionnaire was distributed to 102 novice nurses. Participants were asked about situations and reasons where they felt: “I wanted to decline but could not”.

## 3. Results

The number of valid responses was 81, and the mean age was 23.7 years. The descriptions of non-assertive situations were 51 nurse senior, 9 boss, 5 patient, 2 peers, 2 co-medical, 1 patient family, and 3 doctor. The situations toward their senior nurses yielded 9 categories: “I cannot decline tasks assigned to me”, and others. The reasons yielded 7 categories.

## 4. Discussion

Novice nurses were not able to be assertive. This study reinforced the importance of assertiveness education for novice nurses, and suggested encouraging assertive communication and collaboration throughout the ward.

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# Development and Verification of a Clinical Process Chart for Nutritional/Dietary Management

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**Keywords.** Nutritional/Dietary Management, Deglutition Disorders, Clinical Paths

## 1. Introduction

Using the Patient Condition Adaptive Path System, we visualized and structured a nutritional/dietary management process adapted to patient status. Herein, we report the verification outcomes for the bodily organs related to deglutition disorder.

## 2. Methods

Nutritional/dietary management in the clinical setting was analyzed in terms of alimentary canal function, swallowing function, and alternative nutrition by dental surgeons, nurses, managerial dietitians, and quality management engineering researchers to create a clinical process chart (CPC)/transitional logic. On the basis of the transitional logic, the CPC verification study was conducted in X acute hospital to monitor clinical courses using hospital charts, and the nutrition/dietary-related data for 22 patients with deglutition disorder were analyzed.

## 3. Results

Patient status in terms of nutritional/dietary management was classified into the following 7 types. Our verification of the CPC revealed that the cover ratio was 59% (13 cases), and 15 patients (68%) started enteral feeding (including tubal/oral feeding) within 3 days after hospitalization.

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#### **4. Discussion**

The CPC amended according to our verification outcomes should be corroborated in future studies. The possibility to analyze/assess/improve the validity of our designed clinical process is indicated.

# A Report on Nursing Information During Volunteer Activities Conducted by Nursing Faculty Members and Students After the Great East Japan Earthquake

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**Abstract.** A survey was conducted about nursing information in volunteer activities of nursing faculty members and students after the Great East Japan Earthquake. Results indicated that it was important to attempt collecting information in every possible way and to always be prepared. During activities, it is important to record information, to share information with individuals other than nursing professionals and to make good use of it.

**Keywords.** Great East Japan Earthquake, volunteer activities, nursing faculty members, nursing students

## 1. Introduction

Due to the Great East Japan Earthquake that occurred on March 11, 2011, some of the facilities at our university were destroyed. For this reason, classes could not be held for about two months.

In the midst of this situation, a week after the earthquake, we nursing faculty members and students, began volunteer activities in regions devastated by the tsunami. We have been continuing volunteer activities for more than four years now.

The objective of this study is to identify methods of gathering and utilizing nursing information in volunteer activities after the earthquake.

## 2. Methods

A survey was implemented regarding methods of gathering and utilizing nursing information in the volunteer activities conducted by nursing faculty members and students after the earthquake. This was done by reviewing activity records made between March 2011 and August 2015. For ethical considerations, the approval of the Ethics Committee of the institution was obtained.

### 3. Results

Nursing students needed guidance in regard to conducting volunteer activities after the Great East Japan Earthquake. Therefore, methods of quickly and efficiently gathering nursing information related to disaster nursing were considered. As the laboratories and the library were partly damaged, it was not possible to go and get books. Three days after the earthquake, faculty members residing in areas where electricity had recovered, realized that documents related to disaster nursing had been emailed by academic institutions to which they belonged. On obtaining the documents we were able to provide guidance to nursing students. Furthermore, after volunteer activities, we made sure to record the nursing information. Next, we used this record and passed on the information to the next person in charge. As a result, we were able to gain trust from the disaster victims. In addition, when we came across cases which were difficult to resolve solely through nursing, we shared this information with administrative officials and welfare specialists. Consequently, we were able to efficiently solve the problems of disaster victims.

### 4. Discussion

It is essential that nursing professionals start volunteer activities immediately after a disaster. However, nursing faculty members and students of universities in disaster-stricken areas are also disaster victims. This study revealed that when facilities are damaged, one cannot use books, the most typical method of gathering information. From this, it was considered necessary that information should be gathered by using all possible methods and not just from facilities within the university. The study revealed that in regard to methods of quickly and efficiently gathering information related to disasters, methods of utilizing network systems and information gathered from academic institutions in which individual faculty members belonged to were effective. A university located near ours experienced a server shut down due to the earthquake. In addition, in case of a large scale earthquake, major aftershocks may continue and power cuts reoccur.

From the abovementioned, it is indicated that in regard to methods for gathering nursing information after a disaster, it is important to try all possible methods and be always prepared against disasters even for information gathering. Furthermore, in order to continue volunteer activities after a disaster, it is indispensable to gain the trust of disaster victims. The study revealed information records were essential for such times.

In addition, problems of disaster victims become complicated after a disaster, and there are cases where the problems cannot be solved by nursing professionals alone. The study revealed that on such occasions it was important for nursing professionals to share information they possessed with administrative officials and welfare specialists and make good use of it.

### 5. Acknowledgments

This study was supported by MEXT-Supported Program for the Strategic Research Foundation at Private Universities to the Kansei Fukushi Research Institute, Tohoku Fukushi University (2012-2016).

# Feasibility of Describing Wellbeing and Strengths at the Community Level Utilizing the Omaha System

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**Abstract.** Capturing strengths at the community level offers an emergent perspective to a strength-based approach for population health. The Omaha System standardized terminology has been found feasible to describe individual strengths in patient care planning. This study depicts results of using the Omaha System to capture strengths at the community level. Descriptive statistics and visualization were used to examine patterns of strengths and signs/symptoms by Omaha System Problem concept based on the secondary data analysis from 118 student-generated community assessments. Results suggest that it is feasible to use the Omaha System as a method classifying strengths and problems at the community level. The relationship between strengths and signs/symptoms is consistent with the pattern observed at the individual-level. Utilizing a strength-based model may provide robust information about community strengths leading to new approaches to population health management in support of community wellbeing.

**Keywords.** strength, community assessment, standardized terminology, Omaha System, population health, wellbeing

## 1. Introduction

Capturing strengths at the community level offers an emergent perspective to a strength-based approach for population health. Methods are needed to support a strengths-based approach for understanding population health and wellbeing.<sup>[1-3]</sup> The Omaha System standardized terminology has been used to describe individual strengths in patient care planning.<sup>[1]</sup> This study from the United States is one of several ongoing studies evaluating use of the Omaha System to capture strengths at the community level internationally.<sup>[4]</sup>

## 2. Methods

Secondary data from 118 student-generated community assessments include a checklist of 11 concepts from the Omaha System Problem Classification Scheme.<sup>[2]</sup> Data were

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analyzed using descriptive statistics, and visualization methods were used to examine patterns of strengths and signs/symptoms by Omaha System Problem concept.

### 3. Results

Results are shown in Figure 1. The average number of strengths per concept was 53.2 (range = 29-88). The average number of signs/symptoms per concept was 141.4 (range = 30-301). Problem concepts with a higher number of strengths had fewer signs/symptoms.

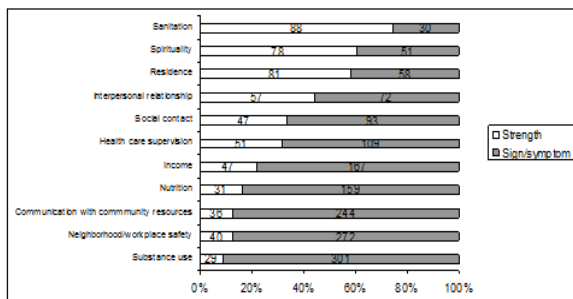


Figure 1. Proportions of strengths and signs/symptoms for problem concepts at the community level

### 4. Discussion

It is feasible to use the Omaha System as a method of classifying strengths and problems at the community level. The relationship between strengths and signs/symptoms is consistent with the pattern observed at the individual-level.<sup>[1]</sup> Community presents an integral dimension of wellbeing. Utilizing a strength-based model may provide robust information about community strengths, potentially leading to new approaches to population health management in support of community wellbeing internationally. Further research is needed to evaluate use of the Omaha System strengths assessments at the community level.

### References

[1] K.A. Monsen, J. Peters, B.S. Schlesner, E.V. Catherine, & D.E. Holland, The gap in big data: Getting to wellbeing, strength, and a whole-person perspective. *GAHMJ* 4(2015): 31-39.  
 [2] K.S. Martin, *The Omaha System: A key to practice, documentation, and information management*. Reprinted Second ed. Health Connections Press, 2005.  
 [3] M.J. Kreitzer, Spirituality and wellbeing: Focusing on what matters. *West J Nurs Res.*, 34(2012): 707-711.  
 [4] M.J. Kerr, C. Flaten, M. Honey, S. Myklebust, K.S. Martin, & K.A. Monsen, Use of an Internet-based Community Assessment for International Public Health Nursing Education. Paper presented 8/27/13 at the 3rd International Public Health Nursing Conference, Galway, Ireland, 2013.

# Using Model of Clinic Care Classification in Clinical Nursing Information System

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**Abstract.** This article provides an example of the how to choose and use standardized nursing terminologies to build clinical nursing information system in the nursing process. In addition to describing the implement and apply clinic care classification (CCC) system, Evidence-based practice (EBP) and Clinical decision support systems (CDSS), by the nursing action automatic output nursing document.

**Keywords.** Standardized nursing terminology, clinical care classification, clinical nursing information system, evidence-based practice, clinical decision support systems.

## 1. Introduction

The CCC is a nursing terminology system which documents nursing care based on the conceptual framework of the six-step nursing process with required elements. It provides a unique standardized framework and coding structure for assessing, documenting, and classifying nursing care of patients [1]. CDSS can link the nurse to the latest EBP guidelines to support decision-making for individual patient situations at the point of care [2]. The use of a standardized language to record nursing care can provide the consistency necessary to compare the quality of outcomes for various nursing interventions across settings [3][4]. The purpose of this paper was to describe the use of CCC system and apply EBP in the clinical nursing information system.

## 2. Methods

The content analysis method for using a model of CCC in clinical nursing information of six steps:

### 2.1 Building nursing care plan system.

Step 1: EBP: Using the wisdom of experts through the integration of the literature search and knowledge, editing completed 93 major nursing care plans.

Step 2: Using the Excel software for data compilation and building a nursing care plan database.

### 2.2 Integration of evidence-based practice into CDSS.

Step 3: EBP and CDSS: Using assessment results and suggesting the relevant

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nursing diagnosis for the individual patient through CDSS.

### 2.3 Standardized nursing terminologies and computerized records

Step 4: Data standardization and coding: Standardizing the nursing interventions and using CCC for coding nursing diagnoses and nursing outcomes.

Step 5: Classification: We take CCC system (four action types) as a reference to adjust nursing information systems by six action types

Step 6: Using the structured and coded database to design an automatic nursing electronic document system for each action type of semantic methodology.

## 3. Results

1. Using the structured and coded database to design an automatic nursing electronic document system for each action type.
2. By semantic methodology enrich the nursing efficiency and care. Nurse staffing have highly identified the system for the nursing record.
3. Provide decision-making, reduce to nursing care plan memory load, provide care guidelines to assist new staff expertise and learning and growth.
4. In order to consider the ability to streamline the work process, the developing system procedure to transmit intervention/actions decreased from 5916 to 1856 items.
5. Stored data for the most objective, massive databases (big data), can use data mining (data-mining) as administrative and research the truest Database.

## 4. Discussion

The clinical nursing information system had features of a clinical decision support system. Nurses gained experience in using these features (example: promotion of best practices, patient-specific guidelines and recommendations, and using a computer for support with clinical decisions), which may be of value in the implementation of more sophisticated decision support systems. These factors are important for clinical decision making in that signs and symptoms serve as the rationale for the nursing diagnoses.

Using the model of the CCC system in clinical nursing information system, although time-consuming longer and slower (time spent nearly two years), but proved to be better supported in the clinical nursing information system. Example: The system will create a clinical nursing big data warehouse, can be used by data-mining for quality improvement reports and development of new knowledge.

## 5. References

- [1]. V.K. Saba, Clinical care classification (CCC) system manual: A guide to nursing documentation. New York, NY: Springer Publishing Co, 2006.
- [2]. K. Dontje, Mapping evidence-based guidelines to standardized nursing Terminologies. CIN: Computers, Informatics, Nursing. 29 (2011), 698–705.
- [3]. M Rutherford, Standardized nursing language: What does it mean for nursing practice. OJIN: The Online Journal of Issues in Nursing. 13 (2008), 243-50.
- [4]. A. Thoroddsen, M. Ehnfors, A. Ehrenberg, Content and completeness of care plans after implementation of standardized nursing Terminologies and computerized records. CIN: Computers, Informatics, Nursing. 29 (2011), 599–607.

# The Experience of the ICNP Francophone Research and Development Centre of Canada with Validating the ICNP® French-Canadian Version

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**Abstract.** The mission of the ICNP Francophone Research and Development Centre of Canada is to promote and support the use of the French ICNP® by French-speaking nursing students, health-care workers and health organizations. This paper presents the different steps performed to achieve validation of the ICNP's French-Canadian version, which is now available for its integration into the electronic health-care records.

**Keywords.** ICNP®, French, Terminology, EHR

## 1. Introduction

Nursing terminologies are offering numerous benefits such as: (1) providing a common language; (2) making it possible to document nursing practice in a standardized way, so it can be understood by all; (3) analyzing links between problems, interventions and outcomes; (4) performing comparisons during research to identify trends; and (5) supporting the computerization of nursing care as nursing classifications are coded (Jetté, 2014). The Canadian Nurses Association (CNA, 2006) supports the use of the International Classification of Nursing Practice (ICNP®). Therefore the mission of the [ICNP Francophone Research and Development Centre of Canada](#) was to promote and support the use of the French ICNP® by French-speaking nursing students, health-care workers and organizations. In this paper, we describe the steps taken to achieve the first goal of the centre to validate the French Canadian translation of the ICNP®. Sharing this kind of experience should be useful for countries preparing to translate the ICNP® English version into their official language (Hou, Chang, Chan & Dykes, 2013).

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## 2. Methods

The French version of the ICNP® terminology was first developed in Switzerland by a team at the University of Lausanne. However, because of important cultural differences, this French version is not entirely suitable for francophone nurses in Canada. To validate the French-Canadian translation of the ICNP®, we were inspired by the Delphi method for obtaining a consensus on each of the language elements. Among those participating in the validation process were university professors and master's students in nursing science. Developing a consensus on these nursing terms entailed using a spreadsheet. When we could not reach a consensus, we undertook further research or gathered information from specialist colleagues in the relevant fields to ensure we used the right vocabulary from each area. In general, we sought consensus and received feedback through e-mail. But when we could not find consensus on specific terms by e-mail, we did so through meetings.

## 3. Results/Discussion

The validation of the French-Canadian for ICNP® versions 3 and 4 are finalized, and has been sent to ICN. It appears to us that the creation of an ICNP Francophone Research and Development Centre of Canada will have significant impact on the use of this terminology in Canada. Future work will therefore focus on the integration of this French-Canadian terminology in information systems and technologies in order to perform research projects on this topic.

## References

- CNA. Nursing information and knowledge management [Position statement]. 2006. Retrieved from [http://cna-aaic.ca/~media/cna/page-content/pdf-fr/nursing-information-and-knowledge-management\\_position-statement.pdf](http://cna-aaic.ca/~media/cna/page-content/pdf-fr/nursing-information-and-knowledge-management_position-statement.pdf)
- I.C. Hou, P. Chang, H.Y. Chan & P.C. Dykes. A modified Delphi translation strategy and challenges of International Classification for Nursing Practice (ICNP®). *International Journal of Medical Informatics*, 82 (2013) 418-26.
- S. Jetté. Dossier clinique informatisé et soins infirmiers. Un rendez-vous manqué? *Perspective Infirmière* 11(5) (2014) 27-30.

# The Construction of a Subset of ICNP® for Patients with Dementia

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**Abstract.** This study identifies concepts for development of an ICNP® catalog for nursing documentation of dementia in nursing homes. A Delphi study and a focus group was used for data collection. A total of 301 concepts were identified and an increased focus on concepts related to basic psychosocial needs was recommended.

**Keywords.** Delphi study, nursing documentation, psychosocial needs, standardised terminology

## 1. Introduction

If the nursing documentation is not accurate and adequate there is an obvious risk to patient safety and well-being and to the continuity of nursing care [1]. Accurate information in the Electronic Healthcare Record (EHR) is important to secure the quality of nursing care for individuals with dementia because they in many cases are unable to communicate their needs [2, 3].

The International Classification of Nursing Practise (ICNP®) is designed to facilitate expression of nursing diagnoses, nursing interventions and patient outcomes. ICNP® 2015 has more than 4000 terms to describe nursing. Development of ICNP® catalogues may support nurses by providing terms that are appropriate for documenting nursing care [4].

## 2. Methods

In accordance with the guidelines adopted by the International Council of Nursing, the study followed the process model for the development of an ICNP® catalog [4].

A modified form of the Delphi method was used to identify appropriate and relevant concepts [5]. A total of six nurses from the healthcare services in the municipality with postgraduate education in geriatric psychiatry and dementia care participated in the Delphi study. The participants described their experiences of nursing documentation in EHRs as on an intermediate or expert level. The participants were asked to rank terms relevant for a subset during two Delphi sessions, with the

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opportunity to present alternative formulations on terms they found suitable for people with dementia or propose new terms that did not exist in the given directory.

For the face-validity of the subset, a focus group interview with six new nurses was conducted. The six focus-group participants had postgraduate education in geriatric psychiatry and dementia care. Their clinical experience was from long-term care of people with dementia mainly from nursing homes. Their experience with documentation in the EHRs was described as intermediate or at the expert level. The transcribed interviews were analyzed using content analysis.

### 3. Results

Terms for an ICNP® catalogue to guide observations and documentation of nursing care for patients with dementia were identified; 77 nursing diagnoses, 78 outcomes and 146 nursing interventions. The study identified that it is important to have specific and adequate concepts in terms of physical needs for people with dementia. However, according to knowledge and theory about nursing care for people with dementia, there should be a greater focus on concepts related to basic psychosocial needs such as identity, comfort, connection, inclusion and engagement.

### 4. Discussion

The identified subset contained a larger portion of terms related to physical needs relative to terms related to psychosocial needs. The results from the focus group interview reported views and experiences about the terms in the identified subset that did not appear in the written feedback from the participants in the Delphi study. The discussion provided important data to clarify the terms perceived as meaningful and relevant to nursing practice. Furthermore the focus group helped to identify relevant differences of opinion about the concepts and expressions.

A limitation is that the relevant terms can have been overlooked initially by the experts. Another limitation might have been that the participants in the Delphi study were not provided the opportunity to explain their opinion and clarify their statements orally. Further research should test and implement the subset for EHRs.

### 5. References

- [1] P. Voutilainen, A. Isola, and S. Muurinen, Nursing documentation in nursing homes – state-of-the-art and implications for quality improvement, *Scand J Caring Sci* **18** (2004), 72-81.
- [2] A-G. Naustdal and G. Netteland, Documentation of health care from an electronic coordination perspective, *Sykepleien Forskning* **7** (2012), 270-277.
- [3] C. While and A. Jocelyn, Observational pain assessment scales for people with dementia: a review, *Br J Community Nurs* **10** (2009), 438-442.
- [4] A. Coenen and T.Y. Kim, Development of terminology subsets using ICNP®, *Int J Med Inform* **79** (2010), 530-538.
- [5] G.J. Skulmoski, F.T. Hartman, and J. Krahn, The Delphi Method for Graduate Research, *JITE* **6** (2007), 1-12.

# Success Criteria for Implementing Standardized Care Plans in Community Health Care

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**Abstract.** Standardized Care Plans (SCPs) based on ICNP® are currently being piloted in the community health care setting in four Norwegian municipalities. The goal is that SCPs will improve the quality of nursing documentation, and that they will contribute to improved continuity of care and thereby increased patient safety. We are studying the implementation process of the SCPs, and will report on success criteria for them to become an integral part of everyday nursing documentation in community health care.

**Keywords.** Community health care, ICNP, Standardized terminology, Electronic Health Records,

## 1. Introduction

Nursing documentation in Norwegian community health care has been found to be incomplete or lacking important information elements [1]. Nursing documentation of high quality is a prerequisite for continuity of care, which generally is a challenge in community health care [2]. SCPs are seen as tools for improving nursing documentation. The SCPs that are being piloted in Norway are based on ICNP, a terminology developed specifically for nursing practice. ICNP has never before been used in Norway, and SCPs in general have rarely been used in community health care. Thus, we are studying the implementation process carefully to find the success criteria of what it takes for SCPs to be taken into use and being seen as useful.

## 2. Methods

The ICNP terminology has been translated into Norwegian, and is yet to be taken into use. The Norwegian Nurses Organization has to date developed five SCPs based on ICNP terminology that are to be piloted in the community health care setting. Our study is using a qualitative approach, combining observations and interviews to answer the research questions.

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### 3. Results

Preliminary observations show several tendencies that could be of importance to the results. Firstly, the nursing leaders from the four included municipalities show great enthusiasm about the SCPs. Secondly, within the nursing group, there is an expressed acknowledgement of the need for improving nursing documentation. These are factors that most likely will affect nurses' motivation for using the SCPs.

### 4. Discussion

The quality of nursing documentation will never exceed the knowledge and expertise of the provider writing it. SCPs can, if used correctly, contribute to an improvement of nursing documentation [3]. However, individualization of the SCPs is pivotal for knowing what to do at point-of-care and when. Hence, for SCPs to be successfully integrated into nursing practice and become useful tools, nurses need to actually use them, and use them correctly. Involvement, encouragement and positive attitude from leaders is a factor well known to have a positive effect on use [4]. Based on this, one can assume that the implementation process in community health care will be likely to succeed. However, this will be explored in further studies.

### 5. Acknowledgments

We would like to thank the Norwegian Nurses Organization for funding this research.

### References

- [1] E. Gjevjon, R. Hellesø. The quality of home care nurses' documentation in new electronic patient records. *Journal of Clinical Nursing* **19** (2010), 100-8.
- [2] E. Gjevjon, K.H. Eika, T.I. Romøren, B.F. Landmark. Measuring interpersonal continuity in high-frequency home healthcare services. *Journal of Advanced Nursing* **70** (2013) 3, 553-63.
- [3] A. Thoroddsen, M. Ehnfors, A. Ehrenberg. Content and Completeness of Care Plans After Implementation of Standardized Nursing Terminologies and Computerized Records. *CIN: Computers, Informatics, Nursing* **29** (2011) 10, 599-607.
- [4] V. Venkatesh, M.G. Morris, G.B. Davis, F.D. Davis. User acceptance of information technology: Toward a unified view. *MIS quarterly* **27** (2003) 3.

# Proposal for Inclusion of New Terms for Submission to the ICNP<sup>®</sup>

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**Abstract.** The present study aims to validate 15 terms and definitions for submission to the International Classification for Nursing Practice ICNP<sup>®</sup>. The terms were extracted from 148,299 narratives of the evolution of nursing care, free texts from Electronic Health Records, in a Brazilian university hospital. These terms were mapped with ICNP<sup>®</sup> 2013 for identifying differences, similarities and nonexistent terms. Definitions were made for the 15 most frequent nonexistent terms. Five Brazilian experts evaluated the settings through the Content Validity Index (CVI). Validation by 68 clinical practice experts is in progress. 2,638 different terms have been identified. After mapping and analysis, 15 terms were selected. Despite the importance of experts' assessment, the terminology is used by nurses in their daily practice. The classification of concepts is essential for the development of standards for Electronic Health Records.

**Keywords.** Terminology; Electronic Health Records; Classification; Validation studies as Topic; Nursing Diagnosis.

## 1. Introduction

The present study is aimed to report the ongoing research on a proposal for updating terms of the International Classification for Nursing Practice – ICNP<sup>®</sup>. The study is currently at the stage of validation of new terms identified by experts in clinical practice. The use of standardized and validated clinical terminology facilitates the inclusion of care patterns in Electronic Patient Records (EPR).

## 2. Methods

Identification was performed based on 148,299 clinical field narratives of the evolution of nursing care in Electronic Patient Records (EPR) of a university hospital of Southern Brazil in the 2010-2012 period. With the use of Poronto<sup>(1)</sup>, a software for semi-automatic construction of ontologies in Portuguese, 257,893 terms were extracted.

The identified terms were mapped using the 2013 version of the ICNP<sup>®</sup>, and 15 nonexistent terms were selected for definition and analysis. ISO-18104<sup>(2)</sup> and the principles of terminology of Pavel and Nolet<sup>(3)</sup> guided the construction of terms.

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The terms and definitions were subjected to five Brazilian experts in ICNP®. They were intentionally selected from scientific publications related to the area. Data assessment was based on the content validity index (CVI)<sup>(4)</sup>, which was separately calculated for each item<sup>(5)</sup>. The definitions were considered valid when a CVI score > 0.80 was obtained between the experts.

Subsequently, the defined terms were arranged according to the 7-axis model of the ICNP®. The research is currently being validated by 68 clinical practice specialist nurses from two Brazilian university hospitals.

### 3. Results

Based on the EPRs, 2,638 words were identified; of these, after mapping, 2,249 different terms were obtained. Also, 366 identical terms, 622 similar terms and 443 terms present in the definition of other terms of the ICNP®.

After analysis of the terms not present in the ICNP®, 63 new terms were identified. Of these, the 15 most frequent nonexistent terms were selected, according to experts' analysis: Agony, Now, Ampoule, Anasarca, Baby crib, Cervical collar, Concussion, Bruise, Empty, Stretcher, Fowler position, Speech therapy service, Pull, Surgery unit, Via cystostomy.

### 4. Discussion

In the classification of a new term and its respective definition, it is necessary to check for possible similarities with current ICNP® terms in order to avoid duplication. This process requires knowledge of the different versions and hierarchical construction of the classification.

Despite the importance of validation of new terms by ICNP® experts, these terms will be used by nurses in their daily clinical practice. Therefore, their participation in the process of validation of new terms is critical.

One limitation of this study is related to the characteristics of the hospital, which led to the identification of terms associated to orthopedics.

### References

- [1] F.M. Zahra, D.R. Carvalho, A. Malucelli, Poronto: ferramenta para construção semiautomática de ontologias em português, *J. Health Inform* 5 (2013), 52-59.
- [2] ISO 18104, International Standard. Health informatics – Categorical structures for representation of nursing diagnoses and nursing actions in terminological systems, Geneva (Switzerland), 2009.
- [3] S. Pavel, D. Nolet, *Manual de Terminologia*. Tradução de Enilde Faulstich, 2002.
- [4] N.M.C. Alexandre, M.Z.O. Coluci, Content validity in the development and adaptation processes of measurement instruments. *Cienc Saude Colet*. 16 (2011), 3061-68.
- [5] D.F. Polit, C.T. Beck, The content validity index: are you sure you know what's being reported? Critique and recommendations. *Res Nurs Health*. 29 (2006), 489-497.

# Analysis the Nursing Documentation of the Observation Plans and Practices of Breast Cancer Using Nursing NAVI® Contents

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**Abstract.** We analyzed in nursing observation planning and practices circumstances of a breast cancer patient using the Nursing NAVI® Contents. The result of this analyzed were clearly that the master plan item was satisfying a vital signature, so it could be practiced 100 %. But even if the observation item of in-out balance were not records so the implementation rate of the 50 %, comparison with the Nursing NAVI® Contents. About the item esteemed as required item, like, the thing with the low observation implementation rate became clear. We found that problem about estrangement of the difference between the planning the observation drafting and the implementation. The implementation item can see a little tendency much, and later, the plan item will be also a problem about the current state to which the necessary item is inferior.

**Keywords.** Nursing informatics, Structured knowledge, thinking process, Professional judgment, Nursing documentation

## 1. Introduction

We have developed a tool named the “Nursing NAVI®”, including the items for nursing observation and nursing action.<sup>1)~3)</sup>

We analyzed the Nursing documentation of the Observation plans and practice records of Breast Cancer compared with “Nursing NAVI®”

## 2. Methods

We had selected the 2 cases documentation that included the care plans and the practices in all hospitalization period. And analyzed the Nursing documentation of the Observation plans and practice records with “Nursing NAVI®”.

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### 3. Results

Almost the observation plans were planning, but the practice record were not found. So the vital sign items consistent with the “Nursing NAVI®”. But the in-out balance records were not found ; accordingly only the planning.

On the other hand, the signs and symptoms were not planning, so only 37% compared with “Nursing NAVI®”.

### 4. Discussion

We think it's affected by 2 reasons. It isn't recorded about the item which has no abnormality. It was found that the observed records were limited compared with “Nursing NAVI®”.

On the other hand the numbers of items were added, so that means, nurses add the new observation items along the new guidelines. We have to keep probing to reflect the latest current state.

### 5. Acknowledgments

We found that problem about estrangement of the difference between the planning the observation drafting and the implementation. The implementation item can see a little tendency much, and later, the plan item will be also a problem about the current state to which the necessary item is inferior.

### References

- [1] Tsuru S, Nakanishi M, Ohta K, et al. The problem of nursing common language for the information sharing in clinical practice: The fact-finding in regard to the correspondence between name and contents of nursing action. *Japan J Med Informatics*. 2002; 22 (1): 59-70.
- [2] S. Tsuru, F. Wako, M. Inoue, et al. Issues in terminology for describing nursing practice in Japan: Development of standardized terminology for nursing observation and action. *Proc. of the AMIA 2012 11th International Congress on Nursing Informatics (2012)*, 665
- [3] The navigator for thinking process in nursing, (eds.) Tsuru S, Watanabe C. 2011. Japan Standard Association, Tokyo, [in Japanese]

# Development and Evaluation of a Low Fertility Ontology for Analyzing Social Data in Korea

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**Abstract.** The purpose of this study is to develop a low fertility ontology for collecting and analyzing social data. A low fertility ontology was developed according to Ontology Development 101 and formally represented using Protégé. The content coverage of the ontology was evaluated using 1,387 narratives posted by the public and 63 narratives posted by public servants. Six super-classes of the ontology were developed based on Bronfenbrenner's ecological system theory with an individual in the center and environmental systems impacting their surroundings. In total, 568 unique concepts were extracted from the narratives. Out of these concepts, 424(74.6%) concepts were lexically or semantically mapped, 67(11.8%) were either broadly or narrowly mapped to the ontology concepts. Remaining 77(13.6%) concepts were not mapped to any of the ontology concepts. This ontology can be used as a framework to understand low fertility problems using social data in Korea.

**Keywords.** low fertility population, low fertility ontology, ontology, social media

## 1. Introduction

The purpose of this study is to develop a low fertility ontology for collecting and analyzing social media data to understand low fertility problems in Korea.

## 2. Methods

A low fertility ontology was developed according to Ontology Development 101 [1]. We extracted terms from government policy, policy related research papers, scientific literatures and postings on social media on low fertility. We used a top-down approach using an individual and their surroundings in Bronfenbrenner's ecological system theory as top classes. Then we further specified sub-classes under these top classes. The ontology was formally represented using Protégé.

The content coverage of the ontology was evaluated using 1,387 narratives posted by the public and 63 narratives posted by public servants on the Ministry of Health and

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Welfare Website. We extracted key concepts from the narratives using natural language program (NLP) in R. Extracted concepts were mapped to the ontology concepts by the authors and then validated by a third ontology expert.

### 3. Results

In total, 2,681 terms were extracted from government policy, policy related research papers, scientific literatures and postings on social media. They included 165 entity concepts and 77 synonyms, 418 attribute concepts and 219 synonyms, 1,288 value concepts and 514 synonyms. Six super-classes of the ontology were developed using an individual and their surroundings in Bronfenbrenner's ecological model. They are 'Individual', 'Family', 'Workplace', 'Childcare and Education', 'Policy', and 'Sociocultural Environment'. Figure 1 shows these six super-classes and their relationships formally represented in Protégé.

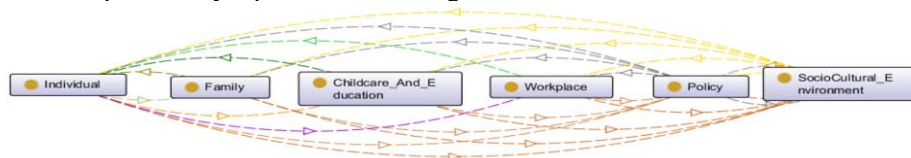


Figure 1. Six Super-classes and Their Relationships of the Ontology

For the content coverage of the ontology, 473 unique concepts were extracted from the public's postings and 95 from the public servants' postings. Out of these 568 concepts, 424(74.6%) concepts were lexically or semantically mapped, and 67(11.8%) concepts either broadly or narrowly mapped to the ontology concepts. Remaining 77(13.6%) concepts were not mapped to any of the ontology concepts.

### 4. Discussion

A low fertility ontology based on an ecological model was developed in this study. The concepts in our ontology could represent most of terms extracted from the narratives on low fertility posted by the public and public servants. This ontology can be used as a framework to understand low fertility problems using social data in Korea from the individual's perspective and the policy makers' perspective.

### 5. Acknowledgments

This research was supported by the National Research Foundation of Korea (NRF) funded by the Korea government (MSIP) (No. 2010-0028631 and NRF-2015R1A2A2A01008207).

### 6. References

- [1] N.F.Noy, D.L.McGuinness. Ontology Development 101: A Guide to Creating Your First Ontology. Stanford Knowledge Systems Laboratory Technical Report. 2001

# Mapping Wound Assessment Data Elements in SNOMED CT

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**Abstract.** The use of standardized terminologies is an essential component to support interoperability in electronic health records. In British Columbia, Canada, a commonly used nursing wound assessment template was mapped to SNOMED CT. Preliminary results have found that 50.8% of the wound assessment data elements had direct matches to concepts within SNOMED CT. Results of this mapping activity have produced a set of mapped wound assessment parameters to SNOMED CT.

**Keywords.** Standardized Terminology, SNOMED CT, Wound Assessment

## 1. Introduction

The use of standardized terminologies is an essential component to support interoperability between disparate electronic health records (EHRs) [1]. In British Columbia, Canada, nurses in all provincial health authority hospitals, community care units, and residential care facilities use the same wound assessment template. However, this wound assessment is not being shared between different EHRs. As a measure to support our provincial health authority to move forward with interoperable solutions, work has begun to map this wound assessment template to the Systematized Nomenclature of Medicine – Clinical Terms (SNOMED CT). The purpose of this poster is to present the mapping activity of wound assessment data elements to SNOMED CT.

## 2. Methods

Access to SNOMED CT, through the browser CliniClue® Xplore (January 2015 edition), was made available through membership from Canada Health Infoway. Using this browser, 116 wound assessment data elements were mapped to SNOMED CT. Matches were determined on the criteria of direct match (pre-coordinated), one-to-many, no match, or vague data element [2]. These 116 data elements will also be compared for rate of equivalence, to the 419 skin inspection, wound assessment and pressure ulcer assessment data elements mapped to SNOMED CT and Logical Observations Identifiers Names and Codes (LOINC) completed by Harris et al. [3]. Once completed, the results of these 116 mapped data elements will be validated by a

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second wound care clinician for agreement of clinical mapping and concept interpretation.

### 3. Results

Preliminary results have indicated that 59 data elements have direct matches (50.8%); 8 data elements have one-to-many matches; 34 data elements have no matches, and 15 data elements were considered to be too vague to make a match to a SNOMED CT concept. The next phase will include comparison to an existing mapped wound assessment data set, as well as, validation of mapping results by a second wound care clinician. Final results will be re-evaluated based on this further analysis.

### 4. Discussion

This mapping activity will produce a set of wound assessment data elements that have been mapped to SNOMED CT. This mapping activity may also indicate nursing wound assessment concepts missing within the SNOMED CT database.

Finally, this analysis will inform the next stage of work planned by the first author; that of mapping further nursing wound assessment data elements to standardized clinical terminologies (i.e.: lower leg and ostomy assessment). This future work will consider the advantages and challenges clinical terminologies possess for nursing care concepts, as well, provide recommendations to health care organizations navigating this reality.

### 5. Acknowledgments

Support and guidance of this mapping activity was given by Dr. Leanne Currie, Professor at the University of British Columbia, School of Nursing.

### References

- [1] T. Y. Kim & S. A. Matney, Standards. In Nelson, R., & Stagger, N. (eds). *Health informatics: An interprofessional approach* Elsevier Mosby, St. Louis Missouri (2014), 351-396.
- [2] T. Y. Kim, N. Hardiker, A. Coenen, Inter-terminology mapping of nursing problems, *Journal of Biomedical Informatics* **49** (2014), 213-220.
- [3] M. R. Harris, L. Heermann Langford, H. Miller, M. Hook, P. Dykes, & S. Matney, Harmonizing and extending standards from a domain-specific and bottom-up approach: an example from development through use in clinical applications, *Journal of American Medical Informatics Association* **22** (2015), 545-552.

# Lightweight Expression of Granular Objects (LEGO) Content Modeling Using the SNOMED CT Observables Model to Represent Nursing Assessment Data

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*Apelon, Inc.*

**Abstract.** This poster presentation presents a content modeling strategy using the SNOMED CT Observable Model to represent large amounts of detailed clinical data in a consistent and computable manner that can support multiple use cases. Lightweight Expression of Granular Objects (LEGOs) represent question/answer pairs on clinical data collection forms, where a question is modeled by a (usually) post-coordinated SNOMED CT expression. LEGOs transform electronic patient data into a normalized consumable, which means that the expressions can be treated as extensions of the SNOMED CT hierarchies for the purpose of performing subsumption queries and other analytics. Utilizing the LEGO approach for modeling clinical data obtained from a nursing admission assessment provides a foundation for data exchange across disparate information systems and software applications. Clinical data exchange of computable LEGO patient information enables the development of more refined data analytics, data storage and clinical decision support.

**Keywords.** Electronic clinical data, nursing assessment, lightweight expressions of granular objects, observables model, content modeling

## 1. Introduction

Electronic clinical data gathered from nursing admission assessments provide the most essential information needed to commence the discharge planning process and provide the foundation for the delivery of patient-family centered care. The LEGO modeling approach has been used to represent data elements typically included within a nursing admission assessment. Lightweight Expression of Granular Objects (LEGO) is a strategy to capture complex clinical statements by combining small information units based on standard terminologies. LEGOs are thus conceptually similar to Lego® building blocks, in that small standardized pieces can be combined to create large, complex structures. Although many standard terminologies exist, LEGOs rely heavily on SNOMED CT, which is emerging as the de facto standard for structured clinical documentation because of its wide domain coverage and formal semantic structure. The use of SNOMED CT exploits the integration of several American Nurse Association (ANA) recognized nursing terminologies<sup>1</sup>.

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## 2. Methods

Apelon developed a comprehensive LEGO Modeling Style Guide by applying the Understandable, Reproducible, Useful (URU) principle, which explains the LEGO framework in detail and current thinking (based on discussions with the IHTSDO Observables Project Group and the VA) on how to apply the Observables Model to questions on clinical data collection forms. A repeatable process for modeling LEGOs was developed to represent clinical concepts in order to ensure a consistent approach.

Apelon also created a specialized software tool, the LEGO Editor, in close conjunction with clinical and informatics stakeholders. Although the tool has not been formally evaluated, anecdotal evidence from users indicates that it has improved both the productivity and the consistency of modeling work as compared to prior, manual methods.

## 3. Results

The more than 9000 LEGOs created to date demonstrate the feasibility of using the Observables Model to represent “presence observables,” which commonly appear on clinical data collection forms as questions asking whether a particular condition is observed to be present or absent in a patient.

## 4. Discussion

The number of LEGOs completed to date and the breadth of subject areas modeled demonstrate the feasibility of using this framework. While other clinical content modeling efforts have been undertaken, none follows the formal semantics of SNOMED CT as closely as LEGOs. This semantic infrastructure offers a greater likelihood of achieving true semantic interoperability. It is clearly possible to model items on electronic data collection forms, such as nursing admission assessment forms, as SNOMED CT expressions within a larger framework intended to support refined data analytics, data storage and clinical decision support.

## 5. Acknowledgments

The first phase of the LEGO Project was supported under contract VA701-14-J-0173 from the United States Department of Veterans Affairs.

## References

- [1] C. Lundberg, J. Warren, J. Brokel, G. Bulechek, H. Butcher, J.M Dochterman, M. Johnson, M. Mass, K. Martin, S. Moorhead, C. Spisla, E. Swanson, & S. Giarrizzo-Wilson. (June, 2008). Selecting a Standardized Terminology for the Electronic Health Record that Reveals the Impact of Nursing on Patient Care. *Online Journal of Nursing Informatics (OJNI)*, 12, (2). Available at [http://www.ojni.org/12\\_2/lundberg.pdf](http://www.ojni.org/12_2/lundberg.pdf)

# Implementation of Improvements in an Electronic Documentation Nursing Process System Structured on NANDA -I, NOC and NIC (NNN) Classification

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**Abstract.** The aim of this study was to present the experience of a teaching hospital with the implementation of improvements to an electronic documentation system of the nursing process (PROCEnf-USP®). The improvements were based on functional performance and technical quality of the system. It was adopted Scrum™ method for version control PROCEnf-USP® by enabling agility, flexibility and possibility of integration between development and users. The PROCEnf-USP® has been used since 2009 and has professional and academic environments. The current version lets you generate reports and supports decisions about diagnoses, outcomes and interventions. It is provided the use of indicators to monitor results and registration at the point of care. The establishment of important.

**Keywords.** Nursing Information Systems; Information Systems; Nursing Diagnoses, Classification System; Nursing Process.

## 1. Introduction

Classification systems are instruments to improve the reliability, validity and usability of the nursing documentation<sup>1</sup> The implementation of the NNN linkages (classifications of nursing diagnoses, outcomes and interventions) in electronic nursing documentation systems encourages nurses to adopt the nursing process and improves both diagnostic accuracy and, therefore, patient outcomes.<sup>2</sup> The aim of this study was to present the experience of a teaching hospital with the implementation of improvements to an electronic documentation system of the nursing process (PROCEnf-USP®).

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## 2. Methods

The improvements were based on functional performance and technical quality of the system. It was adopted Scrum™ method for version control PROCenf-USP® by enabling agility, flexibility and possibility of integration between development and users.

## 3. Results

The PROCenf-USP® has been used since 2009 and has professional and academic environments. The current version (Figure 1) lets nurses and students generate reports and supports decisions about diagnoses, outcomes and interventions. It is provided the use of indicators to monitor results and registration at the point of care. The system performance improvement is the ergonomics for users.

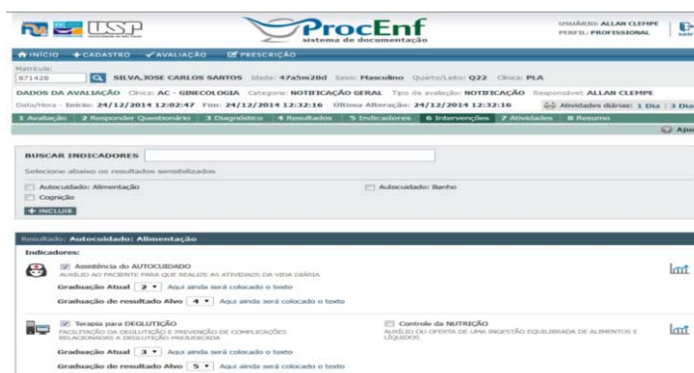


Figure 1. PROCenf-USP® - Current version of the system

## 4. Conclusion

The establishment of continuous improvement through evaluation, monitoring, updating and testing is important for improvement the ergonomic of the electronic documentation system of the nursing process.

## References

- [1] F.O.M. Maia, D.C.F. Ortiz, N. B. Oliveira, M.M. Trinity, A. V. S. Gomes, C. A. M. Pimenta. *Computerized system to support diagnostic decision : the experience of the University Hospital of the University of São Paulo*. In: Herdman TH , Lopes MVO , Almeida MA, Chianca TCM. *PRONANDA* . 2nd Cycle . Porto Alegre : Artmed , 2014 .
- [2] M. Johnson, et al. *Ligações NANDA, NOC, NIC: condições clínicas: suporte ao raciocínio e assistência de qualidade*. Rio de Janeiro: Elsevier, 2012.

# Developing Standardized Physiologic Assessments

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**Abstract.** A terminology for nursing assessments does not exist to support exchange of information and research. A team of nurse informaticists collaborated to create a standard for medical/ surgical assessment terms coded in LOINC and SNOMED CT. Nursing assessments represented 106 observation (50% new LOINC), and 348 Values (20% New SNOMED CT) organized into fifteen panels (86% new LOINC).

**Keywords.** Assessment, LOINC, SNOMED CT, Medical/Surgical Nursing, Nursing Informatics

## 1. Introduction

Terminology standardization is key to sharable comparable data. Recently, the American Nurses Association released a position statement stating The American Nurses Association (ANA) released a position statement recommending that “when exchanging a C-CDA with another setting for problems and care plans, SNOMED CT® and LOINC® should be used for exchange.”<sup>1</sup> This poster illustrates the standardization of medical surgical assessment using LOINC and SNOMED CT.

## 2. Methods

A team of nurse informaticists organized through the University of Minnesota Big Data Conference collected medical/surgical nursing assessments from six large organizations. The data were analyzed to identify common observations between all institutions. The answers (values) for each observation were harmonized. LOINC panels and observations, and SNOMED CT values were mapped and new codes submitted when needed.

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### 3. Results

The standardized nursing assessments represented 106 observations (50% new LOINC), and 348 Values (20% new SNOMED CT) organized into 15 panels (86% new LOINC). Missing LOINC and SNOMED CT content were submitted for inclusion in future updates. Some of the assessment panels included subpanels (indicated in Figure 1).

Missing SNOMED CT content was submitted to the U.S. SNOMED CT® Content Request System. For each of the major panels, a LOINC “impression” code was created for documentation of nursing judgments using “Within Defined Limits”.

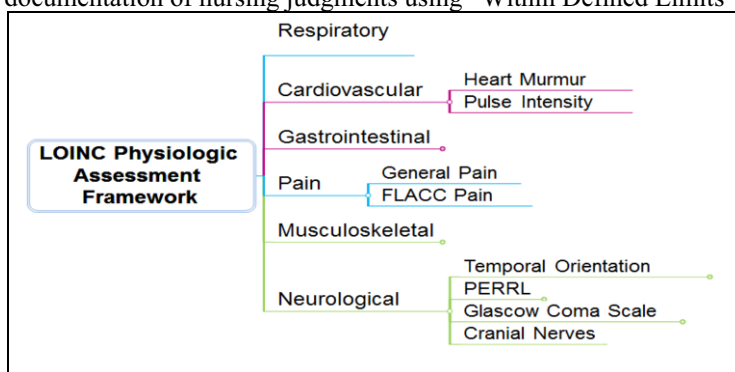


Figure 1: LOINC physiologic assessment framework.

### 4. Discussion

This project is the first phase for standardization of nursing assessments and working through the standards development process from a bottom-up perspective. The results are intended to be only a minimum set of medical/surgical assessments and much work is yet to be done before complete interoperability can be achieved.

### 5. Acknowledgments

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### References

- [1] American Nurses Association. Inclusion of Recognized Terminologies within EHRs and other Health Information Technology Solutions. American Nurses Publishing, Washington, D.C.; 2015; Available from: <http://www.nursingworld.org/MainMenuCategories/Policy-Advocacy/Positions-and-Resolutions/ANAPositionStatements/Position-Statements-Alphabetically/Inclusion-of-Recognized-Terminologies-within-EHRs.html>.

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## Subject Index

7 E's	188	assistive technology	567
a learning program	965	atrial fibrillation	153
ability training	208	attitudes	881
academia	774	Austria	806
acceptance	78	basic nursing education	965, 973
acceptance model	118	basic nursing skills	1055
access log	858	basic principles of nursing care	476
accident prevention	800	beacons	658
accidental falls	800	benefits realization	88
active aging	721	best practice(s)	18, 680
active learning	319	bibliometric mapping	950
activity monitoring	663	big data	63, 222, 417, 607, 675, 753, 753, 975
adaptive practice	417	big data analysis	68
ADDIE model	969	big data science	123
adherence	856	biomarker discovery	387
adolescents' depression	442	biometric attendance	68
adoption	88, 795, 903	blended study	1055
advanced nurse practitioner	193	blogging	572
advanced practice nursing	302	blood transfusion	844
advancing dementia	545	bluetooth low energy	658
adverse drug reaction	808	bone health	193
adverse event	840	brain wave	917
Africa	1013	burden	854
age	832	business education	282
aged	28, 724	business model	1047
aging	780	call center	113, 866
aging in place	486	cancer care	930
AHRQ Common Formats	452	cancer care plan	921
alert system	852	capacity building	1013
allergy	808	cardiovascular biomarker	1053
alpha wave band content	917	cardiovascular disease	1030, 1036
Alzheimer's disease	1028	cardiovascular risk	1001
ambient assisted living (AAL)	213, 422, 919	care	705
anger	1001	care coordination	232, 505, 765
app quality	1040	care management	505
application	1030, 1036	care transition	359
app(s)	481, 587, 1024, 1032	caregiver burden	919
Arabic	587	caring interactions	932
ARCS model	913	case-based	540
assertiveness	1057	catheter management	952
assessment	919, 1084	CCDSS	53
assisted living	721	CDSS	952

certification	738, 746	co-production	334, 1028
certified nurse	999	cognitive artifacts	641
chart review	915	cognitive testing function	1045
chemotherapy	232	cohort discovery	387
chemotherapy medication	840	collaboration	744, 1057
child	971	collaborative	1051
child abuse	826	collaborative research	545
chronic disease(s)	108, 505, 515, 577, 879, 1032	colorectal cancer	387
chronic kidney disease	1047	common data model	63
chronic pain	577	communicable disease(s)	680, 991
classification	553, 806, 1072	communication robot	913
classification system	1082	community assessment	635, 983, 1062
clicker	319	community health care	1070
clinical care classification (CCC)	13, 471, 850, 1064	community health nursing	905
clinical care classification system	13, 748	community planning	1020
clinical competence	697	community-based interventions	768
clinical dashboard	364	competency(ies)	43, 203, 292, 307, 329, 705, 707, 762, 774, 1009
clinical data model	407	competency based education	302
clinical decision support	18, 53, 765	competency skills self-assessment	43
clinical decision support systems	364, 812, 1064	complexity	38
clinical dilemma	615	composite pictograms	397
clinical education	334	computer literacy	817
clinical information system(s)	28, 88, 118, 724, 877	computer science education	324
clinical information systems success model	846	computer simulation	905
clinical intelligence	417	computer use	817
clinical IT	798	computerized decision support	98
clinical nursing information system	1064	concept analysis	625
clinical nursing records	437	concerns	1003
clinical paths	1058	conflict management	1009
clinical practice	1024	confusion assessment model for intensive care unit	668
clinical protocols	592	connected health	307, 602
clinical simulation	38, 247	connectivism	282
clinical skills	979	consensus validation	810
clinicians	762	consumer	1043
cloud	834, 836	consumer behavior	535
cloud-based medical service	623	consumer engagement	183
cluster analysis	382	consumer health	610
co-creation	334, 545, 963, 1028	consumer health informatics	582, 602
co-design	334, 963, 1028	consumer informatics	631
co-medical staff	1057	consumer participation	198
co-operation	950	contact nurse	921
		content mining	925
		content modeling	1080
		context	392
		continuing education	678

continuing health education	1009	deployment	277
continuing professional		design	796, 995
development	267	detailed clinical models	367
continuity care	13	developing countries	1003
continuity of care	713	diabetes	530, 587, 597, 607
continuity of patient care	198	diagnosis related groups	402
contribution	163	diagnostic test study	668
COPD consultation	883, 885	diffusion of innovation	981
COPD patient	926	digital game	1026
correlation coefficient	917	digital health	412, 610, 771, 971, 1013
CPOE	73, 903	digital health literacy	237
creation format	645	digital patient modelling	562
critical information	359	digital story	965
cross-sectional study	515	discharge	349
cross-sectional survey	889	display methods	967
cultural diversity	881	distance based education	989
curriculum	242, 329, 729, 783	distance education	987, 1009
curriculum design	344	doctor of nursing practice (DNP)	750
curriculum development	329	doctor-patient relationship	627
customer-oriented approach	942	document review	163
daily-living settings	392	documentation	461, 748, 796, 1022
data analysis	387, 727	donation	1015
data collection	727, 806	dysphagia	619
data discoverability	447	e-documentation	879
data exchange	437	e-geoplatform	791, 907
data integration	387	e-learning	619, 645
data mining	128, 461, 675, 856, 930	e-patients	627
data modeling	447	ECG	1018
data quality	452	education	203, 252, 302, 307, 329, 339, 705, 715, 762, 774, 791, 832, 905, 907, 975, 1024
data science	753, 753	eHealth	168, 193, 203, 242, 307, 582, 631, 700, 707, 721, 738, 768, 777, 923, 930, 934, 946, 950, 954, 971, 1013
data standardization	447	eHealth literacy	237, 895, 899
data visualization	732	eHealth service	942
data warehousing	727	eHealth strategy	163
decision literacy	1015	eHealth systems	227
decision making support system	887	elderly	178
decision support	540, 562, 810, 830, 844, 1015	electric medical records	858
decision support system	558, 909	electric textbooks	1038
decision-making	791, 864, 907	electronic clinical data	1080
deglutition disorders	1058	electronic documentation	13
delivery of nursing care	103	electronic health information	
Delphi study	1068	systems	417
Delphi technique	997		
dementia	1028, 1045		
dementia care	567		
dementia caregiver	1045		
dementia caregiving	925		

electronic health records		evidence based nursing	
(EHRs)	18, 133, 143, 168, 349, 367, 427, 457, 471, 476, 495, 641, 700, 735, 750, 756, 795, 800, 802, 870, 879, 956, 985, 1003, 1066, 1070, 1072	procedures	756
electronic health record system	808	evidence-based care standards	887
electronic health report	810	evidence-based nursing	302
electronic healthcare record	842	evidence-based	
electronic medical		practice	23, 417, 686, 979, 1064
record(s)	828, 877, 1005	exchange of information	349
electronic messages	367	exercise	545, 1032
electronic nursing discharge		eye tracking	525
summary	819	Facebook	621
electronic nursing		Facebook for research	613
documentation	1005	factor analysis	710
electronic nursing		fall(s)	48, 193, 637, 639, 828
record(s)	133, 637, 639	fall prevention guidelines	637, 639
electronic patient record	349	fall risk	639
electronic patient records		fall risk factors	637
system	402, 967	family care	567
electronic prescribing	812	fatigue	372
elements	796	feature selection	553
emergency	826	Finnish Care Classification	
emergency department	53, 875	system (FinCC)	466
emergency medicine	535	first operation	824
emergency nurse coordinator	875	FITT-model	819
emergency nursing	893	flipped classroom	208
emergency outpatient unit	520	focus group discussion	997
emergency room	138	focus group interviews	218, 802
EMR	1018, 1042	force sensing insole	663
end-user design	481, 692, 963	French	1066
engagement	932, 1028	funding	950
eNursing	928	future	771
ePatients	237	future trends	123, 222
epidemiological surveillance	991	fuzzy logic	897
epidemiology	319	gamification	262, 605, 658
ePrescribing	73	Geneva	700
ER length of stay	138	genomics	686
ergonomics	247	geo-spatial science	983
errors	868	geographic information system	983
essentials	252	geomatics	791, 907
ethics	738, 540, 718, 750, 1015	geriatric nursing	721
evaluation	88, 247, 466, 842, 897	gerontotechnology	213
evaluation of care data	402	Glasgow coma outcome scale	866
evaluation study(ies)	28, 83, 118	goal-based scenario theory	1055
evidence	476	governance	277
evidence based nursing care	466	Great East Japan Earthquake	1060
		guideline adherence	520
		guidelines	617
		handoff	641
		harmonization	744
		HCV	267



head Injury	113, 866	HL7	427
head nurse	993	HL7 CDA	928
health analytics	138	HL7 v3	367
health and nursing informatics	703	home context	173
health care	262, 868	home health care	724
health care research	613	home-ventilation	928
health care/standards	367	homecare	28, 359, 372
health coach	1034	HONcode	718
health data	382	hospital	218, 349, 944, 995
health disparities	732	hospital acquired infections	658
health education	500, 697, 956, 991	hospital hygiene	658
health informatics	203, 587, 985	hospital information	
health informatics education	750	systems	78, 558, 654, 822
health information		housing and daily activities	213
exchange	735, 1003	human factors	535, 689
health information		human needs	476
system(s)	103, 783, 795	human papillomavirus	432
health information system		humanoid robot	422
implementation		ICF	1016
health information		ICN	683
technology	38, 83, 163, 314, 158, 354, 718, 735, 738, 780, 1003	ICNF	1016
health literacy	397, 895	ICNP	928, 1070
health pictograms	397	ICNP®	437, 1066
health policy	753	ICT	178, 705, 783
health professionals	903	ICT tool	58
health promoting behaviors	1043	ICU delirium	668
health promotion	193	identification of outliers	402
health promotion/disease		IHCA	862
prevention	1034	immunizations	680
health related quality of life	926	implementation	88, 218, 903, 971
health strategy	183	improved ability to use nursing	
health systems	735	information	993
healthcare	786, 1018	improving performance	138
development	227	in-situ	247, 689
healthcare applications	587	incident reporting system	452
healthcare delivery	113, 866	incident reports	860
healthcare information system	897	industry	774
healthcare providers	267	inertial measurement unit	663
healthcare staff	923	infection control	852
healthy ageing	193	informal carers	919
healthy aging	954	informatics	43, 292, 382, 697, 762, 786, 873, 938, 1007
heart failure	143, 856, 1026	Informatics competency(ies)	123, 222, 412, 710, 848
heart team	98	informatics/computerized	
heuristic evaluation	530	technology systems	997
history project	873	information	23, 832
HIV	267, 481	information and communication	
		technology(ies)	868, 932, 934

information flow	359	knowledge transfer	287, 377
information literacy	178, 297, 324, 1007	knowledgebase	432
information need(s)	724, 864	labor	977
information platform	956	laboratory	247
information privacy	718, 967	leadership	715, 774, 1009
information resourcing	975	leadership vision	957
information retrieval	33	learning	287, 377
information seeking	23	learning and teaching	277
information sharing	168	learning motivation	913
information system(s)	8, 826, 862, 1082	learning objects	991
information systems success		learning strategy	973
model	860	learning support	525
information technology(ies)	173, 643, 802, 881	learning tool	995
innovation	73, 218, 762	lessons learned	158
innovativeness	881	lightweight expressions	
inpatient care	287, 377	of granular objects	1080
inpatient setting	828	LillyPad	372
instant feedback	798	liver transplantation	382
instant messaging system	804	logistic regression	143
instruction design	319	LOINC	928, 1084
integration into EHR	686	long-term care	108
integrity	830	longitudinal study	349
intensive care units	836	low fertility ontology	1076
interactive patient engagement	631	low fertility population	1076
interactive systems	83	low-cost	372
interface	798	m-learning	619
international classification		Malawi	1013
for nursing practice	471	management information systems	3
international council of nurses	476	management of treatment	
international partnership	1013	regimen	407
international survey	938	manual health records	1003
internet	607, 895, 899	mapping	744, 1016
internet groups	597	mapping of the health	
internet use	178	professional	997
interoperability	683, 1020	medical care	8
interprofessional	242, 979	medical centers	623
interrupted time-series	53	medical device	840
intervention	954	medical informatics	98, 213, 520
intravenous injection(s)	525, 812	medical records	128, 967
iPad	973	medical records systems	367
Iran's 2025 Health Map	163	medical visualization	
ISO 13606	427	knowledge	791, 907
ISO 13972	427	medical/surgical nursing	1084
IT adoption	780	medication	515, 713, 1036
IT education	1011	medication administration errors	860
knowledge	1026	medication care	359
		medication error(s)	808, 812
		medication instruction	397
		medication management	422

- medication plan 262  
 medication safety 959  
 meta model 582  
 meta-analysis 491  
 metabolic syndrome X 510, 1001  
 MFER 1018  
 mHealth 48, 481, 515, 530, 587,  
 602, 607, 654, 721, 765, 936,  
 1034, 1036, 1043  
 mindful yoga 621  
 mixed methods 83  
 mobile 605, 621, 689  
 mobile app 334, 963, 1028, 1040  
 mobile application(s) 339, 505, 654,  
 668, 936, 1024  
 mobile apps for health 721  
 mobile device(s) 287, 377, 495,  
 587, 944  
 mobile health 486, 510, 602, 707,  
 765, 889, 1030, 1034  
 mobile health management 1047  
 mobile information 297  
 mobile learning 272, 277  
 mobile medical applications 623  
 mobile nursing 840  
 mobile phone 1032  
 mobile technology(ies) 232, 334,  
 491, 500, 765, 963, 981, 1005,  
 1024, 1028  
 model 108  
 model (theoretical) 786  
 MonDossierMedical.ch 700  
 monitoring 741  
 motivation 553  
 multi-criteria 540, 1015  
 multimedia situational teaching 615  
 multiple account recording  
 system 891  
 multiple accounting information  
 system 854  
 multiple sclerosis 605  
 national strategy 168  
 naturalistic observations 38  
 nearables 658  
 need assessment 1049  
 needs analysis 486  
 networks 950  
 new graduate nurses training  
 program 1049  
 new nurses 615  
 NICA-L3/L4 252, 292  
 noise exposure 1053  
 Norris method 625  
 nosocomial infections 658  
 novice nurse 1057  
 nurse(s) 23, 78, 163, 476, 572, 617,  
 625, 654, 762, 832, 889, 944  
 nurse care records 830  
 nurse e-chart 93  
 nurse informatics specialist 113  
 nurse manager 864  
 nurse trainees 314  
 nurse video-consultation 883, 885  
 nurse-patient relationship 615  
 nursing 203, 267, 302, 540, 617,  
 643, 683, 748, 777, 786, 795,  
 873, 879, 938, 995, 1009  
 nursing action(s) 639, 1022  
 nursing assessment 8, 495, 1080  
 nursing business intelligence  
 and analytics 63  
 nursing care 103, 800, 806, 836, 934  
 nursing care plan 850  
 nursing competence 58  
 nursing curriculum 324  
 nursing diagnoses 1082  
 nursing diagnosis 407, 471, 1022,  
 1072  
 nursing documentation 18, 128, 457,  
 466, 641, 850, 877, 1074, 1068  
 nursing education 183, 257, 272,  
 282, 297, 324, 610, 750, 969,  
 979, 981, 983, 987, 1005, 1011  
 nursing faculty members 1060  
 nursing human resources  
 allocation 558  
 nursing informatics 13, 18, 123, 148,  
 153, 183, 218, 222, 252, 272,  
 302, 324, 329, 339, 495, 649,  
 678, 727, 729, 732, 746, 753,  
 771, 774, 783, 795, 806, 817,  
 830, 836, 873, 985, 999, 1013,  
 1034, 1074, 1084  
 nursing informatics competencies 610  
 nursing informatics education 48, 729  
 nursing informatics trends 715

nursing information		operational effect	645
system(s)	407, 846, 848, 909, 911, 969, 1082	optimization	1051
nursing instruction	909	organizational benefits	903
nursing item	822	organizational culture	957
nursing management	466	organizational effectiveness	957
nursing minimum data set	806	organizational innovation	535
nursing observations of adverse effects	686	orthopedic surgery	457
nursing payment	871	outcome calculation	457
nursing practice	934	overview	934
nursing practicums	1038	P.A.T.C.H Scale	997
nursing process	93, 133, 457, 495, 806, 842, 879, 965, 1082	pain	272
Nursing Process – Clinical Decision Support Systems (NP-CDSS)	810	pain control	887
nursing professionals	946	parenteral infusions	812
nursing record(s)	93, 806, 813	participatory approaches	940
nursing research	510, 613	participatory design	227, 627, 692, 923
nursing sensitive outcomes	934	participatory health	577
nursing skill	525	participatory planning	1020
nursing staff	3	partogram	977
nursing standardized language	1016	patient	108, 967
nursing student(s)	334, 572, 645, 881, 963, 987, 1024, 1060	patient (citizen) engagement	707
nursing task	858	patient activation	631
nursing taxonomy	133	patient care	735
nursing techniques	973	patient care team	28
nursing terminology	471	patient classification	871
nursing value	63	patient classification systems	834
nursing workload	402, 822, 871	patient communication	921
NursingNAVI	977	patient dynamic evaluation	8
nutrition	756	patient education	237, 397, 432, 631, 718, 913
nutritional/dietary management	1058	patient empowerment	627
observables model	1080	patient engagement	486
older adults	354, 486	patient outcome assessment	520
older people	178	patient participation	198
older person	193	patient portal	168, 354, 631
Omaha System	633, 635, 983, 1053, 1062	patient risk	8
oncology	232	patient safety	48, 168, 262, 602, 689, 741, 808, 834, 836, 844, 860, 862, 868, 979, 247
online bibliographic databases	33	patient safety event	452
online education	267	patient trajectory	349
online evidence	33	patient-centered evaluation	530
online health information	895, 899	patient-centricity	227
online platform	567	patient-reported outcomes	577
ontology	432, 442, 592, 879, 1076	patients left without treatment	138
open education resource	979, 981	patients with alcohol dependence	956
operation room	824	pediatric	971
		pediatric obesity	491
		peer network	610

peer support	597	prototyping	649
people living with HIV	932	provenance	592
Pepper	913	psychometric testing	710, 768
performances	824	psychosocial needs	1068
perioperative emergencies	796	public health	607
perioperative nursing	500	public health informatics	602, 983
perioperative settings	864	public health information systems	680
peritoneal dialysis system	915	public health nurse	971
person-centered	232, 505	public policy	183
person-centred	1015	publication	703
personal digital assistants	889	qualitative research	932
personal health information management	173	qualitative study	802, 946
personal health record	971, 1053	quality	247, 718, 808
personal satisfaction	535	quality assessment	1030
personnel staffing and scheduling	3	quality assurance	148
persuasive technology	272	quality evaluation	1040
pharma cloud system	959	quality improvement	103, 741, 870
pharmacogenomics	686	quality measurement	476
phenomenology	926	quality of care	168, 780, 871
physical activity(ies)	447, 553, 605, 1032	quality of healthcare	535
PICC	952	quality standard	738
pill sorting	262	questionnaire design	520
planning	824	radiation therapy nursing	999
point-of-care information	724	random forest	143
population health	732, 975, 1020, 1053, 1062	ranking	897
positive attitude	615	rapid prototyping	940
post-phenomenology	188, 885	re-use	727
practice	715	readmission	143, 883
practice-based evidence	417	real-time	663
prediction	828	recommendation system	879
predictive models	143	record quality	813
predictors	382	reference standard concept formation	1022
pregnant women	621	reflections	973
pressure ulcer	48	regional hospitals	623
primary health care	991	research	715
principle-based	540	research evaluation	297
problem-based learning	905	research methods	768
problems in EHR(s)	870, 985	research priorities	938
process	108	research results	707
professional identity	344	research trends	938
professional judgment	148, 999, 1074	responsive web design	619
professional literature	476	review	364, 936
programmed medical choice	791, 907	RFID	1042
project governance	158	risk assessment	705
project management	252	risk management	800
prospective cohort study	893	robotics	545

roles for nursing and health care		social network(s)	232, 282, 627
professionals	707	social network analysis	675
root cause analysis (RCA)	452	software	68, 995
routine nursing data	727	software design	654
routines	392	software quality	741
rural	113, 866	specialty	1051
salivary cortisol	1053	speech-recognition	649
satisfaction	78, 808, 832, 891, 1005	staff assignment	58
scenario based learning	257	staff development	987
scheduling	824	standard(s)	427, 744, 748, 810
school health services	942	standard terminologies	123, 222
scientific writing	703	standardised terminology	1068
scope and standards		standardization	756
of practice	678, 746	standardized nursing data	753
secondary use	727	standardized nursing	
secondary use of care data	402	terminology	1064
security	1003	standardized terminology	447, 633, 635, 1062, 1070, 1078
seeking health information	1043	statistical methods	402
self-assessment	292	STD	267
self-care	108, 173	stem cells	1015
self-efficacy	881	strategy	203
self-evaluation tool	710	streaming data	675
self-management	481, 510, 577, 627, 856, 1026	strength(s)	635, 1062
semantic social network	592	stress	1001
seniors	178	stroke	1040
serious games	791, 905, 907	Structural Equation Modeling	
sexual assault	826	(SEM)	58, 1043
shared care plan	700	structured knowledge	148, 1074
shared medication list	700	students	729
shared treatment plan	713	suicide	257
Short Message Service (SMS)	491	support services	919
Sickle-Cell disease	627	supportive decision making	952
signal processing	372	surgery	500
Simone de Beauvoir	721	Swedish healthcare organization	923
simplifying workflow	870, 891	symptom management	930
simulation	242, 750, 989, 1009	synchronization	917
simulator	995	system evaluation	915
smart glasses	377	system implementation	802
smartphone(s)	1024, 1049	system user satisfaction	846
smartphone application	510, 515, 963, 1045	systematic review	491, 633, 643, 946, 954
SNOMED CT	683, 928, 1078, 1084	tablets	1049
social data analysis	442	tacit knowledge	525
social media	344, 562, 572, 577, 597, 602, 607, 617, 621, 925, 1007, 1076	Taiwan model	848
social media for nursing	613	TAM	798
social media for research	613	TANIC	252, 292
		task force	848, 1051
		TAVI	98

TCPI	862	Triage Classification (RETTS)	893
teaching quality	208	trigger	128, 461
teaching strategies	981	tripartite partnerships	158
team resource management	804	triple aim	188
teamwork	957	trust	718
technology	777, 795	Turkey	633, 817
technology acceptance	118, 944	twitter	617
technology acceptance model	889, 909	ubiquitous computing	771
technology and data enablers	707	undergraduate education	783
technology assessment	43	undergraduate nurse(s)	277, 344
technology enhanced learning	193	undergraduate nursing	329
technology evaluation	28	undergraduate nursing students	297, 899
technology induced errors	741	undergraduate research	613
technology readiness	314	usability	227, 481, 530, 619, 689, 692, 796, 870, 911, 1026
technology support	987	usability engineering	689
technology-induced error(s)	38, 247	usability evaluation	668
tele-consultation	113, 883, 885	usability issues	842
tele-nursing	625	usability testing	38
telehealth	188, 242, 934, 946, 989	use case development	1020
telemedicine	153, 198, 768, 883, 885, 926	use dependence	846
telepresence	989	use of evidence	33
terminal tablet	1038	usefulness	808
terminology(ies)	437, 461, 683, 744, 1022, 1066, 1072	user expectation	897
text messaging	500	user experience	798
text mining	128, 461, 732, 813, 856, 930	user interface design	93, 911
“The Coming of Age”	721	user participation	227
thematic content analysis	577	user requirements	339
theory testing	768	user-centered design	93, 530, 649
therapeutic affordances	577	user-centred design	692
therapeutic duplications	959	user-computer interface	98, 535, 654, 905
thinking process	148, 999, 1074	vaccine	432
threat	881	validation	227
TIGER	252, 292, 848	validation studies as topic	1072
time study	1042	value(s)	73, 188
topic modeling	675, 925	vibratory stimulation	917
traditional teaching mode	208	video analysis	257
training program develop	969	virtual electives	975
transformational change	73	virtual nursing intervention	932
transformational nursing leadership	412	virtual patient	645
transfusion incidence	844	virtual systems	198
trauma	866	virtual visit	625
treatment support	936	vital sign	1018, 1042
triage	53, 535	volatility of situation	148
		volunteer activities	1060
		vulnerable populations	158

wearable devices	486	workflow	247, 392, 765, 826, 854, 875
wearable mobile device	1045	workflow design	860
wearable sensors	562, 663	workflow processes	753
wearable technology	1053	workforce development	697
wearables	649, 658	workload	3, 58, 558, 834, 836
Web 2.0	1007	workshop	965, 993
web-solution	921	wound assessment	1078
website development	940	wound care	649
weight loss	597	xMOOC	208
wellbeing	1062	youth counseling record	442
WISN-model	3		
work sampling	915		



## Author Index

Abbott, P.	780	Bell, J.F.	232
Abdelhak, M.	707	Benedik, P.	879
Agrawal, D.	68, 113, 866, 875	Benítez, S.E.	93, 133, 324, 495
Ahonen, O.	203	Bennett, P.	53
Akdeniz, S.	817	Beogo, I.	954
Albiez, D.	658	Bettermann, R.	262, 629
Alexander, G.L.	735, 780	Beuscart, R.	791, 907
Alexander, M.M.	735, 780	Bias, R.	1026
Alhuwail, D.	123, 222, 587, 938	Bickford, C.J.	678, 746
Ali, S.	123, 222, 938	Bjarnadottir, R.I.	732
Al-Masslawi, D.	649	Björvell, C.	1016
Alvarez, A.G.	272	Blaser, J.	812
Aminian, K.	663	Blaz, J.W.	641
Amith, M.	432	Blažun Vošner, H.	950
Ammenwerth, E.	806	Block, L.	649, 1078
Anderson, C.	762	Bolboacă, S.D.	572
Andrews, T.	334, 963, 1024	Bold, R.	232
Arcia, A.	732	Bonacina, S.	627
Argentin, Y.	654	Boom, J.	432
Arifulla, D.	203, 617	Borycki, E.M.	38, 339, 602, 689, 703, 741, 783, 247
Arnott Smith, C.	173	Bosse, C.	870
Årsand, E.	597	Bosshart, K.	952
Asikainen, P.	819	Botin, L.	188
Atique, S.	901, 903	Bouamrane, M.-M.	971, 1028
Aung, H.	178	Bowles, K.H.	28
Azadi, Tania	163	Boyer, C.	718
Azadi, Tannaz	163	Bradley, P.	1026
Badger, M.K.	123, 222, 938	Brattheim, B.	349
Bakken, S.	481, 553, 925	Brennan, P.F.	173
Ball, M.J.	738, 762	Brixey, J.J.	750, 873, 975
Baquapuri, H.I.	372	Brown III, W.	481
Barken, T.L.	926	Budasu, R.	153
Barthel, C.	377	Budz, B.	981
Barton, A.J.	307	Buergin, R.	402
Basler, S.	213	Bukowski, M.	262, 629
Bass, E.J.	28	Büla, C.	663
Bastin, H.L.	476	Burke, K.	631
Bastos, F.	407	Bürkle, T.	213
Baumberger, D.	402	Burman, P.	143
Becker, K.	582	Buyl, R.	954
Becker, M.	377	Byun, A.	491, 1043
Behrends, M.	287, 377, 944	Carballo-Diequez, A.	481
Bell, E.	397		

Caregnato, R.C.A.	995	Clarke, S.	98, 364
Carroll, D.	486	Cloyes, K.G.	641
Carter-Templeton, H.D.	237, 1007	Co Jr., M.C.	553, 925
Caruso, L.	387	Coenen, A.	471
Carvalho, D.R.	1072	Collins, S.	710, 759
Casper, G.R.	173	Cooper, C.	545
Cervi, G.H.	995	Cordoş, A.A.	572
Chan, P.-T.	969	Cormier, E.	895
Chan, W.-Y.	808	Cornelius, B.	921
Chang, C.-P.	802	Cornford, T.	73
Chang, H.	1040	Corvo, E.	949
Chang, H.-M.	813	Côté, J.	932, 934
Chang, L.-Y.	871	Courtney, K.L.	768
Chang, P.	515, 668, 762, 840, 844, 848, 887, 1036, 1040, 1047	Crawford, V.	721
Chen, B.-L.	625	Croucher, J.L.	387
Chen, C.-M.	830	Cruz, D.	1082
Chen, C.J.	909	Cruz, I.	407
Chen, H.	558, 822	Cubas, M.R.	1072
Chen, H.-C.	804	Cui, Y.	515, 1040
Chen, H.-F.	615	Cummings, E.	277, 329, 339, 344, 783
Chen, H.-P.	830	Cunningham, R.	432
Chen, M.-J.	437	Currie, L.	282, 692, 940
Chen, M.C.	854, 891	Cyu, L.-Y.	1049
Chen, S.-J.	826, 832	da Costa, D.G.	834
Chen, S.C.	1064	da Silveira, L.M.B.	1009
Cheng, C.-I.	915	Daehne, P.	656
Cheng, Y.-C.	969	Dal Sasso, G.T.M.	272, 705
Cheung, N.-T.	808	Davis, A.	232
Cheung, S.-K.C.	808	de Camargo, M.D.	836
Chiang, C.-L.V.	808	De Caro, W.	948, 949
Chien, T.-F.	804	de Cássia Gengo e Silva, R.	1082
Chin, D.L.	1053	de Fátima Marin, H.	697, 762
Chiou, S.-F.	813, 846, 915	de Oliveira Riboldi, C.	834
Chirambo, G.B.	1013	de Souza, A.	1072
Cho, I.	828	Delaney, C.W.	697, 753
Cho, S.	1045	Denecke, K.	562
Choi, E.	637, 639	Devlin, A.M.	971
Choi, H.	1043	Dewenter, H.	928
Choi, Jeeyae	103	Dias, V.L.M.	834
Choi, Jeungok E.	103	Dichmann Sorknaes, A.	883, 885
Choi, JiYeon	1001	Ding, S.	668
Choi, K.-S.T.	808	Diogo, R.	1082
Choi, M.	1005	Doig, A.K.	641
Chomutare, T.	597	Donovan, H.	930
Chu, C.-H.	911	Dowding, D.	83, 732
Chuang, P.L.	1064	Dowie, J.	540, 1015
Chung, E.	828	Doyle, G.J.	282, 297, 610, 979, 981
Cilene Ferreira Pacheco, K.	991	Drosatos, G.	592

Dubois, C.-A.	934	Gray, K.	577
Dufosse, F.	791, 907	Greenwood, K.	697
Duret, C.	535	Griebel, L.	582
Duymelinck, S.	567	Guo, S.H.-M.	619, 621
Dykes, P.	748	Gupta, S.	985
Eberle, C.L.	28	Gürsel, G.	897
Ehrenberg, A.	1016	Haatainen, K.	128
Ehrler, F.	535, 654, 656	Hackl, W.O.	727, 806
Eler, G.J.	123, 222, 938	Hagberg, H.	656
Endo, M.	800	Halloran, E.J.	476
Erdley, W.S.	786	Handfield, S.	1078
Eschmann, E.	812	Hansen, M.	500
Eslami, S.	23	Hardardottir, G.A.	168
Estes, K.	242, 307	Hardiker, N.	53, 471, 744, 777
Evans, S.	118	Harper, E.M.	63
Eyvazi Hesar, M.	658	Hartvigsen, G.	597, 627
Favela, J.	83	Hasegawa, Y.	1058
Feng, J.	208	Hashiya, A.	858
Feng, L.	558, 822	Hasvold, P.E.	607
Feng, R.-C.	846, 887	Hawkins, N.J.	387
Fernandez-Luque, L.	602, 607	Haynes, S.	505
Fleck, E.M.	1034	He, Y.	173
Flores, C.D.	995, 1009	Hebda, T.	43, 292
Florin, J.	1016	Hellesø, R.	349, 724, 1070
Fnu, V.	397	Heydari, A.	1011
Fossum, M.	780, 842, 905, 1068	Hibberd, R.	73
Fruhling, A.	905	Hikita, T.	858
Fu, C.	1040	Hill, T.	43, 292
Fujita, K.	858	Hirano, K.	645
Fukayama, K.	1038	Ho, H.-T.	844
Furlong, K.E.	297	Hoerbst, A.	422
Gadd, C.	697	Hofflander, M.	923
Gagnon, M.-P.	934, 954	Hogarth, M.	143
Gallagher, J.	1013	Holmén, A.	893
Gao, G.	1062	Honey, M.	178, 183, 705, 975, 983
Gassino, F.D.	93, 133	Hong, O.	1053
Georgsson, M.	123, 222, 530, 938	Hosseini, S.-M.	1011
Gervais, A.	535, 656	Hou, I.-C.	437, 830
Gilliam, E.	242, 307	Hovenga, E.	329
Giunti, G.	605	Hsiao, L.-C.	844
Glenna, G.	895	Hsing, H.-C.	621
Gluck, F.	654	Hsu, C.J.	1064
Gonen, A.	881	Hsu, C.-Y.	903
Gong, W.	208	Hsu, S.	257
Gong, Y.	48, 452, 486, 820	Hsu, S.-M.	862
González, Z.A.	93, 133, 324, 495	Huang, H.-C.	619
Goossen, W.	367, 427, 735	Huang, H.L.	909, 1064
Gordon, J.S.	198, 302, 987	Huang, X.	1036
Goshima, M.	58	Hübner, U.	762

Hudson, E.	934	Karthik, K.	997
Hueckel, R.	989	Kejonen, P.	3
Hullin, C.	689, 729	Kelly, K.	870
Hunter, K.	43, 292	Kennedy, M.A.	158, 417
Hussey, P.	193	Kerr, M.J.	635, 983, 1053, 1062
Ichinose, M.	1060	Khalifa, M.	78, 138
Inoue, M.	148, 999, 1074	Kim, C.-J.	1001
Iribarren, S.	481, 732, 936	Kim, D.	1018
Ishigame, A.	917	Kim, H.	397, 447
Ishiguro, K.	913	Kim, I.K.	1045
Ishihara, K.	1042	Kim, J.	397, 447, 491, 637, 639, 1043
Ishii, M.	1055	Kim, K.K.	232, 505
Islam, T.	123, 222, 938	Kim, M.	1026
Issom, D.-Z.	627	Kim, M.G.	1045
Iwao, Y.	977	Kim, S.	1018, 1018
Iyengar, S.	272	Kim, T.Y.	471
Izumi, T.	993	Kim, Y.	637, 639
Jansen, K.	471	Kimiafar, K.	23
Jansson, I.	1016	Kimura, E.	1042
Jensen, S.	247	Kinnunen, U.-M.	128, 203, 461, 748
Jeon, E.	123, 222, 510, 938	Kinosada, Y.	58
Jetté, S.	1066	Kivekäs, E.	128, 461
Jhan, S.-J.	826, 832	Klein, F.	658
Jhang, H.-L.	826	Klem, P.	392
Ji, M.	668	Knapfel, S.	242, 307
Jiao, C.	1032	Koch, S.	627
Jo, E.	852	Koivunen, M.	946
Jo, S.	510	Kokol, P.	950
Johnsen, H.M.	905	Kouri, P.	203
Johnson, C.	1080	Krediet, I.	367
Jonas, S.	262, 372, 629	Krijnen, W.P.	457
Jones, C.	282	Krishnamurthy, M.	1007
Jones, J.	392	Krzyzanowski, B.	983
Jonnagaddala, J.	387	Kühn, M.	262, 629
Joseph, J.G.	232	Kulikowski, C.A.	602
Joshi, S.	607	Kuo, C.-H.	123, 222, 938
Jovanović, M.	658	Kuo, M.-C.	840, 848, 911
Jue, T.R.	387	Kupka, T.	287, 944
Jung, H.	123, 222, 442, 938	Kuroda, T.	58, 858
Junttila, K.	203, 864	Kushniruk, A.W.	38, 339, 689, 741
Kaipio, J.	339	Kutafina, E.	372
Kaizu, M.	965	Kuttler, K.	118
Kajimura, A.	858	Kuusisto, A.	819
Kaldoudi, E.	592	Kuziemy, C.E.	38, 602
Kaltoft, M.K.	540, 1015	Lacroix, P.	783
Kälviäinen, R.	128, 461	Lai, H.-F.	844, 862
Kang, H.	510	Lam, A.H.Y.	961
Karimi Moonaghi, H.	1011	Lamb, K.V.	515, 1036
Karlen, S.	812		

Lamblin, J.	43, 292	Liu, Y.	48, 515, 1036
Lan, A.-R.	826	López, G.E.	93
Lancia, L.	948, 949	Losiouk, E.	520
Lanzola, G.	520	Lovis, C.	535, 627, 654, 656
Larsson, G.	893	Lu, C.	257
Laukvik, L.B.	1068	Lu, C.-L.	623, 959
Lavander, P.	3	Lu, S.	1030
Le, W.	208	Lu, S.-C.	969
Leal, R.G.	1072	Lu, Y.-C.A.	877, 1049
Lee, C.	242, 307	Luna, D.R.	133, 495
Lee, C.-W.	621	Lunde, L.	919
Lee, C.Y.	1064	Lundgrén-Laine, H.	864
Lee, E.	1045	Luque, A.E.	267
Lee, H.	257, 838	Macedo, A.B.T.	834
Lee, H.S.	1005	Mackert, M.	1026
Lee, J.	491	Madsen, I.	783
Lee, J.H.	1045	Maekawa, Y.	525
Lee, J.-H.	1076	Magalhães, A.M.M.	834, 836
Lee, J.Y.	510, 1022	Mahajan, S.	143
Lee, K.	1018	Mahmoodian, S.	643
Lee, P.-F.	798	Mair, F.S.	971, 1028
Lee, T.-T.	802, 860, 911	Majima, Y.	319, 525, 645, 913, 917, 993, 1038
Lee, W.R.	844, 862	Major, K.	663
Lee, Y.	637, 639, 1018	Malvezzi, M.L.F.	834
Lee, Y.J.	930	Mantas, J.	33
Lee, Y.-L.	804, 1047	Manzano, S.	656
Lehmann, M.	213	Marschollek, M.	287, 377, 602, 944
Lei, V.	856	Martins, F.Z.	836
Lenoble-Hoskovec, C.	663	Martin-Sanchez, F.	577
Lev-Ari, L.	881	Marucci, A.R.	948, 949
Lewis, A.	123, 222, 938	Maruyama, A.	1057
Li, B.	8	Mather, C.	277, 329, 344
Li, F.-S.	826	Matney, S.A.	1084
Li, L.	848	Mayer, M.-A.	607
Li, N.	1036	McCormick, K.	686
Li, Q.	820	McCutcheon, J.	979
Lialiou, P.	33	McDonald, J.	735
Liang, C.	820	McGee-Lennon, M.	971
Licata, M.	1034	McGillis Hall, L.	795
Lichtner, V.	73	McGonigle, D.	43, 292
Liljamo, P.	3, 203	McNew, R.E.	198, 302, 987
Liljequist, D.	227	Meagher, N.S.	387
Lin, C.	668	Medini, M.	213
Lin, J.-C.	860	Meetim, A.	13
Lin, J.-Y.	615	Mei, T.C.	824
Lin, K.	8	Mejova, Y.	607
Lin, K.-W.	447	Melby, L.	349
Lin, Y.-J.	877, 1049	Meraji, M.	643
Liu, H.-Y.	813		

Merasto, M.	617	Norri-Sederholm, T.	359
Mercier, G.	1066	O'Brien, A.	18
Mergen, T.	834	O'Connor, S.	334, 963, 971, 1013, 1024, 1028
Merolli, M.	577	O'Donnell, C.A.	971, 1028
Meyenburg-Altvarg, I.	287, 377, 944	O'Donoghue, J.	1013
Michiwaki, Y.	1058	O'Hair, M.	1026
Miettinen, M.	466	Odlum, M.	314
Milavec Kapun, M.	108	Ohe, K.	800
Millar, J.	683	Olli, J.	617
Misawa, S.	1060	Omori, M.	148, 1058, 1074
Misgeld, B.	372	Onogi, H.	1060
Mitello, L.	948, 949	Onori, K.	476
Mitsubishi, S.	965	Ortiz, D.	1082
Moen, A.	705, 919	Ortiz, D.R.	1082
Mohri, O.	800	Østensen, E.	1070
Molloy, M.	989	Ota, K.	967
Mølstad, K.	1068	Ozkaynak, M.	392, 817
Monsen, K.A.	382, 633, 1053, 1062	Paakkonen, H.	359
Moore, G.	307	Paananen, P.	128, 461
Moraes, K.B.	836	Paans, W.	457, 810
Moufawad el Achkar, C.	663	Palojoki, S.	741
Moyo, C.	1013	Pandit, S.	452
Müller-Staub, M.	457, 810	Paraschiv-Ionescu, A.	663
Mundt, M.P.	815	Parimbelli, E.	153
Munuswamy, S.	997	Park, Hyejin	895, 899
Muranaka, Y.	965, 1055	Park, Hyunmi	899
Murphy, J.	765	Park, H.-A.	v, 442, 510, 637, 639, 1022, 1076
Murray, P.J.	771	Park, J.H.	1005
Mykkänen, M.	466, 748	Park, N.-J.	1001
Myneni, S.	486	Pavel, R.	1066
Nøhr, C.	188	Payne-Gagnon, J.	934
Nüssli, S.	952	Pearce, M.	680
N, R.	875	Peck, M.	486
Nagle, L.	795	Peleg, M.	153
Nagle, L.M.	88	Peltonen, L.-M.	123, 222, 864, 938
Nahcivan, N.O.	633, 635	Penders, J.	545
Nahm, E.-S.	354	Peng, S.-T.	832
Nakai, M.	1042	Pereira, F.	407
Nakamura, R.	1060	Peres, H.	1082
Nakamura, Y.	1038	Perfetti, F.	520
Napolitano, C.	153	Pergler, L.	812
Nelson, R.	237, 1007	Perreault, É.	1066
Newbold, S.K.	873	Phillips, J.C.	940
Ngo, V.	232	Piao, M.	491
Nichols, L.	344	Plaut, O.	700
Nielsen, J.B.	540	Pobiruchin, M.	582
Niimi, Y.	967	Portokallidis, N.	592
Nilsson, L.	923		

Prijatelj, V.	868	Saranto, K.	128, 203, 359, 461, 466, 703, 741, 748, 819, 946, 950
Procter, P.M.	vii, 545, 705, 975, 1020	Sarbaz, M.	23
Prokosch, H.-U.	118	Sarkar, I.N.	703
Pruinelli, L.	123, 222, 382, 774, 938, 1084	Sarmiento, R.F.	123, 222, 938
Qiu, W.	208	Sato, K.	58
Quach, J.	447	Sato, S.	1057
Quaglino, S.	153, 520	Sato, Y.	1057
Quesnel, A.	791, 907	Scandurra, I.	227
Radhakrishnan, K.	856, 1026	Schaad, P.	213
Rajalahti, E.	942	Schachner, M.B.	93, 133, 324, 495
Rajkovič, U.	879	Schenk de Azambuja, M.	991
Rajkovič, V.	108, 868, 879	Schmeer, R.	287, 377, 944
Ramazan Ghorbani, N.	643	Schmid, A.	700
Randell, R.	83	Schnall, R.	481, 936
Ranegger, R.	806	Schneemann, M.	812
Recondo, F.J.	93, 133	Schnyder, F.	952
Reed, S.C.	232	Schulz, S.	602
Reeder, B.	392	Schweitzer, M.	422
Remus, S.	412	Secco, L.	297
Richard, L.	932	Secginli, S.	633, 635
Richardson, A.	447	Segev, R.	881
Robin, M.	113, 866, 875	Seiyama, A.	58
Robinson, K.	218	Seljutin, E.	658
Rodger, D.	193	Sensmeier, J.	735
Romero, M.R.	796, 1051	Senthriajah, Y.	741
Ronquillo, C.	123, 222, 649, 715, 938, 940	Sermeus, W.	vii
Rosemberg, A.	700	Settergren, T.	1084
Rosenqvist, S.	942	Severijns, C.	658
Rotegård, A.K.	756	Shabbir, S.-A.	903
Rouleau, G.	932, 934	Shan, W.	820, 820
Rowsell, D.	940	Sharon, D.	881
S, P.	875	Shaw, R.J.	780, 989
Saba, V.	471, 748	Sheikhtaheri, A.	23
Sacchi, L.	153	Shenvi, E.	447
Sadoughi, F.	163	Shi, Z.	848
Sagherian, K.	354	Shin, D.-S.	1001
Saito, M.	1057	Shin, E.H.	329
Saito, Y.	965, 973, 1055	Shu, I.	257
Sakaki, S.	917	Siebert, J.	535, 656
Sakuma, T.	965	Siirala, E.	864
Salanterä, S.	864	Sik, K.Y.	1045
Salkeld, G.	540, 1015	Silva, A.	407
Samadbeik, M.	643	Silva, S.N.	613, 1003
Sannomiya, Y.	1055	Silveira, D.T.	834, 836
Sansoni, J.	948, 949	Simon, G.J.	382
Santos, B.S.	1072	Simón, M.	93
		Sipes, C.	43, 252, 292
		Skiba, D.J.	242, 307

Slettebø, Å.	842, 905	Tokunaga, K.	645
Sockolow, P.	28, 83	Tomizawa, Y.	1060
Söderhamn, U.	926	Tomotaki, A.	800
Soga, M.	525	Tong, L.-H.E.	808
Solvoll, T.	689	Topaz, M.	123, 222, 856, 938
Somensi, R.M.	995	Toprac, P.	1026
Sommer, J.A.	93, 123, 133, 222, 495, 938	Torkar, S.	879
Song, T.-M.	442, 1076	Toussaint, P.	349
Sorbello, D.	218	Trangenstein, P.	198, 302, 987
Soula, J.	791, 907	Trbovich, P.	795
Sousa, P.	407	Trinkley, K.	307
Spahni, S.	713	Tsai, H.-H.	846
Spencer, A.	193	Tsao, C.-M.	621
Staggers, N.	530, 641	Tsuru, S.	148, 977, 999, 1058, 1074
Stanziola, E.	93	Turner, P.	339
Staub, A.	796, 1051	Vabo, G.	842
Strandberg, E.	1016	van Berlo, M.	567
Straus, E.	881	van Rossum, E.	567
Strudwick, G.	795	Vaughn, J.	989
Sudo, K.	1074	Ventura, R.	218
Suero-Tejeda, N.	553	Verma, M.	985
Sun, L.	889, 1030, 1032	Verma, N.	68
Šušteršič, O.	108, 868, 879	Verwey, R.	567
Sutjiadi, B.	447	Vieira, D.F.	836
Suzuki, C.	1060	Vilmarlund, V.	602
Suzuki, E.	1057	Visetti, E.	520
Suzuki, S.	1055	Vivekananda-Schmidt, P.	905
Syed-Abdul, S.	721	Vollmer, A.-M.	118
Taherzadeh, Z.	23	Wajdan, A.	372
Takayama, Y.	1057	Wako, F.	148, 1074
Takeda, H.	741	Wamba, N.	1013
Takemura, T.	858	Wang, D.	267, 432
Talbot, L.R.	1066	Wang, J.	486, 1036
Tang, S.-J.	826	Wang, L.	515
Tanguay, A.	1066	Wang, P.	8
Tao, C.	432	Wang, T.-C.	846
Tattone, M.A.	324	Wang, Y.	889, 1030, 1032, 1036
Tayaben, J.L.	123, 222, 938	Ward, R.	387
Tellez, M.	1082	Waterworth, S.	178
Teraoka, M.	965, 1055	Weaver, C.	18
Terhaar, M.	98, 364	Weber, P.	vii
Thoroddsen, A.	168	Weiner, E.	198, 302, 987
Thouvenot, V.I.	777	Weiss, J.	392
Thun, S.	928	Welton, J.M.	63, 476
Thygesen, E.	926	Weng, S.-H.	911
Tiase, V.L.	218, 1034	Weng, Y.-C.	830
Tissera, S.R.	1003	Werner, N.E.	173
Todhunter, F.	975	Westbrooke, L.	183
		Westman, B.	921



Westover, S.	1066	Yokota, S.	800
Westra, B.L.	382, 1084	Yoon, S.	553, 675, 732, 838, 925
Whittenburg, L.	13, 850	Yoshihara, W.	858
Wiesner, M.	582	You, H.-J.	826
Willard, S.	567	Yu, H.-C.	813
Williamson, J.J.	697	Yu, H.-H.	871
Wilson, M.L.	98, 364, 705, 762, 1020	Yu, H.C.	854, 891
Wipfli, R.	535	Yu, P.	780
Wissler, I.	213	Zahid, Z.	901
Wu, M.-P.	846	Zakletskaja, L.I.	815
Wu, Y.	48, 515, 668, 889, 1030, 1032, 1036, 1040	Zenhäusern, R.	952
Xavier, T.	68, 113, 866, 875	Zenz, D.	928
Xiao, Q.	889, 1030, 1032	Zhang, H.	8, 820
Xie, B.	1026	Zhang, R.	820
Yamashita, K.	58	Zhang, Y.	1032
Yamato, H.	1055	Zhao, S.	558, 822
Yan, Y.-H.	623, 957, 959	Zhao, X.	262, 629
Yang, E.	637, 639	Zhou, H.	208
Yang, F.	668	Zhou, L.	856
Yang, L.	956	Zhu, J.	208
Yang, N.	820	Zhu, S.	354
Yang, X.	668	Ziegert, K.	893
Yeh, H.-T.	844, 862	Zucatti, A.P.N.	1009
		van Munster, D.	367

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