Proposal for Implementation of a Barcode Medication Administration System

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**Introduction**

Through the utilization of information technology, healthcare inadequacies can be identified and solved (Coiera, 2003b, p. 124).  Issues involving patient safety, specifically medication errors, remain prominent and available informatics solutions should be considered to improve upon current processes (Doyle, 2005, p. 11). This proposal aims to identify an opportunity for improvement upon the current process of medication administration within an organization by developing, implementing, and evaluating a bar code medication administration (BCMA) system.

**Scope and Formulation of Informatics Problem**

Despite advancements in technology, medication errors, considered “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”, are prevalent ([Gokhman, Seybert, Phrampus, Darby, & Kane-Gill, 2011](file:///C%3A%5CDocuments%20and%20Settings%5Chpadmin%5CMy%20Documents%5CDownloads%5Cscope%20paper.docx#_ENREF_3), p. 2; [Prusch, Suess, Paoletti, Olin, & Watts, 2011](file:///C%3A%5CDocuments%20and%20Settings%5Chpadmin%5CMy%20Documents%5CDownloads%5Cscope%20paper.docx#_ENREF_5), p. 835). Medication errors are the second leading cause of medical errors and account for 7,000 deaths annually (Doyle, 2005, p.11). Currently, electronic dispensing systems, computerized physician order entry systems (CPOEs), and electronic health records (EHRs) assist nurses in prescribing, transcribing, and dispensing medications (Doyle, 2005, p. 14). However, current technology does not proactively decrease the potential for human error during administration of medications ([Dwibedi et al., 2011](file:///C%3A%5CDocuments%20and%20Settings%5Chpadmin%5CMy%20Documents%5CDownloads%5Cscope%20paper.docx#_ENREF_2), p. 1026). Implementation of a barcode medication administration (BCMA) system will replace the current system and improve patient safety by assisting nurses in administering medications (Appendix A) ([Dwibedi et al., 2011](file:///C%3A%5CDocuments%20and%20Settings%5Chpadmin%5CLocal%20Settings%5CTemporary%20Internet%20Files%5CContent.IE5%5CX5FX4N1P%5Cscope%2520paper%5B1%5D.docx#_ENREF_2), p. 1026).

**Significance of Informatics Problem**

Administration of medication is a fundamental nursing responsibility, requiring several steps to ensure patient safety (Doyle, 2005, p. 13; [Dwibedi et al., 2011](file:///C%3A%5CDocuments%20and%20Settings%5Chpadmin%5CLocal%20Settings%5CTemporary%20Internet%20Files%5CContent.IE5%5CX5FX4N1P%5Cscope%2520paper%5B1%5D.docx#_ENREF_2), p. 1026). More than 30% of preventable adverse drug events occur during the step of administration, and only 2% of administration errors are intercepted before reaching the patient” ([Dwibedi et al., 2011](file:///C%3A%5CDocuments%20and%20Settings%5Chpadmin%5CMy%20Documents%5CDownloads%5Cscope%20paper%20%281%29.docx#_ENREF_2), p. 1026). Principles behind the BCMA system support the belief that medication errors can be reduced through the effective use of technology (American Hospital Association (AHA), Health Research and Educational Trust (HRET), & The Institute for Safe Medication Practices (ISMP), 2002, p. 3.1.4). Implementation of a BCMA system will decrease medication administration errors by requiring nurses to scan patient identification bands and medication barcodes to support the nurse in verifying the five rights of medication administration: right patient, right drug, right dose, right route, right time, and alerting the nurse to discrepancies and contradictions to medication administration ([Dwibedi et al., 2011](file:///C%3A%5CDocuments%20and%20Settings%5Chpadmin%5CMy%20Documents%5CDownloads%5Cscope%20paper.docx#_ENREF_2), p. 1027). Current literature supports the use of barcode technologies as a means for reducing medication errors. For example, a clinical trial at Beloit Memorial Hospital in Wisconsin reported an 86% reduction in medication errors after only one year of implementation ( [Dwibedi et al., 2011](file:///C%3A%5CDocuments%20and%20Settings%5Chpadmin%5CLocal%20Settings%5CTemporary%20Internet%20Files%5CContent.IE5%5CX5FX4N1P%5Cscope%2520paper%5B1%5D.docx#_ENREF_2), p. 1027). Therefore, this strategic planning team proposes the implementation of a BCMA system in the care setting to reduce medication administration errors.

**Environmental Risk Analysis**

**Description of Environment**

The bar code system will be implemented into a small, inpatient, surgical clinic in Phoenix, Arizona (Figure B1). There are no computers located in patient rooms, but wireless internet is accessible throughout the unit. Each computer is configured with the Paragon Health Information System (HIS), which integrates EHRs, CPOEs, and electronic medication administration records (eMARs). The staff is comprised of thirty nurses, five physicians, five nurse practitioners, six pharmacists, six respiratory therapists, and eight administrative staff. Each shift, five nurses, one physician, one respiratory therapist, one pharmacist, one nurse practitioner, and one physician monitor the patient care unit.

**Environmental Risk Analysis**

An environmental risk analysis was performed to determine threats to safe medication administration and security of patient health information (PHI) (Centers for Medicare and Medicaid Services (CMS), 2007, p. 1). Currently, environmental threats to safe medication administration consist of the location of computers and disposition of the medication room. Computers located outside of patient rooms result in nurses using paper MARs at the bedside. Paper presents threats to patient safety and confidentiality of PHI because it can only be used by one person at a time, is easily damaged, and can be lost (Coiera, 2003, p. 115.) Additionally, confidentiality of PHI is threatened by computer screens that are easily viewable to persons entering patient rooms (Bertin, 2009, p. 185). Implementation of a BCMA system will replace paper and protect PHI confidentiality by allowing nurses to use laptops at the bedside (Perry, Shah, & Englebright, 2007). Furthermore, manually entering data outside of patient rooms threatens data integrity by introducing the opportunity for errors and data manipulation (Bertin, 2009, p. 185). Replacement of manual data entry by a barcode scanner will allow for immediate, accurate, and complete charting (AHA, HRET, &ISM, 2002, p. 3.1.3). Lastly, a shared, poorly lit, cluttered medication room introduces distractions, whereas the BCMA system enables medications to be pulled at the bedside in a controlled, minimally disruptive environment (Perry, Shah, & Englebright, 2007).

Although the BCMA system prevents risks, it also presents new risks (Coiera, 2003c, p. 119). The placement of mobile medication carts to minimize disruptions in nurses’ workflows threatens confidentiality and integrity of PHI (Bertin, 2003, p. 191; AHA, HRET, & ISMP, 2002, p. 3.1.4). Therefore, equipment must be configured with automatic log offs and tracking software (Bertin, 2009, p. 191). Countermeasures for additional risks associated with technology, listed as ‘implemented’ in Table B1, were enabled prior to initiation of the current system and will remain in place after implementation of the BCMA system. Therefore, it can be determined that implementation of a BCMA system is appropriate, as it will prevent more environmental risks than it will produce.

**Systematic Analysis of Problem**

The GassertModel for Defining Information System Requirements for Nursing (MDISRN) was used to define requirements for a BCMA system that will enhance safe medication administration (Figure C1) (Gassert, 1996, p. 67). The BCMA system implemented in this facility will include the requirements discussed below.

**Nurse User Element**

Inputs in step I of the MDISRN were related to determine the medication administration related nursing functions that the BCMA system must support (Figure C2) (Gassert, 1996, p.70-71). The inputs were considered in relation to the constraints of professional goals set forth by JCAHO and the nursing value of safe medication administration (Gassert, 1996, p.72; Rich, 2004, p. 1355). According to JCAHO, identifying the correct patient, charting, and verifying medications through the five rights require information sources, such as, EHRs, CPOEs and eMARs (Rich, 2004, p. 1356).

**Information Processing Element**

Information processing requirements of the BCMA system, determined by integrating inputs in step II of the MDISRN (Figure C3), are required to support nursing information functions (Gassert, 1996, p. 72). The importance of integrating information processing requirements with nursing practice was accentuated by relating inputs to the constraints of prior experience and beliefs that information systems create additional work and decision support hinders practice (Bates et al., p. 525, 2003; Nagle, 2009, p. 141).

**Nursing Information Systems Element**

Inputs from step III of the MDISRN were analyzed to determine the appearance of outputs that will be obtained from using the BCMA system to process information (Figure C4) (Gassert, 1996, p.72). The new system will be linked to the legacy system to allow for the transfer of data and production of eMARs (Figure C5) and alerts (Figure C6), which will appear on the screen of the BCMA system’s laptop (Gassert, 1996, p. 72). Constraints of software and hardware malfunctions, costs, and support for nurses were evaluated using an environmental risk analysis, cost-benefit analysis, and educational plan.

**Nursing Information Element**

Inputs from step IV of the MDISRN were combined and considered in relation to constraints of professional standards and ethical beliefs to determine data required for the performance and documentation of information functions (Figure C7) (Gassert, 1996, p. 73). Data will be standardized between systems to ensure accurate exchange (Hardiker, 2009, p. 98). Additionally, security of data was evaluated using a risk analysis to determine necessary measures for the protection of the ethical beliefs of privacy and confidentiality (Mastrian, McGonigle, & Farcus, 2009, p. 152).

**Nursing System Goals Element**

Lastly, inputs from step V of the MDISRN were compared to determine that the benefits of the BCMA system will decrease medication errors (Figure C8) (Gassert, 1996, p. 73; Doyle, 2005, p.11). Ensuring benefits of the system will require consideration of both the cost of system maintenance and the “vast difference in computer literacy and information management skills that healthcare workers possess” (Kenney, Androwich, 2009, p. 116)

**Feasibility of Solution**

Feasibility of BCMA within the organization must be taken into account prior to implementation. Current environmental conditions, including existing systems, should be considered, along with the organization’s clinical and strategic goals (McDowell, Wahl, & Michelson, 2003, p. 64). Return on investment (ROI) expectations, to include financial and clinical categories, are also measured (McDowell et al., 2003, p. 64). Upon appraisal of these components, BCMA technology appears to be a feasible solution for the organization.

**Environmental Conditions and Organizational Objectives**

 The solution of BCMA fits within the constraints of the organization’s current environmental conditions and objectives. Hardware and software selections are appropriate for the size of the facility, patient load, and number of staff, and also integrate well into existing information systems, as described in greater detail in the hardware and software portions of this proposal. The addition of BCMA will support the organization’s objectives of increasing patient safety, minimally increasing staff time requirements, improving staff job satisfaction in relation to patient safety, and improving patient satisfaction through the prevention of medication errors (Work, 2005). The BCMA system will be evaluated to ensure it supports the work of clinicians and incorporates well into clinician workflow (McDowell et al., 2003, p. 64). Finally, a readiness assessment will be conducted to confirm viability of implementation (AHA, HRET, & ISMP, 2002, p. 3.2.1).

**Return on Investment**

 Financial and clinical categories were evaluated for ROI, helping to determine the feasibility of BCMA. When considering the financial component, adverse drug events (ADEs) occur 28.4 times per year for the average hospital and are estimated to carry a direct cost of $2257 per event (Healthcare Information and Management Systems Society [HIMSS], 2003, p. 30). Prevention of this incurred cost is where the true financial benefit of BCMA implementation becomes clear. The benefit of costs avoided by the prevention of ADEs outweighed total implementation plan costs and annual BCMA operating costs (Appendix D). This prevention of ADEs carries over into clinical ROI by demonstrating a reduction of medication errors and improving patient safety (McDowell et al., 2003, p. 64). Current users of BCMA technology report reduction of medication error rates ranging from 70 to 86 percent (HIMSS, 2003, p. 29). This reduction of errors may also improve utilization of nursing time, leading to higher-quality care (HIMSS, 2003, p. 31).

**Hardware/Software Selection**

The facility’s current Microsoft Windows based system, including hardware, software, and wireless network, will remain in use with implementation of the BCMA system (see Appendix E) (G. Slattery, Personal Communication, November 22, 2011). In addition, implementation of the BCMA system in the facility (Appendix A) will require utilization of the hardware and software listed below.

**Hardware**

 Implementation of the BCMA system will institute the addition of 6 Howard Hi Pinnacle medication carts (WOWs). The top of each WOW will be equipped with a HP Pavillion dm1z laptop computer and a wireless mouse (Howard Medical, 2011). Drawers on the WOW will create a configurable storage area and electronic locking system, allowing for safe storage of medications in individual patient bins (Howard Medical, 2011). Additionally, each WOW will include a lithium battery for sustained use by the nurse, along with the Honeywell Xenon 1900 bar-code scanner, which was chosen for its high percent of readability (G. Slattery, Personal Communication, November 22, 2011). One barcode scanner will be tethered to each WOW and placed in a docking station to allow for longer battery life (G. Slattery, Personal Communication, November 22, 2011; Honeywell, n.d.).

Zebra Technologies manufactures the HC 100 Wristband printer, which will be used to dispense thermal 2 dimensional barcode patient identification wristbands (Zebra Technologies, 2011). Wristbands will be scannable for up to 14 days, positively impacting patient safety (Zebra Technologies, 2011).

 With implementation of the BCMA system, the McKesson PROmanager-RX dispensing system will serve as the primary medication distribution center (McKesson Corporation, 2010; McKesson Corporation, 2011b). The PROmanager RX will allow nurses to administer patient medications directly from the WOW by dispensing medication into individual patient bins (McKesson Corporation, 2011b). AcuDose, the facilities current medication dispensing system, which runs on a Connect-RX platform that is interfaced with the Paragon system, will serve as a secondary dispensing system.

**Software**

The McKesson Paragon HIS, currently implemented, will be the software used to support the BCMA system. This HIS was chosen for its ability to meet Meaningful Use as defined by Healthcare Information Technology for Economic and Clinical Health Act (HITECH) (McKesson Corporation, 2011a). For the past four years, Paragon HIS has been ranked as the top community hospital information system for smaller environments by KLAS Research (KLAS, 2011). Along with the high ratings of Paragon, the system is user friendly, running on a Microsoft platform, and cost effective, due to the lack of hardware required for implementation of the software (McKesson Corporation, 2011a).

**Implementation Plan**

The complete implementation plan, or work plan, for BCMA was developed using Kurt Lewin’s Change Management Model in conjunction with literature documenting other organizations’ successful implementation strategies. This portion of the proposal will identify theories and rational for the work plan. Details of the plan, along with project dates, are included in Appendix F.

**Project Stages**

 The project is divided into four stages, which were created through utilizing themes present in existing literature. The strategic planning stage focuses on the development of a multi-disciplinary team (MDT), current situation analysis, and identification of problems and solutions to the current situation (McDowell et al., 2003, p. 63-4). The decision stage includes identification of organizational objectives and vendor selection (McDowell et al., 2003, p. 65). Additionally, the decision stage contains components, such as product testing and assessment of clinician workflow, which form the beginnings of the evaluation plan (Agency for Healthcare Research and Quality [AHRQ], 2008, p. 4; HIMSS, 2003, p.7). The implementation stage features expansion of the MDT to include additional end -users, along with development and execution of a roll-out plan and an education plan (HIMSS, 2003, p. 7; Protocare Sciences, 2001b, p. 1). Finally, the post-implementation evaluation stage is further continuation of the evaluation plan, focusing on the critical components of staff feedback and success of the solution (Work, 2005).

**Lewin’s Change Management Model**

 Lewin’s model was chosen for this organization because of its demonstrated applicability to inpatient healthcare environments and the model’s focus on identifying human factors pertinent to successful implementation (Suc, Prokosch, & Ganslandt, 2009, p. 419). Application of Lewin’s model includes field theory, group dynamics, action research, and three steps of change (Suc et al., 2009, p. 421). Figure F6 demonstrates specific tasks of the work plan that address the applied model components. Field theory involves the identification of field forces, or viewpoints, that can facilitate or constrain a project (Suc et al., 2009, p. 422). Field theory was addressed during the strategic planning stage of the work plan to identify forces relevant to the project early on (Suc et al., 2009, p. 422). Group dynamics considers the influence that group culture has on the individual and suggests the focus for change should be aimed at the group level to be successful (Suc et al., 2009, p.421). The developed work plan satisfies this component by taking a multidisciplinary approach throughout the plan and fostering organizational support from the beginning stages (Suc et al., 2009, p. 422). Action research involves creating a sense of need for change within the group, which is fostered early on in the work plan (Suc et al., 2009, p.421). The three steps of change, *unfreeze, move,* and *refreeze*, take place throughout the plan. The *unfreeze* step focuses on sensitization to the problem and feedback on solutions (Suc et al., 2009, p. 422). The *move* step involves training and feedback, which is incorporated into the education and evaluation plans described later in this proposal (Suc et al., 2009, p. 422). Finally, the *refreeze* step occurs later in the work plan, through feedback portions of the evaluation plan and post-implementation evaluation stage (Suc et al., 2009, p. 423).

 **Education Plan**

An education plan was designed following the DIVERGENT training program methodology (Appendix G) (Mercer & Felt, n.d.).

**Define**

During the define phase, the audience, resources needed for training, and strategies for education were determined (Mercer, &, N.D). Necessary resources were found to include a six person MDT to train end- users. Multiple methods of education were chosen to train both the MDT and end-users because blended coursework enhances education and promotes advanced learning (Brandt et al., 2009, p.e-167).

**Design**

The Design phase consisted of defining curricula, creating lesson plans, defining a timeline, and creating a practice system (Mercer. Felt, n.d.). During the initial implementation plan it was determined that training for BCMA will last two and a half months, with the first 2 months of training being dedicated to the MDT. Afterwards, each end-user will attend one four hour class over the following two weeks. Curricula taught during this time will contain material about the BCMA system that is meaningful to end-users (Ball, 1996).

**Direct**

During the direct phase, MDT members will work closely with vendors to create an efficient training program for all end- users (Mercer, & Felt, n.d.). Training for the MDT will be taught by McKesson representatives and include power point presentations, online modules, and hands on activities. Each class will meet once a week and last for four hours. At the end of the two months, members of the MDT will direct a simulated training course to demonstrate proficiency (Mercer & Felt, n.d.)

**Deliver**

During the deliver phase, end-users will each attend one four-hour class taught by members of the MDT. The environment will promote learning through physical comfort, mutual respect, and freedom of expression, also facilitators will actively encourage learning by providing goals and aiding learners in applying new material to real-life experiences (Ball, 1996). Along with power point presentations, self- directed online modules will be used for training because of their appeal to adult learners (Ball, 1996). Additional class activities will include hands on training with the scanning equipment to promote confidence in users. End-user testing will be used to evaluate proficiency of BCMA use and end- users will be provided the opportunity to evaluate the effectiveness of training by completing surveys (Mercer & Felt, n.d.).

**Distill**

End-users will continue their training outside of the classroom during the distill phase. Influenced by the BCMA system rollout at Bloomington Hospital in Indiana, the computer based training programs will be implemented on desktop computers throughout the unit, allowing for staff to practice BCMA scenarios on their own time (Vaughn, 2011, p.E2). One member of the MDT will function as a super-user during the first month of implementation in the practice setting, allowing for cost-efficient use of staffing resources. The need for continued support will be re-evaluated prior to removal of the MDT and feedback collected from end-users will be considered during re-evaluation of the education plan (Mercer & Felt, n.d.).

 **Evaluation Plan for BCMA**

 It is imperative that the BCMA system undergoes an iterative, user-centered process of functionality and usability evaluations throughout the design and implementation phases prior to utilization in the clinical setting (Jaspers, 2009).

**Functional analysis**

 The BCMA system was selected because it fulfills the requirements for nursing information systems identified by the Gassert MDISRN model (Gassert, 1996). The BCMA system will be linked to the legacy information system and multiple domain interfaces within the facility to allow transfer of data across these systems (Figure H1 ) (AHA, HRET, &ISM , 2002, p. 3.1.3 ; Gassert, 1996, p. 72). A functional analysis framework was developed to evaluate the efficiency of the BCMA system’s ability to communicate with the EHR and domain interfaces within the hospital’s information system (Figure H1). In addition, the framework illustrates the relationship of the information system entities and their interaction with BCMA to achieve the end-user goal of successful medication administration (Johnson, Johnson, & Zhang, 2005, P. 78).

**Cognitive walkthrough and keystroke level model**

Following the functional analysis framework evaluation, effective communication between domain interfaces and initial usability of the BCMA will be evaluated using a cognitive walkthrough method involving a keystroke level model. The cognitive walkthrough evaluation method was selected to evaluate the BCMA because of its structured approach to carrying out the tasks the users will perform (Jaspers, 2009, p. 343). With this approach, usability specialists and members of the aforementioned multidisciplinary team (see Education Plan section) will function as the novice end- users carrying out the tasks of the BCMA system (Jaspers, 2009). By evaluating each step required to perform a task, the cognitive walkthrough will help detect potential mismatches between designers’ and users’ conceptualizations of the tasks and potential usability problems with the BCMA process (Jaspers, 2009, p. 343). Designers will use this information to improve usability of the BCMA system before it is implemented. During the cognitive walkthrough, members of the aforementioned MDT and informatics specialists will evaluate each interface domain (i.e. pharmacy, lab, CPOE, EHR, etc.) through a keystroke level model. While each task is being completed by the end-user, keystroke level analysis will evaluate the execution time required for information to be transmitted from the BCMA system to each domain interface (Johnson, Johnson, & Zhang, 2005, p. 78). By evaluating the system at the keystroke level, specialists will be able to identify connectivity issues with other interfaces of the information system (Johnson, Johnson, & Zhang, 2005, p. 78).

**End-user usability testing**

After the BCMA usability is evaluated through cognitive walkthrough analysis, the system will undergo further usability testing through end-user evaluations. All end-users will participate in usability testing to evaluate a BCMA prototype to accomplish real-world tasks in the simulated work setting (Effken, 2009, p. 71). This testing will take place during the BCMA education sessions and will evaluate the time needed by end-users to complete the tasks, their accuracy in the tasks, and their satisfaction with application’s usability (through satisfaction questionnaires completed after their education session) (Effken, 2009, p. 71). This form of evaluation will help to reveal issues interfering with usability of the application that can be corrected prior to implementation (Effken, 2009, p. 71).

**Post-implementation evaluation**

The usability and efficacy of the BCMA system will be reevaluated after implementation in the practice setting through completion of Doyle’s (2005) BCMA Utilization Questionnaire by end -users (Figure H2). This questionnaire evaluates usability by assessing users’ adherence to the BCMA protocol, identifying workarounds that may have been developed to deal with usability issues (Doyle, 2005, p. 71). Workarounds can induce more opportunity for error, therefore it is important to continually address usability issues within the BCMA system (Doyle, 2005, p. 71). Using the pre-existing adverse-event documentation application included in the information system, the efficacy of the BCMA system will be evaluated by analyzing the incidence of ADEs pre- and post- BCMA implementation (Doyle, 2005, p. 67-69).

**Solutions for identified usability issues**

Lack of connectivity between BCMA software and other domain interfaces within organizations has been identified as a major barrier to usability (Mims, Tucker, Carlson, Schnieder, & Bagby, 2009). To resolve connectivity issues between the BCMA and other interfaces (Figure H1), IT specialists will integrate standardized codes and terminologies (i.e. NANDA, SNOMED CT, ICNP, etc.) between the BCMA application and the information system software already in place to ensure that data can be transmitted across the system (McDowell & Michelson, 2003; Hardiker, 2009).

 According to Mims et al. (2009), poor print quality of barcode labels, inappropriate label placement, and lack of barcode labels are also major contributors to usability problems and can perpetuate the use of workarounds by end-users of the BCMA application (p. 1125). To ensure that all medications are properly labeled with barcodes and can be recognized and decoded by scanners, the BCMA application will employ a pharmacy barcode verification process (Figure H3). During the process, the pharmacy will establish a barcode archive through manual scanning of all externally printed medication barcodes, linking these barcodes to their specific medication identification file (Mims et al., 2009, p. 1127). The pharmacy will also utilize the PROmanager-Rx system and in-house barcode printers to properly label every medication with scannable barcodes, facilitating the medication administration process at the point of care (Mims et al., 2009, p. 1125-1127).

**Potential Issues**

 It is important to identify and determine how to manage and resolve issues that may arise during implementation of the BCMA system. Social issues, including non-compliance of staff members with the new BCMA system, may pose barriers to successful implementation (Kaplan & Harris-Salamone, 2009, p. 292). Establishing a collaborative MTD during the design and evaluation processes of the BCMA system will ensure that all users of the application will be represented and that the implementation of BCMA will enhance users’ workflow (Kaplan & Harris-Salamone, 2009, p. 294-296). Ergonomic issues, such as interruptions of nurse’s workflow because of lack of available workstation on wheels (WOW), may also contribute to non-compliance with the application. WOWs will be readily available and set up to be user-friendly (e.g. placed in convenient locations) so as to minimize any disruption of a nurse’s workflow (AHA, HRET, &ISM, 2002, p. 3.1.4). The costs necessary to purchase BCMA equipment are significant and may create economic issues within the organization. However, when evaluating the ROI of this system (Appendix D), the financial benefits of BCMA outweigh the system costs through its prevention of ADEs (HIMSS, 2003, p. 30). Furthermore, given its potential to improve medication safety, BCMA technology may qualify for federal funding because it meets the definition of “meaningful use” under the American Recovery and Reinvestment Act of 2009 (Poon et al., 2010, p. 1699).

Ethical, legal, and security issues may also arise with implementation of the BCMA system. Through BCMA, one of the major principals of healthcare ethics, nonmaleficence, is promoted by preventing harm to patients by reducing the occurrence of ADEs (Mastrian, McGonigle, & Farcus, 2009, p. 155). Negative beneficence may occur in response to the BCMA system as the scanning process constrains administration of emergency medications by the clinician if these medications are not listed within the patient’s eMAR (Mastrian, McGonigle, & Farcus, 2009, p. 155). To rectify this issue, a process of overriding the program’s error message for emergency situations will be established, allowing the clinician to scan and document the administration of the emergency medication to the patient (Early, Riha, Martin, Lowdon, & Harvey, 2011). Both security and legal issues may arise as data from BCMA software is transmitted across the facility’s informatics system interfaces through wireless Internet. To minimize these issues, the software within the BCMA application will comply with electronic transaction and code set standards as established by HIPAA (McGonigle, Mastrian, & Farcus, 2009, p. 172).

**Conclusion**

This proposal encompasses a plan for the implementation of a BCMA system to ameliorate the problem of medication administration errors. The environmental analysis, system analysis, and cost-benefit analysis indicate that implementation of a BCMA application would prove beneficial to this facility. End-users will undergo education and the BCMA system will be evaluated to enhance usability and implementation success. The efficacy and usability of the BCMA application will continue to be evaluated post-implementation. Through implementation of the BCMA system, the facility will be utilizing informatics technologies to address the problem of medication administration errors.

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Appendix A

Nurse puts password into AcuDose

Nurse chooses patient in AcuDose system

Nurse pulls out desired medication

At bedside, nurse checks medication against paper MAR and patient ID

Nurse administers medication to patient

Nurse charts medication outside room in EHR

**Current Process**

Health care provider enters medication order into EHR.

Pharmacist checks order for clinical assessment and accuracy.

Nurse scans badge at WOW and selects patient & individual patient bin. If add’l meds are needed, RN can obtain from AcuDose.

Nurse takes WOW into patient’s room and scans badge ID with BCMA.

**Bar-Code-Assisted Medication Administration (BCMA) Process**

Using BCMA, the nurse scans each medication to be given to patients.

If no warning of error received from BCMA, the nurse administers the medication to the patient.

The BCMA system automatically updates EHR that all medications were given.

Nurse scans patient’s wristband with BCMA.

*Figure A1.* Comparison of current process to new BCMA process. Adapted from “Integrating technology to improve medication administration,” A.E. Prusch, T.M. Suess, R.D. Paoletti, S.T. Olin, and S.D. Watts, 2011, *American Journal of Health-System Pharmacy, 68(9)* p. 836.

Appendix B

Room 4

Room 3

Room 2

Room 1

Room 15

Room 14

Room 13

Room 12

Room 11

Room 10

Room 9

Room 8

Room 7

Room 6

Room 1

*Figure B1.* Diagram of the environment of the inpatient surgical clinic. Diagram is not to scale.

Legend

AcuDose Medication Dispenser

Machine

Patient Room

Workstation

All in one printer, scanner, and fax machine

Patient Supplies

Telephone

Desktop Computer

Med

Room

|  |
| --- |
| Table B1Environmental Risk Analysis |
| Risk Description | Probability of Risk | Severity of Risk | Countermeasures | Status of Countermeasure |
| Environmental disasters (floods, hurricanes, tornadoes) damaging and inhibiting access to PHI (CMS, 2007, p. 4) | Low | High | Contingency plans for accessing and charting PHI during emergencies (CMS, 2007, p. 18) | Implemented |
| Technology malfunctions and power outages inhibiting access to PHI (CMS, 2007, p. 4 ) | Medium  | Medium  | Contingency plans for accessing PHI, charting PHI, and placing orders during emergencies (CMS, 2007 , p. 18)  | Implemented |
| Hackers using computers and wireless internet to access PHI (Bertin, 2009, p. 190) | Medium | Medium | Password requirements, firewalls, antiviruses, and encryption of data (Bertin, 2009, p. 186, 189, 190) | Implemented |
| Paper MARs being lost or destroyed (Coiera, 2003, p. 115) | High | Medium | Mobile BCMA system for access to PHI at the bedside(Perry, Shah, & Englebright, 2007) | Proposed  |
| Location of computer screens next to patient rooms threatening confidentiality of PHI (Bertin, 2009, p. 185) | High | Medium | BCMA system laptops with configurable screens (Howard Medical, 2011.) | Proposed |
| Manual data entry introducing possibility for errors and data manipulation (Bertin, 2009, p. 185) | High | Medium | BCMA system barcode scanners for immediate, accurate, and complete charting (AHA, HRET, & ISMP, 2002, p. 3.1.3) | Proposed  |
| Shared, cluttered, poorly lit medication room introducing distractions (Perry, Shah, & Englebright, 2007) | High | High | Mobile BCMA system to allow for medications to be pulled at the bedside (Perry, Shah, & Englebright, 2007 ) | Proposed |
| Easy accessible, mobile medication carts threatening PHI confidentiality and data integrity (Bertin, 2003, p. 191; AHA, HRET, & ISMP, 2002, p. 3.1.4) | Medium | Medium | Automatic log offs and tracking software for BCMA(Bertin, 2009, p. 191) | Proposed  |
|  |
|  |  |  |  |  |

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*Note*. PHI= patient health information; BCMA= barcode medication administration system. Low probability of risk= 0-25% chance of threat occurring; Medium probability or risk= 25-50% chance of threat occurring; High probability or risk = 50-75% chance of threat occurring. Low severity of risk = no immediate threat to security of PHI or patient safety; Medium severity of risk= immediate threat to security of PHI; High severity of risk = immediate threat to patient safety. Adapted from “Risk Register Template,” by N.M. Baker, 2011, *Bright Hub*, Copyright 2011 by Project Management Media Gallery.

Appendix C

**II. Information Processing** **Element**

**I. Nurse User Element**

v.

IV.

III.

II.

Compare NDR, NSO and NSG to describe system benefits

Combine NSO and AD to determine nursing data requirements

Relate NF, PR, and IHN to identify nursing information functions

III

**Inputs**

Nursing Data Requirements (NDR)

Nursing System Outputs (NSO)

Nursing System Goals (NSG)

**Output**

Nursing System Benefits (NSB)

**IV. Nursing Information Element**

**Inputs**

Nursing System Outputs (NSO)

Available Data (AD)

**Output**

Nursing Data Requirements (NDR)

**V. Nursing System Goals Element**

I. Nurse User Element

**Inputs**

Nursing functions (NF)

Information Handling Needs (IHN)

Practice Responsibilities (PR)

**Output**

Nursing Information Functions (NIF)

**Inputs**

Nursing Information Functions (NIF)

Practice Responsibilities (PR)

**Output**

Nursing Informatics Processing Requirements (NIPR)

Constraints

Constraints’

I.

Integrate NIF and PR to describe nursing information processing requirements

Relate NF, PR, and IHN to identify nursing information functions

**Definition of Requirements for a Nursing Information** **System**

**III. Nursing Information Systems Element**

*Figure C1*.Model used to identify requirements of a nursing information system. Adapted from “Defining Information Requirements Using Holistic Models: Introduction to a Case Study,” by C.A. Gassert, 1996, *Holistic Nursing Practice*, 11(1), p. 68. Copyright 1987 by Carole A. Gassert.

Analyze NIPR, CSC and ECS to identify nursing system outputs

Constraints

**Inputs**

Nursing Information Processing Requirements (NIPR)

Computer System Characteristics (CSC)

Existing Computer Systems (ECS)

**Output**

Nursing System outputs (NSO)

Constraints

Constraints

**I.** **Identify nursing informatics functions by relating NF, IHN, and PR and considering inputs in relation to constraints of professional standards and nursing values**

*Figure C2*. Diagram of the process used to determine nursing information function requirements. Adapted from “Defining Information Requirements Using Holistic Models: Introduction to a Case Study,” by C.A. Gassert, 1996, *Holistic Nursing Practice*, 11(1), p. 68. Copyright 1987 by Carole A. Gassert.

**Output**

**Nursing Information functions (NIF)**

* Confirming orders and administration times (Doyle, 2005, p. 16)
* Selecting correct medication and dose (Doyle, 2005, p. 16)
* Identifying correct patient (Doyle, 2005, p. 16)
* Verifying that there are no contradictions to medication administration (Rich, 2004, p. 1356)
* Using the correct route of administration (Doyle, 2005, p. 16)
* Accurately charting medications

JACHO professional goals of safe medication administration

Nursing Value of safe and accurate medication administration

**Nursing functions (NF)**

Identifying orders and administration time (Doyle, 2005, p.16)

* Selecting medication and dose (Doyle, 2005, p. 16)
* Checking medication expiration date (Rich, 2004, p. 1356)
* Checking stability of medication (Rich, 2004, p. 1356)
* Identifying patient (Doyle, 2005, p. 16)
* Verifying that there are no contradictions to medication administration ( Rich, 2004, p. 1356)
* Administering medication (Doyle, 2005, p. 16)
* Charting medications

**Practice responsibilities (PR)**

* Safe medication administration (Doyle, 2005, p. 13)

**Information Handling Needs (IHN)**

* EHR (AHA, HRET, & ISMP, 2002, p. 3.2.12)
	+ Containing demographic information, clinical information, and patient monitoring information
* eMAR (AHA, HRET, & ISMP, 2002, p. 3.2.12)
* CPOE (AHA, HRET, & ISMP, 2002, p. 3.2.12)
* Protocols (AHA, HRET, & ISMP, 2002, p. 3.2.12)
* Computerized drug reference information (AHA, H ET, & ISMP, 2002, p. 3.2.12)

**I. Nurse User Element**

**II.** **Integrate NIF and PR and relate inputs to constraints of clinical experiences and nursing beliefs to describe nursing information processing requirements**

*Figure C3*. Diagram of the process used to determine nursing information processing requirements of a BCMA system. Adapted from “Defining Information Requirements Using Holistic Models: Introduction to a Case Study,” by C.A. Gassert, 1996, *Holistic Nursing Practice*, 11(1), p. 68. Copyright 1987 by Carole A. Gassert.

Prior Clinical experience of working with systems that create additional work

Nursing beliefs that decision support hinders practice

 **Inputs**

**Nursing Information functions (NIF)**

* Confirming orders and administration times (Doyle, 2005, p. 16)
* Selecting correct medication and dose (Doyle, 2005, p. 16)
* Identifying correct patient (Doyle, 2005, p. 16)
* Verifying that there are no contradictions to medication administration (Rich, 2004, p. 1356)
* Using the correct route of administration (Doyle, 2005, p. 16)
* Accurately charting medication

**Practice responsibilities (PR)**

* Safe medication administration (Doyle, 2005, p. 13)

**Output**

**Nursing Information Processing Requirement (NIPR)**

* Patient specific lists of both scheduled and PRN medications, time of administration, doses, routes, and parameters for administration (Rich, 2004, p. 1356 )
* Automatically chart administered and held medications (Doyle, 2005, p. 20*)*
* Alerts for allergies, unsafe doses, drug-lab problems (AHRQ, 2009)

**II. Information Processing Element**

**III.** **Analyze NIPR, CSC, and ECS and relate inputs to constraints of computer technology, clinician support, and cost to identify nursing system outputs**

*Figure C4*. Diagram of the process used to determine nursing system output requirements of a BCMA system . Adapted from “Defining Information Requirements Using Holistic Models: Introduction to a Case Study,” by C.A. Gassert, 1996, *Holistic Nursing Practice*, 11(1), p. 68. Copyright 1987 by Carole A. Gassert.

Hardware and software malfunctions

Cost

Need for clinician support

**Outputs**

**Nursing System Outputs (NSO)**

* MAR on BMAS laptop screen (McKesson, 2011a)
* Alerts on BMAS laptop screen (McKesson, 2011a)

**Computer System Characteristics (CSC)**

* McKesson Paragon Hospital Information System (HIS) (McKesson Corporation, 2011a)
* Cisco 2951 Integrated Services Router and Cisco Catalyst 2960 (G. Slattery, Personal Communication, November 22, 2011)
* Howard Hi Pinnacle medication carts (WOWs) (Howard Medical, 2011 )
* Barcode Scanner (Honeywell, n.d)
* HP Pavillion dm1z laptop computers (Howard Medical, 2011 )
* McKesson PROmanager-RX dispensing system (McKesson, 2011b )
* HC 100 Wristband printer (Zebra Technologies, 2011 )

**Existing Computer Systems (ECS) (**G. Slattery, Personal Communication, November 22, 2011)

* McKesson Paragon Hospital Information System (HIS)
* Microsoft SQL Server 2008 R2 Datacenter database
* Intel Xeon 5100 series processor
* Windows Server 2008 SP2 64-bit x64 Datacenter with 4 GB RAM
* Hewlett Packard (HP) 5510 Thin-Client workstations
* Cisco 2951 Integrated Services Router and Cisco Catalyst 2960
* AcuDose

**III. Nursing Information Systems Element**

 **Inputs**

**Nursing Information Processing Requirement (NIPR)**

* Patient specific lists of both scheduled and PRN medications, time of administration, doses, routes, and parameters for administration (Rich, 2004, p. 1356)
* Automatically chart administered and held medications (Doyle*, 2005, p. 20*)
* Alerts for allergies, unsafe doses, drug-lab problems (AHRQ, 2009)

|  |
| --- |
| **Patient Name Patient Identification Number Allergies** |
| **Scheduled Medications** | **0700** | **0800** | **0900** | **1000** | **1100** | **1200** |
| Medication A |  | Medication A |  |  |  | Medication A |
| Medication B |  |  |  |  |  | Medication B |
|  |  |  |  |  |  |  |
| **PRN Medications** |  |  |  |  |  |  |
| Mediation AA |  |  |  |  |  |  |
| Medication BB |  |  |  |  |  |  |
|  |
| **Continuous fluids** |  |  |  |  |  |  |
| Medication AAA |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Discontinued Medications**  |  |  |  |  |  |  |
| MedicationAAAA |  |  |  |  |  |  |
| MedicationBBBB |  |  |  |  |  |  |

Medication

Dose

Route

Frequency of Administration

Contradictions to Administration

*Figure C5*. Example of a MAR screen output as seen on the laptops of the barcode medication administration system. Scrolling over any boxes with a medication name will produce a smaller box stating the medication name, dosage, route of administration, frequency of administration and contradictions to administration. Scanning the patient’s identification bands and medications will automatically chart medications in the box corresponding with the appropriate medication and time.

|  |
| --- |
| **Warning**Patient has allergy to ZosynOverrideAccept |

*Figure C6*. Example of the alert screen output as seen on the laptops of the barcode medication administration system.

**IV. Combine NSO and AD and relate inputs to constraints of professional standards and ethical beliefs to determine nursing data requirements**

*Figure C7*. Diagram of the process used to determine nursing data requirements of a BCMA system. Adapted from “Defining Information Requirements Using Holistic Models: Introduction to a Case Study,” by C.A. Gassert, 1996, *Holistic Nursing Practice*, 11(1), p. 68. Copyright 1987 by Carole A. Gassert.

Ethical beliefs of privacy and confidentiality

Lack of professional standards for standardization of data

**Outputs**

**Nursing Data Requirements (NDR)**

* Orders from CPOE
* Medications (administered and held), time, administration route, parameters for administration from MAR
* Demographic information, clinical information (allergies, histories, home meds, allergies), patient monitoring information (vital signs, labs) found in the EHR
* Medication administration protocols
* Computerized drug information

 **Input**

**Nursing System Outputs (NSO)**

* MAR on BMAS laptop screen (McKesson, 2011a)
* Alerts on BMAS laptop screen (McKesson, 2011a)

**Available Data (AD)**

* Orders from CPOE (McKesson, 2011a )
* Medications (administered and held), administration time, administration route, parameters for administration from MAR ( McKesson, 2011a)
* Demographic information, clinical information (allergies, histories, home meds, allergies), patient monitoring information (vital signs, labs) found in the EHR ( McKesson, 2011a)
* Medication administration protocols
* Computerized drug information

**IV. Nursing Information Elements**

**V.** **Compare NDR, NSO, and NSG to relate to constraints of user capabilities and cost to describe nursing system benefits**

**Outputs**

**Nursing systems benefits (NSB)**

* Improve patient safety (Doyle, 2005, p. 11)
* Decrease medication errors (Doyle, 2005, p. 11)
* Improve documentation of medication administration (Doyle, 2005, p. 11)
* Capture medication accountability data (Doyle, 2005, p. 11)

**Nursing System Outputs (NSO)**

* MAR on BMAS laptop screen (McKesson, 2011a)
* Alerts on BMAS laptop screen (McKesson, 2011a)

**Nursing System goals (NSG)**

* List of all medications due for assigned patients (Doyle, 2005, p. 20)
* Confirmation of matches for right patient, medication, dose, route, time (Doyle, 2005, p. 16)
* Alerts (AHA, HRET, & ISMP, 2002, p. 3.1.3)
* Automatic documentation (Doyle, 2005, p. 20)

 **Inputs**

**Nursing Data Requirements (NDR)**

* Orders from CPOE
* Medications (administered and held), time, administration route, parameters for administration from MAR
* Demographic information, clinical information (allergies, histories, home meds, allergies), patient monitoring information (vital signs, labs) found in the EHR
* Medication administration protocols
* Computerized drug information

**V. Nursing System Goals Element**

*Figure C8*. Diagram of the process used to determine nursing system benefits of a BCMA system. Adapted from “Defining Information Requirements Using Holistic Models: Introduction to a Case Study,” by C.A. Gassert, 1996, *Holistic Nursing Practice*, 11(1), p. 68. Copyright 1987 by Carole A. Gassert.

Cost of system care and upgrades

Vast difference in user capabilities

Appendix D

**Estimated Costs For BCMA**

*Hardware*

6 HP laptops with recommended configuration = $469.99 x 6 = $2819.94 (Hewlett-Packard Development Company, 2011)

6 Howard Cart with Hi Pinnacle small keyboard with HC150 iron = $12278.39 x 6 = $73670.43 (T.K. Ketterhaggen, Personal Communication, November, 30, 2011)

6 Honeywell Xenon scanners = $329.99 x 6 = $1979.94 (Howard Technology Solution, 2011)

 1 Zebra 100 HC barcode printer = $4850 (Zebra Technologies, 2011)

 Hardware installation fee included in consultant salary and hardware prices = 0

 Total = $83320.31

*Software*

 Included in EHR software, no additional costs = 0

*Consulting Costs for System Configuration/Implementation*

 Nurse Informatics Specialist 1 year, part-time = $49351.50 (HIMSS, 2011, p. 8)

*Staffing for Training and Implementation*

 Salaried Staff (minimal time investment)

 Administration, included in salary = 0

 Providers, included in salary = 0

 Hourly Staff

 Respiratory Therapy

 $26.54 per hour (Bureau of Labor Statistics [BLS], 2010c)

 Stage 1- 1 person- 20 hours = $530.80

 Stage 2- 1 person- 200 hours = $5308

 Stage 3- 1 person- 250 hours = $6635

 - 5 staff- 4 hours x 5 = 20 hours = 530.80

 Stage 4- 1 person- 130 hours = $3450.20

 Pharmacy

 $52.59 per hour (Bureau of Labor Statistics [BLS], 2010a)

 Stage 1- 1 person- 20 hours = $1051.80

 Stage 2- 1 person- 200 hours = $10518

 Stage 3- 1 person- 250 hours = $13147.50

 - 5 staff- 4 hours x 5 = 20 hours = $1051.80

 Stage 4- 1 person- 130 hours = $6836.70

Nursing

 $32.56 per hour (Bureau of Labor Statistics [BLS], 2010b)

 Stage 1- 1 person- 20 hours = $651.20

 Stage 2- 1 person- 200 hours = $6512

 Stage 3- 3 persons- 250 hours x 3 = 750 hours = $24420

 - 27 staff- 4 hours x 27 = 108 hours = $3516.48

 Stage 4- 1 person- 130 hours = $4232.80

 Total = $88393.08

|  |
| --- |
| Table D1*Estimated Cost Savings Worksheet* |
| A. Estimated Annual Hospital Costs Related to Preventable Adverse Drug Events (ADEs)  |
| 1. Number of hospital admissions (per year)  | 1500 |
| 2. Estimated number of total preventable ADEs (per year)\* | 21 |
| 3. Estimated hospital costs attributed to preventable ADEs (per event)\* | $5000 |
| 4. Total annual costs related to preventable ADEs (A2 x A3): | $105000 |
| B. Estimated Annual Costs for Technology |
| 1. Software license (perpetual license, one-time) | 0 |
| 2. Monthly support fees | 0 |
| 3. Hardware cost | $16664.06 |
| 4. Installation fee (for hardware) | 0 |
| 5. Implementation/consulting costs for system configuration | $9870.30 |
| 6. Training and implementation (staffing) | $17678.62 |
| 7. Total costs for technology (sum B1-B6) | $44212.98 |
| C. Estimated Annual Cost Avoidance Using Technology to Address Medication Errors |
| 1. Preventable ADEs due to dispensing = (11%) x (A4)\* | $11550 |
| 2. Preventable ADEs due to administration = (38%) x (A4)\* | $39900 |
| 3. Total cost savings (C1 + C2) | $51450 |
| D. Estimated Cost Avoidance Using Technology to Address Medication Errors  |
| C3 – B7 | $7237.02 |
| *Note.* Total costs for technology were allocated over 5 years, the longer the system is used, the greater the cost savings. Adapted from “Tool #9: Estimated Cost Savings Worksheet,” by Protocare Sciences, 2001, *Addressing Medication Errors in Hospitals: Ten Tools*, p. 2-3.\*Formulas for calculations obtained from above mentioned reference. |

Appendix E

*Figure E1.* Current hardware used in facility. The facility houses a Microsoft SQL Server 2008 R2 Datacenter database with Intel Xeon 5100 series processor ,which runs a Windows Server 2008 SP2 64-bit x64 Datacenter with 4 GB RAM as the operating system. This particular database was chosen due to its capability of virtualization and scalability, allowing for a cost efficient infrastructure (G. Slattery, Personal Communication, November 22, 2011). Hyper-V, the Microsoft virtualization platform, decreases hardware costs by allowing for a virtual database to replace an additional server.



*Figure E2.* Wireless network. Wireless capabilities are accomplished through the Cisco 2951 Integrated Services Router and Cisco Catalyst 2960 series switches, allowing multiple healthcare professionals access to the Electronic Health Record (EHR) from anywhere in the facility (Coiera, 2003a). Adapted from “Wireless-G Access Point with Power Over Ethernet and Rangebooster,” by Cisco Systems, 2008, p. 6.

Microsoft Office 2010 Professional Plus

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Microsoft Forefront Endpoint Protection Security Management Pack 2010 antivirus software

Hewlett Packard 5510 Thin-Client workstations with a wireless HP keyboard and mouse

**Workstations utilized in facility**

Paragon HIS

System access via the Citrix Presentation Server 4.5

Microsoft Windows XP SP2 operating system

Hewlett Packard L1702 Flat Panel Monitor

Remote access via Citrix Access Gateway with XenApp.

*Figure E3.* Workstation Diagram.

Appendix F

*Figure F1.* BCMA work plan stages.

Pharmacy

Providers

Administration

Nursing

Resp. Therapy

Consulted Informatics Specialist

Formation of Change Team

1/9/12

Team to Develop Change Timeline

1/10

Team Holds 2 Hour Meeting with Staff

1/1

Team Identifies: current process, problems, field forces

1/12 to 1/16

 MDT

*1 person- each dept.*

Informal interviews with staff

Team member’s personal observations

Identify current process

Identify need for change

Identify problems

Discuss identified field forces

Promote sense of organizational support for change

Discuss potential solutions

*Figure F2.* Strategic planning stage work process. (Suc et al., 2009; McDowell et al.2003; & HIMSS, 2003)

Team formulates selection criteria

1/30 to 2/

*Figure F3.* Decision stage work process. (Suc et al., 2009; McDowell et al., 2003; & HIMSS, 2003)

Change Team becomes Decision Team

1/23/12

Team to Develop Decision Timeline

1/2

Team identifies clinician workflow

2/6 to 2/10

Team formulates organizational objectives

1/27

Keystroke analysis

Cognitive walkthrough

Identify potential vendors

2/13 to 2/17

Identify problems/ feedback/ changes

Functional analysis

Team oversees usability testing with staff

2/20-3/16

*Figure F4.* Implementation stage work process. (Suc et al., 2009; McDowell, 2003; HIMSS, 2003; & Work, 2005)

Addition of 2 nursing staff

Decision Team becomes Implementation Team

4/2/12

Team to Develop Implementation Timeline

4/3 to 5/4

Identify problems/ feedback/ changes

Team to provide staff support during go live

9/24 to 10/26

System Testing

5/2 to 6/15

Software Update

5/21 to 5/25

Hardware Installation

5/14 to 5/18

Staff Training

9/3 to 9/21

Team Training

7/2 to 8/31

Implementation Team becomes Post-Implementation Team

9/24/12

Staff feedback through Doyle’s utilization questionnaire

10/8/12

Team Holds 2 Hour Meeting with Staff

12/21/12

Evaluation of medication error rates

9/24/12-*ongoing*

Discuss impact on medication errors

Discuss results of implementation

*Figure F5.* Post-implementation evaluation stage work process. (Suc et al., 2009; McDowell et al., 2003; & HIMSS, 2003)

Support and commend staff on achievement

***Ongoing Evaluation and Feedback***

**Action Research** Demonstrate need for change with staff during strategic planning stage meeting

**Field Theory** Identify Field Forces 1) Informal interviews 2) Personal observations

 3) Discuss field forces with staff

**Group Dynamics** 1) Multidisciplinary teams 2 )Usability testing with staff feedback

3) Promote organizational support during staff meeting

**Unfreeze**

1. Identify current problems with staff
2. Identify possible solutions with staff
3. Develop implementation plans with staff input
4. Staff feedback

**Move**

1. MDT training
2. Staff training
3. Staff feedback after implementation

**Refreeze**

1. Discuss results of implementations
2. Discuss success

Of solution

1. Commend

staff

**CHANGE**

*Figure F6.* Work plan tasks that satisfy Lewin’s Change Management Model components. Adapted from “Applicability of Lewin’s Change Management Model in a Hospital Setting,” by J. Suc, H.U. Prokosch, and T. Ganslandt, 2009, *Methods Inf Med, 5,* p. 426.

Appendix G

*Figure G1.* Education Plan for BCMA Rollout. Adapted from “Divergent Design in your EHR Training Program,” by L. Mercer and P.F., n.d.

**3**

**Deliver**

**Deliver**

1. Four hour class to be taught to all remaining staff

-Goal attainment, enthusiasm, self-directed learning = decreased resistance to change and acceptance of new workflow

**2**

**Design**

**Design**

1. Curricula

-Significance of BCMA. Impact on patient care, advantages, proper use

1. Timeline

-7/2/12 to 9/21/12

1. Meaningful Material

-Classes taught by McKesson representatives to ensure appropriate information taught

**1**

**Define**

**Define**

1. Resources

-MDT

-Audience

-Meeting rooms with computers

1. Strategies: Blended

-Computer Based Training

 PowerPoint

 Modules

-Hands On Learning

 With system

**4**

**Distill**

**Distill**

1. Continued opportunities for practice with CBT
2. MDT member present on unit for one month during roll out as resource





*Figure H2.* Doyle’s BCMA Utilization Questionnaire. Adapted from “Impact of the bar code medication administration (BCMA) system on medication administration errors,” by M.D. Doyle, 2005.



Appendix I

**Executive Summary**

Medication administration is a critical element of patient care (Dwibedi et al., 2011). Errors that occur during this process can result in compromised patient safety and increases in patient morbidity and mortality (Bond, Raehl, & Franke, 2001). “More than 30% of preventable adverse drug events occur during the medication administration stage, and only about 2% of administration errors are intercepted before reaching the patient” (Dwibedi et al., 2011, p. 1026). An increasing number of organizations, including the Federal Drug Administration (FDA) and the Joint Commission International (JCI), are pushing for the utilization of barcode technology to reduce the incidence of medication administration errors (HIMSS, 2003, p. v & 29). This facility suggests implementation of a barcode medication administration (BCMA) system as described within the attached proposal. The plans for this implementation process will be released at this time and changes to the plan will be updated prior to the implementation date of the BCMA system.

 A multidisciplinary strategic planning team has assembled to discuss the current process in place for medication administration and discuss the feasibility of implementing a BCMA application within this facility. Through environmental risk analyses, system analyses, and cost benefit analyses, the BCMA system has proven itself to be beneficial to this facility. The team has identified specific equipment required for the BCMA system and established an implementation plan with projected timelines for each step of the implementation process.

 The proposed BCMA system includes the addition of Howard Hi Pinnacle medication carts, each equipped with HP Pavillion dm1z laptop computer and a tethered Honeywell Xenon 1900 bar-code scanner. The barcode scanning technology interfaces with the current McKesson Paragon Hospital Information System (HIS) to allow access to and documentation within patients’ electronic health records. Zebra Technologies HC 100 Wristband printers will be implemented to produce wristbands containing patients’ individual barcode identifier. The McKesson PROmanager-RX dispensing system will be added in conjunction with existing McKesson AcuDose dispensing systems. The PROmanager-RX is compatible with the Howard Hi Pinnacle medication carts and it has the capability of automatically applying barcode labels to all unit-dose medications.

 Members of the strategic planning team invite staff members and administrators to review this proposal and will openly accept any suggestions regarding the proposed implementation plan. As stated by Kaplan & Harris-Salamone, “health care requires collaboration, as does system implementation” (2009, p. 295). Therefore, input from all departments is requested, as subsequent revisions and modifications to the implementation process will ensure the successful implementation of the BCMA system.