



## Implementing competency-based medical education: Moving forward

Jason R. Frank, Linda Snell, Robert Englander, Eric S. Holmboe & on behalf of the ICBME Collaborators

To cite this article: Jason R. Frank, Linda Snell, Robert Englander, Eric S. Holmboe & on behalf of the ICBME Collaborators (2017) Implementing competency-based medical education: Moving forward, *Medical Teacher*, 39:6, 568-573, DOI: [10.1080/0142159X.2017.1315069](https://doi.org/10.1080/0142159X.2017.1315069)

To link to this article: <https://doi.org/10.1080/0142159X.2017.1315069>



Published online: 09 Jun 2017.



Submit your article to this journal [↗](#)



Article views: 2998



View related articles [↗](#)



View Crossmark data [↗](#)



Citing articles: 6 View citing articles [↗](#)

COMMENTARY



## Implementing competency-based medical education: Moving forward

Jason R. Frank<sup>a,b</sup>, Linda Snell<sup>a,c</sup>, Robert Englander<sup>d</sup> and Eric S. Holmboe<sup>e</sup>; on behalf of the ICBME Collaborators

<sup>a</sup>Royal College of Physicians and Surgeons of Canada, Ottawa, Canada; <sup>b</sup>Department of Emergency Medicine, University of Ottawa, Ottawa, Canada; <sup>c</sup>Centre for Medical and Department of General Internal Medicine, McGill University, Montreal, Quebec, Canada; <sup>d</sup>School of Medicine, University of Minnesota, Minneapolis, MN, USA; <sup>e</sup>Accreditation Council for Graduate Medical Education, Chicago, IL, USA

### ABSTRACT

For more than 60 years, competency-based education has been proposed as an approach to education in many disciplines. In medical education, interest in CBME has grown dramatically in the last decade. This editorial introduces a series of papers that resulted from summits held in 2013 and 2016 by the International CBME Collaborators, a scholarly network whose members are interested in developing competency-based approaches to preparing the next generation of health professionals. An overview of the papers is given, as well as a summary of landmarks in the conceptual evolution and implementation of CBME. This series follows on a first collection of papers published by the International CBME Collaborators in *Medical Teacher* in 2010.

### Background

Big breakthroughs happen when what is suddenly possible meets what is desperately necessary.  
Thomas Friedman (2012)

In a special issue of *Medical Teacher* in 2010, competency-based medical education (CBME) was defined by the International CBME Collaborators as “[a]n outcomes-based approach to the design, implementation, assessment, and evaluation of medical education programs, using an organizing framework of competencies” (Frank et al. 2010b, p. 641) and as “an approach to preparing physicians for practice that is fundamentally oriented to graduate outcome abilities and organized around competencies derived from an analysis of societal and patient needs. It de-emphasizes time-based training and promises greater accountability, flexibility, and learner-centredness” (Frank et al. 2010a, p. 636).

Formed in 2009 and sponsored by several medical education organizations, the International CBME Collaborators are a scholarly network whose members are interested in exploring, developing, and enhancing competency-based approaches to preparing the next generation of health professionals. CBME is recognized as a promising means of addressing certain challenges and shortcomings attributed to contemporary models of medical curriculum design. More specifically, the development of the CBME model is a response to

- calls for greater accountability and a greater focus on outcomes relating to patients, populations, and health professions education programs (Frank et al. 2010);
- the need to reduce unacceptable variability in graduate abilities after medical training (Langdale et al. 2003; Raymond et al. 2011);
- evidence that some graduates are not prepared for safe and effective practice;

- patterns of suboptimal patient outcomes in health care systems (e.g. IOM 2000, 2001; OECD 2000–2015a, 2000–2015b, 2000–2015c);
- calls for a fundamental re-examination of curriculum content to ensure relevance to the twenty-first century practice. This includes an expanded vision of the desired outcomes of training, such that they go beyond expert medical knowledge to include competencies in communication, collaboration, professionalism and professional identity formation, systems thinking, lifelong learning, population health, and continuous improvement;
- concerns that models of education in which time spent in training is a surrogate marker of competence are no longer desirable or defensible.

### The evolution of CBME

CBME did not begin in 2009. Its history has been described by ten Cate (2014), and landmark developments are summarized in Table 1. In the United States, the idea of competency-based training first surfaced almost a century ago within industrial and business models that focused on specific outcomes and behaviors. In the 1960s, competency-based education training was introduced in teacher education in response to demands for more relevant and outcomes-focused training (Houston 1973; Burke 1999).

Throughout the twentieth century, health professions educators considered numerous tentative innovations in curriculum development. In 1978, in a visionary report for the World Health Organization, McGaghie et al. called for the worldwide adoption of CBME to ensure that health professions education could truly meet local and regional population health needs. In fact, for more than 60 years competency-based education has been used, or suggested, as an approach to education in multiple jurisdictions

**Table 1.** Landmarks in the evolution of CBME.

Year	Organization or country	Landmark
1978	World Health Organization	Produces a report in which competency-based models are first promoted for wide use. The authors define CBME as follows: "The intended output of a competency-based program is a health professional who can practise medicine at a defined level of proficiency, in accord with local conditions, to meet local needs" (McGaghie et al. 1978, p. 18)
1990	Ontario's medical schools (five, at that time), the Council of Ontario Faculties of Medicine, Associated Medical Services, and the Ontario Ministry of Health	Prompted by tensions between the medical profession and the Ontario public, the Educating Future Physicians for Ontario project is launched to address issues related to changing expectations and resource constraints. The overall goal of the project is to modify medical education to make it more responsive to evolving health care needs (Neufeld et al. 1993)
1981	Association of American Medical Colleges (AAMC)	The GPEP (General Professional Education of the Physician and College Preparation for Medicine) Panel is created to develop strategies to improve physician education for the twenty-first century. The panel's final report, issued in 1984, recommends that physicians in all specialties share a common foundation of knowledge, skills, attitude, and values (Anderson et al. 1998, p. 2)
1992	AAMC	The "ACME-TRI" report is issued, summarizing the results of a 1990 survey of deans of 84 North American medical schools concerning whether and how changes recommended in three major reports published in the 1980s on medical student education were being implemented. The report concluded that "most medical schools had done little to correct the major shortcomings in the ways they educate their students" and had not solved recurring problems that had been reported since 1932 (Abrahamson et al. 1992, pp. xi, xv)
1996	AAMC	The MSOP (Medical School Objectives Project) task force is established in response to the ACME-TRI report (Anderson et al. 1998, pp. 1–3)
1996	Royal College of Physicians and Surgeons of Canada (RCPSC)	The report of a task force on the future of postgraduate medical education (the "Maudsley report") called for "mastery learning" to be built into medical training design (Maudsley et al. 1996)
1996	RCPSC	The CanMEDS Project releases its first framework for physician competencies (Frank et al. 1996)
1999	Association for Medical Education in Europe (AMEE)	AMEE publishes an influential model for outcomes-based medical education (Harden 1999)
2001	Accreditation Council for Graduate Medical Education (ACGME)	The ACGME Outcomes Project is launched. This initiative is focused on the increased use of educational outcomes for improving residents' education (Batalden et al. 2002; Swing 2007)
2002	United States	Carraccio and colleagues conduct an influential literature review to generate practical insights into how to accomplish full implementation and evaluation of a paradigm shift from structure- and process-based to competency-based education (Carraccio et al. 2002)
2004	Australia, Netherlands, United States	Competency-based residency programs begin to be implemented globally (e.g. Borleffs & ten Cate 2004; Long 2004; Collins et al. 2007)
2005	RCPSC	CanMEDS 2005, an expanded competency framework, is published and becomes widely adopted in various countries (Frank et al. 2005)
2007	ACGME	Initiates the development of milestones for internal medicine residency training in six general dimensions of practice (Green et al. 2009)
2007	Netherlands	The concept of Entrustable Professional Activities (EPAs) within competency-based training is introduced (ten Cate 2005; ten Cate & Scheele 2007)
2009	United Kingdom	The Tomorrow's Doctors initiative of the General Medical Council defines graduate outcomes pertaining to the doctor as scientist and scholar; practitioner; and professional (General Medical Council 2009)
2009–2016	International CBME Collaborators	<ul style="list-style-type: none"> <li>• Hold a summit on CBME in 2009</li> <li>• Promote CBME through an invitational summit in 2013</li> <li>• Conduct ongoing monthly one-hour webinars on a number of topics that explore various models and approaches to CBME. These webinars are open to all and offered at no cost (International CBME Collaborators 2016)</li> <li>• <i>Medical Teacher</i> publishes a series of articles by the Collaborators in its August 2010 issue</li> <li>• A 2016 world summit on CBME, held in conjunction with the AMEE conference, attracts over 200 participants from around the world</li> </ul>
2009	University of Toronto	The University of Toronto Orthopedic Surgery program modifies its residency training model in keeping with the CanMEDS competency framework. The pilot focuses on competency-based modular training linked to specific learning objectives that form the basis of learning contracts between residents and faculty. Progression is centered on demonstrating competency in the objectives and is not linked to time spent (Ferguson et al. 2013)
2010	Carnegie Foundation for the Advancement of Learning	A report of the Carnegie Foundation calls for "standardizing learning outcomes and individualizing the learning process" (Cooke et al. 2010).
2011	College of Family Physicians of Ontario	The Triple C Competency-based Curriculum is launched: this model, centered in Family Medicine, emphasizes comprehensive care and education, and continuity of education and patient care (Tannenbaum et al. 2011)
2011	AAMC, American Board of Pediatrics, ACGME, and others	Five medical schools test the feasibility of time-variable, competency-based advancement in pediatrics from undergraduate education through to transition to independent practice (Powell et al. 2011)
2012–13	ACGME	<ul style="list-style-type: none"> <li>• Implementation of the Next Accreditation System (NAS) is launched in seven core specialties</li> <li>• The aim of NAS is "to enhance the ability of the peer-review system to prepare physicians for practice in the 21st century, to accelerate the ACGME's movement toward accreditation on the basis of educational outcomes, and to reduce the burden associated with the current structure and process-based approach" (Nasca et al. 2012)</li> <li>• A key element of the NAS is the use of educational milestones in formation, continuous quality improvement, and the measurement and reporting of outcomes</li> </ul>
2015	Royal College of Physicians and Surgeons of Canada	A revised and expanded CanMEDS 2015 framework is published (Frank et al. 2015)
2015	Australia, Canada, Netherlands, United States	Implementation continues (e.g. Caccia et al. 2015; Jurd et al. 2015; Stodel et al. 2015; Carraccio et al. 2017)
2016		The CBME Charter outlines principles and sets directions for future work (Carraccio et al. 2016)

and across multiple professions, including social work (Menefee & Thompson 1994), chiropractic medicine (Wangler 2009), and pharmacy (Marshall et al. 1997). In the 1990s, many jurisdictions witnessed the emergence of “outcomes-oriented approaches” that used competency frameworks as a key component of education and training.

Today, the three most widely known competency-based frameworks are the Good Medical Practice standard in the United Kingdom (General Medical Council 2013), the Outcomes Project of the Accreditation Council for Graduate Medical Education in the United States (Swing 2007), and the CanMEDS Competency Framework of the Royal College of Physicians and Surgeons of Canada (Frank et al. 2015). In 2010, *Medical Teacher* published a series of widely cited papers from the International CBME Collaborators dedicated to documenting, elaborating, developing and disseminating this emerging competency-based paradigm (Campbell et al. 2010; Dath et al. 2010; Frank et al. 2010a, 2010b; Harris et al. 2010; Holmboe et al. 2010; Iobst et al. 2010; Snell & Frank 2010; Swing et al. 2010; Taber et al. 2010; ten Cate et al. 2010).

## Series II

CBME continues to evolve in exciting ways as those involved learn and gain experience in the theories, principles, and practices of this approach. Both CBME and our global network of educators have grown dramatically in the last decade, and in this issue of *Medical Teacher*, we are pleased to offer a second series of papers focused not just on CBME concepts and controversies, but also on the implementation of CBME. The International CBME Collaborators held further summits in 2013 and 2016. Topics and issues of interest to the participants were prioritized using a Delphi process (see Table 2), and the resulting discussions were distilled into this series of articles.

In an introductory paper, Holmboe and colleagues discuss the growth of CBME as a major international movement and address some of the criticisms that have been leveled against the model (Holmboe et al. 2017). Englander and coauthors take a further step, presenting the efforts of the International CBME Collaborators to develop common definitions and to identify the relationships between certain core concepts, as medical educators move toward a shared language necessary for this adaptive change in medical education (Englander et al. 2017).

Because implementation is a current issue for many, overarching challenges to implementing CBME are discussed by Caverzagie et al. (2017). Nousiainen et al. (2017) continue the implementation theme by exploring the structural changes needed to support the transition to CBME. Ferguson et al. (2017) delve deeper to consider changes needed in the professional, institutional, and organizational cultures surrounding the training of medical professionals. They identify key barriers to the acceptance of CBME within the current culture of medical education and propose ways to address them.

Assessment remains a challenge from the perspective of principles and practice. Harris et al. (2017) explore recent developments in CBME assessment, describing key issues regarding assessment as discussed at the 2013 invitational summit on CBME. Core principles of assessment in CBME

**Table 2.** Summary of top-ranked topics after three rounds of a Delphi process.

CBME across the continuum
Milestones EPAs: shared language and definitions
Designing assessment programs: balancing rigor with utility
Evaluating the impact of CBME: key and unintended outcomes
Faculty development for CBME: preparing teachers and assessors
Practical CBME implementation
Research agenda for CBME
Understanding entrustment decisions

are described by Lockyer et al. (2017b), who also examine ways to ensure the effectiveness of assessment programs.

The Collaborators also looked to the future. Although the principles of CBME have yet to be widely adopted in continuing professional development (CPD), Lockyer et al. (2017a) suggest that they are just as important after residency as they are during postgraduate training, and that significant changes are needed in the approach to CPD to ensure that practicing physicians maintain competence throughout their careers. Their paper explores the rationale for CPD reform; considers the key elements that would facilitate a transition to a CBME–CPD framework and an expanded role for the assessment of competence and performance in the workplace; suggests educational activities to support CPD in a CBME environment; and highlights the implications for different stakeholders. Finally, Gruppen et al. (2017) present a range of questions, both theoretical and practical, that require research in the context of CBME. The authors further explore methodological issues that will need to be addressed in gathering evidence about outcomes and best practices in implementing CBME.

The two most recent summits of the International CBME Collaborators resulted in additional papers that have been published in other journals. A charter for clinician–educators framed by Carraccio et al. (2016) outlines three basic tenets of CBME: medical education must be based on the needs of society; it must focus on outcomes, not structure or process; and it must be seamless across the continuum from early medical student to senior practitioner. The Charter then proposes nine commitments to ensure that implementation is effective. In a paper on entrustment decision-making, ten Cate et al. (2016) describe the process of making entrustment decisions in clinical training, outline varied modes of trust, and discuss the factors that lead to entrustment. This paper lays a foundation for the assessment decisions made in CBME. Van Melle et al. (2016) propose using contribution analysis as a rigorous approach to evaluate CBME programs and understand its impact.

## The near future

Competency-based, outcomes-focused education is now implemented in a number of jurisdictions. It has been transformed from a set of aspirations, innovations, concepts, and experiments into the systematic and espoused directions of numerous institutions of health professions education. Although much has happened, much remains to be done. Challenges remain, and resources are not limitless, but we are certain the opportunities for improvement in our medical education and training systems exist, and that the move to a competency-based framework will have a significant positive impact on the health of individual patients and society through the better education of future

physicians. The end of training based only on time is now ... and it is about time.

## Disclosure statement

Eric Holmboe is employed by the ACGME and receives royalties for a textbook on assessment from Mosby-Elsevier. Resources and secretariat support for this project was provided by the Royal College of Physicians and Surgeons of Canada.

## Notes on contributors

**Jason R. Frank**, MD, is Director, Specialty Education, Strategy and Standards in the Office of Specialty Education at the Royal College of Physicians and Surgeons of Canada, and the Director of Educational Research & Development in the Department of Emergency Medicine, University of Ottawa, Canada.

**Linda Snell**, MD, is Professor of Medicine and Core Faculty member, Centre for Medical and Department of General Internal Medicine, McGill University, and Senior Clinician Educator, Royal College of Physicians and Surgeons of Canada, Canada.

**Robert Englander**, MD, is Associate Dean for Undergraduate Medical Education, University of Minnesota School of Medicine, USA.

**Eric S. Holmboe**, MD, is Senior Vice President for Milestone Development and Evaluation, Accreditation Council for Graduate Medical Education, USA.

## References

- Abrahamson S, Beaty HN, Bryan GA, Carver S, Friedman CP, Morahan PS, Reich C, Rosse C, Seidel HM. ACME-TRI report. 1992. Educating medical students: assessing change in medical education. The road to implementation. Washington: Association of Medical Colleges; [cited 2017 Feb 3]. Available from: <http://files.eric.ed.gov/fulltext/ED354818.pdf>
- Anderson MB, Cohen JJ, Hallock JE, Kassbaum DG, Turnbull J, Whitcomb ME. 1998. Report I: learning objectives for medical student education. Guidelines for medical schools. Washington: Association of American Medical Colleges; [cited 2017 Feb 5]. Available from: <https://members.aamc.org/eweb/upload/Learning%20Objectives%20for%20Medical%20Student%20Educ%20Report%20I.pdf>
- Batalden P, Leach D, Swing S, Dreyfus H, Dreyfus S. 2002. General competencies and accreditation in graduate medical education. *Health Aff (Millwood)*. 21:103–111.
- Borleffs C, ten Cate TJ. 2004. Competency-based training for internal medicine. *Neth J Med*. 62:344–346.
- Burke JW, editors. 1999. *Competency-based education and training*. London: Falmer Press.
- Caccia N, Nakajima A, Scheele F, Kent N. 2015. Competency-based medical education: developing a framework for obstetrics and gynaecology. *J Obstet Gynaecol Can*. 37:1104–1112.
- Campbell C, Silver I, Sherbino J, ten Cate O, Holmboe ES. 2010. Competency-based continuing professional development. *Med Teach*. 32:657–662.
- Carraccio C, Englander R, Gilhooly J, Mink R, Hofkosh D, Barone MA, Holmboe ES. 2017. Building a framework of entrustable professional activities, supported by competencies and milestones, to bridge the educational continuum. *Acad Med*. 92:324–330.
- Carraccio C, Englander R, Van Melle E, ten Cate O, Lockyer J, Chan MK, Frank JR, Snell LS. International CBME Collaborators. 2016. Advancing competency-based medical education: a charter for clinician-educators. *Acad Med*. 91:645–649.
- Carraccio C, Wolfsthal SD, Englander R, Ferentz K, Martin C. 2002. Shifting paradigms: from Flexner to competencies. *Acad Med*. 77:361–367.
- Caverzagie KJ, Nousiainen MT, Ferguson PC, ten Cate O, Ross S, Harris KA, Busari J, Bould MD, Bouchard J, Iobst WF, et al; ICBME Collaborators. 2017. Overarching challenges to the implementation of competency-based medical education. *Med Teach*. 39:588–593.
- Collins JP, Gough IR, Civil ID, Stitz RW. 2007. A new surgical education and training programme. *ANZ J Surg*. 77:497–501.
- Cooke M, Irby DM, O'Brien BC. 2010. *Educating physicians: a call for reform of medical school and residency*. San Francisco: Jossey-Bass.
- Dath D, Iobst W. International CBME Collaborators. 2010. The importance of faculty development in the transition to competency-based medical education. *Med Teach*. 32:683–686.
- Englander R, Frank JR, Carraccio C, Sherbino J, Ross S, Snell L; ICBME Collaborators. 2017. Toward a shared language for competency-based medical education. *Med Teach*. 39:582–587.
- Ferguson PC, Caverzagie KJ, Nousiainen MT, Snell L; ICBME Collaborators. 2017. Changing the culture of medical training: an important step toward the implementation of competency-based medical education. *Med Teach*. 39:599–602.
- Ferguson PC, Kraemer S, Nousiainen M, Safir O, Sonnadora R, Alman B, Reznick R. 2013. Three-year experience with an innovative, modular competency-based curriculum for orthopaedic training. *J Bone Joint Surg Am*. 95:e166.
- Frank JR, editor. 2005. *The CanMEDS 2005 physician competency framework. Better standards. Better physicians. Better care*. Ottawa: Royal College of Physicians and Surgeons of Canada.
- Frank J, Jabbour M, Tugwell P, Boyd D, Fréchette D, Labrosse J, MacFayden J, Marks M, Neufeld V, Polson A, et al. 1996. *Skills for the new millennium: report of the societal needs working group*. Ottawa: Royal College of Physicians and Surgeons of Canada.
- Frank JR, Mungroo R, Ahmad Y, Wang M, De Rossi S, Horsley T. 2010a. Toward a definition of competency-based education in medicine: a systematic review of published definitions. *Med Teach*. 32:631–637.
- Frank JR, Snell LS, ten Cate O, Holmboe ES, Carraccio C, Swing SR, Harris P, Glasgow NJ, Campbell C, Dath D, et al. 2010b. Competency-based medical education: theory to practice. *Med Teach*. 32:638–645.
- Frank JR, Snell L, Sherbino J, editors. 2015. *CanMEDS 2015 physician competency framework*. Ottawa: Royal College of Physicians and Surgeons of Canada.
- Frank J, Chen L, Bhutta ZA, Cohen J, Crisp N, Evans T, Fineberg H, Garcia P, Ke Y, Kelley P, et al. 2010. Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. *Lancet*. 376:1923–1958.
- Friedman TL. 2012. Come the revolution. *New York Times* [Internet]; [cited 2012 May 15]. Available from: [www.nytimes.com/2012/05/16/opinion/friedman-come-the-revolution.html](http://www.nytimes.com/2012/05/16/opinion/friedman-come-the-revolution.html)
- General Medical Council. 2009. *Tomorrow's Doctors: Outcomes and standards for undergraduate medical education*. Manchester (UK): General Medical Council; [cited 2017 Feb 6]. Available from: [www.gmc-uk.org/Tomorrow\\_s\\_Doctors\\_1214.pdf](http://www.gmc-uk.org/Tomorrow_s_Doctors_1214.pdf) 48905759.pdf
- General Medical Council. 2013. *Good medical practice (2013)*. Manchester (UK): General Medical Council; [cited 2017 Feb 4]. Available from: [www.gmc-uk.org/guidance/good\\_medical\\_practice.asp](http://www.gmc-uk.org/guidance/good_medical_practice.asp)
- Green ML, Aagaard EM, Caverzagie KJ, Chick DA, Holmboe E, Kane G, Smith CD, Iobst W. 2009. Charting the road to competence: developmental milestones for internal medicine residency training. *J Grad Med Educ*. 1:5–20.
- Gruppen LD, Frank JR, Lockyer JM, Ross S, Bould MD, Harris P, Bhanji F, Hodges BD, Snell L, ten Cate O; ICBME Collaborators. 2017. Toward a research agenda for competency-based medical education. *Med Teach*. 39:623–630.
- Harden RM. 1999. AMEE guide no. 14: outcome-based education: Part 1 – an introduction to outcome-based education. *Med Teach*. 21:7–14.
- Harris P, Bhanji F, Topps M, Ross S, Lieberman S, Frank JR, Snell L, Sherbino J; ICBME Collaborators. 2017. Evolving concepts of assessment in a competency-based world. *Med Teach*. 39:603–608.
- Harris P, Snell L, Talbot M, Harden RM. 2010. Competency-based medical education: implications for undergraduate programs. *Med Teach*. 32:646–650.
- Holmboe ES, Sherbino J, Englander R, Snell L, Frank JR; ICBME Collaborators. 2017. A call to action: the controversy of and rationale for competency-based medical education. *Med Teach*. 39:574–581.
- Holmboe ES, Sherbino J, Long DM, Swing SR, Frank JR. International CBME Collaborators. 2010. The role of assessment in competency-based medical education. *Med Teach*. 32:676–682.

- Houston RW. 1973. Designing competency-based instructional systems. *J Teach Educ.* 24:200–204.
- International CBME Collaborators. 2016. ICBME webinar series. Ottawa: Royal College of Physicians and Surgeons of Canada [cited 2017 Feb 15]. Available from: [www.royalcollege.ca/rcsite/education-strategy-accreditation/innovations-development/icbme/icbme-webinar-series-e](http://www.royalcollege.ca/rcsite/education-strategy-accreditation/innovations-development/icbme/icbme-webinar-series-e)
- Iobst WF, Sherbino J, ten Cate O, Richardson DL, Dath D, Swing SR, Harris P, Mungroo R, Holmboe ES, Frank JR, et al. 2010. Competency-based medical education in postgraduate medical education. *Med Teach.* 32:651–656.
- [IOM] Institute of Medicine, Committee on Quality of Health Care in America. 2000. Kohn LT, Corrigan JM, Donaldson MS, editors. *To err is human: building a safer health care system.* Washington: National Academy Press.
- [IOM] Institute of Medicine, Committee on Quality of Health Care in America. 2001. *Crossing the quality chasms: a new health system for the 21st century.* Washington: National Academy Press.
- Jurd S, de Beer W, Aimer M, Fletcher S, Halley E, Schapper C, Orkin M. 2015. Introducing a competency based fellowship programme for psychiatry in Australia and New Zealand. *Australas Psychiatry.* 23:699–705.
- Langdale LA, Schaad D, Wipf J, Marshall S, Vontver L, Scott CS. 2003. Preparing graduates for the first year of residency: are medical schools meeting the need?. *Acad Med.* 78:39–44.
- Lockyer J, Bursley F, Richardson D, Frank JR, Snell L, Campbell C; ICBME Collaborators. 2017a. Competency-based medical education and continuing professional development: a conceptualization for change. *Med Teach.* 39:617–622.
- Lockyer J, Carraccio C, Chan MJ, Hart D, Smee S, Touchie C, Holmboe ES, Frank JR; ICBME Collaborators. 2017b. Core principles of assessment in competency-based medical education. *Med Teach.* 39:609–616
- Long DM. 2004. Competency based training in neurosurgery: the next revolution in medical education. *Surg Neurol.* 61:5–14.
- Marshall JM, Adams JP, Janich JA. 1997. Practical, ongoing competency-assessment program for hospital pharmacists and technicians. *Am J Health Syst Pharm.* 54:1412–1417.
- Maudsley RF, Augustine JR, Embil JM, Dandavino A, DesGrosseilliers JP, Goldsand G, Mikhael NZ, Taylor BR, Junrull J, VanBoxel J, et al. 1996. Report of the task force to review fundamental issues in specialty education. Final report. Ottawa: Royal College of Physicians and Surgeons of Canada.
- McGaghie WC, Miller GE, Sajid AW, Telder TV, Lipson L. 1978. Competency-based curriculum development in medical education: an introduction. *Public Health Papers No. 68.* Geneva: World Health Organization; [cited 2017 Feb 6]. Available from: [http://apps.who.int/iris/bitstream/10665/39703/1/WHO\\_PHP\\_68.pdf](http://apps.who.int/iris/bitstream/10665/39703/1/WHO_PHP_68.pdf)
- Menefee DT, Thompson JJ. 1994. Identifying and comparing competencies for social work management: a practice driven approach. *Adm Soc Work.* 18:1–25.
- Nasca TJ, Philibert I, Brigham T, Timothy C, Flynn TC. 2012. The next GME accreditation system – rationale and benefits. *N Engl J Med.* 366:1051–1056.
- Neufeld VR, Maudsley RF, Pickering RJ, Walters BC, Turnbull JT, Spasoff RA, Hollomby DJ, Lavigne KJ. 1993. Demand-side medical education: educating future physicians for Ontario. *CMAJ.* 148:1471–1477.
- Nousiainen MT, Caverzagie KJ, Ferguson PC, Frank JR; ICBME Collaborators. 2017. Implementing competency-based medical education: what changes in curricular structure and processes are needed? *Med Teach.* 39:594–598.
- OECD. 2000–2015a. OECD.Stat: Health care utilization [Internet]. Paris: Organisation for Economic Co-operation and Development. Available from: [http://stats.oecd.org/Index.aspx?DataSetCode=HEALTH\\_PROC](http://stats.oecd.org/Index.aspx?DataSetCode=HEALTH_PROC)
- OECD. 2000–2015b. OECD.Stat: Health care quality indicators [Internet]. 2000–2015. Paris: Organisation for Economic Co-operation and Development. Available from: [http://stats.oecd.org/Index.aspx?DataSetCode=HEALTH\\_HCQI](http://stats.oecd.org/Index.aspx?DataSetCode=HEALTH_HCQI)
- OECD. 2000–2015c. OECD.Stat: Health status. Paris: Organisation for Economic Co-Operation and Development. Available from: [http://stats.oecd.org/Index.aspx?DataSetCode=HEALTH\\_STAT](http://stats.oecd.org/Index.aspx?DataSetCode=HEALTH_STAT)
- Powell D, Aschenbrenner C, Carraccio C. 2011. Pediatrics redesign project: a pilot implementing competency-based education across the continuum. *Acad Med.* 86:e13
- Raymond MR, Mee J, King A, Haist SA, Winward ML. 2011. What new residents do during their initial months of training. *Acad Med.* 86:S60–S63.
- Snell L, Frank JR. 2010. Competencies, the tea bag model, and the end of time. *Med Teach.* 32:629–630.
- Stodel EJ, Wyand A, Crooks S, Moffet S, Chiu M, Hudson CC. 2015. Designing and implementing a competency-based training program for anesthesiology residents at the University of Ottawa. *Anesthesiol Res Pract.* 2015:713038.
- Swing SR. 2007. The ACGME outcome project: retrospective and prospective. *Med Teach.* 29:648–654.
- Swing SR, International CBME Collaborators. 2010. Perspectives on competency-based medical education from the learning sciences. *Med Teach.* 32:663–668.
- Taber S, Frank JR, Harris KA, Glasgow NJ, Iobst W, Talbot M. International CBME Collaborators. 2010. Identifying the policy implications of competency-based education. *Med Teach.* 32:687–691.
- Tannenbaum D, Kerr J, Konkin J, Organek A, Parsons E, Saucier D, et al. 2011. Triple C competency-based curriculum. Report of the Working Group on Postgraduate Curriculum Review – Part 1. Mississauga (ON): College of Family Physicians of Canada.
- ten Cate O. 2005. Entrustability of professional activities and competency-based training. *Med Educ.* 39:1176–1177.
- ten Cate O. Medical education, competency-based 2014. [Internet]. In: *The Wiley Blackwell Encyclopedia of health, illness, behavior, and society.* Hoboken (NJ): Wiley, p. 1329–1335. [cited 2017 Feb 14]. Available from: <http://onlinelibrary.wiley.com/doi/10.1002/9781118410868.wbehibs331/abstract>
- ten Cate O, Hart D, Ankel F, Busari J, Englander R, Glasgow N, Holmboe E, Iobst W, Lovell E, Snell LS, et al. 2016. Entrustment decision making in clinical training. *Acad Med.* 91:191–198.
- ten Cate O, Scheele F. 2007. Competency-based postgraduate training: can we bridge the gap between theory and clinical practice?. *Acad Med.* 82:542–547.
- ten Cate O, Snell L, Carraccio C. 2010. Medical competence: the interplay between individual ability and the health care environment. *Med Teach.* 32:669–675.
- Van Melle E, Gruppen L, Holmboe ES, Flynn L, Oandasan I, Frank JR. 2016. Using contribution analysis to evaluate competency-based medical education programs: it's all about rigor in thinking. *Acad Med.* Available from: <http://dx.doi.org/10.1097/ACM.0000000000001479>
- Wangler M. 2009. Usefulness of CanMEDS competencies for chiropractic graduate education in Europe. *J Chiropr Educ.* 23:123–133.

## Appendix

International CBME Collaborators at the time of publication.

---

### *Co-chairs*

Dr. Jason Frank, Royal College of Physicians and Surgeons of Canada  
Dr. Linda Snell, McGill University

### *Members at large*

Dr. John Andrews, University of Minnesota  
Dr. Felix Ankel, University of Minnesota Medical School  
Dr. Farhan Bhanji, Royal College of Physicians and Surgeons of Canada  
Dr. Jacques Bouchard, University of Calgary  
Dr. M. Dylan Bould, University of Ottawa  
Dr. Ian Bowmer, Medical Council of Canada  
Dr. Tim Brigham, Accreditation Council for Graduate Medical Education  
Dr. Ford Bursey, Memorial University of Newfoundland  
Dr. Jamiu Busari, Maastricht University  
Dr. Craig Campbell, Royal College of Physicians and Surgeons of Canada  
Dr. Carol Carraccio, American Board of Pediatrics  
Dr. Kelly Caverzagie, University of Nebraska Medical Center  
Dr. Ming-Ka Chan, University of Manitoba  
Dr. Deepak Dath, McMaster University  
Dr. Mike Donoff, University of Alberta  
Dr. Robert Englander, University of Minnesota Medical School  
Dr. Peter Ferguson, University of Toronto  
Dr. Leslie Flynn, Queens University  
Dr. Nicholas Glasgow, Australian National University Medical School  
Ms. Lisa Gorman, Royal College of Physicians and Surgeons of Canada  
Dr. Jane Griffiths, Queens University  
Dr. Larry Gruppen, University of Michigan Medical School  
Dr. Stanley Hamstra, Accreditation Council for Graduate Medical Education  
Dr. Ronald Harden, Association for Medical Education in Europe (AMEE)  
Dr. Ken Harris, Royal College of Physicians and Surgeons of Canada  
Dr. Peter Harris, University of New South Wales  
Dr. Danielle Hart, Hennepin County Medical Center & University of Minnesota Medical School  
Dr. Karen Hauer, University of California San Francisco School of Medicine  
Dr. Eric Holmboe, Accreditation Council for Graduate Medical Education  
Dr. William Iobst, The Commonwealth Medical College  
Dr. Jolanta Karpinski, Royal College of Physicians and Surgeons of Canada  
Dr. Yves Lafortune, Medical Council of Canada  
Dr. Steve Lieberman, University of Texas Medical Branch  
Dr. Jocelyn Lockyer, University of Calgary  
Dr. Donlin Long, Johns Hopkins University  
Dr. Elise Lovell, University of Illinois at Chicago  
Dr. Aleisha Murnaghan, University of Ottawa  
Dr. Viren Naik, University of Ottawa  
Dr. Markku Nousiainen, University of Toronto  
Dr. Ivy Oandasan, College of Family Physicians of Canada  
Dr. Anna Oswald, University of Alberta  
Dr. Denyse Richardson, University of Toronto  
Dr. Shelley Ross, University of Alberta  
Dr. Karen Schultz, Queen's University  
Dr. Jonathan Sherbino, McMaster University  
Dr. Daniel Schumacher, Cincinnati Children's Hospital  
Dr. Ivan Silver, University of Toronto  
Dr. Lesley Southgate, St George's Hospital Medical School, University of London  
Ms. Sarah Taber, Royal College of Physicians and Surgeons of Canada  
Dr. Olle ten Cate, University Medical Center Utrecht  
Dr. Maureen Topps, University of Calgary  
Dr. Claire Touchie, Medical Council of Canada  
Dr. Elaine Van Melle, Royal College of Physicians and Surgeons of Canada & Queen's University  
Dr. Andrew Varney, SIU School of Medicine  
Dr. Eric Warm, University of Cincinnati College of Medicine  
Dr. Ramses Wassef, Université de Montréal  
Dr. Keith Wycliffe-Jones, University of Calgary

### *Project secretariat*

Royal College of Physicians and Surgeons of Canada (icbme@royalcollege.ca)

---