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Competency-based medical education: theory to practice

JASON R. FRANK¹, LINDA S. SNELL², OLLE TEN CATE³, ERIC S. HOLMBOE⁴, CAROL CARRACCIO⁵, SUSAN R. SWING⁶, PETER HARRIS⁷, NICHOLAS J. GLASGOW⁸, CRAIG CAMPBELL⁹, DEEPAK DATH¹⁰, RONALD M. HARDEN¹¹, WILLIAM IOBST¹², DONLIN M. LONG¹³, RANI MUNGROO¹⁴, DENYSE L. RICHARDSON¹⁵, JONATHAN SHERBINO¹⁶, IVAN SILVER¹⁷, SARAH TABER¹⁸, MARTIN TALBOT¹⁹ & KENNETH A. HARRIS²⁰

¹Royal College of Physicians and Surgeons of Canada and University of Ottawa, Canada, ²McGill University and Royal College of Physicians and Surgeons of Canada, ³Center for Research and Development of Education, University Medical Center, Utrecht, the Netherlands, ⁴American Board of Internal Medicine, USA, ⁵Department of Pediatrics, University of Maryland, Baltimore, USA, ⁶Accreditation Council for Graduate Medical Education, USA, ⁷University of New South Wales, Australia, ⁸Australian National University, Canberra, Australia, ⁹Royal College of Physicians and Surgeons of Canada and University of Ottawa, Canada, ¹⁰McMaster University and Royal College of Physicians and Surgeons of Canada, ¹¹University of Dundee, Scotland, ¹²American Board of Internal Medicine, USA, ¹³Johns Hopkins University, Baltimore, USA, ¹⁴Canadian Association of Internes and Residents, ¹⁵University of Toronto and Royal College of Physicians and Surgeons of Canada, ¹⁶McMaster University, Hamilton, and Royal College of Physicians and Surgeons of Canada, ¹⁷University of Toronto, ¹⁸Royal College of Physicians and Surgeons of Canada, ¹⁹University of Sheffield, England, ²⁰Royal College of Physicians and Surgeons of Canada, University of Ottawa and University of Western Ontario, Canada

Abstract

Although competency-based medical education (CBME) has attracted renewed interest in recent years among educators and policy-makers in the health care professions, there is little agreement on many aspects of this paradigm. We convened a unique partnership – the International CBME Collaborators – to examine conceptual issues and current debates in CBME.

We engaged in a multi-stage group process and held a consensus conference with the aim of reviewing the scholarly literature of competency-based medical education, identifying controversies in need of clarification, proposing definitions and concepts that could be useful to educators across many jurisdictions, and exploring future directions for this approach to preparing health professionals.

In this paper, we describe the evolution of CBME from the outcomes movement in the 20th century to a renewed approach that, focused on accountability and curricular outcomes and organized around competencies, promotes greater learner-centredness and de-emphasizes time-based curricular design. In this paradigm, competence and related terms are redefined to emphasize their multi-dimensional, dynamic, developmental, and contextual nature. CBME therefore has significant implications for the planning of medical curricula and will have an important impact in reshaping the enterprise of medical education.

We elaborate on this emerging CBME approach and its related concepts, and invite medical educators everywhere to enter into further dialogue about the promise and the potential perils of competency-based medical curricula for the 21st century.

Introduction

We believe that in the future, expertise rather than experience will underlie competency-based practice and... certification (Aggarwal & Darzi 2006)

Issues surrounding competency-based medical education (CBME) have generated increasing attention and debate among health professions educators in recent years. This is evidenced by sessions at major international conferences (Frank et al. 2008; Thompson et al. 2009; Frank & Snell 2010), innovative pilot projects (Kraemer 2009), and a growing number of key publications in medical education journals (Harden 1999; Long 2000; Carraccio et al. 2002;

Practice points

- Competency-based education is a resurgent paradigm in professional education.
- CBME is organized around competencies, or predefined abilities, as outcomes of the curriculum.
- The CBME paradigm employs redefined concepts of competence and its development.
- CBME holds great promise along with many challenges for physician training worldwide.
- CBME has the potential to transform contemporary medical education.

Correspondence: Dr. Jason R. Frank, Associate Director, Office of Education, Royal College of Physicians and Surgeons of Canada, 774 Echo Drive, Ottawa, ON, Canada K1S 5N8. Tel: (613) 260-4173; email: jfrank@rcpsc.edu

Albanese et al. 2008). CBME has entered the lexicon of the profession and is now debated in the top general medical journals (Leung 2002; Aggarwal & Darzi 2006). “Competencies” have become the unit of medical educational planning in many jurisdictions (Leung 2002; Albanese et al. 2008). Competency frameworks such as CanMEDS (Frank et al. 2005; Frank & Danoff 2007), the Outcome Project of the (US) Accreditation Council for Graduate Medical Education (ACGME 2001), and the Scottish Doctor (Simpson et al. 2002) now arguably form the basis of training for the majority of medical learners in the Western world – at least on paper. However, significant controversies remain. The rationale, definition, components, pros and cons, and implications of CBME are all still hotly debated (Leung 2002). To address these recurring issues, and in an effort to advance the profession through CBME discussions, the Royal College of Physicians and Surgeons of Canada convened an international “theory to practice consensus conference” in 2009 (Royal College 2009b). Participants in this process formed the International CBME Collaborators group to work in partnership on key themes. In this paper, we report the initial consensus findings of the ICBME Collaborators.

Methods: The ICMBE Collaborators

Medical educators and institutions around the world are exploring the premises and practicalities of CBME. In 2009, the Council of the Royal College passed a resolution directing the Office of Education to move forward on a CBME agenda for specialty education in Canada:

The Royal College in collaboration with key partners, [will] explore opportunities for incorporating competency-based education in residency training and across the spectrum of medical education. This would ensure that the 21st century PGME [postgraduate medical education] system is focused squarely on meeting societal needs as the primary goal of training. Implementing any such change would conceivably take many years and require a coordinated, resourced, collaborative approach (Royal College 2009a).

Part of the initial work involved a systematic review of the literature (see Frank et al. 2010, pp. 631–637 in this issue), which identified authors from various countries who have published key papers on CBME. Authors of papers that defined and elaborated contemporary concepts of CBME were invited to join in a multi-stage group process to advance work in this area. The goals of the ICBME Collaborators are summarized in Box 1. In addition to conducting the systematic

review, the Collaborators submitted written statements on various aspects of CBME, participated in teleconferences, attended a three-day summit in Ottawa, Canada, and contributed to international thematic writing groups to articulate the consensus findings. The group process identified several important topics for contemporary educators to consider. These included the origins of CBME, the rationale for CBME, key definitions related to CBME, the elements of planning CBME, and practical implications of the CBME approach across the continuum of medical education.

Origins of competency-based education

Calls for competency-based approaches to preparing professionals go back 60 years or more (Grant 1975; Spady 1977; Carraccio et al. 2002) Although an emphasis on program goals and objectives articulated in the work of Tyler (1949) and Mager (1997) was widely adopted in the early 20th century, others rejected the ensuing focus on process at the expense of program end-products. Outcome-based education (OBE) arose in response (Block 1974; Rubin & Spady 1984; Levine 1985; Spady 1994; Harden 1999). OBE emphasized learner and program outcomes, not the pathways and processes to attain them. Whereas traditional criteria organized around knowledge objectives tend to emphasize the instructional process, regardless of the product of the program, OBE takes the opposite position: outcomes guide all curriculum decisions, and curriculum processes are secondary (Harden 1999). In this context, competency-based approaches to curricula can be seen as a type of OBE. Competency-based curricula have been used across multiple professions, including chiropractic (Wangler 2009), social work (Menefee & Thompson 1994) teacher education (Houston 1973), pharmacology (Marshall et al. 1997) and others (Pruitt & Epping-Jordan 2005; du Toit et al. 2010). Within medicine, CBME has been proposed for over 50 years (McGaghie et al. 1978). but has only recently come to the fore (Leung 2002).

The rationale for CBME

If CBME is not new, why is it attracting such interest now? Calls to reform medical education have been a recurring theme in the medical literature and the subject of many proposals since Flexner’s report of 1910 (Neufeld et al. 1993; Christakis 1995; Institute of Medicine 2001). In recent years, however, a number of forces and trends have given rise to a particular interest in CBME. From recent arguments in favour of CBME, four overarching themes have emerged: a focus on outcomes, an emphasis on abilities, a de-emphasis of time-based training, and the promotion of learner-centredness. The following sections reflect on these themes, which are also outlined in Table 1.

1. A focus on curricular outcomes

Advocates of CBME have criticized contemporary health professions curricula on the grounds that they fail to ensure that all medical graduates demonstrate competence in all the

Box 1. Goals of the International CBME Collaborators.

1. Review the international CBME literature.
2. Identify controversies in need of clarification.
3. Explore future directions.
4. Propose consensus definitions that could be useful to educators around the world.

Table 1. The rationale for CBME.

Main principle	Elaboration
<p>Focusing on outcomes In an era of greater public accountability, medical curricula must ensure that all graduates are competent in all essential domains.</p>	<ul style="list-style-type: none"> • Not all current curricula explicitly define desired outcomes. • Not all current curricula address all of the desired outcomes. • Not all current curricula assess or ensure that graduates have acquired all of the necessary abilities. • In the health professions, assessment scores should not be compensatory from one domain to another (i.e., excellent knowledge does not compensate for poor communication skills). • Medical education needs to be transparent for learners, teachers, and the public with respect to its goals and effectiveness. • Standards must be criterion-oriented. • Medical education tends to emphasize process issues (e.g., instructional methods) over outcomes (e.g., graduate performance and satisfaction). • Medical education must prepare trainees for practice. • Content that does not contribute to preparation for practice should be dropped.
<p>Emphasizing abilities Medical curricula must emphasize the abilities to be acquired.</p>	<ul style="list-style-type: none"> • There is too much emphasis on knowledge, and not enough on skills, attitudes and their synthesis into observable competencies. • An emphasis on the abilities of learners should be derived from the needs of those served by graduates (i.e., societal needs). • Educational objectives as an organizing framework should be replaced with a hierarchy of competencies.
<p>De-emphasizing time-based training Medical education can shift from a focus on the time a learner spends on an educational unit to a focus on the learning actually attained.</p>	<ul style="list-style-type: none"> • Time is a resource to be tailored to the needs of teachers and learners. • Current curricula and credentialing tend to emphasize fixed times spent in training. • Learners may progress at different rates, and may achieve threshold competencies faster or slower than the average peer. • Greater emphasis should be placed on the developmental progression of abilities and on measures of performance. • Greater flexibility may make some curricula more efficient and engaging.
<p>Promoting greater learner-centredness Medical education can promote greater learner engagement in training.</p>	<ul style="list-style-type: none"> • A curriculum of competencies provides clear goals for learners. • A roadmap of milestones provides a transparent path to achieve the competencies. • An individual learner can adjust their own learning using the milestones.

domains of their intended practice. They argue that, in an era of greater accountability and scrutiny of the professions, medical educators must ensure that every graduate is prepared for practice. Commentators in many countries have noted that many curricula do not even explicitly define the outcome abilities needed of graduates, let alone ensure they are learned, assessed, and acquired. They advocate an approach to curriculum planning that, explicitly tied to the needs of those served, is inherently utilitarian: each curricular element must contribute to learner outcomes or be cut. In addition, they argue that the phenomenon of allowing ability in one essential domain (e.g., procedural skills) to compensate for lack of ability in another (e.g., communication) does a disservice to both the profession and the public served. CBME is seen as an answer to these challenges in that it is focused on outcomes, is inherently tied to the needs of those served by graduates, and involves explicit definitions of all essential domains of competence to be acquired (Neufeld et al. 1993; Tamblyn 1999; Voorhees 2001b).

2. An emphasis on abilities (competencies as the organizing principle of curricula)

Proponents of CBME favour a curriculum organized around competencies or abilities over long lists of knowledge objectives. It can be argued that the reductionism of

objectives-based approaches has led to an over-emphasis on knowledge at the expense of skills, attitudes, and higher order aspects of practice (Talbot 2004). In addition, independent lists of knowledge objectives can create a program in which learning is not integrated across the curriculum. In the CBME paradigm, curricular elements are tailored to build on one another in a constructivist manner. As we will discuss, by using competencies as an organizing framework, educators have an opportunity to address these issues by designing learning experiences that continuously incorporate prior learning elements and emphasize observable abilities (McGaghie 1978; Voorhees 2001a; Carraccio et al. 2002).

3. A de-emphasis of time-based training

Calls to reform medical curricula through the implementation of CBME have also judged much of contemporary medical education to be oriented toward the amount of time spent in an aspect of training (e.g., a rotation) rather than the abilities actually acquired (Long 2000). Aspects of physician credentialing, such as eligibility for certification exams, also tend to focus on time spent on specific experiences. Contemporary education, they argue, should shift its focus in favour of developing the learner's abilities. Learners may progress faster or slower than their peers in a given curricular component. Theoretically, by accommodating these different rates of

learning and skills attainment, a curriculum with flexible time periods may be more efficient and engaging than a strictly time-based curriculum (Bell et al. 1997; Long 2000; Carraccio et al. 2002).

4. The promotion of learner-centredness

Closely related to the de-emphasis of time-based training is the concept of enhancing the learner-centredness of training. CBME, some authors have argued, encourages trainees to take responsibility for their progress and development by mapping out a transparent pathway from milestone to milestone on their way toward competence. Again, individual learners may reach these milestones at varying speeds; accordingly, a CBME system could afford them the flexibility they need to adjust the time spent on each learning task (Carraccio et al. 2002).

What is CBME? Defining the key concepts

As the systematic review by Frank and colleagues demonstrates (2010; see pages 631–637 in this issue), the definition of “competency-based medical education” is highly variable in the literature. In our literature review and discussions, it became clear to the ICBME Collaborators that a lack of consensus on definitions and terms limits the advancement of discourse on CBME, and thereby the advancement of health professions education (Diwakar 2002; Albanese et al. 2008). We therefore propose the definitions of CBME-related concepts listed in Box 2.

The central tenets of the CBME paradigm require an understanding of physician competence as multi-dimensional, dynamic, contextual, and developmental. The current view of physician competence is that it involves multiple domains of ability, in keeping with the work of Epstein and Hundert

(2002), Gardner’s work on multiple intelligences (2006), and expertise theory (Ericsson 2004; Ericsson et al. 2006). For each domain of competence, there is a corresponding spectrum of ability from novice to master, as described by Dreyfus (2004; see also Carraccio et al. 2008). However, instead of a static concept of competence that postulates a physician who, once certified to practise, is competent forever, we emphasize the concept of competence as an ever-changing, contextual construct (Koens et al. 2005). For example, a surgeon certified as fit for practice in an urban academic teaching hospital soon after graduation from residency may find it difficult to cope in a rural hospital in a developing country. Similarly a physician may find that some aspects of her abilities atrophy during the course of her career, while others develop to the mastery level. In this way, each physician has a unique constellation of abilities at any time in any one context. The idea of “progression of competence” speaks to this conception of competence as dynamic, developing or receding over time, and as grounded in the environment of practice or learning.

Furthermore, we propose that *competencies* be viewed as ingredients of *competence*, which can be assembled from smaller elements of learning. For example, as discussed by Susan Swing in this issue (see pp. 663–668), specific elements of knowledge, skills, and attitudes are the components of a given specific ability, and several of these specific competencies can be combined into a broader overarching competency. Competencies are considered abilities or capabilities and are the organizing units of CBME (Albanese et al. 2008). A competency-based curriculum therefore begins with outcomes in mind, on the basis of which it defines the abilities needed by graduates and then develops milestones, instructional methods, and assessment tools to facilitate their acquisition by learners.

A further conclusion of our group process was that, in this renewed CBME paradigm, the contemporary vocabulary

Box 2. Proposed definitions of CBME and related terms by the International CBME Collaborators.

Competence

The array of abilities across multiple domains or aspects of physician performance in a certain context. Statements about competence require descriptive qualifiers to define the relevant abilities, context, and stage of training. Competence is multi-dimensional and dynamic. It changes with time, experience, and setting.

Competency

An observable ability of a health professional, integrating multiple components such as knowledge, skills, values, and attitudes. Since competencies are observable, they can be measured and assessed to ensure their acquisition. Competencies can be assembled like building blocks to facilitate progressive development.

Competency-based medical education

An outcomes-based approach to the design, implementation, assessment, and evaluation of medical education programs, using an organizing framework of competencies.

Competent

Possessing the required abilities in all domains in a certain context at a defined stage of medical education or practice.

Dyscompetence

Possessing relatively less ability in one or more domains of physician competence in a certain context and at a defined stage of medical education or practice.

Incompetent

Lacking the required abilities in all domains in a certain context at a defined stage of medical education or practice.

Progression of competence

For each aspect or domain of competence, the spectrum of ability from novice to mastery. The goal of medical education is to facilitate the development of a physician to the level of ability required for optimal practice in each domain. At any given point in time, and in a given context, an individual physician will reflect greater or lesser ability in each domain.

related to a physician being “competent” needs to be updated. Currently, a physician is deemed competent at the point where he or she is considered ready to practise independently. This static view of competence often rests quite arbitrarily on time-based credentialing. We therefore propose that the term “competent” be used with modifiers that specify which domains of ability, which context, and what stage of medical education or practice it refers to. Thus, a second-year medical student could be competent to enter a supervised undergraduate clinical rotation on a teaching hospital ward, a resident trainee could be competent to run an intensive care unit autonomously overnight, and a graduate of a residency program could be competent to perform some, but not all, procedures independently in a rural institution. This notion of the term “competent” as requiring specification is aligned with the work of ten Cate (2005; ten Cate & Scheele 2007) and the concept of entrustable professional activities. Entrustable professional activities are essentially competencies in context; that is, an integration of the competencies that allow one to perform the professional activities expected of a good doctor within a given specialty.

Similarly, we offer definitions for the expressions “incompetent” and “dyscompetence.” Dyscompetence has been used in several ways in the medical education literature already (Pierson 1992; Leape & Fromson 2006). We propose “dyscompetence” as a comparative term to refer to physicians who have a relative deficiency in one or more domains of competence (e.g., communication abilities). To say that a physician is “incompetent” would be a judgment that his or her constellation of abilities does not meet the requirements for a specified stage of training or practice, in a specified setting (e.g., a third-year medical student could be incompetent to function in an ambulatory clinic with intermediate supervision).

Planning CBME

The approach to planning CBME, and how this contrasts with contemporary process-based curricula, has been well described by Carraccio and colleagues (2002). Whereas a traditional program may begin with the question, “What do learners need to know?” or “How shall we teach our learners?”, CBME begins with outcomes. CBME is organized around the question, “What abilities are needed of graduates?” (Harden et al. 1999). The answer to this question can come from educational needs assessments, such as practice profiling, task analysis, defining population health needs, or identifying entrustable professional activities for the specialty or subspecialty (ten Cate 2005; Wang et al. 2005; ten Cate & Scheele 2007). The identified abilities are organized as competencies for a curriculum, and are further delineated in terms of their building blocks. Working backward, educators can then identify milestones that trainees will need to reach as they acquire the required competencies. Instructional methods and assessment tools can then be selected to facilitate the development of learners for these abilities (Bienenfeld et al. 2000; Carraccio et al. 2002). These steps are summarized in Box 3. CBME curricula developed from this process can reflect

a spectrum in terms of structure and time flexibility, as in Figure 1.

Promise and perils: implications of the CBME approach for the health professions

Among the various important implications of considering a competency-based approach to medical education, some hold tantalizing prospects for improving training, while others present challenges to the adoption of CBME.

Among the benefits promised by the adoption of CBME are:

- A new paradigm of competence. The terms identified by the ICBME Collaborators can facilitate a new discourse on what is meant by physician competence and the role of medical education in the acquisition, maintenance, and enhancement of the abilities of each individual professional.
- A renewed commitment to outcomes. CBME curricula, with their emphasis on graduate abilities, can fulfill medicine’s societal contract to prepare clinicians to serve their patients and communities.
- A new focus for assessment on developmental milestones. CBME’s requirement for frequent, utilitarian assessment to guide development emphasizes the role of assessment in the learning process
- A mechanism to promote a true continuum of medical education. By defining competencies and milestones for each stage of medical education and practice, CBME can promote vertical and horizontal integration of training programs, from undergraduate medical education to residency to continuing professional development.
- A method to promote learner-centred curricula. By providing experiences within a more flexible time frame and focusing on the learner’s development, CBME can help

Box 3. Steps in planning CBME curricula.

1. Identify the abilities needed of graduates.
2. Explicitly define the required competencies and their components.
3. Define milestones along a development path for the competencies.
4. Select educational activities, experiences, and instructional methods.
5. Select assessment tools to measure progress along the milestones.
6. Design an outcomes evaluation of the program.

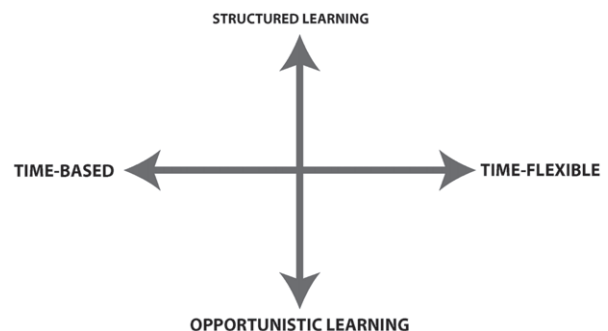


Figure 1. The spectrum of CBME curricula.

physicians-in-training to become truly engaged in a process that progresses at their own rate of acquisition.

- A way to de-emphasize time-based credentialing in medicine. Transitions from undergraduate education to residency education to continuing professional development or maintenance of competence would be based primarily on evidence of skills rather than on predetermined and universally applied time frames. Time then becomes a resource for education, not the marker of learning itself.
- Potential for portability of training. The adoption of a competency-based approach can facilitate the movement of physicians, physician credentials, and credit for training across jurisdictions.

Among the potential perils and challenges of CBME are:

- The threat of reductionism. In an effort to address the challenges of defining and assessing competencies, some have resorted to breaking them down into the smallest observable units of behaviour, creating endless nested lists of abilities that frustrate learners and teachers alike.
- Promoting the lowest common denominator. Critics of CBME have pointed out that, by focusing on an array of competencies so comprehensively, learners may perceive a underlying message that milestones and not excellence are the ultimate pursuit in medicine.
- Logistical chaos. Given that many educational systems around the world are time-based (e.g., requiring a prescribed number of weeks for each rotation), how can a transition to a more competency-based system be accomplished? How can health care manage the scheduling of the thousands of medical trainees progressing at their own pace (in a pure CBME curriculum, for example)?
- Loss of authenticity. If a CBME curriculum is implemented, along with its language of domains for instructional design and its focus on outcomes, what happens to the mentoring and immersion that has served medicine well for 2000 years? Can we use CBME without losing the fidelity and strengths of our current curricula?
- The tyranny of utility. A pure CBME approach is inherently utilitarian, and proposes cutting content and experiences that do not directly contribute to defined program outcomes. This can be unacceptable to some stakeholders in the profession.
- The need for new educational technologies. Adopting CBME on a larger scale would require new teaching techniques, new modules, and new assessment tools to be practical and effective.
- Inertia and lack of resources. For many jurisdictions, adopting a CBME approach would require significant investments in teaching, infrastructure and assessment, and perhaps even an augmented workforce.

An agenda for further development

Finally, in considering the steps needed to move the dialogue on CBME forward, the Collaborators agreed that there is a need for further debate among medical educators, teachers, policy-makers, learners, and other stakeholders as to whether

the future of health professions education should be competency based. We call upon medical education leaders, researchers, journal editors, and conference chairs to engage our communities in this important discussion. To advance the discourse in this area, medical education requires universally accepted definitions for CBME and related terms. We have proposed such a set of terms here, for modification or adoption. Finally, we feel that further scholarship is needed, especially to document the design, feasibility, acceptability, and impact of CBME curricula of all kinds.

Conclusions

Competency-based medical education has emerged as priority topic for medical education planners in the early 21st century. From its origins in the outcomes movement, it has resonated with those who feel that our current curricular paradigm is anachronistic. Our unique partnership, the International CBME Collaborators, recognizes CBME as an educational approach that has the potential to transform how we prepare the physicians of the next decade. We have elaborated on the CBME paradigm and encourage those engaged in medical education around the world to enter into a debate on its utility.

Declaration of interest: The authors report no conflict of interest. The authors alone are responsible for the content and writing of this article.

Notes on contributors

JASON R. FRANK, MD, MA(Ed), FRCPC, is the Associate Director of the Office of Education, Royal College of Physicians and Surgeons of Canada, and the Director of Education in the Department of Emergency Medicine, University of Ottawa.

LINDA S. SNELL, MD, MHPE, FRCPC, FACP, is Professor of Medicine, Vice-Chair (Education), Department of Medicine, and a member of the Centre for Medical Education, McGill University, Montréal. She is also Senior Clinician Educator at the Royal College of Physicians and Surgeons of Canada, Ottawa, Canada.

OLLE TEN CATE, PhD, is Professor of Medical Education and Director of the Center for Research and Development of Education at University Medical Center, Utrecht, the Netherlands.

ERIC HOLMBOE, MD, is Senior Vice President and Chief Medical Officer at the American Board of Internal Medicine and American Board of Internal Medicine Foundation. He is also Professor Adjunct of Medicine at Yale University, and Adjunct Professor at the Uniformed Services University of the Health Sciences.

CAROL CARRACCIO, MD, MA, is Professor of Pediatrics and Associate Chair for Education at the University of Maryland, Baltimore, MD, USA.

SUSAN R. SWING, PhD, is Vice President of Outcome Assessment at the Accreditation Council for Graduate Medical Education. Dr. Swing is a co-developer of the ACGME/ABMS Toolbox of Assessment Methods and is working on collaborative projects to evaluate the quality of assessment tools and develop performance milestones for residents.

PETER HARRIS, MB BS, FRACGP, is a Senior Lecturer in the Medical Education and Student Office of the Medical Faculty, University of New South Wales, Sydney, Australia, where he co-ordinates the Medical Faculty's Assessment Working Party and has been involved in undergraduate and specialty training curriculum design.

NICHOLAS J. GLASGOW, BHB, MBChB, MD, FRNZCGP, FRACGP, FACHPM, is Dean of Medicine and Health Sciences and Dean of the Medical School at the Australian National University, Canberra, Australia.

CRAIG CAMPBELL, MD, FRCPC, is a specialist in Internal Medicine, Associate Professor of Medicine at the University of Ottawa, and is the Director, Professional Affairs, at the Royal College of Physicians and Surgeons of Canada. He directs the Centre for Learning in Practice; a CPD research and development unit at the Royal College focusing on physician lifelong learning.

DEEPAK DATH, MD, MEd, FRCSC, FACS, is Associate Professor of Surgery at McMaster University, Hamilton, Ont., and a Clinician Educator with the Royal College of Physicians and Surgeons of Canada.

RONALD M. HARDEN MD was formally Professor of Medical Education and Director of the Centre for Medical Education, Teaching Dean and Postgraduate Dean at the University of Dundee, Scotland. He is currently General Secretary of the Association for Medical Education in Europe (AMEE) and is the Editor of *Medical Teacher*.

WILLIAM IOBST, MD, is Vice President of Academic Affairs at the American Board of Internal Medicine. He is also an Associate Professor of Clinical Medicine at the Pennsylvania State University College of Medicine.

DONLIN M. LONG, MD, PhD, is Distinguished Service Professor, The Johns Hopkins University School of Medicine, Baltimore, Md., USA.

RANI MUNGROO, MPA, is Manager, Education & Professionalism at the Canadian Association of Internes and Residents, Ottawa, Ontario.

DENYSE RICHARDSON, MD, MEd, FRCPC, is a Clinician Educator at the University of Toronto. She is the Lead for Faculty Development in the Division of Physiatry. She is also a Clinician Educator at the Royal College of Physicians and Surgeons of Canada, Ottawa, Canada.

JONATHAN SHERBINO, MD, MEd, FRCPC, is the Director of Continuing Professional Education, Division of Emergency Medicine, McMaster University, Hamilton, Ont., and a Clinician Educator with the Royal College of Physicians and Surgeons of Canada.

IVAN SILVER, MD, MEd, FRCPC, is Professor of Psychiatry and Vice-Dean of Continuing Education and Professional Development in the Faculty of Medicine, University of Toronto.

SARAH TABER, MHA, is the Manager of Educational Strategy, Innovations and Development at the Royal College of Physicians and Surgeons of Canada, where she oversees strategic initiatives and major projects related to key policy issues in postgraduate medical education.

MARTIN TALBOT, MAEd, MEd, FRCP Lond, F Acad M Ed, is a Consultant Physician in Genitourinary Medicine/HIV and Honorary University Reader in Medical Education at the University of Sheffield, England. He is a Senior Fellow of the United Kingdom's Higher Education Academy, an Associate of the Institute of Education, London University, Fellow of the Academy of Medical Educators, and Policy Lead of the Association for the Study of Medical Education, Edinburgh, Scotland. (The views expressed here are not the official views of the ASME.)

KENNETH A. HARRIS, MD, FRSCS is Director of Education at the Royal College of Physicians and Surgeons of Canada, has an adjunct appointment with the University of Ottawa, and is Professor Emeritus at the University of Western Ontario.

References

Accreditation Council for Graduate Medical Education [ACGME]. 2001–present. Outcome project. Chicago (IL): ACGME. Available from: www.acgme.org/Outcome (Accessed 7 June 2010).

Aggarwal R, Darzi A. 2006. Technical-skills training in the 21st century. *N Engl J Med* 355(25):2695–2696.

Albanese MA, Mejicano G, Mullan P, Kokotailo P, Gruppen L. 2008. Defining characteristics of educational competencies. *Med Educ* 42(3):248–255.

Bell HS, Kozakowski SM, Winter RO. 1997. Competency-based education in family practice. *Fam Med* 29(10):701–704.

Bienenfeld D, Klyklyo W, Knapp V. 2000. Development of competency-based measures for psychiatry residency. *Acad Psychiatry* 24:68–76.

Block JH. 1974. *Schools, society, and mastery learning*. New York: Holt, Rinehart and Winston.

Carraccio CL, Benson BJ, Nixon IJ, Derstine PL. 2008. From the educational bench to the clinical bedside: Translating the Dreyfus developmental model to the learning of clinical skills. *Acad Med* 83(8):761–767.

Carraccio C, Wolfsthal SD, Englander R, Ferentz K, Martin C. 2002. Shifting paradigms: From Flexner to competencies. *Acad Med* 77(5):361–367.

Christakis NA. 1995. The similarity and frequency of proposals to reform US medical education. *Constant concerns*. *JAMA* 274(9):706–711.

Divakar V. 2002. Commentary: The baby is thrown out with the bathwater. *BMJ* 325(7366):693–696.

Dreyfus SE. 2004. The five-stage model of adult skill acquisition. *Bull Sci Technol Soc* 24(3):177–181.

du Toit R, Cook C, Minnies D, Brian G. 2010. Developing a competency-based curriculum for eye care managers in Sub-Saharan Africa. *Rural Remote Health*. 10(2):1278.

Epstein RM, Hundert EM. 2002. Defining and assessing professional competence. *JAMA* 287(2):226–235.

Ericsson KA. 2004. Deliberate practice and the acquisition and maintenance of expert performance in medicine and related domains. 79 10 Suppl:S70–81.

Ericsson KA, Charness N, Feltovich PF, Hoffman R, editors. 2006. *The Cambridge handbook of expertise and expert performance*. New York: Cambridge University Press.

Frank JR, editor. 2005. *The CanMEDS 2005 physician competency framework: Better standards, better physicians, better care*. Ottawa: The Royal College of Physicians and Surgeons of Canada.

Frank JR, Danoff D. 2007. The CanMEDS initiative: Implementing and outcomes-based framework of physician competencies. *Med Teach* 29(7):642–647.

Frank JR, Holmboe E, Reznick R, Snell LS. The future of competency-based education and the implications for residency. Symposium. The International Conference on Residency Education 2008, Ottawa, Canada. 26 September 2008. Available from: <http://rcpsc.medical.org/meetings/2008>. (Accessed 4 June 2010).

Frank JR, Mungroo R, Ahmad Y, Wang M, De Rossi S, Horsley T. 2010. Toward a definition of competency-based education in medicine: A systematic review of published definitions. *Med Teach* 32(8):631–637.

Frank JR, Snell LS, for the International CBME Collaborators. A new vision of competency-based medical education and definition of competence. The 14th Ottawa Conference on Assessment of Competence in Medicine and the Healthcare Professions. 18 May 2010. Miami, USA.

Gardner H. 2006. *Multiple intelligences: New horizons in theory and practice*. New York: Basic Books.

Grant G, associates. 1979. *On competence: A critical analysis of competence-based reforms in higher education*. San Francisco: Jossey-Bass.

Harden RM. 1999. AMEE Guide no 14: Outcome-based education. Part 1 – An introduction to outcome-based education. *Med Teach* 21(1):7–14.

Harden RM, Crosby JR, Davis MH, Friedman M. 1999. AMEE Guide no. 14: Outcome-based education: Part 5 – from competency to meta-competency: A model for the specification of learning outcomes. *Med Teach* 21(6):546–552.

Houston RW. 1973. Designing competency-based instructional systems. *J Teach Ed* 24:200–204.

Institute of Medicine Committee on Quality of Health Care in America, Institute of Medicine Crossing the Quality Chasm: A new health system for the 21st century. 2001. Washington: National Academies Press.

Koens F, Mann KV, Custers EJ, ten Cate OT. 2005. Analysing the concept of context in medical education. *Med Educ* 39(12):1243–1249.

Kraemer W. Development and implementation of a competency-based curriculum in orthopaedic surgery. 35th Gallie Day symposium, Department of Surgery, University of Toronto, Toronto, Canada. 8 May 2010.

Leape LL, Fromson JA. 2006. Problem doctors: Is there a system-level solution? *Ann Int Med* 144(2):107–115.

Levine D. 1985. *Improving student achievement through mastery learning*. San Francisco (CA): Jossey-Bass.

Leung W. 2002. Competency based medical training: Review. *BMJ* 325(7366):693–696.

- Long DM. 2000. Competency-based residency training: The next advance in graduate medical education. *Acad Med* 75(12):1178–1183.
- Mager RF. 1997. Preparing instructional objectives: A critical tool in the development of effective instruction. 3rd ed. Atlanta (GA): Center for Effective Performance.
- Marshall JM, et al. 1997. Practical, ongoing competency-assessment program for hospital pharmacists and technicians. *Am J Health-Syst Pharm* 54(12):1412–1417.
- McGaghie WC, Miller GE, Sajid AW, Telder TV. 1978. Competency-based curriculum development in medical education. Geneva: World Health Organization. Available from: http://whqlibdoc.who.int/php/WHO_PHP_68.pdf (Accessed 7 June 2010).
- Menefee DT, Thompson JJ. 1994. Identifying and comparing competencies for social work management: A practice driven approach. *Adm Soc Work* 18(3):1–25.
- Neufeld VR, Maudsley RF, Pickering RJ, Walters BC, Turnbull JM, Spasoff RA, Hollomby DJ, LaVigne KJ. 1993. Demand-side medical education: Educating future physicians for Ontario. *CMAJ* 148(9):1471–1477.
- Paulson K. 2001. Using competencies to connect the workplace and postsecondary education. *New Dir Inst Res* 110:41–54.
- Pierson RN. 1992. Remedial medical education: The problem of incompetence. In: Rosof AB, Felch WC, editors. *Continuing medical education: A primer*. 2nd ed. New York: Praeger.
- Pruitt SD, Epping-Jordan JE. 2005. Preparing the 21st century global healthcare workforce. *BMJ* 330 :637–639.
- Royal College of Physicians and Surgeons of Canada 2009b. *Imagine the future: An international summit on competency-based medical education* [consensus conference]. Ottawa, 9–11 July.
- Royal College of Physicians of Canada. 2009a. *Directions for residency education, 2009: A final report of the core competency project*. Ottawa: The Royal College of Physicians of Canada. Available at: <http://royalcollege.ca>
- Rubin SE, Spady WG. 1984. Achieving excellence through outcome-based instructional delivery. *Educ Leadersh* 41(8):37–44.
- Simpson JG, Furnace J, Crosby J, Cumming AD, Evans PA, Friedman Ben David M, Harden RM, Lloyd D, McKenzie H, McLaughlan JC, et al. 2002. The Scottish doctor – learning outcomes for the medical undergraduate in Scotland: A foundation for competent and reflective practitioners. *Med Teach* 24(2):136–143.
- Spady WG. 1977. Competency-based education: A bandwagon in search of a definition. *Educ Res* 6(1):9–14.
- Spady WG. 1994. *Outcome-based education: Critical issues and answers*. Arlington (VA): American Association of School Administrators.
- Swing SR. 2010. Perspectives on competency-based medical education from the learning sciences. *Med Teach* 32(8):663–668.
- Talbot M. 2004. Monkey see, monkey do: A critique of the competency model in graduate medical education. *Med Educ* 38(6):587–592.
- Tamblyn R. 1999. Outcomes in medical education: What is the standard and outcome of care delivered by our graduates? *Adv Health Sci Educ* 4(1):9–25.
- ten Cate O, Scheele F. 2007. Competency-based postgraduate training: Can we bridge the gap between theory and clinical practice? *Acad Med* 82(6):542–547.
- ten Cate O. 2005. Entrustability of professional activities and competency-based training. *Med Educ* 39(12):1176–1177.
- Thompson A, Gordon D, Frank JR, ten Cate O. Competency-based postgraduate education. Association for Medical Education in Europe 2009 Conference. September 1, 2009. Malaga, Spain. Available from: <http://www.amee.org/documents/AMEE%202009%20Final%20Programme.pdf> (Accessed 4 June 2010).
- Tyler RW. 1949. *Basic principles of curriculum and instruction*. Chicago: University of Chicago Press.
- Voorhees RA. 2001a. Competency-based learning models: A necessary future. *New Dir Inst Res* 110:5–13.
- Voorhees AB. 2001b. Creating and implementing competency-based learning models. *New Dir Inst Res* 110:83–95.
- Wang N, Schnipke D, Witt EA. 2005. Use of knowledge, skill, and ability statements in developing licensure and certification examinations. *Educ Meas* 24(1):15–22.
- Wangler M. 2009. Usefulness of CanMEDS competencies for chiropractic graduate education in Europe. *J Chiropr Educ* 23(2):123–133.