Implementation of competency-based medical education: are we addressing the concerns and challenges?

Richard E Hawkins,[1] Catherine M Welcher,[2] Eric S Holmboe,[3] Lynne M Kirk,[4] John J Norcini,[5] Kenneth B Simons[6] & Susan E Skochelak[7]

CONTEXT Competency-based medical education (CBME) has emerged as a core strategy to educate and assess the next generation of physicians. Advantages of CBME include: a focus on outcomes and learner achievement; requirements for multifaceted assessment that embraces formative and summative approaches; support of a flexible, time-independent trajectory through the curriculum; and increased accountability to stakeholders with a shared set of expectations and a common language for education, assessment and regulation.

OBJECTIVES Despite the advantages of CBME, numerous concerns and challenges to the implementation of CBME frameworks have been described, including: increased administrative requirements; the need for faculty development; the lack of models for flexible curricula, and inconsistencies in terms and definitions. Additionally, there are concerns about reductionist approaches to assessment in CBME, lack of good assessments for some competencies, and whether CBME frameworks include domains of current importance. This study will outline these issues and discuss the responses of the medical education community.

METHODS The concerns and challenges expressed are primarily categorised as: (i) those related to practical, administrative and logistical challenges in implementing CBME frameworks, and (ii) those with more conceptual or theoretical bases. The responses of the education community to these issues are then summarised.

CONCLUSIONS The education community has begun to address the challenges involved in implementing CBME. Models and guidance exist to inform implementation strategies across the continuum of education, and focus on the more efficient use of resources and technology, and the use of milestones and entrustable professional activities-based frameworks. Inconsistencies in CBME definitions and frameworks remain a significant obstacle. Evolution in assessment approaches from *in vitro* task-based methods to *in vivo* integrated approaches is responsive to many of the theoretical and conceptual concerns about CBME, but much work remains to be done to bring rigour and quality to work-based assessment.

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[1]Medical Education Outcomes, American Medical Association, Chicago, Illinois, USA
[2]Medical Education Outcomes, American Medical Association, Chicago, Illinois, USA
[3]Milestone Development and Evaluation, Accreditation Council for Graduate Medical Education, Chicago, Illinois, USA
[4]Department of Internal Medicine, Faculty of Medicine, University of Texas Southwestern, Dallas, Texas, USA
[5]Foundation for Advancement of International Medical Education and Research (FAIMER), Philadelphia, Pennsylvania, USA
[6]Graduate Medical Education, Medical College of Wisconsin, Milwaukee, Wisconsin, USA
[7]Medical Education, American Medical Association, Chicago, Illinois, USA

Correspondence: Richard E Hawkins, Medical Education Outcomes, American Medical Association, 330 North Wabash Avenue, Suite 39300, Chicago, Illinois 60611, USA. Tel: 00 1 312 464 5058; E-mail: Richard.Hawkins@ama-assn.org

INTRODUCTION

Competency-based medical education (CBME) has become a core strategy in the USA and internationally as a means to educate and assess the next generation of physicians. Models of CBME are driven by the perceived need for better accountability to the public, rapid expansions in scientific knowledge and changes in medical practice.[1–5] Competency-based frameworks, which break down competencies into measurable subcompetencies or milestones, focus on the achievement of individual competencies and move beyond the conventional approach to assessment, consisting primarily of knowledge-based examinations and global ratings, to one that embraces the assessment of patient care and performance-based education outcomes.[4] By focusing on the ultimate outcomes of physician performance and patient care, CBME seeks to produce professionals whose skills are responsive to the needs of the populations and communities they serve[6] and meet the needs of the health care systems and communities in which they practise.[7]

Competency-based frameworks offer structural, content- and process-based benefits. Perceived advantages of CBME include: a focus on outcomes and learner achievement; requirements for a multi-faceted, observation-based assessment approach that embraces formative assessment; support of flexible learning and a time-independent trajectory along the continuum of education, and increased transparency and accountability to all stakeholders with a shared set of expectations and a common language for education, assessment and regulation.[1,6,8,9]

Several studies demonstrate educational or clinical benefits of implementing CBME frameworks. For example, the implementation of a central venous catheter simulation-based, mastery learning curriculum led to improved procedural skills in residents and a reduction in central line-associated bloodstream infections.[10] In research involving surgical residents, competency-based learning approaches led to improvements in clinical skills and patient care,[11] and more rapid acquisition of procedural skills.[12] Faculty members from an internal medicine residency programme, responding to a survey about the milestones format, felt that it provided a valid approach to the assessment of residents.[13] The introduction of a competency-based framework at a large US medical school led to more frequent identification, remediation or disciplinary action for non-cognitive competencies.[14] A focused,

competency-based programme for Year 4 medical students led to increased confidence, increased cognitive and technical skills, and higher performance ratings in relation to the management of critical patient care tasks at the beginning of the surgical residency, as well as fewer violations of work hour requirements.[15] By contrast, the implementation of a competency-based undergraduate curriculum did not impact knowledge acquisition, clinical performance ratings or self-assessment regarding readiness for practice.[16]

Despite widespread enthusiasm for CBME and the noted advantages of such a framework, numerous articles, delineated below, have raised concerns or identified challenges in the implementation of CBME, and consequently have advised caution. The present review is intended to outline these concerns and challenges and to then discuss their implications for the implementation of CBME, while also summarising the responses of the education community to these concerns and challenges. A recent editorial characterised concerns about CBME in three categories: conceptual problems; psychometric considerations, and logistic problems.[17] This review divides the concerns and challenges into two primary categories: (i) those that relate to the practical, administrative and logistical requirements and the related consequences of implementing competency-based frameworks, and (ii) those that have more conceptual or theoretical implications. Psychometric considerations are addressed within the latter category. The concerns and challenges are divided in this manner as their respective resolutions will be likely to depend on different processes: the former will be resolved through structural, policy or procedural actions, and the latter through ongoing research and development activities. However, the line between the two categories is occasionally blurred. For example, psychometric issues may create administrative and logistical challenges when they increase faculty development needs or become obstacles that prevent the implementation of time-independent programming. Following the exposition of concerns and challenges, we will describe activities underway that may provide solutions to facilitate the implementation of CBME programmes. We will close our discussion by considering next steps for education and regulatory communities as they continue to implement CBME frameworks.

PRACTICAL AND LOGISTICAL CHALLENGES

Practical and logistical concerns and challenges to the implementation of competency-based education

and assessment frameworks include: (i) lack of structural models for CBME that accommodate individual, flexible learning plans, (ii) increased administrative requirements for competency-based education programmes, including the need for increased faculty development, and (iii) inconsistency in how competences are defined, developed, implemented and assessed. Addressing the challenges in the implementation of CBME requires the consideration of the implications for the complex systems in which our education programmes reside.[18]

Lack of structural models for CBME that accommodate individual, flexible learning plans

Models of CBME can be used to support individual learning needs through flexible learning plans. Although this is perceived as an advantage, this outcome may have significant implications regarding programme structure and resources, and, if not effectively managed, could result in a chaotic learning environment.[2,18,19] Best practices and models for accommodating individual learning needs and variability in the pace of learning among trainees have not yet been developed. Programmes of CBME implemented at the undergraduate medical education (UME) and graduate medical education (GME) levels may support early graduation based on the individual achievement of competencies, but this perceived advantage may be offset by the potential for adverse impacts on teaching and role-modelling, particularly in GME. The early departure of the most talented trainees may impact both the educational culture of the programme and imply a need for additional faculty development to cover the loss of residents as teachers. In addition, the uncertain timing of transitions (rotation-to-rotation, year-to-year) across the education experience may have workforce implications and impact on health care delivery by disrupting resident schedules.[18]

Individualised and flexible learning plans with the potential for asynchronous graduation have implications regarding the administration and funding of education programmes.[18] Policies and procedures that support financing in proportion to the use of educational resources and duration of training have not been developed. Variability in the timing of graduation may create challenges in managing transitions across the continuum of education and practice, particularly the UME to GME transition. Lastly, implications for the licensure and certification of physicians and accreditation of programmes have not been fully explored.

Increased administrative requirements for CBME programmes and need for increased faculty development

One of the concerns raised by educators refers to the increase in administrative requirements that may result from the implementation of CBME.[9] The more detailed assessment and scoring systems and documentation required may become too cumbersome for many programme leaders to manage.[20] A recent study of education leaders in internal medicine training programmes revealed concerns about the complexity of implementing the milestones and the feasibility of evaluating every resident on every milestone, including the need for extensive faculty development and engagement in direct observation of trainees to ensure quality and accuracy in assessment.[13] There is a fear that educators may spend more time on administering a competency-based programme than on ensuring the quality of the learning experiences.[3,21]

Inconsistencies in how competencies are defined, developed, implemented and assessed

There are concerns about the lack of consensus and consistency in how competencies are defined, developed, implemented and assessed. There is considerable heterogeneity across countries, along the continuum of education and among specialties.[1,9,17,19,22] Furthermore, the relationship between behaviour-derived competencies and education goals, objectives and outcomes is often unclear.[22] This confusion further aggravates an existing level of uncertainty created by different conceptualisations of competence, competencies, competency frameworks, roles and performance by a variety of international regulatory and education bodies.[23–25] Within specialties, differences between the milestone structure across competencies creates difficulty for faculty users.[13] Faculty staff who teach or assess trainees across different disciplines, or learners transitioning along the continuum of education and practice, will be likely to confront education and assessment approaches based on different frameworks of competencies, milestones and entrustable professional activities (EPAs). The inconsistency across competency frameworks, as well as the lack of a standardised approach and language regarding competencies themselves, present significant challenges to the generalised adoption of

CBME across the continuum of education and regulation.[6,26]

Practical and logistical issues and the response of the education community

One of the potential arguments against the introduction of CBME models is that our current medical education systems work well and meet the needs of both patients and health care systems. However, we know that our graduates are not well prepared to address current patient care and health care system needs and additional effort is necessary to better prepare them.[27–30] A fundamental flaw in some of the arguments against the implementation of CBME is based on this assumption that the current or previous model has served us well.[4] Fifteen published reports from a broad spectrum of professional associations, foundations and government agencies identify how the US medical education system has not fulfilled its societal contract to meet the needs of the public and our health care system.[29] Recommendations from these reports follow several themes, including the need to transform our education system so that graduates possess lifelong learning skills, are able to improve the health of communities and populations, are able to monitor their performance and improve the quality and safety of health care, and are able to function within interprofessional teams to provide patient-centred care. In the minds of those advocating for the implementation of CBME, views of our previous approaches to medical education as anachronistic lend further support to arguments for a transition to a more accountable paradigm.[19]

Lack of structural models for CBME that accommodate individual, flexible learning plans

Whether or not we move to CBME, we need to improve the quantity and quality of direct observation, assessment and feedback. The implementation of a CBME framework actually supports that need by making explicit the learning outcomes that will address the deficits identified above. Well-constructed CBME models may indeed be part of the solution in that they may provide a framework to support the definition of the strengths and weakness of our education systems and graduates, to facilitate communication and a shared understanding about the objectives of our education programmes, and to track progress in addressing and remediating the underperformance of our learners and programmes.[31] Recent research supports this assumption. Mapping of the Accreditation Council for Graduate Medical Education (ACGME) general competency framework to an existing undergraduate curriculum shows the current overemphasis on medical knowledge in the curriculum, with minimal to modest coverage of practice-based learning and improvement and systems-based learning domains.[32] Hospital leaders agree that the competencies are relevant to their performance expectations of physicians practising in their health care systems and at the same time identify important deficits among our graduates in these competencies.[30]

Addressing the logistical hurdles in transitioning from time-based to competency-based education programmes presents significant challenges to implementation.[18] Educational activities that focus more on knowledge acquisition and are linked to assessment using traditional multiple-choice question (MCQ) testing formats, particularly if delivered via computer-based formats, are amenable to flexible administration based on individual learner needs and achievement rates. Models for flexible programming in clinical training present challenges, particularly as they require dependence on trustworthy assessments to support learner development and decisions regarding transition across the education continuum. An area worth exploring involves the placement of responsibility for managing assessment and monitoring achievement into the hands of learners, a process that may enhance the development of lifelong learning attitudes and skills, and also enable efficiencies in the implementation of CBME frameworks.[33–35] Faculty development will be necessary to ensure competent mentors and coaches are available to assist learners in interpreting and acting on their assessment results.

The need for education programme leaders to assess the competence of learners in aggregate is rate-limiting in implementing flexible, independent learning plans, moderating the impact on administrative and regulatory systems. The need to deliver competence assessments to a minimum number of learners at a given time to ensure both cost-effective administration and the attainment of trustworthy psychometric outcomes will limit the number of potential transitions to no more than a few per year. Models will need to be developed to accommodate variation in learner achievement in the clinical setting. More longitudinal and practice-relevant experiences have several benefits over the current clerkship and rotation experiences, including the ability to support more sustained and accurate appraisal of learner development and defensible decisions regarding readiness to move forward along the education continuum.[36–40]

Increased administrative requirements for CBME programmes and need for increased faculty development

There is little doubt that the adoption of CBME frameworks will result in increased expectations for the assessment and documentation of learner achievement and administrative requirements for record keeping and reporting. Meaningful supervision and direct observation of trainees in the workplace, the provision of high-quality feedback to inform learner development, and the application of trustworthy, multifaceted assessment tools to ensure that trainees are ready to move to the next step along the continuum of education will require increased effort and deployment of additional resources.[18,19,26,27,41,42] Similarly, increased efforts are necessary to prepare faculty staff to teach and assess learners, particularly in domains that historically have not been well addressed (e.g. quality and safety, team-based care and stewardship).[42]

Having demonstrated that traditional approaches to medical education have not met societal needs, and that a competency-based model may provide a solution, we need to consider ways to address the increased administrative workload, demands for increased direct observation of learner performance, and requirements for robust faculty development.[18] Acceptance and buy-in from those responsible for implementing CBME will depend on the development of efficient methods to overcome these challenges.[43] Educators and researchers should continue work to identify best practices and models for addressing these needs. Some published work exists to help guide the implementation of competency-based frameworks, including feasible approaches to implementing competency-based models within an EPA framework.[44–47] Aylward *et al.*[46] described approaches to overcoming some of the challenges imposed by system barriers and the limited availability of faculty time. Smith *et al.*[48] documented the successful implementation of a medical school-wide competency-based curriculum over 10 years ago, defining a core set of learner competencies, graduation-level proficiency requirements, a multifaceted assessment programme inclusive of a wide range of quantitative and qualitative assessments and individual competency-based assessment committees, and a computer-based management system to track learner progress. In addition, there are a number of organisational strategies and creative techniques for efficiently introducing direct observation into clinical workflow.[49] Structural innovations, such as moving from a rotation-based curriculum to a longitudinal integrated experience, lead to

enhanced continuity of the learner–patient and learner–teacher relationships and may increase efficiency by improving the quality and quantity of supervision, mentoring and assessment.[36–38] More trustworthy decisions about learner progress, as well as the potential to improve the quality and safety of patient care are noteworthy byproducts of such innovation.[36–38]

Technology holds some promise. Deployments of electronic portfolios and learning platforms, and web-based assessment systems are examples of efficient linkages between the education and assessment processes and documentation that enables reporting to regulatory authorities.[50] Innovations, such as the initiation of instruction and assessment using digitalised platforms and the use of 'flipped' classrooms, may create economies of scale by allowing resource sharing across programmes and institutions, and support the efficient reallocation of faculty resources.[51] Should legislation follow the recommendations of the Institute of Medicine report on GME financing and governance, direct payment to education institutions sponsoring GME and funding of innovations may provide additional resources to support these activities.[52]

Linking faculty development activities to clinical learning needs or administrative and regulatory requirements is a way both to provide incentives for faculty participation and to enhance efficiency. Ensuring access to faculty development opportunities and providing incentives for participation through academic award programmes that recognise innovation and scholarship in educational activities may help promote engagement.[27] At the Brody School of Medicine at East Carolina University, an initiative funded by the American Medical Association (AMA) programme 'Accelerating Change in Medical Education' in the form of a 'quality academy' supports the training of faculty staff to engage in, and later to teach and assess, quality improvement (http://www.ecu.edu/reach/). The American Board of Internal Medicine (ABIM) Module in Clinical Supervision allows physicians to obtain credit for the maintenance of certification by observing, assessing and providing feedback to trainees in the clinical care setting.[53,54] More recently, as follow-up to a pilot study led by the Association of American Medical Colleges (AAMC) and conducted in collaboration with the AMA, the AMA Council on Medical Education approved a new type of live activity, 'Faculty credit for the learning associated with teaching medical students and residents/fellows', whereby physician faculty can earn AMA Physician's

Recognition Award (PRA) Category 1 Credit™ for learning that occurs in preparation for clinical teaching, provided that the activity is certified for credit by an accredited continuing medical education (CME) provider.[55]

Inconsistencies in how competencies are defined, developed, implemented and assessed

Differences in how competencies are developed and defined may appropriately reflect differences in expectations for successful practice within different communities, contexts and specialties along the continuum of education.[22] However, unnecessary variation in competency frameworks that define curriculum components, comprise learning objectives, organise assessment approaches and inform faculty development may confuse learners and compromise their achievement as they traverse the continuum of education. They also complicate the work of educators, whose responsibilities may span the continuum and cross specialties. Inconsistency in language and competency frameworks presents a significant obstacle to developing a research agenda and sharing best practices in teaching and assessment in the context of CBME.[19,26] Furthermore, the adoption of models that differ in terms of being either milestone-based or EPA-based approaches, or in qualitative or quantitative characteristics within either approach by various education or regulatory organisations will confuse and frustrate learners and have the potential to impact on outcomes of interest to the public.[56,57] There currently exists international interest in developing consensus among CBME models; it would certainly be beneficial for various stakeholders to work towards developing more consistent definitions and models for education and assessment.[22,43] Recent articles endorsing common definitions for key concepts in CBME signal movement in the right direction, although calls for a shared taxonomy and propositions for yet another variation in the current CBME paradigm may add to the confusion.[19,56] The wide adoption of CBME across international communities provides an opportunity for us to work together in collaborative research to appraise and analyse the value and outcomes of different taxonomies and developmental approaches.[23]

THEORETICAL AND CONCEPTUAL CHALLENGES

Theoretical or conceptual challenges to CBME focus on whether: (i) something as complex as clinical competence can be adequately represented by the sum of its individually defined subcompetencies, (ii) competencies themselves exist as separate, general attributes divorced from their clinical content or the contexts in which they are exercised, (iii) competency frameworks adequately capture the knowledge, skills and abilities requisite to the needs of contemporary physicians, and (iv) the current assessment approach to competencies emphasises or de-emphasises domains important to competence related to the differential availability of valid assessment methods for the individual competencies.

Clinical competence is not represented by the sum of its subcompetencies

Several experts have raised concerns about whether CBME can capture, for learning or assessment purposes, something as complex and challenging to measure as clinical competence. They assert that competence is more than the sum of its parts and that demonstration of individual competencies using a reductionist, behaviourist approach does not mean that a physician is clinically competent to care for a variety of patients of varying degrees of complexity and in different contexts.[3,4,19,58,59] An argument advanced along with these concerns relates to the origins of competency-based curricula, which were first developed for manual trades.[21] Concerns have been expressed that CBME models are better applied to 'lower-level' technical and vocational occupations that involve more routine tasks and less complex skills and abilities, not to situations in which higher-order skills and complex judgements are required.[3,4,60,61]

Competencies, as characterised in medical education, are global, complex constructs (communication skills, professionalism, systems-based practice) that were initially delineated at a level of generality that precluded specific, 'objective' assessment.[62] Efforts to assess the general competencies and define measurable learning outcomes led to the division of the competencies into simpler, specified units of observable behaviours that were theoretically amenable to more 'objective' and standardised assessment.[4,6,19] Assessment approaches often involved checklist-based scoring of performance in controlled or simulated settings.[4] This reductionist approach supported assessments about learners' ability to perform discrete tasks, but was less helpful in informing judgements about the integration of those tasks in patient care situations.[6] Some aspects of clinical competence are difficult to measure, and a tension existed between the desire for quantifiable, 'objective' assessment data and the

overarching need to capture authentic representation of the competent physician.[63]

Critics of this approach have also posited that controlled sessions, such as an observed encounter with a simulated patient, do not accurately recreate the context of real clinical work, and checklist-based approaches to scoring learner behaviours favours thoroughness at the expense of expertise.[64,65] For example, replicating the chaos of even the most well-organised medical practice and the most complicated patients may not be possible in a controlled session, and asking the right question may be more important than asking the most questions in the least amount of time. Higher-level competence cannot necessarily be ascertained by assessing learning objectives that intend to represent its building blocks, and learners who demonstrate competence in the discrete tasks may struggle when confronted with complex, multi-faceted patient presentations in real clinical contexts.[3,4,66] Here, varying clinical contexts and complexity require the competent practitioner to have a 'creative and flexible capacity' to utilise those building blocks effectively[4] and an intuitive decision-making and situational understanding that is gained through experience.[20] A behaviourist approach that divides work roles into discrete tasks may not capture the connections between the individual tasks and the overall meaning underlying complex, real-world situations.[9,61,67] In this context, concerns that the 'atomisation' intrinsic to such assessment methods may lead to the trivialisation of assessment results, and thereby pose serious threats to the validity of those results, have been expressed.[64]

These theoretical concerns are supported by research showing faculty staff do not sum individual domains in a linear manner when formulating overall impressions of a trainee's clinical competence.[63] Deficiencies in specific domains did not detract from the ratings of residents judged to be outstanding; conversely, excellence in selected domains did not materially enhance ratings of problematic residents. In this study, there was significant variability in how faculty members weighted individual domains in developing their overall impression about a resident's competence.

There have also been concerns raised about the reductionist approach and scoring format that deploys checklists to make pass/fail decisions in terms of reinforcing test-taking behaviours and a lower standard, as well as de-emphasising a drive for excellence and deep and reflective engagement in professional practice.[9,20,58,61] Such approaches may

limit the content of the curriculum and result in 'teaching to the test',[3,60] whereby students limit learning to the specified competencies that are to be assessed.

Competencies do not exist as general attributes separate from their clinical content or context

Another question concerns whether competencies actually exist as distinct or sole entities outside the content or the context of care in which they are exercised.[9] This initial representation of the competencies led experts to object to their characterisation as entities that exist within physicians and are generalisable across all clinical contexts. The concept of content or context specificity, or the case-dependent nature of real-world clinical practice, suggests that competencies do not exist as independent abilities outside of the patient care context.[62] Trainees will not perform uniformly relative to their medical knowledge or patient care skills on cases reflecting different clinical content (such as chest pain versus depression) or context (such as in the primary care clinic versus the intensive care unit).

Criticism of the current competency framework refers to the fact that it was derived by a consensus-based process rather than an empiric, evidence-driven model of professional practice characteristics; consequently, the derived competencies may not even exist as discrete entities that are specifically measurable.[62] Ambiguous or unexpected assessment results may not reflect the use of invalid tools or poor faculty preparation, but may occur because the competencies may not actually exist as distinct entities in the exercise of patient care.[62] In fact, assessment methods may not reliably separate the competencies as independent constructs.[62,63] Research involving commonly used assessment methods shows that items tend to cluster into 'traditional' medical knowledge and interpersonal skills dimensions or in other ways not specifically related to the general competency framework.[68,69] Experts point out that functional analyses of occupational roles can be very difficult, and the identification of a range of competencies that accurately address work activities can be problematic.[9] As such, the derived list of competencies may be incomplete and debatable.[66]

Competency-based frameworks do not adequately capture the knowledge, skills and abilities requisite of contemporary physicians

Another concern refers to whether gaps in learning or assessment of critical competencies may result

from the framework adopted and specific competency areas identified. Gaps may result from the failure to include an important competency or subcompetency in the framework or the underemphasis of competencies or subcompetencies in education programmes. Concerns are that CBME limits curricular content to that which is concrete and can be more easily defined and measured.[3] A singular focus on measurable outcomes that eliminates more educationally salient processes, content and structural elements critical to the education and professional development of physicians may result in the loss of learning opportunities and potential.[70] There is evidence from nursing that suggests emphasis on skill acquisition may negatively impact cognitive and critical thinking and interpersonal skills.[71–73] Examples of domains that may receive limited attention in competency models that are behaviours-focused include: attitudes; humility; personal values; responsibility; reflection, and the ability to respond to events as they unfold.[20,66] Recent research shows that faculty members may weigh attributes (disposition, impact on staff) that are generally not considered competency domains when formulating an impression about a resident's overall competence.[63] Caution is also recommended when assessment results are interpreted as reflecting underlying domains not specifically assessed by the particular method; an example would be potentially false assurances regarding a physician's respect or empathy based on behaviours demonstrated during a clinical skills examination.[66]

There is evidence that trainees themselves have concerns about potential gaps in clinical competency that may result from shorter competency-based programmes.[70] Kjaer et al.[70] found that the introduction of a 33% shorter competency-based programme resulted in trainees who felt less qualified to enter practice than did the traditional model. As this study demonstrates from the perspective of the learner, being an effective trainee and ultimately practitioner requires other components, such as experience (i.e. time).[20,74] If steeping our trainees in the learning environment and health system culture for some defined period of time is important to enabling them to better develop their clinical judgement or acumen, then graduation based upon demonstration of core competencies may pose some eventual risks to patients and physicians.

Recent efforts to add or modify the American Board of Medical Specialties (ABMS)/ACGME competency framework suggest that, in the opinions of some,

this framework may not be relevant to or inclusive of domains that are perceived to be important. In addition, there are concerns that, once adopted, current frameworks are not amenable to innovation or the incorporation of new ideas.[75] Among those domains that are not felt to be represented or adequately covered in the current framework are those of science competency,[76] patient safety competencies,[77] cultural competency,[78] stewardship,[79] interprofessional collaboration and teamwork[80,81] and humanitarian response.[82]

The previous paragraphs collectively raise concerns that a competency-based model that is derived from a functional analysis of physician tasks and roles may not ideally address domains that are based on tacit knowledge or intrinsically related to professional identity formation. Observational knowledge and skills-based performance and outcome measures may not capture the true essence of an individual's professional orientation, values, self-reflection, moral perspectives and judgement, inquisitiveness and practical wisdom. Such qualities are not necessarily reflected in observable behaviours and skills, amenable to 'objective' assessment or able to be framed in the context of milestones and performance standards.[83–85]

Current assessment approaches do not adequately address all competencies

Lastly, the current assessment approach to competencies emphasises or de-emphasises domains important to competence in relation to the differential availability of valid assessment methods for the individual competencies. The reliability and validity of methods and tools used in assessment do not meet the need for high-quality formative assessment or allow for the defensible summative (pass/fail) judgements necessary in a competency-based environment. The perceived lack of trustworthy assessment tools and an overarching assessment strategy is one of the primary factors contributing to the slow adoption of competency-based models and remains one of the most significant challenges to implementation.[1,6,20] The availability of assessments may be an important driving factor in how competency frameworks are accepted or implemented; domains for which assessment tools exist or are of high quality will receive more attention than those in which good assessment methods do not exist.[86] Again, issues of concern refer to the fact that domains in competency frameworks such as humanism, professionalism, altruism and scholarship are difficult to measure, and consequently may be

underemphasised in assessment and then in educational activities.[17] Some attributes may be more tacit and not specifically characterised or measurable.[20,87] This may aggravate concerns about faculty staff 'teaching to the test' because only competencies that are clearly specified, and thus assessed, will be taught.[3,60] This may be a more critical issue when competency-based frameworks include flexible learning plans that support a competency achievement-based (rather than a time-based) trajectory through the education programme. Some domains underlying effective practice, such as effective monitoring strategies and flexible allocation of attention, may only be acquired with experience and time.[20]

Discussion of the theoretical and conceptual challenges

Although the category of theoretical and conceptual challenges is divided into four subcategories above, the ongoing work and responses of the community to these challenges cannot be cleanly grouped within these four areas. In particular, the evolution from more reductionist *in vitro* to more holistic *in vivo* assessments and the introduction of milestones and EPAs as a means to better position CBME as a way to frame learner development or represent clinical work, respectively, overlap and conceptually join the four subcategories. In the narrative that follows, the section headings represent the primary subcategory addressed in the discussion, although the relevance of the discussion in that section may extend to the other subcategories.

Clinical competence is not represented by the sum of its subcompetencies

Much of the criticism of CBME and assessment focused initially on the representation of the competencies as general qualities that were not easily amenable to specific teaching or assessment approaches and then on subsequent work to divide the competencies into discrete, measurable behaviours.[19] Assessment methods then included, to a large extent, the use of checklists and observation in controlled settings.[4,20,48] This was perceived as necessary to disaggregate the general competencies into observable elements for the purposes of learning and assessment. The initial focus was on learner performance of more basic tasks, rather than on the integration of those tasks in patient care situations.[6,88] Although not the ideal way to capture the performance of seasoned practitioners in responding to complex patient presentations, such an approach may be reasonable from a developmental

perspective in targeting more novice learners, for whom the mastery of individual skills may logically precede the integration of those skills in more authentic clinical contexts.[4] In fact, the value of 'componential approaches' to mastering complex skills is well supported by theory and evidence from the learning sciences.[89] Complex cognitive–perceptual or cognitive–motor skills are formed from a sequence of more simple components, as are many complex, higher-order skills. Simple components or skills can be formed into unitary complex, higher-order skills by repeated exercise in a stable sequence, strengthening bonds between the individual components. Furthermore, subsequent practice in diverse contexts potentiates the ability to recognise future situations in which the application of such skills is appropriate.[89] Depending on one's larger view of competence, individual simple or more complex skills may be selected or integrated as needed in a variety of clinical contexts.[90]

In addition to meeting learner development needs, there are other situations in which a task-based or 'reductionist' approach to learning and assessment may be utilised. Assessment of learners with poor performance or poor clinical outcomes might also benefit from observation in controlled contexts with a focus on selected knowledge, skills or behavioural subcompetencies in order to diagnose and support the remediation of underlying deficits. An argument can also be made for a 'reductionist model' of assessment and learning to the extent that the subcompetencies and milestones themselves have evidence-based relationships to patient care and health outcomes, and thus should be individually mastered. For example, numerous studies describe the relationship between specific communication behaviours and patient safety and health care outcomes, thus supporting the value of assessing and providing feedback on those specific behaviours.[49]

Although teaching and assessing individual tasks and subcompetencies have value from a developmental and diagnostic perspective, in general, the teaching and assessment of more advanced learners require a more integrative and constructivist approach in increasingly authentic clinical situations.[42,91,92] Breaking down competencies into their component knowledge and skills cannot lead to trustworthy assessment of the ability to integrate such components as a meaningful whole within the context of variable and complex clinical situations.[72] Indeed, one of the important goals and purported advantages of CBME frameworks refers to the intent to move beyond assessment using MCQ examina-

tions and periodic global ratings to include performance domains critical to patient care and outcomes in a variety of clinical contexts in order to capture what the physician *does* in the clinic.[41] An incremental and iterative process for implementing milestones in one residency programme led to the development of milestones that reflected the complexity and contextual integration and prioritisation of multiple steps or tasks to achieve expertise. Milestones were characterised as 'progressive' if their execution required that each step be built on another. Milestones were characterised as 'additive' if multiple behaviours culminated in successful demonstration, and as 'descriptive' if they required a proscribed set of predetermined steps. Implicit in this approach is the prerequisite demonstration of each of the smaller steps or tasks along the developmental continuum, followed by their integration in the patient care context.[81] Assessment needs then evolve away from a controlled, checklist-based approach to the use of tools that more authentically capture how faculty staff conceptualise learner competence within the context of their daily activities in the workplace,[93] with a more holistic approach that focuses on the whole as greater than the sum of its parts.[64]

Competencies do not exist as general attributes separate from their clinical content or context

With regard to the question of competencies as distinct entities independent of clinical context, the ACGME competencies themselves, as one competency framework, were developed as context-independent domains meant to apply to all physician learners.[88] However, the introduction of EPAs and milestones has served to place competency-based achievement in the context of well-recognised and important professional activities and responsibilities.[19,45,63,84,88,94] Although milestones and EPAs represent different approaches to the conceptualising of learner performance and development of competence (Table 1), they can be integrated in a manner that has the potential to support defensible assessment results through the milestones structure while reinforcing the contextual salience of EPA framing to clinical care.[45,46] Each EPA can be mapped to reveal successive layers of competence domains, competencies within those more general domains, and respective milestones.[46,95] Such EPAs then provide a lens through which to view the integration and interrelationships between competency domains, and the competencies themselves and related milestones provide a framework and a shared mental model and common language to sup-

Table 1 Characteristics of competencies, milestones and entrustable professional activities (EPAs)

Characteristic	Competencies	Milestones	EPAs
Granularity	Low	Moderate to high	Low to moderate
Synthetic/ integrated	Moderate	Low to moderate	High
Practicality	Low	Moderate	High
Conceptual	High	Low	Low to moderate

Source: Eric S Holmboe. First presented March, 2013 at the American Board of Internal Medicine Faculty Development Course in Philadelphia in a workshop entitled "Assessment and Systems Basics."

port learning, assessment and feedback.[6,13,63,94–97] The milestones offer more concrete language and a level of specificity that is felt to help represent expectations for trainee progression over time.[13] Thus, EPAs serve to operationalise the more abstract competencies (that some fear may be omitted from CBME models) into the context of the learner's clinical work,[84] and are representative of that work, whereas the competencies denote features of the learners themselves.[47]

Although EPAs and milestones provide a shared education framework and a common language, it is not clear that either provides for an assessment process and outcome that identify discrete domains.[63] Despite an evidence base supporting the ability of competency-based assessment to discriminate among learners in a manner consistent with theoretical expectations for knowledge and skill development,[98] the interdependent and interrelated nature of competencies in the patient care context may preclude their separate identification during assessment.[63,68] This is not a surprising finding as we know that commonly used assessment methods often do not discriminate between individual domains in rating learners.[99–102] Likewise, it should be no surprise that a tool such as factor analysis, a data reduction technique designed to find correlations and relationships between variables, shows high intercorrelations between numerical rankings of individual competencies.[68,103,104]

However, the recommendation to 'abandon the unwarranted certainty and move toward a more

evidence-based approach to assessing patterns of clinical performance' seems premature and excessive for several reasons.[62] Firstly, there is literature showing the validity of results from different assessment methods targeting competencies that themselves have an evidence base supporting their relationship between quality of care and patient outcomes.[98,105] Secondly, competency frameworks in internal medicine and paediatrics, at least in part, are already evidence driven,[106,107] and existing clinical research suggests that evidence-based milestones could be adopted for selected competencies, such as communication skills.[49] Thirdly, there is research suggesting that various stakeholders find the competency framework to be a valid, shared mental model for competence in the learning environment.[97] Perhaps a better approach would be to let the evidence regarding clinical performance and assessment results guide continued refinement of the competencies and milestones, and the framework and methods for their assessment. In the meantime, the language of the competencies can provide a shared understanding and common vocabulary with which to guide learner feedback and achievement.[63,97]

Competency-based frameworks do not adequately capture the knowledge, skills and abilities requisite of contemporary physicians

Current CBME frameworks are deliberate in addressing domains that are important for contemporary physicians, which many feel have not been well covered in previous educational models, such as teamwork, population management, quality improvement and stewardship.[28–30] In fact, two of the examples mentioned above as potential models for implementing CBME curricula include EPA content on important current challenges, including managing a patient hand-off and leading an interprofessional team.[46,47] The ability to obtain and make reliable judgements on a diverse sample of cases with varying contents and contexts through EPAs does provide some assurance regarding the abilities of the learner to execute a range of competencies in responding to new clinical challenges within the broad universe of possible patient presentations.[63,84] Optimally capturing these complex 'system-related' competencies requires approaches that meaningfully embed learning and assessment into the context of patient problems, deploying an array of performance- or quality-based tools, and thus enabling assessment of the integration of multiple competencies into the patient care context. Various competencies may be exercised in a compensatory manner based on the patient situation and

environmental resources, demonstrating the interaction between physician behaviour and clinical context in determining patient care outcomes.[95] Here, competency-based models include learning and assessment approaches that may also target non-behavioural attributes such as values, ethical conduct, advocacy and professionalism,[84] as well as the integration of competencies in a variety of clinical contexts and the capacity of the physician to learn and improve within the activities of health care delivery.

Current assessment approaches do not adequately address all competencies

There is concern that the current assessment approach to competencies emphasises or de-emphasises domains important to competence in relation to the differential availability of valid assessment methods for the individual competencies.

Confidence in assessment results may vary across competency domains. For example, results from assessing knowledge with MCQ examinations or from assessing clinical skills with objective structured clinical examinations (OSCEs) generally provide data adequate to support valid inferences, whereas the same level of supporting research may not exist to support methods to assess teamwork, professionalism or health care quality. However, in relation to the move to assess learners in the workplace, there has been an evolution in thinking about more authentic, integrative, 'qualitative' assessments of the competencies that may not fit well with more traditional psychometric approaches that have been used in MCQ examinations.[91,108] The introduction of a general competency framework is helping to lead assessment toward viewing competence as integrated phenomena, requiring the application of qualitative, descriptive and narrative information, in addition to quantitative numerical data.[64] This movement is important as qualitative methods and narrative descriptions of learner performance may allow for the capture of domains of competence that are difficult to measure.

Narrative comments accompanying numerical ratings often enrich the assessment and feedback process and may be more sensitive in identifying areas for improvement, although they may not necessarily align with the competency framework used in the assessment.[109–114] As with narrative descriptions themselves, written or oral qualitative comments contribute unique information and complement and contextualise quantitative ratings, particularly in

areas that are difficult to assess with numerical data (such as professionalism and interpersonal skills).[111,113,115] Some comments may add a holistic, synthetic impression that locates learners along a trajectory of performance and achievement, addressing the adequacy of improvement, as well as identifying additional improvement needs.[114] Furthermore, feedback based on narrative information may provide context and offer a higher level of specificity and actionable language to target learning and improvement needs.[111,113] Qualitative feedback certainly plays an important role as one element within an assessment system that supports overall defensible judgements regarding competence.[33,114]

Assessment tools that address learner performance in real clinical settings, often using global rating scales and approaches involving narrative descriptions of learner performance, are generally considered more subjective or less reliable in terms of their assessment results. However, assessment in the workplace may benefit from some degree of 'subjective' professional judgement, which some may actually consider as a necessary part of assessment, not as a problem to overcome.[42,91,116] Assessment modalities involving direct observation of clinical work, unannounced standardised patients and multi-source feedback may provide more authentic and complete appraisals of the learner's mastery of complex and integrated competencies and a more holistic impression regarding his or her competence in a range of contexts.[84] A defined and essential element of CBME, the assessment of real-time tasks in authentic clinical settings by multiple observers, lends enhanced validity to the assessment and feedback outcome, although it potentially reduces reliability.[26] However, in adopting an EPA-based model or milestones for learner assessment, educators can fall back on more easily understood assessment 'rules' and sampling strategies to potentially increase reliability.[64,117] For example, a reliable estimate of a trainee's ability to perform an EPA and perhaps, at least theoretically, achieve critical milestones within an EPA may require a sample of X different cases in that clinical area. As it turns out, most commonly used assessment methods can achieve sufficient reliability with 4–8 hours of total testing time.[64]

In general, assessment instruments may be viewed as having strengths and weaknesses and appropriate purposes and contexts for their use.[33] Viewing assessments as part of an overall assessment programme linked to curricular goals allows for broader thinking about how each assessment contributes in relation to its individual qualities and depending on the purpose and context of the assessment.[64,117] The concept of the utility of a particular method that includes consideration of a tool's educational value, catalytic effect, credibility and cost, in addition to its reliability and validity, allows educators to begin to deploy a range of methods to best meet the goals of assessment.[33,64] Tools of lower reliability can be used to inform areas for learning and improvement on an ongoing basis, but results can be aggregated (and thus yield more reliable findings) at various intervals to support summative judgements regarding learner progress,[118,119] although there may be challenges in mixing formative and summative purposes.[91] Aggregation that follows a well-designed sampling strategy (such as by covering the range of possible patient presentations in a given specialty area) helps yield a more reliable, trustworthy summative decision,[64] while the overarching goal of assessment remains assisting the learner in his or her trajectory along the continuum of the development of expertise.[6] Schuwirth and Ash[118] point to the need for both formative and summative assessment in a competency-based framework and the synergistic value of combining the formative and summative features of assessment in inhibiting the test-taking behaviours induced by purely summative assessment, as well as encouraging learners to take formative assessment more seriously. Critical to the success of deploying such assessments is the adequate preparation of faculty staff to support the attainment of a psychometric threshold that instils confidence in the formative directions provided to guide learning and improvement.[98] Education programme leaders recognise the need for extensive faculty development to successfully introduce milestones for assessing residents.[13]

CONCLUSIONS

Competency-based medical education is increasingly understood and appreciated as a conceptual framework that is designed to increase transparency and accountability and improve health care outcomes in response to societal expectations and community needs.[7,24] Through the inclusion of higher-order competencies that address practice-based learning and improvement, systems-based practice and professionalism, it seeks to correct deficiencies in our medical education systems that have failed to sufficiently prepare graduates to succeed – to learn and to practise – in our evolving health care systems.

However, perceptions of the utilitarian nature of CBME fuel fears that some higher education values intrinsic to medical education are threatened and the integrated, complex and contextual nature of competence is overlooked.[3,4,19,25,58–61] Similarly, some fear this will result in decreased attention to aspects of competence intrinsic to the art of medicine (humanism, aspiration to excellence and so on). However, a review of the evolution in thinking and the assessment practices associated with CBME suggests there are efforts underway to address these fears and concerns. Assessments, as drivers of education, are evolving to embrace the contextual, integrated nature of competence and the salience of those domains that are more difficult to measure, and are supportive of the 'progression from competence to excellence'.[43] Much work remains to be done in terms of bringing rigor and quality to work-based assessment, and we are appropriately advised to be cautious in moving forward. Even strong proponents of CBME recommend that competency-based outcomes alone should not drive the entire curricular experience or define all education goals. A strictly utilitarian or vocational approach that removes from the curriculum all content and experiences that do not specifically relate to competency-based outcomes will detract from the richness of the education process supporting our learners' professional development and maturation.[19]

The education community has begun to address many of the logistical and administrative challenges involved in implementing CBME programmes. Models and guidance are being promulgated to inform implementation strategies across the continuum of education, focusing in particular on the development of milestones and EPAs, means of developing and engaging faculty staff and the use of technology to support efficient documentation and reporting. Some work has begun to understand the implications of individual, flexible learning and a time-independent trajectory, but further efforts are necessary to better understand the implications of time-independent programming in clinical education and to anticipate and address obstacles imposed by the many regulatory processes and requirements that exist in parallel with our education programmes.

Significant challenges remain in relation to the widely varying use of language by advocates and implementers of CBME, and the nuances of meaning associated with 'competence' and 'competency'.[25,90] The terms 'competence' and 'competency' have not been defined in a way that is consistent or agreed upon by regulators, educators and others in the medical education community. It follows that a wide variety of CBME definitions exist, although the concepts of defined education outcomes organised around competencies, alignment with community needs and developmental progression of competence permeate most definitions.[19,120] Numerous definitions complicate a shared understanding of competence and competencies and confound and confuse the implementation of CBME. It is critically important that current efforts to develop consistency in language and frameworks progress expeditiously, and that they are, as far as possible, informed by research and evidence.

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