

Toward a definition of competency-based education in medicine: a systematic review of published definitions

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Abstract

Background: Competency-based education (CBE) has emerged in the health professions to address criticisms of contemporary approaches to training. However, the literature has no clear, widely accepted definition of CBE that furthers innovation, debate, and scholarship in this area.

Aim: To systematically review CBE-related literature in order to identify key terms and constructs to inform the development of a useful working definition of CBE for medical education.

Methods: We searched electronic databases and supplemented searches by using authors' files, checking reference lists, contacting relevant organizations and conducting Internet searches. Screening was carried out by duplicate assessment, and disagreements were resolved by consensus. We included any English- or French-language sources that defined competency-based education. Data were analyzed qualitatively and summarized descriptively.

Results: We identified 15,956 records for initial relevancy screening by title and abstract. The full text of 1,826 records was then retrieved and assessed further for relevance. A total of 173 records were analyzed. We identified 4 major themes (*organizing framework, rationale, contrast with time, and implementing CBE*) and 6 sub-themes (*outcomes defined, curriculum of competencies, demonstrable, assessment, learner-centred and societal needs*). From these themes, a new definition of CBE was synthesized.

Conclusion: This is the first comprehensive systematic review of the medical education literature related to CBE definitions. The themes and definition identified should be considered by educators to advance the field.

Introduction

The intended output of a competency-based programme is a health professional who can practice medicine at a defined level of proficiency, in accord with local conditions, to meet local needs... It would be pointless to suggest that there is a single definition. (McGaghie et al. 1978, p. 18)

Competency-based education (CBE) is an emerging discourse in health professions education. This is evidenced by recent papers on the topic (Long 2000; Carraccio et al. 2002; Diwakar 2002; Leung 2002; Talbot 2004; Glasgow et al. 2006; Aggarwal & Darzi 2007; Frank & Danoff 2007; ten Cate and Scheele 2007; Harden 2007; Whitcomb 2007; Albanese et al. 2008a; Albanese et al., 2008b; Carraccio et al. 2008; Brooks 2009). However, the literature also describes an ongoing debate about what exactly is meant by "competency-based education" in the health professions (McGaghie et al. 1978; Leung 2002). CBE has previously been described as an orientation toward curricular outcomes (Harden et al. 1999a; Harden et al. 1999b; Albanese

Practice points

- Competency-based education is an emerging hot topic in the health professions.
- Until now, there has been no widely accepted definition of CBE.
- This systematic review identified 4 themes and 6 sub-themes in the CBE literature.
- A new definition of CBE is proposed to facilitate the development of the field.

et al. 2008b), as a contrast with time-based credentialing (Bell et al. 1997; Long 2000; Carraccio et al. 2002; Collins et al. 2007), or as an organizing paradigm that de-emphasizes process issues in medical training (Bell et al. 1997; Long 2000; Carraccio et al. 2002; Collins et al. 2007; Tsuda et al. 2009). Commentators have asserted that CBE is an example of an outcomes-based approach to curricular design (Harden et al. 1999a; Harden et al. 1999b; Glasgow et al. 2006), a negative

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Table 1. Inclusion and exclusion criteria for obtaining sources for abstract and full paper review.

Inclusion criteria	Exclusion criteria
<ol style="list-style-type: none"> 1. Published and unpublished sources 2. Sources published in print format or on the Internet 3. English and French language sources 4. Sources containing text that define (or attempt to define) "competency-based education" 5. Sources utilizing any type of study design; because research methodology in this area is varied, we included all types of study designs: narrative reviews, systematic reviews, meta-analyses and descriptive studies, randomized, controlled, prospective cohort, retrospective cohort, cross-sectional, survey, controlled before-and-after studies, interrupted time series, paired design studies, and pragmatic trials 6. Because context in medical education is important, we included sources from systems with similar curricular elements. As a frame of reference, we used the 29 international jurisdictions that the Royal College of Physicians and Surgeons of Canada has assessed and deemed as having met Royal College criteria (Royal College 2006). These jurisdictions fall within: Australia, Canada, Hong Kong, Ireland, Singapore, South Africa, Switzerland, the United States of America, and the United Kingdom. 	<ol style="list-style-type: none"> 1. Sources published in languages other than English and French 2. Sources from jurisdictions other than those identified as comparable (Royal College 2006) 3. Sources containing text that define "competency-based education" outside of the medical education context (e.g., veterinary medicine).

oversimplification of physician competence (Talbot 2004), and a method to ensure that health professions training is societally responsive (Neufeld et al. 1993; Frank & Langer 2003). At a glance, the scholarship to date appears remarkably diverse and heavily weighted to models and commentaries. Despite recent proposals to enhance the evidence base of medical education in general, progress is suboptimal (Chen et al. 2004). Without a common language in the medical education enterprise, educators and policy-makers are hampered in their attempts to pursue quality, ensure outcomes, evaluate policies, and further innovation. A serious discourse on CBE would benefit from a shared understanding of terms, concepts, and elements. At this time, there appears to be no widely accepted, applicable definition of CBE that would facilitate a global dialogue to advance the field.

We therefore systematically studied the medical education literature in order to characterize the recurring themes and elements related to CBE and, on that basis, develop a new definition to advance the discourse on competency-based medical education (CBME).

Methods

Using methods similar to those used in other systematic reviews intended to create common definitions (Ainoda et al. 2005; Oh et al. 2005), we conducted a comprehensive inquiry of the scholarly sources related to CBE that provided definitions in English or French.

Inclusion/exclusion criteria

Records were included if they contained a definition or terms for *competency-based education*, *-assessment*, *-models* or *-curriculum*. We excluded records if they (1) did not include a relevant definition; (2) were not published in English or French; (3) were not from a jurisdiction deemed to have an equivalent system of medical education, as defined by the Royal College of Physicians and Surgeons of Canada's

Accreditation Committee (Royal College 2006); (4) cited a primary source publication (e.g., secondary referencing was considered to be a duplicate record and thus excluded); or (5) were outside the context of medical education (e.g., from another profession). A detailed description of inclusion and exclusion criteria is provided in Table 1.

Search strategy

We searched electronic databases using search strings developed by an experienced information specialist in collaboration with the authors. Searches were conducted from inception in MEDLINE (1950 – November, Week 1, 2009, Ovid interface), EMBASE (1980 – Week 46, 2009, Ovid interface) and ERIC (1966 – 17 November 2009) using a combination of search terms: "medical education," "competency," "competency-based education," "clinical competence," "outcome-based education," and "mastery learning."

Recognizing that relevant records were likely to exist within non-indexed sources (e.g., grey literature), searches were supplemented with the use of authors' files and by checking reference lists. To ensure currency, Web searches were conducted using the online search engine Google™ on 6 separate occasions (17 April and 30 July 2008, and 6 February, 22 June, 16 November and 20 November 2009). We are not aware of any validated web-searching method, and therefore adopted a strategy that we found to be both comprehensive and systematic. Using a combination of the terms "medical education," "competency-based education," and "what is?" we ran searches to identify sites containing the term "competency-based education." We examined the first 500 hits of each search, recognizing that the search engine ranks sites by importance and relevance. One reviewer searched all sites using a snowballing technique that allowed for examination of both the site itself and of records embedded within each site (Greenhalgh & Peacock 2005).

Selection methods

Titles and abstracts were examined using conservative criteria developed a priori to ensure accuracy and broad inclusion. Records were considered potentially relevant if they included *competency-based education* or related terms (*outcome-, time- or competence-based education*). All potentially relevant records were retrieved in full text and screened independently by two authors for final inclusion.

Data extraction

Competency-based education definitions were extracted from the original text. In some instances, definitions of CBE were provided in separate sections of the source; extractions were coded as either “VB” (verbatim) or “SS” (separate sections) to ensure transparency. All definitions and terms were extracted by one author and checked for accuracy by another. Disagreements, when they arose, were resolved through discussion. When resolution could not be obtained, a third author was involved as an arbiter. Contextual interpretations of text were not permitted; in sources where ambiguity prevented a clear extraction of text, the source was ultimately excluded by consensus.

Data analysis

A qualitative methodological approach was adopted to code and identify common themes and broad categorizations (Creswell 1998). Analysis of the definitions was performed in a sequential series of cycles. In cycle one (initial review), one member of the research team identified and described themes that emerged from the data set. To limit the effect of our own biases, all texts were examined independently to label and categorize each extraction until theme saturation was achieved. The themes were coded using NVivo qualitative data software version 8 (QSR International Pty Ltd., Doncaster, Australia; 2008) from free text of the definitions within each record (Bazeley 2007). Within the initial review, the research team reviewed the independently created themes and generated one master definition per theme. In cycle two, a second member of the research team independently reviewed and coded all texts for accuracy and consistency. Disagreements were resolved through consensus discussions.

Results

Overview of literature included in the review

Following a process of de-duplication to identify similar records between electronic databases, we identified 15,956 unique records for initial relevancy screening by title and abstract. We removed 14,014 records that did not appear to be applicable on primary screening. The full-text report of 1,826 records were then retrieved and further assessed for relevance. Internet searching identified a total of 2,021 sites and contributed 82 potentially relevant reports for screening. A total of 1,653 sources were excluded because the source contained no relevant definition, it was not within a medical education context or it was published outside of a relevant jurisdiction. In

total, 173 sources satisfied all inclusion criteria and form the basis for our analysis (see Figure 1).

Of the 173 relevant records, 1 was published in French, and the remainder were English-language records. Publications originated from the United States (60.7%), United Kingdom (27.7%), Canada (5.8%), Australia (5.8%), and Switzerland (0.6%). The majority of records were published in journal article format (67.7%), the remainder being reports and guidelines (11.0%), editorials and commentaries (8.7%), electronic resources (4.1%), PowerPoint presentations (3.5%), book chapters (1.7%), newsletters (1.7%), and letters (1.2%). The 173 records are included in the online appendix, List of sources, available at www.medicalteacher.org.

Definitions ranged in length between 13 and 205 words. Year of publication spanned all decades searched, the majority (74.6%) being published between 2000 and 2009, and 44.5% since 2005 (see Figure 2).

Identifying recurring CBE themes

Following a rigorous and thorough qualitative analysis of the 173 included definitions, we identified 4 major themes (*organizing framework, rationale, contrast with time, and implementing CBE*), which included 6 descriptive sub-themes (*outcomes defined, curriculum of competencies, demonstrable, assessment, learner-centred and societal needs*). A summary of themes and broad categorizations, along with frequency counts, are presented in Table 2. Records containing original definitions are presented in Table 3; these identified definitions are coded by theme in Table 4. (Tables 3 and 4 are available online at www.medicalteacher.org.) The majority of definitions (165, 95.4%) addressed the concept of CBE as an educational approach organized around competencies and fundamentally oriented to graduate outcomes. The other major themes were less frequent and included “rationale” (53, 30.6%), “contrast with time” (35, 20.2%), and “implementing CBE” (20, 11.6%).

Discussion

The elements of CBE in medicine

Competency-based education is clearly an emergent topic in medical education, as the exponential growth in citations in the literature within the last decade demonstrates (Albanese 2008b; see Figure 2). There is great heterogeneity in the medical CBE literature, from which we identified 10 recurring themes that form the fundamental concepts of the competency-based approach. Nearly every publication emphasized the cardinal idea that CBE is a distinct approach because of its dedication to predefined graduate abilities as the organizing principle (theme 1 in Table 2) (Harden et al.1999a). The papers included in the final selection for this review described a variety of methods for identifying and defining these outcomes (Harden et al. 1999b). The authors also collectively promoted the concept of “progression of competence,” meaning that learners advance along a series of defined milestones on their way to the explicit outcome goals of training (theme 1a) (Lane and Ross 1994b; Bandiera &

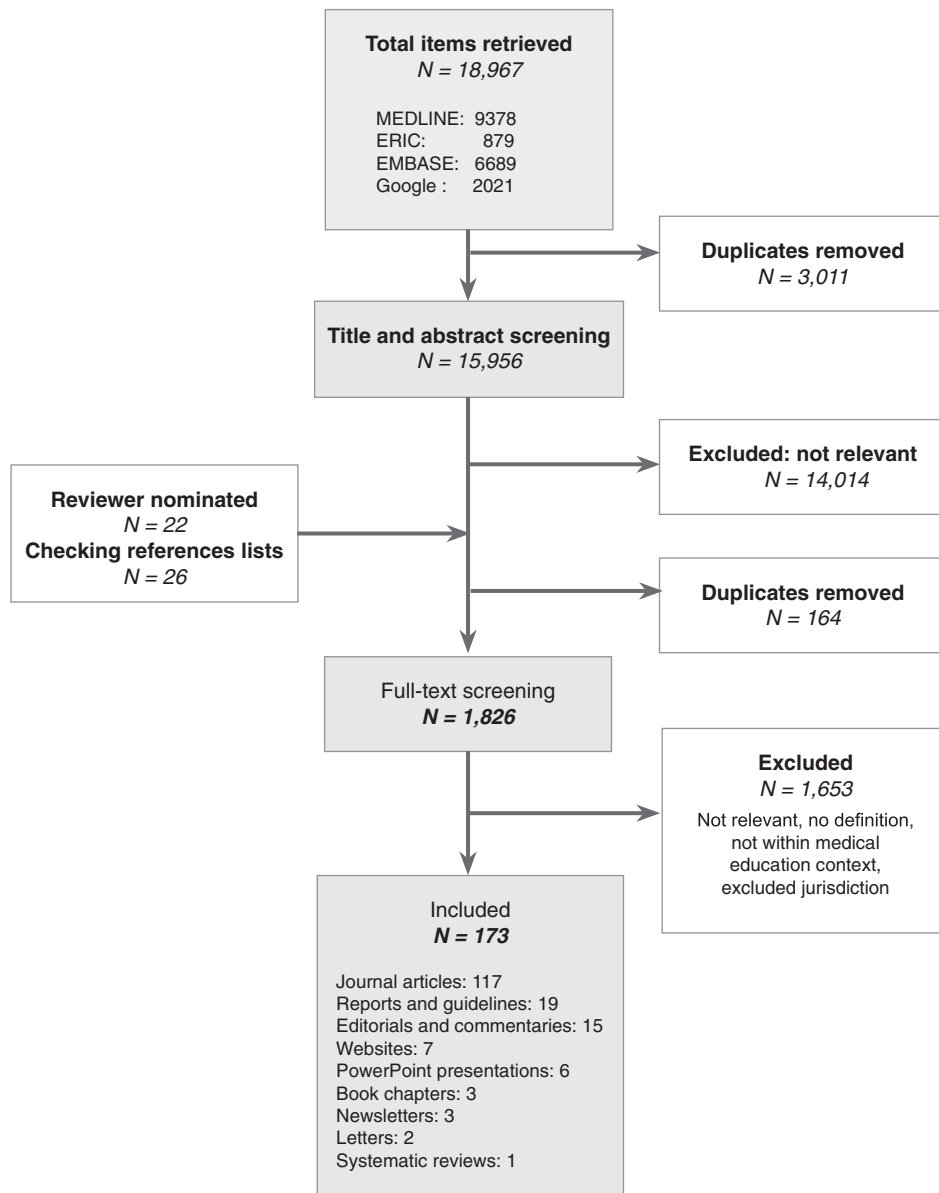


Figure 1. Flow chart of selection of items for systematic review.

Lendrum 2008). This is articulated by Ben-David (1999): “Outcome-based frameworks require a defined scheme of levels of progression towards the outcome.” In CBE, it is suggested that curriculum and assessment are to be organized around the defined standards of the program outcome abilities and their milestones (Craton & Matheson 1993; Lane & Ross 1994; Martin et al. 1998; Harden et al. 1999a). Many of the identified definitions also included arguments as to the rationale for adopting CBE for the health professions (theme 2) (Newble et al. 2005). That all of the efforts to employ CBE would be aligned with societal or patient needs was a major rationale for adoption (Long 2000; Davis & Harden 2003; Lee 2003). Authors argued that a CBE program, when organized around the competencies needed to best serve patients, is the right choice in an era of greater accountability to the public (Glasgow et al. 2006). Furthermore, several authors (e.g., Broski et al. 1977; Demczuk 2009 et al.; Levinson 2009) emphasized the attraction of learner-centredness (theme

2a): greater flexibility in organizing a curriculum, greater transparency of standards, goals and procedures, greater engagement of learners, and the ability of learners to progress at their own pace. Closely related to learner-centredness, the third major theme, the promise of de-emphasizing time- and process-based training, was also prominent in the definitions of CBE (e.g., Brown et al. 1973; Weinstein & Russell 1976; Botticelli & Anderson 1981; Carraccio et al. 2002). Finally, several of the identified descriptions of CBE emphasized elements (theme 4) needed to successfully implement this approach, such as faculty development and engagement, new assessment methods, change management, and resources (Broski et al. 1977; McGaghie et al. 1978).

Toward a definition of CBE in medicine

This systematic review of terms and constructs has provided a thorough and comprehensive view of CBE definitions within

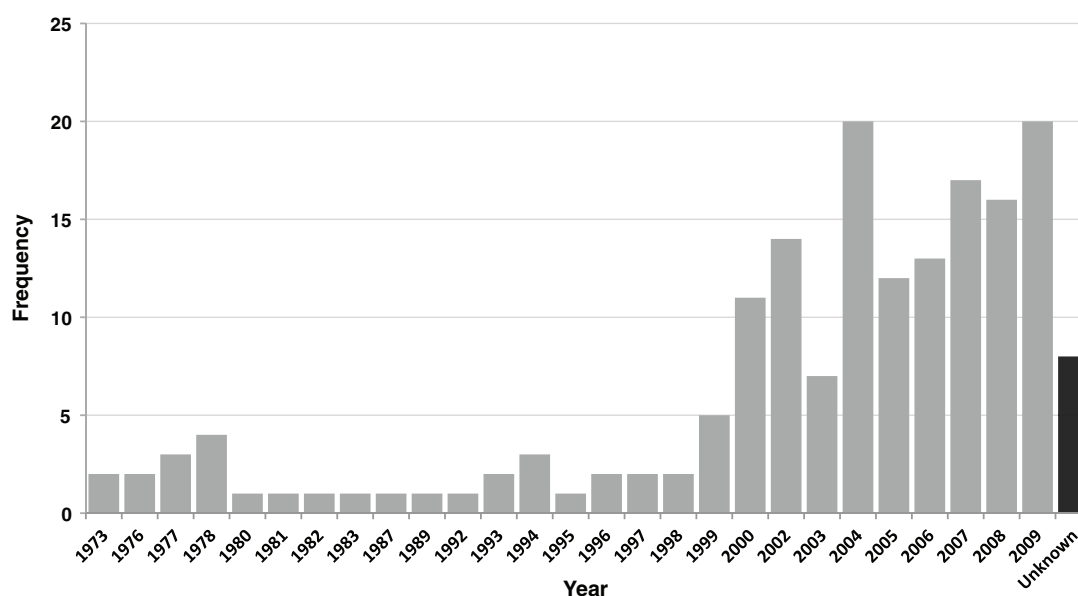


Figure 2. CBE definitions by year of publication.

Table 2. Definitions of themes.

Theme (major)/Sub-themes	Definition	Records, <i>n</i>
1. Organizing framework	All descriptions of competency-based education (CBE) as an approach to education explicitly oriented to graduate outcomes.	165
a. Defined outcomes and milestones	Refers to the identification of specific competencies that are aligned to the outcomes of a training program. These outcomes are derived from the abilities required of physicians for practice or to meet the standards of the profession. Competencies may also be described in terms of milestones or benchmarks that indicate progression of competence in one domain.	144
b. Curriculum of competencies	Includes all references that describe how curricula are organized around the identified competencies. The curriculum node includes references to learning strategies, teaching methods, and instructional design.	50
c. Demonstrable abilities	Includes all references that articulate the need for the components of competency-based education to be observable and comparable to objective criteria for all learners.	20
d. Assessment of competencies	Contains all citations that refer to the assessment of pre-defined standards or milestones that indicate progress toward the defined outcomes of a curriculum. Assessment is criterion-referenced, in that learners are measured against set standards and not other learners. Assessment may also involve threshold standards that must be achieved before further progression of the learner through the curriculum.	73
2. Rationale	Includes all arguments as to the rationale for employing competency-based education as an approach to medical education. This may include how patient needs are a driver to use CBE, how physicians are better prepared for practice or the next stage of training, how it is better for learners, or how it can increase educational efficiency.	53
a. Learner-centred	Includes all discussion of the use of CBE to ensure curricula are aligned with the learning needs of diverse medical learners. It includes all references to organizing teaching and learning around facilitating the progression of trainee competence toward the defined outcome abilities for a program. This involves active engagement of learners in managing their learning, in regular self-assessment, and in ongoing frequent assessment of progress. This thread includes discussion of learner awareness of transparent goals, curriculum design, and assessment methods. It also includes mention of the self-directed continuing professional development of physicians in practice, and flexibility of curriculum processes to meet learners' needs.	29
b. Societal needs	Includes all discussions of the need for CBE to ensure that graduates have the essential abilities to effectively serve patients and populations once in practice. It also encompasses references to CBE as a mechanism to align curriculum goals with patient needs and optimal health care delivery.	26
3. Contrast with time	Includes all discussions that contrast time- or process-based medical education designs with CBE. All references to the pace of learning being tied to the acquisition of competence by a learner are incorporated. In this thread, training time is seen as a resource for instruction and not the organizing framework for medical education and credentialing.	35
4. Implementing CBE	Includes all discussions of CBE implementation designs, components, and ingredients.	20

contemporary medical education literature. From this research we have developed a proposed 21st century definition of CBE for medical education, namely:

Competency-based education (CBE) is an approach to preparing physicians for practice that is fundamentally oriented to graduate outcome abilities and organized around competencies derived from an analysis of societal and patient needs. It de-emphasizes time-based training and promises greater accountability, flexibility, and learner-centredness.

This definition is intended to assemble the component terms and concepts we identified into a brief, accessible, and useful reference. Such a description should be useful for medical educators, teachers, learners, and policy-makers to judge the nature of a program or policy with respect to CBE.

Study limitations

The strength of our review is embedded within strong systematic review methodologies to minimize bias and a comprehensive search of the literature developed by an experienced information specialist. Our review, however, does have several limitations, which include the fact that the scope of the search was confined to English- and French-language sources, as well as to only the jurisdictions deemed “comparable” to the medical education systems of the Royal College of Physicians and Surgeons of Canada. A number of important papers, such as the work of ten Cate and Scheele (2007) from the Netherlands, could therefore not be included in this protocol. Nevertheless, the comprehensive nature of this study should ameliorate the risk of missing critical citations.

Conclusion

This is the first comprehensive systematic review of the medical education definitions related to CBE. We document the essential recurring concepts in the discourse over several decades. We identified 10 key themes and propose a working definition of CBE that should be considered by educators to advance the discourse on CBE in medicine.

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References

- Aggarwal R, Darzi A. 2007. Competency-based training and practice – what does it really mean? *J Am Coll Surg* 205(1):192–193.
- Ainoda N, Onishi H, Yasuda Y. 2005. Definitions and goals of “self-directed learning” in contemporary educational literature. *Ann Acad Med Singapore* 34(8):515–519.
- Albanese MA, Mejicano G, Anderson WM, Gruppen L. 2008a. Building a competency-based curriculum: the agony and the ecstasy. *Adv Health Sci Educ Theory Pract*. May 15 [Epub ahead of print]. Available from: <http://www.springerlink.com/content/g1w11258v173u6r6/> (Accessed 8 April 2009).
- Albanese MA, Mejicano G, Mullan P, Kokotailo P, Gruppen L. 2008b. Defining characteristics of educational competencies. *Med Educ* 42(3):248–355.
- Bandiera G, Lendrum D. 2008. Daily encounter cards facilitate competency-based feedback while leniency bias persists. *Can J Emerg Med* 10(1):44–50.
- Bazeley P. 2007. *Qualitative data analysis with NVivo*. London: Sage Publications Ltd.
- Bell HS, Kozakowski SM, Winter RO. 1997. Competency-based education in family practice. *Fam Med* 29(10):701–704.
- Ben-David MF. 1999. AMEE Guide No. 14: Outcome-based education: Part 3 – Assessment in outcome-based education. *Med Teach* 21(1):23–25.
- Botticelli MG, Anderson AS. 1981. MD-level competence in internal medicine. Objectives and the flexible clerkship. *Arch Intern Med* 141(2):235–236.
- Brooks MA. 2009. Medical education and the tyranny of competency. *Perspect Biol Med* 52(1): 90–102.
- Broski D, Alexander D, Brunner M, Chidley M, Finney W, Johnson C, Karas B, Rothenberg S. 1977. Competency-based curriculum development: A pragmatic approach. *J Allied Health* 6(1):38–44.
- Brown TC, McCleary LE, Stenchever MA, Poulson AM Jr. 1973. A competency-based educational approach to reproductive biology. *Am J Obstet Gynecol* 116(7):1036–1043.
- 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.
- Chen FM, Bauchner H, Burstin H. 2004. A call for outcomes research in medical education. *Acad Med* 79(10):955–960.
- Collins JP, Gough IR, Civil ID, Stitz RW. 2007. A new surgical education and training programme. *ANZ J Surg* 77(7):497–501.

- Craton N, Matheson GO. 1993. Training and clinical competency in musculoskeletal medicine: Identifying the problem. *Sports Med* 15(5):328–337.
- Creswell JW. 1998. *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks (CA): Sage.
- Davis MH, Harden RM. 2003. Competency-based assessment: Making it a reality. *Med Teach* 25(6):565–568.
- Demczuk L, Gottschalk T, Littleford J. 2009. Introducing information literacy into anesthesia curricula. *Can J Anaesth* 56(4):327–335.
- Diwakar V. 2002. Commentary: The baby is thrown out with the bathwater. *BMJ* 235(7366):693–696.
- Frank JR, Danoff D. 2007. The CanMEDS initiative: Implementing and outcomes-based framework of physician competencies. *Med Teach* 29(7):642–647.
- Frank JR, Langer B. 2003. Collaboration, communication, management, and advocacy: Teaching surgeons new skills through the CanMEDS project. *World J Surg* 27(8):972–978.
- Glasgow N, Wells R, Butler J, Gear A, Lyons S, Rubiano D. 2006. Using competency-based education to equip the primary health care workforce to manage chronic disease. Australian Primary Health Care Research Institute. Available from: http://www.acerh.edu.au/publications/Glasgow_APHCRI-Report_Summary_Sep06.pdf (Accessed 17 April 2008).
- Greenhalgh T, Peacock R. 2005. Effectiveness and efficiency of search methods in systematic reviews of complex evidence: Audit of primary sources. *BMJ* 331(7524):1064–1065.
- Harden RM, Crosby JR, Davis MH. 1999a. 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. 1999b. 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.
- Harden RM. 2007. Outcome-based education: The future is today. *Med Teach* 29(7):625–629.
- Lane DS, Ross V. 1994. The importance of defining physicians' competencies: Lessons from preventive medicine. *Acad Med* 69(12):972–974.
- Lee AG. 2003. The new competencies and their impact on resident training in ophthalmology. *Surv Ophthalmol* 48(6):651–662.
- Leung W. 2002. Competency based medical training: Review. *BMJ* 235(7366):693–696.
- Levinson W. 2009. Time for innovation: The ABIM view of competency-based education. *Academic Internal Medicine Insight*, 7(3):6–7.
- Long DM. 2000. Competency-based residency training: The next advance in graduate medical education. *Acad Med* 75(12):1178–1183.
- 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).
- Martin M, Vashisht B, Frezza E, Ferone T, Lopez B, Pahuja M, Spence RK. 1998. Competency-based instruction in critical invasive skills improves both resident performance and patient safety. *Surgery* 124(2):313–317.
- 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.
- Newble D, Stark P, Bax N, Lawson M. 2005. Developing an outcome-focused core curriculum. *Med Educ* 39(7):680–687.
- Oh H, Rizo C, Enkin M, Jadad A. 2005. What is eHealth: A systematic review of published definitions. *J Med Internet Res* 7(1):e1.
- QSR International Pty Ltd. 2008. NVivo qualitative data analysis software. Version 8. NVivo qualitative data analysis software; QSR International Pty Ltd. [Doncaster, Australia] Version 8, 2008.
- Royal College of Physicians and Surgeons of Canada. 2006. Jurisdiction approved training: International postgraduate medical education. Last updated 13 June 2006. Available from: http://rcpsc.medical.org/residency/certification/img_page2_e.php (Accessed 13 April 2010).
- Talbot M. 2004. Monkey see, monkey do: A critique of the competency model in graduate medical education. *Med Educ* 38(6):587–592.
- 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.
- Tsuda S, Scott D, Doyle J, Jones DB. 2009. Surgical skills training and simulation. *Curr Probl Surg* 46(4):271–370.
- Weinstein HM, Russell ML. 1976. Competency-based psychiatric education. *Am J Psychiatry* 133(8):935–939.
- Whitcomb ME. 2007. Redirecting the assessment of clinical competence. *Acad Med* 82(6):527–528.