CHEST Supplement

CME: ACCP EVIDENCE-BASED EDUCATIONAL GUIDELINES

Lessons for Continuing Medical Education From Simulation Research in Undergraduate and Graduate Medical Education*

Effectiveness of Continuing Medical Education: American College of Chest Physicians Evidence-Based Educational Guidelines

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Background: **Simulation technology is widely used in undergraduate and graduate medical education as well as for personnel training and evaluation in other healthcare professions. Simulation provides safe and effective opportunities for learners at all levels to practice and acquire clinical skills needed for patient care. A growing body of research evidence documents the utility of simulation technology for educating healthcare professionals. However, simulation has not been widely endorsed or used for continuing medical education (CME).**

Methods: **This article reviews and evaluates evidence from studies on simulation technology in undergraduate and graduate medical education and addresses its implications for CME.**

Results: **The Agency for Healthcare Research and Quality Evidence Report suggests that simulation training is effective, especially for psychomotor and communication skills, but that the strength of the evidence is low. In another review, the Best Evidence Medical Education collaboration supported the use of simulation technology, focusing on high-fidelity medical simulations under specific conditions. Other studies enumerate best practices that include mastery learning, deliberate practice, and recognition and attention to cultural barriers within the medical profession that present obstacles to wider use of this technology.**

Conclusions: **Simulation technology is a powerful tool for the education of physicians and other healthcare professionals at all levels. Its educational effectiveness depends on informed use for trainees, including providing feedback, engaging learners in deliberate practice, integrating simulation into an overall curriculum, as well as on the instruction and competence of faculty in its use. Medical simulation complements, but does not replace, educational activities based on real patient-care experiences.** ***(CHEST 2009; 135:62S–68S)***

Key words: deliberate practice; mastery learning; simulation; systematic review

Abbreviations: AHRQ = Agency for Healthcare Research and Quality; BEME = best evidence medical education; CME = continuing medical education; GME = graduate medical education; UME = undergraduate medical education

This article has four sections. The first defines medical simulation and summarizes presumptive findings about simulation-based continuing medical education (CME) from the Agency for Healthcare Research and Quality (AHRQ) Evidence Report.[1] The report aims to synthesize the results of nine literature reviews about "the effectiveness of simulation methods in medical education *outside of* CME."[1] It also serves as a foundation for other sections of this article. The second section amplifies the findings from best evidence medical education (BEME) in one of the nine reviews.[2] The BEME review warrants special attention because it receives superficial coverage in the AHRQ Evidence Report,[1] addresses a different question about simulation in medical education beyond its effectiveness, is not confined to a single medical specialty or medical simulator, and offers practical advice about simulation-based medical education program planning and operation. The third section distills and presents lessons learned about best educational practices drawn from both the AHRQ report and the BEME review as well as from two graduate medical education (GME) and research programs and other published sources. The fourth section presents implications for CME grounded in the preceding narrative, the changing focus and professional character of CME, and observations about education for other learned professions.

Medical education using some form of simulation generally has been aimed at the junior trainee both for undergraduate medical education (UME) and for GME. The benefits of simulation derive from its standardization and reproducibility in contrast with the traditional apprenticeship approach to teaching where medical students and residents learn through practice with real patients in the clinic or hospital setting. With the increasing number of patients who are hospitalized and the shorter lengths of hospital stays, requirements for limited trainee work hours, and an emphasis on patient safety, simulation has received greater attention at the UME and GME levels. However, simulation seldom is discussed in the context of CME.

This article reviews the use of simulation education in baseline assessment of knowledge and skills, education grounded in learning objectives, intended outcomes expressed in metrics, deliberate practice with feedback, rigorous outcome evaluation, and professional accountability. These constructs are addressed thoroughly in a call for CME reform in the United States.[3] This article urges the physician-learner to participate in CME activities that include deliberate practice and where he or she can work toward a mastery learning of CME objectives. Physician-teachers should design CME activities that make use of teaching techniques that assist the physician-learner in mastery learning and deliberate practice, embrace outcome measurement, and address cultural barriers to incorporate these educational approaches. Simulation as a teaching technique can be used by the physician-teacher to achieve these goals.

Definition and AHRQ Evidence Report

Medical simulation is defined as "a person, device, or set of conditions which attempts to present [education and] evaluation problems authentically. The student or trainee is required to respond to the problems as he or she would under natural circumstances. Frequently the trainee receives performance feedback as if he or she were in the real situation."[4] "Simulation procedures for evaluation and teaching have the following common characteristics:

- Trainees see cues and consequences very much like those in the real environment.
- Trainees can be placed in complex situations.
- Trainees act as they would in the real environment.
- The fidelity (exactness of duplication) of a simulation is never completely isomorphic with the real thing. The reasons are obvious: cost, [limits of] engineering technology, avoidance of danger, ethics, psychometric requirements, time constraints.
- Simulations can take many forms. For example, they can be static, as in an anatomical model [for task training]. Simulations can be automated, using advanced computer technology. Some are individual, prompting solitary performance while others are interactive, involving groups of people. Simulations can be playful or deadly serious. In personnel evaluation settings they can be used for high-stakes, low-stakes, or no-stakes decisions."[4]

Medical simulations are located on a continuum of fidelity, ranging from detached, multiple-choice examination questions;[5] to more engaging task trainers (arms for phlebotomy practice); to full-body, computer-driven mannequins with sophisticated physiologic features that respond to pharmacologic and mechanical interventions.[6] Simulations also include standardized patients who are live persons trained and calibrated to portray patients with a variety of presenting complaints and pathologies. Decades of experience and research demonstrate that standardized patients are highly effective for medical education and evaluation.[7] Standardized examinees (students) also have been used as a way to calibrate and improve clinical skills examinations.[8,9] Medical educators have recently combined these modalities where standardized patients, inanimate models, and medical equipment are integrated to evaluate train-

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Manuscript received October 20, 2008; revision accepted December 10, 2008.

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DOI: 10.1378/chest.08-2521