Article

Simulation-Based Medical Education: An Ethical Imperative

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Abstract

Medical training must at some point use live patients to hone the skills of health professionals. But there is also an obligation to provide optimal treatment and to ensure patients' safety and well-being. Balancing these two needs represents a fundamental ethical tension in medical education. Simulation-based learning can help mitigate this tension by developing health professionals' knowledge, skills, and attitudes while protecting patients from unnecessary risk. Simulation-based training has been institutionalized in other high-hazard professions, such as aviation, nuclear power, and the military, to maximize training safety and minimize risk. Health care has lagged behind in simulation applications for a number of reasons, including cost, lack of rigorous proof of effect, and resistance to change. Recently, the international patient safety movement and the U.S. federal policy agenda have created a receptive atmosphere for expanding the use of simulators in medical training, stressing the ethical imperative to "first do no harm" in the face of validated, large epidemiological studies describing unacceptable preventable injuries to patients as a result of medical management. Four themes provide a framework for an ethical analysis of simulation-based medical education: best standards of care and training, error management and patient safety, patient autonomy, and social justice and resource allocation. These themes are examined from the perspectives of patients, learners, educators, and society. The use of simulation wherever feasible conveys a critical educational and ethical message to all: patients are to be protected whenever possible and they are not commodities to be used as conveniences of training.

Acad. Med. 2003;78:783–788.

Medical training must at some point use live patients to hone the skills of health professionals. At the same time, there is an obligation to provide optimal treatment and to insure patients' safety and well-being. These conflicting needs create a fundamental ethical tension in medical education, one that is widely recognized although little discussed. Recent articles in the bioethical literature have condemned the unreflective use of patients—especially sedated or dying patients—as training tools for clinicians.[1–3]

Simulation-based medical education (SBME) (see Table 1 for an overview) can be a valuable tool in mitigating these ethical tensions and practical dilemmas. Recent discussions of medical error and risk reduction strategies[4–8] have highlighted simulation as an important tool in improving the safe delivery of medical care. Nevertheless, medicine has lagged behind other high-technology, high-risk professions in the use of simulation, such as aviation, in which sophisticated technical and behavioral skills are necessary.[9–11] The reasons include financial outlays in an era of increasing cost containment, limits to accurately modeling complex human pathophysiology, demands for rigorous scientific evidence of effectiveness, and resistance to change from

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a strong professional culture. However, a more receptive atmosphere for expanding the use of simulators in medical training may now exist. An international patient safety movement based on epidemiological studies delineating the numbers and costs of preventable patient injuries due to medical management has reinvigorated the principle of "first do no harm" in policy debates.

Simulation has been used unsystematically since the early days of medicine. In the 16th century, mannequins (referred to as "phantoms") were developed to teach obstetrical skills and reduce high maternal and infant mortality rates.[12] Today, it is common for students to do their first injections on an orange, practice suturing on pieces of cloth, rehearse medical interviews while role playing, or practice physical examination on simulated (standardized) patient-actors.[13–16]

Application of modern medical technologies requires complex team interactions that mandate improved training techniques. Advanced SBME can provide realistic representations of complex clinical environments and allow educators to alter patient reactions and responses in ways unattainable with actual patients.[18] The recent Institute of Medicine report on medical errors recommends such an interactive use of simulation.[5,p.152] Recent studies have supported the efficacy of screen-based and realistic simulators in enhancing technical, behavioral, and social skills in medicine.[17,19–26] Modern medical simulation falls into five main categories[18] (Table 1). Further research is needed to establish the effectiveness of each of these categories of SBME, as well as their limitations. Equally important is an examination of the ethical features of SBME and its potential contributions and challenges to medical pedagogy.

In the rest of this article, we discuss the four themes that provide a framework for an ethical analysis of SBME: best standards of care and training, error management and patient safety, patient autonomy, and social justice and resource allocation.

Table 1

Simulation Tools and Approaches Used in Simulation-Based Medical Education

Tool or Approach	Description
Low-tech simulators	Models or mannequins used to practice simple physical maneuvers or procedures.
Simulated/standardized patients	Actors trained to role-play patients, for training and assessment of history taking, physicals, and communication skills
Screen-based computer simulators	Programs to train and assess clinical knowledge and decision making, e.g., perioperative critical incident management, problem-based learning, physical diagnosis in cardiology, acute cardiac life support
Complex task trainers	High-fidelity visual, audio, touch cues, and actual tools that are integrated with computers. Virtual reality devices and simulators that replicate a clinical setting, e.g., ultrasound, bronchoscopy, cardiology, laparoscopic surgery, arthroscopy, sigmoidoscopy, dentistry
Realistic patient simulators	Computer-driven, full-length mannequins. Simulated anatomy and physiology that allow handling of complex and high-risk clinical situations in lifelike settings, including team training and integration of multiple simulation devices

BEST STANDARDS

Best Standards for Patient Care

Patients have the right to receive the best care that can be reasonably provided. It is understood that physicians-in-training will treat patients. However, from an ethical perspective, harm to patients as a byproduct of training or lack of experience is justified only after maximizing approaches that do not put patients at risk.

The clinical encounter in a teaching environment may focus too much on training, at times to the detriment of the patient. Although instructors monitor trainees and patients during procedural and cognitive tasks, strategies to place patient well-being foremost occasionally fail. Novices experience significant performance anxiety, generally cannot focus on multiple tasks, and follow simple rules inflexibly.[27] SBME allows trainees to more often have their first encounters with real patients when they are at higher levels of technical and clinical proficiency. Practitioners can use SBME to improve proficiency when learning new procedures or when honing existing skills. The use of simulation wherever feasible also can convey a critical educational and ethical message to all stakeholders in health care: patients are to be protected whenever possible and they are not commodities to be used as conveniences of training.

Best Standards for Education

The responsibility of educators, decision makers, and society to provide clinicians with the best training and most constructive learning experience can also be viewed as a moral commitment to trainees. Yet, increasing fragmentation, production pressure, and cost cutting have placed unprecedented constraints on training, making systematic training in real settings unattainable. SBME may allow consistent trainee exposure to a variety of clinical presentations and procedural contexts, including atypical patterns, rare diseases, critical incidents, near misses, and crises. The process and structure of medical education then becomes a series of progressive choices by educators rather than a response to ad hoc clinical availabilities.

SBME can be complex and subtle, enabling training for encounters such as unanticipated patient demise. Curricula have been developed and tested in which medical students and residents engage "speaking" computerized mannequins who unexpectedly die, or in which simulated operating room resuscitation fails. The "deaths" of such simulated patients can evoke close-to-real feelings of loss and responsibility. The SBME protocols may even involve actors posing as the "families" of the simulated patient. Clinician trainees can be trained and evaluated on their approach to informing families of adverse events or the death of a loved one.

Student autonomy in medical education leads to better-trained students with a more humanistic outlook toward patients.[28] As with learners in general, trainees and providers in health care learn at different speeds and have different educational needs. SBME allows trainees to practice clinical skills at their own pace, repeating procedures as needed to gain comfortable levels of confidence and proficiency.

Best Standards for Skills Evaluation

Simulation-based skills assessment has played a major role in the transformation of the determination of providers' competency. The traditional focus on the assessment of cognitive skills has slighted the skills of communication, management, cooperation, and interviewing. Deficiencies in these skills are causal factors in adverse outcomes.[29,30] Simulation-based assessment has increasingly become a standard method for evaluation.[17,31,32] Objective structured clinical examinations (OSCEs) have become a part of licensure examination in both Canada (by the Medical Council of Canada)[33] and the United States (by the Educational Commission for Foreign Medical Graduates).[34] Currently, simulation assessment is restricted to "low-tech" methods, using standardized patients to evaluate history taking, physical examination, and communication skills. As the fidelity of medical simulators improves, however, performance assessment studies of hands-on management skills may advance beyond current methods constrained by the use of live patients. Consequently, more professional boards may eventually include more sophisticated simulation-based performance assessment in their routine certification and recertification procedures.[35]

ERROR MANAGEMENT AND PATIENT SAFETY

Although medical trainees should be closely supervised, especially during the early parts of their clinical training, it is inevitable that trainees will occasionally cause preventable patient injuries. Although such risks are usually considered an unavoidable concomitant of training, the harm caused is ethically tolerable only when minimized to the degree possible by medical pedagogy.

In the clinical setting, errors must be prevented or terminated immediately by supervisors to protect the patient. In contrast, in a simulated environment, errors can be allowed to progress to teach the trainee the implications of the error and allow reactions to rectify deviations. Video feedback strengthens the impact of these learning opportunities and may provide strong incentives to modify behavior. Learning from errors is a key component of improving expertise and serves to organize future behavior.[36–38]

Errors and failures of expertise occur throughout health professionals' careers.[27] SBME is therefore as valuable for continuing medical education and recertification as it is for novice preparation. The model for the use of simulation in a systematic, career-long approach already exists in aviation.

House staffs often handle medical mistakes by denial, discounting personal responsibility, or distancing themselves from the consequences.[39] Mistakes made during simulated exercises do not cause harm to living patients and can be more easily exposed and discussed. Mishaps in the course of learning can thus be reviewed openly without concern of liability, blame, or guilt—even decisions and actions that result in the death of the simulated patient. SBME can help break the culture of silence and denial in medicine regarding untoward outcomes and mistakes and their implications about the learner's competence. SBME can foster and nourish a culture of safety, possibly improving the quality of event reporting, an important national policy directive.[5]

Simulation approaches provide additional means for exploring vulnerabilities in health care delivery and for using that information to improve the competence of providers, the system of care, and interaction between the two. Examples of systems-level applications of simulation include uniform training for interdisciplinary in-hospital resuscitation teams and the increasingly relevant assessment of technology, information systems, and procedures.[40]

PATIENT AUTONOMY

A fundamental principle of modern bioethics is that patients have the right to direct their own care.[41] Standards of informed consent require full disclosure of all pertinent information, and give patients virtually unrestricted rights to refuse a treatment, to participate in research, or to be treated by a trainee or novice.[42]

In practice, however, these ethical precepts are often violated. Patients are frequently asked in a perfunctory fashion if a learner can engage them or are not asked at all. Sometimes, patients may not even realize they are being treated by a trainee.[43] Academic care is time pressured, complex, and hierarchical. Patients may be tired, in pain, or sedated. Procedures for obtaining consent for major anesthesia and surgery have been weakened by the rapid pace and fragmentation of care today. The right to refuse a procedure performed by a trainee is often qualified and may be a fiction in some settings. Research in informed consent procedures indicates that patients frequently do not grasp the nuances and consequences of their consent, even under optimal conditions.[44,45]

Unconscious, heavily sedated, and recently dead patients are vulnerable subjects for medical training.[46] Articles have periodically exposed such practices as the use of anesthetized women for preoperative pelvic examinations by trainees.[47] A recent survey of physicians-in-training confirmed the practice of performing nontherapeutic, invasive training procedures during cardiac resuscitation and presented a review of the literature on the controversy of using the recently dead for such purposes.[3,48] SBME can significantly reduce the need for training on such patients, helping to fulfill an ethical imperative.[49] SBME can also enhance the quality of informed consent by having learners practice informed consent procedures on simulated patients in ethically challenging scenarios, resulting in a more ethically sensitive approach when actual patients are involved later.

SOCIAL JUSTICE AND RESOURCE ALLOCATION

The basic bioethical principle of distributive justice requires that citizens equally share risks of medical innovation, research, and practitioner training. Yet, academic health systems (AHSs) are located in urban areas (only two of more than 115 AHSs are not within a metropolitan statistical area [MSA]), and they provide disproportionate amounts of care to the poor. For example, although AHS hospitals account for only 16% of the beds within MSAs, they recently were noted to account for 45% of the hospital-based charity care.[50] As AHSs also provide the vast majority of medical training, it is clear that the already disadvantaged are parties to an unwritten contract to bear a disproportionate amount of the risk of novice training. It is therefore an issue of distributive justice that SBME be explicitly directed toward reducing the proportion of indigent patients used as objects of medical training.

SBME also reduces the need to use live animals for training. Simulators can provide models of human physiology and metabolic responses as well as (and sometimes better than) animals typically used for training purposes. Only recently, the Subcommittee on Advanced Trauma Life Support (ATLS) and the Committee on Trauma of the American College of Surgeons has approved an alternative model for use during the ATLS Surgical Skills Practicum: an anatomical human body manikin.[51]

AN ETHICAL IMPERATIVE

Medical schools are redesigning their curricula and rethinking the nature of medical education. This transformation includes a greater emphasis on bioethics, patient-focused care, and the incorporation of the fruits of the medical–technological revolution. Although overreliance on technological medicine may sometimes be a threat to humanistic care, the proper use of simulation technology has the potential to enhance humanistic training in medicine. To optimize the use of SBME and overcome resistance by health professionals, SBME trainers should be skillful in creating a receptive atmosphere, providing constructive feedback, and using video feedback and debriefing. Skillful use of SBME can use the intensity of the simulated experience to nourish culture change and support recognition of fallibility and areas of weakness.[52–54]

The cost-effectiveness of potentially expensive SBME should also be examined in terms of improvement of clinical competence and its impact on patient safety and error reduction in an era of limited resources.[55] Encounters with real patients will always remain essential in exposing health providers to the full complexity of practice. SBME is thus a complementary educational modality rather than an attempt to replace real-patient training encounters.

We suggest that the proper and careful development of SBME is an ethical imperative. While the actual contribution that SBME can make to improving skills awaits empirical study, there seems little question that, when used in a sophisticated manner, SBME has the potential to decrease the numbers and effects of medical errors, to facilitate open exchange in training situations, to enhance patient safety, and to decrease the reliance on vulnerable patients for training. Moreover, by adopting simulation as a standard of training and certification, health systems will be viewed as more accountable and ethical by the populations they serve.

Dr. Small was supported by grant numbers U18 HS 11905 and P20 HS 11553 from the Agency for Healthcare Research and Quality.

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