How Does Health Care Simulation Affect Patient Care?

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Perspective

Introduction

Health care simulation programs have spread to many parts of the United States health care system, including hospitals, medical and nursing schools, community college programs, and clinics. Many educational and training units use simulation to help teach new skills, refresh old skills, and promote teamwork in the delivery of health care. Health care simulation is "a technique that creates a situation or environment to allow persons to experience a representation of the real health care event for the purpose of practice, learning, evaluation, testing, or to gain understanding of systems and human actions."(1)

In a 2013 PSNet perspective, Cook presented evidence that health care simulation was effective as an instructional tool and that simulation-based rehearsal was an effective supplement to working directly with patients.(2) However, there remain many health care professionals that have only a vague idea of what health care simulation actually is and what impact it can have on
clinical practice. What modalities comprise health care simulation and in what areas can these modalities help improve patient care?

**Methods Used in Health Care Simulation**

Four main methods are used in health care simulation: human patient simulators, task trainers, standardized/simulated patients, and virtual reality. The use of these methodologies depends upon the end goal.

*Human patient simulators* (mannequins) are whole-body human simulators designed to provide an accurate anatomic representation of patients. They can display physiologic signs and physical cues and can be remotely controlled by an operator through the use of a computer control module or a handheld remote. Modern simulators also allow learners to practice a variety of medical procedures including airway maneuvers (bag-valve-mask ventilation, intubation, and needle cricothyrotomy), various forms of vascular access (intravenous, interosseous), and life support procedures such as cardioversion and defibrillation.

*Task trainers* are partial body simulators that are used for training in specific tasks and/or procedural skills. Commonly used task trainers include endotracheal intubation simulators, lumbar puncture simulators, and intravenous catheter trainers. The use of task trainers allows learners to repeatedly practice a specific procedural skill until proficiency is attained. Studies involving patients have demonstrated that procedural skills training using simulation is associated with improved patient outcomes during central venous catheter insertion, hemodialysis catheter insertion, paracentesis, and lumbar puncture.(3-7)
Standardized, or simulated, patients are well accepted and widely used in medical education. Standardized patients are real people who are recruited and trained to portray patients in a reliable and consistent manner. Simulations involving standardized patients are a means to assess selected competencies in patient care, interpersonal communications, and professionalism. These areas include counseling or conducting difficult conversations, such as end-of-life discussions. (8)

Virtual reality (VR) simulators use a computer screen, or other type of graphic user interface, to create simulated patients and patient care environments. As indicated by the name, the interactions that take place are virtual in that the learner interacts with the patient utilizing a computer interface in an electronically rendered environment, rather than a physical simulator. With the integration of haptic interfaces, some VR simulators now have the capacity to promote the acquisition of a full range of cognitive, technical, and behavioral skills.

Hybrid simulations involve the melding, or simultaneous use, of two or more methods of simulation. Using a mix of mannequins, task trainers, standardized patients, and VR simulators, educators can create a variety of multimodal and interactive simulation experiences for users with a range of difficulty and clinical scenarios.

Patient Care and Simulation

The key question many ask about simulation is about its clinical impact. A systematic review analyzed clinical outcomes after the introduction of simulation-based education; these outcomes included patient complications, duration of stay, procedural success, and patient discomfort. (9) Participants in simulation were postgraduate physicians, nurses, and emergency medicine
technicians. Most of the valid studies were in the areas of airway management, endoscopic procedures, central venous catheter insertions, and obstetrics—all high-risk areas. The effect size of simulation on patient outcomes across 33 studies was 0.47, suggesting a moderate benefit for patients.\(^{(9)}\) This finding is superior to the effect sizes for patient outcomes reported for conferences, workshops, and rounds in another review.\(^{(10)}\)

Simulation has also been studied for its impact on medication errors. In 2007, the Institute of Medicine estimated that 1.5 million preventable adverse drug events occur each year in the US.\(^{(11)}\) A systematic review of 21 studies over 15 years tested the impact of the use of simulated patients.\(^{(12)}\) The authors concluded that well-constructed simulation programs for physicians, nurses, and pharmacists led to lower rates of drug administration and preparation errors, better compliance with checklists, and improved detection of medication errors: "Learning by simulation is an additional support in educational programs for health care professions involved in risk management."\(^{(12)}\)

The use of simulation in situ (i.e., taking place in the actual patient care setting/environment)\(^{(1)}\) has also shown benefits in patient outcomes. In a review, nurses and respiratory therapists scored higher on performance skills in pediatric resuscitation when the simulation was conducted in situ compared to standard classroom training.\(^{(13)}\) In obstetrics, one study demonstrated improved teamwork measures when simulation in situ was added to TeamSTEPPS training.\(^{(14)}\) This improvement was accompanied by a decrease in malpractice claims activity and the average amount paid per claim.\(^{(14,15)}\) Using in situ simulation to detect errors in facility design, organization, or training can have a significant impact on patient safety (latent safety threats).\(^{(16)}\) In that study, researchers made extensive use of simulation before
opening a large tertiary care pediatric hospital. In studying high-risk areas of
the operating room, intensive care unit, emergency department, and the
heliport, they identified 641 issues in equipment, code alarms, patient care
flow, and emergency response concerns that would have been missed or
minimized if not tested first in simulation.(16)

The Future

Looking forward, screen-based simulations and augmented reality simulators
are maturing and may have a significant impact on health, patient care, and
training in the future. One example is so-called serious medical games. Serious
medical games are simulations of real-world events played on a computer
screen in accordance with specific rules for a primary purpose other than pure
entertainment.(1) An example is PediatricSim, an interactive, three-
dimensional, single-player, first-person game designed to evaluate a player’s
decision-making capability in seven high-risk pediatric scenarios.(17) The
game has strong validity evidence for usefulness among medical students,
trainees, and practicing pediatric emergency department and intensive care
unit physicians.

Another example of screen-based simulation is augmented reality. Augmented
reality is a type of virtual reality in which digital computer-generated objects are
superimposed onto real-world objects to enhance learning. Currently, many
augmented reality simulators have been developed to practice procedural
skills. An integrative review of augmented reality in health care found that
augmented reality had been implemented in a variety of health care areas and
aimed at all levels of learners.(18) More than 96% of papers reviewed showed
improved performance accuracy and decreased amount of practice needed in
skills training. Augmented reality simulators were also well accepted by
learners. While developing better simulators is important, both the literature and experience demonstrate that it is probably more important to develop curricula and education theories that help to understand how simulation can help learners to learn better and faster.

**Advocating for Health Care Simulation**

We now have been employing simulation in health care for over 2 decades. The evidence base for its impact on learning and patient care is broad and robust. The health care simulation community has published standards of practice for many of the simulation modalities in current use.\(^{(19,20)}\) More than 1200 professionals now have been certified as health care simulation educators and operations specialists, and there are a number of simulation societies around the globe. There are several academic simulation journals and a vigorous research community. Simulation programs can become accredited much as hospitals and universities do, through either the Society for Simulation in Healthcare or the American College of Surgeons. There is even a health care simulation dictionary published by AHRQ to define terms and promote standardization.\(^{(1)}\) With all of this in place, the argument can be made that health care simulation is now a professional specialty with a defined set of principles and practices, a certifying examination for individuals, accreditation standards for programs, and a research base. What is missing is more advocacy for simulation as a vital part of patient care. Health care executives, insurance companies, regulators, and other opinion leaders must be made more aware of what simulation is and how it contributes to quality patient care and outcomes. Simulation can also be a tool for administrators to increase workforce competence through better training, which in turn might reduce staff turnover as confidence in skills increases. Rather than speaking only of a financial return on investment, perhaps we should also talk about a return on
expectations for simulation, in which we judge the value of simulation partly by whether it contributes to more successful staff, improved morale, better patient outcomes, and more satisfied patients. With so much at stake, it is important for all involved in health care today to become familiar with the specialty of simulation in health care and speak clearly and often with leaders and regulators about its value in today's complex medical environment.

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References


