

## Simulation Training

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### Background

Clinical training for health care professionals has historically relied heavily on learning from actual patients, even for invasive procedures and life-threatening situations. In fact, medicine has had a history of promoting “see one, do one, teach one” that has persisted for decades.

However, considerable evidence documents the dangers posed by inexperienced clinicians and poorly functioning clinical teams, which prompted many to consider other teaching methodologies including simulation. Simulation is not new to healthcare training. There is evidence of surgical skill practice on animal cadavers in the Middle Ages, task trainers and birthing simulators in the 1600 and 1700's and the first nursing manikin, Mrs. Chase, was developed in 1911.<sup>1</sup> In recent years, the use of simulation in healthcare education has continued to grow, including into the [allied health professions](#). It has emerged as a key component of the patient safety movement and is increasingly being used to improve clinical and teamwork skills in a variety of settings.<sup>1,2</sup> This is based in part on its success in other industries including aviation. Simulation offers a way for learners to gain fluency with skills without risk to patients, and gain experience recognizing and responding to uncommon, high-risk, situations that might not otherwise occur over the course of their training.

When employed properly, simulation-based training allows the opportunity to learn new skills, engage in deliberate evidence-based practice, and receive focused and real-time feedback. The goal of simulation-based training is to enable the accelerated development of expertise, both in individual and team skills, by bridging the gap between classroom training and real-world clinical experiences in a relatively risk-free environment.

## Methods and Settings of Simulation-based Training

There are several approaches to simulation training and depending on the material being emphasized, simulation curricula may employ one or more of these methods. While technology-enhanced simulation is effective, increasing technological sophistication of simulation may not always be necessary.

The learning objectives of the simulation should drive the simulation methods used. Below are common methods and settings for simulation to take place.

- One method of simulation is to use devices for clinical skills trainings. Known as part-task trainers, these life-like simulators are used to train specific clinical skills. An example would be anatomically correct limb models, which are used to demonstrate phlebotomy skills or placement of intravenous catheters.
- Full-scale simulators are also widely used; the most common example is a full-body manikin. These range from low fidelity, offering anatomic landmarks, to high-fidelity manikins with realistic physiologic responses (such as heart sounds, seizure behavior, responsive pupils, and respirations). These are increasingly used to teach physical examination and other fundamental clinical skills, in addition to more complex clinical response. Almost all healthcare providers experience the use of manikins during Basic Life Support training.
- Another frequently used method is to use standardized or simulated patients. Employing trained actors to simulate real patients has long been used to teach basic history taking and physical examination skills, and this strategy is also being applied to teach [patient safety skills](#) such as [error disclosure](#). These methods are not mutually exclusive, and successful curricula often use combinations of these approaches.

Simulation can be used in a variety of different settings and the particular setting will often dictate the method selected. Below are examples of settings:

- **Simulation centers:** Simulations take part in specialized learning centers. Many are designed to replicate the variety of clinical spaces learners work in such as ambulatory offices, operating rooms, and emergency rooms, as well as equipment they work with such as ultrasound machines, task simulators, and virtual surgery simulators.
- **Classrooms and skills or task labs:** Many organizations do not have a simulation center but can use a classroom, break room, or a skills/task lab for simulation. While the room may not emulate an operating room or emergency room, part- and full-scale simulators can be set up on tables to demonstrate and practice skills.
- **[In situ simulation:](#)** This approach refers to simulation carried out in the actual clinical environment with the providers who work in that location. It may involve use of part-task or full-scale simulators or standardized patients as well. Because of the potential risks to patient and staff safety in the clinical environment, special care needs to be taken when conducting simulation here, including identification of [“no-go” criteria](#).

Over the past decade, more sophisticated and technologically enhanced settings have been developed.<sup>3-6</sup>

- Virtual reality: In this modality, learners are immersed in a highly realistic digital clinical environment, such as an operating room or intensive care unit. Learners physically interact with the environment and each other, standardized patients or digital patients, as they would in real life, using systems that are increasingly complex and technologically sophisticated. This technology also allows for learners to be physically distanced from each other, which could be different rooms in a building or across oceans.
- Augmented reality: a variation of virtual reality in which images are superimposed over the users view of the world. This also offers distance learning approaches.

Simulation has been successfully applied as formative experiences to develop foundational clinical skills as well as more advanced cognitive, communication and technical skills in both pre-licensure and residency training for medical and nursing students.<sup>7-9</sup> It is also being used for summative learner assessments in the form of Objective Structured Clinical Exams (OSCE), which are a required component of many health professions training programs.<sup>10-11</sup>

### **Simulation and Patient Safety**

Simulation training is an effective educational modality, with strong evidence demonstrating improvement in learners' knowledge, skills, and behaviors and simulation approaches have been shown to improve [patient-level outcomes](#). A classic [systematic review](#) of more than 600 studies of technology-enhanced simulation training programs in health care found that technology-enhanced simulation training was associated with improvements in learners' knowledge, skills, and behaviors, and improved patient outcomes. [Virtual reality](#) is being explored for usefulness in teaching team skills, communication, leadership and stress management. The recent evidence on simulation as a modality for teaching nontechnical skills is summarized in a 2018 [PSNet Perspective](#). It is worth noting that some reviews have raised concerns regarding the methodological limitations of many simulation studies, including lack of standardization of training techniques,<sup>12</sup> randomization of participants,<sup>13</sup> and measurement methods<sup>14,15</sup> and highlight this as an area to consider in future simulation research.

Simulation is being widely integrated into [teamwork training](#) in a variety of environments, including the [emergency department](#), [operating room](#), and [obstetrics units](#). Teamwork training that incorporates simulation often focuses on improving the ability of multidisciplinary teams to handle acute or emergent situations. Teamwork training with simulation has also been used with non-clinical personnel, such as one [study](#) in which non-clinician leadership and management had to respond to a simulated patient safety crisis. Research have shown that multidisciplinary simulation-based teamwork training can yield improvement in participants' knowledge and skills in teamwork.

Simulation in patient safety has shown reduction in adverse events after targeted simulation training, including medication errors as described in this [quality improvement intervention](#) that showed improved nurses' adherence to medication administration best practices from 51% to 84%. The application of [human factors engineering](#) methods to patient safety represents another purpose for simulation. Usability testing, which refers to testing new equipment and technology under real-world conditions, and [clinical systems testing](#) can be thought of as a form of simulation designed to identify [latent safety issues](#), [workarounds](#) and test workflows, and operational readiness. In fact, advanced technologies have helped to provide learners

experiences that integrate challenges such as difficult airway intubations, difficult births, and other technically challenging skills.

Simulation is a useful tool to improve patient outcomes, improve teamwork, reduce adverse events and medication errors, optimize technical skills, and enhance patient safety culture.<sup>2, 16-19</sup>

### **Learner Experience**

Creating a simulation environment conducive to learning is a key consideration in simulation training. Researchers examined 327 learner narrative accounts of simulation experiences and found that while the majority of respondents focused on the development of knowledge, skills, and attitudes of health practice, a small portion (2%) focused on feelings of humiliation, lack of safety, and embarrassment.<sup>18</sup> According to another [review](#), key features of successful simulation education are those of successful curricula in general: individualized feedback, cognitive interactivity, deliberate practice, and longer duration of the curricula. To maximize learner experience and prevent harm, simulation pedagogy should be considered when developing and conducting simulation and facilitators should be trained in best-practice guidelines.

### **Best-Practice Guidelines**

As simulation use and research has grown, the need for evidence-based best practice guidelines has emerged. There are several organizations that provide guidelines as well as profession-specific and modality specific standards. Generally, the standards include expectations around simulation design, pre-briefing, facilitation, debriefing and evaluation of simulation experiences, as well as operational and professional development standards. It is recommended that anyone participating in the design and facilitation of simulation activities be familiar with, and trained in, best practices. Below are a few organizations.

- International Nursing Association for Clinical Simulation and Learning (INACSL) has released the [Healthcare Simulation Standards of Best Practice](#).
- [Society for Simulation in Healthcare \(SSH\)](#) is an accreditation body for simulation programs.
- [American College of Surgeons](#) sets standards for simulation-based surgical education and training. They are also an accrediting body for simulation centers.
- [Association of Standardized Patient Educators](#) focuses specifically on simulations involving standardized patients.
- The Interprofessional Education Collaborative (IPEC) publishes [Core Competencies for Interprofessional Collaborative Practice](#), including competencies regarding interprofessional simulations.
- [The Committee on Accreditation of Education Programs for the Emergency Medical Services Professions \(CoAEMSP\)](#) has released [simulation guidelines](#) and recommendations for EMS education.

## **Current Context**

In 2015, the National Council of State Boards of Nursing (NCSBN) released their national simulation study, demonstrating that high-quality simulations could be used to successfully replace up to 50% of traditional nursing clinical hours.<sup>20</sup> Currently, implementation varies by State, but several allow for [25-50% of nursing clinical hours](#) to be replaced by simulation. The American Association of Colleges of Nurses recently published updated “Essentials”, a framework for the preparation of baccalaureate, master’s, and doctoral nurses that focuses on competency-based education. The new essentials document encourages simulation as a valid and reliable element of nursing education that supplements and even enhances certain aspects of direct patient care.<sup>21</sup>

In medical education, all graduating medical students are required to complete a simulated patient encounter to pass the United States Medical Licensing Examination. The Accreditation Council for Graduate Medical Education requires that residency programs provide simulation training, although the specific requirements vary between specialties. The American Board of Anesthesiology requires practicing anesthesiologists to complete a simulation course in order to maintain board certification, but this requirement is not present for other specialties. A [WebM&M commentary](#) discusses emerging approaches to simulation, including virtual reality and other technological advancements, as well as the potential for using simulation to assess and remediate [individual clinician performance issues](#).

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