2 Types of Healthcare Simulation: Locations and Training – Who, What, and Where?

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Academic Groups: Who Is Being Trained?

Simulation is being integrated into the curriculum for both academic and nonacademic healthcare learners. This type of training is of importance across disciplines and between disciplines, as errors in communication and shared understanding are some of the most difficult areas to train and yet may be the most important to improve healthcare delivery [1]. While all individuals who work with patients can impact safety and patient care, the diversity of specific roles and training backgrounds is difficult to understand even for those in the healthcare field. It is with this rationale in mind that interprofessional education in simulation is being encouraged to improve communication and understand between care providers, and allow those involved with training and support across disciplines to understand the background and expectations for each type of learner [2]. Understanding who is being taught and their role in the larger healthcare system will help to match the learning objectives with the tools and appropriate space to ensure the most appropriate functional space is available to conduct training [3].

The following sections will describe the general background and role that each group has in the delivery of healthcare and how simulation has been integrated into their training experiences.

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Prehospital: Emergency Medical Services (EMS) and Other First Responders

Prehospital care providers can include any bystander or first responder, but generally this term focuses on ambulance crews and paramedics. Systems around the world vary in the training and possible scope of care provided. In the United States, emergency medical technicians (EMTs) are part of a national registry and certification with levels of EMT, advanced EMT (AEMT), and paramedic [4]. An entry-level EMT can administer a small number of medications and provide oxygen and CPR, while a paramedic can give opiate pain medications, cardiac active medications, and perform intubations. A physician is usually available to provide online knowledge and care assistance via a radio or telephone in addition to EMTs following established or written protocols. Countries outside of the United States have systems that vary significantly. France, for instance, may have an anesthesiologist physician on the ambulance that arrives at the scene.

Prehospital learners commonly practice skills training focusing on emergency stabilization of airway, breathing, and circulation. Simulation training may be conducted in a classroom, a simulation room, or in the field. EMT, paramedic, police, and fire and rescue personnel work individually as well as in groups for specific simulation trainings. Paramedic courses may include anatomy lab training that is directly applicable to their procedure training. There have been partnerships with police, fire, and rescue training programs working with academic-based standardized patient programs to be able to deploy hybrid training with manikins and actors. Often, these trainings will be done in situ which includes training on the side of the road and integrating moulage to create a more immersive experience [5]. Mobile simulation lab spaces have been added inside of functional ambulances with specialty cameras and recording devices to allow review and evaluation of learners as well as systems to control manikins on board (Fig. 2.1).

While the implementation of healthcare simulation-based training uses multiple modalities, in situ training using field exercises is the most applicable to this group. This can be everything from practicing lifts and carries for firefighters performing a

Fig. 2.1 Example of an ambulance that has been modified to allow simulation activities to be run and controlled within the existing and realistic space. This also allows simulation to travel to sites or areas without requiring learners to travel to a physical simulation center

rescue, to police drills with active shooter scenarios and incorporation of curricula for tourniquet training and campaigns like "Stop the Bleed," or working in lowlight conditions to evaluate a patient to provide stabilization and evaluation of a victim on the side of the road [6, 7].

Nursing School

Nursing training focuses on management and coordination of care through patient assessment and procedural skills and patient care interventions [8]. One of the most critical aspects of this role includes medication administration and monitoring. While their scope of practice limits autonomy to provide care or treatment only as directed by protocols or physician orders, they serve as the eyes and ears for changes in patient condition. Nurses are more likely to catch an error when in a supportive healthcare system such as that promoted in simulation training [9]. Nursing education for clinical practice can be an associate's, bachelors, or master's degree with training duration ranging from 12 to 48 months depending on the type of degree program and background of the student.

Nursing school at the undergraduate level has integrated skills training, high-fidelity manikin training, and often hybrid training with both standardized patients and manikins. There is strong literature that has come from nursing describing the debriefing components of simulation training and best practices for integration into curricula [10–12].

Skills training using task trainers is a common method to provide hands-on training to students prior to entering the clinical environment. This allows learners to demonstrate and educators to assess the evaluation and care for lines, tubes, IVs, surgical wounds, and examination skills. In addition to focused skills training, simulation centers have reproduced the look and feel of hospital wards, clinics, and intensive care units (ICUs) to allow familiarization with workflow, system processes, and equipment such as headwall systems, patient call requests, "code blue" activations, and medication dispensing units such as Pyxis and Omnicell that are ubiquitous in clinical practice.

Advanced practice nurses (APNs) progress beyond an initial nursing degree to become nurse practitioners (NPs), clinical nurse specialists (CNSs), certified nurse-midwives (CNMs), and certified registered nurse anesthetists (CRNAs) [13]. APN students integrate skills throughout their curriculum and have integrated Objective Structured Clinical Examinations (OSCEs) as well as the previously mentioned training for their initial nursing degrees. These OSCE scenarios can be high-stakes exams and can partner standardized patients (SPs) along with procedural skills training [14]. The APN curriculum may include gross anatomy, directly associated with clinical procedures, using an anatomy lab.

The hybrid model of training (mixing SPs and task trainers) is being used more and more to simulate the complexities of the healthcare environment across training disciplines. For example, nurse midwifery programs often incorporate hybrid solutions such as standardized patients with a birthing task trainer such as the Laerdal MamaNatalie® birthing simulation unit to create added realism from the human face-to-face interaction with a mom during delivery. Not only are these procedural and skills training opportunities being assessed for grading and instruction, but there are also team training and communication components to improve the "soft skills" of communication with patient and coworker interactions.

Medical School

Doctors begin training with potentially limited or no prior specific health background. While any undergraduate training background is possible, many premedical students will major in biology or chemistry. Most medical school curriculums focus on providing an overview of basic sciences in the first 2 years of medical school, covering topics like gross anatomy, physiology, pharmacology, physical examination skills, biochemistry, and pathology. These involve simulation modalities that may access 3D-imaged human tissue, plastinated human tissue, or preserved donor tissue for dissections. Standard cadaveric dissection is still preferred at most programs but is frequently being enhanced with newer technologies such as augmented and virtual reality [15, 16]. As the learners move toward preclinical experiences in their first and second years, there is an increase in use of simulation to build on fundamental medical education. These simulations include high-fidelity manikin scenarios and hybrid training opportunities. Some of these simulation experiences are of even greater need during the first 2 years of training as other clinical exposure is often limited. The carefully constructed ability to apply book knowledge to clinical cases is invaluable as a training and educational tool.

During the third and fourth years of medical school, exposure to patients truly begins and rotations through the primary specialties of medicine round out the educational experience. These core specialties include Pediatrics, Internal Medicine, Surgery, Family Medicine, Neurology, Obstetrics and Gynecology, and Psychiatry. Medical schools utilize integrated skills training and use simulation training with the OSCE and Clinical Performance Examination (CPX) with standardized patients. In order to complete medical school, three separate licensing examinations must be completed and passed. One of these is a high-stakes OSCE-based clinical skills test.

Programs may create educational content to support textbook knowledge for body systems using different simulation modalities based on the subject matter being taught. In addition to working with standardized patients, learning procedures on task trainers is commonly incorporated into rotations for some specialties. This type of task training exposure may be a student's only exposure to a procedure before performing that skill on a real patient.

Physician Assistant (PA) School

Physician assistants are clinical care providers with significant autonomy, depending on the setting, to evaluate and direct patient care in much the same manner as a physician [17]. Although closely monitored and supervised by a physician, PAs are allowed prescriptive authority (the ability to write for prescription medications) as allowed by state and national regulations. Most PA programs provide a master's degree as part of the training. PAs can work in a variety of settings including surgical and medical inpatient hospital settings, outpatient clinics, and across most specialties [18].

Physician assistant programs average 27 months in length and have integrated advanced science courses and skills training in addition to clinical experience. Training programs may also conduct simulation training utilizing OSCE and Clinical Performance Examination (CPX) formats using standardized patients in their training activities similar to physician and nurse practitioner programs. As would be expected from the potentially broad scope for practice, physician assistant programs use the anatomy lab environment as well as different modalities of simulation to train applied clinical skills. This is done with task trainers, manikin-based and hybrid simulations using standardized patients with the same knowledge and care expectations as most physicians [19].

Pharmacy School

As one of the public's most accessible healthcare professionals, pharmacists provide medication information and services. Community pharmacists require skills and training in over-the-counter medications, homeopathic remedies, and counseling that delve beyond the required compounding, packaging, labeling, and distribution tasks. Many pharmacists receive additional training in medical services like vaccination administration, anticoagulation management, pain management, and in some settings, prescriptive authority under protocol [20, 21].

Doctoral pharmacy programs have integrated skills training and many conduct simulation training [22]. With the integration of standardized patient encounters into training activities, learners are able to prepare with varying degrees of fidelity. Pharmacy students focus most training on clinical skills necessary for pharmacotherapy [23]. The Accreditation Council for Pharmacy Education has approved the use of simulation to count toward up to 60 hours of the clinical hour requirements for training and education and specifically encourages the development of interprofessional education activities [24]. Practice settings in community, acute care, and long-term care, among others, may require tailored experiential learning beyond the textbook. Many inpatient pharmacists are part of the hospital code response team, for example, and participate in monthly mock code training programs. By using high-fidelity manikins, learners are able to see and interact with the physiological response to medication administration, adverse effects, and complications using ACLS guidelines and CRM principles during a code.

Graduate Medical Education (GME)

After completing medical school, a medical student is awarded the initials MD (doctor of medicine) or DO (doctor of osteopathic medicine). Both degrees reflect extensive and similar training on physical diagnosis and treatment as well as compliance with at least one of two national certification standards: United States Medical Licensing Examination (USMLE) for MDs or Comprehensive Osteopathic Medical Licensing Examination (COMLEX) for DOs. Most patients will not notice a difference in care provided by either type of physician. Either training type will then usually continue on to receive an additional 3–7 years of training in a medical specialty. Some physicians may then pursue an additional 1–3 years of subspecialty training called a fellowship. These training programs and expectations in the United States are governed by the American College of Graduate Medical Education (ACGME) with specific guidelines of training experiences and skills development. The American Osteopathic Association (AOA) and ACGME are transitioning to a single accreditation system for GME in the United States. It is to be fully implemented by July 2020.

Accredited GME programs have resident/fellow education guidelines and requirements facilitated through the American College of Graduate Medical Education (ACGME) and the associations that work with each specialty. Surgical skills competency is now being reviewed and guided by recommendations from a six-specialty group known as the Surgical Council on Residency Education (SCORE). SCORE has the goal to develop a comprehensive technical skills curriculum for surgeons and ensure competency [25]. GME learners often need off-hours access to labs to have opportunities for deliberate practice to achieve these expectations [26, 27]. Currently, each medical specialty has milestones that are outlined in the ACGME Milestones Guidebook. Individual specialty groups have developed outcome-based milestones to assess resident/fellow performance in the six core competency areas (Fig. 2.2) [28]. Surgical and nonsurgical GME programs use a variety of simulation modalities to assess these competency areas. Task trainers,

Fig. 2.2 The six ACGME core competencies

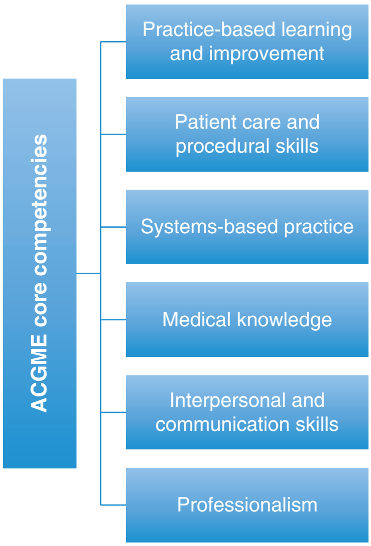

Fig. 2.3 Example of hybrid simulation using a live actor as a standardized patient wearing a surgical cut suit task trainer

virtual reality (VR) simulation, hybrid manikin cut suits (Fig. 2.3), high-fidelity manikins, standardized patients, human donor tissue, and live animal subjects may all be utilized during this time in training [29].

Residents and fellows are scheduled for training using various surgical and nonsurgical VR trainers based on their specialty [30]. Traditionally, this training has taken place in cadaver labs and throughout simulation centers across the globe. Laparoscopic surgical simulators and box trainers have been mandated by the American College of Surgeons as a minimum standard in graduate training [31]. Some of the groups that utilize this type of training include general surgery residents, thoracic surgery residents, and gynecological surgical residents. For the non-laparoscopic surgical simulators, there are VR trainers that have been designed specifically for otolaryngology, orthopedics, and neurological surgery [32]. Other forms of skills training use VR simulators or VR goggles. VR is used in procedural training and provides opportunities for learners to practice surgical, bronchoscopy, and endoscopy procedures with the use of virtual reality units (Fig. 2.4). There is also simulator training and residents will log in and have their hours and experiences documented and recorded into a personalized portfolio for faculty review. Centers are using VR for operating room safety training as well as basic employee or student safety modules. This type of orientation training may

Fig. 2.4 Examples of realistic computer-based virtual reality task trainers to allow clinicians to develop technical skills such as ultrasound (US), endoscopy, and laparoscopic surgery

be required and utilized for onboarding and new employee education. General surgery and obstetrics and gynecology residents are required to gain minimally invasive surgical skills, called laparoscopic surgical skills. Prior to their respective surgical board applications, they must successfully complete the high-stakes exam, Fundamental of Laparoscopic Surgery. General surgery residents are also required to complete the Fundamental of Endoscopic Surgery exam. These exams have a didactic and hands-on skills assessment and are completed at SAGES (Society of American Gastrointestinal and Endoscopic Surgeons)-certified testing centers [33, 34].

Professional and Healthcare Teams

Once the initial training and degree has been awarded, it is no longer acceptable for healthcare professionals to continue without some form of continuous medical teamwork and skills training. Professional and healthcare teams may have annual competencies where skills are reviewed and communication activities are implemented. There are also specialty certification programs such as the Maintenance of Certification for Anesthesiologists (MOCA) 2.0 that provides an intensive longitudinal assessment model to foster lifelong learning and assessment [35]. This is in contrast to the previous design of MOCA as high-stakes recertification process initially pioneered by the American Board of Anesthesiologists.

For trauma surgeons, there are the Advanced Surgical Skills for Exposure in Trauma (ASSET) or Advanced Trauma Operative Management (ATOM) courses that instruct operative management of traumatic injury [36, 37]. These also review team-based skills development and communication in high-stakes situations. Hospitals and clinics participate in simulation to achieve better outcomes with patient interactions as well as with complex but rare event situations. These can range from employees doing annual harassment simulations with standardized participants to de-escalation of a mental health patient in the emergency department. Hospitals use simulation to evaluate patient transport flow due to construction, or for critical infectious situations, such as Ebola training. There are also many examples of hospital-based code team training such as the Simulated Code Interdisciplinary Team Training (SCITT) program that was created collaboratively by an RN manager and an MD at Oregon Health & Science University. There are others across the country and the world as well that are looking at team training opportunities to improve patient outcomes. One example of such a program is the healthcare solutions company MEDNAX®. This company has a network of over 3700 physicians across the country and supports them with a mobile simulation training program to provide on-demand, in situ, clinic- or hospital-based review and training for its providers [38].

Many hospitals have onboarding training that is done in collaboration with simulation centers and also in situ within units and departments. Some of the more intensive internship programs include specialized simulation trainings that include a variety of tools including: VR units or VR goggles, task trainers, high-fidelity manikins, standardized patients, and combinations of these. Healthcare teams often incorporate methods of Crisis Resource Management (CRM) into their training with the goals of improvement of quality and safety outcomes [39].

The World Health Organization (WHO) has advocated for inter-professional education (IPE) and team training to improve communication and collaboration. IPE requires two or more groups from different specialties to learn about, with, and from one another with the goal to improve communication and understanding about one another [40]. This is becoming a focus of current simulation training programs. With the number of specialties and types of training described in this section, it is no wonder that communication problems and discrepancies about the knowledge and skills between members of the healthcare team can occur. Many healthcare providers may not even fully understand the role, training, and expertise of other members of the healthcare team and it is the goal that IPE can improve this.

Military Simulations

The military has one of the most robust, evolving, and comprehensive systems for simulation training. Each branch of the military focuses on specific support trainings that are applicable to their division, but each shares in a growing standardization on what is required prior to deployment as well as maintenance of skills post deployment. The Navy's Healthcare Simulation and Bioskills Training Center (HSBTC) does this through three main lines of operation: Graduate Medical Education Support, Patient Safety/Skills Sustainment Initiatives, and Combat Casualty Care training [41]. Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) is a training program initially created jointly by the Agency for Healthcare Research and Quality (AHRQ) and the Department of Defense (DoD) in 2004. Since that time, it has been adopted by healthcare organizations globally due to its utility in training team communication and patient safety practices. Its use is supported by the Joint Commission, the Institute for Healthcare Improvement and the Surgeon General. The US Army now requires this training at all healthcare facilities [42, 43]. Medical Unit Simulation Team Training (MUSTT) is a derivative of TeamSTEPPS that utilizes a simulation-based course to allow for sustainment of TeamSTEPPS principles; it has been encouraged for use by all branches of the military [44]. TeamSTEPPS training examples that are important for review by surgical healthcare teams include the preoperative surgical team "huddle," making enough time in the operating room (OR) for the OR checklist, and preparing for rare but catastrophic events like hemorrhage, fire, massive transfusion protocols, and bad behavior in the OR.

Many of the following courses may be required prior to deployment depending on the location or background of the individual: Advanced Trauma Life Support (ATLS), Advanced Cardiac Life Support (ACLS), Tactical Combat Casualty Care (TCCC), the American College of Surgeons ATOM or ASSET courses, Emergency War Surgery Course (EWSC), and Combat Extremity Course [45–49]. Standardized patients, as well as high-fidelity manikins or hybrid manikin cut suits are used for these simulations. The military has training centers of varying sizes throughout the United States that recreate spaces such as rural villages, urban cities, foreign hospitals, low-light facilities, and various styles of aircraft or other vehicles. It is important to have different environments to execute these education events due to the varied and unpredictable situations in which military providers must be able to work successfully. One newer method for training these activities can utilize simulation centers with immersive training environments like the Wide Area Virtual Environment (WAVE) to simulate the complex environment of rendering care in a battle field situation [50].

There is currently legislation under review that would mandate military medical training to use only human-based training methods for the treatment of combat trauma injuries; this bill would likely continue to push simulation innovation to the forefront of military healthcare training [51]. This is on top of existing policies already calling for restricted use of animal tissue training activities except when alternatives do not exist [52].

Allied Health and Other Groups

Simulations are used increasingly in allied health programs including but not limited to physical therapy, occupational therapy, speech therapy, and hospital ancillary staff, among others. Some simulation centers have built apartments or living spaces to allow therapists a deeper understanding of how patients interact with objects such as sinks, handles, doors, and appliances. These apartment-style living spaces may even have functioning showers and a variety of door handles and cabinet hardware to allow evaluation of how to interact with each. Additionally, some therapists work with patients in the hospital and intensive care units. Being exposed to the sights, sounds, tubes, lines, and equipment of these spaces will allow these individuals to interact more effectively and safely in this environment after gaining experience through simulation.

While simulation is used in multiple settings, this chapter is by no means all inclusive. The benefits of simulation are being seen now beyond the walls of the hospital and are even incorporated into programs in public health, dentistry, and veterinary medicine.

Lay Public/Good Samaritan

Healthcare training is offered to the lay public and increasingly enhanced using simulation training aids. These skills trainings range from allergic reaction epinephrine training, babysitting certifications, newborn preparation, basic first aid, Stop the Bleed, and Basic Life Support (BLS) training. These courses can be taken through the American Heart Association and the Red Cross and many community colleges, hospitals, and community outreach public health programs [53]. Training for these events may be at community centers, libraries, or even brief trainings like hands-only CPR that have been offered at supermarkets and shopping centers [54].

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