PennState Health
Milton S. Hershey Medical Center
Clinical Simulation Center

Why Use Simulation?

Imagine you are a patient in a hospital in the 1890's. You have had trouble with upper abdominal pain and your doctor says he has to remove your gall bladder. You are moved from the ward into the operating room where several young men are standing around the room, attentively watching the surgeon prepare his equipment. They are the residents, or doctors in training. Another resident, obviously more advanced than the others, is assisting the surgeon with preparations. As they begin putting you to sleep, you hear the doctor giving instructions to the assistant regarding where to make the incision and what to look for. The doctor is going to talk the resident through the operation. If the resident (and you) are lucky, he has already observed several operations and has probably assisted with a couple of them. Now it is his turn to be "in the driver's seat" for the first time, with you on the other end of those instruments.

The following excerpt is from Dr. Floyd Burroughs. It chronicles one of his real life experiences as he began his residency in June, 1897. (from "Reminiscences from the Turn of the Century" by Floyd Burroughs, M.D. New York State Journal of Medicine, 66 (23), 1 Dec 1966, p 3072-5.)

"Later on, I revisited a forlorn, cheerless room in a sequestered corner of the second floor, reserved as an arena for conducting surgical operations. My classmates and I were required to attend surgical clinics in this room. Across its rear was a row of two or three wooden benches on which we sat in patient misery.

During an operation we students were summoned in groups of three to approach the table on which the unfortunate patient was stretched, and were permitted to peer over a surgeon's shoulder at the field of action and this attempt to memorize with almost photographic ability the technique displayed by a nimble surgeon. We were expected to acquire enough information to qualify us to tackle a similar job someday…"

This method of teaching is called the apprenticeship model. "Learning on the job" has been used for thousands of years to teach everything from the proper way to waterproof a canoe to the best time of year to trim back a garden. Until recently, it was also the only way to teach doctors how to practice medicine. Trial and error, with hopefully not too many of the latter. Of course, many safeguards were developed over the years for the patient's well-being, but the resident still had to start somewhere. Cadavers were used to learn anatomy, but you cannot see inadvertent bleeding or understand the difference in texture, consistency, and appearance between good and bad tissue if the tissue has been preserved. Animal labs have been a necessary adjunct to medical training, but still do not give a completely realistic experience.

When learning to drive, no one would suggest that a teenager read the driving manual, then jump into a car for the first time and merge onto a 6 lane highway during rush hour. Teenagers have already spent time observing others driving. When it is their turn to get behind the wheel for the first time, they are taken to a parking lot or some other safe area, and are allowed to get the feel of the car in a sheltered, protected environment. From there, they will progress to side streets, then maybe a highway when there is little traffic. Only after learning the basics are they ready to learn the advanced skills of handling their own car while at the same time interacting with the other cars on a crowded road, or dealing with dangerous conditions like icy roads or thick fog.

Today technology has enabled the medical community (and other professions as well) to learn in a sheltered, protected environment. Simulated patients are replacing real ones in the early parts of education. Beginning doctors can now make their most common, most dangerous, and most preventable mistakes on a simulated patient, where the worst possible outcome is having to restart the program. A technique can be practiced over and over until the trainee is comfortable with the steps and safeguards.

The proper handling of an emergency condition is very difficult to teach during the actual emergency. Preparation is essential in the form of lectures and rehearsal. During an emergency situation, however, there is no time to stop and think about what the next step should be. The actions and protocols should come naturally; they should be second nature. An instructor cannot withhold treatment during a code and allow the patient to deteriorate while he waits for the resident to stop and think through the protocol on his own, or allow the resident to administer inappropriate treatments just to make a teaching point. Unless the patient isn't real. The only way to practice a crisis without endangering a patient is to learn in a simulated environment.

Another boon of the simulated environment is the ability to allow every student the opportunity to see any disease they may encounter in their practice. In the example at the beginning of this page, the doctor from the 1890's was required to recognize a limited number of diseases and to know only a handful of operations commonly practiced in his day. Today's doctor is expected to recognize and treat literally hundreds of conditions, some of which are rare enough that he may not encounter them during his entire residency. For those less common illnesses, residents can use simulation to gain experience, and practicing physicians can use simulation to keep their knowledge and skills current.

Instead of the old adage "see one, do one, teach one", medical education now has the option of "see one, practice safely, do one, teach one". After learning from lectures and observation, residents can practice on a realistic – but not real – patient. When they are ready to perform the task for the first time on a real patient, they are merely fine tuning their technique.

Nothing will completely replace learning by interacting with real patients, but the early learning should take place in a controlled, safe way.

Educational Issues

Simulation training is incorporated into a medical curriculum using a stepwise procedure (see diagram). First task trainers are used to grasp the basic concepts of a technique and to practice the related psychomotor skills.

Then a computer program or a more detailed anatomic model is incorporated to illustrate the three dimensional anatomy of the procedure or to give a physical context into which the basic tasks fit.

The next step is to incorporate multiple basic tasks into a complex task using the anatomy to understand the order and necessity of each task. This step can be accomplished initially on a flat screen computer program, in order to establish the sequence of events, and then moved to a virtual reality trainer to practice the steps of the task in sequence and to make the environment more realistic.

The last training module would be to perform the entire operation from beginning to end on a high fidelity simulator or instructor driven simulator. The additional challenge at this stage is to incorporate the complex tasks into a realistic setting. Trainees are required to perform multiple, unrelated complex tasks amid the usual distractions not only under “ideal” conditions, but also to see how these tasks change when there is a problem. The trainee must now sort relevant information from the environment and make real time decisions on how to modify the complex tasks based on constantly changing conditions as the patient responds to their interventions.

There only remains the fine tuning of skills and judgment on a real patient in the operating room, under the supervision of a skilled health care provider.

Benefits to Users

Physicians

Physicians make use of the lab by reviewing techniques and diseases that they do not encounter often in practice. The lab is the ideal place to practice these rare conditions. Both in-house staff and visiting professional groups can obtain the practice needed to keep their skills honed, even though they may not see a patient with a certain condition for many years. But when they do encounter that rare case, they will be prepared to handle it; the treatment protocols will be almost second nature to them.

Doctors also renew certifications (for example, ACLS) on the manikins. The manikins, especially the human patient simulator, are able to present a set of practice cases over and over, until the trainee feels comfortable recognizing and treating the conditions or events that they are responsible for knowing. Then the educator uses the manikin to present a test case and run the trainee through a recertification test. (At the present time, the manikins are used only in “try until you pass” situations or recertification tests, not in reported tests that are linked in any way to a trainee’s job performance.)

Another benefit for staff physicians is to obtain Continuing Medical Education (CME) Credits for programs held in the lab.

Nurses

Nurses from many specialties take advantage of the courses offered through the Simulation Lab. Orientees from a number of areas spend time getting used to their new environment and the equipment currently being used in the hospital. This time can also be used to educate them in treatment protocols they will be a part of. An example is the Malignant Hyperthermia session for operating room nurses. In the OR, the anesthesiologist is expected to diagnose the disease, but the nurses need to be aware of the treatment protocol so they can assemble the correct equipment and drugs. This session is sometimes followed by a “scavenger hunt,” where the nurses must then return to the work unit and find the various items required by the protocol.

Nurses who are already practicing at the RN level can also acquire additional training through various internships offered at the medical center. These programs give the advanced training necessary in order to move up to a more challenging patient care environment, such as the intensive care unit. In these cases, nurses spend time in the lab being introduced to the equipment and procedures they will encounter. Introducing them to highly invasive procedures and how to monitor the patient appropriately is easily done in the lab.

Codes are another regularly practiced skill. Since nurses are often the first ones at the bedside when a patient codes, they must know the beginning steps of all the resuscitation protocols, and perform them until the doctor arrives. Once the doctor is with the patient, the nurse must also know what will come next in order to have everything ready for the next step when called for. This includes drugs and common dose ranges, patient monitoring equipment, and invasive procedures.

Residents

Residents are among the largest users of the Education Lab. Skills stations and crisis preparation are part of the curriculum in several departments (Surgery, Anesthesia, General Internal Medicine, Pulmonary/Allergy/Critical Care, Pediatrics, and Emergency Medicine) and are present at various stages throughout residency training.

Two resident programs that were developed at this institution are the First Three Days in Anesthesia and the First Three Days in Surgery. These programs are intensive introductions for beginning residents to learn basic patient care skills before beginning their residency.

Residents generally begin their exposure to the Sim Lab in the first or second year. Education continues throughout their residency, mostly in the form of small group teaching and hands-on tutorials. There is also a component of informal education, either with or without an instructor. After initial exposure to a technique, the residents will frequently return within the next couple of weeks to get some additional practice. Impromptu practice sessions are also common before a recertification, especially ACLS.

Cross-training also occurs on an informal basis. If the objectives are met before the scheduled time is over, it is common for the residents to want to explore the other equipment available in the lab, even if it does not pertain to their specialty. The Sim Lab encourages this exploration as a way to enhance the residents' understanding of how their procedures and protocols fit into the larger patient treatment picture.

Medical Students

The medical students have access to the lab during all four years as part of or in addition to their scheduled curriculum.

During the 2nd year, the curriculum involves studying patient cases in a case-based learning (CBL) format. The students come to the lab several times during the year as a chance to correlate what they are learning with a clinical context, and get some hands-on time on patient care equipment. During the cardiology block, the students experience a scenario that is directly connected to the case they are studying at that time. The human patient simulator is presented as that patient, with the same symptoms, vital signs, and on the same medicines. The students have a brief facilitator-led review of the case, where they are given a chance to examine the patient and ask any questions. Then they examine the invasive monitors that are at the crux of the case. Then the discussion proceeds to the pharmacologic and physiologic implications of the monitor readings at each stage of the case. The respiratory block lab revolves around acquiring an understanding of the significance of ventilator readings and settings. The human patient simulator is used to simulate several patients under a variety of conditions, so that the students can appreciate the implications of the altered ventilator readings. The lab also gives the students hands-on experience on a real ICU ventilator. Clinical skills week, at the end of second year, uses the lab to teach some of the skills.

During rotations in the 3rd and 4th years, the students are exposed to the human patient simulator several more times. An example is Surgery's student rotation curriculum includes shock lab, where the students are presented with three patients, all of whom have some type of shock. They are then responsible for diagnosing the illness

and proposing a treatment. The students also use the lab during the Trauma portion of the rotation.

The Anesthesia rotation allows the students to learn how to manipulate airways (including hand ventilation and intubation) and proper use of anesthetic equipment. The students are also given cases in the simulated operating room where they are responsible for managing a patient's anesthetic from induction to reversal.

Several other departments, such as Obstetrics & Gynecology use the lab to orient students to the skills they will need during their rotation through that department.

Commercial Users

The Simulation Lab is an ideal site for commercial manufacturers to train their sales representatives. It allows the reps to get a chance to use the products they are selling in a clinical type of situation. The reps perform real procedures on the Human Patient Simulator as well as the task trainer models using real equipment. This makes them much more knowledgeable about the product and allows them to better understand the questions clinicians often ask and the changes the end users would like to see developed and incorporated into the products.

The lab is also used in conjunction with commercial partners to conduct research projects or design studies on new monitors and equipment. They can explore how providers use their instruments, where problems are likely to occur, and get a feel for how the instruments and monitors fit into the environment with the equipment currently in place.

Equipment Manufacturers

- Arrow International
- Draeger Medical, Inc

Pharmaceutical Companies

- AstraZeneca Pharmaceuticals

Community Outreach

Two local high schools (Lower Dauphin and Hershey) participate in the Youth Apprenticeship Program, which allows juniors and seniors to spend time 1 day a week in the hospital, rotating through various departments. The Simulation Lab is scheduled as part of the operating room block. The students spend a session in the Simulation Lab to learn about traces they see on the monitors, basic physiology, and a little about the

stages and components of anesthesia. They also are given an opportunity to try an intubation, spend time on a laparoscopic surgical trainer, or diagnose a patient. This gives them a better idea of what is involved in the procedures they will see during their OR block.

Other high schools bring their biology and advanced biology students into the lab to give them an idea what sorts of things are learned in medical school. They go through a program similar to the Youth Apprenticeship Program, with a little extra time scheduled to talk about what medical school, nursing school, and residency are like.

These programs are designed to give a more realistic view of what is involved in choosing health care as a career, as well as giving students an appreciation for the applications of what they are currently learning. So often students lose enthusiasm for classes when they see no real world use for what they are studying. But to see basic chemistry and physics in action sparks their interest again. Examples that we discuss include the pH color change of soda lime in an anesthesia machine circuit as it absorbs carbon dioxide from a patient; and an oxygen saturation monitor, which works by comparing the changes in the absorption of red and infrared light that are transmitted through a patient's finger (hemoglobin absorbs certain wavelengths of light differently based on whether it is carrying oxygen).

Report researched and written by Jody Wood, Penn State Hershey Simulation Technologists