Simulators in Medicine

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Abstract

Today, advances in technology have created new and better, methods for teaching the practice of medicine and reinforcing best practices. One of the most exciting innovations in health care is in the field of medical simulation

Clinical Simulations is the use of model-driven patient simulators in a realistic clinical environment for the purpose of immersing the healthcare profession students/trainee in environments that closely mimic real patient environments.

Simulations in healthcare are also used to teach therapeutic and diagnostic procedures using surgical simulators and trainers.

Background

Until recently, practicing on cadavers, laboratory animals, or real patients has been the only way to teach doctors, nurses, and other health professionals about anatomy and how to practice medicine.

Using anesthetized animals for medical training is challenging - the animals do not have the correct anatomy for realistic training, they are expensive, and they are not reusable.

While cadavers have the correct anatomy, their use presents other challenges, including expense, difficulty in procuring the cadaver, and tissue degradation. In both instances, ethical issues are raised as well.

A health care provider's ability to react prudently in an unexpected situation is one of the most critical factors in creating a positive outcome in a medical emergency, regardless of whether it occurs on the battlefield, freeway, or hospital emergency room. This ability, however, is not a skill that one is born with, but rather it is learned and developed with time, training, practice, and repetition

Need for development of clinical simulators

- Data shows that in U.S medical errors result in death of as many as 98,000 people annually (In India, it could be worse) at a total national cost of between $37 to $50 billion for adverse events and between $17 to $29 billion for preventable adverse events.
- Patient safety issues that restricts student participation in critical care events in hospitals which results in gaps in clinical experience in critical care.
- Medical residents are operating under strict new rules that limit them to an 80-hour work week leaving less time for direct interactions between students and instructors.
- Nursing shortages, which are expected to reach 20% by the year 2020, are forcing some health care facilities to implement mandatory overtime for nurses and increased patient care loads, contributing to an already high number of stress related errors.
- Bioterrorism threats and concerns are forcing institutions and governments to reconsider how quickly providers can be trained and ready to react to a health crisis.

- Reserve troops are deployed into combat situations with insufficient time and resources to prepare them to provide medical care in battlefield conditions.

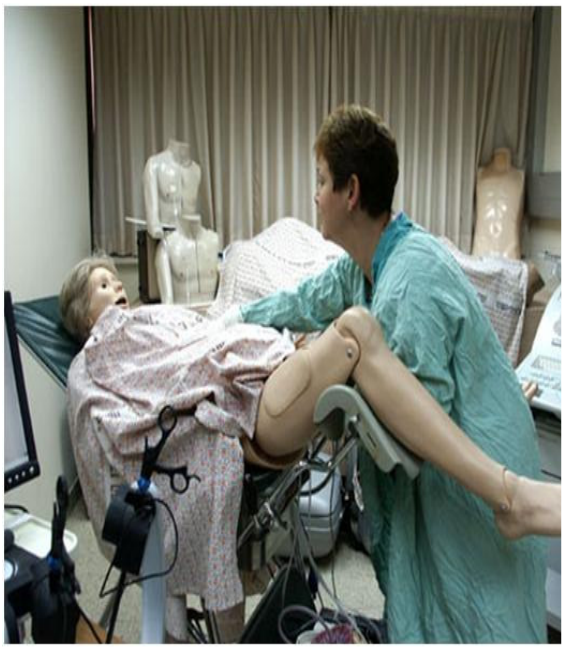
What are Clinical Simulators?

The clinical simulators are not “virtual” as the trainee does not sit in front of a computer manipulating a mouse similar to playing a computer game. He or she is actually treating a patient, albeit a robotic patient, with the use of real medical equipment and real medical techniques and the simulator responds to medical intervention, and vice-versa. It is an actual application of the trainees psycho-motor skills, decision making skills, communication skills, and medical knowledge in real-time. Clinical simulations can become so “real” that students have been known to cry as it may also involve trainees’ emotions as well; the adrenalin rush experienced during a simulation is very much real

These simulators are connected to computers that may provide feedback, reaction and/or assessment of the trainee.

Model driven patient simulators are mannequins that provide “actual” hands-on experience for the trainee. Utilizing technology that embodies unique physiological models that imitate real human response in multi-layered, real time ways vital to a truly authentic and objective medical learning experience. Among the features of a patient simulator are:

- Model driven for automatic physiologic response to such interventions as the administration of drugs and fluids, ventilation, defibrillation.
- A twelve pulse sites synchronized to physiology of circulation and chest compressions
- Realistic intubateable airway that can manifest occlusion of the airway due to pharyngeal obstruction, tongue edema and laryngospasm, left and right bronchial obstruction to simulate “Can Intubate, Can Ventilate”, “Cannot Intubate, Can Ventilate”, “Cannot Intubate, Cannot Ventilate” scenarios.
- Heart, lung and bowel sounds
- CPR – ABC check (Airway, Breathing, Circulation), Spontaneous and mechanical ventilation, Chest Compression, Blood Pressure.
- Symmetric and Asymmetric Lung Ventilation.
- Pharmacologic intervention through a library of over 50 intravenous drugs with pre-programmed pharmacokenitic and pharmacodynamic parameters, patient’s response to drug administration is automatic
- ECG Monitoring via real 3 or 5 lead ECG, patient can be defibrillated, paced and cardioverted.
- ECG, heart rate, respiratory rate, blood pressure, and other physiologic parameters can be displayed on simulated waveform display.
- Patient profiles can be created via Patient Editor
- Medical scenarios can be created via Scenario Editor



Benefits of using clinical simulators

Computer simulations have the advantage of allowing a student to make judgements, and also to make errors. The process of iterative learning through assessment, evaluation, decision making, and error correction creates a much stronger learning environment than passive instruction. Simulators have to be proposed as an ideal tool for assessment of students for clinical skills. Programmed patients and simulated clinical situations, including mock disaster drills, have been used extensively for education and evaluation. These “lifelike” simulations are however, expensive, and lack reproducibility. A fully functional “3Pi” simulator would be the most specific tool available for teaching and measurement of clinical skills. Such a simulator meets the goals of an objective and standardized examination for clinical competence. This system is superior to examinations which use "standard patients" because it permits the quantitative measurement of competence, as well as reproducing the same objective findings. The "classroom of the future" will probably contain several kinds of simulators, in addition to textual and visual learning tools. This educational environment will allow students to enter the clinical years better prepared, and with a higher skill level. For the advanced student or postgraduate, we will have a more concise and comprehensive method of retraining, or incorporating new clinical procedures into their skill set. This will assist the process of credentialling and competency evaluation which is a major task for regulatory bodies and medical institutions. The classroom of the future can form the basis of a clinical skills unit for continuing education of medical personnel. Similar to the use of periodic flight training for airline pilots, this unit will assist practitioners throughout their career. The simulator will be more than a "living" textbook, it will be a part of the practice of medicine. The simulator environment will be a standard platform for curriculum development in institutions of medical education.

Worldwide use of “clinical simulators”

Patient Simulators from METI are used worldwide, from the United States, the UK, Germany, Japan, Korea, Singapore, Canada, Spain and other countries of advanced economies. However, the use of patient simulators are not limited to advanced economy countries as they are also in use in Mexico, China, Malaysia, Egypt, Brazil, Chile, Brunei, Pakistan, Afghanistan, India and of course, the Philippines. 100% of all nursing students in Singapore would have had clinical experience through clinical simulations by the time they graduate.

There are many fields related to medical care that use METI(Medical Education Technologies, Inc, Philippines) Patient Simulators, doctors, and anaesthesiologists in particular use these simulators that

have what is sometimes called “anaesthesia lungs”. They simulate a person breathing in gases, from normal air to anaesthesia gases from an anaesthesia machine, and they will then respond accordingly. It features powerful computers and gas analyzers to simulate the breathing of a real person and how a person will react to anaesthesia or drugs. Nurses, EMS, and Search and Rescue crews, worldwide are trained with METI’s line of model driven Patient Simulator such as the HPS, the Emergency Care Simulator® - ECS®, or the iStan, to hone their skills in saving human lives.

Other first responders, such as firemen and policemen are also regularly trained in many countries using patient simulators, again to train them in saving lives in a realistic simulated environment. Soldiers throughout the world are regularly trained using the ECS and iStan, and the iStan was specifically developed to make the patient simulator totally mobile for use in training in the field, and transfer procedures whether via an ambulance, a helicopter or fixed-wing aircraft. Even NASA astronauts are trained on airway management in zero gravity environment and other medical emergencies using METI patient simulators

Some of the commercial clinical simulators

For anaesthesia training and/or anaesthesia residency programs the METI HPS (Human Patient Simulator) with its “anaesthesia lungs” is ideal.

For military, EMS Crews, Search & Rescue, Police, Firemen and other first responders, or where mobility is crucial the iStan is ideal.

For nursing education the METI ECS or iStan is ideal

Simulations in healthcare are also used to teach therapeutic and diagnostic procedures using surgical simulators and trainers', such as the SurgicalSIM® LTS for laparoscopic training & SurgicalSIM® TURP for Transurethral Resection of the Prostate (TURP), and the Pelvic ExamSIM® for female pelvic examination skills training.

PediaSIM® HPS, the iStan, PediaSIM® ECS and BabySIM®,

Surgical simulators called SurgicalSIM® - SurgicalSIM LTS - Laparoscopic Training Simulator, SurgicalSIM TURP (Transurethral Resection of the Prostate).

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