Simulation in Medical Education

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Abstract: Simulation is the imitation of the operation of a real-world process or system over time. Simulation can be used to show the eventual real effects of alternative conditions and courses of action. Simulation is also used when the real system cannot be engaged, because it may not be accessible, or it may be dangerous or unacceptable to engage, or it is being designed but not yet built, or it may simply not exist. Simulation can be used to resemble existing curricular Material. The simulated scenarios are realistic enough to engage the students emotionally, thus providing a unique learning experience, where the high fidelity simulator "patient" actually talks, breathes, blinks, and moves like a real patient. Simulation can be adapted to accommodate the need of various medical specialties such as anesthesia, emergency medicine and trauma, intensive care medicine, obstetrics, pediatrics, and radiology as well as for the use of other professionals such as nurses, paramedics, and respiratory therapists. Innovative simulation training solutions are now being used to train medical professionals in an attempt to reduce the number of safety concerns that have adverse effects on the patients. Use of simulation starting from first MBBS is helpful to teacher for teaching, student for understanding and patient in terms for increase safety.

Keywords: Simulation, Physiology, Patient

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Introduction: Simulation is the imitation of the operation of a real-world process or system over time[1] Aviation and aerospace industries have been using simulation as a teaching tool for many years. Simulators are now widely used in education and training in a variety of high risk professions and disciplines, including the military, commercial airlines, nuclear power plants, business and medicine[2]. Recently, the inclusion of clinical skills training into the curricula of medical students has seen significant growth. There are many examples of curricular reform that include clinical skills training, the use of simulators, and the creation of clinical skills centres[3]. Simulation has been defined as a situation in which a particular set of conditions is created artificially in order to study or experience something that is possible in real life; or a generic term that refers to the artificial representation of a real world process to achieve educational goals via experimental learning[4].

Simulation can be used to show the eventual real effects of alternative conditions and courses of action. Simulation is also used when the real system cannot be engaged, because it may not be accessible, or it may be dangerous or unacceptable to engage, or it is being designed but not yet built, or it may simply not exist[5]. Key issues in simulation include acquisition of valid source information about the relevant selection of key characteristics and behaviours, the use of simplifying approximations and assumptions within the simulation, and fidelity and validity of the simulation outcomes.

Classification of Simulation: Simulators are classified into different categories[6,7]. Initial Virtual patient “simulators” were hardly simulators. They were little more than powerpoint slides with embedded MCQs. Simulators can be classified according to their resemblance to reality into low-fidelity, medium-fidelity and high-fidelity simulators.

- Low-fidelity simulators are often static and lack the realism or situational context. They are usually used to teach novices the basics of technical skills. Example of a low-fidelity simulator is the intravenous insertion arm and Resusci-Anne.

- Moderate fidelity simulators give more resemblance of reality with such features as pulse, heart sounds, and breathing sounds but without the ability to talk and they lack chest or eye movement. They can be used for both the introduction and deeper understanding of specific, increasingly complex competencies. An example of a moderate fidelity simulator is the "Harvey" cardiology simulator

- High fidelity simulators combine part or whole body manikins to carry the intervention with computers that drive the manikins to produce physical signs and feed physiological signs to monitors. They are usually designed to resemble the reality. They can talk, breathe, blink, and respond either automatically or manually to physical and pharmacological interventions.

Simulations in education are somewhat like training simulations. They focus on specific tasks. The term 'microworld' is used to refer to educational simulations which model some abstract concept rather than simulating a realistic object or environment, or in some cases model a real world environment in a simplistic way so as to help a learner develop an understanding of the key concepts

Use of simulation in Teaching- Learning: Medical simulators are increasingly being developed and deployed to teach therapeutic and diagnostic procedures as well as medical concepts and decision making to personnel in the health professions.

Simulation can be used to resemble existing curricular Material. The simulated scenarios are realistic enough to engage the students emotionally, thus providing a unique learning experience, where the high fidelity simulator "patient" actually talks, breathes, blinks, and moves like a real patient. Simulation can be adapted to accommodate the need of various medical specialties such as anesthesia, emergency medicine and trauma, intensive care medicine, obstetrics, pediatrics, and radiology as well as for the use of other professionals such as nurses, paramedics, and respiratory therapists[4,8,9]

Simulators have been developed for training procedures ranging from the basics such as blood draw, to laparoscopic surgery[10] and trauma care. They are also important to help on prototyping new devices[11] for biomedical engineering problems. Currently, simulators are applied to research and develop tools for new therapies[12] treatments[13] and early diagnosis[14] in medicine.

Simulation-Based Medical Education is one form that allows students to learn for educational purposes in a classroom. SBME works well with all forms of classroom learning such as lectures, problem solving, in hospital teaching, and other traditional forms of education. Several advantages appear while using this approach such as patient safety, higher knowledge retaining, teamwork, competence, and skill at the bedside.

One of the most prominent versions is Adobe Flash based medical simulations and animations. While textbooks are sufficient for certain diagrams and process flow explanations, certain high quality animations created in Adobe Flash are extremely beneficial when it comes to learning. Some of the advantages to Flash-based medical simulations and animations include a visually animated representation of blood flow within a body or other physiological processes occurring within the body that would otherwise seem awkward or impossible to understand through static images. A rather annoying disadvantage to these animated approaches stems from the fact that they are extremely costly to create in terms of time and money. Most people have used Flash to create linear animations to enliven text Materials. The programming language – Action Script, that supports Flash enables creation of interactive animations (beyond the linear ones that most create), but few have used this. Until recently, this has been the predominant method for creating rich web interactive multi-media. However, Adobe Flash is a dying technology, as it does not support mobile devices. Some of the better animations require teams of people equal in size to major movie productions when it comes to after effects.

A user-friendly interface to a mathematical model for teaching cardiovascular physiology is developed. I-Human is an attempt to model a real-life or hypothetical situation on a computer so that it can be studied to see how the system works. By changing variables in the simulation, predictions may be made about the behaviour of the system. It is a tool to virtually investigate the behaviour of the system under study[1]. Students interact with the model through the X Window System interface, using the mouse to create continuously updating, realistic graphs of blood pressure, volume, or flow for any of the compartments. Students perform experiments on a `virtual patient' in order to understand the intrinsic properties of the system as it responds dynamically to normal stresses and pathological

insults. Instructors may set up patient cases with simulated diseases and ask students to examine the hemodynamics in order to make a diagnosis.

I-human offers a discrete clinical skills simulators, e.g., practicing BP assessment, physiology/pathophysiology simulators and also works as simulator for patient assessment and diagnostic reasoning. This is significantly more complex than the practicing (simulating) of clinical skills. we can consider it a new category of “Diagnostic reasoning Simulator”. The real distinction of i-Human is its’ ability to simulate patient assessment and diagnostic reasoning.

Only a few institutions worldwide use simulation in this way to teach fundamental physiology where the simulator is used as a healthy human subject (the concept of 'simulator as subject') as well as a treatable patient. This allows the demonstration of key principles of physiology that students find difficult when taught using traditional methods and classic experiments which are no longer possible using human subjects due to ethical constraints. In the same way we also use the simulators to teach principles of pharmacology. Using this program, students are able to explore the pathophysiology of disease in greater depth than would be possible through conventional teaching methods

Simulators have been also proposed as an ideal tool for assessment of students for clinical skills[15].Such a simulator meets the goals of an objective and standardized examination for clinical competence[18]. This system is superior to examinations that use "standard patients" because it permits the quantitative measurement of competence, as well as reproducing the same objective findings[17].

Benefit to Society: Patient safety is a concern in the medical fraternity. Medical errors also contribute to the cost of medical care throughout the world. The annual cost attributable to all adverse drug events and preventable adverse drug events for a 700-bed American teaching hospital was estimated by one study as $5.6 million and $2.8 million respectively[18]. With these types of statistics as well as medico legal system, it is no wonder that improving patient safety is a prevalent concern in the industry.

Innovative simulation training solutions are now being used to train medical professionals in an attempt to reduce the number of safety concerns that have adverse effects on the patients. One such attempt to improve patient safety through the use of simulations training is pediatric care to deliver just-in-time service or/and just-in-place. This training consists of 20 minutes of simulated training just before workers report to shift. It is hoped that the recentness of the training will increase the positive and reduce the negative results that have generally been associated with the procedure. The purpose of this study was to determine if just-in-time training improves patient safety and operational performance of orotracheal intubation and decrease occurrences of undesired associated events and “to test the hypothesis that high fidelity simulation may enhance the training efficacy and patient safety in simulation settings[19].” It could be therefore hypothesized that by increasing the number of highly trained residents through the use of simulation training, that the simulation training does in fact increase patient safety. This hypothesis would have to be researched for validation and the results may or may not generalize to other situations.

For patients, "cybertherapy" can be used for sessions simulating traumatic expericences, from fear of heights to social anxiety[20]

Programmed patients and simulated clinical situations, including mock disaster drills, have been used extensively for education and evaluation. These “lifelike” simulations are expensive, and lack reproducibility. A fully functional "3Di" simulator would be the most specific tool available for teaching and measurement of clinical skills.

Immersive disease state simulations also allow a doctor or HCP to experience what a disease actually feels like. Using sensors and transducers symptomatic effects can be delivered to a participant allowing them to experience the patient’s disease state.

Thus, use of simulation starting from first MBBS is helpful to teacher for teaching, student for understanding and for betterment of patient managment.

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