REVIEW ARTICLE

SHOULD MEDICAL SIMULATION BE AN INTEGRAL PART OF MEDICAL EDUCATIONAL CURRICULUM? A REVIEW
Varsha Vyas¹, Amit Nagpal², Shirish Patil³, Surekha Patil⁴, Sanjay Oak⁵, S. N. Mohite⁶, Nitin Kumar Sharma⁷, Freston Marc Sirur⁸

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ABSTRACT: With increasing concern about patient safety and focus on quality care delivery, there is a shift of teaching paradigm from bedside teaching to simulation based training. A number of research papers have shown simulation to be a valuable tool and it is emerging as an educational technique very rapidly. Simulation has increasingly become a part of mainstream postgraduate medical education in most of the western countries. Many centres in USA, UK and Canada have built curricula incorporating simulators in teaching programs. In India, around twelve to fifteen simulation centres are in existence and are developing new programs in different domains of medicine. Various Medical Councils, professional societies and industries could collaborate to advance medical education to the next level by developing curricula that employ the technology of simulation to improve clinical skills and assess performance and set a benchmark. For maximal effectiveness, Simulation based education needs to be integrated into the curriculum and not used as a stand-alone intervention.

KEYWORDS: Medical Simulation, Medical Education, Curriculum.

INTRODUCTION: Undergraduate curriculum should include training in clinical skills competencies including communication skills, history-taking, professional attitudes, awareness of ethical basis of healthcare. Physical examination, procedural skills, clinical laboratory skills, diagnostic skills, therapeutic skills, resuscitation skills should also be incorporated. Critical thinking, clinical reasoning, problem solving, team-work, organizational skills, management skills, and information technology skills are also necessary for medical practice.¹[1]

With simulation it is possible to experience life threatening and uncommon events in a controlled environment and even the most complex skills can be practiced until perfected without risk to human patients. Clinical Experiences are simulated in the form of SCE or Simulated Clinical Experiences for teaching and learning purposes. This expands the breadth of the trainee's clinical experiences [²] and repeatability is good for clinical skill mastery. Simulation can be an ideal way to study human factors. The application of crisis resource management training through simulation exercises is likely to improve patient safety.

Simulation can be adapted to accommodate the need of various medical specialties such as anaesthesia, 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.¹[3][4]
Simulation will be completely embedded in the fabric of education, from early students of sciences to medical residents and practitioners. The objective of this narrative review article is to highlight the importance of simulation as a new teaching method in undergraduate and postgraduate education.

**What is Simulation?**

Simulation is defined by David Gaba, Pamela Jeffries and S. Barry Issenberg in 2007, 2005 and 2008. David Gaba [Stanford University] defined, “Simulation is a technique, not a technology, to replace or amplify real experiences with guided experiences, often immersive in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion”.

**Types of Simulators:** Currently the types of simulators available for medical education are vast and varied, but most can be categorized as standardized patients, partial-task trainers, mannequins (High-fidelity patient simulators), screen-based computer simulators, and virtual-reality simulators.

**Fidelity:** Classically this term has been used to define the degree of realism of the models and is divided into three levels high, intermediate and low fidelity. According to the simulation environment it is also classified as Environment fidelity, Engineering fidelity and Psychological fidelity.

**Simulation Centre:** One can install a simulator in a laboratory or conference room, or conduct in site to simulation. Many institutions have chosen to establish a complete dedicated simulation centre for mannequin based simulation. This centre provides separate control room and a debriefing room. The audio/visual systems allow recording of the simulation session which can be reviewed during debriefing.

**Design of a Scenario:** Scenarios are usually designed to achieve learning objectives such as Crisis Resource Management skills or Clinical and Technical skills. The scenario should be relevant to the trainees. The relevance is more important than realism.

**Debriefing:** The Debriefing concept was introduced to simulation training by Gaba and colleagues as a part of the whole concept of CRISIS RESOURCE MANAGEMENT-based training for anaesthesia teams. It is the key element of simulation training. It is a self-reflective episode where maximum learning takes place. The special time and format for talking about an episode of action which took place during the scenario is referred to as debriefing.

**The Need for Simulation:** The need for simulation in medical education and training is increasing because of a] overall increase in the number of medical students vis-à-vis the availability of patients; b] increasing awareness among patients of their rights and consequent increase in litigations and c] tremendous improvement in simulation technology which makes simulation more and more realistic.
Patients are now increasingly treated on an outpatient basis, and less time is afforded to patient interaction. Continuity of care has also decreased as time limits are placed on resident work hours.[12]

Traditionally, the acquisition and ongoing improvement of high level psychomotor skills required by the future physician take place in an apprentice-style model of ‘See One, Do One, Teach One.’ This apprentice-style of learning is no longer considered acceptable because of the increasing concern for the quality of patient care and safety and change in health care systems.[1]

Advances in technology like ventilators and cardiac catheterization has made it possible to treat a higher percentage of acutely ill patients in critical care units. This has resulted in fewer opportunities for the medical learner to access a wide variety of diseases and physical findings. Medical simulation has been proposed as a technique to bridge this educational gap.[1]

The aim of medical simulation training is to imitate reality, or rather, to mimic reality to the closest extent possible so that the learner is in a state of “suspended disbelief” and he believes himself to be undergoing a real experience.[11]

We feel simulation provides one of the greatest potentials for improving the quality of medical education, improving patient safety and reducing the cost of medical errors. Medical students value simulation-based learning highly.

Simulation allows for the application of theoretical knowledge to practice. Simulation-based learning aids development of teamwork skills. Students can develop a systematic approach to medical emergencies.

**Non-Technical Skills:** Non-technical skills can be defined as ‘the cognitive, social, and personal resource skills that complement technical skills, and contribute to safe and efficient task performance.’ In essence, they enhance workers’ technical skills, and typically include situation awareness, decision-making, teamwork, leadership, and the management of stress and fatigue.[13],[14]

Salas and Colleagues define teamwork as ‘a distinguishable set of two or more people who interact, dynamically, interdependently, and adaptively towards a common and valued goal/objective/mission, who have each been assigned specific roles or functions to perform, and who have a limited life-span of membership.[15],[16]

Teamwork is of critical importance for patient safety.[17],[18] Effective team coordination is not a case of good luck. It is trainable through training interventions.[19],[20]

Continuous, intensive, realistic training over an entire career is necessary to achieve a sustained cumulative effect when used as a complement to current teaching methods. A combination of SBT with classroom teaching offers the most viable solution to the current gaps in medical education.

**Simulation Based Training:** 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.[1]
Simulated clinical experiences (SCE) are process tools that enable the facilitator to execute a learning strategy using simulation. Each process tool provides an extensive overview and outline of the learning exercise.

These are a few early pioneers who have seen the importance and need and have gone out of their way to implement it within their systems, building curriculum around the simulators and activities carrying out research on these.\cite{21}

**The United Kingdom:** In the last few years, the National Health Service [NHS] and London imperial college have paid extra focus on quality assurance and have decided to incorporate medical simulation into their curriculum.\cite{21}

Looking ahead Switzerland is developing a new national curriculum for post graduate training in anaesthesia. At Geneva University Hospital, Switzerland, like many educators, Dr. Savoldelli was convinced that simulation was an effective route to improve individual medical skills and the performance of interdisciplinary teams.\cite{22} Learning resources in the form of simulators and computer based learning modules developed in one country can be successfully and adopted and implemented in another country.\cite{23}

**Denmark:** Denmark also has put a very high priority on safety and quality standards of patient care. Many Universities have already developed a curriculum for their simulators and actively conduct research on this type of training.\cite{24}

**Canada Toronto:** Canada has also started to implement medical simulation and this is particularly evident in Toronto. The city houses two Simulation centres, one located at St. Michael’s hospital and the other at the Sunny brooks health service centres.\cite{25}

**United States – Florida:** The largest simulation centres like University of South Florida and the Nicolson centre of the Florida hospital train clinician from all around the world. Standford was one of the first to build a full scale simulation Centre [VA Simulation Centre],\cite{26} John Hopkins Medicine Simulation centre is a state-of-the-art medical training facility that incorporates many types of simulation training including:

- Standardized patients and teaching associates.
- Human patient simulation.
- Virtual reality.
- Task trainers.
- Computerized simulation.

Centre of Research in medical education, University of Miami School of Medicine, Miami, adopted and integrated simulation based training and learning technology into the curriculum from a UK Undergraduate education program.

**Simulation in Chile:** The first approach to simulation in Chile was given by the Catholic University of Chile in 2003.

2006 onwards some higher education institute began to incorporate simulators in teaching.
In 2008 simulation was integrated in the curriculum giving a formal start to use this model in the internship for the surgery in the trauma unit centre.\[27\]

**Simulation in Israel:** The Israel centre for medical simulation is a national centre, which provides a broad range of simulation training. Curriculums have been built for the centre especially and these provide the trainees for a wide range of scenarios.\[28\]

**Medical Simulation in Gothenburg:** Gothenburg is home to three of the globally leading companies these are Orzone, Mentice and Surgical Science.

According to the Society for Simulation in Healthcare, simulation has the potential for the evolution of a new teaching paradigm for the new millennium.

Issenburg SB and Prigle S and others recognized the international dimension and global issue relating to the application of the new technologies like simulation.

Simulation in Asia: many Universities in Singapore and Malaysia have integrated simulation into their curriculum in nursing, anaesthesia and in undergraduate training.

**Simulation in India:** There are around 12 to 15 centres all over India in different cities of India. Simulation courses such as CPCR trainer course for nurses, physiotherapist and dental students are regularly organized by many colleges. CMEs for undergraduates, postgraduates and interns are conducted by many of the departments such as anaesthesia emergency medicine and pediatric using simulation.

**Simulation as an Educational Tool:** The medical learner at any stage—undergraduate, graduate, or postgraduate—is truly an adult learner.\[29\] Adult learners have strong motivation to participate in a set of experiences to learn a specific discipline.

Many of the anticipated curricular changes are in response to research showing adults learn best in small groups where they can apply new knowledge to real world problems and not in medicine’s traditional lecture method. In fact studies show audiences retain only about five percent of material presented in lecture settings.

Many of today`s students are millennial generation men and woman.\[30\] This generation has grown up with computer based technology in their everyday environments ranging from cell phones and I-pods to high-tech, interactive-learning smart boards in each of their classrooms. Millennial learners prefer experiential learning methods and are comfortable with web-based and virtual environments.

**Future of Medical Simulation:**

1. **Hybrid simulation:** Hybrid simulation is a method that combines a hardware experiment with a numerical simulation and on the transferability of acquired into subsequent clinical practice. Hybrid simulation is a set of methods for examining the seismic response of structures using a hybrid model comprised of both physical and numerical sub-structures.

   It has been induced from the literature review that hybrid simulation can be used in three different formats: hierarchical format, process-environment format, and integrated
format. Literature on different modes of governance in UK healthcare further points out that there are three modes of governance in UK healthcare: top-down performance hierarchical mode, network partnership mode, and quasi-marked

2. Simulation in Situ: A recently growing training format is the concept of the ‘mobile in situ simulation’. The idea is to bring the simulator to where participants actually work and to train together those who work together. The participants in mobile simulation course can concentrate more on training content because they know the environment in which the case is simulated. Mobile courses also facilitate organizational development along with training.

Evidence Based: Chul-Ho Chang Concluded in his article Medical Simulation is needed in Anaesthesia Training To Achieve Patient Safety that simulation has a potential to promote a new paradigm compared to traditional education tools.[31]

Technical skills and non-technical skills can be taught to anesthesiology residents via a standardized and organized simulation program.

In a study by Weller et al., a simulation based model was shown to provide rigorous evidence on safety interventions.[32] Domuracki et al. found that learning resuscitation skills transferred to clinical practice. Kuduvali et al. reported on the retention of airway skills associated with simulation and on the transferability of the acquired skills into subsequent clinical practice.

Research has shown that medical training is directly linked with improved medical outcomes.[33] Therefore it has been greatly hypothesized that simulation training could yield many benefits for the healthcare system. Various studies have demonstrated the effectiveness of medical simulation training in different disciplines and at varying career levels, ranging from students to professionals.

Simulation in medical education is a useful tool for evaluating performance and increasing the knowledge of the medical students. It also increases confidence. One study using simulation training within the field of central venous catheterization showed that physicians who have performed the procedure over fifty times on simulator are half as likely to cause complications in comparisons to those who have done the procedure a fewer number of times.[34]

Another field where simulation training has proved to be successful is in emergency medicine where there has been a significant improvement in emergency airway management and team performance.[35]

Strum, Ld. P. et al. showed in 2008 that the skills acquired through simulation training are transferable to real life operational settings.[36]

The added benefits of implementing simulation training within the disciplines of anesthesiology pediatrics, critical care, obstetrics and surgery have been documented in 2009 by Okuda Y et al.[37]

Classroom of the Future: The "classroom of the future" will probably contain several kinds of simulators, in addition to textual and visual learning tools. This will allow students to enter the clinical years better prepared, and with a higher skill level.

The advanced student or postgraduate will have a more concise and comprehensive method of retaining-or of incorporating new clinical procedures into their skill set. The regulatory
bodies and medical institutions will find it easier to assess the proficiency and competency of individuals.

The classroom of the future will also form the basis of a clinical skills unit for the continuing education of medical personnel; and in the same way that the use of periodic flight training assists airline pilots, this technology will assist practitioners throughout their career. The simulator will be more than a "living" text book, it will become an integral a part of the practice of medicine.

CONCLUSION: For maximal effectiveness, SBE needs to be integrated into the curriculum and not used as a stand-alone intervention. The industry, academia and healthcare, professional societies and various driving forces could collaborate and propel simulation forward and create a benchmark for simulators within medical education through the development of curriculum. The future of simulation in health care depends on the commitment and ingenuity of the health care simulation community to see that improved patient safety, using this tool becomes a reality.

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