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Original Article

Simulation Based Teaching and Learning in Clinical Education

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Abstract:

Medical education is undergoing significant changes each day in different corners of the world. Calls from different stakeholders for a change in the instructional methods have resulted in innovative medical curriculum. The new curriculum stresses the importance of proficiency in several clinical skills by medical students rather than mere acquisition of knowledge. Teaching and training using simulation technique is very powerful. It provides valuable opportunities to learn and practice the key competencies in medical education, such as communication, problem-solving, teamwork, and leadership as well as management skills such as physical examination, diagnostic and surgical procedures. Pedagogical innovations like simulation-based teaching needs to be brought to the forefront in clinical education in our country. Simulation programs may function well from a technical point of view, but they are often difficult to fit into a curriculum, especially in low-resource settings, where money and technical-know-how are the main limitations. Medical educators have been pushed inevitably to rely on such technology-based learning looking at the future of medical education. However, they should not only embrace it but also develop and evaluate its sustainability and application in preclinical and clinical settings. If well-designed, learning how to operate a simulation program generally requires little effort for them and their students. A short introduction by the teacher is often sufficient to enable the student to work with the program.

Keywords: *Simulation, clinical procedure communication skill, pedagogy, medical education*

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Introduction

Medical education is undergoing significant changes each day in different corners of the world.[1] Calls from different stakeholders for a change in the instructional methods have resulted in innovative medical curriculum. The new curriculum stresses the

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importance of proficiency in several clinical skills by medical students rather than mere acquisition of knowledge.[2,3] It is universally accepted that clinical skills constitute an essential learning outcome.The acquisition of appropriate communication and clinical skillsare key to medical education; however, students sometimes complete their educational programs armed with theoretical knowledge but lack many of the clinical skills vital for their work.[2,3] A major challenge for medical undergraduates in Bangladesh is the application of theoretical knowledge to the management of patients. Some medical colleges in Bangladesh have modified their teaching-learning strategies and adopted problem-based learning, integrated teaching, etc. Only few medical colleges have and utilize their clinical skills laboratories for training. However, simulation-based learning is not yet well-established in country.

Simulation-based medical education can be defined in simple words as any educational activity that utilizes simulative aides to replicate clinical scenarios. Simulation tools serve as an alternative to the real patient. Trainers can make mistakes and learn from them without the fear of distressing the patient. According to McGaghie, Simulation-based training in medical education was defined as "the use of a person, device, or set of conditions… … to present evaluation problems authentically. The simulation participant is required to respond to the problems as he or she would under natural circumstances."[4] According to McDougall, "Simulation can involve a person, a device, or set of conditions, and permits repetitive practice of skills to a prescribed level of proficiency in a risk-free environment."[5] In the last two decades, simulation-based medical education (SBME) has grown more common in clinical education. The necessity for updated medical/surgical training models, instruction utilizing standardized clinical scenarios, patient safety considerations, and studies supporting the educational benefits of simulation have all contributed to this rise.[3,6-9] This review paper aims to highlight the importance of implementation of simulation laboratory in different medical colleges and specialized institutions as an effective, innovative teaching method for clinical education in our country at the moment.

Use of Simulation in Medical Teaching and Learning

There arenumerous examples of using simulation in medical teaching and learning. Using simulation may range from task training, skills training, and procedure training to provide error-response and group training.[5,8,10] Many simulation formats require the use of manikins, which have a wide range of training capabilities. A manikin can help health care professionals engage in patient assessment through simulated vital signs such as pupil dilation, rate of breath shown with chest rise and fall, or circulatory deficiency shown with cyanotic discoloration. A manikin can also help health care professionals learn to safely administer medications and to treat patients suffering from heart failure, a blocked airway, or massive blood loss.[3,5,8-10]

Ther are two types of simulation facilities used in clinical education: low-fidelity, mid-fidelity and high-fidelity. A low-fidelity manikin is a segmented clinical task trainer used for a small number of specific skills or procedures. Examples include an IV arm used for practicing injections, a pig's foot used for practicing wound closure techniques, and a manikin used for practicing CPR (e.g., resuscitation simulator).[3,5,9] A mid-fidelity manikin is usually a fullbody simulated patient with few computer components (e.g., heart sounds simulator).[5] A high-fidelity manikin incorporates the very latest in computer technology, is commonly wireless, and can be programmed to provide a very realistic fullbody patient presentation.High-fidelity manikins are typically used in a variety of high-stakes learning scenarios, such as a mock code standardized patients (e.g., mimicking interaction/communication between patientand doctor), critical scenario (e.g., a postpartum hemorrhage simulator), or a mass-casualty incident (e.g., casualty simulation kit). A low-fidelity simulation requires instructor or mentor, while more complex and computerized high-fidelity simulators can incorporate a virtual instructor, too.[3,5.9] Other high-fidelity simulations can involve cadaveric materials to do further complex procedures.[5,9]

Simulators are not only for general surgery (e.g., laparoscopic appendectomy or cholecystectomy), but also for the practice of techniques for heart catheterization, neurological embolization of bleeding aneurysms, and peripheral vascular surgery.[11-15] There are so many different simulators that allow for learning of ultrasound of heart and vessels[16] as well as of breast lesions and the practice of core needle biopsies of those lesions.[17] Virtual eye surgery simulation training improves trainee ophthalmic surgery skills (e.g.,

cataract or retinal surgery).[18,19] Several implications of simulation training have been identified from literature which include open surgical models, laparoscopic models as well as scenario-based simulation and distributed simulation in gastroenterology (e.g., endoscopy of upper GIT) training,[6] ear, nose throat (e.g., laryngoscopy, bronchoscopy, mastoidectomy and functional endoscopic sinus surgery, cricothyrotomy, tracheotomy etc.) training,[20-22] neurosurgery (e.g., minimally invasive procedures, vascular, skull base, tumour resection, functional neurosurgery, and spine surgery) training,[23-25] and urological (e.g., endourologic procedures like ureteroscopy and cystoscopys and operative procedure like prostatectomy or tumour removal) training for adult and paeditric patient handling in either elective or emergency cases.[26-28] In Obstetrics & Gynaecology, clinical simulation encounters offer learning skills for standard delivery, postpartum hemorrhage, instrument deliveries, shoulder dystocia, fetal malpresentation, massive blood transfusion protocol, disseminated intravascular coagulation, or amniotic fluid emboli, whilelaparoscopicsimulations facilitate operative skills for hysterectomy, oophorectomy, salpingectomy, and any diagnostic access to the abdomen.[29-31] Similarly, several procedures can be explored through simulation in pediatrics and neonatology specialties (e.g., intubation, chest tube insertion, and pericardiocentesis).[32,33] Simulation-based settings provide the valuable opportunity to train and evaluate learners' performance in scenarios including airway management including intubation, ventilation, monitoring, and regional, cardiac, paediatric, and obstetric anesthesiology.[34-37] In many specialties (e.g., emergency medicine), often they have multiple scenarios built into them that allow for practice of the technique itself and also for complications a physician may encounter as well.[5,11,12,31,38] Last but not the least, simulation-based trainings are also applicable to gross anatomy and physiology as well as pathology disciplines in clinical education.[39,40]

Advantages:

Teaching and training through simulation is very powerful resource. Simulation has continued to evolve with the development of simulation software for medical education in the 1980s.[41] Since very beginning, it provides valuable opportunities to learn and practice the key competencies in medical education, such as communication, problem-solving, teamwork, and leadership as well as management skills such as physical examination, diagnostic and surgical procedures.[41-43] Simulation allows for hands-on learning of procedural and cognitive skills in a real-life environment, but without risk to patients or staff.[3,5,41-43] If the learner fails, he/she can try any number of times until he/she succeeds. It allows a comprehensive, faster, and more efficient development of skills necessary in basic and advance procedures in clinical education.[41-43]

Simulation provides opportunities to rehearse and learn from mistakes without risks to patients. The use of simulation can help overcome some limitations of the current medical education and practice environment, including work-hour limitations and concerns for patient safety.[5,42] Simulation models can be used to accomplish educational goals and objectives addressing cognitive, affective, and psychomotor domains of learning through exercising basic and advanced skills as well as the management of medical and surgical problems. Thus, simulation exercises provide reproducible curriculum for all trainees, instant performance feedback, improved psychomotor skills, enhanced clinical decision-making, and fostering of multidisciplinary teamwork.[5,11,31,43]

In the recent COVID-19 pandemic, while "live" patient contact was an irreplaceable tenet of clinical teaching, such extraordinary times demanded such exceptional measures. Hence, pedagogical innovations like simulation-based teaching needs to be brought to the forefront.[44.45] Medical educators have been pushed inevitably to rely on such technology-based learning looking at the future of medical education. However, they should not only embrace it but also develop and evaluate its sustainability and application in preclinical and clinical settings. Medical colleges may create a host of medical problems in their respective simulation laboratory – from the most common like bedside examination skills to the unusual like doing complex surgical operation using simulation. Computer-driven patient simulators respond just like a real human patient would to learners who are performing clinical interventions such as, CPR, intubation and catheterization. Those skills can be practiced repeatedly, and learners can be tested to ensure competency.During simulation-based training, learners' actions can be monitored in a control room, reviewed and evaluated. Debriefing sessions give

learners immediate feedback so they can refine and improve their management techniques, as well as their diagnostic and decision-making skills ensuring patient safety.[5,46,47]Such experiential learning using simulation, as studentsare purposefully engaged in direct experiencewith an emphasis on reflection, helps them increase theirability to develop clinical skillsand competences in clinical education.[48]

Disadvantages:

Simulation provides several opportunities to learning process; however, it has also some drawbacks. The greatest drawbacks of using any simulation technology are the speed at which it gets outdated and the cost involved in updating the technology.[5,7,8,10] Learning simulations are no different in this aspect. In order to keep them as relevant as possible, learning simulations require regular updates and maintenance based on the changing trends in the industry.[4,5]

Moreover, the more we lean towards technology, the higher is the need within institution to train people who can handle these technologies to ensure best use.[4] Learning simulations, for their proper maintenance and usage, require people who are well trained and equipped to handle all related aspects. This training requires time and money and can be a deterrent to using learning simulations.[3,10] Last but not the least, simulation programs may function well from a technical point of view, but they are often difficult to fit into a curriculum,[31] especially in low-resource settings, where money and technical-know-how are the main limitations, e.g., in Bangladesh.

One more important point is that simulation is an adjunct to patient-centered training; it is not an alternative to real human encounter in training. Some criticize simulation-based clinical educationbecause it restricts the real tactile and emotional experience gained by the trainees that is delivered by real patients.[3,10]

Conclusion:

We know that no educational tool is effective for everyone. If well-designed, learning how to operate a simulation program generally requires little effort. A short introduction by the teacher is often sufficient to enable the student to work with the program.Simulation is now a well-established method in clinical education/ training programs for healthcare professionals. Simulation can also be used to objectively assess performance in clinical education.

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