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The role of simulation in postgraduate medical education

Indika Karunathilake

Department of Medical Education, Faculty of Medicine, University of Colombo, Sri Lanka

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Corresponding Author: Indika Karunathilake, E-mail: < karunathilake@hotmail.com > https://orcid.org/ 0000-0001-9772-116X
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Introduction

The healthcare environment and postgraduate medical education are rapidly changing in global, regional and national contexts. Changes in the healthcare environment are driven by advancing technology, increasing costs, legal and ethical implications, diversity of care providers and settings, changing expectations of patients and the public (including professionalism, patient safety, ethics and communication) and commodification of healthcare [1,2]. This increasingly complex nature of healthcare results in postgraduate teaching requirements that are more challenging and sophisticated [3,4]. Can a paradigm shift in postgraduate medical education be achieved through the systematic incorporation of simulation?

What is simulation based medical education?

Simulation can be defined as a "technique to replace or amplify real-life experiences with artificially contrived guided experiences." [5] Simulation based medical education (SBME) involves educational activities that replicate clinical scenarios and mirror real-life circumstances and situations in which healthcare and clinical services are provided [6].

When compared with conventional apprenticeship-based training, simulation provides designated opportunities to learn from trial and error within a safe learning environment, without compromising patient safety. A learning environment that is separate from demanding service commitments that are applicable to both the learner and the educator will provide time, space and opportunity for learning through feedback and reflection. These characteristics make simulation an ideal method to optimise and enhance postgraduate medical education [2,4,6].

Why simulation for postgraduate medical education?

Simulation has much to offer postgraduate medical education. A range of higher level competencies expected by a postgraduate trainee, including critical thinking, analytical skills, specialized procedures, leadership, decision-making, interpersonal skills and professionalism could be trained and achieved through simulation. Simulation also provides a safe and educationally orientated environment for both teaching and assessment by ensuring patient safety and opportunities for feedback and reflection [2,4,7,8].

Postgraduate training can involve management of patients with high-risk conditions, and at times requires performance of high-risk invasive procedures. This raises several ethical and legal implications. A simulated learning environment can remove the patient from the student's learning curve during the initial learning of invasive procedures and allow students to achieve the required competencies of patient safety without placing real patients at risk [2.8,9].

A specialist is expected to be competent in managing rare and serious conditions. Simulation provides both training and assessment opportunities in a wide range of situations to supplement real-life clinical experiences and offers the opportunity to recreate scenarios that are not frequently experienced in routine clinical practice [2,7].

Simulation offers frequent opportunities for learners to practice and enhance their skills at their own pace and in a safe environment. This deliberate and repetitive practice is essential to reach the mastery level expected from a specialist [2,4,9].

Simulation also provides a unique opportunity for learners to understand the immediate results of their behaviours. This allows for reflective practice, a process of systematically reflecting upon experiences with the objective of improvement [2]. In simulation, scenarios can be purposefully planned to allow time and space for reflection in a manner that will not be possible in a real life clinical training setting. The feedback that educators provide during a simulation session gives postgraduate trainees further insights into their practice, strengths and areas for further improvement [2,9,10].

In Sri Lanka, as well as in most settings worldwide, postgraduate trainees will receive their clinical training at a centre which is geographically separate from the central training institute. These centres may vary widely in terms of available resources, facilities and expertise. Simulation allows this distributed learning to be more systematic and uniform [2,11].

Different methods of simulation

The uses of simulation range from simple to sophisticated, from low-fidelity task trainers to complex human interactions by simulated patients or high-fidelity, highly realistic simulators replicating whole body appearance and variable physiological parameters. Virtual patients, hybrid patients, computer-based simulations and virtual reality are among many options available for simulation [6,7,8].

Simulated patients are trained to act as a real patient in order to simulate a set of symptoms or even physical signs. This allows clinical scenarios to be provided as and when they are needed and for teaching sessions to be planned in a more systematic manner. Furthermore, simulated patients may tolerate more students than real patients. These advantages allow students to learn in-depth about situations they may not be able to manage in a real clinical setting [7,8,12].

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Integrated simulators combine a mannequin with a sophisticated computer programme that provides variations of patient monitoring parameter outputs such as pulse rate, oxygen saturation or ECG. "Harvey" the cardiology simulator, introduced in the 1970s and one of the earliest using high fidelity, has proven to be effective in teaching and assessing postgraduate trainees [2,8,13].

In contrast, task trainers are designed for training of specific skills such as digital rectal examination or specific procedures such as suturing, injection techniques or intubation. Task trainers can range from low cost and low fidelity to high cost and high fidelity. Rapid advances in technology and increasing demands in clinical training have led to more innovative and widespread use of task trainers in postgraduate medical education. Palp-Sim is an example of a high-fidelity task trainer that uses a haptic system to replicate the kinaesthetic and tactile perception during inserting a cannula to an artery. Hybrid patients are a combination of a simulated patient and a task trainer and makes simulation more realistic for the students [1,2,8,14,15].

Computer-based simulations with realistic clinical scenarios can facilitate learning of clinical decision making. High fidelity computer models that can simulate visual, kinaesthetic and tactile sensations encountered during procedures with a high degree of realism are increasingly used in postgraduate medical education. Virtual reality simulation represents a paradigm shift in postgraduate training. Three dimensional (3-D) virtual reality (VR) is now available with high-tech, high-fidelity simulators. VR simulation is defined as the recreation of environments as a complex, computer-generated image [15]. In VR, the computer display simulates the 3-D representation of a simulated environment and user interactions are within that virtual environment. There are a number of VR programs used in postgraduate medical education. For example, MIST-VR (minimally invasive surgery trainer–virtual reality) is designed to provide postgraduate trainees with a realistic environment for developing surgical skills in laparoscopy [6,7,8,16,17].

Computer based and online learning can offer the added option of virtual patients. Virtual patients, presented in the form of a hypothetical case scenario, simulate the essence of clinical practice in a virtual environment by placing the trainee in the position of a doctor managing and interacting with patients. It simulates the real-life situation of seeing the same patient over long period of time and learning from the patient during different stages of patient management [1,6,4].

The effectiveness of simulation in postgraduate medical education

There is an ever-expanding body of evidence establishing the effectiveness of simulation in postgraduate medical education. Studies conducted worldwide within the postgraduate specialities of surgery, anaesthesiology, paediatrics and emergency medicine have demonstrated that simulation is effective in teaching patient safety and practical procedures, leading to better adherence to safety guidelines and improved clinical practice [8,9,12,13. Several studies have demonstrated that VR simulators can effectively discriminate novices from experts and also VR-trained surgical postgraduates performed better on time, injury rates and rate of progress when compared with those who were traditionally trained [2,18,19,20,21].

Although many educators and researchers expect that high-fidelity, expensive simulators lead to better learning outcomes when compared to low-fidelity options, the research evidence shows that high-fidelity and low-fidelity simulators can have equally positive impacts on learning, at least at the beginner level. Several advances in simulation have been made through low-fidelity, low-cost approaches as well. Low-fidelity simulation in particular has potential to be used widely with a significant impact on training and patient safety [22,23,24].

Simulation centres are designed to replicate entire clinical care settings such as hospitals, wards, operating theatres, intensive care units and emergency departments. A well-structured case used in the simulation centre can teach and assess a range of clinical and procedural skills as well as team work, interpersonal skills and management [2,8].

Areas for improvement

Unfamiliarity, high cost, implementation issues, possibilities of negative learning and false confidence are serious concerns regarding the effectiveness of SBME. There is a need for seamless integration with the system, a robust evidence-base and cost effectiveness [2,7,8].

SBME still remains a novel concept and unfamiliar territory for many postgraduate trainers in Sri Lanka and South Asian Region despite several initiatives aimed at capacity building. In Sri Lanka, SBME is limited to few boards of study such as Surgery, Anaesthesiology, Obstetrics & Gynaecology, Forensic Medicine and Family Medicine. A lack of integration is apparent, and simulation needs to be integrated more methodically and systematically into postgraduate training programmes. There is a need for greater communication and collaboration between the Postgraduate Institute of Medicine (PGIM); researchers, medical educators and clinical teachers; between different medical specialties, boards of study, professional colleges and other healthcare professionals [11,25,26,27].

The current body of research in SBME can be described as mostly descriptive, with more focus on the use of task trainers and manikins in simulation. There is a need for research that moves beyond description and towards greater understanding of simulation-based education [1,2,6].

Examinations at postgraduate level are of high-stakes and call for robust, valid and reliable measurements of performance if simulated scenarios are to be used for assessment. In postgraduate examinations, clinical cases should be at an appropriate level of difficulty and assessment tools capable of measuring relevant levels of complexity in critical thinking and decision making must be used. The only method of simulation currently used systematically for high-stakes postgraduate assessment in Sri Lanka is simulated patients, while actual patients and clinical cases remain the core of postgraduate examinations. However, objective structured clinical examinations (OSCEs), an assessment method commonly used by the PGIM in Sri Lanka provide an alternative option for incorporation of simulation into postgraduate examinations [2,11,27].

Simulation, especially high-fidelity simulation can be expensive and costly. However, the unaccounted cost of apprenticeship learning in the clinical settings, too, is very high. Well planned, systematically implemented SBME is cost effective in the long run [2,7,8].

Conclusion

SBME is gradually becoming an important and necessary component of postgraduate training. However, it is not a panacea to solve all challenges within postgraduate medical education and there are several limitations of SBME. It is unlikely that simulation will replace the importance of learning from real-life clinical experiences. Further improvements through faculty development, research and an evidence-based approach are needed to ensure that simulation is better integrated into the system and simulation-based educational activities are designed to optimize postgraduate medical education.

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