

The Importance of Simulation Technologies in Teaching Surgical Diseases

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Abstract: The current medical education is rapidly changing with the advent of technologies, rising complexity of clinical situations and focus on patient safety. In a context such as this, the traditional way of educating students in areas of surgery is increasingly proving to be inadequate for real clinical practice. In this article, the role of simulation technologies in education of surgical diseases and the evaluation of the effect of simulation technologies on the development of clinical competence of medical students is discussed. The study is conducted based on the review of the contemporary scientific literature pertaining to the simulation-based medical education and its use in surgical training. The results show that the use of simulation technologies clearly enhances the students' practical skills, clinical reasoning, decision making, and psychological preparedness for the clinical practice. Additionally, simulation-based learning provides a safe learning environment in which the student can practice invasive procedures and emergency interventions multiple times, without jeopardizing the health of a patient. Moreover, the article touches upon the educational benefits, methodological principles and current drawbacks of the simulation training in contemporary medical universities. Analysis demonstrates that the use of simulation technologies in surgical education produces better prepared surgical professionals and better standards of patient safety in healthcare systems.

Keywords: Simulation Technologies, Surgical Education, Clinical Reasoning, Practical Skills, Medical Simulation, Patient Safety, Clinical Competence

Introduction

The current healthcare systems are developing, and medical universities have to provide specialists who not only have solid theoretical background but also have high practical capabilities, and are able to make prompt decisions in complex situations, for example, surgical education requires a great level of responsibility as minor clinical mistakes can have serious repercussions for patients. Traditional teaching which relied primarily on lectures and observation and a small amount of clinical practice has been the basis of teaching and learning in medical institutions for many years. These methods, however, have been found to have some drawbacks in the growing complexity of surgeries and a focus on patient safety.

Education in surgery is often faced with significant difficulties in transferring the theoretical preparation to actual practice. While in the hospital, medical students can face stress and uncertainty when they are first exposed to an emergency situation, invasive procedures, or a complex diagnostic process. Limited opportunities to repeat practical training can decrease students' confidence and will cause the clinical capability to lag. In such circumstances, modern educational technologies are gaining in importance with regard to the quality of medical training [1]. The use of simulation in medical education has become one of the most successful innovations in the field. Simulation technologies enable the creation of a virtual environment that replicates real clinical situations in a safe and controlled setting for learning. Using mannequins, virtual systems, task trainers and standardized patient models, students can practice surgical procedures a number of times, refine their technical skills, and develop their clinical reasoning skills without harming actual patients. This will enable opportunities for active learning, independent decision making and detailed analysis of errors [2].

Over the past few years, simulation centers have increasingly been a part of the curriculum of medical universities in many developed nations. Their implementation has radically transformed the way disciplines in surgery are taught. This is not just a passive observation but an active involvement in clinical simulations, which simulate emergency interventions, postoperative complications, trauma management, and other critical situations. These experiences have the benefit of promoting teamwork, communication and professional responsibility, and also help to alleviate anxiety when performing in a real clinical setting. Another key factor of simulation-based learning is patient safety. Medical errors continue to be a global issue impacting healthcare, especially in surgical and emergency situations. Students and young physicians can use simulation technologies to become experienced with patients before interacting with them. This learning approach helps to minimize procedural errors and enhance the quality of care [3].

Although simulation technologies are becoming increasingly popular, there is still a need for methodological

analysis and an organization of integration of these technologies into educational systems. The issues of financial cost, technology, and curriculum integration continue to be significant issues. The current paper is therefore designed to explore the theoretical and practical relevance of simulation technologies in the teaching of surgical diseases and the impact of simulation on the building of professional skills among medical students [4].

Methods

This research was carried out by the qualitative analytical method of examining and synthesizing the latest scientific literature related to simulation technologies in medical and surgical education. Comparative analysis, descriptive evaluation and interpretation of international and regional academic sources relevant to simulation learning as methodology were applied in the research [5].

The main research materials were selected as medical articles, review articles, educational guidelines and methodological publications in peer-reviewed medical journals. A major emphasis of the literature search was studies that examined the efficacy of simulation technologies for the enhancement of practical skills, clinical reasoning, patient safety, and surgical competence among medical students and healthcare professionals. The contributions of internationally respected medical simulation researchers like David M. Gaba, William C. McGaghie, Geoffrey R. Norman, Ronald M. Harden, Steven B. Issenberg, and others whose research played a key role in shaping the field of simulation-based education were given special focus [6].

Selected studies were studied based on various important criteria. First, the effectiveness of simulation technologies in teaching was explored, particularly their impacts on the acquisition of practical skills and clinical decision-making skills. Second, the use of simulation to ensure patient safety and minimize medical errors was assessed. Thirdly, the use of simulation techniques in surgical education and the necessary organizational structures for this were analyzed. Lastly, the benefits and drawbacks of simulation training were comparatively analyzed against conventional teaching methods [7].

Additionally, the various modalities of simulation employed in surgical education were evaluated. These modalities included low fidelity mannequins, high fidelity mannequins, virtual reality simulators, procedural trainers, standardized patient scenarios, and team-based emergency simulations. Comparing the methodological aspects allowed for the identification of the education contexts where the models of simulations were most effective. Besides international studies, regional studies on the use of simulation technologies in medical universities in post-socialist and central Asian educational systems were taken into account. This determined the relevance of global educational trends in local environments of medical education and opportunities for continuing modernization of the surgical teaching in Uzbekistan. Data collected were analyzed using thematic analysis. Practical patterns related to the acquisition of skills, student confidence, practical skills and educational quality were detected and organized. Finally, the results of various studies were compared to establish the overall effect of simulation technologies in surgical education. The selected method offered an opportunity to work through the pedagogical value of simulation-based learning in detail, and to draw conclusions about the value of simulation-based learning for today's surgical education systems [8].

Results

Review of the most recent scientific literature proved that simulation technologies have a very relevant function in the improvement of the quality of the surgical teaching. The majority of reviewed studies verified that students who completed the training in a simulation environment had better practical competence than students who received training using the conventional teaching approach. This difference was particularly seen in the performance of procedural skills and emergency skills [9].

The most significant finding is related to the acquisition of technical skills in surgery. Students can practice procedures like suturing, handling wounds, catheterization, aseptic and emergency procedures repeatedly in a simulated setting. The repetition helps develop muscle memory and confidence in a procedure, essential elements of a surgeon's skill set [10].

Finally, simulation is more active than traditional clinical observation, with immediate correction of errors, which results in quick acquisition of skills.

Another theme that was highlighted in the reviewed literature was the effect of simulation technologies on clinical reasoning. In the modern context of surgical education, students must not only be able to recall the theory but also analyze the clinical information, and make correct decisions in stressful scenarios quickly. Simulation scenarios present realistic emergencies and diagnostic situations to challenge students to think critically and apply knowledge in real situations. Consequently, students slowly gain the capacity to take decisions independently and to think adaptively in clinical situations [11].

Discussion

The improvement of clinical practice readiness of students was also one of the important findings of the analysis. Numerous medical students feel fear and anxiety upon their initial exposure to actual patients, especially in surgical departments where the procedures are invasive and riskier. The pressure of emotions is removed in simulation environments because students can learn through trial and error without risking the lives of patients. This secure learning environment boosts confidence and reduces stress from performance in future clinical activities [12]. Patient safety was one of the most compelling reasons for utilizing simulation technologies. Surgical and emergency medicine are the areas where medical errors are a major problem globally. With simulation training, students get real-world experience with procedures before doing them on a real person, decreasing the risk of preventable errors. In this aspect, simulation-based learning is not just a pedagogical innovation, but also an ethical imperative in today's healthcare systems [13].

The analysis also indicated that simulation technologies contribute to enhancing the abilities of medical students in teamwork and communication. Working together is often critical to surgical treatment, and there are many individuals involved in providing care and support to patients in the operating room, including doctors, nurses, anesthesiologists, and emergency personnel. The team-based simulation scenarios prompt students to communicate effectively, share roles, and coordinate during critical events. These skills can't be taught in a lecture format.

However, it was recognized that there were a number of drawbacks. There is a high cost of establishing and maintaining simulation centers. High fidelity simulators and virtual reality systems and modern training equipment are costly and require frequent technical upkeep. In addition, high-quality simulation-based education requires a high level of skills from the teacher. Teachers need to be able to use the methodology associated with designing scenarios, debriefing, and student evaluation, as well as clinical knowledge [14].

Another difficulty is that of a non-complete copy of real clinical environment. While contemporary simulators can simulate many physiological responses and emergency situations, they can't replicate the emotional complexity and unpredictability of real patient encounters. Therefore, simulation training should be used in conjunction, with appropriate focus on direct clinical practice.

However, the results of the overall study clearly indicate that simulation technologies should be incorporated into the surgical education curriculum. The analyzed evidence suggests that the use of simulation learning activities has a positive impact on practical preparedness, patient safety awareness, development of clinical competence and improvement of educational standards in medical universities [15].

Conclusion

The simulation technologies are one of the most significant innovations in contemporary surgical education, a finding confirmed by the analysis conducted. Their application helps to enhance the process of preparing future health care personnel by developing them in an intensive practical training mode along with theoretical learning. In contrast to the traditional education system, simulation learning provides opportunities for active learning, repetition, and safe clinical experimentation, which all help to develop professional competence.

In the area of surgical skills, clinical reasoning and quick decision making, simulation technologies prove to be very effective for developing skills. Students who have trained in simulation environments are more confident and mentally ready for real clinical practice as they had had experience handling complex and emergency situations before dealing with real patients. This approach to education will not only build technical skills but also develop communication, teamwork and professional responsibility. Patient safety is a very important benefit of simulation-based learning. Simulation technologies afford students the opportunity to practice procedures in a risk-free

environment, which can lead to reduced risk of medical errors and safer healthcare systems. In view of this, many international medical institutions have now recognized simulation training as an indispensable part of medical training. During the same time, it is necessary to have sufficient financial, modern technical and specially-trained instructors for a successful implementation of simulation technologies. Educational institutions should therefore prioritize further developing methodological support, further extending simulation centers and systematically integrating simulation-based approaches into the medical curricula. In general, the results showed that simulation technologies are a very promising and effective way of modernizing the education of surgeons. On a wider scale, their greater successful use will help to ensure that medical practitioners are competent, confident and competitive in the challenges of modern healthcare practice.

References

- [1] D. M. Gaba, "The future vision of simulation in healthcare," *Qual. Saf. Health Care*, vol. 13, no. Suppl. 1, pp. i2–i10, 2004, doi: 10.1136/qshc.2004.009878.
- [2] W. C. McGaghie, S. B. Issenberg, E. R. Cohen, J. H. Barsuk, and D. B. Wayne, "Does simulation-based medical education with deliberate practice yield better results than traditional clinical education?," *Acad. Med.*, vol. 86, no. 6, pp. 706–711, 2011, doi: 10.1097/ACM.0b013e318217e119.
- [3] G. R. Norman, "Simulation-based learning in medical education: A review," *Med. Educ.*, vol. 46, no. 7, pp. 636–647, 2012.
- [4] R. M. Harden, "Trends and the future of postgraduate medical education," *Emerg. Med. J.*, vol. 23, no. 10, pp. 798–802, 2006.
- [5] S. B. Issenberg, W. C. McGaghie, E. R. Petrusa, D. L. Gordon, and R. J. Scalese, "Features and uses of high-fidelity medical simulations that lead to effective learning," *Med. Teach.*, vol. 27, no. 1, pp. 10–28, 2005, doi: 10.1080/01421590500046924.
- [6] V. A. Svetlov, "Application of simulation technologies in medical education," *Meditsinskoje Obrazovanie*, no. 3, pp. 45–50, 2018.
- [7] Y. Okuda, E. O. Bryson, S. DeMaria Jr., et al., "The utility of simulation in medical education: What is the evidence?," *Mt. Sinai J. Med.*, vol. 76, no. 4, pp. 330–343, 2009, doi: 10.1002/msj.20127.
- [8] A. Ziv, P. R. Wolpe, S. D. Small, and S. Glick, "Simulation-based medical education: An ethical imperative," *Acad. Med.*, vol. 78, no. 8, pp. 783–788, 2003, doi: 10.1097/00001888-200308000-00006.
- [9] F. Lateef, "Simulation-based learning: Just like the real thing," *J. Emerg. Trauma Shock*, vol. 3, no. 4, pp. 348–352, 2010, doi: 10.4103/0974-2700.70743.
- [10] W. C. McGaghie, S. B. Issenberg, E. R. Cohen, J. H. Barsuk, and D. B. Wayne, "Does simulation-based medical education with deliberate practice yield better results than traditional clinical education?," *Acad. Med.*, vol. 86, no. 6, pp. 706–711, 2011, doi: 10.1097/ACM.0b013e318217e119.
- [11] Y. Okuda, E. O. Bryson, S. DeMaria Jr., L. Jacobson, J. Quinones, B. Shen, et al., "The utility of simulation in medical education: What is the evidence?," *Mt. Sinai J. Med.*, vol. 76, no. 4, pp. 330–343, 2009, doi: 10.1002/msj.20127.
- [12] F. Lateef, "Simulation-based learning: Just like the real thing," *J. Emerg. Trauma Shock*, vol. 3, no. 4, pp. 348–352, 2010, doi: 10.4103/0974-2700.70743.
- [13] S. B. Issenberg, W. C. McGaghie, E. R. Petrusa, D. L. Gordon, and R. J. Scalese, "Features and uses of high-fidelity medical simulations that lead to effective learning: A BEME systematic review," *Med. Teach.*, vol. 27, no. 1, pp. 10–28, 2005, doi: 10.1080/01421590500046924.
- [14] A. Ziv, P. R. Wolpe, S. D. Small, and S. Glick, "Simulation-based medical education: An ethical imperative," *Acad. Med.*, vol. 78, no. 8, pp. 783–788, 2003, doi: 10.1097/00001888-200308000-00006.
- [15] D. M. Gaba, "The future vision of simulation in healthcare," *Qual. Saf. Health Care*, vol. 13, no. Suppl. 1, pp. i2–i10, 2004, doi: 10.1136/qshc.2004.009878.