

Medical simulation in medical science education

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Abstract

Simulation is described as a reproduction, imitation of a phenomenon or action by using the model that is the most accurate copy. Today medical simulation is the one of the most actively developing methods of education in medical professions. Learning standards in the field of medical sciences emphasize three aspects of education: knowledge, skills and social competencies. Medical universities lay emphasis on the creation of medical simulation centers and attempt to standardize education according to the global trends. Learning through medical simulation is much more than an normal training with phantoms, moreover medical simulation perceived as a game is often associated with the attractive form of education. This form of education fosters memorizing and consolidating the knowledge or skills which student already possesses. In contrast, the use of high-fidelity simulators in medical education and training helps to increase patients' safety.

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Introduction

Simulation is an approximated recreation or imitation of a certain process or activity, using a model that is as close as possible to the reality. Many situations occurring in nature are difficult to observe or reproduce, making it difficult to carry out educational and training activities at a chosen time and in a chosen place. The use of medical simulation in education is a “problem method”, i.e. one where the students obtain knowledge themselves. The most commonly used simulation method is the so-called simulation game, which involves a simulation model representing a fragment of a given reality [1].

Education standards in medical science emphasize three aspects of education. These are: knowledge, i.e. familiarity with the basic concepts of a discipline; skills, i.e. the correct performance of steps of relevant medical procedures; and social competence, i.e. the student's attitudes and ability to cooperate with others to perform a given procedure, often including stress management in difficult situations [2].

The purpose of the standards is to make education more practice-oriented. Medical simulation methods can undoubtedly help achieve this goal. Many medical schools establish medical simulation centers, with a view to modernizing their educational methods and aligning them with global trends [2,3].

Medical simulation is currently one of the most rapidly developing educational methods in the medical professions. It is intrinsically associated with the development of simulation technology required for these educational purposes. The models used in education include the so-called task trainers, which assist in practicing particular steps without excess complexity (e.g. an arm for practicing intravenous injections), and computerized phantoms (or “patient simulators”) providing high-fidelity simulation for training in a simulated clinical setting. The patient simulators are meant to provide maximum fidelity with regard to the patient and their vital signs in a given situation [3,4].

Training using a patient simulator is highly beneficial, both to the student and to their future patients. Phantoms available on the market provide a very realistic simulation of a human patient's reactions,

such as coughing, bleeding, respiratory distress etc. Various scenarios can be practiced, as relevant for the skill being taught. At any point, the teacher/moderator can influence the course of simulation based on the student's actions. Such modifications allow the student to practice communication and interaction with the patient, recognizing their needs and reacting appropriately. This also improves decision-making skills, especially in a restricted time frame, as the student must correctly assess the dynamically changing situation [5,6].

The use of highly-specialized simulators requires cooperation and the development of a collaborative action plan with the whole therapeutic team. During such exercises, students learn to communicate with other professionals taking part in diagnosis and treatment, which can be a demanding task. In these situations, students test their own capabilities and limitations, and practice work under stress. Based on the scenario and requirements, this allows students to experience leading the team or following orders from others. All team members must work in a consistent manner, towards a common goal [7].

Using a simulator ensures a realistic recreation of a real-life clinical situation, while preventing any risk to actual patients. Moreover, in a simulated environment, it is possible to follow an incorrect diagnosis and incorrect course of treatment, thus highlighting the need for immediate reaction in such cases, and enabling students to learn from mistakes [3].

Medical simulation also involves work with simulated (or “standardized”) patients, i.e. healthy individuals or actors trained to act as real patients with a given condition would. Such an individual realistically simulates the signs and symptoms of a condition. They also answer students' questions regarding their medical history. By talking to the patient, students acquire skills necessary for adequate history-taking, which is an often underestimated component in the diagnosis of many diseases. With standardized patients, all students can practice a given skill in the same manner and under the same conditions. Work with a real person offers multiple benefits, including an opportunity to practice psychological competence, empathy, and good communication with a patient, which significantly affects the quality of patient

history taken, and allows students to become familiar with situations they will encounter in a hospital setting [5].

Training in a simulated clinical setting, i.e. in conditions closely resembling the relevant reality, is mainly based on feedback, that is, a dialog between the participants and the simulator, “controlled” by the teacher/moderator. The objective in this dialog is to provide better understanding of the situation and to identify the correct course of action [8]. The use of interactive devices in training requires more involvement of the student in performing the relevant activities. Such increased intellectual effort enhances educational outcomes [9].

Training using medical simulation is more than merely using a phantom. This educational modality comprises four stages [10].

The first stage is the identification of the educational objective and the development of the appropriate scenario to fulfill the said objective. Important considerations include the time available to perform the task and the availability of the necessary teaching materials, as well as the number of students taking part in the simulation game. Moreover, the scenario must take into account the knowledge and skills of the participants. At stage two, participants are assigned teams and roles, and then act the scenario out, following rules set out in advance [10].

This second stage of the simulation game should be carefully followed by the teacher and, optimally, video-recorded, so that each team member’s performance can be evaluated in detail at stage three. Stage three is the so-called debriefing, meaning a discussion of activities performed, with the use of the audio and video recording of the exercise. Multiple authors emphasize that without debriefing, the training is simply an exercise using a phantom, and not a full-fledged medical simulation [10].

By viewing the recording, each student can see whether their behavior and course of action were correct at any given time, and whether the medical procedures were performed in accordance with the relevant standards. The viewing is followed by a group discussion with the teacher, enabling an assessment of the whole team’s work and its members’ interactions with the patient and family. Students

draw conclusions from what they saw in the recording, learning from their mistakes and minimizing the risk of repeating the same mistakes in future real-life situations. The discussion also includes the theoretical basis for the task and the broad psychological perspective [10].

The psychological aspect is discussed even more extensively during debriefings following difficult scenarios, particularly those with “no solution”, that is, when the patient dies. Other aspects covered in the discussion are interactions with the surroundings, e.g. a crowd interfering with the therapeutic team’s actions, and communicating information on the patient’s health to their family members, who often react with extreme emotions [10].

At stage four of the training, the acquired skills and conclusions are transposed into daily practice [9].

Medical simulation in the form of a game is perceived as an attractive teaching method. During such a simulation game, participants are involved and stimulated, and at the same time aware of the possibility to make mistakes and correct them. The natural impulse to compete and to seek one’s own solutions makes the teaching process faster and more engaging. Participants of a medical simulation are less likely to become tired or disinterested. Simulation participants must select, out of all the information and skills they possess, only those necessary for the specific task they are to perform, which develops logical thinking skills. This educational modality promotes memorization and mastery of skills the student already has, as it is much easier to remember information associated with one’s own actions than to retain knowledge received passively, e.g. in a lecture [9].

A key role in medical simulation is played by the teacher, who should have previous training in this form of education. The teacher’s task is to prepare the simulation scenario so that it enables the achievement of specific educational objectives. Each exercise should engage the participants; add to their knowledge, skills, and social competence; and make them arrive at relevant conclusions. When students perform their tasks, the teacher should observe closely, and intervene only when necessary for the objectives to be achieved. Excess interference from the teacher or imposition of their own thoughts in

problem solving may hinder the students' learning process [9,10].

Students performing complex tasks using high-fidelity simulators, which closely imitate a real-life situation, can experience a range of genuine emotions. These may include negative emotions towards some team members or towards other teams, feelings of failure following a wrong decision, or disappointment with a teammate who came up with an incorrect diagnosis. In such cases, the teacher must appease the emotions, which undoubtedly requires highly developed communication skills and the ability to identify the conflict and to prevent its escalation [9,11].

Medical simulation in obstetrics and midwifery

First reports on simulation methods in this field date back to the 18th century, when Louis XV, king of France, ordered his court midwife to travel around the kingdom and instruct other women in midwifery skills. For this purpose, one of the first obstetric phantoms was built out of fabric and animal bone and hide. It was used for teaching abdominal palpation and for demonstrating the mechanisms of childbirth [12].

Currently, medical simulation is commonly used. Its fast development is made possible by the continuous improvement of technology, which enables the creation of ever more realistic medical simulators. Increasing numbers of medical schools obtain such devices and establish their own medical simulation centers, which improves the quality of training provided to students in all medical programs [13].

Globally, a number of institutions operate advanced simulation facilities for obstetrics and midwifery training; in Poland, the field is still nascent, but develops rapidly.

In the Polish market, one can find task trainers for practicing non-complex skills, such as catheterization, blood pressure measurement, performing injections or Leopold's maneuvers; simple childbirth simulators allowing for assisted demonstration of childbirth mechanisms; and other devices. High-fidelity computerized phantoms, perfectly simulating

a woman in labor and enabling students to practice a range of different scenarios, may contribute to better specialization of future midwives and obstetricians, and consequently, to better patient care. Modern birthing simulators imitate actual patients' reactions with increasing fidelity and allow for simulating various, also potentially life-threatening, labor complications. This proves very useful in training future midwives and obstetricians. Thus, the use of high-fidelity simulators in education can enhance patient safety [14].

Simulation exercises should be performed in rooms closely resembling a birthing room, an obstetrics or neonatal ward in a hospital etc. The only difference would be replacing the actual patient with a simulator, imitating a woman in labor, a postpartum patient, a neonate or a patient with a gynecological condition [9].

Exercises using the simulator should follow the general principles of medical simulation training. The teacher should prepare a relevant scenario, taking into account that the practice stage, where students perform their tasks using the simulator, should not exceed 15 minutes. More time, between 30 and 45 minutes, should be allocated to debriefing, where students analyze and discuss the audio and video recording of their team's performance, which is crucial to competence development [10,13].

Work with obstetric simulators allows students to experiment without endangering the patient's health, which is especially important with regard to newborn children, requiring utmost precision in all procedures [9].

Similarly, simulating a variety of labor complications gives students an opportunity to practice in a safe environment, so as to be prepared for any such cases in a real-life hospital setting. Repetition of the simulated experience ensures better outcomes in future clinical practice.

Medical simulation offers great potential with regard to developing skills that cannot easily be taught in a clinical setting. This holds especially true for rare, but rapidly developing and life-threatening complications. In cases of pathological course of delivery, students or junior staff are typically moved aside and replaced by more experienced colleagues, which means

they must develop their complication management skills by observation or by performing simple tasks and assisting the team that provides more advanced care [14,15].

Conclusion

The use of medical simulation offers enormous benefits both in students' training and in continuing professional development of medical staff, thereby improving the quality of medical education in Poland. Thanks to these methods, highly qualified medical professionals can be trained, contributing to better patient safety and a higher quality of care.

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