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Basic guidelines for high-fidelity medical simulation

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Abstract

Introduction

Simulation based medical education is an increasingly popular pedagogical approach. It provides students with the opportunity to practice their clinical skills and decision-making through various simulation activities. The main purpose of medical simulation is to educate and improve patient safety.

The aim

Presentation of the basic guidelines for the implementation of medical simulation methods in the education of nurses.

The method

Non-systematic review of literature, based on a thematic selection of articles with a preference for the studies being systematic reviews of papers published in the last 13 years.

Results

Based on the review of the literature on SBME covering the period from 1969 to 2003 and from 2003 to 2009 Mc.Gaghie and the co-authors present twelve features and best practices for effective medical education based on simulation. The authors of this study found them to be fundamental for the development of this method and for forming and improving medical competences.

Summary

Medical Simulation in education is a very important step on the way of gaining key competences in team work and decision-making skills. It is also a complementary training to many methods and educational strategies, but it will not substitute the training in natural conditions of in-patient care and professional experience arising from this.

Keywords: medical simulation, medical education, simulation exercises

Introduction

Medical simulation is now one of the fastest growing areas of medical students training. It provides the learners with the opportunity to act in a realistic situation, while minimizing or eliminating the risk to the patient, medical personnel, equipment, or environment[1]. As a technique, simulation has been employed and used already in the early twentieth century in the aerospace and arms industry, the first flight simulator was developed in 1929[2]. Through the use of simulation in aviation the accident rate was reduced by about 50%[3].

Simulation based medical education (SBME) is a tool that works between "see" and "do". The main objective of SBME is to gain clinical skills, but also those related to affective communication, through communication training or standardized patient training during the simulation classes[4]. It represents a complete simulation of the clinical environment in which learners can acquire not only technical skills but also gain team management skills, team communication skills and decision-making skills.

The history of medical simulation started with the construction of simple control simulators to end with high fidelity simulators.

In 1960 Ausmund Laerdal, who was a producer of plastic toys designed a realistic simulator of a man to be used for teaching mouth to mouth method of artificial respiration. When creating it, he was inspired by the story of a young European girl whose body was found on the banks of the river, calling his work "Resusi – Anne"[5].

The face of the dummy is a post-mortem form of the face of this "beauty of the Seine." Then in 1968, Dr. Michael Gordon presented during the session of American session Heart Association a model of a cardiac patient, giving him the name of Harvey. The dummy displayed almost any disease of the heart, and the change in its blood pressure lead to the changes in the heart sounds and to murmurs, as well as in the heart rate and breathing. It was used for training and for the assessment of clinical competence of trainees in various medical schools[5].

The above mentioned simulators gave rise to the creation of increasingly complex models copying physiological and pathological processes occurring in the human body, up to very recent models of phantoms supported by advanced operating technologies. Development of technology makes the computer software of such dummies and simulators increasingly easy to use while they are equipped with more and more features that simulate physiological and pathological processes of a human. Systematically implemented innovative research projects increase the level of the simulators' fidelity, thus enabling us to perform a variety of invasive and non-invasive treatments/ procedures. Another important aspect of the simulation functionality is development of cooperation skills in multidisciplinary team members, or assistance skills needed in emergency situations or in treating people with acute illness.

The aim of the study is to present basic guidelines for the implementation of medical simulation methods in education of nurses.

The method used in the literature review is unsystematic, thematic selection of articles with the preference for studies being systematic reviews of papers published in the last 13 years.

In high-fidelity simulation we can use a patient role-playing. Barrows described the simulated patien**t** (SP) as a person who has been thoroughly trained to simulate a real patient, in order for a qualified doctor not to detect it. Bnarrows and Abbrahanson first used the simulated patient to develop skills necessary for the assessment of neurological status of the patient. There is also a concept of a standardized patient. During the classes with this kind of patient the focus is on

consistency and standardization of the simulation process. Nevertheless, it is worth noting that these two terms essentially correlate with each other. Their dominance in use is related to the stage of development of medical simulation, its objectives, and often with a regional tradition. And, as the literature indicates, the term "standardized patient" is frequently used in the United States, while "simulated patient" is frequently used in Asian or European countries[6].
Simulated/ standardized patients are used in medical simulation to teach students how to properly enquire the patient about his medical history or to obtain permission for examination or surgery. Practical classes with the use of simulated patient further enrich the students with new skills related to dealing with the emotions that often accompany difficult situations in the process of treatment or health care.
It should be noted, however, that there are factors hindering the acquisition of a patient for simulation. Training such persons usually require clinical knowledge and medical vocabulary, bearing in upon the preparation for a new role, which takes a quite long time. On the other hand, making use of professional actors services is rather expensive.[5]

As previously mentioned education based on medical simulation provides an environment accessible for both a beginner and advanced practicpian. These can practice without harm to the patient. Learning by experience which is inextricably linked with the simulation is an active process in which the student gains knowledge by combining new information with previously gained knowledge and experience in accordance with the principle of cumulation. Implementation of classes based on really high-fidelity simulation scenarios engages emotionally each participant, thus providing a unique experience, during which the simulator faithfully copies the patient, i.e.: speaks, breathes, sweats and moves e.g. his eyelids like a real patient.
Also noteworthy is the fact that medical simulation can be adapted to the needs of different medical specialities - paediatrics, paediatric nursing, geriatrics, geriatric nursing and any other, to physical examination or emergency medicine and various professional groups - nurses, doctors or paramedics as well as fire fighters and policemen.

Based on a review of the literature on SBME covering the period from 1969 to 2003 and from 2003 to 2009 Mc.Gaghie and co-authors present twelve features and best practices for effective simulation based medical education. The authors of this study found them to be fundamentally important for the development of this method of forming and improving competence. They include:
1. Feedback
2. Deliberate practice
3. Curriculum integration
4. Outcome measurement
5. Simulation fidelity and simulator validity
6. Skill acquisition and maintenance
7. Individualized mastery learning
8. Transfer to practice
9.Team training
10. High – stakes testing
11. Instructor training
12. Educational and professional context .[7]

Feedback

As defined in the Sim-Dictionary a feedback is an action in which information is provided to the student in a constructive way, with his participation, supported with his life experiences, it should take into account aspects of learning and focus on the objectives of learning. [8]
Analysis of the available literature shows that feedback is considered the most important and most frequently cited feature of SBME[9].
There can be distinguished two types of feedback - formative and a summative one. What differs summative evaluation from the formative one is first of all the purpose. The purpose of summative

assessment is to give value and therefore it is often quantitative, whereas formative assessment is qualitative. In simulation based medical education most feedback information is formative in nature. This is to improve the student's performance, and not to assess his/her mistakes[7].
The source of feedback information should be provided by the teacher during debriefing, e.g. by analysing the the available video footage of the simulation training classes. Salsa and others present twelve points of effective debriefing, which relate inter alia to encouraging the team leaders and team members to pay attention to the processes of teamwork during the implementation of class studied situations; forming the attitude of team leaders in terms of taking reports; describing specific interactions in the team and processes that the team members were involved in; providing both individual and team feedback; recording the conclusions and setting goals to be achieved in the future, which should be part of the summary, to facilitate feedback in future classes. [10]

Deliberate practice

Sim-Dictionary gives the following explanation under the term "deliberate practice" - systematically designed action which has been created specifically to improve the performance of a person in a given area of study.[8]
Target-oriented practice has nine features/ requirements when it is used to achieve the objectives of medical education. These relate to:

1. High motivation of student,
2. Involvement in a well-formulated objective related to science,
3. Adjusted level of difficulty
4. Focus on purpose, repeated practice,
5. Rigorous and accurate measurement
6. Feedback from educational sources,
7. Students are also involved in monitoring their educational experience and improving strategies, mistakes and levels of understanding, they engage in target-oriented practice and continue it;
8. Assessment marks to achieve the master level,
9. Systematic shifting to different tasks or units of classes[11].

The importance of target-oriented practice as an educational variable was noticed by the internists R. Cabot & E. Locke. It was over a hundred years ago, in 1905. They formulated the following conclusion: "Learning medicine is not fundamentally different from learning anything else. If one had one hundred hours in which to learn, one might profitably spend perhaps 1 hour in being told how to do it, 4 hours in watching a teacher do it, and the remaining 95 hours in practice, at first with close supervision, later under general oversight."[12]

Curriculum integration

SBME, being one of the approaches to the development of competencies of graduates ready to take up a job of a nurse, should not be treated as exceptional or dominant method. It should be built into the existing curriculum, adequate to the current guidelines for the standards of nursing education and achieving the results in the form of established competence. It should be emphasized that SBME can only complement clinical education and it can not replace education based on patient care in natural clinical conditions. The premise of education featuring SBME is the use of this method for the achievement of some basic skills which the later is considered the optimal method of training.

Outcome measurement

This is a very important part of the above list since it concerns the evaluation of progress made by the participants of the simulation training in terms of their competences. They are more determined to improve particular skills if we clearly and precisely define what levels they are expected to achieve before starting a given exercise, if we consistently strive to achieve them and identify together the level to which they reached their goals.[10]

Simulation fidelity and simulator validity

It is essential here is to select a tool, which in this case is a control simulator or training simulator (of low, intermediate or high fidelity) for a given activity. The simulator will be used to learn basic skills such as venipuncture, bladder catheterization or intubation. It is necessary to match the learning objectives to the selected simulation tools. More advanced tasks require specialized equipment, hence the significance of the right choice of high-fidelity simulators and additional medical equipment. Some procedures are too dangerous to educate students in natural conditions and, what follows,
endanger human life, therefore high fidelity simulators provide a realistic approximation of clinical assumptions. [7, 10]

Skill acquisition and maintenance

Without further target-oriented practice in a professional environment, each of the skills acquired in SBME tends to disappear within 3-12 months of learning. This time depends on the type of acquired skills, the degree of obtained efficiency in the exercise of a skill and duration of the training. Therefore, when planning an SBME training schedule be aware of the above variables to determine the optimal duration of SBME for beginner or advanced students. Helping students in mastering the skills on increasingly challenging levels slows the time of their losing/ disappearing.

Individualized mastery learning

This target assumes that all students will achieve their educational goals with little or no variation in the results. The amount of time needed to achieve them depends on individual capabilities of a student. [7]

Transfer to practice

Skills acquired during the course should be used in clinical reality. Higher diversity of simulated patients which students can see and use in their education, helps to standardize clinical curriculum in educational institutions and makes the learners more confident and able to participate in the process of forming their competence.
This transfer of learning into practice must be observed and sought as part of the assessment of SBME program. Observed shortcomings must be taken into account in the redesigning of SBME educational experience so that the SBME program can be more effective.

Team training

The psychologist Eduardo Salas and his colleagues argue that patient care is a team sport;. They provide evidence that some of the determinants of teamwork is verbal and non-verbal communication and behaviour. Whereas behaviour or communication is the cause of almost 7% of the mistakes in clinical practice. Other indicators of ineffective teamwork, such as the lack of common objectives, voluntary identification with the situation, the quality of leadership, coordination, mutual respect and submission of reports as a form of continuity of communication, have been matched with adverse clinical outcomes of patients such as hospital-acquired infection, adverse events related to medicine taking and the risk of mortality.[13]
Salas, along with other researchers have identified and described the key principles of team training in health care which should be included in the curriculum and thus in the education based on medical simulation method.[13]They made a quantitative and qualitative review of the available

literature, including, "the analysis the content of the team training in health care". The result is a set of "eight principles of team training in health care based on scientific facts, i.e.:

1. Identification of key competencies in teamwork and using them as a focal point for the training content.
2. The emphasis on teamwork; designing it to streamline team processes;
3. "One size does not fit all" - Let the team learning outcomes be identified by the team and, therefore, expected, or even desirable by the team.
4. Carrying out practical cooperation in a the team, theoretical implementation of a task is not enough.
5. The power of simulation, which has a large impact, will make the training match the conditions of the transfer environment.
6. Opinions matter and therefore they must be descriptive, timely and accurate.
7. Evaluating clinical outcomes, learning and behaviour at work is the basis for constructive change.
8. Reinforcing the desired team behaviour through coaching and positive evaluation of results. [13]

High – stakes testing

Due to standardization, fidelity and repeatability of medical simulation, the high-fidelity simulation method is suitable for formative and summative assessments of clinical competence. Formative assessments apply to practice and feedback information on the stage of competence development, whereas summative/ summarizing assessments relate to the final assessment, a subject exam or a 3-year cycle of education (diploma examination) as a result of which a person obtains a certificate/ license. [7.10]

Instructor training

Simulation experience is not an indicator of the instructor's effectiveness. Therefore, instructors should repeatedly participate in trainings raising their qualifications, verifying the mistakes which they make when teaching with the SBME method and improving skills in raising students motivation to participate in the simulation. [7.10]

Educational and professional context

Since SBME is meant to help students become ready to work, the educational context must be as close as possible to the professional context (authentic/ realistic) also during the training sessions. Schuwirth and van der Vleuten state that "situations in which a candidate's competencies are assessed, should resemble a situation in which these competences must actually be used", which means a frequent use of standardized/ simulated patients during the medical simulation classes. SBME which ignores its educational and professional context of teaching, evaluation or use in clinical practice, is wrongly directed. It should also be noted that "highly accurate medical simulations more effectively represent a wide range of medical problems or patient's conditions than simulations with a narrow choice of patients. They provides more "contextual experience" which are critical in acquiring skills necessary to solve problems similar to those that occur in situations of real health care.

Conclusion

Medical simulation in education is a very important step to acquire key competences in team work and decision-making skills. It is also a complement to many educational methods and strategies. Professional competence mastered through the use of SBME represent the minimum level of professional competence that can be trusted on when providing safe care to the patient in real conditions. However, students must continue their practice in realistic conditions in real patient health care and in the team-based systems of service provision in order to learn to be part of them and lead the health care teams in their patient care in accordance with their competencies.

For learners, simulation-based learning experiences reasonably built into the curriculum are an ideal opportunity to practice patient care based on the principles of learning and principles of target-oriented practice on their way to the mastery of knowledge and skills. Whereas, when assessing the advantages for the patients, it should be emphasized that students who were trained with the use of medical simulation and developed a certain minimum level of professional competence before clinical interaction with the patients, are more likely to be allowed by the patients to perform medical procedures on them, or nursing.

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