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The Possibilities of using Simulators in Medical Education

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Abstract - *The article deals with topical issues of application of simulation techniques in the modern educational process associated with the use of virtual simulators in medical education. The purpose of this article was to review the use of simulators in the educational process of medical school. Research methodology: scientific publications were searched by keyword: simulation technologies, simulators, medical education (in Russian and English), using Google Scholar and Medline search system, search time range from 2009 to 2019. Results: it was shown and identified the main benefits of using training simulators that allow undergraduate medical student to imagine the object of study and to implement practical actions to him without his direct involvement, to set the initial parameters for the study and register the relevant changes in the results of the experiment, to analyze, identify patterns and draw conclusions, if necessary, repeating the attempt. It also shows the difficulties associated with significant initial costs for training teachers, the lack of current educational modeling programs.*

Keywords: *simulation technologies, virtual simulators, medical education.*

INTRODUCTION

At present, in the era of rapid development of high-tech medicine society imposes increased demands on the quality of medical services. The classical system of clinical medical education is not able to fully solve the problem of high-quality practical training of the doctor [1, 2, 3, and 4]. In order to enhance the cognitive activity of the student, it is necessary to use all possible simulation technologies for practical, laboratory and independent studies [5, 6, and 7].

It is necessary to create a real situation for each practical skills of assistance, as well as cause interest and desire to learn more, improve the quality of learning new material [8, 9, and 10]. To master these technologies, it is advisable to acquaint teachers with didactic capabilities of simulation training tools, including:

- *Variety of reporting forms*
- *Different types of clinical situations*
- *Creation of educational environments that provide "immersion" of the student in certain social and industrial situations*
- *Application of gaming technologies*
- *An implementation of the playback capabilities of the fragment production activities*
- *Activation of educational work of students, strengthening of their role as the subject of educational activity; strengthening of their motivation [8].*

One of the tasks of medical education is to provide training of specialists who can use modern medical information systems, participate in their development and maintenance [11, 12, 13, and 14]. Simulation is increasingly used for teaching medical procedures [15, 16].

It is extremely important to use humanistic teaching methods in medical education in accordance with the principle of "do No harm". Learning practical skills using simulators (or models) is becoming common in different areas. Simulators used in medicine allow the student to master many skills before meeting real patients. Students have the opportunity to acquire basic medical skills without causing any harm to the patient, with the help of standard practices used in simulation centers [17]. It is also possible to produce more qualified doctors, first of all, teaching student's practical skills for basic medical interventions, and then practice these skills with real patients. In General, it is believed that the use of skills models in medical training will lead to better elaboration and assimilation of practical competencies, a significant reduction in the number of medical errors, to improvement and efficiency of medical care [18].

AIM:

The aim of this work was a literature review of the use of simulators in the educational process of medical school.

RESEARCH METHODOLOGY

Scientific publications were searched by keyword: simulation technologies, simulators, medical education (in Russian and English), using Google Scholar and MEDLINE search system, search time range from 2009 to 2019. More than 19000 articles were found, using sorting by date and exact matches, we narrowed down the search result to 98 articles that we analyzed, selected 34 of them, taking into account the purpose of the article.

RESULTS AND DISCUSSION

Software for modeling and simulation has been used in almost all areas of education, as well as actively used in medical education [19, 20]. This simulation gives students the opportunity to apply different approaches and techniques before they encounter real patients. The objectives of these simulation applications are to enable students to gain basic medical skills without harming the patients [21, 22]. They are aimed at practicing certain medical practices according to standards on models and simulators, and then on patients, which allows to achieve a higher level of qualification of doctors [23, 24].

Thus, simulation applications are extremely important in terms of improving clinical skills [15]. It is not always possible to provide clinical skills training in the hospital. The decline in time with patients and empowering care at home, in hospitals there are only very serious cases, and sometimes students graduate without having the opportunity to see some of different clinical cases and diseases [19]. This situation further emphasizes the importance of modelling. The practical possibilities offered by the simulation software facilitate the learning process, learning time and minimize the risk of harm to patients [25, 26, and 27]. In medical education it is possible to classify the areas in which simulations are used:

1. Study and planning. *Saving money and time, simulation of the operation before release, identifying areas of concern.*

***2*. Skill assessment**. *A good example of this is testing and evaluating a doctor's capabilities.*

3. Education. *An example of such software could be an educational simulation that is used to practice the skill by medical students before they meet a real patient.*
There are a number of advantages of using simulation and simulation applications in medical education from different points of view: students, patients, teachers and medical institutions, they are given in table 1 [1, 28, and 29].

Table 1.The Advantages of using simulation applications.

Point of view	*Advantage of using using simulation applications*
From the student's point of view:	*Reducing the psychological burden on students.* *Improving clinical experience.* *Quick feedback.* *Possibility to use without any safety concerns.* *Possibility to test all possible cases.* *Makes students think about their own achievements.* *Minimization of possible risk as a result of wrong actions.* *Equal opportunities in education.* *Opportunity to study in a group.* *The mechanism for repetition of skills.* *The possibility of "working out" rare pathologies.*
From the patient's perspective	*High quality service.* *Patient-centered approach.* *Reducing the level of complications.*
From the teacher's point of view	*Safety during the educational process.* *Can be integrated into the curriculum.* *Reduces the likelihood of complications.* *Consolidate theoretical knowledge with instant practical skills.* *Active participation of students.* *Provides opportunities for development of competencies.*
From the point of view of medical institutions *Higher quality service.* *Reducing the risk of complications.* *For companies prefer doctors with high qualifications.*	*Higher quality service.* *Reducing the risk of complications.* *For companies prefer doctors with high qualifications.*

In addition to the many advantages of simulation medical education,

There are some disadvantages [30]:

- High cost;

- Different educational environments are required;

- The planning process takes a long time;

- Limited number of competent instructors;

- Unfavorable attitude of a number of students and teachers to simulation training;

- Lack of confidence in simulation-based learning;
It should be remembered that simulation-based training is only an auxiliary method and cannot replace clinical training when working with patients.

Classification of training AIDS, simulators, models and simulations on 7 different levels of realism [1]:

1. Visual - training is based on visual perception. Classic tutorials, posters, electronic and computer textbooks, educational games, online tests.
2. Tactile - visual perception is complemented by the analysis of tactile sensations. Simulators, phantoms and mannequins for practicing practical skills.
3. Reactive - the reaction of the equipment to the actions of the cadet and their simplest, usually binary evaluation: "Yes" or "no". Simulators are equipped with a system of indication of the result: an electronic controller with a light or sound signal, simulation of bleeding.
4. Automated - script-based reaction - more complex, but still standard, programmed. Simulators and simulators with computerized control and/or video recording of actions.
5. Hardware - the reliability of training is enhanced by the interaction of simulators with existing medical equipment, up to the ambulance.
6. Interactive - the reaction of simulators is calculated on the basis of complex mathematical models, each time individual, as realistic as possible. Patient simulators and virtual simulators with feedback, including tactile sensitivity.
7. Integrated - integration of several simulators into a single complex. Complex integrated interactive simulation systems, with the presence of automated recording protocols and training management.
As the realism of the educational device increases, its price increases [1].

In a study by Shanks D (2010), evaluated the preferences of medical students on the use of simulators in the learning process. The authors concluded that students appreciate learning on the simulator in the form of small group classes [16].

Study Wahidi et al. [31] shows that training using simulators leads to measurable, statistically significant, and sustained improvements in bronchoscopy technique when working with real patients. Students, who were trained using simulators, achieved high results, much earlier in the learning process: their results when performing the 20th bronchoscopy were the same as the results of the 50th bronchoscopy of students who studied without simulators. This indicates a much greater efficiency of simulators in comparison with standard training [32].

The study is of great value to confirm the effectiveness of simulators, as it includes multiple, long-term evaluation of the implementation of this procedure. Students after the transition to work with real patients, rely on the tested system of evaluation of results and demonstrate sustainable improvement of bronchoscopy techniques.

According to long-term observation of several students, the experts empirically established the required number of procedures. The result curves obtained by the BSTAT system indicate a rapid improvement of the results during the first 30 procedures, then the results improved more slowly. These data not only confirm the requirements for a minimum number of bronchoscopy procedures, but also correspond to a recent proposal to increase the number of necessary procedures. The aim of the training is to achieve a sufficient level of practical skills in the minimum number of procedures, which should be correlated with improving the quality of skills, as in the study Wahidi [31].

Central vein catheterization is a common standard procedure, and more accurate and safe installation of Central venous catheters is the goal of many health professionals. The Agency for research and evaluation of the quality of medical care and other institutions recommend ultrasound control during Central vein catheterization to avoid possible complications [32]. Some institutions have organized special training groups to develop these skills. Training on the simulators imply zero risks for the patient. Taking into account the frequency and prevalence of procedures, introduction of Central venous catheters, aspiration to the elimination of risks when performing this manipulation, the increased risks associated with the work of inexperienced physicians, and the availability of relatively inexpensive simulators for practicing skills in the installation of Central venous catheters, studies have been

conducted in the use of simulators for learning this technique in the field practicing skills in the use of ultrasound for this technique, as well as in the field of methods of integrated assessment of competencies of students and tasks [32].

Several small studies have confirmed the benefits of using simulators in training, including no risk of complications, fewer needle misses, and a higher level of confidence of the doctor during the procedure. The value of the Dong study [33] is to develop and test a tool to evaluate the results of students. The tool includes several methods from different areas, is characterized by external validity and acceptable inter-expert reliability, and is regulated depending on the level of competence of the doctor.

A similar technique was considered in the study Huang [34]. He used a tool for the subclavian installation, not including ultrasonic testing, but containing more specific and detailed exercises. Huang technique was developed using precise methods, but has not yet been tested as Dong technique.

According to S. Murrin, it is time to abandon the approach of using only one method or tool of learning [32]. Modern training program should include a variety of methods and equipment. In addition the system should be provided for testing the level of doctors ' skills before admission to procedures in a real clinical situation [32, 33].

Of course, to determine how to optimize the integration of simulators in the training program requires additional research, but should not postpone the use of this high-tech tool in the training and assessment of the professional level of doctors. Various articles on this topic only confirm the advantages of simulators.

CONCLUSIONS

The use of computer simulation technology in the educational process increases the objectivity and quality of testing and evaluation of knowledge, skills and practical skills of students, and in clinical practice can improve the skills of practitioners.

Thus, the simulation technology is certainly communicative, since it involves establishing contact and interaction between the participants of the educational process. Information, penetrating into consciousness, initiates its active work and, as a result, starts the reverse information process, response, action. And of course, the introduction of a simulation training system provides a number of advantages for students, teachers, health care and medical education in General. It should be noted that simulation techniques cannot replace the entire scope of practical activities of medical students, especially its clinical part, providing direct experience of interaction with patients.

Conflict of interest: *All the authors state that there is no conflict of interest.*

REFERENCES

1. *Svistunov A.A. Simulation training in medicine. M.: Publishing House of the First MGMU. IM Sechenov. 2013; 288. (In Russ.).*
2. *Shubina LB, Gribkov D.M., Khokhlov.V. Survey of Participants of the Second Stage of the Primary Accreditation 2018. Virtual technologies in medicine. 2018; No. 2 (20): 6-9. (In Russ.).*
3. *Prasmytsky O.T., Kostrova E.M. Simulyatsionny technologies of training of students at medical university on maintaining patients in critical situations. Medical Journal. 2015; 2 (52): 34-41. (In Russ.).*
4. *Stan L.C., Grozavu V.D. Simulation technology in the educational process. Proceedings of IAMU AGA. 2013; 14: 219-222.*
5. *Bulatov S.A. Prospects for the use of simulation centers for competence-based approach in the training of specialists for practical public health. Medical education and professional development. 2012; 3 (9): 124-125. (In Russ.).*
6. *Naygovzina NB, Filatov V.B., Gorshkov MD, Guschina E.Yu., Kolysh A.L. All-Russian system of simulation training, testing and certification in health care. Medical education and professional development. 2012; 3 (9): 122-123. (In Russ.).*
7. *Svistunov A.A., Krasnolutsky I.G., Togoev O.O., Kudinova L.V., Shubina L.B., Gribkov D.M. Certification using simulation. Virtual'nye tekhnologii v medicine [Virtual Technologies in Medicine]. 2015; 1 (13): 10-12. (In Russ.).*
8. *Gorshkov M.D., Fedorov A.V. Simulation training of basic medical and surgical skills. Virtual'nye tekhnologii v medicine [Virtual Technologies in Medicine]. 2014; 1 (11): 34-9. (In Russ.)*
9. *Gur'eva V.A., Remneva O.V., Gorbacheva T.I., Kravtsova E.S., Chechina I.N., Galchenko A.I. Practical skills training optimization in obstetrics and gynecology: from routine to up-to-date robotic technologies. Medical education and professional development. 2018; 2: 42-52. (In Russ.).*
10. *Singer, B. D., Corbridge T. C., Schroedl C. J. et al. Fist-year residents outperform third residents after simulation-based education in critical care*

medicine. Simul. Healthc. 2013; (8): 67–72. doi.org/10.1097/sih.0b013e31827744f2.

11. *Bakr MM, Massey WL, Alexander H. Can Virtual Simulators Replace Traditional Preclinical Teaching Methods: A Students' Perspective? Int J Dent Oral Health. 2015; 2(1). doi.org/10.16966/2378-7090.149.*
12. *Svistunov A.A. Simulation training in the specialty 31.02.01 Medical business. M.: GEOTAR-Media, 2014; 288. (In Russ.).*
13. *Nikitin V.M., Efremova O.A., Churnosov M.I., Lipunova E.A., Kamyshnikova L.A. Efremova O.A. Risk method assessment of coronary heart disease in carriers of polymorphic cardiogenic. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2016; 7(6): 3233-3238.*
14. *Efremova O.A., Nikitin V.M., Muromtsev V.V., Lipunova E.A, Kamyshnikova L.A. ECG computer analysis system with the advanced features of automated search and identification of its diagnostically significant changes. International Journal of Pharmacy & Technology. 2016; 8(2): 14174-14181. https://doi.org/10.4314/jfas.v9i1s.746.*
15. *Levkin O.A., Ryazanov D.Yu., Serikov K.V. Simulation training forms of doctors, residents, nurses and paramedics. Meditsina neotlozhnykh sostoyaniy [Critical Care Medicine]. 2016; 5 (76): 94-7. (In Russ.).*
16. *Shanks, D., Wong, R.Y., Roberts, J.M. et al. Use of simulator-based medical procedural curriculum: the learner's perspectives. BMC Med Educ. 2010; 10: 77. https://doi.org/10.1186/1472-6920-10-77.*
17. *Perry S., Bridges S.M., Burrow M.F. A review of the use of simulation in dental education. Journal of the Society for Simulation in Healthcare. 2015; 10 (1): 31–37. doi: 10.1097/SIH.0000000000000059.*
18. *Alekseeva O.V., Nosova M.N., Ulitina O.M., Lycheva N.A., Bondarchuk Yu.A. [Electronic resource] Simulations methods in educational process of medical high school. Modern problems of science and education. 2015; 5 URL: http://science-education.ru/ru/article/view?id=22506. In Russ. (Date of access: 30.05.2019)].*
19. *Tatli Ö., Tatli Z. Simulation applications in emergency medicine education Procedia Social and Behavioral Sciences. 2010; (9): 1825–1829. doi:10.1016/j.sbspro.2010.12.408.*
20. *Britt R.C., Novosel T.J., Britt L.D., Sullivan M. The impact of central line simulation before the ICU experience. Am J Surg. 2009; 197 (4): 533 - 536. https://doi.org/10.1016/j.amjsurg.2008.11.016.*
21. *Romantsov MG, Melnikova I.Yu. Modern educational technologies are a means of innovative development of higher medical education. Medical education and professional development 2015; 1: 88-95. (In Russ.).*
22. *Lendahls L., Oscarsson M.G. Midwifery students' experiences of simulation-and skills training. Nurse Education Today. 2017; 50: 12-16. https://doi.org/10.1016/j.nedt.2016.12.005*
23. *Basak T., Unver V., Moss J., Watts P., Gaioso V. Beginning and advanced students' perceptions of the use of low-and high-fidelity mannequins in nursing simulation. Nurse Education Today. 2016; 36: 37-43. https://doi.org/10.1016/j.nedt.2015.07.020.*
24. *Zúñiga B.B., Estrada A.F., Febles Rodríguez J.P., González Peñafiel A. Perception of medical students about the use of simulators in classes. International Research Journal of Engineering and Technology (IRJET). 2017; 4 (6): 2395-0072 www.irjet.net.*
25. *Martin C.T. & Chanda N. Mental health clinical simulation: therapeutic communication. Clinical Simulation in Nursing. 2016; 12(6): 209-214. https://doi.org/10.1016/j.ecns.2016.02.007.*
26. *Vermeulen J., Beeckman K., Turcksin R., Winkel L.V., Gucciardo L., Laubanch M., Peersman W., Swinnen E. The experiences of last-year student midwives with High-Fidelity Perinatal Simulation training: A qualitative descriptive study. Women and Birth. 2017; 30(3): 253-261. https://doi.org/10.1016/j.wombi.2017.02.014.*
27. *Burden A. R., Torjman M. C., Dy G. E. et al. Prevention of central venous catheterrelated blood stream infections is it time to add simulation training to the prevention bundle? J. Clin. Anesthesiol. 2012; 24:555560.https://doi.org/10.1016/j.jclinane.2012.04.006.*
28. *Sevbitov A.V., Kuznetsova M.YU., Davidyants A.A., Borisov V.V., Dorofeev A.E., Timoshin A.V. Integration of simulators 5th level of realism in the educational process of the institute of dentistry. Indian journal of science and technology. 2018; 11(35): 91507 https://doi.org/10.17485/ijst/2018/v11i35/131450.*
29. *Putkov K.A., Shmatko A.D. [Electronic resource]. The advantages of using virtual laboratory complexes in the training of medical students. NovaInfo.Ru. 2016; 54 (2), URL: https://novainfo.ru/pdf/051-2.pdf. In Russ. (Date of access: 20.05.2019).*
30. *Kosagovskaya I.I., Volchkova E.V., Pak S.G. Modern problems of simulation training in medicine.*

Epidemiol. and infection. Disease. 2014; (1): 49-61 (in Russ.).

31. *Wahidi M.M., Silvestri G.A., Coakley R.D., et al. A prospective multicenter study of competency metrics and educational interventions in the learning of bronchoscopy among new pulmonary fellows. Chest. 2010; 137 (5): 1040-1049. 4. https://doi.org/10.1378/chest.09-1234*
32. *Murin S., Stollenwerk N.S. Simulation in procedural training: at the tipping point. Chest. 2010. 137(5): 1009-1011.*
33. *Dong Y., Suri H.S., Cook D.A., et al. Simulation-based objective assessment discerns clinical proficiency in central line placement: a construct validation. Chest. 2010; 137 (5): 1050-1056. https://doi.org/10.1016/j.yane.2011.01.011.*
34. *Huang GC, Newman LR, Schwartzstein RM, et al. Procedural competence in internal medicine residents: validity of a central venous catheter insertion assessment instrument. Acad Med. 2009; 84 (8): 1127 - 1134. https://doi.org/10.1097/acm.0b013e3181acf491.*