Review Article

Creation of New Types of Medical Simulation Systems with Feedback and Interactive Guides Using Augmented and Virtual Reality: The Innovative Project

Petimat Vahaevna Musaeva[1], Linda Ruslanovna Makhmudova[1], Khava Vakhaevna Dzhambulatova[1], Heda Zayput'evna Erzanukaeva[2], Amina Adamovna Ezhieva[1], Zubaidat Merdenovna Pashaeva[3], Akmaglay Menmuratovna Kurbanova[4] and Sergey Nikolaevich Povetkin[5]*

[1]Department of Medicine, Medical Institute of the Chechen State University, Grozny, Chechen Republic, Russia; [2]Department of Medicine, Kabardino-Balkarian State University Named after HM Berbekov, Nalchik, Kabardino-Balkarian Republic, Russia; [3]Department of Medicine, Dagestan State Medical University, Makhachkala, Dagestan Republic, Russia; [4]Department of Medicine, Stavropol Regional Clinical Consulting and Diagnostic Center, Stavropol, Russia; [5]Department of Medicine, North Caucasus Federal University, Stavropol, Russia

Corresponding author:
Sergey Nikolaevich Povetkin,
Department of Medicine,
North Caucasus Federal University,
Stavropol, Russia
E-mail:
ruslankalmykov777@yandex.ru

Abstract

The article considers the features of the use of simulation technologies in distance learning, including in a complex epidemiological situation. The Purpose of the Work: To evaluate the role of simulation technologies in distance learning of senior students of medical universities. The study included 29 6th-year students of the medical institute of the Chechen state university (Grozny, Russia). The introduction of simulation technologies makes it possible to improve the connection of theoretical material with clinical practice, increase interest in learning and self-discipline.

Keywords: Simulation training; Distance education; Medical education; Students

Introduction

The discipline of hospital pediatrics, taught in the 6th year of the medical institute, is devoted to improving knowledge and acquired competencies in previously studied sections of pediatrics, familiarization with rare and complex in diagnostic terms, diseases and syndromes in the age aspect (neonatology, early age, older age). [1-3] Traditionally, the training took place on the basis of a multidisciplinary pediatric hospital "at the patient's bedside". However, despite the undeniable advantages of teaching students on real patients, this method has its limitations: Parents and children may refuse to be examined, in the case of rare diseases, a patient with an appropriate diagnosis is not always in the hospital at the time of passing the appropriate training cycle, when studying immune compromised patients, their contact with students is undesirable for epidemiological indications. [4-6] Special difficulties arise when analyzing urgent conditions, complications of the course of the disease and the development of iatrogenia. In addition, it is shown that the number of medical errors is reduced when simulation technologies are included in education before the stage of communication with real patients [7,8] in the absence of risk for both the patient and the student. Simulation training can take various formsboth the development of individual skills, for example, auscultation of the cardiovascular and respiratory systems, [9-11] and working with the patient as a whole (the "standardized patient" technique, [12-16] the use of robot simulators of the child with advanced functions of monitoring vital functions and feedback, virtual simulators of the patient). An important positive factor when using simulation technologies is the possibility of their repeated repetition by each participant, video recording with subsequent debriefing (in the case of a real patient, it is poorly implemented due to the need to protect personal data and respect the rights of the patient), the possibility of modeling rare diseases and syndromes, as well as modeling complications, including iatrogenic origin. [17,18] In meta-analysis, Cheng et al. it has been shown that simulation is a highly effective teaching method for pediatric education. [19]

Due to the sharp deterioration of the epidemiological situation caused by the COVID-19 coronavirus infection pandemic, it became necessary to minimize the risks of "live" communication around the world. [20-23] We believed that the use of exclusively distance learning at senior courses of medical universities does not allow us to fully develop such skills as communication with the patient, teamwork. Even in the work of Lopreiato et al. it is emphasized that simulation is not a substitute for clinical experience. [24] Therefore, a combination of distance learning and work on the basis of a multidisciplinary accreditation and simulation center in small groups was made, also based on C++ programming skills. [25] Unfortunately, due to the deterioration of the epidemiological situation, the training was completely transferred to the remote form in the future, but we plan to resume this work after the pandemic subsides.

Objective

To evaluate the role of simulation technologies in distance learning of senior students of medical universities.For the simulation lesson, a workstation was prepared on the basis of

How to Cite this Article: Musaeva PV, et al. Creation of New Types of Medical Simulation Systems with Feedback and Interactive Guides Using Augmented and Virtual Reality: The Innovative Project. Ann Med Health Sci Res. 2021;11:S3:110-113.

a multidisciplinary accreditation and simulation center of the Medical Institute of the Chechen state university (Grozny, Russia), equipped with a child simulator robot with advanced functions for monitoring vital functions and automated feedback (PediaSIM robot simulator), medical devices, consumables and medicines for the purpose of modeling the situation of metabolic and electrolyte disorders in acute kidney injury. During the lesson, a direct assessment of the actions of students of the 6th year of the pediatric faculty was carried out. Classes were held in small groups (4 people-6 people) in March 2021. After completing the cycle of training and certification of trainees, a questionnaire was conducted, in which 29 students of the 6th year of the pediatric faculty took part. The survey was personalized, since it was already conducted remotely due to the deterioration of the epidemiological situation on the basis of the distance education portal with mandatory authorization of participants.Since the study was a pilot study, no calculation of the sample size was carried out.

Results

When directly evaluating the actions of students, both a low willingness to work in a team and an orientation to work in the "question-answer" and "monologue on a given topic" with a sufficient level of theoretical training with insufficient synthesis of existing knowledge and the need to provide assistance in a specific clinical situation were obvious. These shortcomings were demonstrated to some extent by 100% of students. It was also noted that there was an established hierarchy of relations in the groups of students, which was rigid to changes in the conditions of emergency and emergency care. During the debriefing process, the students also indicated that it was emotionally difficult for them to perceive the robot dummy as a living patient requiring emergency medical care. Therefore, if there was a sufficient theoretical basis, the students provided insufficient assistance in an illogical sequence. In addition, the lack of perception of the simulator as a real patient led to the adoption of ill-considered therapeutic decisions that threaten the development of iatrogenia. Thus, when modeling arterial hypertension with bradycardia against the background of electrolyte disorders, beta-blockers were recommended. The advantage of simulation training in this case was the opportunity to clearly demonstrate the development of complications. During debriefing, the trainees reported that they knew about the effect of beta-blockers on heart rate, but in an emergency they missed this fact.

During the survey, 63% of students indicated that distance learning is comparable to full-time for them, 18% had the impression that it was easier to study, 18% was harder to study because of technical problems and 9% because of problems with self-discipline and other reasons (students could choose several answer options). All students were satisfied with the quality of the lecture material; the vast majority (90%) found the completion of tests and tasks comparable in complexity to the full-time part. A total of half of the students visited the MASC, the rest took advantage of the opportunity to attend freely. Of those who visited, 100% believe that simulation technologies are a good addition to distance learning, of those who did not attend and took part in the survey, all regret the missed opportunity.

Discussion

The shortcomings of the traditionally accepted training identified in the course of our research are well known and at one time served as an impetus for the development of simulation training using augmented reality. [26,27] Previously, we successfully used the positive aspects of simulation training in the traditional study of the discipline of hospital pediatrics in the form of a combination of face-to-face analysis of patients and modeling on a child simulator robot with advanced functions for monitoring vital functions and the reverse response of complications, including iatrogenic origin, for example, acute tumor lysis syndrome in the treatment of leukemia, water-electrolyte disorders in acute renal injury.

Simulation robots with advanced vital function monitoring and feedback functions create a focus for team interactions and treatment decisions, as it happens in real life. The simulator also provides an integrated model on which not only medical manipulations and procedures can be performed, but also coordination and interaction between team members can be practiced. [28,29] It should be noted that the scenario program should include the solution of no more than three educational tasks. [30,31] In this regard, it seems appropriate to conduct separate trainings on team building, starting with junior courses. However, these trainings will be ineffective without systematic support in the study of clinical disciplines. In addition, an important task is to create a favorable psychological climate during the training using special cocktails with control of general toxicity conditions, [32-35] especially given the emotional difficulties with the perception of the robot simulator as a living patient, noted in our study.

The inclusion of simulation technologies in distance learning, in our opinion, helped to smooth out the negative consequences of minimizing contact with patients in the context of a pandemic when studying hospital pediatrics. A well-structured logistics of visiting the MASC by small groups of students with the use of personal protective equipment is relatively epidemiologically harmless on the one hand; on the other hand, it allows preserving the advantages of "live communication", which was noted by the students themselves during the survey.

However, the deterioration of the epidemiological situation due to the COVID-19 coronavirus pandemic required the transfer of training completely to a remote model. A similar situation has developed all over the world, but it should be considered not only as a period of missed opportunities, but also as an incentive to revise the goals of medical education themselves. [1] It is also shown that the distance education model contributes to the increase of self-discipline, which is necessary for further professional formation and growth. [6] In our study, 9% of students indicated problems with self-discipline, but we assume that they were also insufficiently self-critical and in reality a much larger percentage of students had such problems.

Conclusion

In our opinion, simulation technologies in distance learning of senior medical students harmoniously complement distance learning and can be used in a complex epidemiological

situation. At the moment, we are also developing models of online simulation trainings.The introduction of simulation technologies makes it possible to improve the connection of theoretical material with clinical practice, increase interest in learning and self-discipline.

Acknowledgment

The authors express their gratitude to Professor. Igor Spartakovich Baklanov.

References

1. Nuzhnaya KV, Mishvelov AE, Osadchiy SS, Tsoma MV, Rodin IA, Nagdalian AA, et al. Computer simulation and navigation in surgical operations. Pharmacophore. 2019;10:46-52.
2. Kim KJ, Jang HW. Changes in medical students' motivation and self-regulated learning: A preliminary study. Int J Med Educ. 2015;6:213-215.
3. Li HOY, Bailey AMJ. Medical education amid the covid-19 pandemic: New perspectives for the future. Acad Med. 2020;95:e11-e12.
4. Ya HG, Mishvelov AE, Nuzhnaya CV. New image modeling features for planning surgical interventions. Res J Pharm Biol Chem Sci. 2019;10:140-143.
5. Mallon D, Pohl JF, Phatak UP, Fernandes M, Rosen JM, Lusman SS, et al. Impact of covid-19 on pediatric gastroenterology fellow training in North America. J Pediatr Gastroenterol Nutr. 2020;71:6-11.
6. Rudolph JW, Simon R, Dufresne RL, Raemer DB. There's no such thing as "nonjudgmental" debriefing: A theory and method for debriefing with good judgment. Simul Healthc. 2006;1:49-55.
7. Sahi PK, Mishra D, Singh T. Medical education amid the covid-19 pandemic. Indian Pediatr. 2020;57:652-657.
8. BledzhyantsGA, Mishvelov AE, Nuzhnaya KV, Anfinogenova OI, Isakova JA, Melkonyan RS, et al. The effectiveness of the medical decision-making support system "electronic clinical pharmacologist" in the management of patients therapeutic profile. Pharmacophore. 2019;10:76-81.
9. Razin MP, Minaev SV, Axelrov MA, Tarakanov VA, Svirsky AA, Trushin PV, et al. Diagnosis and treatment of the congenital diaphragmatic hernia in children: A multicenter research. Med News North Cauc. 2019;14:302-308.
10. Minaev SV, Kirgizov IV, Akselrov MA, Gerasimenko IN, Shamsiev JA, Bykov NI, et al. Efficiency of retrieval bags for use during laparoscopic surgery to remove hydatid cysts of the liver. Med News North Cauc. 2019;14:461-465.
11. Demchenkov EL, Nagdalian AA, Budkevich RO, Oboturova NP, Okolelova AI. Usage of atomic force microscopy for detection of the damaging effect of CdCl2 on red blood cells membrane. Ecotoxicol Environ Saf. 2021;208:1-7.
12. Siddiqui SA, Ahmad A. Implementation of newton's algorithm using Fortran. SN Comput Sci. 2020;1:1-8.
13. Salins SS, Siddiqui SA, Reddy SVK, Kumar S. Experimental investigation on the performance parameters of a helical coil dehumidifier test rig. Energy Source Part A. 2021;43:35-53.
14. Siddiqui SA, Ahmad A, Siddiqui AA, Chaturvedi P. Stability analysis of a cantilever structure using ANSYS and MATLAB. 2nd International Conference on Intelligent Engineering and Management (ICIEM). 2021.
15. Nagdalian AA, Rzhepakovsky IV, Siddiqui SA, Piskov SI, Oboturova NP, Timchenko LD, et al. Analysis of the content of mechanically separated poultry meat in sausage using computing microtomography. J Food Compos Anal. 2021;100.
16. Hite GJ, Mishvelov AE, Melchenko EA, Vlasov AA, Anfinogenova OI, Nuzhnaya CV, et al. Holodoctor planning software real-time surgical intervention. Pharmacophore. 2019;10:57-60.
17. Zimmerman T, Siddiqui SA, Bischoff W, Ibrahim SA. Tackling airborne virus threats in the food industry: A proactive approach. Int J Environ Res. 2021;18:1-10.
18. Ayivi R, Ibrahim S, Colleran H, Silva R, Williams L, Galanakis C, et al. COVID-19: Human immune response and the influence of food ingredients and active compounds. BCHD. 2021;4.
19. Cheng A, Lang TR, Starr SR, Pusic M, Cook DA. Technology-enhanced simulation and pediatric education: A meta-analysis. Pediatrics. 2014;133:e1313-e1323.
20. Mishununa VV, Chapanov MM, Gakaeva KI, Tsoroeva MB, Kazanova SA, Gorlova MI, et al. Computed quantum chemical modeling of the effect of nanosilver on coronavirus covid-19. Pharmacophore. 2021;12:14-21.
21. Magomedova UG, Khadartseva ZA, Grechko VV, Polivanova MN, Mishvelov AE, Povetkin SN, et al. The role of Covid-19 in the acute respiratory pathology formation in children. Pharmacophore. 2020;11:61-65.
22. Baturin VA, Grudina EV, Zagrebailova ND, Baturin MV, Fil AA, Fisher VV, et al. Evaluation of IgG-dependent humoral and cellular immunity in persons after covid-19 and in healthy volunteers. Med News North Cauc. 2021;16:27-30.
23. Baturin VA, Kostrovskaya MV, Grudina EV, Baturina MV, Fil AA, Fisher VV, et al. Evaluation of the neurospecific autoantibodies level in patients with COVID-19: Preliminary report. Med News North Cauc. 2021;16:66-68.
24. Lopreiato JO, SawyerT. Simulation based medical education in pediatrics. Acad Pediatr. 2015;15:134-142.
25. Siddiqui SA, Ahmad A. Implementation of thin-walled approximation to evaluate properties of complex steel sections using C++. SN Comput Sci. 2020;1:1-11.
26. Nguyen NQ, Ramjist JM, Jivraj J, Jakubovic R, Deorajh R, Yang VXD. Preliminary development of augmented reality systems for spinal surgery clinical and translational neurophotonics. SPIE. 2017;10050.
27. Bernhardt S, Nicolau SA, Soler L, Doignon C. The status of augmented reality in laparoscopic surgery as of 2016. Med Image Anal. 2017;37:66-90.
28. Baklanov I, Rodionova V, Ivashova V, Shvachkina L, Medvedeva V. Social trends for increasing satisfaction with the educational services of a modern university. Qual-Access Success. 2020;21:88-90.
29. Baklanov IS, Baklanova OA, Shmatko AA, Gubanova MA, Pokhilko AD. The historical past as a factor of sociocultural transformations of postmodernity. J His Cul Art Res. 2018;7:373-378.
30. Salins SS, Siddiqui SA, Reddy SVK, Kumar S. Parametric analysis for varying packing materials and water temperatures in a humidifier. 2020.
31. Siddiqui SA, Ahmad A. Dynamic analysis of an observation tower subjected to wind loads using ANSYS. 2021.
32. Kotsoeva GA, Esiev RK, Toboev GV, Zakaeva RS, Kulova AA, Tsokova LV, et al. Phytoadaptogenic cocktail use "biorithm-e" in the complex treatment of odontogenic inflammatory diseases of the maxillofacial region. Ann Dent Spec. 2021;9:52-57.
33. Blinov AV, Siddiqui SA, Nagdalian AA, Blinova AA, Gvozdenko AA, Raffa VV, et al. Investigation of the influence of zinc-

containing compounds on the components of the colloidal phase of milk. Arab J Chem. 2021;14:1-15.

34. Nagdalyan AA, Oboturova AP, Povetkin SN, Ziruk IV, Egunova A, Simonov AN, et al. Adaptogens instead restricted drugs research for an alternative items to doping in sport. Res J Pharm Biol Chem Sci. 2018;9:1111-1116.
35. Lopteva MS, Povetkin SN, Pushkin SV, Nagdalian AA. 5% Suspension of albendazole echinacea magenta (*Echinacea purpurea*) toxicometric evaluation. Entomol Appl Sci Lett. 2018;5:30-34.