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Distance learning - new educational challenges in the field of emergency medicine

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Abstract

The work presents the process of distance learning in the field of emergency medical services conducted at the Medical University of Wroclaw. The period of the COVID-19 pandemic. The lack of direct education of students and the involvement of staff in the process of treating patients in the pre-hospital process and in infectious wards has opened up new possibilities related to the use of medical staff education through e-learning and virtual medical simulators. Close cooperation was established with hardware and software suppliers. Cooperation was also started with the Wrocław University of Technology and the Military University of Land Forces in Wrocław in the area of creating proprietary tools for learning triage management at all levels of emergency services. Currently available tools in the field of virtual medical simulation offer great didactic possibilities that can be used in the process of educating students of emergency medical services and professional paramedics. The training can take place in VR or PC technology, among others at BLS, ALS or Hospital Emergency Department levels. The cooperation between Wrocław universities led to the creation of the POLTRIAGE project. Its goal is to build a training system based on mobile devices using Wi-Fi and Bluetooth connectivity. Currently, a concept has been developed for its operation at the tactical, strategic and executive levels. It should be mentioned that all the tools described above are used to learn rescue procedures in accordance with the latest guidelines of global organizations. However, they are not a substitute for learning how to perform emergency procedures at the patient's hands.

Keywords: Medical simulation; triage; distans learning; e-lerning

1. Introduction

The key links in the State Emergency Medical Services (PRM) system in Poland are Hospital Emergency Departments (SOR) and Medical Emergency Teams (ZRM). Currently there are 232 SOR and 1541 ZRM ground-based and 21 Air Rescue Teams (HEMS) operating in Poland. In all of the above entities, paramedics play a key role. They constitute the largest share of staff both in the SRD (61% of the total staff employed) and in ZRM and HEMS (89% of the total staff employed). Such a large percentage of paramedics working in PRM obliges the state and medical universities to provide an adequate level of medical training in the field of emergency medicine. Currently, the education process takes place during three-year undergraduate studies. After completing

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education, a diploma awarding the paramedic status is issued. He authorizes him to work in SOR and ZRM as a member of the rescue team. A medical rescuer with at least 5 years of service in PRM may apply for the position of ZRM head. During the education process the student takes classes in clinical sciences, behavioural and social sciences, and takes apprenticeships. The process of educating medical staff is a long-term process that obliges medical universities to provide access to both the didactic base and to evaluate the entire educational process. Only continuous control of the teaching process can increase the competence of medical rescue graduates. A strategy for development of the course should be prepared and didactic tools should be selected appropriately. In this way, continuity of the course will be ensured through the influx of new students and the medical staff in the field of emergency medicine with the highest level of competence for the provision of emergency medical services as well as training in first aid and emergency medical services will be prepared.

1.1. Organizational structure

In order to meet the above requirements, the Medical University of Wroclaw established the Medical Rescue Department, which operates at the Faculty of Health Sciences. It consists of 3 laboratories carrying out exercises in simulated conditions: Laboratory of Innovative Simulation Techniques, Laboratory of Simulation of Medical Emergency Activities and Laboratory of Experimental Medicine and Innovative Technologies. This form of organization of education allows the use of modern teaching tools using its own equipment and premises. The implementation of topics is a supplement to the simulation classes in the centre of medical simulation, in high and low fidelity laboratories. The forms of classes implemented there are also of the nature of credits and exams. It is a recognized form of checking the knowledge of students studying at medical universities.

1.2. Changes during the COVID-19 pandemic

The current situation related to the COVID-19 pandemic forced the state authorities to decide to close medical schools. This was associated with the immediate interruption of teaching and the suspension of all forms of education until new standards of education were developed. Academic teachers were directed to work, thus supporting the work of SOR, ZRM and infectious hospitals. Activities were also undertaken to analyze the possibilities of conducting theoretical and practical classes using the available database, and to create new didactic tools for remote teaching. The activities were aimed at developing a distance learning method and establishing cooperation with other academic centres in Wroclaw. The commercial Webex platform and Big Blue Button (BBB) were chosen for theoretical classes. Both tools give the opportunity to conduct lectures and online seminars using video and audio in real time. In addition, the BBB platform was used in the process of defending theses.

2. Medical simulation

Medical simulation is the latest didactic tool used in the process of educating medical staff. Simulation training has been used much earlier in high-risk areas, such as aviation. Medical simulation is an alternative to patient exercises. The training participant can make countless mistakes without harming the injured person. The above solution finally allows for the expansion of the practical part during studies for medical faculties. It happens many times that students of medical universities have a very good theoretical preparation, but they lack adequate clinical preparation. The capabilities of medical simulators are currently causing major changes in curricula. Medical simulation centers and laboratories for innovative simulation techniques are being established. The simulation itself is a defined set of artificially created conditions that are reflected in real life. These conditions can be influenced and assessed on the basis of certain parameters. An important functionality of a medical simulation is the ability to record it and conduct online debriefing. It is also connected with the possibility of using standardized tools to evaluate the performed activities. Simulation classes also allow you to practice and evaluate students in the field of: team management, stress management or team management. However, it should be strongly emphasized that simulation is a new element in the education process. It cannot replace the actual student-patient contact. However, it is a didactic tool that should be used between theoretical classes and internships in hospital wards. The process of education with the use of medical simulation can be divided into simulation with the use of real simulators or computer simulation with the use of PC and virtual and augmented reality.

2.1. Realistic simulators

Realistic simulators can be divided according to the advancement and the number of possible procedures. The low-fidelity simulator is a device that allows the performance of most often one specific procedure, eg intravascular access, endotracheal intubation, suturing a wound, etc. They cannot be used for comprehensive life-saving procedures. Their structure is most often an imitation of a limb or respiratory tract. The average fidelity simulator usually resembles the entire human body. Procedures that can be performed on the casualty are limited to the level of CPR with the use of automatic defibrillation or treatment of injuries, e.g. wounds. The bleeding, however, cannot be modified in any way depending on the procedures performed. The high-fidelity simulator shows clinical situations in the most realistic way. The simulator can move, sweat, talk with the trainee. A big problem when organizing simulation centres with the above simulators is the high purchase and operating

costs of simulators. You also need an appropriate number of qualified staff for service and debriefing.

2.2. Computer simulators

Computer simulation is based on the human-computer relationship. A desktop computer or software using virtual and augmented reality is used to carry out the tasks. Scenarios allow you to practice events with a large number of injured people. You can also implement basic and advanced life support scenarios. The hardware and software capabilities do not provide full capabilities for the correct performance of individual activities. A realistic environment in which the scenario takes place allows you to practice the execution of individual procedures in accordance with the applicable guidelines. The above tool has its limitations in terms of realism in the performance of medical procedures. However, it is a very good tool in the field of exercises involving the performance of individual activities in accordance with the applicable procedures (BLS, ALS, TRIAGE). Pre-developed scenarios are assessed automatically after their completion. This tool is cheaper, requires fewer staff and can be used in the remote learning process with the appropriate equipment.

3. Distance learning at the Medical University of Wroclaw

The Laboratory of Innovative Simulation Techniques has been appointed to prepare classes implementing practical educational effects in the field of emergency medicine. The centre was to divide the work into two stages: Stage 1 - classes conducted remotely and Stage 2 - classes conducted using the "master-student" technique while maintaining the sanitary regime. For the first stage, stations with virtual reality (VR) PCs were used [6]. They consist of graphics stations equipped with eighth generation i5 processors, GTX 1060 graphics processors, 16 GB RAM and the Windows 10 platform. In addition, each workstation is equipped with headphones with a microphone and an Oculus Rift S set. Cooperation with the software developer and the World platform has been implemented of Rescue. The platform consists of an instructor panel and a student panel. It can be used to implement scenarios at the level of first aid (BLS, PLS), qualified first aid, medical rescue operations, SOR and triage. An additional tool that can be implemented with the help of the platform is receiving HEMS in the contingent area. The instructor has the ability to create a virtual world by placing in it various threats hindering the completion of the mission by a rescuer trained at the appropriate level. It also has an impact on the number of victims participating in a given event. It can determine basic life parameters such as: consciousness, number of breaths, pulse quantity and quality, capillary recurrence, bruising of skin coatings. In addition, in more advanced scenarios at the level of medical rescue operations and SOR there are a whole series of additional parameters that can be changed depending on the condition of the injured party: saturation, laboratory results, electrocardiogram printout (ECG), X-rays, CT and many others. The basis of each scenario is to create a timeline. The instructor places key actions related to the injured party on it. In this way, it is possible to determine the time, e.g. of cardiac arrest in an injured person. Each scenario created underwent a two-stage substantive and technical control to meet all the requirements of distance learning requirements and in the "student-master" relationship. The entire project was monitored continuously for the correctness of the didactic tool used. The tool does not give the possibility to change the exercised scenario during its duration. All dependent data should be entered in the instructor panel. Depending on the student's actions, the injured person's condition changes, forcing further rescue actions. An important teaching tool is the possibility of conducting debriefing immediately after the end of the scenario. The student and the instructor receive information about the performed therapeutic procedures and about the time of their implementation. Activities are classified in categories: carried out correctly on time, carried out correctly outside the prescribed time and not carried out. Critical errors are indicated separately, which would lead to death for a real victim. All the above-mentioned scenarios can be carried out using the PC in both singleplayer (SP) and multiplayer (MP) versions. Communication between students in an MP session is done via chat or voice using headphones with a microphone.

3.1. The #RatownicyRatownikom project (Rescuers to rescuers)

The possibilities of the software were used to carry out the nationwide project #RatownicaRatownikom. The developer has adapted the software in a way that allows its launch and efficient use on computers with an i3 processor, 8 GB of RAM, an integrated graphics card and the Windows 10 platform. The license has been made available to all students of medical rescue. In this way, they could remotely perform tasks on their personal computers. A condition for using the platform was having a stable internet connection. The most common problems reported by platform users were: unstable internet connection and too high software requirements for the software. High marks in the surveys concerned interactive contact with the teacher, online debriefing and the use of modern technology in the distance learning process. It should also be mentioned that the use of the platform was voluntary. 93% of emergency medical students used it. The return of students to practical classes in the "master-student" relationship allowed the implementation of the same scenarios on the VR platform. Silicone goggles and controllers were used, which were disinfected after each use. The Heli VR module was implemented, which was to prepare for the adoption of a rescue helicopter in a contingent area. The results of surveys conducted among students

coincided with the layers collected during the evaluation of the World of Rescue tool by employees of the Medical University in Wrocław. The main disadvantage indicated in the evaluation survey was the inability to establish physical contact with the injured person, which significantly hindered the rendering of realism and the involvement of the exercisers. When assessing the implemented program #RatownicyRatownikom, a survey was conducted among the participants of the project. The Likert scale was used for closed responses (range 1-5, where 1 is very bad and 5 is very good). In open-ended questions, a short written answer was asked. The key questions and answers are presented in the table 1 and 2.

Table 1. Closed questions

Closed questions	1	2	3	4	5
How do you rate the medical simulation program?	0%	0%	0%	4%	96 %
How do you rate the substantive support of the teacher?	0%	0%	5%	10%	85%
How do you rate the program's ease of use?	0%	10%	0%	12%	78%
Have the e-learning classes improved your knowledge?	0%	0%	0%	0%	100%
Did the e-learning classes improve your skills?	10%	25%	40%	10%	15%
Should medical simulation classes be permanently introduced into the curriculum?	0%	0%	0%	10%	90%

Table 2. Open questions

Open questions	Answers
List the biggest problems when using from the medical simulation program (most common answers)	1. No internet access. 2. Poor internet connection 3. No computer 4. Poor computer parameters 5. No direct contact with the teacher

3.2. POLTRIAGE project

Another activity undertaken by the Laboratory of Innovative Simulation Techniques was obtaining a grant for young scientists. Its purpose is to create a platform for learning to manage and conduct triage at various levels of competence using mobile devices capable of sending data in the GSM, WiFi and Bluetooth technologies. After positive consideration, the project received the name POLTRIAGE. Experts from the Wrocław University of Technology and the Academy of Land Forces in Wroclaw were invited to cooperate.

The starting point was to define the tasks and competences of people involved in rescue operations during the mass incident and disaster. The strategic level covers the activities of the crisis staff - it is the highest level of rescue operations. The tasks of the crisis staff include providing all emergency services with the necessary amount of forces and resources that are needed for good organization and operation at the scene of an accident. Other tasks of the crisis staff also include: supervising the evacuation of victims, ensuring psychological and social assistance to event participants, providing information to the mass media. Tactical level is the work of the action staff that operates at the scene of the event. The tasks of the tactical level include controlling the work of all emergency services at the place of the incident, constant communication with the crisis staff and recognizing current needs at the place of the incident. The coordinator of medical emergency operations is the head of the emergency medical team who first came to the scene. His task is to familiarize himself with the situation at the scene of the incident and notify the dispatcher of the mass accident procedure. In this situation, the algorithm is very helpful, which determines:

1. Number of victims and number of victims,
2. Threat which is at the scene of the accident,
3. Way to get to the place of the incident,
4. Where is the event, location, access roads,
5. Recognition of the type of event,
6. Specify actions that have been taken, start saving time.

The executive level is the last level, which consists in the work of all emergency services at the scene of the event, i.e. all doctors, paramedics, nurses, fire and rescue units. After defining the tasks at each level, a training system diagram was created based on mobile and stationary devices. At the initial stage of training with the POLTRIAGE system, victims will be replaced with smartphones. They will generate a "lifeline" (LL) read by the mobile device of the triage rescuer. After reading vital signs, the rescuer will give the injured the appropriate priority of evacuation. This information will be transferred to the tablet of the coordinator operating at the tactical level and the dispatcher making decisions at the strategic level. The medical dispatcher will be able to dispose of available ZRM and HEMS and instruct the coordinator of rescue operations at the tactical level to which SOR is to be directed to individual victims. The instructor using his mobile device will be able to interfere at any stage with the collected data at individual levels. By introducing emergency situations, he will be able to monitor the behaviour of high-stress rescuers. All data will be saved and analyzed during debriefing organized immediately after the exercise. Individual data transmission technologies and their reliability will also be analyzed, e.g. in difficult to access area. The POLTRIAGE project is currently in the concept phase. In September 2020, work related to software development and the possibility of its implementation on mobile devices will begin. The results of the above work will be published in a scientific journal.

4. Conclusions

Training medical rescuers in Poland is a key task for medical universities. They constitute the largest percentage of personnel employed in the PRM system. The situation related to COVID-19 forced the Medical University of Wrocław to change the teaching system by introducing distance education. The biggest challenge was the introduction of techniques enabling the implementation of practical learning outcomes. One remote access to the virtual medical simulation platform was a possibility of this task. The biggest diagnosed problems while using the platform were: unstable internet connection, too high hardware requirements and lack of access to a computer and the Internet. It is a big challenge for all universities how to provide the necessary tools to each student for the implementation of distance learning. The biggest advantages of this system include constant contact with the teacher, interactive debriefing and a standardized system of assessing the person exercising. The pandemic period is also an intensive search for new didactic tools in remote education. Cooperation was established with technical and military centres to create the POLTRIAGE system. All the tools presented in the work relate to work in front of the screen. At each stage of the work, an expert in ergonomics was used, who pointed out possible threats, among others for eyesight and corrected assumptions made by the research team. To sum up, the creation and implementation of modern teaching techniques in the field of emergency medicine in the remote process requires the cooperation of many specialists in the fields of medical, technical, military and ergonomics.

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