ORIGINAL ARTICLE

SIMULATION TRAINING AND VIRTUAL PATIENTS AS A COMPONENT OF CLASSROOM TRAINING OF FUTURE DOCTORS UNDER COVID-19 CONDITIONS

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ABSTRACT

The aim: To present and substantiate the theoretical and applied aspects of the organization of simulation training for higher education applicants in the field of health care based on the analysis and generalization of the experience of the Bogomolets National Medical University.

Materials and methods: To perform the set tasks, the following theoretical and empirical methods of scientific research were used: system analysis; comparison and generalization; bibliosemantic method; the analysis and simulation methods.

Results: The experience of organizing simulation training for higher education students in the field of health care was analyzed and summarized. There have been investigated the functional capabilities of the most common "virtual patient" modeling systems for the formation of the practical component of the future doctors' professional competence. Finally, the features of the organization of the educational process at a medical university in classroom, mixed (classroom-distance) and synchronous (hybrid) forms of education during the period of quarantine restrictions have been described.

Conclusions: A technology for conducting an objective structured practical (clinical) exam has been developed. It helps to standardize the procedure for checking the level formation of the clinical professional competence of a future doctor in accordance with the requirements the standard of higher medical education. It is shown that the use of simulation training and modeling systems "virtual patient" in the preparation of future healthcare professionals increases the effectiveness of training, the interest of students and interns, motivating them to develop the necessary components of the future doctor's professional competence.

KEY WORDS: distance learning, simulation training, virtual patient, objective structured clinical exam (OSCE), special competence

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INTRODUCTION

During the current COVID-19 pandemic, many national medical (pharmaceutical) institutions of higher education (M(Ph)HEI) are facing a number of challenges related to the organization of the educational process under quarantine restrictions and to the need for ensuring the quality and accessibility of higher medical (pharmaceutical) education. The problems of shaping the practical component of the professional competence for future doctors are therefore of particular relevance.

There is the recent normative content of training in terms of learning outcomes, which highlights the list of mandatory general and special competencies of a graduate in the standard of higher education that was approved within the "222 Medicine" specialty for the second (master's) level of higher education [1]. It is noted that students should study clinical disciplines and learn professional competencies at clinical departments of the educational institutions (using simulation methods, diagnostic equipment, etc.) and directly at the patient's bedside.

The system of organization of the educational process and the development of various aspects of the methodology for teaching clinical disciplines to future healthcare professionals is the subject of research by local and foreign teachers. Thus, the paper [2] presents the approaches to organizing training in radiation diagnostics for future doctors using modern cloud services. In the publication [3], the team of authors defines the correct conditions for modern educational environment of a higher medical (pharmaceutical) institution. The paper [4] presents the approaches to organizing teaching biostatistics of future physicians in the context of the introduction of a new curriculum. The works [5, 6] reflect the principles of formation and structure of the simulation training educational and practical center, its role in the assimilation of knowledge and skills in the process of training medical specialists. The papers [7-9] explore the use of "virtual patient" models. The analysis of these works gives grounds for making an assumption about the prospects of using system models as an effective addition to other educational tools in order to consolidate knowledge in clinical disciplines and form the practical skills of a future doctor.

THE AIM

The aim of the article is to present and substantiate the theoretical and applied aspects of the simulation training organization for the applicants for higher education in the

field of health care based on the analysis and generalization of the experience within the Bogomolets National Medical University.

MATERIALS AND METHODS

To accomplish the tasks set, the following theoretical and empirical methods of scientific research were used: system analysis, comparison and generalization for the theoretical substantiation of approaches to the organization of simulation training for future healthcare professionals, bibliosemantic method (for the study of psychological and scientific literature, regulatory documents on the formation of professional competence of future healthcare professionals), empirical methods (interviews with students, interns, and teachers), analysis of the most common "virtual patient" modeling systems for training students of medical HEI, simulation (to develop the structure of the basic concepts of the medical university simulation center).

RESULTS

The organization of the educational process at the Bogomolets National Medical University is undergoing systemic transformations due to implemented quarantine restrictions in March, 2020. Firstly, the university training was carried out distantly, and then – in a mixed (classroom-distance) form of education using the distance learning platform Neuron. Since 2021, it was realized on its own university platform LIKAR_NMU (https://likar.nmuofficial.com/), which is synchronized with automated control system (ACS).

It should be noted that distance learning technologies provide not equal opportunities for forming various components of the professional competence of the future doctors. Most of the difficulties arise in the formation of the practical component of professional competence, namely mastering clinical skills and practicing them on a patient, holding laboratory and instrumental studies, medical manipulations, personal communication with the patient when collecting an anamnesis, etc.

Students are allowed to practice in operating rooms, surgical dressing rooms, manipulation and resuscitation departments of hospitals if they have a document confirming their full course of vaccination or an international, internal, or a foreign certificate confirming vaccination from COVID-19 with a single dose of a two-dose vaccine (yellow certificates), or one dose of a single-dose vaccine or two doses of a two-dose vaccine (green certificates), or a negative polymerase chain reaction test result (valid during 72 hours). If these documents are not available or students are not able to get to the classroom, they have the opportunity to practice their skills in the university simulation center. The specificity of each clinical discipline should be taken into account in the process of developing special competencies, both directly at the patient's bedside and in the conditions of simulation classes at the department and simulation centers.

In the process of studying medical disciplines, it is compulsory to conduct training of clinical skills and constant monitoring of learning special competencies. The latter are defined in the relevant educational and professional programs (EPP) with the involvement of simulation teaching methods for at least 20% of the academic hours allocated in the working curriculum for practical classes during the current academic year. As shown by the authors in work [5], the simulation form of training is optimal for mastering the tactics of providing emergency and urgent medical care with scenario development in the emergency room and the cardiopulmonary resuscitation room.

Summarizing the practical experience and the results of the study of scientific sources, it is possible to define the main tasks of simulation training:

- ensuring the process of forming the practical component of the professional competence of students for higher medical education in simulation centers;
- shaping communication skills, comprehending the sequence of stages of the algorithm for providing medical care;
- formation of principles of work in a team;
- the use of phantoms (imitation models) in order to increase the level of learning theoretical material and mastery of practical skills;
- debriefing — the discussion of implementing scenarios, analysis of the team's actions (communication and interaction in a team, decision-making processes, the role of the leader, distribution of tasks, etc.);
- control of the completed educational material using tests, as well as with the use of computer simulation programs.

At present, one of the promising teaching technologies focused on the formation of practical component of the future doctors' professional competence is a range of modeling systems under the common name "virtual patient".

The results of the analysis of scientific works suggest that "virtual patient" simulators allow modeling the behavioral patterns of a future doctor and providing cognitive activities in several aspects [7]. First, it is an interception, that is the perception of a physiological phenomenon (e.g. symptoms), its interpretation and memorization. The next important aspect is decision making, that is the student's activity in solving a specific case with specific virtual patients and the characteristics of their physical and mental state. Another aspect is the formation the communicative component of the future doctors' professional competence, the perception of the patient's natural speech, understanding and correct interpretation of the doctor's communication with the patient. Moreover, the last but not the least important aspect is the receipt by the system of new knowledge, medical terms and phrases from the user and the formation of a certain ontology, the definition of concepts and their organization.

The example of a modeling system that has a multifunctional didactic potential for use in the process of professional training of future doctors is the *Body Interact* virtual patient simulator [10], running on the Body Interact Studio platform with educational process management capabilities. Using this simulator enables performing a physical examination of a virtual patient, monitoring changes in

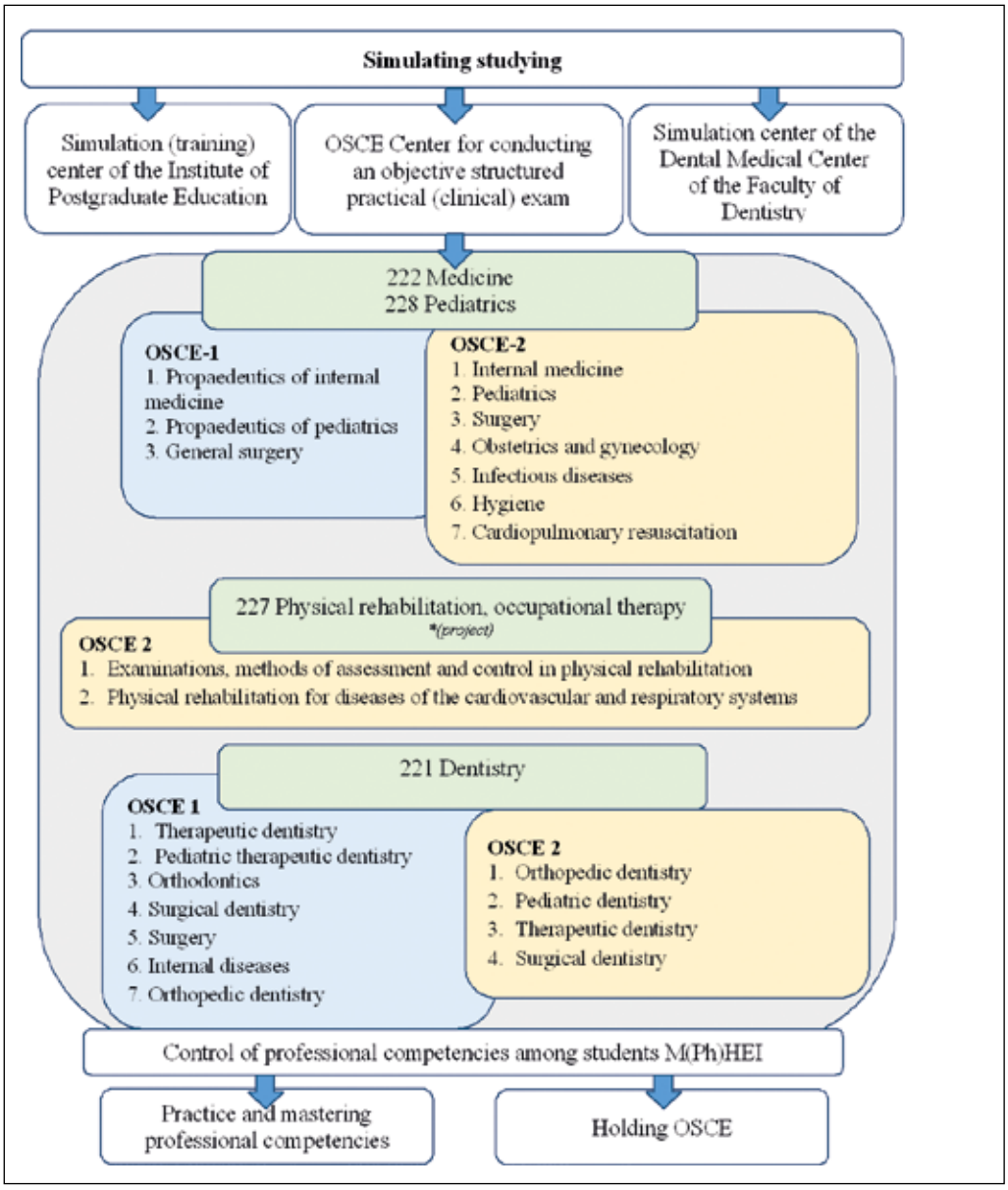

Fig. 1. Scheme of simulation training of Bogomolets National Medical University

their condition in real time, performing medical manipulations, and tracking reactions to treatment, thereby creating opportunities for improving diagnostic skills and decision making in various clinical cases.

Another widespread system for modeling a virtual patient is Academix3D [11] with a detailed description of the classification, pathogenesis, anamnesis, complaints, examination, symptoms, methods of diagnosis and treatment. The system includes the following seven sections: cardiology, pulmonology, nephrology, gastroenterology, endocrinology, rheumatology, and hematology. Similar to the previous simulator, it is possible to perform various manipulations with the patient (laboratory tests, diagnostic procedures, medical manipulations, etc.).

The organization scheme of Bogomolets National Medical University simulation training is shown at the Figure 1. Such organization is implemented in the simulation (training) center of the Institute of Postgraduate Education, the simulation center of the Dental Medical Center of the Faculty of Dentistry and the OSCE Center for conducting an objective structured practical (clinical) exam.

DISCUSSION

Establishing the level of formation of the student's clinical skills in accordance with the requirements of the higher education standard is done on the basis of grades obtained after passing a sequential chain of specially equipped standardized places (stations), where various clinical situations are simulated, allowing to check the individual elements of the practical component of professional competence. For the formation of a comprehensive assessment, the method of objective structured clinical examinations (OSCE) is used, which have been practicing at Bogomolets National Medical University since 2018.

To pass the exam, the students must go through specially equipped places (OSCE stations), where, for a short period of time (5-20 minutes), they have to interact with a clinical

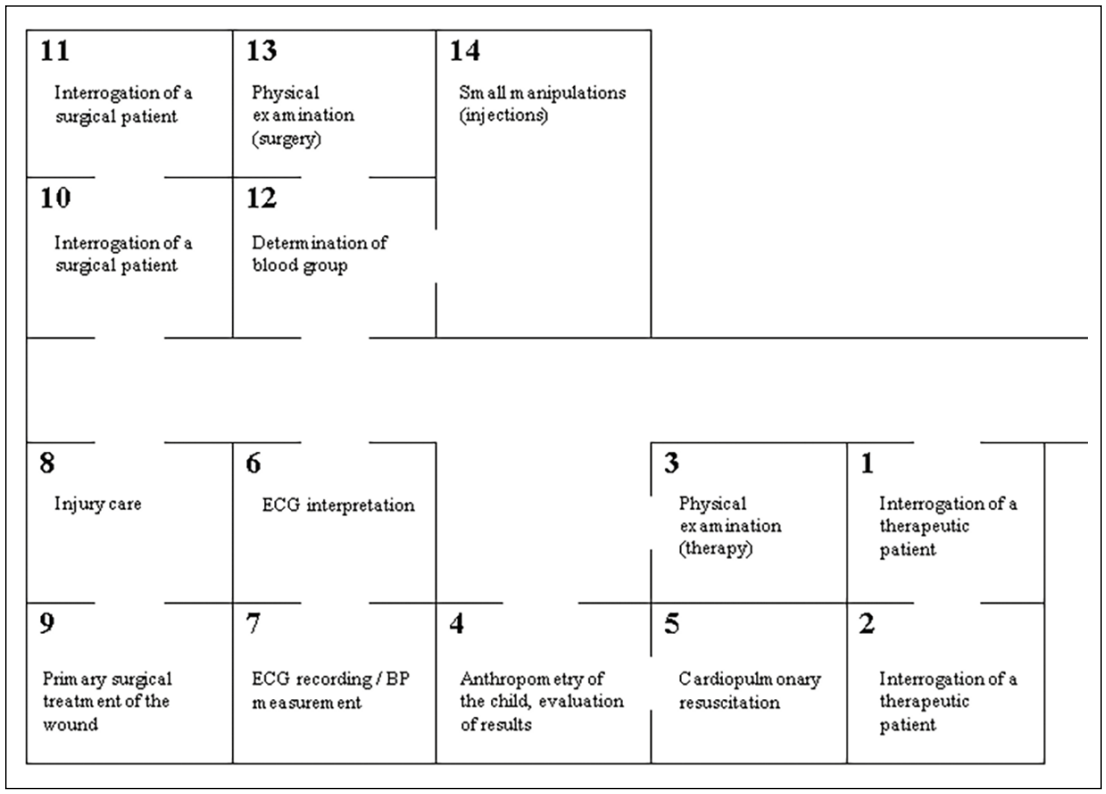

Fig. 2. Scheme of placement of stations for OSCE-1 of 222 medicine and 228 pediatrics specialties

task (OSCE-1) or a clinical situation (OSCE-2) according to a standardized scenario under close to real conditions. Based on the obtained results, the level of formation of the professional competence of the future doctors is assessed. The list of components of professional competence, the verification of which is submitted to OSCE-1 and OSCE-2, is approved at meetings of the relevant cyclic methodological commissions based on the current standards for training specialists and medical care. The departments prepare the methodological support of the OSCE: station passports (containing information about the general format of the station), accommodation and equipment, the process duration, instructions for students, instructions for teachers, instructions for standardized patients, visual materials, algorithm for performing a clinical task, and checklists.

For example, for OSCE-1 (Figure 2), which is based upon third-course students of 222 medicine and 228 pediatrics specialties, 14 rooms are used (where 12 therapeutic, pediatric, and surgical stations will be deployed among them).

Here are these stations in more detail:

THERAPEUTIC PROFILE – 5 STATIONS:

1. Questioning of the patient of therapeutic profile.

2. Physical examination of a therapeutic patient (student demonstrates one of the following professional competencies: pulse study, palpation of apical impulse, determination of relative dullness of the heart, auscultation of the heart, comparative percussion of the lungs, lung auscultation, deep sliding palpation of the sigmoid colon, deep sliding palpation of the liver).

3. ECG registration. Blood pressure measurement.

4. Interpretation of the ECG (student receives one standardized ECG from the following list: sinus tachycardia, sinus bradycardia, atrial fibrillation, atrial flutter, ventricular arrhythmia, atrial extrasystole, atrioventricular first-degree blockade, intranasal blockade, tunicular fibrillation, myocardial infarction).

5. Cardiopulmonary resuscitation.

PEDIATRIC PROFILE – 1 STATION:

1. Anthropometry of the child.

SURGICAL PROFILE – 6 STATIONS:

1. Questioning the patient of surgical profile.

2. Physical examination of a surgical patient (student examines a standardized patient who has one of the following symptoms of clinical situations: pain in the right iliac region, pain in the left iliac region, pain in the epigastric region, or pain in the right hypochondrium).

3. Small manipulations (student demonstrates skills of one of the following manipulations: intravenous, intramuscular, or subcutaneous injection).

4. Determination of blood groups by the AB0 system using coliclons.

5. Primary surgical treatment (PST) of the wound (two options: a cut wound received 2 hours ago or inserting and removing a nodal suture).

6. Injury care (one of the following options: stopping arterial bleeding with a tourniquet, stopping arterial bleeding with finger pressure on the artery, stopping venous bleeding with a bandage, immobilization of the upper and lower extremities with a pneumatic splint, applying a splint bandage in open pneumothorax).

For a student, the minimum percentage of points at each OSCE-1 station to pass the exam is 70%. There are also stations with red flags required to pass the exam, namely "Trauma" and "Cardiopulmonary resuscitation (CPR)". Without

successful completion of these stations, the exam cannot be passed by a student. The OSCE-1 exam is considered passed if a student has successfully gone through more than 9 stations (including two red-flagged ones) out of 12 [12].

The OSCE-2 exam is taken at the end of the 6th year (semester 12) under the conditions that are as close as possible to real clinical situations. Therefore, in the process of doing a therapeutic unit, the students solve tasks from the four stations, where specific clinical situations of a therapeutic kind are imitated. Here is an example of a general instruction that students receive while dealing with a therapeutic unit of the exam.

1. You open the therapeutic unit (consisting of 4 stations) dedicated to one nosological issue.
2. Greet those present.
3. Show an individual letter of passing the OSCE-2 stations.
4. Do not use non-regulated technical means.
5. Interview the patient (station 1).
6. Do a physical examination (using a suggested version of clinical competence), provided that you have previously completed the preparation of hands for the study (washing with soap; if necessary, treat your hands with an antiseptic) and analyze the proposed results of the physical examination (station 2).
7. Interpret the proposed results of laboratory and/or instrumental research methods, establish and formulate a preliminary diagnosis (in written form), select four most informative ones, and minimally necessary laboratory and/or instrumental research methods in order to confirm the diagnosis in a specific clinical situation (station 3).
8. Write a treatment plan for a patient according to the proposed clinical diagnosis with the definition of tactics, the appointment of non-drug and drug therapy (up to four most important drugs): indicate the group of drugs and write out prescriptions using international (non-proprietary) drug names (in Latin) indicating doses, ways in multiplicity reception, and (if necessary) the duration of treatment (station 4).
9. Finish each station at the sound signal.

The clinical situation, the variant of which deployed in the therapeutic unit, changes after two examination cycles (4 examination cycles take place in one day, each of them involves 13 students). This system helps to avoid disclosing information about the exam situations. The passing of one station takes 5 minutes (a unit contains from one to four stations), which allows to pass all the exam stations during a single 75-minute exam cycle,

CONCLUSIONS

Based on the generalization of experience, the main tasks of simulation training have been established. They are to ensure the process of forming the practical component of the future doctors' professional competence. Next, the technology for conducting an objective structured practical (clinical) exam has been developed. It helps to standardize the procedure for checking the level formation of the future doctors' clinical professional competence in accordance with the standard requirements to higher medical education.

The analysis of the didactic potential of "virtual patient" modeling systems and respective approaches to the organization of the educational process was carried out. It was demonstrated that the use of simulation training and "virtual patient" modeling systems increases the effectiveness of training, the interest of students and interns during their preparation as future healthcare professionals. Thus, it motivates them to develop necessary components of their professional competence as future doctors.

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The Authors declare no conflict of interest.

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