AVRAMENKO M.O.,
Ph.D. of Pharmaceutical Sciences,
Associate Professor,
Acting Rector of Zaporizhzhia State Medical University,
Zaporizhzhia, Ukraine
FURYK O.O.,
Ph.D. of Medical Sciences,
Associate Professor, Infectious Diseases Department,
Zaporizhzhia State Medical University,
Zaporizhzhia, Ukraine

EXPERIENCE OF IMPLEMENTATION OF D-PBL METHODOLOGY WITH VIRTUAL PATIENTS AND MEDICAL ERRORS IN SURGERY AT ZAPORIZHZHIA STATE MDICAL UNIVERSITY

У статті наведені дані щодо впровадження методу D-проблемно-орієнтованого навчання з використанням віртуальних пацієнтів з медичними помилками в хірургії в рамках проекту «TAME: навчання на медичних помилках». Навчання студентів у безпечних умовах за методикою D-PBL з використанням віртуальних пацієнтів з медичними помилками в хірургії сприяло підвищенню рівня знань з дисципліни ($p<0,01$) й субтесту «Хірургічний профіль» державного ліцензійного іспиту «КРОК-2» ($p<0,05$), проти результатів студентів контрольної групи. При порівняльному аналізі за гендерною ознакою виявлено, що студенти II групи (жіночої статі) мали вищі ($p<0,01$) результати від I групи з державного ліцензійного іспиту «КРОК-2» та субтесту «Хірургічний профіль» ($p<0,05$). У майбутній професійній діяльності це стане основою запобігання медичних помилок, зменшення шкоди та підвищення загального рівня медико-санітарної допомоги.

Ключові слова: *проблемно-орієнтоване навчання, медичні помилки.*

В статье приведены данные по внедрению метода D-проблемно-ориентированного обучения с использованием виртуальных пациентов с медицинскими ошибками в хирургии в рамках

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проекта «TAME: обучение на медицинских ошибках». Обучение студентов в безопасных условиях по методике D-PBL с использованием виртуальных пациентов с медицинскими ошибками в хирургии способствовало повышению уровня знаний по дисциплине (p <0,01) и субтеста «Хирургический профиль» государственного лицензионного экзамена «КРОК-2» (p <0,05), против результатов студентов контрольной группы. При сравнительном анализе по гендерному признаку выявлено, что студенты II группы (женского пола) имели более высокие (p<0,01) результаты от I группы по государственному лицензионному экзамену «КРОК-2» и субтесту «Хирургический профиль» (p <0,05). В будущей профессиональной деятельности это станет основой предотвращения медицинских ошибок, снижения вреда и повышения общего уровня медико-санитарной помощи.

Ключевые слова: *проблемно-ориентированное обучение, медицинские ошибки.*

The article presents data on implementation of D-Problem-Based Learning method using virtual patients with medical errors in surgery as part of the TAME: Training Medical Against Error project. Training students in a safe environment using the D-PBL method with virtual patients and medical errors in surgery contributed to athe improving of level of knowledge in the discipline (p <0.01) and results of the sub-test "Surgical profile" of the State Licensing Examination KROK-2 (p <0,05), in comparison with the results of control group students. A comparative analysis by gender showed that students of the 2nd group (female) had higher (p <0.01) results compared to the 1st group on the state licensing examination "KROK-2" and sub-test "Surgical profile" of the State Licensing Examination KROK-2 (p <0, 05).In the future medical career it will become the basis for avoiding medical errors, limiting further harm and improving overall health-care safety.

Key words: *Problem-Based Learning, virtual patients, medical errors.*

Due to the development of the labor market, general cultural and educational level of the population of the Earth, the introduction of a model of credit technology of training and multi-level education an issue of preparation of professionals who would not only be well-informed, but could also develop scientific and technological progress to resolve urgent problems of society and meet its requirements

appeared. In order to achieve this goal, a methodology of problem-based learning was developed in the higher education system [1].

For the first time the problem-based learning was used at the universities of Canada and Australia in the late 60's of the twentieth century [2]. It took more than twenty years to create the required techniques and materials. The real implementation of problem-based learning was possible only from the early 90's of the twentieth century and it has been most successfully used in medical education. Currently, more than 80% of medical schools and universities in the United Kingdom, the United States, Canada, and Australia use the methodology of problem-based learning [3]. Today, some Ukrainian medical universities are doing their first steps towards the implementation of problem-based learning.

Problem-Based Learning or PBL is a special pedagogical strategy with its own style of knowledge delivering, which enables a complex mastering of the problem with deep, active, sustainable contextualized covering of material of real life situations, with maximum use of evidence-based global information resources [4].

Medicine is one of those areas of knowledge where problem-based learning methods can be most useful. Taking in account the peculiarities of problem learning, it is most effective in those areas of knowledge where cognitive activity, the constant enhansement of the theoretical and practical knowledge, as well as the time of problem solving, self-confidence and independence are important. A modern medical university strives for the training of competitive international experts who possess the skills of non-standard critical thinking and ability to act independently. This method is intended to stimulate the study of traditional fundamental disciplines from the clinical point of view. It also emphasizes the application of the principles of basic science to clinical situations [5].

One of the types of problem-based learning is D-PBL (Decision Problem-Based Learning), requiring special methodological support - Virtual Patients (VPs). VPs are a training toolkit for developing clinical decision-making skills and improving clinical competence developed basing on real situations by a special group of academic staff [6].

The main differences between problem-based learning and traditional way of learning are a forming of small groups of students (6-8 students each) and organization of classes in such a way that students should formulate the questions they need to solve the VPs independently and find answers to them as a result of the search for relevant information and joint-discussion. The main objectives of VPs withing the D-problem-based learning are to teach students to formulate a sequence of study objects to solve a specific problem, to develop the skills of self-collecting the necessary information, to teach the ability of joint-discussion of the problem and joint decision-making, to prepare for work in a team.

Classes conducted within the D-PBL approach are divided into 2 parts. At the first tutorial, students get acquainted with the situation, formulate hypotheses and learning objectives. At the first stage, students receive general information and a brief description of the current case (complaints, anamnesis, concomitant information about the patient's condition, results of physical, laboratory, and instrumental examinations). As a result of consideration, brainstorming and discussion, students must formulate possible hypotheses that explain thepossible causes of the case. All hypotheses are recorded on the board as key information. In the process of discussion students also use boards to record diagrams, graphics, drawings, etc. At the same time, students form new learning objectives, so-called questions for preparation. Gradually, students receive additional information from the tutor, after which students review their hypotheses. After further analysis of the problem and obtaining additional information number of objectives is gradually reduced to three. For the second tutorial, which is organized in a few days, students come with prepared information (independently studied theoretical material), analyze and discuss it with each other. Students must make the final decision after discussing and analyzing all the information received. At the end of the lesson, students get acquainted with the detailed comments made by the VPs' developers regarding possible medical errors.

It should be noted that special classrooms with several boards are used for problem-based learning. This allows storing information in a certain way, wiping out the unnecessary information and replacing it with a new one. In addition, auditoriems are equipped with a computer with free access to the OpenLabyrinth platform, projector, or modern electronic boards.

One of the most important conditions for problem-based learning is the active collaboration of students within a comprehensive study of the problem and the adoption of group decisions. Problem learning is such type of training sessions that involves creating problems under supervision of a tutor and futher active independent activity of the students on their solving, which leads to creative mastering professional knowledge, gaining skills and developing mental abilities. Setting a problem when considering a clinical case allows students to determine the area of knowledge required to solve the situation. The task of a tutor is to guide students to determine the boundaries of this area, beyond which their competence is limited, and problem issues arise [7].

The main aspects of problem-based learning are 1) relevance due to the need for active participation in complex projects that ensure the development of abilities, creative thinking and independence of students, the use of their acquired theoretical knowledge and practical skills and abilities; 2) the interdisciplinary nature of learning that is connected with the constant need for students to use the knowledge gained during the study of various disciplines in order to accomplish

tasks and solve problems effectively; 3) complex problem solving, which involves setting up and joint research of difficult problems, analysis and generalization of the material studied and collected independently in order to find the optimal path and to identify possible solutions to the problem; 4) motivating character of the training, aimed at developing the interest of students in the educational process, their needs for constant self-improvement, self-education by giving them the right to choose, the ability to control the process and collaborate with groupmates themselves; 5) credibility and realistic character of training, which are demonstrated within implementation of such projects that are of great nterest for modern society, science and education; 6) the mood for cooperation, due to the need for joint performing of tasks, the solving of complex tasks, the establishment of partnerships with a tutor; 7) a positive mood arising from the stimulation of cognitive activity of students, giving them freedom of choice and independence [13]. When performed a case, the student should be able to: 1) clearly formulate the problem for study and analysis of; 2) to suggest hypotheses; 3) make a plan of work and necessary procedures; 4) collect, summarize and systematize the material, taking into account own experience, observations, conclusions, inferences, level of theoretical and practical knowledge; 5) compare the obtained data in order to verify their reliability, validity and logic nature; 6) issue in oral and written forms the results of their research; 7) answer the questions settled; 8) critically re-think the conclusions obtained during the discussion in the classroom [8].

There is no doctor who would not make mistakes. From a legal point of view, medical errors include the false actions of a doctor in establishing a diagnosis or treatment of a patient due to the level of medical science at this stage of its development, the special, unfavorable conditions and circumstances of the provision of medical care or the lack of medical experience, made in the absence of awareness of danger, without foreseeing of causing harm or with confidence in preventing it [9, 10]. Work on the analysis and elimination of errors should become the norm of medical self-improvement [11].

That is why, in the framework of the TAME: Medical Error Education (Erasmus + 561583-EPP-1-2015-1-KZ-EPPKA2-CBHE-JP (2015-2944 / 001-001) project, realized during the period of 2015 - 2018, virtual patients with medical errors were used. The main task of the project was not only to introduce a new method of pedagogy, but also to develop 6 virtual patients (brunch) using medical errors in surgery [12].

To realize the project during 2016-2018 academic years a database of Virtual Patients of surgical direction with medical errors was developed, the academic curriculum was modernized and elective course for 32 students of the 6th year of the specialty “General Medicine” was implemented. For the training of the students

the D-BPL methodology with branch cases (Virtual Patients) was used. For analysis the students were divided into 2 groups: 1st group consisted of 14 male students and 2nd group was formed by 18 female students. Other 12 students who were taught traditionally formed the control group. The statistical analysis was conducted on the PC using the students' database (both branch and control groups) in the software application «STATISTICA® for Windows 6.0» (StatSoft Inc., № AXXR712D833214FAN5). A non-parametric statistical method - Mann-Whitney U test (for quantitative attributes) was used to measure the reliability of the difference among two independent samples.

The training in the frames of "Training on medical error in Surgery" elective course lasted 6 weeks and included 48 hours for classwork (36 hours for tutorials and 12 hours for lectures) and 72 hours for independent work (120 hours in total).

Before the beginning of the tutorials the pre-assessment was conducted for the students involved to evaluate the initial level of their knowledge in the field of Surgery (36 questions on finding right answer were used), the average index was (56,42%), wherein the index of the students of the 1st group had only a tendency to the highest one and did not reliably differ ($p>0,05$) from the index of the 2nd group (54,93%).

Three months after the tutorials on-line evaluation of students' knowledge was conducted to identify the sustainability of knowledge on Surgery after some period of time. For this reason a test of 36 questions was created (6 questions per one case): 2 single questions for finding the best answer directly related to a case; 2 single questions for finding the right answer related to a disease; 2 open questions connected with the disease (on diagnostics or management strategy). The average results of the assessment (65,34%) were reliably higher ($p<0,001$) than the results of the pre-assessment (56,42%), and also higher than the results of the assessment of students of the control group (the average index 52%). Comparison of the results of the 1st and 2nd groups showed no reliable difference ($p>0,05$), (65,64%) and (65,11%) respectively.

The results of the State Licensing Examination KROK-2 and the rate value of the correct answers of the sub-test "Surgical profile" of the students, who were taught according to the D-PBL training methodology with VPs and medical errors, were also taken into consideration.

Thus, the average result of the 1st and 2nd groups on the State Licensing Examination KROK-2 had only the tendency ($p>0,05$) to the highest result of the control group and measured up to respectively (79,99%) against (77,73%). The comparative analysis showed that the result of the 1st group (76,79%) was reliably lower ($p<0,01$) then the result of the 2nd group (82,49%).

However, the average result of the sub-test "Surgical profile" (80,98%) was higher ($p<0,05$) than the control group's results (75,21%). Wherein, it was found

that the 1st group (77,43%) had a reliable decreasing ($p<0,05$) of knowledge in comparison with the results of the 2nd group (83,75%).

Conclusions: the students were trained in safe environment according to the D-PBL methodology with Virtual Patients and medical errors, and this training contributed to knowledge improvement on the discipline ($p<0,01$) and results improving in the sub-test "Surgical profile" of the State Licensing Examination KROK-2 ($p<0,05$) in the comparison with the control group.

The gender-related comparative analysis showed that the students of the 2nd group (female gender) had higher ($p<0,01$) results to the ones of the 1st group on the State Licensing Examination KROK-2 and the sub-test "Surgical profile" ($p<0,05$).

In the medical practice, it will become the basis for avoiding medical errors, limiting harm and improving overall healthcare safety.

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AVRAMENKO M.O.
Ph.D. of Pharmaceutical Sciences, Associate Professor, Acting Rector of Zaporizhzhia State Medical University, Zaporizhzhia, Ukraine
FURYK O.O.
Ph.D. of Medical Sciences, Associate Professor, Infectious Diseases Department, Zaporizhzhia State Medical University, Zaporizhzhia, Ukraine

E-mail: furyko@i.ua

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