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TRANSFORMATION OF PHARMACEUTICAL EDUCATION: WORLD EXPERIENCE

Summary

Introduction. The article is devoted to the system of higher pharmaceutical education in Europe and the United States of America. This issue is currently very relevant because education plays a key role in ensuring equal opportunities and access to the labor market. Most European countries have implemented and are implementing a system of higher education, which consists in successively obtaining the degrees of "Bachelor", "Master" and "Doctor of Sciences". The peculiarities of pharmaceutical education in Great Britain, Germany, France and the United States of America were considered in detail. The conducted analysis of the training of pharmaceutical specialists in the world made it possible to establish that there is no single curriculum in the training system, the content of the training also has significant differences. Historically, there have been three groups of countries characterized by different approaches to pharmaceutical education. This determines the contradiction of the world practice of training pharmaceutical personnel. There are significant differences in terms, curricula, academic disciplines, etc. At the current stage, transnational standards for the training of pharmacists have not yet been created, which significantly complicates the preparation, recognition of diplomas and qualifications at the international level.

Purpose of the study is to establish whether there are significant differences in the system of training pharmaceutical specialists in Ukraine and the world.

Materials and methods. Analysis of the training of pharmaceutical specialists in the world, based on the study and comparative evaluation of curricula, programs and terms of study.

Key words: *pharmaceutical education, higher educational institution, quality of education, European standards, education standards.*

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ТРАНСФОРМАЦІЯ ФАРМАЦЕВТИЧНОЇ ОСВІТИ: СВІТОВИЙ ДОСВІД

Анотація

Стаття присвячена системі вищої фармацевтичної освіти в Європі та Сполучених Штатах Америки. Це питання наразі є дуже актуальним, оскільки освіта відіграє ключову роль у забезпеченні рівних можливостей та доступу до ринку праці. Більшість європейських країн впровадили і впроваджують систему вищої освіти, яка полягає в послідовному отриманні ступенів «бакалавр», «магістр» і «доктор наук». Детально розглянуто особливості фармацевтичної освіти у Великій Британії, Німеччині, Франції та Сполучених Штатах Америки. Проведений аналіз підготовки фармацевтичних фахівців у світі дозволив встановити, що в системі підготовки не існує єдиного навчального плану, зміст навчання також має суттєві відмінності. Історично склалося три групи країн, які характеризуються різними підходами до фармацевтичної освіти. Це визначає суперечливість світової практики підготовки фармацевтичних кадрів. Існують суттєві відмінності у термінах, навчальних планах, навчальних дисциплінах тощо. На сучасному етапі ще не створені транснаціональні стандарти підготовки фармацевтів, що значно ускладнює підготовку, визнання дипломів і кваліфікацій на міжнародному рівні.

Мета дослідження. Встановити, чи існують суттєві відмінності в системі підготовки фармацевтичних фахівців в Україні та світі.

Матеріали та методи. Аналіз підготовки фармацевтичних фахівців у світі на основі вивчення та порівняльної оцінки навчальних планів, програм і термінів навчання.

Ключові слова: *фармацевтична освіта, вищий навчальний заклад, якість освіти, європейські стандарти, стандарти освіти.*

Introduction. Education and training play a key role in ensuring equal opportunities and access to the labor market [1]. Under such circumstances, qualifications are important, because they can open people's access to better opportunities for development and career growth [2].

Ukraine ratified the Lisbon Convention on the Recognition of Higher Education Qualifications in 2000 and has been a full member of the Bologna Process since 2005. Since then, our country has fulfilled the key obligations of the European Higher Education Area, such as those related to the implementation of the National Qualifications Framework, the European credit transfer and accumulation system, and the quality assurance system. In 2014, Ukraine concluded the Association Agreement with the EU, thereby confirming its European aspirations, which became the root cause of the Revolution of Dignity. The invasion of Russia not only strengthened Ukraine's determination to join the European Union (on June 23, 2022, Ukraine received the status of a candidate for membership), but also proved the relevance of the European Qualifications Framework: in a situation where more than six million displaced Ukrainians found themselves in the EU, understanding Ukrainian qualifications have become more important than ever.

EU and US countries have their own peculiarities of education models, but they have one thing in common - continuity of education. In Europe and the USA, higher education consists of three cycles: compulsory preparatory (undergraduate), basic (professional degree program) and

postgraduate (graduate).

The pharmaceutical personnel of Ukraine, as in most European countries, are specialists with a higher pharmaceutical education who have the qualification "pharmacist".

Most European countries have implemented and are implementing a system of higher education, which consists in successively obtaining the degrees of "Bachelor", "Master" and "Doctor of Sciences". Reforms in this direction are carried out in higher education systems exclusively in universities. The two-level bachelor/master's degree directly leads to the master of science degree and is traditional in many countries. The two-stage structure promotes the development of national and international mobility, as it provides for the modular (block) nature of educational programs. In today's age of lifelong learning, one of the important advantages of the two-stage structure is that it facilitates the combination of study and work.

Purpose of the study. The purpose of the study is to establish whether there are significant differences in the system of training pharmaceutical specialists in Ukraine and the world.

Materials and methods. Analysis of the training of pharmaceutical specialists in the world, based on the study and comparative evaluation of curricula, programs and terms of study.

Results and discussion. Pharmaceutical education in Europe. In most European countries, pharmaceutical specialists are

trained by pharmaceutical educational institutions or pharmaceutical faculties in medical educational institutions. The leading countries in Europe for training pharmaceutical personnel are: Germany, France and Great Britain.

British universities are traditionally considered the best in the world and at the same time the most expensive. Currently, there are about a hundred universities and more than 250 higher education institutions in Great Britain. There are only two private universities in Britain, the rest are public. Higher education is specialized, studying pharmacy at a British university, a student studies only those disciplines that relate to the chosen specialty [3–5].

The first degree of higher education is a Bachelor's degree, which is awarded after three or four years of study in specialized full-time programs in a university or college department. Upon graduation from a specialized pharmaceutical program, a Bachelor of Pharmaceutical Science degree is awarded. From the first year, pharmaceutical practice begins (medical prescription, preparation and distribution of medicinal products, consultation of patients, social aspects of pharmacy). In senior years, students undergo therapeutic practice and clinical pharmacy practice. In the last year, students undergo pharmaceutical practice under the supervision of a personal supervisor, which lasts from 2 to 7 months. After receiving a bachelor's degree, postgraduate education begins, which ends with the award of a master's degree and a doctorate.

There are two large groups of programs for obtaining a Master's degree: the first are focused on research activities, the second

are educational programs from one of the specialties, focused on improving the professional level. Master's study programs are organized as follows: after 8–9 months of lectures and seminars, students take exams, and then complete a diploma project within 3–4 months. The Master of Pharmaceutical Sciences degree is awarded based on the results of the exams and thesis defense. Further, those who want to have their own pharmaceutical practice must complete a one-year internship in public and industrial pharmacy under the supervision of a pharmacist as his assistant, after which the specialist is entitled to a license to conduct pharmaceutical activities. Also, the graduate must pass an exam at the Royal Pharmaceutical Society to confirm professional qualifications.

In order to receive a research master's degree (M. Ph. – Master of Philosophy), it is necessary to conduct independent research work under the supervision of a representative of the teaching staff for 1–2 years. According to the results of the research, the degree of Master of Philosophy is awarded.

Degree programs at English pharmaceutical universities are accredited by the Royal Pharmaceutical Society and cover all the main pharmaceutical disciplines, but there may be some variation in the quantity and quality of subjects taught. The term of bachelor's training is 3 years, master's – 4 years. Professional training is represented by such disciplines as pharmacology, pharmacokinetics, pharmaceutical legislation, drug manufacturing, pharmaceutical supply, clinical pharmacy, modern pharmaceutical sciences, etc.

Most doctoral programs are purely research projects. The scientific supervisor in the laboratory or at the department where the candidate is preparing to obtain a doctor's degree, determines the topic of scientific research for him and provides the necessary conditions for the research (workplace, equipment and materials). It usually takes 2–3 years to complete a research program. By the end of this period, the applicant must publish the obtained results in official reports, in specialized scientific journals and write a dissertation based on the published materials. The degree of Doctor of Philosophy is awarded after the successful defense of the thesis.

The pharmaceutical training of pharmacists in Germany [6, 7] involves 4 years of university study and 8 weeks of practical training, which must be completed during the first cycle of study (after the second year). The curriculum, divided into semesters, gives recommendations on the forms and types of educational classes, the amount in hours. The content of education includes training in inorganic, organic, pharmaceutical and analytical chemistry, biology, mathematics, physics, theory of dosage forms, medical microbiology, pharmaceutical and medical terminology, etc. In the next cycle, students study clinical pharmacy, pharmacology, toxicology, pharmacotherapy, pharmacoeconomics, jurisprudence, quality assurance in the manufacture and control of medicinal products, etc. Students practice their skills and abilities in laboratory, practical classes and training seminars. The purpose of the internship is to acquaint students with various types of activities in the pharmacy, and the university education is complemented

by a 12-month industrial internship. Students do their internship under the guidance of an experienced pharmacist in their spare time. Four weeks of practice are spent in a branch pharmacy, the rest of the time can be selectively spent in one of the institutions: a hospital pharmacy, a pharmaceutical enterprise or a research laboratory.

Pharmacy exams consist of three parts. The first part includes the following subjects: general, inorganic and organic chemistry, the basics of pharmaceutical biology, physics and the basics of pharmaceutical chemistry, the basics of pharmaceutical analytics. The second part includes pharmaceutical chemistry, pharmaceutical biology, drug technology, pharmacology and toxicology. The second part of the exams includes a psychology course. The third part provides control of knowledge, skills and abilities in such disciplines as pharmaceutical practice, pharmaceutical legislation.

Diplomas in Germany which are issued after the end of the study cycles, as, for example, in France, there are none, or they are only a necessary condition for the transition to the second cycle. The main principle of higher education in Germany is academic freedom. The student himself chooses his specialty and independently organizes his study plan based on the general requirements of the given faculty. He himself decides in what order and for which lectures and seminars he should sign up, chooses the time for internships and practice, allocates time to work at his discretion. German doctoral studies are an important component of postgraduate education. The doctoral course in Germany

does not have a generally accepted structure, program and list of mandatory subjects. The doctor's degree is awarded after the defense of a thesis completed under the supervision of a «senior» and passing an oral scientific interview.

In France, the duration of study at pharmaceutical faculties is 6 years for general pharmacy and 9 years for special. Already after the end of the first course, students undergo practice in a pharmacy for 2 months in order to familiarize themselves with professional activities. For the first four years, the student masters the disciplines of fundamental and professionally oriented cycles, including biology, pharmacology, organic and analytical chemistry, hematology, physiology, etc. They also study pharmacy activity, pharmacy and pharmaceutical supply, pharmaceutical law, medicine sciences (pharmacology, pharmacognosy, toxicology, etc.).

It is important to note that the higher education system of France is represented by a system of training specialists of higher and secondary level [8, 9]. More than 300,000 students study in a two-year program with a clear professional orientation. A bachelor's degree obtained at a lyceum is considered the first stage of higher education. Direct university education in France consists of three cycles, each of which ends with taking exams and obtaining a diploma.

The first cycle, in which graduates study after graduating from the lyceum, lasts two years and provides general training. After completing the two-year study cycle, students receive a diploma of general university education. During the second

cycle, which also lasts two years, students receive more specialized knowledge. The first year of the second cycle is called a licentiate – it is the equivalent of the concept of "incomplete higher education". The second year of the second cycle is a master's degree, upon completion of which students receive a Maitrise diploma.

The third cycle of study (we have postgraduate and doctoral studies) is postgraduate education. Students with a master's degree are admitted to the third cycle of study. The first stage (1 year) is the acquisition of higher professional education. At this stage, the student is offered two areas of study. The first is professionally oriented, taking into account specialization, which involves an internship from three months to six months. Upon completion, a diploma of professional higher education is issued. The second is a theoretical-research direction, which ends with receiving a diploma (research diploma) of advanced higher education, which allows its holder to continue scientific work and submit an application for writing a dissertation. The full third cycle of study can last another three years and end with the writing of a dissertation, defense and obtaining a doctoral degree.

The system of training pharmacists in France has its own peculiarities. Pharmacists study longer than students of other faculties – from 6 to 8 years, and stricter requirements are imposed on them. For example, those who did not pass sufficiently difficult exams, do not have the required number of good grades and did not pass the competition are not admitted to the second year. Those who fail the exam are

allowed to retake this course, but only once. Students of the 2nd–4th years undergo an introductory research practice in the directions offered by the educational institution. The student attaches himself to the teacher or scientist who directs his work. The duration of practice is at least 150 hours. The 5th–6th courses are professional education. At this time, students are divided according to the following programs: implementation of medicines in a pharmacy; industrial pharmacy; biology and clinical pharmacy.

In the majority of educational institutions in Europe, the following disciplines are present in the curricula for the training of pharmacy specialists: pharmaceutical management, ethics of pharmaceutical activity, interpersonal communications of health care specialists, pharmaceutical legislation, economics. Students also study such disciplines as evaluation of pharmaceutical literature, which expands knowledge and improves students' skills in pharmaceutical information management; the study of computer databases, Internet resources, as well as Professional Practice Management, including the concepts of financial management, pharmacoeconomics, cost containment strategies, and labor resource management is expected. Students may be offered the opportunity to choose a specialization in one of the areas of pharmaceutical management (community pharmacy, entrepreneurship, drug production, research, pharmaceutical supply management). It is important to note that the curricula of most French universities provide pharmaceutical practice from various directions. Thus, the practice of pharmaceutical business (two lectures and

one class per week) includes the study of the social concept of marketing, analysis and assessment of the state of the enterprise, organization and design of the exhibition, merchandising, consumer behavior, pricing principles, pharmaceutical services, promotion, positioning of the pharmacy, personnel management, drug use reviews, pharmacoeconomics, health care management.

Thus, the systems of training pharmaceutical specialists in the European Union differ in terms, content, number of hours, control and evaluation system, etc.

Thus, the teaching of analytical chemistry in Germany makes up 46% of the teaching time, and in Great Britain – 26%, clinical pharmacology takes up 30% in France and 10% in Germany.

Pharmaceutical education in the United States of America. Each US state has its own requirements for pharmaceutical education, taking into account the specifics of each region. Decisions regarding pharmaceutical education are approved by public organizations of pharmacists, not by the Ministry of Health or the Ministry of Education.

In the USA, you can get a doctor of pharmacy education at a pharmacy college [10, 11]. In this country, it is not legally regulated which higher education institution should be called a university and which should be called a college. Therefore, in pharmaceutical colleges, 4-year study can be both a part of university studies and a separate higher education institution.

It is not possible to enter pharmacy college immediately after school. It is necessary to first complete 2–3-year pre-pharmacy or pre-professional preparatory

courses (preparatory cycle of education). You can take them at any regional technical, municipal (Community Colleges) or junior colleges accredited for this purpose.

Each college of pharmacy has its own requirements for disciplines that must be studied in preparatory courses, therefore, before starting studies, it is important to agree the study program with the one required for admission to the university.

Mathematics and fundamental sciences (chemistry, biology, physics), some social sciences and humanities are usually mandatory subjects for study.

The Pharmacy College Admission Test, which is a multiple-choice test, is divided into 6 sections: verbal abilities, knowledge of chemistry and biology, computational skills, reading comprehension, and two written sections. Except for the last two, all sections consist of 48 questions and work with each of them lasts 30 minutes. You can take the test only 5 times, you need to register yourself on the website. The cost of one attempt in 2016 was \$199. USA.

The main cycle of training involves obtaining a qualification level in accordance with the need for a specialty at the college of pharmacy. Educational institutions in the country train only pharmacists with a single qualification level – doctor of pharmacy (PharmD).

During 6 years of study, students study pharmacology, clinical pharmacy, pharmacognosy, pharmaceutical chemistry, toxicology, pharmaceutical administration, biostatistics, pharmacokinetics and therapy. The main difference from the Ukrainian education system is the possibility of a real choice of disciplines, the formation of an individual curriculum and the study of

modern elective disciplines (autotherapy, nuclear biology, the basics of evidence-based medicine, stereochemistry, pharmaceutical psychology, etc.).

After passing a series of exams and obtaining a basic pharmaceutical education, a pharmacist is awarded the degree of Doctor of Pharmaceutical Sciences (PharmD). But for further work, it is necessary to complete a residency (postgraduate cycle of study), which lasts 1–2 years (depending on the specialization) and consists of practical classes in hospitals, hospital and retail pharmacies and other health care institutions. There are about 400 residency programs in total. Pharmacists who are going to open their own pharmacies will also need to obtain a Master of Business Administration degree. The American Society of Hospital Pharmacists (ASHP) is the accrediting body for hospital pharmacists (except pharmacists who provide medical and social care and retail pharmacy workers). Most residency programs are accredited by ASHP.

But that's not all. In order to get a job, pharmacists need to get a license. This requires passing a series of additional exams and tests, the list of which is determined in each state separately.

The process of obtaining a license is as follows: completion of residency; passing the exam for obtaining a pharmacist's license (North American Pharmacist Licensure Examination – NAPLEX); taking the jurisprudence exam and other exams, which are appointed in each state additionally; after that, the issuance of a license to practice law in the state. NAPLEX lasts 4 hours 15 minutes with a 10 minute break after the first 2 hours of the exam. It

is necessary to score at least 75 points, that is, to answer correctly 162 questions (somewhat similar to the Ukrainian KROC exam).

Jurisprudence Exam – Multi-State Pharmacist Licensing Exam covers aspects such as licensing law, drug law and other regulations in force at the time of the exam and lasts 2 hours. As a result of this exam, it is also necessary to score 75 points by answering at least 77 questions.

In addition, an exam on the management of disease treatment (Disease State Management – DSM) may be prescribed. This is a computer test that determines the level of knowledge according to the standards of treatment of patients with common diseases, such as diabetes, asthma, etc.

Pharmacists must take 40-hour refresher courses every 2 years.

There is also a special postgraduate course for those who wish to study science, which lasts 2–3 years. All the work consists in the performance of scientific work and does not include classes as such. After graduation, it is necessary to defend a thesis, and in case of successful defense, the degree of Doctor of Philosophy (PhD) is awarded, which is equivalent to our candidate of sciences.

What is currently happening in Ukraine? Back in 2011, there were 10 levels in the Ukrainian NRC. In 2017, after the introduction of junior bachelor's and professional pre-higher education qualifications, the eleventh level was added. In 2020, the levels were adapted to the ERC. Although the levels of the Ukrainian NRC are designed with the ERC in mind, they are not exactly the same. The levels of the

Ukrainian NRC are more detailed, and in addition to the categories "Knowledge", "Skills/Skills", "Responsibility/Autonomy", special attention is paid to the category "Communication" in its level descriptors.

Ukraine became the first country to participate in the work on the comparison of qualification frameworks. Our country is unique for many reasons, but especially because of its close ties with the EU. For many years, Ukrainians have been working and studying in the EU, and European companies have been hiring Ukrainians.

Conclusions. Researchers attribute the increase in the need for pharmacists to some factors of social development, such as an increase in the life expectancy of the population, a wide range of drug choices, a greater range of preventive medicines, higher standards of medical care, an increase in the proportion of the elderly population, as well as an increase in research conducted by governments and enterprises of the pharmaceutical industry.

The analysis of the curricula of pharmaceutical faculties of universities in Europe and the USA made it possible to establish that in the system of training pharmaceutical specialists there is no single curriculum and a single appendix to the diploma, and even within the borders of the same country, different curricula may operate. The content of the training of future specialists also has significant differences, and the right decision would be to bring it into line with the recommendations of the Bologna Declaration, to harmonize and unify it with the plans of leading European institutions.

The study of the organization of world higher

pharmaceutical education showed that historically three groups of countries have formed: the first - where chemical sciences are the basis of teaching; the second group - where preference is given to medical and biological disciplines; the third group includes countries where training takes place according to the traditions of the English pharmaceutical school. There are significant differences in terms, curricula, academic disciplines, etc. At this time, there are still no transnational standards for the training of pharmacists, which significantly complicates the recognition of diplomas and qualifications at the international level and necessitates changes to the methodology and methods of training pharmaceutical specialists, the development of a model of specialist training based on a competent

approach, the creation and implementation of an innovative model of continuous professional training of pharmaceutical specialists.

Prospects for further research. We see the prospects for further research in the study of the transformation of pharmaceutical education in Ukraine. The results that will be obtained will allow to avoid mistakes and serious disagreements in bringing curricula and programs to a single transnational standard and recognition of diplomas and qualifications of Ukraine at the international level.

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