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Pharmacy Learning and Information: Progression of Pharmacy Learning Data of Specialty in Science

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ABSTRACT

Pharmaceutical learning plays an important role for the education and health care system of the country and the world, because errors related to the action of medicines can sometimes be fatal. Pharmaceutical education programs are regulated at the legislative level and require constant improvement to solve problems of modern society. Our research is aimed at determining the main principles of modern pharmacological education in Ukraine and Europe. According to the literature, a paradigm shift in the training of pharmacists from a production direction to a patient-oriented model has been determined. In accordance with this paradigm, the competencies and skills that must be mastered while studying in pharmaceutical schools have been formed such as: flexibility, communication, analytical and critical thinking, ethics, the ability to learn quickly, etc. In order to achieve competitive competencies, educational programs should be student-oriented, teachers should be creative and highly qualified, and educational institutions should be provided with a sufficient level of material and technical support.

KEYWORDS: Integration of Pharmaceutical Education, Pharmaceutical Studying Programs, Patient-oriented Model, Student-oriented Education, Competencies and Skills, Pharmaceutical Curriculum.

1. Introduction

Pharmacology occupies an important place in modern society, because it is difficult to find a medical intervention, treatment or prevention, which would do without medicines. At the same time, the development of the pharmaceutical industry affects both health care(Veera Boopathy et al., 2024) and the country's economy, as it includes production, commercial activity, the service sector, education and science. In the modern world, there is a large number of medicines that continues to grow, drug are improved and diversified, therefore it is so important to provide the pharmaceutical industry with qualified specialists. Pharmacological education faces new challenges that meet the requirements and trends of global medical and, in particular, pharmaceutical education. Educational process programs in the field of

pharmacy are developed by teachers, scientists, and politicians who fix the norms with legislative documents based on the European education system in this field(Neelima et al., 2024). However, despite the long-term reform of the educational system, it is impossible to fully integrate Ukrainian pharmaceutical education into the European one, mainly due to the fact that the education system of European countries is also flexible and constantly changing, which responds the challenges of society(Baskar et al., 2024). However, the application of European approaches to improving pharmaceutical education can significantly improve the qualifications of pharmacists and doctors and help teachers create the most effective educational programs(Kodric et al., 2021).

2. Literature Review

Pharmacology as a science has existed alongside medicine since its inception, therefore both pharmaceutical and medical sciences are intertwined with each other. After all, there are no clinical disciplines that do not include drugs and their effects on the human organism. In the same way, pharmaceutical education does not exist without the use of medicines in clinical practice.At the beginning of the 20th century, pharmaceutical education was horizontal, namely, curricula consisted of separate courses that practically did not overlap with other disciplines. The development of pharmaceutical education was also influenced by the political systems of the countries, which determined the vector of the movement of science and education. In the 20th century in Ukraine, which was part of the USSR, educational programs were formed in accordance with the socio-political views of the country.Among the disciplines, many hours were devoted to political disciplines, in particular the history of communism, which increased student fatigue and reduced the effectiveness of education (Kotvitska et al., 2022). The teachers strictly adhered to the curriculum and enjoyed undisputed authority among students, students' creativity and additional questions were often perceived as a low level of knowledge, so students were reluctant to discuss with the teacher, and the goal of education was often exam results, rather than understanding the practical application of the acquired knowledge. Such a system existed in other countries as well, and was described as a passive model of education.

The modern system of pharmacological education includes interdisciplinary cooperation in the creation of educational programs, namely the vertical integration of fundamental disciplines into the clinical context from the beginning of medical school. The concept of vertical integration emerged after the adoption in 1984 of Harden's SPICES model as a basis, although this trend has been present since the 1950s, when the Association of American Medical Colleges (AAMC) promoted a move away from the narrow study of separate disciplines, instead delegating the combination of the study of different disciplines for better implementation of knowledge in practice (Wijnen-Meijer et al.,2020). At the same time, the authors emphasized that vertical integration forms the philosophy of learning, promotes motivation, as it closely links learning with the practical application of knowledge and determines the continuity of professional development. This system still works through the combination of fundamental and clinical disciplines, theoretical

knowledge and practical skills(Bobir et al.,2024).

Moreover, the view on pharmacological education cannot be considered only in the context of training qualified pharmacists, but also as a quality of pharmacological education and its place in medical education. That is why the curricula of the pharmacologycal faculties include a large number of hours studying clinical disciplines, and the medical faculties in their curriculas include pharmacology as one of the main directions. At the same time, pharmacological education must closely cooperate with science and clinical practice, since drugs must be tested for their effectiveness through clinical trials (Steinel et al., 2019). The combination of pharmacology with other sciences and practices Quesnelle et al. (2021) analyzed in the curricula of seven medical schools in the United States, according to the ICAP (Interactive, Constructive, Active, Passive) Framework and determined that a multidisciplinary approach gives high results in learning materials. Authors also noted that different schools use different approaches, which sometimes differ significantly, however, the level of GQ of students in all these institutions was high, which indicates the effectiveness of educational programs that are flexible and student- oriented and adapt to the cultural characteristics of the institution. The principles of European pharmaceutical education are defined in the format of mastering certain competencies. That is why, the number of hours of studying disciplines in the curriculum is not the main factor, instead, the acquisition of skills is decisive, as skillscreate a competitive qualified specialist. It is important to note that there is no single ideal pharmaceutical education system in the world, so educational institutions change educational programs in accordance with the challenges they face.

The purpose of the study was to analyze the development of pharmaceutical educational programs in Ukraine and the world, to determine the main principles and achievements of reforming educational approaches and challenges facing the industry and ways to improve educational programs.

3. Materials and Methods

An analysis of the literature in the field of pharmaceutical education and educational programs was carried out. The author systematized the competencies and mechanisms of the educational process that contribute to the acquisition of these competencies based on the analysis of scientific publications of recent years and his own experience and presented the results in Table 1 and Figure 1.

4. Results

Integration into the Worldwide system in accordance with its requirements has become a new vector for the development of pharmaceutical education in recent years. The requirements for the integration of pharmacological education into Worldwide standards provided for the introduction of the Bologna Process in 2005 into curricula, the reform of the education system through the adoption of the National Framework of Qualifications and the introduction of amendments to the

Law of Ukraine "On Higher Education" (Shulhai et al., 2020).

In this way, a paradigm changes in pharmaceutical education took place: the focus of drug production changed into patient orientation, and the assessment of the assimilation of theoretical educational materials through the approach in the number of hours of classes changed into a competency approach through the assessment of mastery of skills and the possibility of their application in practice. The patient orientation of the pharmaceutical industry is due to the responsibility associated with the effect of drugs on the human organism and the possible side effects, which sometimes can be fatal. Therefore, within the framework of patient orientation, the number of hours for studying clinical disciplines has been significantly increased.The implementation of the competence approach corresponds to the integration of pharmaceutical education and science into the European model and meets the needs of the modern labor market of the industry. After all, employers need employees in accordance with the expected mastered competencies, among which such qualities as flexibility, analytical thinking, creativity, openness to new knowledge and skills, sociability and compliance with ethical standards are most valued.

The flexibility and creativity of a specialist determines his ability to adapt to changing working conditions, the ability to make independent decisions in extreme situations, because pharmacists are constantly faced with new challenges. An example of such extreme challenges was the COVID-19 pandemic, when the conditions for pharmacists, scientists and teachers changed (Kennedy et al., 2022; Fuller et al., 2020). It was the ability to quickly adapt to the demands of society that enabled the rapid creation of vaccines by scientists and the pharmaceutical industry. Also pharmacists partially took over the burden of medical personnel, carrying out educational and advisory work among the population. At the same time teachers of the pharmacology faculties continued the educational process in a distance format, quickly creating new educational programs in the conditions of online communication with students.

Analytical thinking and openness to new knowledge are competencies that contribute to mastering a large amount of information, news in the field and developments, clinical research with proof of the effectiveness of certain drugs in various pathologies. Analytical thinking develops critical thinking, which allows pharmacists to distinguish between quality and reliable information, increases the ability to critically evaluate the influence of commerce and marketing on the promotion of certain drug (Persky et al., 2019).

Communicability in the field of providing pharmaceutical services plays one of the key roles, because in modern society, the development of Internet technologies has caused the spread of self-medication. That is why pharmaceutical education is aimed at mastering the skills of communicating with the patient for the purpose of additional consultation to prevent possible harm from taking drugs that are not indicated, contraindicated for this pathology or incompatible with other drugs that the patient is taking. Often, patients avoid going to the hospitals, either because of ignorance of the system, lack of time, money, or even fear of medical interventions. I this case people use information from drug advertisements or various medical

forums. However, due to the lack of medical education, such self-medication can lead to fatal consequences. Fortunately, pharmacies are obliged to sell some drugs according to prescriptions, but in Ukraine, a large number of medications are still available without a prescription, which poses significant risks to the health of the population. An important step in the fight against self-medication was the creation of electronic prescriptions and the inclusion of antibacterial drugs in the prescription section, which had a positive effect on seeking advice from doctors and contributed to the reduction of resistance of microorganisms to antibacterial drugs.

Pharmaceutical ethics is closely related to physician ethics and uses the principle of protecting the patient's rights. That is why the pharmacist, when recommending analogues of medical preparations, should take into account the effectiveness of drugs efficiency, but not the commercial benefit. The manufacturer of medicines also should choose the safest components for drug production. Attention and politeness in communication with the patient is also very important, because it contributes to the fact that the patient asks for advice from the pharmacist and listens to professional recommendations. Ethics is also important when conducting clinical research to determine the effectiveness of researched drugs. The doctor or pharmacist must provide detailed and complete information to the research participant, tell about the possible risks, side effects of the medicines. and in communication must not put pressure on the.

Table 1: Educational Mechanisms of Competence Acquisition

Competence	Educational mechanisms
Flexibility	The combination of active and passive learning, the use of different approaches in learning, the interdisciplinary nature of the subjects of classes.
Creativeness	Creation of projects, reports on the topic independently or in cooperation with other students.
Analytical thinking	Extracurricular work, creation of projects, work with scientific metric bases, discussion.
Openness to new knowledge and skills	Self-study, active learning, introduction of practical classes and internships forstudents at clinical, production bases and research centers.
Communicability	Studying native and foreign spoken and written language, discussion between students and teachers on problematic topics, communicating with patients.
Etics	Cultivating empathy through communication with ethics teachers, analysis of clinical cases, communication with clinic patients, introduction of a philosophy course with literature reading and viewing of films which showeethical problems.

Source: compiled by author based on (Katoue & Schwinghammer, 2020; Croft et al., 2019; Reed et al., 2019; Cerbin-Koczorowska et al., 2020; Reva et al., 2020)

The development of pharmaceutical education, in addition to a competency-based and patient-oriented approach, should be student-oriented to improve efficiency. Among the components of quality pharmaceutical education, it is worth highlighting the following: student, teacher, material and technical support that influence educational programs (Figure 1). All these components are interconnected and oriented towards each other.

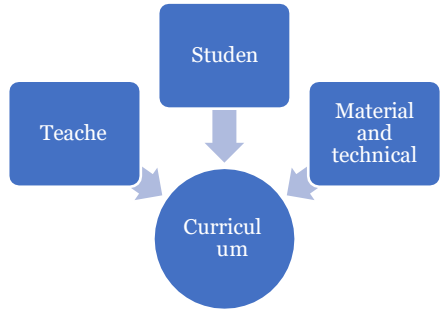

Figure 1: Components of Pharmaceutical learning Source: compiled by author

An important factor in the development of the educational process is the high-quality contingent of applicants. Until 2022, entrants in Ukraine passed independent testing (External independent assessment) in general and specialized subjects, for pharmaceutical faculties - chemistry. Such a system overcame corruption risks, because it ensured transparent conditions for admission and leveled the subjectivity of assessment of initial knowledge levels. For pharmacological faculties, a passing score is established, which confirms the importance of the profession and the high requirements for entrants.

Some authors believe that setting a passing score is unfair because the advantage of a specialized subject is not taken into account, because an applicant with high scores in a specialized subject (chemistry) and a low score in the main one, for example, native language, has no chance to enter a pharmaceutical university, instead, the authors recommend the introduction of a test on identifying opportunities for rapid learning (Shulhai et al., 2020). In our opinion, the competence of communication requires a high level of native and foreign languages, which indicates the benefit of introducing a high passing score in this subject, and additional testing for the ability to learn quickly is unnecessary.The last 2 years of a full-scale war opened new obstacles to the development of the educational process. In particular, for applicants, because instead of an exam in selected subjects, graduates take a multi-subject test, which has limited capabilities in determining the depth of knowledge, especially in special disciplines. At the same time, the stress that occurs due to a possible air alarm, shelling, distraction for the transition to shelter, can also significantly affect the test results. Therefore, we do not consider the selection of prospective applicants to be effective in the conditions of multi-subject testing.

Although a high score on a multi-subject test can simultaneously indicate a high or sufficient level of knowledge, high stress resistance and the ability to learn, which are also valued among medical professionals. We consider theimportance of priority points given by applicants, which indicates their desire to study at this particular institution, and eliminates the possibility of accidentally entering a pharmaceutical university based on the principle of free places by state order.

A qualified teacher of the modern education system must be student-oriented, meet the requirements for continuous professional development, possess theoretical material and practical skills, as well as show creativity to interest students in classes, follow the latest changes in the field, new developments, and constantly improve

pedagogical skills.

Educational programs must be of high quality, meet the requirements of legislation and the vector of European integration of pharmaceutical education. At the same time, to ensure student orientation, it is necessary to ensure a certain autonomy of the institution in the mechanisms of mastering competencies. In particular, it is recommended to conduct constant surveys of students in order to determine which form of education is the most interesting, receptive and effective. Within the framework of the new educational programs, there is an opportunity to choose additional disciplines, which allows the student to independently fill the gaps in knowledge.

An important component of pharmaceutical education is the material and technical support of the educational institution for filling laboratories with the aim of achieving practical skills, the presence of clinical bases and simulation centers, the combination of scientific and research work, cooperation with other institutions. To improve the educational process, it is necessary to ensure active cooperation with industry, science, in particular, between various institutions with a chemical and technological direction, a pharmacy network, quality control institutions of the pharmaceutical industry for the possibility of providing internships for students in scientific centers, production and clinical bases (Reva et al., 2020).

Thus, the development of pharmaceutical education and educational programs of Ukraine is influenced by the integration of the education system into the European one, which is explained by the high degree of trust in the European pharmaceutical industry. However, the educational programs of economically and scientifically developed countries in the field of pharmaceuticals are not stable, because pharmacology is constantly developing, the number of scientific publications that analyze the effectiveness, pharmacokinetics and bioavailability of drugs increases daily. That is why, in the conditions of a large amount of information, constant changes in the field of pharmacy, educational programs change according to the requirements, using the principles of mastering competences and guidelines for improving education.

5. Discussion

Since the modern pharmaceutical industry and science are constantly improving, new technologies and drugs constantly appear, a large number of clinical studies are conducted, comparing the action of drugs with placebo,, there is a need to improve pharmaceutical education, which would be able to face the challenges of modern times without losing its quality and efficiency. The cost of a medication error is too high, authors describe over 7,000 medication error deaths in the United States in 2000 year, and 2,420 drug reaction deaths in the UK each year (Engels, 2018, Elliott et al., 2018, Donaldson et al., 2000). That is why pharmaceutical education and training is so meticulously researched, and norms and programs are established at the legislation level.

Pharmacology includes a large theoretical load in the field of fundamental and

clinical medicine and is perceived by most students as a difficult and boring subject. Therefore, according to the authors, the number of hours of pharmacology as a separate course should be limited, instead pharmacology should be integrated into other disciplines (Karas Kuželički et al., 2019; Gill et al., 2019). It helps to understand the practical application of pharmacology, which becomes more understandable for students, however, in our opinion, a special course in pharmacology is important because it allows you to systematize knowledge and study the basics of pharmacology. In the conditions of constant changes in the quantity and quality of drugs, it is necessary to be able to systematize pharmacological knowledge, so that when meeting a new drug, understand its group of classification and roughly know its effect. This will help to navigate the interaction of drugs, save the the doctor's and pharmacist's time, because in practice a complex of drugs is used and it is necessary to understand how they interact with each other, without referring to additional sources of information.

With traditional passive learning, students perceive information in the context of passing the exam and mostly do not remember the essence of the subject, so the acquired knowledge is not applied in practice in the future (Sajjad & Gowani, 2021). Wu et al. (2022) proposed the introduction of a flipped classroom model, which includes watching short video files with the content of the topic and highlighting the main theses of the topic before the class. After comparing the effectiveness of the flipped classroom based on the micro-video class with the traditional type of teaching class, better knowledge and satisfaction among students were found in the video class group. This technique contributes to better assimilation of materials, selection of key theses and the possibility of repetition. At the same time, the development of this program increases the load on teachers who develop videos, requires the teacher to have a high level of knowledge and creativity in classes, because after working on the videos, the classes have a question-and-answer model, and in the absence of questions, the teacher is forced to find topics for discussion in order to work on the acquired knowledge on practical model. This model of learning promotes development of flexibility, creativity, sociability, self-learning, and is an example of a student-oriented model.

French pharmacologists also recommend using the discussion as a method of interdisciplinary education, which consists in the joint resolution of clinical cases, which are essentially a therapeutic impasse, by pharmacologists and therapists. (Carton et al., 2023).

The COVID-19 pandemic made adjustments to the educational process in 2019, opening distance learning as the only possible option under those conditions. Hernandez et al. (2021) describe the rapid shift to distance learning due to the COVID-19 pandemic and its impact on the quality of learning. It is obvious that distance learning conditions negatively affected students' perception of educational materials, which is explained by the change in the pass/fail grading system for USMLE Step-1/COMLEX Level-1 tests.

Distance learning in pandemic conditions was analyzed by the Japanese Pharmacological Society and described such problems as the instability of access to the network, the impossibility of the teacher checking the understanding of scientific

material by students, the disruption of students' daily rhythms, the occurrence of mental disorders, copyright infringement, etc. Distance learning has made it possible to improve existing programs after the end of the pandemic, using its advantages, namely the availability of educational materials at any time, the possibility of repeating materials, as well as increasing the number of questions among students (Mogi et al., 2021; Alqurshi, 2020).

Domínguez-Alegría et al. (2022) emphasize the importance of pharmaceutical education not only among students but also among qualified pharmacists as part of continuous professional development.

6. Conclusions

In this way, modern pharmaceutical education has changed the paradigm from a production direction to a patient-oriented one.The creation of educational programs is fixed at the legislative level and corresponds to the principles of acquiring competencies and skills. At the same time, educational institutions are given certain autonomy in the mechanisms of acquiring professional competencies and knowledge. In this way, a student- oriented approach to learning is maintained, which increases the student's perception and curiosity, as well as an interdisciplinary approach to the study of pharmacy.The effectiveness of pharmacological educational programs is determined by the desire and ability of the student to learn, the high qualification of the teacher with the constant improvement of pedagogical skills in the conditions of continuous professional development, sufficient material and technical support and the actual studying programs focused on mastering competencies and skills.

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