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A REVIEW OF MODERN TOOLS FOR TEACHING PHARMACOLOGICAL NOMENCLATURE TO STUDENTS AT HIGHER MEDICAL EDUCATIONAL INSTITUTIONS

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A review of modern tools for teaching pharmacological nomenclature to students at higher medical educational institutions
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Training of a modern medical and health care specialist is not complete without teaching pharmaceutical nomenclature, as a good doctor cannot be without a deep knowledge of pharmacology. Based on this, clinical pharmacology is included in the list of compulsory disciplines in the preparation of a future doctor. Despite this importance of the discipline of clinical pharmacology in the higher medical education, less attention was paid to this field of education. Teaching clinical pharmacology is less described in scientific literature.

Purpose. We have analyzed scientific publications on teaching pharmaceutical terminology / pharmacological nomenclature in the context of higher medical education for the high-quality training of future medical specialists at the Department of Pharmacology by means of improving and implementing the effective methods of teaching clinical pharmacology.

Methods. The authors of the article present a review of research publications on the quality issues arising in the process of training personnel in Pharmacology at all levels of university and postgraduate medical education which by all means contributes to the development of the practical issue under study.

Results. The results of the study demonstrate challenges in teaching pharmaceutical terminology in the context of changing professional and educational standards for teachers; difficulties in discussing the meaning of the concepts in depth and implementing them in a clinical context for students; a gap in the education between the introduction of the core concepts of pharmacology and the application of these concepts in a clinical context.

Conclusions. The conducted literature review by means of scientific and research publications' analysis actualizes the use of modern methods of teaching pharmacological terminology at a medical university and an update of curricular within the field.

Keywords: *pharmacological nomenclature, pharmaceutical terminology, teaching clinical pharmacology, specialist training, teaching methods.*

Медициналық жоғары оқу орындары студенттерінің фармацевтикалық номенклатурасын оқытудың заманауи құралдарына шолу
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Фармацевтикалық номенклатураны оқытпай, заманауи медициналық және денсаулық сақтау маманының дайындығы толық болмайды, өйткені жақсы дәрігер фармакологияны терең білмей қалыптаса алмайды. Бұл негізде клиникалық фармакология болашақ дәрігерді дайындауда міндетті пәндер тізіміне енгізілген. Жоғары медициналық білім беруде клиникалық фармакология пәнінің маңыздылығына қарамастан оқытудың бұл саласына аз көңіл бөлініп келді. Клиникалық фармакология пәнін оқыту отандық және шетелдік ғылыми әдебиеттерде жеткіліксіз сипатталған.

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Мақсаты. Клиникалық фармакологияны оқытудың тиімді әдістерін жетілдіру және енгізу арқылы фармакология кафедрасында болашақ медициналық мамандарды сапалы даярлау үшін жоғары медициналық білім беру үдерісінде фармацевтикалық терминологияны / фармакологиялық номенклатураны оқыту бойынша ғылыми жарияланымдарына талдау жасауға мақсат қойылды.
Әдістер. Мақалада зерттеліп отырған сала ауқымында нақты тәжірибелік сұрақтарды шешуге үлес қосатын университеттегі медициналық білімнің барлық деңгейлерінде клиникалық фармакология бойынша кадрларды даярлау процесінде туындайтын сапа мәселелерін талқылауға арналған басылымдарға шолу жасалды.
Нәтижелер. Зерттеу нәтижелері профессор-оқытушылар құрамы үшін кәсіби және білім беру стандарттарының өзгеруі жағдайында фармацевтикалық терминологияны оқыту проблемаларын; ұғымдардың мәнін терең талқылаудағы қиындықтарды және оларды студенттердің практикалық қызметте қолдануын; білім берудегі фармакологияның негізгі тұжырымдамаларын енгізу мен оларды клиникалық тұрғыда пайдалану арасындағы алшақтықты көрсетеді.
Қорытынды. Зерттеу тақырыбы бойынша ғылыми-зерттеу басылымдарына талдау арқылы өткізілген әдебиеттерге шолу медициналық университетте фармакологиялық терминологияны оқытудың заманауи әдістерін қолдануды және осы бағыттағы оқу бағдарламаларын жаңартудың маңыздылығын айқындайды.
Негізгі сөздер: *фармакологиялық номенклатура, фармацевтикалық терминология, клиникалық фармакология пәнін оқыту, маман даярлау, оқыту әдістемесі.*

Обзор современных инструментов обучения фармацевтической номенклатуре студентов высших медицинских учебных заведений

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Введение. Подготовка современного специалиста в области медицины и здравоохранения не обходится без обучения фармацевтической номенклатуре, так как хороший врач должен обладать глубокими знаниями в области фармакологии. Исходя из этого, клиническая фармакология входит в перечень обязательных дисциплин при подготовке будущего врача. Несмотря на важность дисциплины клинической фармакологии в высшем медицинском образовании, этой области образования, по сравнению с другими отраслями ранее уделялось меньше внимания. Преподавание клинической фармакологии недостаточно описано в научной литературе.
Цель. Анализ научных публикаций по преподаванию фармацевтической терминологии / фармакологической номенклатуры в процессе высшего медицинского образования для качественной подготовки будущих медицинских специалистов путем совершенствования и внедрения эффективных методов обучения.
Методы. Предпринят обзор публикаций, посвященных обсуждению вопросов качества, возникающих в процессе подготовки кадров по клинической фармакологии на всех уровнях вузовского и послевузовского медицинского образования, что несомненно внесет вклад в решение определенных практических задач в этой области.
Результаты. Результаты исследования демонстрируют проблемы преподавания фармацевтической терминологии в условиях изменения профессиональных и образовательных стандартов для профессорско-преподавательского состава; трудности в углубленном обсуждении значения понятий и их применении студентами в практической деятельности; разрыв в образовании между введением основных концепций фармакологии и использованием их в клиническом контексте.
Выводы. Проведенный обзор литературы, посредством анализа научных и исследовательских публикаций по теме исследования актуализирует использование современных методов преподавания фармакологической терминологии в медицинском университете и обновление учебных программ по данной области.
Ключевые слова: *фармакологическая номенклатура, фармацевтическая терминология, ведение клинической фармакологии, подготовка специалиста, методы преподавания.*

Introduction

The correct prescription of drugs is an essential skill of medical doctors [1]. Training of a modern medical specialist is not complete without teaching pharmaceutical nomenclature. As stated by the World Health Organisation (WHO), "a doctor cannot be without a deep knowledge of clinical pharmacology" [2], as knowledge of pharmacology is essential in gynecology to prevent reproductive loss, endocrinology – in the choice of therapy [3]. According to M.K. Kevra, clinical pharmacology studies "the effect of drugs on the human body in order to use them for the treatment, prevention, diagnosis of various diseases" [4]. Therefore, it is included in the list of compulsory disciplines in the training of a future doctor who can safely and successfully treat based on the knowledge of medicines' properties effect on human health.

Modern clinical pharmacology has developed since the second half of the 19th century [5]. The World Health Organisation (WHO) convened a study group on clinical pharmacology in 1969 to demarcate the scope of the new discipline [6]. According to them the tasks comprise of research into the action of drugs in humans; services such as providing information on drugs; and teaching clinical pharmacology and therapeutics to medical students, hospital staff and physicians [6]. While both research and services are important areas of clinical pharmacology, it is in their roles as medical students` teachers of clinical pharmacology and therapeutics that clinical pharmacologists have an extremely important effect on the development of rational prescribing by medical doctors. However, despite this importance, teaching clinical pharmacology and therapeutics is reflected in the small number of scientific publications, and as stated by Richir et al, only about 20 articles on teaching clinical pharmacology and therapeutics were published in the European Journal of Clinical Pharmacology within twenty years [1]. In many European medical schools undergraduate students learn little about the therapeutic use of drugs which is also indicated in the survey conducted under the auspices of the WHO in 1989 [7,8].

The science behind drug nomenclature has advanced over the years with the advent of better analytical techniques for identification and purity verification. With the introduction of biotechnological methods that are used in the manufacture of biologics and other biomedical treatments, the characterization of biologicals has become more precise and unambiguous. All these new advancements have underpinned the development of more sophisticated chemical and biological therapeutics and with this advances, the naming of new pharmaceutical substance candidates has become more complex and challenging [9].

As stated by the pharmacology faculty members of the Ohio State University (Rodis et al, 2009), it is the responsibility to lead by example for the profession, and help to shape the future of profession through influence on the students of today. The risks associated with misusing terminology related to the pharmacy profession are great. The terms used will be adopted by future specialists who are now in the classrooms [10]. As the field of the clinical pharmacology evolves, specialists must advance together as a united group of professionals. All faculty members and specialists in any setting should embrace their commonalities across the profession through consistent use of terminology [10].

The study conducted among the students of health care at Swedish universities (Aronson et al, 2015) was aimed at exploring their understanding of core concepts in pharmacology. The results of the study showed that the participants of the study were in general able to define pharmacological concepts, but showed less ability to discuss the meaning of the concepts in depth and to implement these in a clinical context. They found it easier to grasp concepts related to pharmacodynamics than pharmacokinetics and drug interactions [11].

Bracket et al (1999) and Woodman et al (2004) indicate a gap in the education between the introduction of the core pharmacology concepts and the application of these concepts in a clinical context. It necessitates caution when attempting to extrapolate the results to all health care students. Since the curricula in all programs represented in the study include both the parts; introduction of concepts and patient cases, the translation of the concepts into a clinical context is potentially a key issue [12,13]. Gregson et al (2015) agree that the latter step is important for a more functional understanding of pharmacology concepts [14].

Thus, we agree with Richir et al (2008) that clinical pharmacologists play an important role in the development of skills required to a health care student by teaching clinical pharmacology and therapeutics to undergraduate medical students [1]. Each medical university should have a separate department of pharmacology. So, in the West Kazakhstan Marat Ospanov Medical University such department has existed since 1959. For the high-quality training of future medical specialists, the teaching staff of the Department of Pharmacology is improving methods of teaching pharmacological nomenclature in the process of teaching training courses. With the right teaching techniques to grab attention and encourage active participation [15] the planned final outcomes of the education programme contributing to the development of a good professional will be reached.

In this respect we set the aim of our study as conducting the analysis of scientific and research publications in the field of teaching pharmaceutical terminology / pharmacological nomenclature to higher medical students. The stated purpose is relevant for developing the high-quality training of future medical specialists at the Department of Pharmacology by means of improving and implementing the effective methods of teaching clinical pharmacology.

Methods

The review of research papers on the quality issues of teaching pharmacology at all levels of higher medical

education is conducted along the study. The issues of teaching pharmacological nomenclature in the context of updating pharmaceutical terminology and challenges of teaching clinical pharmacology to a health care student are comparatively analyzed in the course of the study.

As a first step of our methodology a simple search in PubMed, Scopus, ISI, Cochrane, Google Scholar and other research databases with search terms teaching pharmacology and pharmaceutic terminology was conducted. While doing this step, we identified determinant factors influencing quality in teaching pharmacology to healthcare students related pharmacological nomenclature / pharmaceutical terminology, which was a relevant paper to get a deeper insight and fill the gaps of our research question.

Further on, for selection of papers for our research eligibility criteria based on the research aim were applied. Exclusion criteria was unrelated, duplicated, unavailable full texts, or abstract-only papers. The inclusion criteria was articles covering teaching pharmacology in the field of higher medical education. Thus, the articles which contain information answering our research question, mainly teaching pharmaceutic terminology or pharmacological nomenclature were in focus. This process was described by the PRISMA flow diagram (see Fig. 1).

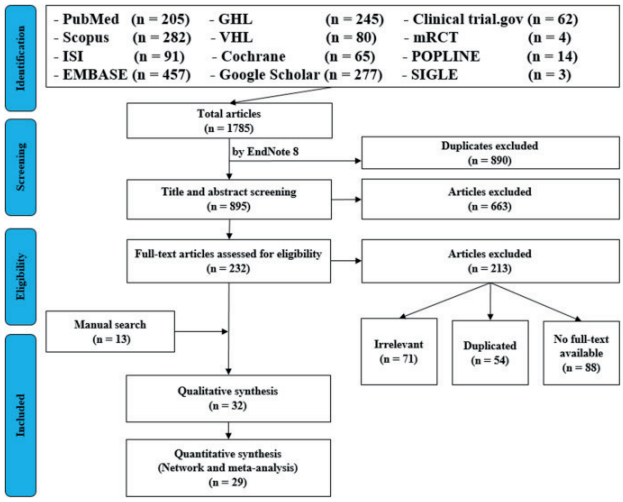

Figure 1. PRISMA flow diagram of studies' screening and selection

Modern approaches and tools for teaching pharmacological nomenclature

To improve the activity on the formation of pharmacological terminology, we turned to publications devoted to modern tools for teaching the pharmaceutical nomenclature of students of higher medical educational institutions.

The importance of reflection on foundations of terminology at medical universities, modern problems of terminology, the state of teaching the basics of medical and pharmaceutical terminology, scientific and methodological problems of the formation of pharmacological terminology are taken into account [16].

Burdina reveals the problems of teaching pharmaceutical terminology and recipe in the context of changing professional and educational standards [17]. Stadnichenko presents the results of a study of the history of the emergence and causes of changes in the modern pharmaceutical nomenclature [18].

Kiseleva states the features of teaching the pharmaceutical nomenclature of future physicians in higher medical educational institutions. She analyzed the concept of pharmaceutical nomenclature, substantiated the need for its assimilation by students of higher medical educational institutions, development of a methodology for its teaching in the process of studying the course of Latin medical terminology at medical universities [19].

In teaching pharmacological terminology, the materials prepared by the departments and courses of the Latin language are used [16]. Arkhipova mentions the relevance of the electronic educational resource "Pharmaceutical nomenclature and the basics of prescribing the Latin part of the recipe", compiled by teachers of the Department of Foreign Languages and the Department of Pharmacology and Clinical Pharmacology of USMU. Its novelty and the ability to form the skills necessary for the prescription of medicines that are relevant today and the correct design of the prescription in Latin are considered [20].

For high-quality preparation for the process of forming a pharmacological nomenclature, not only such educational resources are needed, but also electronic textbooks "Latin language and the basics of pharmaceutical terminology" [21], as well as programs designed to deepen knowledge, the formation and development of practical skills in the field of pharmaceutical terminology [22].

Lukyanova substantiates the effectiveness of the application of "the morphological approach" to the process of forming pharmacological terminology: According to her, "a modern specialist in the medical and pharmaceutical profile must possess a significant stock of Greek-Latin terminology in order to read scientific articles, annotations to medicinal products, descriptions of diseases, popular science literature" [23]. This approach is widely presented in other works, in particular by Arutyunyan, who states that "the linguodidactic potential of suffixation based on the word-formation suffixes of Latin and Ancient Greek is high in teaching medical and pharmaceutical terminology [24]. This directs to considering the specifics of origin and word-formation of pharmaceutical terms while teaching course and introducing the concepts.

Pharmacology textbooks are structured with chapters devoted to anatomical systems, disorders or drug classes. In the present handout, we set to use the ATC classification of drugs established by the WHO Collaborating Centre for Drug Statistics Methodology. WHO offers the classification in which drugs are classified in groups at five different levels. The drugs are divided into fourteen main groups (1st level), with pharmacological / therapeutic subgroups (2nd level). The 3rd and 4th levels are chemical / pharmacological / therapeutic subgroups and the 5th level is the chemical substance [9].

Joshi (2018) highlights that in most of the undergraduate curriculum with the entire course of Pharmacology it is usually taught in the classrooms with little exposure to practical and clinical aspects. As a result, medicines taught

in classrooms mostly differ from medicines prescribed by doctors, and that is the usual informal feedback given by students. This causes a difference between theoretical teaching and practical learning which, in turn, makes it difficult for them to internalize pharmacology. So, he proposes using creative teaching modules as a part of theory as well as practical classes. Teaching-Learning strategies which direct critical thinking and clinical reasoning as well as creative thinking have to be identified. According to him, transition and reformation in the way teachers teach requires an alteration in skill and attitude of teaching by designing creative teaching modules which lead to the creation of significant learning environments [25].

The pharmacology education during the undergraduate medical education at NOVA Medical School in Lisbon, Portugal, described by Brinkman et al (2020), was changed from a traditional programme, which included lectures and was discipline-based, to a problem-based learning (PBL) programme. The new approach was integrated and consisted of case-based discussions without an increase in teaching hours. As a result of this shift, as indicated by the researchers, the prescribing competencies of final-year students have been improved. Namely, PBL programme students demonstrated significantly higher knowledge scores than students taught within the traditional programme (76% (SD 9) vs 67% (SD 15); p= 0.002). Additionally, students in the PBL programme made significantly fewer inappropriate therapy choices (p=0.023) and fewer erroneous prescriptions than did students in the traditional programme (p=0.27). Authors assumed that students in the PBL programme were more confident in prescribing [26]. Innovative curricular in teaching pharmacological nomenclature, according to Achike (2013), should also imply information and communication technology (ICT) in the teaching-learning process, with ICT being the main engine that drives information growth and access [27].

Discussion

We agree that the priority task of higher medical education is to improve the quality of training of doctors in accordance with international standards and the needs of Kazakhstani healthcare. The main condition for the successful medical activity is the formation of the system of pharmaceutical terminology. This system is developed in the process of mastering professional medical activity. It requires constant quantitative and qualitative replenishment, as well as the ability to competently implement the terminology in each individual case in relation to a specific patient.

The relevance of teaching pharmaceutical terminology increases with the replenishment of domestic and mainly foreign drugs (either new groups and or in each group). It becomes more and more difficult for a modern medical student to learn to freely navigate the "pharmacological jungle" [4]. Therefore, the work on improving teaching of pharmacology at the Kazakhstani medical university is intensifying. In solving this most important and complex problem, implementing an electronic database in the field of drug therapy plays an important role. The assimilation of the electronic database is carried out in the process of teaching pharmacology not only in the system of higher and postgraduate medical education, but also in the system of advanced training for doctors [28].

The task of teaching pharmaceutical terminology is being successfully worked out at the Department of Pharmacology of the West Kazakhstan Marat Ospanov Medical University (Aktobe, the Republic of Kazakhstan). To check the level of formation of the system of pharmaceutical terminology, the department developed methodological recommendations for the implementation of independent work of students (IWS) in the form of drawing up a drug formulary for pharmacotherapy of a certain disease in accordance with the clinical diagnosis and introduced them into the educational process. When drawing up, it is important, firstly, not only to know the pharmacological properties of drugs, but also the diagnosis, as well as the individual characteristics of the patient for whom they are intended. To do this, before starting the training of pharmacological terminology, we determine the basic knowledge, skills and abilities, at the end of the course we carry out various forms of control: solving situational clinical tasks, testing, etc. In this regard, at the department, we have developed textbooks containing situational clinical tasks for analysis the level of formation of pharmacological terminology based on real medical records containing medical records of inpatients and outpatients. Such a systematic theoretical training in teaching pharmacological terminology provides for mandatory participation in seminars, conferences at various levels, independent work with the involvement of the archive of medical institutions, etc. [29].

For the successful formation of the pharmacological nomenclature, it is necessary to use and introduce into the educational process a system of traditional and new active teaching methods (project method, case methods, brainstorming, business games, etc.): "it makes a big difference when a doctor just listens to a lecture about antibiotics, or when he himself becomes a participant in the business game "antibiotic trial" [28]. In the process of such interactive learning, students' questions are encouraged, as well as comments and examples from their own experience of students of advanced training courses, discussions and exchange of knowledge and skills.

The importance of electronic resources cannot be overestimated in the course of teaching pharmaceutical terminology. The British Journal of Pharmacology [30] offers an evidence base, with over 4,650 references cited and listed [31] for those who work in the field of pharmacology. It includes official internationally approved classification and nomenclature for human drug targets, links to chemical and omic databases, PubMed or Patents to obtain further information, pharmacological tools to identify a particular target in experimental investigations, lLinks to the open access IUPHAR/BPS Guide to PHARMACOLOGY database.

Conclusions

The study demonstrated challenges in teaching pharmaceutical terminology in the context of changing professional and educational standards for teachers. Healthcare students face difficulties in discussing the meaning of the concepts in depth and implementing them in a clinical context. There is a gap in the healthcare education between the introduction of the core concepts of pharmacology and the application of these concepts in a clinical context. Thus, the conducted literature review and the analysis of research, publications, and guidelines on teaching clinical pharmacology testifies to the efficiency of the use of modern methods of teaching pharmacological terminology at a medical university. In this respect, update of curriculum is required within the field of clinical pharmacology in the context of higher medical education.

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