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CREATION OF A UNIFIED GLOBAL SYSTEM OF INFORMATION SUPPORT FOR MEDICAL RESEARCH

Oliinyk Serhii Petrovich,
PhD in Pharmaceutical Sciences,
Advisor
Pharmaceutical Company “Nobel Pharma Schweiz AG”
ORCID: 0000-0003-1034-4918

Humeniuk Vasyl Vasylovich,
Doctor of Pedagogical Sciences, Associate Professor
Department of Disaster Medicine and Military Medicine
Danylo Halytsky Lviv National Medical University
ORCID: 0000-0003-2736-3875

Rybachuk Anna Petrivna,
PhD in Medical Sciences,
Surgeon Doctor
St. Nicholas Hospital
ORCID: 0000-0003-4402-1543

Oliinyk Petro Volodymyrovych,
Doctor of Pharmaceutical Sciences, Professor
Department of Disaster Medicine and Military Medicine
Danylo Halytsky Lviv National Medical University
ORCID: 0000-0003-2572-5246

Hromovyk Bohdan Petrovich,
Doctor of Pharmaceutical Sciences, Professor
Head of the Department of Organization and Economics of Pharmacy
Danylo Halytsky Lviv National Medical University
ORCID: 0000-0002-6459-6021

Planning and conducting medical research requires information about the results obtained in the framework of other research projects. Searching for information on a specific planned topic of medical research takes a significant amount of time and is the reason for slowing down access to new, more effective drugs and treatment methods. It was defined that the existing system of information provision of medical research with the help of printed and electronic medical scientific journals in the 21st century is losing its efficiency and effectiveness. The main reasons for the decrease in efficiency and effectiveness of the modern system of distribution of medical scientific information include: a large number of scientific journals; low circulations of individual journals; long time for publication of research results; high cost of publishing a scientific article; high cost of journals subscriptions; a significant number of pseudo-scientific journals that publish articles without peer review and editing in order to charge fees for so-called article processing. As a result of the conducted research, the concept of a unified global system of information support for medical research at the WHO level was developed. The study was based on 46 articles retrieved from electronic search databases such as Google Scholar and PubMed and the references contained in these articles. Applied methods of information search, systematization, content analysis, comparison and generalization. On the basis of the generalization of scientific publications, the essence of types of medical research, sources of information about their results, in particular scientific journals and search databases, have been clarified. Taking into account the fact that the policy and practice of health support throughout the world should be based on the best scientific knowledge, confirmed by the results of medical research, it is proposed to create under the auspices of the WHO a unified worldwide system of information support of medical research for use on a free basis.

Key words: *medical research, medical information, scientific journals, search databases.*

Сергій Олійник, Василь Гуменюк, Анна Рибачук, Петро Олійник, Богдан Громовик. Створення єдиної глобальної системи інформаційного забезпечення медичних досліджень

Планування і проведення медичних досліджень потребують інформації про результати, отримані в рамках інших дослідницьких проєктів. Пошук інформації з конкретної запланованої теми медичного дослідження потребує значної кількості часу і є причиною уповільнення доступу до нових, більш ефективних лікарських засобів і методів лікування. Існуюча система інформаційного забезпечення медичних досліджень за допомогою друкованих і електронних медичних наукових журналів у XXI столітті втрачає свою оперативність і ефективність. До основних причин зниження оперативності й ефективності сучасної системи розповсюдження медичної наукової інформації належать: велика кількість наукових журналів; низькі тиражі окремих журналів; тривалий час на публікацію результатів досліджень; висока вартість публікації наукової статті; висока вартість передплати журналів; значна кількість псевдонаукових журналів, які публікують статті без рецензування та редагування з метою стягнення плати за так звану обробку статей. Дослідження базувалася на 46 публікаціях, отриманих з електронних баз даних пошуку, як-от Google Scholar і PubMed, і посиланнях, що містяться в цих статтях. Застосовані методи інформаційного пошуку, систематизації, контент-аналізу, порівняння та узагальнення. У результаті проведених досліджень опрацьовано концепцію єдиної всесвітньої системи інформаційного забезпечення медичних досліджень на рівні Всесвітньої організації охорони здоров'я. На основі узагальнення наукових публікацій з'ясовано сутність видів медичних досліджень, джерел інформації про їхні результати, зокрема наукових журналів та пошукових баз даних. Зважаючи на те, що політика та практика підтримки здоров'я в усьому світі мають ґрунтуватися на найкращих наукових знаннях, що підтверджені результатами медичних досліджень, запропоновано створити під егідою Всесвітньої організації охорони здоров'я єдину всесвітню систему інформаційного забезпечення медичних досліджень для користування на безоплатних засадах.

Ключові слова: *медичні дослідження, медична інформація, наукові журнали, пошукові бази даних.*

Introduction. The process of introducing innovations in the field of health care requires the availability of comprehensive information about the current state of the problem that needs to be solved. The amount of medical research data worldwide is growing every year. Searching for information on a specific planned medical research topic consumes a significant amount of researchers' time and slows down the speed with which future patients can gain access to new, more effective drugs and treatments.

The aim of this work is to substantiate the expediency and prospects of introducing a global system of information support for medical research under the auspices of the WHO.

Methods and analysis. The study was based on 46 articles retrieved from electronic search databases such as Google Scholar and PubMed and the references contained in these articles. The search was carried out by keywords (and their combinations), for example: medical research, medical information, scientific journals, search databases. Applied methods of information search, systematization, content analysis, comparison and generalization.

Results and their discussion. The development of new methods and ways of treating diseases is impossible without conducting medical research. Their results allow scientists to introduce into medical practice new drugs, treatment methods and procedures that can effectively treat and cure various diseases. Medical research play a crucial role in disease prevention, helping to improve the quality of life of people with chronic diseases.

Types of medical research. Medical research are divided into primary, involving the collection and analysis of new data based on the results of direct study of the research subject, and secondary, based on the analysis and use of published primary research results [1]. For their part, primary medical research are classified into laboratory (basic), clinical and epidemiological research. Laboratory (or basic) research includes scientific studies and experiments in a controlled environment to establish or confirm an understanding of chemical interactions, genetic material, cells and biological agents, more precisely, the connections, behavior or properties of agents [2]. Clinical research is carried out with the participation of people, which is conducted to evaluate the effectiveness and safety of the medicinal product. As for epidemiological research, it is conducted to identify problems of prevention, causes, conditions and mechanisms of morbidity formation in order to substantiate effective disease prevention measures and evaluate their effectiveness [1].

Among secondary medical research there are distinguished [1; 3]:

- narrative review, in which researchers carry out a broad description and interpretation of previously published works on a selected topic;
- systematic review, in which the available evidences for a specific study are methodically and comprehensively identified using a rigorous and predetermined process for identifying, selecting and critically evaluating relevant studies;
- meta-analysis, that is, a statistical analysis that combines the results of many scientific studies.

Medical research can also be classified as basic, applied, evaluative, descriptive, exploratory or empirical research and implementation research [4; 5]. Applied research, or translational research is aimed at the potential application of a scientific idea for the direct benefit of people and improvement of life. It acts as a bridge between basic and clinical research, analyzing the value of newly discovered scientific ideas for use in clinical conditions. Evaluation research is a systematic analysis conducted to obtain an assessment of the effectiveness, impact or value of a certain phenomenon or intervention in order to bridge the gap between the results of primary medical research and its practical application. Descriptive research is used to document factors that describe the characteristics, behavior and condition of a person or a target population group. Exploratory or empirical research is conducted to study new ideas and concepts according to conceptual models, hypotheses, and empirical evidences in order to provide researchers with the necessary information and help them form initial hypotheses. Implementation research contributes to the use of research results by determining the optimal approaches to their implementation for a specific environment, which ultimately leads to an improvement in the quality of medical care for the population.

Sources of information about the results of medical research. Planning and conducting research in the field of health care is based on information about the results obtained in the framework of other research projects with the aim of applying the obtained results to solve an existing problem with the application of already existing knowledge, since new research is based on previous discoveries [6].

The classification of scientific literary sources on the results of medical research, proposed by the WHO, distinguishes between primary, secondary and tertiary sources of information [7].

Primary sources of information are the direct results of original medical research and scientific discoveries. To them belong: articles in scientific journals or periodicals; scientific research reports; patents; reports presented at conferences.

Secondary sources of scientific medical information are publications that interpret original research. These include medical technology papers, review articles, systematic reviews, meta-analyses, newsletters, statistic data, textbooks.

Tertiary sources summarize and synthesize primary and secondary sources. These are usually finding aids that provide background information or lists of primary and secondary sources on a particular topic. Tertiary sources include: drug formularies, encyclopedias, handbooks, dissertations, monographs. They contain elements of primary and secondary information that have been collected and succinctly interpreted accordingly [8].

Scientific journals as primary sources of information. A scientific medical journal aims to provide a channel for scientific communication, and an "article" is considered the basic unit of scientific communication [9; 10]. The functions of a scientific journal include registration (prioritization of ideas for authors), distribution, certification (quality control through peer review), and archiving.

There are different estimations of the quantity of scientific journals. One explanation is that some estimations include all established scientific journals, while others include only active (those still publishing) peer-reviewed journals [11]. According to Ghasemi A, et al. (2022), among 52 564 currently active journals, the Institute of Scientific Information (ISI) indexes 13 928 journals in the field of biomedical sciences [12]. As of 2022, more than 5,14 million scientific articles are published each year, including short surveys, reviews, and conference proceedings. The number of published articles increased by 2,06% from 2021, when more than 5,03 million articles were published [13].

Publishing the results of a scientist's research in scientific journals is not only about informing other scientists about discovered knowledge. There are other good enough reasons to publish. Among them: the necessity to confirm the scientist's qualifications for tenure (that is, turning scientific publications into a means of academic advancement); the necessity for a report on the results of research financed by relevant grants, etc. In addition, the current practice of promoting and obtaining funding for further research based on publications in highly prestigious journals leads to an increase in the frequency of questionable research methods, false positive results and can lead to the neglect of new ideas and the independent path of research [14–16].

Scientific journals are owned by a number of publishing houses whose official mission is to enable the scientific world to communicate, read and understand research carried out by scientists around the world. The top 10 publishers by the number of scientific journals include Elsevier, Springer Nature, Taylor & Francis, Wiley, SAGE Publications, Egypts Presidential Specialized Council for Education and Scientific Research, Walter de Gruyter GmbH, Oxford University Press, MDPI AG, Emerald Publishing [17].

Global annual sales of magazine products exceed US$ 28 billion in 2023 [12]. Scientists pay between

$1 000 and $6 000 depending on the journal to publish their research. Scientists pay royalties to journals to publish their self-funded work, and then they pay journals a second time to be able to read their own research and the research of other researchers. Like many aspects of our society, there is a disparity between rich and poor in science as well. Wealthy academic institutions can afford publication fees and journal subscriptions, allowing them to “keep up” with the latest scientific trends. However, many other institutions often struggle to afford expensive subscriptions, denying their scholars access to published works [18; 19]. With the accumulation of evidence over the last decade, there has been a growing awareness that the very existence of scientific journals, due to their inherent hierarchy, poses one of the main threats to state funded science: the hiring, promotion and funding of scientists who publish unreliable scientific data ultimately undermines public trust in science [16].

The existing system of information provision of medical research with the help of printed and electronic medical scientific journals in the 21st century is losing its efficiency and effectiveness. The main reasons for the decrease in efficiency and effectiveness of the modern system of distribution of medical scientific information include: a large number of scientific journals; low circulations of separate journals; a long time for the publication of research results, depending on the number of journal issues during the year; high cost of publishing a scientific article; high cost of journal subscriptions; a significant number of pseudo-scientific journals that publish articles without peer review and editing in order to charge fees for so-called article processing.

An alarming trend is the staggering growth of [20–22]:

− predatory journals, what is not always easy to identify, and which follow an author processing charge business model, requiring authors to pay for article processing, but do not conduct an adequate peer review or any peer review process at all;

− paper factories, that is, companies that “fabricate” scientific articles and sell co-authorship. For example, of the 1,3 million biomedical publications listed on Scimago in 2020, more than 300 000 were likely fake;

− the number of articles generated by artificial intelligence, which raises a number of ethical issues, including the possible creation of false and misleading information, which can have serious consequences if published in the medical literature.

Medical journals may face such risks in the future [23]:

− reduced trust (reputation) among researchers, clinicians and the public if journals are perceived as biased, politicized or influenced by commercial interests;

− reduced relevance, and therefore a decrease in readership and the attraction of high-quality materials in the event that journals are considered outdated or unresponsive to new trends and needs of the scientific and medical communities;

− financial instability if journals are unable to adapt to changes in the publishing space or if they are overly dependent on a single source of income;

− ethical issues related to plagiarism, scientific misconduct, conflict of interest and data confidentiality;

− increasing of competition from new journals and new publishers, as well as from non-traditional sources of scientific information, such as preprint servers, social networks and blogs;

− increased control by regulatory bodies, financial institutions and media, the scientific and medical communities themselves;

− fragmentation and redundancy of information in conditions of growth in the volume of scientific information;

− technological challenges related to data storage, security and availability, as well as the need to adapt to new technologies such as artificial intelligence, blockchain and virtual reality;

− globalization, which will include the necessity to publish articles in several languages, adapt to various cultural norms and practices, and also satisfy the needs and interests of readers and authors from different regions and countries.

Search databases of medical research results. A searchable database of medical research results is a digital repository or collection of academic resources, research articles, reports, journals, books, conference proceedings, and other scholarly materials related to various academic disciplines, stored in electronic format and accessible for processing, retrieval and analysis operations. These databases serve as centralized platforms for researchers and professionals to access high-quality, peer-reviewed information and conduct academic research. Researchers can save time by using databases instead of manually searching numerous journals and publications. Databases collect relevant materials in one place, simplifying the research process. This allows to identify emerging health trends and problems, and to develop and continuate these relevant strategies for improvement of treatment and disease prevention.

A medical database is an organized collection of medical and health-related information that is stored and is accessible by electronic means. These databases serve as a repository for vast amounts of medical literature, scientific articles, clinical data, patient records, and other health-related information. They are essential tools for healthcare professionals and researchers seeking evidence-based information, conducting research and making informed substantiated clinical decisions [24].

Databases are of different types, each of which is designed for specific academic disciplines or purposes [25], namely:

− multidisciplinary databases that cover a wide range of academic fields and contain materials from various disciplines and are suitable for information support of research in various subject areas;

− subject-oriented databases that focus on a single academic field or subject area, providing in-depth and specialized content for researchers in a specific discipline;

− abstract databases that do not provide full-text articles, but instead offer abstracts, citations, and indexing information for academic publications;

− full-text databases that provide access to the full texts of articles, books and other scientific publications in a certain subject area or from various disciplines.

The most famous medical databases include PubMed, MEDLINE, Scopus, Web of Science, Cochrane Library. In addition, there are also a number of other information resources for medical research, such as Google Scholar, Embase, the WHO International Clinical Trials Registry Platform (ICTRP), the database of results of private and publicly funded clinical trials Clinicaltrials.gov, the Registry EU clinical trials, UpToDate and many others.

The huge volume of information contained in various databases requires a significant amount of researchers' time to search and systematize the necessary data. For example, PubMed contains more than 30 million scientific articles in the field of medicine, biology, biochemistry and related disciplines. PubMed covers publications from a variety of medical journals, conferences, and other sources. MEDLINE contains more than 26 million records related to clinical medicine, biochemistry, molecular biology, and other aspects of medical science. Scopus is an abstract database of research literature that covers more than 22 000 journals and more than 150 000 books. Contains nearly 70 million records and 1,4 billion cited references. However, access to databases may be limited and require a subscription or license agreement through libraries, medical institutions, and research organizations.

Among public and private donors, institutions and scientists themselves, support for the availability of scientific research publications is growing [26–28]. In the US, the Office of Science and Technology Policy has announced that all federal agencies must update their public access policies as soon as possible to ensure that the results of research they fund are publicly available, with full implementation of the policy by the end of 2025 [29].

Analysis of a large number of search databases of medical research results indicates on the necessity to create a unified global database that will unite all information resources for medical research.

A unified global system of information support for medical research. There is growing worldwide recognition that health issues are an element of national and global security and must be addressed at the global level. Despite ongoing debate about its exact meaning, the concept of "global health" has been widely adopted at the institutional level. Health is increasingly becoming a matter of diplomacy, foreign policy and international politics as well [30; 31]. WHO's strategy for health care research, endorsed by the 63rd World Health Assembly, is based on the premise that health policies and practices around the world must be based on the best scientific knowledge. The strategy's mission is that all scientists around the world should use science, technology and broader research-based knowledge to provide evidences and tools to global health improvement [32].

In order to promote the use of medical research data for health care decision-making and to shape policy on the development of health research in Europe, in 2011 WHO established the European Advisory Committee on Health Research (EACHR), which reports directly to the WHO Regional Director in Europe. The functions of the EACHR are to advise on policy formulation for the development of health research; revision of the scientific basis of selected regional programs; to coordinate health care research at the international level in the member states of the Region, to consult on new findings on priority health issues and strategies, based on actual data, for their solution; facilitating the exchange of information on research programs in the Region and addressing evidence gaps in priority areas [33].

Free access to scientific information is one of the most important conditions for the progress of science and scientific communication. The global pandemic of COVID-19 and the global health crisis once again vividly demonstrated the need for open, operational and equal access to scientific information for researchers around the world, regardless of geographical, linguistic, gender, or any other limitations. Such access should contribute to the reduction of inequality in access to scientific research, should ensure the rapid exchange of scientific knowledge and received data, promote global scientific cooperation and decision-making based on the base of open scientific knowledge and open data [34]. The efficiency and effectiveness of medical research are essential to achieving the WHO's constitutional goal of "the attainment by all people of the highest attainable standard of health". Article 2 of the WHO Charter defines that one of the main tasks of the organization is "promoting and conducting research in the field of health care" [35]. The plan to create a World Health Research Center within the WHO organizational structure was put forward in the early 1950s. During the 60s, various WHO World Assemblies adopted as many as 15 resolutions on medical research, but a worldwide medical research information system was never created [36].

A significant step towards improving the information provision of medical research was the adoption of the global recommendation on open science. The General Conference of the United Nations Educational, Scientific and Cultural Organization (UNESCO) at its 41st session, held in Paris from November 9 to 24, 2021, adopted the first global recommendation on open science. Open scientific knowledge implies that access to scientific publications on a free basis is provided to everyone, regardless of their location, nationality, race, age, gender, income level, socio-economic status, professional career stage, discipline, language, religion, disability, ethnicity and migration status or any other reasons. Access to paid subscription publications, where immediate access to scientific publications is provided only for a fee, is not in line with this UNESCO Recommendation. Any transfer of copyright to third parties or their licensing shall not limit the right of the public to immediate open access to the scientific publication [37; 38].

Many scientists have already joined UNESCO in developing the first International Recommendation on Open Science, setting global standards for making open science a reality. Geoffrey Bolton, a member of the board of directors of the International Science Council (ISC), said that the fundamental principles of open science are close to crisis. An increasingly dysfunctional scientific publishing system undermines the scrutiny that is vitally important to maintaining scientific rigor by impeding access to the scientific records in a way that undermines global integration, which in turn risks losing public trust [39]. F. Germani (2019), expresses the opinion that there is no need for the existence of scientific journals and proposes the creation of a free online publishing platform based on the UN in the form of a single worldwide database instead of many separate journals [18].

Taking into account the unique challenges associated with the modern system of scientific publication of medical research results, and considering that health promotion policies and practices around the world must be based on the best scientific knowledge and validated medical research results, we believe that WHO, as a global health regulatory agency, can contribute to advancing efforts to improve information support for medical research. Based on the needs of the global health care system, we propose to consider at the level of the WHO a proposal to create under its auspices a unified global system of information support for medical research (UGSISMR).

In our opinion, the structure of the UGSISMR in the form of an electronic database should:

− cover the entire thematic range of medical research results that were conducted and are being conducted in WHO member countries;

− have a convenient interface, the ability to filter the results of scientific research according to various parameters (authors, date of research, keywords), a scientific information management system for centralized aggregation and storage of related data for analysis and reporting.

− to ensure immediate, free to access and free of charge posting of properly peer-reviewed results of fundamental, applied, evaluative, descriptive, exploratory or empirical medical research and implementation research;

− in accordance with the requirements of the Budapest open access initiative [40] to be publicly available on the Internet on a free basis, which will allow any users to freely read, download, copy, distribute, print or refer to the full texts of medical research results, or use them for any other legitimate purpose, without financial, legal or technical barriers;

− to give authors the right to control the integrity of their work and proper recognition and citation;

− to be able to use the flexible capabilities embedded in intellectual property systems to expand general access to knowledge for the benefit of science and society and create opportunities for innovation based on the needs of the global health care system;

− use standardized medical terminology, understandable for researchers from all countries of the world. Standardization of medical terminology greatly facilitates the search and analysis of data related to the patient's age, sex, anamnestic data, performed diagnostic and therapeutic manipulations and procedures, etc. Standardized medical terminology differs in many aspects, and among the most important is the degree of its conceptual orientation and semantic structure, which ensure its rapid computer processing [40]. As of today, the widest list of concept-oriented medical terminology is provided by the terminology resource SNOMED CT, recommended by the National Committee on Vital and Health Statistics (NCVHS). The SNOMED CT model, thanks to its hierarchical structure with an exhaustively detailed set of concepts at each of its levels, can also serve as a source for the development of new concepts for the representation of any medical data [41; 42].

The current outdated system of reviewing texts of medical research results is anonymous, which means that the name of the reviewer is not disclosed. The authors agree with F. Germani (2019) that the evaluation and review system should be open to everyone in the scientific community. Registered users must be allowed to rate and comment medical research results. Publishing the names of reviewers will ensure transparency and improve the quality of reviews [18]. As reviewer selection becomes increasingly difficult due to specialization in increasingly narrow areas of research driven by the gradual growth of knowledge, Andrade- M.A. Navarro, et al. (2012) proposed a method called ***peer2ref*** to support editors in selecting reviewers for scientific manuscripts. The proposed method works on the basis of an input text, usually a manuscript abstract, from which important concepts are extracted as keywords using a fuzzy binary relationship approach and automatically suggests peer reviewers among scholars who are authors of manuscripts published within the last decade on a research topic, which is subject to be reviewed [43].

The introduction of the UGSISMR system will allow establishing uniform requirements for submission and publication of manuscripts, making multilingual scientific knowledge about the results of medical research openly available and reusable for every researcher around the world.

Conclusions. On the basis of the generalization of scientific publications, the essence of types of medical research, sources of information about their results, in particular scientific journals and search databases, have been clarified. Considering that the policies and practices of health support throughout the world should be based on the best scientific knowledge, confirmed by the results of medical research, it is proposed to create UGSISMR under the auspices of the WHO for use on a free basis.

Prospects for further research are a comprehensive study of the principles and mechanism of UGSISMR construction, which will make multilingual scientific knowledge about the results of medical research openly available to every researcher around the world.

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