REVIEW

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CLUSTER ANALYSIS OF INTEGRATED "DRUG SUPPLY" CONCEPT

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The aim of the article is the structure and content specification of the subject area professional term "drug supply" in order to deepen and concretize the conceptual apparatus in the field of the pharmaceutical activity.

Materials and methods. The review presents the analysis of 389 titles of scientific pharmaceutical publications for the periods of 1995–1998 and 2010–2019. The selection of publications was carried out by the random sampling based on the phrases: «drug provision», «medical care», «provision of medicines», «pharmaceutical care», «medicinal services», «drug supply» and their English-language counterparts in Russian and foreign electronic information sources. A methodological base of the study was a cluster analysis of the subject area concept of "drug supply" according to the methodology proposed by E.A. Korzhavykh and I.V. Voronovich. In this study, a cluster was interpreted as a set of publications in which a certain pair of terms was simultaneously cited with a preset frequency of co-citation.

Results. When analyzing the publications, two clusters of the "drug supply" concept were formed for the time periods indicated above. The comparison of the clusters showed an increase in the activity of the scientific research to expand the structure and content of the subject area of the "drug supply" concept. For the modern cluster, 124 co – cited pairs of lexical units were selected. They were grouped into 9 hierarchy levels according to the strength of relationship between an interval of 10 units and mentioning frequencies of the "drug supply" term. At the final stage, a graphical model of the "drug supply" concept cluster was formed. It was established that the lexical units included from the first to the fifth level, are the cluster nucleus of the "drug supply" concept as the most stable part of the lexical array, which it is advisable to rely on when developing a definition for the concept under study.

Conclusion. Thus, the subject field of the "drug supply" concept is characterized by the scientific research, reflecting the socio-economic significance of the objects under study in the field of pharmaceutical activities, and its content is characterized by a high level of pharmaceutical knowledge which describes the most stable elements that make it possible to formulate an adequate definition of the "drug supply" definition.

Keywords: drug supply; pharmaceutical research; cluster analysis; cluster; vocabulary; lexical unit

Abbreviations: DS – drug supply; MEPh – Management and Economics of Pharmacy; LU – lexical unit.

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КЛАСТЕРНЫЙ АНАЛИЗ КОМПЛЕКСНОГО ПОНЯТИЯ «ЛЕКАРСТВЕННОЕ ОБЕСПЕЧЕНИЕ»

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Цель. Уточнение структуры и содержания предметной области профессионального термина «лекарственное обеспечение» для углубления и конкретизации понятийного аппарата в сфере фармацевтической деятельности.

Материалы и методы. В обзоре представлен анализ 389 заголовков научных фармацевтических публикаций за периоды 1995–1998 гг. и 2010–2019 гг. Выбор публикаций осуществлялся методом случайной выборки при помощи словосочетаний: «лекарственное обеспечение», «лекарственная помощь», «обеспечение лекарственными препаратами», «фармацевтическая помощь», «лекарственное обслуживание», «лекарственное снабжение» и их англоязычных аналогов в российских и зарубежных электронных источниках информации. Методической базой исследования выбрали кластерный анализ предметной области понятия «лекарственное обеспечение» по методике, предложенной Э.А. Коржавых и И.В. Вороновичем. Под кластером в настоящем исследовании понимали совокупность публикаций, в которых одновременно цитировалась определенная пара терминов с установленной частотой социтирования.

Результаты. При анализе публикаций сформировали два кластера понятия «лекарственное обеспечение» по указанным временным периодам. Сравнение кластеров показало рост активности научных исследований по расширению структуры и содержания предметной области понятия «лекарственное обеспечение». Для современного кластера отобрали 124 социтируемые пары лексических единиц, которые сгруппировали по 9-ти уровням иерархии по силе связи с интервалом 10 единиц и частотой упоминания термина «лекарственное обеспечение». На заключительной стадии сформировали графическую модель кластера понятия «лекарственное обеспечение». Установили, что лексические единицы, входящие с первого по пятый уровень, являются ядром кластера понятия «лекарственное обеспечение» как наиболее стабильная часть лексического массива, на которую целесообразно опираться при разработке определения для исследуемого понятия.

Заключение. Таким образом, предметное поле понятия «лекарственное обеспечение» характеризуется научными исследованиями, отражающими социально-экономическую значимость изучаемых объектов сферы фармацевтической деятельности, а его содержание – высоким уровнем фармацевтического знания, которым описываются наиболее устойчивые элементы, позволяющие сформулировать адекватное определение дефиниции «лекарственное обеспечение».

Ключевые слова: лекарственное обеспечение; фармацевтическое исследование; кластерный анализ; кластер; лексика; лексическая единица

Список сокращений: ЛО – лекарственное обеспечение; УЭФ – управление и экономика фармации; ЛЕ – лексическая единица.

INTRODUCTION

In modern science, a unity of views on objects, processes and phenomena is ensured by a generally accepted conceptual (terminological) apparatus. However, it is not always possible to obtain consensus in the development of terms due to the presence of subjective approaches to the subject area analysis of scientific knowledge and the description of the changes dynamics taking place in it. Pharmaceutical scientific, practical and educational knowledge exists in the form of a set of interrelated conceptual systems. It should be notified that in the leading profile academic discipline “Management and economics of pharmacy” (MEPh) and a scientific specialty “Organization of pharmaceutical business”, as

their names imply, the concepts and ideas borrowed from management and economic sciences, play a significant role. In modern research, the provisions of these sciences are widely used and developed in relation to scientific tasks and problems of pharmacy as an application area of knowledge.

As a rule, when applying the classical methods of general economics and management, the terms and concepts that have an established interpretation are used, and therefore, no additional interpretations are developed by pharmaceutical specialists. The exception is usually large concepts marked with the word "pharmaceutical" and taking their place in the system of concepts and terminology of the MEPh discipline (i.e., pharmaceutical management, pharmaceutical marketing, and pharmaceutical informing).

The earlier study of the pharmacy fundamental foundations showed that in pharmaceutical knowledge, there are different types of concepts: inherent to only one of the disciplines, interdisciplinary, and so-called concepts-categories. Concepts-categories give an interpretation not only to objects, but also to processes, as well as to phenomena. They are used in almost all pharmaceutical disciplines. This terminology has clear scientific definitions, and can be also institutionalized in legislative and regulatory legal acts that regulate various types of activities. These are such concepts as "drug"; "medicinal preparation"; "dosage form"; "drug circulation"; "drug production"; "pharmaceutical business", etc[1]. At the same time, in the professional pharmaceutical and medical vocabulary, the term "drug supply" (DS) known not only to healthcare professionals, but also to the majority of the population, is widely used. However, this interdisciplinary term has not got an adequate definition yet. In the modern legal field of Russian pharmacy, this concept implies only supplying decreed (preferential) categories of citizens with drugs. Hence it appears that the subject area of the term "drug supply" has not been fully identified and agreed between healthcare professionals.

In the way of formulating the development and substantiation of the DS concept, one of the obstacles, in the authors' opinion, can be its significance not only for pharmaceutical and medical specialists, but also for the general population who are in close contact with the healthcare system. The experience of professional communication shows that the terminological problems of pharmaceutical science and practice go beyond purely linguistic problems. That is due to the high social significance of this terms and concepts group. According to Doctor of Philology, Professor of Tver State University I.P. Susov, "... the formal system becomes a social system, a language in this capacity acts as an activity system. The nomination (name, naming) of elements and processes of human activities is carried out by the entire language system in the unity of its levels"[2]. Therefore, when developing the DS definition, it is necessary to take into account the actual pharmaceutical activities to fulfill the entire range of tasks for the complete, uninterrupted and high quality supplying the population with drugs in order to maintain a socially necessary level of their consumption.

Peculiarities of pharmaceutical terminology, an abundance of terms and nomenclature names that medical and pharmaceutical specialists should master during training in educational institutions and then use in everyday activities, require urgent updating of the existing terminology and developing the modern optimal professional one in order to ensure the unity of approaches to understanding objects, processes and phenomena in the field of pharmaceutical activities, and training the specialists involved in supplying the population with medicines. The expediency of such training is also pointed out by lecturers of leading Russian pharmaceutical universities, who consider the formation of terminological competencies in their students among the priorities of modern and promising pharmaceutical education [1, 2]. For this reason, the authors implemented a review of the subject field to identify and analyze literary sources that define the multidimensional nature of the DS complex concept to clarify its key definition.

The knowledge degree analysis of the scientific problem did not reveal Russian and foreign publications that open up the views of the professional pharmaceutical community on the justification and development of the DS concept.

THE AIM to clarify the structure and content specification of the subject area professional term "drug supply" in order to deepen and concretize the conceptual apparatus in the field of the pharmaceutical activity.

The research objectives were as follows:

1. To identify and explore trends and statistical characteristics of lexical arrays of the structure and content specification of the subject area professional concept term "drug supply" in the main time periods of the formation, development and functioning of the Russian system for providing the population with drugs;

2. To analyze the features of the vocabulary associated with the use of the term "DS" in professional activities;

3. To form and characterize the cluster of the DS concept.

MATERIALS AND METHODS

Study design

At the first stage of the work (February 2020–March 2021), the formation of the initial lexical array of

[1] Federal Law of the Russian Federation on April 12, 2010 No. 61-FZ "On Circulation of Medicines". Available from: http://www.consultant.ru/cons/cgi/online.cgi.

[2] Susov IP. Yazykovaya nominaciya v svete predstavleniya o yazyke kak kodiruyushchej sisteme [Language nomination in the light of the idea of language as a coding system]. Actual problems of language nomination: abstracts of reports of a regional scientific seminar. Saratov: Saratov State Pedagogical Institute. 1988: 14-5. Russian

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scientific papers titles in the MEPh discipline, affecting the subject area of the DS concept (articles, reports, monographs, theses, materials of scientific and practical conferences, congresses) was carried out. At the second stage (April – November 2021), the statistical characteristics of the DS concept lexical arrays were analyzed according to the selected time periods (1995–1998 and 2010–2019). At the third stage (December 2021 – March 2022), the results were discussed and the results of the work done were summed up. The data collection and processing were carried out by the working group of four people: two Doctors of Sciences (Pharmacy), one Doctor of Sciences (Medicine), and one Candidate of Sciences (Pharmacy).

Study time frame

The design of the study included an analysis of trends and qualitative and quantitative changes in the professional pharmaceutical vocabulary in the modern period compared to the trends of the 1990s of the last century, and not a parallel study of two proportional time periods, so the lexical array was formed for the periods of 1995–1998 and 2010–2019. The choice of the non-equivalent time periods used in this study was justified by the fact that in 1995–1998, there was a transition to new market mechanisms for managing pharmaceutical activities, accompanied by a radical transformation of the management system and, in particular, the active formation of a new conceptual apparatus. In the Russian Federation, the end of this period was marked by the adoption of the Federal Law dated June 5, 1998, No.86-FL "On Medicines"[3]. For the first time, it institutionally fixed the basic concepts used in the pharmaceutical science and practice. During 1999–2009, there was practically no scientific activities to improve the terminological apparatus in the field of the Russian pharmacy organization and management. At that time, the industry was adapting to the newly established requirements and accumulating new knowledge, during which some contradictions arose between the institutional order of its regulation and practical development. These contradictions also affected the conceptual apparatus. The second time period (2010–2019) attracted the authors' attention due to the need to review and improve the approaches to the management of the pharmaceutical activities. They were: compiling lists of decreed medicines, introducing labeling of medicines, using good practices in various areas of activity), as well as the widespread use of new terms (for example, "drug care", "pharmaceutical care", "drug service"). On the one hand, the adoption of the Russian Federation Law on Medicinal Products dated April 12, 2010[4] was accompanied by a clarification of professional terminology. On the other hand, it opened a new field for scientific discussions on the problems of forming uniform approaches to defining the conceptual apparatus for the most significant phenomena, processes, objects and subjects that make up the content of pharmaceutical activities.

Information resources

A continuous screening method made it was possible to select 3540 publications in the MEPh discipline and form the initial lexical array on their basis. It consisted of 389 titles of scientific pharmaceutical publications devoted to the problem of forming the conceptual apparatus of modern pharmaceutical science and practice.

The publications choice was carried out with the help of the Russian-language phrases: «лекарственное обеспечение»; «лекарственная помощь»; «обеспечение лекарственными препаратами»; «фармацевтическая помощь»; «лекарственное обслуживание»; «лекарственное снабжение». The English-language analogues were also used: "drug provision", "medical care", "provision of medicines", "pharmaceutical care", "medicinal services", "drug supply". They were used in Russian and foreign electronic sources of information: scientific electronic libraries (e-LIBRARY, CyberLeninka, ational Electronic Library, State Public Scientific and Technical Library, Russian State Library); scientific works archives of the State Commission for Academic Degrees and Titles of the Ministry of Science and Higher Education of the Russian Federation, international databases (Scopus, Web of Science, MEDLINE, Pubmed).

Methodological study base

The main criterion determining the preference of the methodological approach in this work, in comparison with others, was the possibility of decomposing the sample into groups of similar objects with non-numeric features, followed by their processing by standard statistical procedures. As a methodological basis for the study, the cluster analysis was chosen as the most appropriate for the subject area analysis of the term "DS". That includes the processes of selecting objects, generalization and analysis of reliable information about their properties and subsequent clustering, i.e. the distribution of the objects of the obtained sample into separate levels (subgroups), based on their relative identity of properties. The main aim of clustering is to categorize the data into clusters, where the objects are grouped into a certain category according to the principles of a greater similarity between themselves than with the objects from other clusters [3, 4]. The basis for the choice of this cluster analysis was, first, the structure of knowledge in the scientific field, which is a set of cognitive units, the so-called concepts, united by a certain hierarchy and having their own names – terms. A concept is a set of interrelated, simple (elementary) notions and auxiliary lexical units that describe a specific subject area of sci-

[3] Federal Law of the Russian Federation of 05.06.1998 No. 86-FL "On Medicines. Available from: http://www.consultant.ru/document/cons_doc_LAW_19106/.

[4] Federal Law No. 61-FL dated April 12, 2010 "On the Circulation of Medicines" (last edition). Available from: http://www.consultant.ru/document/cons_doc_LAW_99350/.

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ence. Second, the presence of links between elementary notions in the concept makes it possible for us to classify it as a kind of clusters.

Analysis methodology for study subject area

The cluster analysis of the DS subject area was carried out according to the methodology proposed by the specialists of Peoples' Friendship University of Russia – E.A. Korzhavykh and I.V. Voronovich. The essence of the technique lies in the following fact: to calculate strength of relationship between the term DS and another lexical unit (LU), the indicator of the absolute frequency of simultaneous mentioning (co-citation) of the pair "the term "DS → LU" in the analyzed array was used. As a threshold value, the mentioning frequency equal to 3 was taken; therefore, the pairs of co-citations with a link strength value of less than 3 were not included in the cluster. Next, the co-cited pairs were grouped according to the strength of relationship between an interval of 10 LUs and a simultaneous mentioning frequency with the term "DS" equal to from 3 to 10, from 11 to 20, from 21 to 30, "…", from 81 to 90. At the final stage, they formed a graphical model of the DS cluster indicating the frequency of co-citation for its elements and the overall mentioning frequency for the title term. The lexical arrays were characterized using quantitative indicators in absolute and relative (%) terms.

RESULTS AND DISCUSSION

In the pharmaceutical studies devoted to the development of the conceptual apparatus, a cluster was understood as a set of publications in which a certain pair of terms was simultaneously cited (mentioned) with a frequency of joint citations above the accepted threshold value [5, 6]. When analyzing the array of scientific papers, it was revealed that Russian scientists performed a number of works to identify the subject areas of scientific clusters of the MEPh discipline. These are such clusters as "pharmaceutical safety" [7], "management of pharmaceutical activities" [8, 9], "consumers of pharmaceutical products and services" [10], "management of the pharmaceutical products range" [11], "pharmaceutical market" [12, 13] and others. A similar methodological approach was applied by Russian scientists in order to identify the directions and dynamics of the research development in the scientific and practical field of "the drug supply organization" for 1991–2020. [14]. A statistical research tool based on the cluster approach was used by Russian scientists to solve traditional problems when grouping the sets of objects in pharmaceutical marketing [15–17]. In the foreign literature, the publications using the cluster analysis ideology as one of the tools for science researching by quantitative methods, are presented in almost all the areas of health care: in management [18]; in psychiatry [19, 20]; when studying the spread of the COVID-19 pandemic [21]; in pharmacognosy [22, 23]; in pharmacology [24, 25].

General characteristics of lexical arrays

A comparative statistical characteristics analysis of the lexical arrays distributed over periods, made it possible to draw several conclusions about the state of the DS term in the subject area in the analyzed time periods (Table 1).

First, by 2020, the average annual number of papers on the study of the DS system had increased by 3 times: from 11.25 publications per year in the 1990s up to 34.4 publications in 2010s. This fact objectively reflects a difficult economic situation in the country in the 1990s. It prevailed in all areas of activity, including healthcare in general, as well as in medical and pharmaceutical research, which led to a significant decrease in the publication activity of scientists and practitioners.

Second, by 2020, the structure of the subject area of the DS concept had noticeably expanded, which, in the authors' opinion, had been due to the involvement of new ideas, approaches, and resources in the processes of improving the DS system as the Russian healthcare system is being restored and reformed.

Third, by 2020, the subject area of the DS concept had become denser and more concentrated in its content, as indicated by the values of the fourth indicator – "Percentage of LUs with a mentioning frequency equal to 1 and 2". This percentage decreased by 1.3 times (from 80.19% to 59.67%). The fact of the percentage decreasing of such a vocabulary by 2020 may mean its transition to a more stable part of the array. This opinion has been also confirmed by the authors' calculations: 23 positions (21.7%) of the LUs were transferred from the vocabulary array of 1995-1998 in the array of 2010-2019; 7 LUs (6.6%) were entrenched in it with a mentioning frequency of 3 or more times. Therefore, a rarely mentioned vocabulary can be considered as a potential resource for the development of the DS concept cluster.

Fourth, the statistical distribution nature of the mentioning frequency (F_k) has noticeably changed: if in 1995-1998 the first quartile (25% of all LUs positions) accounted for about 60% of the total frequency for these LUs, by 2020 the value of the indicator had reached almost 80%. The fact that in the both arrays the first quartile included more than 50% of the most frequently mentioned LUs allows us to consider such LUs as a "core set" of the vocabulary, the most important for the subject area of the DS term (a cluster core).

Identification and analysis of vocabulary features associated with DS term

The data obtained, primarily at the level of the vocabulary, reflect the formation of quantitative and qualitative changes in the subject area of the DS concept in the studied periods (Table 2).

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Table 1 – Main indicators of vocabulary arrays related to the "drug supply" term in periods of 1995–1998 and 2010–2019

Indicator	Indicator value in periods	
	1995–1998	2010-2019
1. Total number of publications titles with term "DS"	45 (average 11.25 per year)	344 (average 34.4 per year)
2. Total number of LU (without repetitions) mentioned simultaneously with term "DS" (*N*)	106 (average 26.5 per year)	305 (average 30.5 per year)
3. Overall mentioning frequency identified by LUs (*F*)	213 (average 53.3 per year)	1813 (average 181.3 per year)
4. Percentage of LUs positions with mentioning frequency equal to1 and 2 times	80.19%	59.67%
5. First 25% quartile of LUs array: – number of LUs positions (N_k) – total frequency of LUs included in the quartile (F_k)	 27 LUs 27 (59.62% of total frequency)	 76 LUs 414 (78% of total frequency)

Table 2 – Composition of vocabulary most often mentioned simultaneously with "drug supply" term in periods of 1995–1998 and 2010–2019

Ser. No.	Vocabulary	Percentage in the of LU, %	
		1995–1998	2010–2020
1.	Common-literary	35.85	40.57
2.	General scientific	16.98	22.64
3.	Pharmaceutical	3.77	4.72
4.	Medical	17.92	10.38
5.	Other areas of science and technology (economics, finance, sociology, technology, etc.)	25.47	21.69
Total:		100% (106 LUs positions)	100% (LUs positions)

Table 3 – Variants of the term "drug supply" and its synonyms in the array of publications titles for 1995–1998

Ser. No	Variants of the term "drug provision" (identified synonyms)	Number of titles*, units	Percentage of titles, %
1.	Drug provision (including preferential)	32	64.0
2.	Medicinal assistance	9	18.0
3.	Supply by medicinal preparations	4	8.0
4.	Pharmaceutical assistance	2	4.0
5.	Medicinal service	1	2.0
6.	Provision by medicines	1	2.0
7.	Drug supply	1	2.0
Total:		50	100.0

Note: * – 2 LUs could be present in the title at once.

Table 4 – Variants of the term "drug supply" and its synonyms in the array of publications titles for 2010–2019

Ser. No	Variants of the term "drug provision" (identified synonyms)	Number of titles*, units	Percentage of titles, %
1.	Drug provision (including: guaranteed, additional, additional preferential, preferential, preferential and free, software)	255	88.9
2.	Supply by medicinal preparations (including: gratuitous, guaranteed, necessary)	26	9.1
3.	Supply by medicinal preparations	4	1.4
4.	Additional drug provision	1	0.3
5.	Provision by medicinal preparations	1	0.3
Total:		287	100.0

Note: * – 2 LUs could be present in the title at once.

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Table 5 – Rating fragments of LUs mentioned simultaneously with the term "drug supply" in publications titles in 1995–1998 and 2010–2019

Ser. No	LU of 1995–1998 period (in descending order of mentioning frequency)	Absolute frequency	LU of 2010–2019 period (in descending order of mentioning frequency)	Absolute frequency
1.	The sick	15	Population	74
2.	Population	14	The sick	69
3.	System	9	System	69
4.	Conditions	9	Region (*geographic*)	58
5.	City	6	Analysis	57
6.	Organization *(process)*	6	Optimization	41
7.	Improvement	6	Improvement	39
8.	Insurance	6	Citizens	38
9.	Russia	5	Category	34
10.	Optimization	4	Program	32
11.	Problem	4	Assistance	30
12.	State	4	Organization *(process)*	29
13.	Analysis	3	Patients	27
14.	Group	3	Implementation	27
15.	Period	3	Level	27
	…	…	…	…
	Total: *N* = 106	*F* = 213	Total: *N* = 305	*F* = 1813

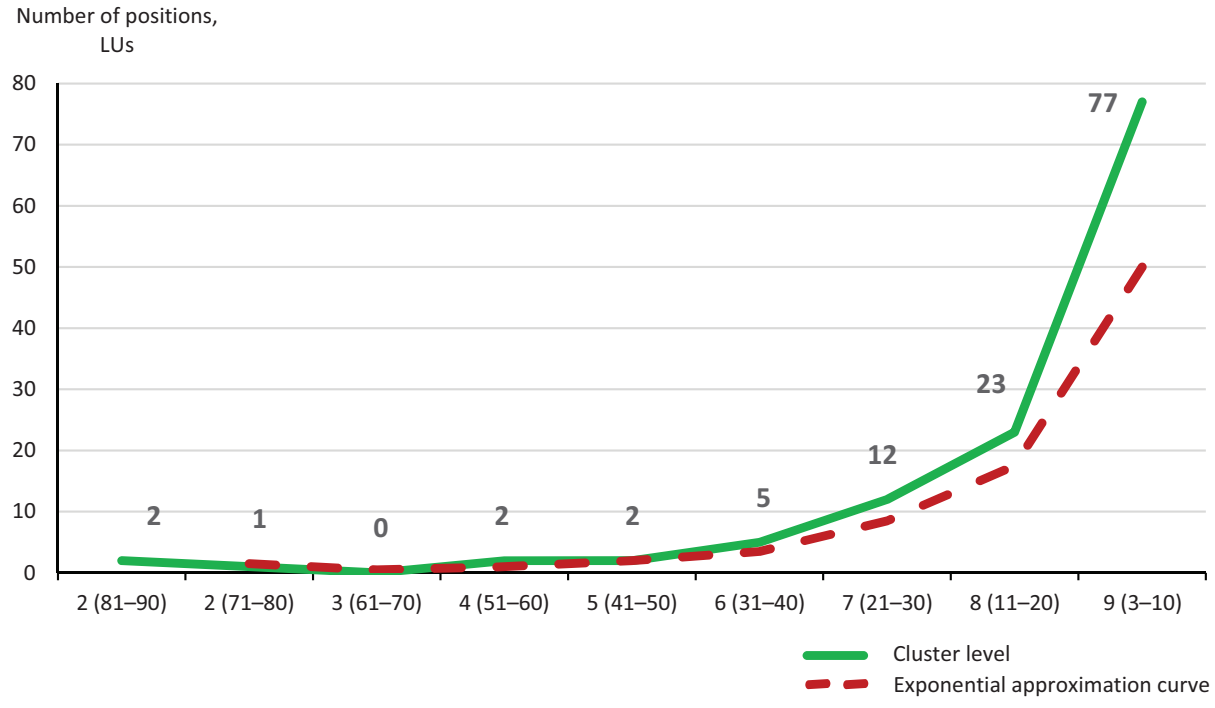

Figure 1 – Distribution of LU by levels in the united cluster of "Medicinal provision" concept for period of 1995–2019

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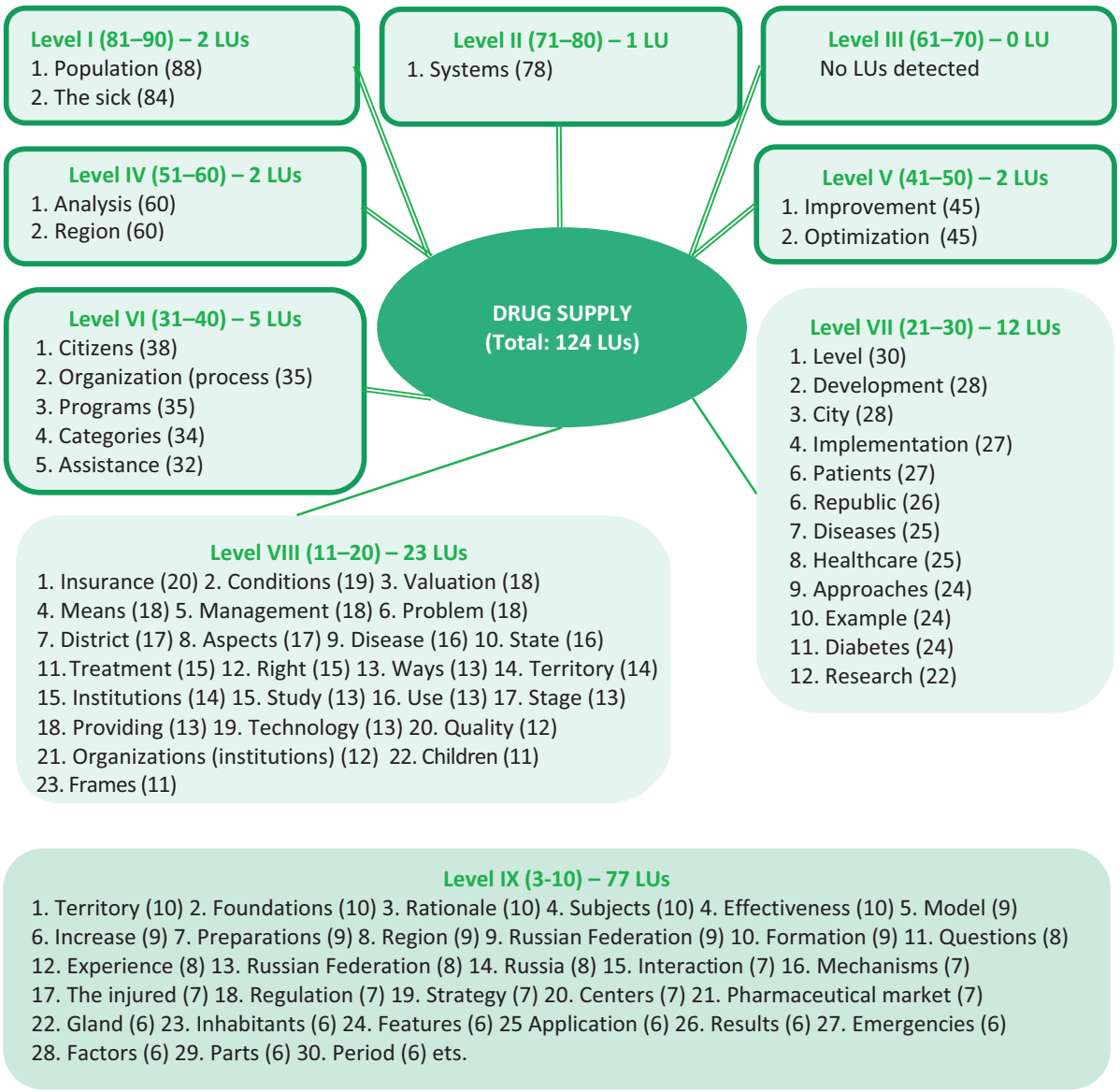

Figure 2 – Modern cluster of the concept of "drug supply"

Note: total number of non-recurring LUs (124) is named DS in the center of the model; for each level of the cluster hierarchy, the number of LUs included in it is indicated; after each LU, in parentheses, the individual strength of relationship is given – this LU named DS, which determined its place at the corresponding level of the cluster.

For a greater accuracy, the comparison was carried out on the same arrays of LUs – 106 positions each with the highest mentioning frequency. It was established that by 1999, general scientific and pharmaceutical vocabularies had begun to prevail in the subject area of DS. Besides, a reduction in the influx of the medical vocabulary and the vocabularies from other fields of science can serve as a sign of the final phase of its formation and the progressive development of the system for providing the population with medicines.

Among the general scientific vocabulary of the array developed by 2020, such conditionally new terms as "mechanism", "modelling", "components", "forecast", etc. have been detected. The modern pharmaceutical vocabulary has included such well-known terms as "pharmacy", "pharmacist", "pharmacy organizations", "pharmacy chains", which had been absent from the array by the beginning of 1999. This circumstance suggests an expansion of the scientific research range, updated by an increase in the role of the distribution network of the pharmaceutical market.

A somewhat different situation is observed with the vocabulary denoting the key functions of pharmaceutical specialists in the system of providing the population with medicines – organization and management. If in 1995-1998 the frequency percentage attributable to the term "organization" (process) was 2.82%, and to the term "management" – 1.41%, then, by 2020, this indicator had decreased to 1.60% and 0.83%, i. e. by 1.8 and 1.7 times, respectively. Consequently, to date, the acti-

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vity of specialists in the field of pharmacy in the study of organizational and managerial functions has decreased. In the authors' opinion, this phenomenon is due to the influence of the external environment, primarily the development and legislative consolidation of the institutional norms that regulate pharmaceutical activities and socio-economic relations that arise between the subjects of the pharmaceutical market.

The frequency dynamics analysis of using LUs "problems" and "approaches" gave paradoxical results: by 2020, with a decrease in the frequency of consideration of "problems" in the publications from 1.88% to 0.77%, the percentage of scientific papers with LUs concerning "approaches" (methodological, organizational-pharmaceutical, organizational-economic, etc.), had increased by almost 3 times. Consequently, the activity of pharmaceutical scientists in relation to the search for ways to improve the system for providing the population with medicines had increased.

An example of a management decision implemented in the healthcare system, adopted at the highest level of the legislative and executive power, is insurance (for example, such LUs as "insurance medicine", "compulsory medical insurance", "voluntary medical insurance"). All these LUs were present in the analyzed arrays. It has been established that in 1995–1998, the above-mentioned terms were used more often than by 2020: with a 3.29% share vs. a 1.05% share of the total frequency (according to the rating of the most frequently mentioned LUs).

One of the most important management functions is related to the possibility of reliable control of process parameters and indicators. A comparative analysis of the vocabulary in the area of the DS population found out that in the array of 1995-1998, there were only 2 such LUs (1.89% of the total number of positions) with a mentioning frequency equal to 2 (0.94% of the total frequency); and these are LUs "quality" and "monitoring". The vocabulary of 2010-2019, on the contrary, is distinguished by a wider set of estimated DS parameters. These are such properties as "quality", "efficiency", "accessibility", "satisfaction", as well as the vocabulary of the evaluation process itself – "monitoring", "indicators", "indices" and others. In total, 9 positions (2.95%) of LUs were identified with a total frequency of 41 mentions (2.26% of the total frequency in the array). The most frequently mentioned LUs were "quality" (12 times) and "efficiency" (10 times). As a rule, in the context of relevant publications, the evaluation aspects of preferential provision of the population with medicines were discussed.

A special area of the studied lexical arrays is formed by a medical vocabulary. This area includes such LUs as "patients", "medical technologies", "treatment", "diagnostics", etc.; the second part of LEs are the terms denoting nosologies, for example, "asthma", "diabetes", "pneumonia", etc. In general, a significant reduction in the percentage of medical LUs and the frequency of their use in the titles of publications was found, respectively, from 16.47% to 8.53% in terms of the number of LUs, and from 15.96% to 10.26% in terms of frequency. In absolute terms, these figures had increased by 2020.

The phenomenon of synonymy in the both studied vocabulary arrays are of particular interest (Tables 3 and 4). The analysis of the publications contexts in which, e.g., the terms "pharmaceutical care", "drug care" are used, showed that it was about providing the population with medicines.

When comparing the data in Tables 3 and 4, it was established that over time the number of synonyms had decreased from 7 to 5, and the use of the term "DS" had increased in absolute and relative terms – from 32 (71.11%) over the period 1995-1998 up to 255 (74.13%) in 2010–2019. This means that the term "DS" is gradually being recognized by an increasing number of researchers as the only one correct.

A noticeable increase in the use of the term "DS" is due to its formation and development within this cluster in 2010–2019. This LU subgroup is associated with the guaranteed provision by medicines to certain categories of citizens who are entitled to state social assistance, including free drug provision. In this array, that is confirmed by the appearance of the following characteristic LUs: "additional drug provision", "citizens", "financing", "beneficiaries", "persons", etc.

Thus, a comparison of the structure and composition of lexical arrays for two periods separated by more than ten years, made it possible to establish the directions the system of providing the population with medicines had developed, and what vocabulary had been consistently mentioned in these years along with the term "DS". The identified features of the vocabulary, form the basis for constructing a schema of the subject area of the term DS in the form of a concepts cluster.

Formation and characteristics of concept "DS" modern cluster

Arranging the analyzed arrays according to the mentioning frequency of the LUs made it possible to form two corresponding ratings. Grouping of LUs by a mentioning frequency, together with the term "DS" and an interval of 10, made it possible to identify the structure of clusters of the DS subject areas by 1999 and 2020. Due to a large volume of ratings, Table 5 shows only 15 positions with the highest frequency.

It was established that by 1999, the cluster of the DS concept had two hierarchical levels: at the first level, there were 2 LUs – "sick" (a mentioning frequency of 15) and "population" (14); at the second level, there were 19 LUs with a mentioning frequency from 3 to 10 – "system(s)", "conditions" (9 of each), "city(cities)", "organization" (process), "improvement", "insurance" (6 of each) and other LUs.

A small number of cluster levels is most likely due to a limited selection of publications and, consequently, relat-

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ed vocabularies. The second reason may be the decrease in the number of the studies on the functioning of the drug supply system for the population in the mid-1990s.

By 2010–2019, the cluster of the DS concept had developed to a significantly larger number of levels – 8, while the numerical values of the mentioning frequency had increased notably. So, at level 1, there was one word – "population" – with a frequency of 74; at level 2, there were two LUs, "sick" and "systems" (69 of each); at level 3, there were also two LUs – "region(s)" as a territorial unit and "analysis" (the frequency of 58 and 57, respectively). As the hierarchical level increased, so did the number of LUs at it. In particular, at level 7, there were 24 LUs with a mentioning frequency from 11 to 20, and at the highest level, 8, there were already 74 LUs with a mentioning frequency from 3 to 10.

Thus, the clusters of the DS concept subject area based on the vocabulary of the two periods differ significantly in structure and in composition; as evidenced by the data shown in Table 5, they have many identical LUs. In the vocabulary of 2010–2019, which is a part of the first 25% quartile, there are 21 LUs (28%) from the array of 1995-1998. Taking into account this fact it was considered expedient to combine these two quartiles and make up a modern cluster of the DS concept based on a new vocabulary array. It is also noteworthy that both 25% quartiles contain more than 60% of LUs positions.

The third (combined) set of the analytical data included 124 LUs with a mentioning frequency from 3 to 88. When grouping LUs by frequency with an interval of 10, 9 hierarchical levels were formed. Fig. 1 shows a statistical distribution of LUs by the established levels (a blue curve), which is described by an exponential curve using the formula (1):

$$y = 02443e^{0.5672x} \quad (1)$$

Herewith, the accuracy of the approximation is high ($R^2 = 0.8628$).

Fig. 2 shows a graphical model of the DS concept united cluster as of 01/01/2020, built at hierarchical levels, taking into account the strength of relationship, i.e. the joint mentioning frequency of LUs with the title term.

Fig. 2 shows the closest relationship of the DS term with the following LUs: "population" (the strength of relationship, i.e. the frequency of the joint mentioning, is 88) and "sick" (84), located at level I. This fact takes place in all two arrays of the vocabulary, retaining its significance for almost 25 years, and, therefore, the LUs "population" and "sick" serve as keys, cluster-forming elements of the DS concept subject area. In this regard, in the authors' opinion, it is incorrect to use the term DS to refer exclusively to the processes of providing reimbursement medicines to the population or certain citizens categories. As this study showed, a preferential provision is only one of the concepts that form the DS concept, and, in turn, is not an elementary (simple) concept either.

The numerical values of the strength of relationship close to the first level of the cluster hierarchy, were revealed for the LUs "system" (78), which was a part of the second level. The third cluster level remained unfilled, while level IV included such LUs very close to it as "region" (an administrative-territorial unit) and "analysis", which have frequency co-citation indicators equal to 60.

The vocabulary denoting processes, activities, is at level V. These are the words "optimization" and "improvement" with the strength of relationship each equal to 45. The LUs occupying level VI – "citizens", "programs", "organization" (process), "categories", "assistance" with the strength of relationship in the range of 31–40, complete the formation of the concepts zone most closely related to the "DS" term (this is confirmed by the horizontal section of the curve in Fig. 1). Due to such a limitation of levels, it is advisable to speak of the "core of the cluster", which includes hierarchy levels from I to V, as the most stable part of the lexical array in terms of composition, which it is advisable to rely on when developing the definition of the DS concept.

Based on the foregoing, a mechanism for the formation of a "cluster core" was developed. A new vocabulary first appears at level IX and can quickly gain a foothold there or quickly go to level VIII (the area of a sharp rise on the exponential curve in Fig. 1); this is the vocabulary operational part of the system for providing the population with medicines. "Borderline" level IX is characterized by the vocabulary that actively penetrates the cluster as it is necessary to promptly solve new organizational and managerial tasks, set by the state for the healthcare system or arising from the practical need for such measures, in the field of providing the population with medicines.

The vocabulary composition at levels VI and VII is also characterized by a variability (the zone of the rise beginning in Fig. 1), representing a kind of "filter" for new words and concepts that come from levels IX and VIII and migrate over time to the higher cluster levels.

Thus, it can be concluded that the DS concept cluster has a dual structure. On the one hand, this is a hierarchical multi-level structure, which is based on the grouping of LUs according to the strength of relationship (a mentioning frequency) with a given interval, and makes it possible to assess the development degree of the subject area under study, based on the number of levels. On the other hand, there are 3 zones in the cluster, conventionally named as "core", "filter" and "border". This type of structure takes into account the distribution nature of the number of LUs by levels and the correspondence of the identified conditional zones to the sections of the exponential curve.

Study Limitation

The presented review limitation of the subject field is in the absence of the quality evaluation of the scientific articles, reports and other materials used in the study.

Besides, the evidence base was limited only by the contexts of these publications titles. Thus, the conclusion drawn from the results of the cluster analysis is based on the available scientific writings, and not on their intrinsic quality or strength of evidence.

CONCLUSION

The results of the study indicate the effectiveness of the applied methodological approach to the quantitative assessment, analysis of the state and dynamics of the subject area development of a large complex pharmaceutical DS concept.

Taking into account the aim and objectives of this study, it should be concluded that the multi-level structure of the DS concept subject area is to a more extent characterized by scientific research reflecting a high degree of socio-economic significance of the objects under study, as well as practical interest in specific problems in the field of pharmaceutical activities and proposals for their decision.

The subject area content of the studied concept is characterized by the methodological conceptual level of accumulated pharmaceutical knowledge, which describes the most stable elements that allow us to formulate an adequate DS definition.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTION

BGS – development of the study concept and design, data collection, analysis and interpretation of the results, preparation of a draft manuscript; KTI – planning and management of the study, processing of the results, participation in the description and analysis of the resultswriting the manuscript; GAB – literature search and analysis, the obtained data analysis and interpretation, writing and design of the final manuscript version.

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