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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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DIGITALISATION OF THE PHARMACEUTICAL INDUSTRY IN KAZAKHSTAN: HOW IS THE SECTOR ADAPTING TO NEW REALITIES?

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Abstract.

Aim: To examine the key areas and main directions of digital transformation in the pharmaceutical industry, with a focus on Kazakhstan, and identify opportunities, barriers and adaptation strategies for pharmaceutical companies to adapt to new technological realities.

Materials and Methods: A narrative analytical review based on secondary data analysis was conducted. Scientific publications, official regulatory documents, state digitalisation materials, market reports, company publications, and industry media sources were analysed. Sources were selected using predefined keywords related to pharmaceutical digitalisation, artificial intelligence, Big Data, e-commerce, drug labelling, traceability, logistics, digital communication, and Kazakhstan's pharmaceutical sector. The selected materials were analysed thematically.

Results: Digitalisation in the pharmaceutical industry includes automation of production processes, artificial intelligence and machine learning, Big Data analytics, e-commerce, digital communication with healthcare professionals and patients, medicine labelling and traceability, and logistics digitalisation. In Kazakhstan, digital transformation is reflected in the development of online pharmacy services, implementation of mandatory medicine labelling, digitalisation of SK-Pharmacy logistics, and the use of Big Data technologies in pharmacy organizations. Kazakhstan-based data show that 97.2% of surveyed pharmacy organizations use basic automation tools, while comprehensive information-analytical systems are implemented in only 23.7%.

Conclusion: Digitalization is becoming a key factor in increasing the competitiveness of the pharmaceutical industry. The experience of pharmaceutical companies demonstrates that effective digital transformation must combine technological innovation, data analysis, engagement with the medical community, and a focus on patient needs. Further development of the industry requires investment in AI, Big Data, digital infrastructure, personnel training, and improved regulatory frameworks.

Key words. Digitalisation of pharmacy, artificial intelligence, pharmaceutical industry, digital technologies, state development programs.

Introduction.

Today, the pharmaceutical market is one of the most dynamic and promising, undergoing active digital transformation. New challenges force companies to focus on customer needs, quickly changing the ways they interact with customers, doctors, and pharmacists.

Digital channels have become a key tool for marketing communications in the digital era. Many pharmaceutical companies are already implementing or planning to implement them. Still, the transition to digital communications and maintaining high efficiency in a traditionally conservative industry is a complex task that requires an integrated approach.

Information technology has become firmly established in the pharmaceutical industry, especially in areas such as information exchange, drug labelling, management accounting, data analysis, the creation of online platforms to improve pharmaceutical services and the discussion of healthcare initiatives. Information systems also automate management, marketing and logistics, significantly impacting pharmaceutical companies' financial performance.

At the beginning of the 21st century, the pharmaceutical industry is experiencing a new stage of informatization associated with the digital transformation of the entire healthcare system. This means the integration of digital technologies into all areas of the pharmaceutical industry, radically changing business processes and interaction with customers.

Thus, digitalisation opens up opportunities for the pharmaceutical industry to revise business models, optimise production processes and increase the industry's ability to respond to modern challenges.

In particular, we are talking about "virtual communication" between pharmaceutical companies and customers, which has received a powerful impetus today thanks to the development of information technology. This highlights the need to pay close attention to current digitalisation trends in the global pharmaceutical industry, as they determine the future of the industry [1].

Digital transformation has become a global trend that determines the competitiveness of the pharmaceutical industry. In Kazakhstan, this process has accelerated thanks to the implementation of the Digital Kazakhstan program (2017–2022), which allowed the country to enter the top 30 digitally developed countries. The growth of the pharmaceutical market by 30% in 2022 (up to 799 billion tenge) and the increase in the share of e-commerce indicate the need to adapt businesses to new technological realities [2,3]. Digital transformation in the pharmaceutical industry is closely linked not only to technological infrastructure but also to the availability of qualified personnel capable of working with new digital tools, regulatory requirements, and inter-organizational

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collaboration models [4]. Previous research on pharmaceutical personnel needs in Kazakhstan showed that the industry faces increasing demand for qualified specialists due to technological development, regulatory changes, and the growing importance of collaboration between organizations [5].

The article aims to analyse key drivers of digitalisation, practical solutions for pharmaceutical companies, barriers to implementation, and workforce-related conditions for digital transformation in the pharmaceutical industry of Kazakhstan.

Materials and Methods.

This study was conducted as a narrative analytical review based on secondary data analysis. The review focused on the main directions of digital transformation in the pharmaceutical industry, with particular attention to the experience of Kazakhstan and examples of digital adaptation among pharmaceutical companies.

The information search was conducted using scientific publications, official regulatory and policy documents, statistical and analytical reports, pharmaceutical market reviews, official websites of state authorities, and publicly available materials from pharmaceutical companies and industry media. The following sources were considered: PubMed, Scopus, Google Scholar, official websites of the Ministry of Health of the Republic of Kazakhstan, the Ministry of Digital Development, Innovations and Aerospace Industry of the Republic of Kazakhstan, materials related to the State Program "Digital Kazakhstan," and publicly available reports and publications on pharmaceutical digitalisation, e-commerce, drug labelling, artificial intelligence, Big Data, and digital communication in healthcare and pharmacy.

The literature and document search was performed using combinations of the following keywords: "digitalisation of pharmacy," "digital transformation in pharmaceutical industry," "pharmaceutical digitalisation," "artificial intelligence in pharmaceutical industry," "Big Data in pharmacy," "e-commerce pharmacy," "digital health Kazakhstan," "drug labelling Kazakhstan," "pharmaceutical traceability," "digital communication with healthcare professionals," and "pharmaceutical industry Kazakhstan." Russian-language search terms were also used, including "цифровизация фармации," "цифровизация фармацевтической отрасли," "искусственный интеллект в фармацевтической промышленности," "маркировка лекарственных средств в Казахстане," and "электронная коммерция в фармации."

The inclusion criteria were: publications and official materials related to digital transformation in the pharmaceutical industry and healthcare; sources discussing artificial intelligence, automation, Big Data, e-commerce, digital communication, labelling, traceability, or digital competencies; documents relevant to Kazakhstan's pharmaceutical sector; and sources published mainly between 2019 and 2025. Earlier publications were included when they provided important theoretical or methodological background on digital transformation, management, or pharmaceutical workforce competencies.

The exclusion criteria were: publications not related to pharmacy, pharmaceutical industry, or healthcare digitalisation; sources without sufficient relevance to the research aim; duplicate materials; non-verifiable web sources; and publications focused only on general information technologies without connection to the pharmaceutical sector.

The selected sources were analysed thematically. The analysis included identification and grouping of the main directions of digital transformation, examples of digital tools used in pharmaceutical practice, Kazakhstan-specific regulatory and market factors, and barriers limiting digital adaptation. Publicly available materials from pharmaceutical manufacturers, distributors, e-commerce services, pharmacy organizations, and biotechnology start-ups operating in Kazakhstan were used as examples of digital adaptation in the sector.

The results of the analysis were grouped into the following thematic categories: production automation and artificial intelligence; Big Data and digital decision-making; e-commerce and digital pharmacy services; digital communication with healthcare professionals and patients; medicine labelling and traceability; digital competencies and management challenges; and regulatory, cybersecurity, and infrastructure barriers.

Results.

Digital pharmacy services and e-commerce in Kazakhstan:

The modern pharmaceutical industry is faced with the need to adapt to digital technologies, which requires a revision of traditional approaches to production, distribution and communication with end consumers [6]. In terms of digital product coverage, the pharmaceutical business in Kazakhstan still remains a fairly conservative area.

In 2022, the e-commerce segment in pharmacy grew by 30%, which is in line with the global trend (global market forecast of USD 4,527 million by 2028). The specialised Daribar service appeared in the summer of 2021, and its clients currently include 146 Almaty and 107 pharmacies in the capital. The main clients of the service are small pharmacy chains and local pharmacies [7].

Big Data and digital maturity of pharmacy organizations in Kazakhstan:

A Kazakhstan-based study on the integration of Big Data technologies into pharmacy organization management provides additional quantitative evidence on the current level of digitalisation in the pharmacy sector. According to the study, 97.2% of surveyed pharmacy organizations used basic automation tools, while comprehensive information-analytical systems were implemented in only 23.7% of organizations. The use of Big Data technologies was uneven and depended on the size of the organization: 2.3% of small pharmacy organizations, 17.8% of medium pharmacy chains, and 51.1% of large pharmacy chains reported using Big Data technologies. This indicates that digital transformation in Kazakhstan's pharmacy sector is developing unevenly, with large pharmacy chains being more digitally advanced than small organizations.

The same study identified several barriers to the implementation of Big Data technologies in pharmacy organizations. The most frequently reported barriers were lack of financial resources, reported by 78.6% of organizations; lack of qualified personnel, 67.2%; insufficient technical infrastructure, 61.9%; low awareness of technology, 58.3%; concerns about information

security, 47.5%; absence of a digitalisation strategy, 42.1%; and complexity of integration with information systems, 39.8%. These findings support the view that digital transformation is not only a technological process but also an organizational, financial, and human-resource challenge. Importantly, pilot implementation of Big Data technologies in pharmacy organizations was associated with measurable operational and economic effects, including a 24.3% reduction in inventory levels, an 18.7% decrease in drug shortages, a 13.2% increase in the average check, an 11.5% increase in gross profit, a 17.9% increase in inventory turnover, and an 8.7-point increase in the net promoter score [8].

Digitalisation of pharmaceutical logistics: SK-Pharmacy case:

Another example of digital transformation in Kazakhstan's pharmaceutical sector is the modernisation of logistics and digital infrastructure by SK-Pharmacy LLP, the Single Distributor of medicines and medical devices. Within the Digitalisation Roadmap for 2025–2026, the company is introducing digital solutions for logistics and warehouse management, developing its own distribution centres, and implementing real-time supply monitoring. The project aims to create a unified digital ecosystem covering the full supply chain, from acceptance and storage to transportation and delivery to medical organisations.

The key planned measures include integration with storage and transportation service providers through external interfaces, creation of a unified warehouse management system database, implementation of a transport management system for route optimisation and supply control, improvement of the Unified Pharmaceutical Information System, and development of automated data exchange between information systems. These measures are expected to increase transparency, accelerate processing of requests from medical organisations, improve logistics accuracy, and reduce dependence on licensed software solutions.

The digitalisation of logistics is also connected with optimisation of procurement and transport services. Since the beginning of 2025, SK-Pharmacy has introduced new rules allowing separate procurement of storage and transportation services, which increased competition and transparency. Cooperation with Kazpost is expected to support the creation of a unified digital delivery chain from central warehouses to medical organisations. According to available reports, the cost of logistics services in several regions decreased by 12–50%, while the total estimated budget savings for 2025 are approximately 600 million tenge [9].

Drug labelling and traceability as a national digitalisation mechanism:

In Kazakhstan, mandatory labelling of all medicinal products began on July 1, 2024. This measure, introduced in accordance with the resolution of the Government of the Republic of Kazakhstan on October 21, 2023, is aimed at increasing the effectiveness of quality control and pharmacovigilance, tracking the life cycle of drugs from production to the consumer, as well as combating illegal trafficking, including counterfeiting. It is expected that the introduction of labelling will contribute to the rational use of drugs, improve procurement planning and ensure reliable drug supply for patients. The system includes all participants in the circulation of medicinal products, and the necessary information systems are integrated to track the movement of drugs from customs to the end user. Nurlan Iskakov, the Chairman of the Medical and Pharmaceutical Control Committee of the Ministry of Health of the Republic of Kazakhstan, noted that the project will prevent the illegal circulation of drugs, including those within the framework of the Medical and Pharmaceutical Administration, which will have a positive effect on the safety of citizens and ensure price control. By the time the system was launched, local executive bodies and medical organisations had worked on purchasing the necessary equipment for reading and marking codes and integrating information systems. Pharmacy organisations had to ensure the presence of a cash register and a 2D scanner for working with branded drugs. At the time of launch, 3,377 pharmacies and pharmacy points, as well as 122 pharmacy warehouses, were equipped with the equipment. The application of marking codes is carried out by manufacturers of medicinal products. The Ministry of Health of the Republic of Kazakhstan made changes to the regulatory acts regarding administrative responsibility for violations of marking rules. Work on the introduction of drug labelling and traceability began in Kazakhstan in 2019, and the pilot project was conducted from September 2019 to July 31, 2021 with the participation of representatives of the pharmaceutical industry [2].

Digital communication and professional engagement: Nobel AFF case:

Digital adaptation in Kazakhstan's pharmaceutical industry is also reflected in the use of online communication channels for healthcare professionals. Nobel Almaty Pharmaceutical Factory, a domestic pharmaceutical manufacturer in Kazakhstan, maintains an official website with a dedicated webinar section intended for doctors and other professional medical personnel. This example indicates the use of digital channels for professional communication and medical information exchange [10].

AI-based biotechnology and pharmaceutical R&D: Arlan Biotech case:

Digital transformation is not limited to pharmacy services, logistics, or marketing; it also affects pharmaceutical and biotechnology research and development. Arlan Biotech, a Kazakhstan-based AI biotechnology start-up, uses generative machine learning to design nanobody sequences targeting specific proteins. According to publicly available information, the technology has potential applications in diagnostics, oncology, autoimmune diseases, and other complex conditions. This example illustrates the emergence of AI-supported R&D approaches in Kazakhstan's biotechnology and pharmaceutical innovation ecosystem [11].

Case of digital transformation: SANTO/Polpharma Group:

In this context, the experience of Polpharma Group, one of the leading international pharmaceutical companies represented in Kazakhstan under the SANTO brand, is of interest. In an interview, the head of the digital technology department, Fabrizio Francesio, reveals the key areas of the company's

innovative activities, including the use of AI, patient behaviour analysis and the development of an ecosystem of interaction with doctors. All this requires constant improvement of their communication skills and the ability to work with diverse groups. Artificial intelligence (AI) is playing an increasingly important role in optimizing production processes [12,13]. At the broader Polpharma Group level, publicly available sustainability data also report measurable operational indicators, including 41 internal system audits in 2023 and a market-based carbon footprint in Poland of 123,858 tonnes CO_2e, 29.77% lower than in 2022 [14].

Digital communication with healthcare professionals and patients:

Digital transformation is not limited to automation and optimization of production. It is also aimed at increasing customer focus and interaction with the medical community. The development of Telegram chats for consultations, such as the I-teka service, allows patients to receive fast and qualified assistance. Personalized marketing based on the analysis of purchase history allows targeting advertising and offering patients the most suitable drugs and services.

Particular attention is paid to increasing adherence to therapy. As Francesio notes, up to 50% of patients stop taking medications a few months after prescription, which increases the risk of relapse. To solve this problem, companies are developing platforms for simplified access to medical information and conducting ethnographic research, studying the real habits of patients.

An important aspect of digital transformation is interaction with the medical community. An example of successful digital communication is the Telegram chat for cardiologists in Kazakhstan. This allows for prompt responses to doctors' requests and reduces the load on traditional communication channels, such as call centres [12,13].

Human-centred and organizational aspects of digital transformation:

In addition, companies pay attention to a human-cantered approach. For example, Polpharma Group is developing internal digital tools for employees, such as remote support systems between plants, and is collaborating with technology companies to test new solutions.

Automation of work processes, application of artificial intelligence, development of customer focus, interaction with the medical community and human-centric approach are interconnected aspects of digital transformation of the pharmaceutical and medical industries. They are aimed at increasing efficiency, reducing costs, improving the quality of patient care and strengthening ties with the medical community [15,16].

Polpharma Group's experience demonstrates that digitalisation in pharmaceuticals should combine technological flexibility ("technological agnosticism") and focus on patient needs.

Discussion.

Digital transformation and managerial competencies.

In the pharmaceutical industry, the effectiveness of sales automation systems implementation is closely related to the level of managers' management competencies, which in turn determines the experience of sales representatives [17]. Insufficient technical literacy of management is often a barrier to sales digitalisation, which highlights the need for training with the support of senior colleagues. In the era of rapid growth of big data, digital platforms are becoming a key solution, providing sales representatives with instant access to up-to-date market information, sales data, and analytical reports. This frees up managers' time to focus on developing their teams and, as a result, improving overall sales performance [5,18,19].

Human capital and risks of digitalisation.

Digitalisation changes the role of pharmaceutical managers and specialists. Digital tools can improve decision-making, accelerate access to information, and support interaction with doctors, pharmacists, and patients. At the same time, the introduction of new platforms may increase the workload of managers and create difficulties if employees are not sufficiently prepared to use digital systems. Previous studies have noted that digitalisation may be associated with risks such as overreliance on data, decision overload, resistance to change, and the need for continuous training [19,20,21].

For pharmaceutical companies in Kazakhstan, these risks are practical rather than theoretical. Digital tools are being introduced in medicine supply, logistics, warehouse management, online communication, and pharmacy services. Therefore, managers must be able to combine digital decision-making with professional judgment, regulatory compliance, and patient safety considerations. The transition from a primarily commercial model to a more information- and patient-oriented model also requires more effective communication resources and better integration between pharmaceutical companies, medical organizations, pharmacists, and patients [3,15,22].

According to Seidaliyeva et al. (2025), pharmaceutical personnel in Kazakhstan face competency gaps related to changing technological and regulatory requirements, including the need for stronger IT and AI-related skills. Therefore, workforce development should be considered one of the supporting conditions for digital transformation, but not as a separate focus of the present review [5].

Barriers to digital transformation in Kazakhstan.

The digitalization process of the pharmaceutical industry in Kazakhstan faces a number of significant challenges that require immediate solutions. First of all, these are regulatory barriers, expressed in the need to adapt existing legislation to rapidly developing digital innovations, such as the introduction of online prescriptions and remote consultations. Secondly, cybersecurity poses a serious threat, since the processing and storage of large volumes of sensitive medical data is associated with high risks of leaks and unauthorized access. Finally, there is the problem of the digital divide, manifested in the uneven implementation of digital technologies in different regions of the country, which can exacerbate inequality in access to modern pharmaceutical services and technologies. Therefore, digital transformation may be limited not only by technological or regulatory barriers but also by insufficient workforce preparedness [5]. Overcoming these barriers is a key condition for a successful and comprehensive digital transformation of the pharmaceutical industry in Kazakhstan.

Conclusion.

The digital transformation of the pharmaceutical industry in Kazakhstan shows significant potential, especially in e-commerce, Big Data analytics, pharmaceutical logistics, automation, digital communication, medicine traceability, and AI-supported biotechnology. The reviewed examples, including Daribar, SK-Pharmacy, pharmacy organizations using Big Data technologies, national medicine labelling, Nobel AFF, Arlan Biotech, and SANTO/Polpharma Group, demonstrate that adaptation occurs at several levels of the pharmaceutical system. Future research should include comparative analysis of several pharmaceutical companies and broader quantitative indicators. Successful digital transformation requires not only investment in AI, Big Data, and digital infrastructure, but also regulatory support, cybersecurity measures, and systematic development of digital and managerial competencies among pharmaceutical personnel.

Author contributions.

Concept – GNK.G., S.S.; Design – C.S., G.U.; Supervision – M.S.; Resources – GNK.G., C.S., S.S.; Materials- G.U., M.S.; Data Collection and/or Processing –GNK.G., S.S.; Analysis and/or Interpretation- GNK.G., S.S..; Literature Search – S.S.; Writing – GNK.G., S.S.; Critical Reviews – C.S., G.U., M.S.

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АННОТАЦИЯ

Цель: *Изучить ключевые области и основные направления цифровой трансформации в фармацевтической отрасли, с акцентом на Казахстан, и определить возможности, барьеры и стратегии адаптации фармацевтических компаний к новым технологическим реалиям.*

Материалы и методы: *Проведен нарративный аналитический обзор на основе анализа вторичных данных. Проанализированы научные публикации, официальные нормативные документы, государственные материалы по цифровизации, отчеты о рынке, публикации компаний и отраслевые СМИ. Источники были отобраны с использованием заранее определенных ключевых слов, связанных с цифровизацией фармацевтической отрасли, искусственным интеллектом, большими данными, электронной коммерцией, маркировкой лекарственных средств, отслеживаемостью, логистикой, цифровой коммуникацией и фармацевтическим сектором Казахстана. Отобранные материалы были проанализированы тематически.*

Результаты: *Цифровизация в фармацевтической отрасли включает автоматизацию производственных процессов, искусственный интеллект и машинное обучение, аналитику больших данных, электронную коммерцию, цифровую коммуникацию с медицинскими работниками и пациентами, маркировку и отслеживаемость лекарственных средств, а также цифровизацию логистики. В Казахстане цифровая трансформация отражается в развитии онлайн-аптек, внедрении обязательной маркировки лекарственных средств, цифровизации логистики СК-Фармации и использовании технологий больших данных в фармацевтических организациях. Данные по Казахстану показывают, что 97,2% опрошенных фармацевтических организаций используют базовые инструменты автоматизации, в то время как комплексные информационно-аналитические системы внедрены только в 23,7%.*

Вывод: *Цифровизация становится ключевым фактором повышения конкурентоспособности фармацевтической отрасли. Опыт фармацевтических компаний демонстрирует, что эффективная цифровая трансформация должна сочетать технологические инновации, анализ данных, взаимодействие с медицинским сообществом и ориентацию на потребности пациентов. Дальнейшее развитие отрасли требует инвестиций в ИИ, большие данные, цифровую инфраструктуру, обучение персонала и совершенствование нормативно-правовой базы.*

Ключевые слова: *цифровизация фармацевтики, искусственный интеллект, фармацевтическая промышленность, цифровые технологии, государственные программы развития.*

რეზიუმე.

მიზანი: ფარმაცევტულ ინდუსტრიაში ციფრული ტრანსფორმაციის ძირითადი სფეროებისა და ძირითადი მიმართულებების შესწავლა, ყაზახეთზე ფოკუსირებით, და ფარმაცევტული კომპანიებისთვის ახალ ტექნოლოგიურ რეალობებთან ადაპტაციის შესაძლებლობების, ბარიერების და ადაპტაციის სტრატეგიების იდენტიფიცირება.

მასალებიდამეთოდები:ჩატარდამეორადიმონაცემების ანალიზზე დაფუძნებული ნარატივი ანალიტიკური მიმოხილვა. გაანალიზდა სამეცნიერო პუბლიკაციები, ოფიციალური მარეგულირებელი დოკუმენტები, სახელმწიფო დიგიტალიზაციის მასალები, ბაზრის ანგარიშები, კომპანიის პუბლიკაციები და ინდუსტრიის მედია წყაროები. წყაროები შეირჩა წინასწარ განსაზღვრული საკვანძო სიტყვების გამოყენებით, რომლებიც დაკავშირებულია ფარმაცევტულ დიგიტალიზაციასთან, ხელოვნურ ინტელექტთან, დიდ მონაცემებთან, ელექტრონულ კომერციასთან, წამლების ეტიკეტირებასთან, მიკვლევადობასთან, ლოჯისტიკასთან, ციფრულ კომუნიკაციასთან და ყაზახეთის ფარმაცევტულ სექტორთან. შერჩეული მასალები თემატურად გაანალიზდა.

შედეგები: ფარმაცევტულ ინდუსტრიაში დიგიტალიზაცია მოიცავს წარმოების პროცესების ავტომატიზაციას, ხელოვნურ ინტელექტს და მანქანურ სწავლებას, დიდი მონაცემების ანალიტიკას, ელექტრონულ კომერციას, ჯანდაცვის სპეციალისტებთან და პაციენტებთან ციფრულ კომუნიკაციას, მედიკამენტების ეტიკეტირებას და მიკვლევადობას, და ლოგისტიკის დიგიტალიზაციას. ყაზახეთში ციფრული ტრანსფორმაცია აისახება ონლაინ აფთიაქის მომსახურების განვითარებაში, მედიკამენტების სავალდებულო ეტიკეტირების დანერგვაში, SK-Pharmacy ლოჯისტიკის დიგიტალიზაციაში და დიდი მონაცემების ტექნოლოგიების გამოყენებაში ფარმაცევტულ ორგანიზაციებში. ყაზახეთის მონაცემები აჩვენებს, რომ გამოკითხული საფთიაქო ორგანიზაციების 97.2% იყენებს ავტომატიზაციის ძირითად ინსტრუმენტებს, მაშინ როცა ყოვლისმომცველი ინფორმაციულ-ანალიტიკური სისტემები მხოლოდ 23.7%-შია დანერგილი.

დასკვნა: დიგიტალიზაცია ფარმაცევტული ინდუსტრიის კონკურენტუნარიანობის გაზრდის მთავარი ფაქტორი ხდება. ფარმაცევტული კომპანიების გამოცდილება აჩვენებს, რომ ეფექტური ციფრული ტრანსფორმაცია უნდა აერთიანებდეს ტექნოლოგიურ ინოვაციებს, მონაცემთა ანალიზს, სამედიცინო საზოგადოებასთან ჩართულობას და პაციენტის საჭიროებებზე ფოკუსირებას. ინდუსტრიის შემდგომი განვითარება მოითხოვს ინვესტიციებს ხელოვნურ ინტელექტში, დიდ მონაცემებში, ციფრულ ინფრასტრუქტურაში, პერსონალის მომზადებასა და მარეგულირებელი ჩარჩოების გაუმჯობესებაში.

საკვანძო სიტყვები: ფარმაციის დიგიტალიზაცია, ხელოვნური ინტელექტი, ფარმაცევტული ინდუსტრია, ციფრული ტექნოლოგიები, სახელმწიფო განვითარების პროგრამები