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INTELLIGENT MEDICAL SYSTEMS BASED ON ARTIFICIAL INTELLIGENCE

The article is devoted to the analysis of modern intelligent systems in medicine based on artificial intelligence. The work aims to analyze the promising areas of application of intelligent medical systems based on artificial intelligence, to identify the most promising ones for use in Ukraine and to explore their advantages and disadvantages. The article provides a rationale for the expediency of using AI-based systems, analyzes the disadvantages and ways to eliminate them. One of the key advantages is the ability to analyze huge amounts of medical data and extract useful information from it, which helps doctors in accurate diagnosis, treatment planning, saves time and makes the approach to treatment personalized. The author formulates the main requirements for such systems: filling in personal data by the patient and answering questions before the appointment, initial examination and prescription of tests, operation of an artificial neural network and its conclusions, and verification of all available data by a narrow specialist for the final treatment strategy. It is proposed to consider three main areas of diseases that are the largest causes of death both in Ukraine and in the world. Other important aspects discussed in this article include ensuring the confidentiality of medical data and addressing ethical issues in the use of artificial intelligence in medicine. It also discusses possible obstacles and challenges associated with the introduction of intelligent medical systems. The article emphasizes the importance and potential of intelligent medical systems based on artificial intelligence to improve the efficiency and accuracy of medical diagnosis and treatment. They are of great importance to the medical community and society as a whole and can contribute to improving the overall healthcare system. This work opens up the possibility of improving the process of diagnosing diseases that are difficult to detect and have no clear protocols for treatment.

Key words: *artificial intelligence, artificial neural networks, intelligent system, medical diagnostics, training.*

Formulation of the problem. Modern medicine is on the verge of revolutionary changes due to the active use of artificial intelligence (AI) and the creation of intelligent medical systems. The integration of artificial intelligence into medical practice is becoming a key point in improving the processes of diagnosing, treating, and monitoring patients. Intelligent medical systems capable of analyzing large volumes of medical data enable not only accurate and fast diagnostics, but also provide support in decision-making by medical professionals.

Recent years have witnessed significant advances in the use of AI in medicine. Due to the increasing availability of data, the development of computing technologies, and the advancement of machine learning methods, intelligent medical systems are becoming more efficient and powerful. For example, systems for automated medical image analysis can detect pathologies with impressive accuracy, and health data analysis systems can predict the development of diseases at early stages, allowing for timely intervention and prevention of complications.

However, despite the variety of achievements in this area, there are issues and challenges that require further research and the development of innovative solutions. Ensuring patient privacy, ethical issues of using artificial intelligence in medicine, and the problem of limited and unrepresentative data are just some of the issues that require attention in the context of intelligent medical systems.

Task statement. The purpose of the article is to analyze the promising areas of application of intelligent medical systems based on artificial intelligence, to identify the most promising ones for use in Ukraine, and to explore their advantages and disadvantages.

Analysis of recent research and publications. After analyzing the research and publications of recent years, we can identify the following promising areas of medical systems based on artificial intelligence:

1. Medical Imaging: AI has made significant advancements in medical imaging, particularly in areas like radiology and pathology. Researchers have been working on AI algorithms that can assist in the detection and diagnosis of various medical

conditions, such as cancer, through the analysis of medical images, including X-rays, MRIs, CT scans, and histopathological slides [1–2].

2. Disease Prediction and Risk Assessment: AI-based systems are being developed to predict the risk of various diseases based on patient data, genetics, and lifestyle factors. These systems can assist in early disease detection and the development of personalized treatment plans [3].

3. Drug Discovery: AI is being used to accelerate drug discovery processes. Researchers are using machine learning models to analyze biological data, identify potential drug candidates, and predict their effectiveness in treating specific diseases [4].

4. Natural Language Processing (NLP): NLP techniques are applied to extract valuable information from electronic health records (EHRs), clinical notes, and medical literature. AI-powered NLP systems help healthcare professionals better understand patient histories and make informed decisions [5].

5. Remote Patient Monitoring: AI-enabled devices and applications are being used for remote patient monitoring, especially for chronic disease management. These systems can collect and analyze patient data in real-time, allowing for timely interventions and reducing the need for frequent hospital visits [6].

6. Robot-Assisted Surgery: AI-driven robotic systems are assisting surgeons in performing complex surgical procedures with enhanced precision and minimally invasive techniques [7].

7. Ethical and Privacy Considerations: As AI becomes more integrated into healthcare, there is a growing focus on addressing ethical concerns and ensuring patient privacy and data security. Research on ethical guidelines and data protection is an important aspect of AI in healthcare [8].

8. Clinical Decision Support: AI-based clinical decision support systems are being developed to provide healthcare practitioners with evidence-based recommendations for patient care, improving diagnosis and treatment planning [9].

9. Healthcare Workflow Optimization: AI is used to streamline administrative tasks, optimize hospital operations, and improve resource allocation, ultimately reducing costs and improving the overall efficiency of healthcare delivery [10].

10. Explainable AI (XAI): Researchers are working on making AI systems more transparent and interpretable, especially in critical healthcare applications where trust and understanding of the decision-making process are essential [11–12].

11. Validation and Regulatory Approval: Ongoing research also focuses on validating AI algorithms and obtaining regulatory approvals, which are crucial steps in bringing AI-based medical systems into clinical practice [13–14].

Outline of the main material of the study. Having analyzed the sources of information, we can identify the main advantages and disadvantages of AI-based medical systems.

Advantages of intelligent medical systems:

1. Improved diagnostic accuracy: Intelligent systems can analyze medical images and data with higher accuracy, which helps in the early detection and accurate diagnosis of various diseases, including cancer and other serious pathologies.

2. Improving the effectiveness of treatment: Intelligent systems can develop individualized treatment plans based on patient characteristics, which contributes to more effective and personalized treatment.

3. Reducing time: AI can perform routine tasks and data analysis much faster than humans, allowing healthcare professionals to focus on more complex tasks.

4. Increased accessibility of medical services: Intelligent healthcare systems can be used for remote patient monitoring and telemedicine, reducing geographical limitations on access to healthcare.

5. Reducing human error: Automated systems are less prone to errors, which can improve patient safety and avoid negative consequences from undiagnosed or misdiagnosed diseases.

Disadvantages of intelligent medical systems:

1. Ethical issues: The use of AI in medicine raises ethical dilemmas, such as data privacy, responsibility for decisions, and disclaimers in case of errors or incorrect decisions.

2. Data privacy: The collection and processing of medical data during the operation of intelligent systems requires strict adherence to privacy and data protection standards.

3. Training on a limited amount of data: AI models may require a large amount of data to train, and it is sometimes difficult to find the right amount of data for rare diseases or specific populations.

4. Need for human expertise: AI may have limited understanding of context and situations that require human expertise and clinical experience.

5. Cost and infrastructure: Implementing intelligent healthcare systems can require significant hardware and infrastructure support costs.

Let's take a closer look at the disadvantages of intelligent medical systems and whether they can be circumvented. The problem of ethical issues can be solved if the intelligent system is only auxiliary in making a diagnosis and choosing tactics and

treatment regimens, i.e. it will give its conclusions in parallel to the doctor as an auxiliary tool. Data privacy and confidentiality can be ensured through information protection at the level of the state or the institution where the doctor works, and the law on medical confidentiality applies to the doctor.

Training models based on limited data and the problem of non-representativeness are significant challenges in the field of artificial intelligence, especially in tasks related to medicine and other fields. Here are strategies and solutions that can be used to address these issues:

1. Collecting more data: The first step is to try to collect more data if possible. This may involve expanding the database, collaborating with other healthcare institutions, or using additional sources of information

2. Synthetic data generation: Using generative models such as GANs (Generative Adversarial Networks) to create synthetic data can help expand the dataset if real data is not enough.

3. Use of pre-trained models: Using pre-trained models, especially large models with neural networks that have been trained on big data, can provide an improved starting point for a model trained on limited data.

4. Balanced sampling: When using unrepresentative data, sampling methods that increase the representativeness of the samples should be preferred, for example, by using random sampling or weighting the data.

5. Overfitting and regularization: It is important to avoid overtraining the model on limited data. Use regularization techniques and limit model complexity to prevent overfitting.

6. Anomaly and duplicate analysis: Data mining and data processing techniques can be used to remove anomalies and duplicates.

7. Expert input: It is important to incorporate clinical experience and expert knowledge into the model training process, as this can help make more informed decisions.

8. Validation on representative data: Once the model is trained, it is important to validate it with representative data to assess its performance in real-world settings.

9. Combining with other sources of information: Combining information from different sources, such as clinical data, images, and genetic data, can enrich the dataset and improve the quality of the model.

The problem of overcoming training on a limited amount of data can be overcome by involving the largest specialized institutions to create a large sample of data for training the neural network, thereby

solving the problem of the need for human expertise: experts from specialized institutions will provide their comments when training the artificial neural network. The issue of infrastructure cost remains, but if the system is implemented at the local level, rather than at the national or global level, the cost of creation and maintenance will not be high.

Based on the above, we can conclude that the advantages significantly outweigh the disadvantages and the proposed steps can correct the disadvantages.

Comparing the causes of mortality in the world and in Ukraine according to the World Health Organization (WHO) (Table 1). The three leading causes of death in the world and in Ukraine are the same, so it is worth paying attention to cardiovascular disease, cancer, and respiratory disease. Many studies have been conducted that can identify abnormalities for these three diseases using artificial intelligence-based image recognition, so it is worth exploring other aspects of these diseases, namely the recognition and classification of poorly diagnosed diseases, and assistance to primary care physicians in decision-making.

Table 1

Causes of mortality in the world and Ukraine

№	World	Ukraine
1	Cardiovascular Diseases	Cardiovascular Diseases
2	Cancer	Cancer
3	Respiratory Diseases	Respiratory Diseases
4	Infectious Diseases	Liver Disease
5	Alzheimer's Disease and Dementia	Injuries
6	Diabetes	Suicides
7	Kidney Disease	Infectious Diseases
8	Liver Disease	Alcohol-related conditions
9	Traffic Accidents	Malnutrition
10	Suicides	
11	Hypertension	
12	Malnutrition	

Since patients first go to family doctors or therapists, the algorithm for an intelligent medical system would look like Figure 1.

Conclusions. Artificial intelligence is actively used in medicine, it's advantages outweigh its disadvantages and make its use expedient. The optimization of the medical system is achieved by improving diagnostics, reducing the workload of medical staff, providing a personalized approach to patient treatment, and making medical care more accessible. The three leading causes of death are cardiovascular disease, cancer, and respiratory diseases. Recently, more and more systems using
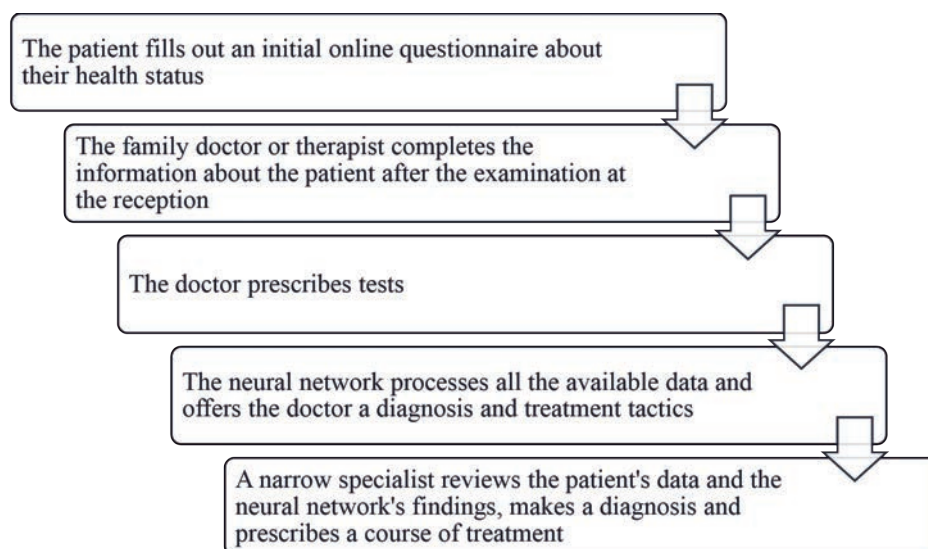
Fig. 1. The algorithm for an intelligent medical system

artificial intelligence have been developed and researched, but the issue of diagnosing and treating difficult-to-diagnose diseases is still a problem for doctors, which reveals a promising area for the application of artificial intelligence in medicine.

Intelligent medical systems based on artificial intelligence have the potential to change the face of medicine, improve the quality of diagnosis and treatment, and make medical care more accessible and efficient.

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Коломоєць С.О. ІНТЕЛЕКТУАЛЬНІ МЕДИЧНІ СИСТЕМИ НА ОСНОВІ ШТУЧНОГО ІНТЕЛЕКТУ

Стаття присвячена аналізу сучасних інтелектуальних систем в медицині на основі штучного інтелекту. Робота має на меті проаналізувати перспективні сфери застосування інтелектуальних медичних систем на основі штучного інтелекту, визначити найбільш перспективні для використання в Україні та дослідити їх переваги та недоліки. У статті наведено обґрунтування доцільності використання систем на основі штучного інтелекту, розібрані недоліки та шляхи їх усунення. Однією з ключових переваг є здатність аналізувати величезні обсяги медичних даних та виділяти з них корисну інформацію, що допомагає лікарям у точній діагностиці, плануванні лікування, економить час та робить підхід до лікування персоналізованим. Сформульовано основні вимоги до подібних систем: заповнення пацієнтом персональних даних та відповіді на питання до прийому, первинний огляд та призначення аналізів, робота штучної нейронної мережі та її висновки, перевірка вузьким спеціалістом усіх наявних даних для остаточної стратегії лікування. Запропоновано розглянути три основних напрямки захворювань, які є найбільшими причинами смертності як в Україні, так і світі. До інших важливих аспектів, розглянутих у цій статті, належить забезпечення конфіденційності медичних даних та вирішення етичних питань у використанні штучного інтелекту в медицині. Також розглядаються можливі перешкоди і виклики, пов'язані з впровадженням інтелектуальних медичних систем. Стаття підкреслює важливість і потенціал інтелектуальних медичних систем на основі штучного інтелекту для підвищення ефективності та точності медичної діагностики та лікування. Вони мають велике значення для медичної спільноти та суспільства в цілому і можуть сприяти поліпшенню загального стану охорони здоров'я. Ця робота відкриває можливості покращення процесу діагностики захворювань які складні для виявлення і не мають чітких протоколів для лікування.

Ключові слова: інтелектуальна система, навчання, медична діагностика, штучний інтелект, штучні нейронні мережі.