

## ARTIFICIAL INTELLIGENCE IN CARDIOLOGY

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### Abstract

One of the ongoing trends in cardiology today is the proposed use of artificial intelligence (AI) to improve and expand the efficiency of the cardiologist. Cardiology is a broad field that focuses on a large number of diseases that are specifically related to the heart, circulatory system, and their functions. Thus, a person may have similar symptoms and diagnostic signs, which makes it difficult for the doctor to determine the real problem associated with the heart. Thus, the use of artificial intelligence is aimed at ridding doctors of this obstacle and improving the quality of patient care. Artificial intelligence techniques such as machine learning, deep learning, and cognitive computing can play a crucial role in the early detection, as well as in predicting and predicting results. The widespread use of electronic medical records (EMRs) has led to the creation of massive data sets (quantitative, qualitative, and transactional data) that require interpretation of artificial intelligence methods.

**Keywords:** artificial intelligence, circulatory system, cardiology, diagnostics, cardiovascular.

### Аңдатпа

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## КАРДИОЛОГИЯДАҒЫ ЖАСАНДЫ ИНТЕЛЛЕКТ

Кардиолог жұмысының тиімділігін арттыру және кеңейту үшін жасанды интеллект (ЖИ) пайдалану бүгінгі таңда кардиологиядағы өзекті бағыттардың бірі болып табылады. Кардиология-бұл жүрекке, қан айналымы жүйесіне және олардың функцияларына байланысты көптеген ауруларға бағытталған кең сала. Осылайша, адамның ұқсас белгілері мен диагностикалық белгілері болуы мүмкін, бұл дәрігерге жүрекке байланысты нақты проблеманы анықтауды қиындатады. Осылайша, ЖИ қолдану дәрігерлерді осы кедергіден құтқаруға және пациенттерге қызмет көрсету сапасын жақсартуға бағытталған. Машиналық оқыту, терең оқыту және когнитивті есептеу сияқты жасанды интеллект әдістері ерте анықтау мен диагностикада, сондай-ақ нәтижелерді болжауда шешуші рөл атқара алады. Электрондық медициналық жазбаларды (ЭМЖ) кеңінен қолдану ЖИ әдістерін түсіндіруді қажет ететін жаппай мәліметтер жиынтығын (сандық, сапалық және транзакциялық мәліметтер) құруға әкелді.

**Түйін сөздер:** жасанды интеллект, қан айналымы жүйесі, кардиология, диагностика, жүрек-тамыр жүйесі.

### Аннотация

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## ИСКУССТВЕННЫЙ ИНТЕЛЛЕКТ В КАРДИОЛОГИИ

Одной из актуальных тенденций в кардиологии сегодня является предлагаемое использование искусственного интеллекта (ИИ) для повышения и расширения эффективности работы кардиолога. Кардиология – это обширная область, которая фокусируется на большом количестве заболеваний, которые конкретно связаны с сердцем, системой кровообращения и их функциями. У человека могут быть схожие симптомы и диагностические признаки, что затрудняет врачу определение реальной проблемы, связанной с сердцем. Таким образом, использование искусственного интеллекта направлено на избавление врачей от этого препятствия и повышение качества обслуживания пациентов. Методы ИИ, такие как машинное обучение, глубокое обучение и когнитивные вычисления, могут сыграть решающую роль в раннем выявлении и диагностике, а также в прогнозировании результатов. Широкое использование электронных медицинских записей (ЭМЗ) привело к созданию массивных наборов данных (количественных, качественных и транзакционных данных), которые требуют интерпретации методами ИИ.

**Ключевые слова:** искусственный интеллект, система кровообращения, кардиология, диагностика, сердечно-сосудистая система.

## Introduction

Relevance of the work. Diagnosis of cardiovascular risk is one of the most important tasks of Cardiology. Currently, an electrocardiogram (ECG) is the most common method of diagnosing the functioning of the human cardiovascular system, as it is a carrier of the most important systemic rhythms. Automatic electrocardio signal analysis is a complex task.

Thus, the relevance of this study is determined by the need to improve the quality indicators of predicting the risk of cardiovascular complications.

Why does AI make diagnoses better than humans?

Cardiological potential AI began to unfold in April 2017. Then at the University of Nottingham, an algorithm was created that, after analyzing the data of 378 thousand patients on 22 indicators (age, nationality, various diseases, cholesterol level...), predicted the risk of developing a heart attack more accurately than doctors: from 74.5% to 76.4% accuracy against 72.8%. "Predictions" were made on the last sample, so you could immediately see that artificial intelligence would save 355 more lives than doctors.

How does it work? A computer program that works with "big data" can find non-obvious connections between different parameters of the body and make more accurate conclusions. For example, doctors (based on research data) it is still believed that diabetes is a risk factor for heart attacks, but the machine ignored this parameter. Strikingly, the program didn't have any data on the patient's lifestyle and genetics, whereas the doctors did. What happens if the AI gets access to more complete data? How many lives can he save?

Google-I detects heart attacks.

Researchers from the medical company Verily (owned by Google) have developed a new method for detecting cardiovascular diseases by scanning an image of the retina of the eye. To train the Verily algorithm, they used data from 300,000 people: an image of their retinas and information about their health status, age, blood pressure, and whether they smoke. The neural network quickly formed an "opinion" about certain patterns and learned to conclude new data [1]. Now, if we compare it with the most accurate medical algorithms that predict the probability of a heart attack in the next 5 years and give an accuracy of 70%, we will see that Verily is right in 72%, and it does not require either a blood donation or a visit to the doctor. While the development is not in a hurry to apply – it is a serious matter, and you need to test everything thoroughly.

AI will help predict the effectiveness of treatment.

Typically, testing new technology or treatment is done like this: patients are randomly divided into two groups, after which one group is given this type of treatment, the other a placebo. Or maybe you can check the effectiveness of the method differently? Could it be that some groups will benefit from a treatment that does not work with others?

Finnish researchers at the University of Eastern Finland have used AI-based modeling to compare different treatment alternatives and understand which cardiovascular patient is best suited for a particular CPAP method. The SIPAP device is a small compressor that supplies a constant flow of air under a certain pressure to the respiratory tract through a flexible tube and a sealed nasal mask. Thus, it does not allow the airways to close and block the flow of air. As it turned out, CPAP helps to reduce mortality and the number of strokes and heart attacks by 5% in patients with sleep apnea, and for patients with heart disease, it is less useful and cannot be the technology of choice for them. In picture 1, you can see what the device itself looks like.

*Current trends.*

Screening test results such as an echocardiogram, MRI, or computed tomography have long been suggested to be analyzed using more advanced techniques in technology [2]. Thus, although artificial intelligence has not yet become widespread in clinical practice, it is seen as the future of healthcare.

This is because artificial intelligence or machine learning will allow you to accurately determine the functions of the patient and make a diagnosis from the beginning to the end of the therapeutic process. In particular, the use of artificial intelligence in cardiology is aimed at research and development, clinical practice, and public health.

Designed as a universal mechanism in the field of cardiac healthcare, AI Technologies includes sophisticated algorithms to determine the appropriate steps required for successful diagnosis and treatment. The role of artificial intelligence extends, inter alia, to the identification of new drugs, stratification or statistics of diseases, remote monitoring and ongoing diagnostics, the integration of multidimensional data, and improving the efficiency and effectiveness of doctors.



Figure 1. SIPAP device

One specific example of the use of artificial examination in cardiology is an experimental study conducted by Dawes and colleagues on patients with heart disease, published in 2017 [3]. The researchers used heart-based MRI algorithms combined with a three-dimensional systolic heart pattern to accurately predict health status. outcomes of patients with pulmonary hypertension. The experiment was successful: the technology was able to obtain 30,000 points of cardiac activity of 250 patients.

How can Artificial Intelligence affect Cardiology?

Artificial intelligence technology can accelerate the understanding of a large set of ECG data by increasing clinical effectiveness and allowing doctors to focus on patient care rather than reviewing questionable strips. However, not all algorithms are created equal. You must understand your experience as an algorithm when choosing a service.

Telemedicine and mobile health (mHealth) are of great importance in the Prevention of PTSD and overall health improvement. Similarly, the Internet of Things (IoT) can radically change healthcare with heart disease; patient data can be sent in real-time to remote doctors who are constantly aware of patients' physical condition. The purpose of this review is to describe the current state of artificial intelligence used in cardiovascular medicine and its potential to change the way we learn, interpret data, and make decisions.

In the picture 2 you can see the Visi Mobile device – a system of small sensors that allows you to record the deterioration of the owner's health in time and connect him with his doctor, regardless of where the patient is at the moment.



Figure 2. Visi Mobile is a body-wearable system of small sensors

### **Purpose and objectives of the study**

The purpose of this article is to discuss modern scientific literature and give an idea of the future possibilities and risks of using artificial intelligence in cardiology.

### **Future directions**

The problems and difficulties of technological innovations in cardiology are overcome by modern research aimed at making artificial intelligence easily accessible and accessible to everyone. With this in mind, various projects are currently being studied.

For example, the use of wearable AI technology is aimed at developing a mechanism by which patients and doctors can easily access and control heart activity remotely. The perfect tracking tool, wearable artificial intelligence technology provides real-time updates, monitoring, and evaluation.

Another area of Cardiology in AI technology is the use of technology for recording and verifying empirical data for further analysis of symptoms, biomarkers, and treatment effectiveness [5]. With the help of artificial intelligence technology, researchers in the field of Cardiology are trying to simplify and expand the scope of knowledge in this field to improve patient care and treatment outcomes.

### **Possible risks**

Despite the optimism, we as a society need to be aware of the potential risks inherent in powerful tools such as artificial intelligence if used improperly. Elon Musk, an entrepreneur who recently worked for Space-X and Tesla, noted that thinking machines can pose an existential threat to humanity, and called for regulation at the national and international levels. Doctors should ask themselves the following question: How to translate these warnings into a medical point of view? Our professional codes of ethics have a long tradition, confirmed by the Hippocratic Oath and its modifications, as well as other modern codes.

Currently, there are several information systems for determining risk groups.

ORISCON is an expert system for determining the individual accumulated risk of major noncommunicable diseases [6]. ORISCON identifies risk factors for death in the next 10 years: cardiovascular diseases, some 13 oncological diseases, bronchopulmonary diseases, etc., there are common risk factors for their development, among which special attention is paid to potentially modifiable risk factors, important for timely prevention of diseases and forecasting improvement.

Cardioexpert system-the program contains calculators, scales, recommendations and is designed for experienced cardiologists.

The HeartScore system is designed to help clinicians optimize their cardiovascular risk reduction. This is an electronic interactive version that determines the risk of developing cardiovascular diseases.

The PROCAM system-developed on the basis of the results of a promising study and assesses the risk of developing PDA complications over the next 8 years in men and women in the postmenopausal period. The mathematical model of PROCAM in the form of a computer program CERCA (coronary event risk calculator) gives values of total risk and provides information about the target levels of LDL cholesterol, TG, HDL cholesterol depending on its level. achieving this will minimize the projected risk.

MyLAB family esaote-for many years, ultrasound systems have been mainly used to diagnose cardiovascular diseases. Their use in prevention is still limited. Ultrasound is a non-invasive and relatively inexpensive technology that allows you to perform a comprehensive examination of the heart and blood vessels at the same time. We compared these systems by initial data, users, and risk assessment parameters (Table 1).

Thus, as a result of the analysis of existing solutions, it can be concluded that none of the existing systems can adapt to a particular area and take into account only some factors, although there are many of them.

### **Literature review**

In the early 80s, Barr and Feigenbaum, scientists of computational theory, proposed the following definition of AI: "Artificial intelligence is the creation of intelligent computer systems, that is, systems with capabilities that we traditionally associate with the human mind-language understanding, learning, thinking, problem-solving, etc.".

Jeff Bezos, CEO of Amazon, writes about AI: "over the past decade, computers have automated many processes that programmers can describe using specific rules and algorithms. Modern machine learning methods allow us to do the same with tasks where it is much more difficult to set clear rules."

Table 1. Comparative analysis of the considered systems

<i>Name</i>	<i>Source data</i>	<i>Users</i>	<i>Risk assessment measure</i>	<i>Interaction With The User</i>
<i>ORISCON</i>	<i>Data from 20 years of research within the country</i>	<i>Doctors and secondary medical staff</i>	<i>Risk of death in the next 10 years</i>	<i>There are recommendations to reduce certain factors that make a big contribution to the overall risk</i>
<i>Cardioexpert</i>	<i>SCORE data</i>	<i>Mostly doctors, but anyone can download this mobile app</i>	<i>Risk of death in the next 10 years</i>	<i>None</i>
<i>HeartScore</i>	<i>SCORE data</i>	<i>Patients and doctors who need to log in via the internet</i>	<i>Risk of death in the next 10 years</i>	<i>There are recommendations to reduce certain factors that make a big contribution to the overall risk</i>
<i>PROCAM</i>	<i>Research data in Germany</i>	<i>Mostly doctors, because it takes into account significantly more factors than SCORE</i>	<i>Risk of developing complications of cardiovascular diseases in the next 8 years</i>	<i>About the target levels of LNP SS, TG, LVP SS provides information that allows you to minimize the estimated risk.</i>
<i>MyLAB family esaote</i>	<i>Reference indicators of biomarkers</i>	<i>Doctors</i>	<i>Assessment of individual risks based on the situation</i>	<i>No, the data is analyzed by the doctor and made his own decision.</i>

Artificial intelligence currently includes various software systems and methods and algorithms used in them, the main feature of which is the ability to solve intellectual problems in the same way as a person who thinks about their solution. Among the most popular areas of application of AI are the analysis of various data by predicting various situations, trying to give any quantitative information to it, as well as searching for hidden patterns.

We note that at present, the computer is not able to simulate complex processes of higher nervous activity of a person, such as the manifestation of emotions, love, creativity.

### **Research methodology**

At the time of writing this article, theoretical research methods were used.

**Analysis.** To better understand the material, you need to break it down into components and study each of them in detail. Therefore, the analysis of various books and research papers was carried out.

**Synthesis.** To get a general idea of the phenomenon under study, we turned to this method.

**Modeling.** To study the subject in detail, we sometimes put it on a specially designed model.

**Similarity.** The principle of its operation is to find certain similarities between several phenomena, and then draw logical conclusions that other features of these phenomena may coincide.

### **The results obtained and their discussion**

Intelligent systems created based on machine learning and artificial intelligence technologies have shown a great perspective in predicting and identifying health risks, as well as improving the results of managing high-risk patients. As they continue to improve, health professionals are increasingly using this powerful tool to provide accurate, timely preventive care to patients. According to estimates by the Sloan Kettering Institute, which has studied the effectiveness of the diagnosis and treatment of cancer patients, doctors use only 20% of the available information. Using advanced algorithms that can process large amounts of data and provide a comprehensive assessment of the medical information available to the doctor in a matter of seconds, you can significantly increase the effectiveness of the doctor, without prolonging the reception time and even reducing the load.

*Contribution of research results to science, business, or society.*

Artificial intelligence can significantly increase the efficiency of our work and increase the amount of work that people can do. When AI takes on repetitive or risky tasks, it frees people to perform well – prepared tasks-tasks that involve creativity and empathy. If people do the job they like, it can increase happiness and job satisfaction.

With better monitoring and diagnostic capabilities, artificial intelligence can have a significant impact on health. By improving the work of medical institutions and medical organizations, AI can reduce operating costs and save money. According to one of McKinsey's estimates, big data can save medicine and pharmaceuticals up to 100 billion a year. The real effect will be patient care. The potential of individual treatment plans and drug protocols, as well as providing service providers with access to information in medical facilities to help provide patient care information, will change their lives.

Our society will gain countless hours of productivity only through the introduction of autonomous transport and artificial intelligence, which will affect traffic congestion problems, not to mention other ways to increase productivity in the workplace. People who are free from stressful trips can spend their time in other ways.

How we solve criminal activities and solve crimes is enhanced by artificial intelligence. Facial recognition technology is as common as fingerprints. The use of AI in the justice system provides many opportunities to determine how best to use this technology without interfering with a person's privacy.

Artificial intelligence will have a significant impact on your life if you don't choose to live remotely and never plan your relationships with the modern world. Even though many problems arise when introducing technology into new areas of application, artificial intelligence is expected to have a more positive impact on society than a negative one.

## **Conclusion**

In conclusion, with the success of the above-mentioned study, as well as the promises of other artificial intelligence studies, it is clear that Cardiology is entering technological practice.

Doctors can actively monitor the continuous development of AI methods and use them following their needs to find specific auxiliary tools for clinical practice. The emergence of artificial intelligence in the field of the cardiovascular system opens up huge opportunities for the provision of new personalized services. How we use Cardiology, especially in the field of heart imaging, will change, and doctors should be prepared for this. Doctors should not be afraid to integrate AI into cardiology, they should accept it because their expert knowledge remains vital in any situation.

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