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THE ROLE OF MODERN DOGS AND ARTIFICIAL INTELLIGENCE IN DETECTION OF CARDIOVASCULAR DISEASES

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Abstract. Today, modern information technologies and artificial intelligence systems play an important role in the early detection and treatment of vascular diseases. Artificial intelligence allows for the analysis of medical data, monitoring of heart activity, and automation of the diagnostic process. For example, machine learning and deep learning algorithms are widely used in the analysis of data obtained from equipment such as ECG (electrocardiogram), CT (computed tomography), and MRI (magnetic resonance imaging).

Using artificial intelligence algorithms, changes in heart rhythm, circulatory disorders, and heart muscle activity are automatically analyzed. This greatly helps the doctor in early detection of the disease and making the correct diagnosis. It also helps to predict risk factors associated with the cardiovascular system. With the help of modern IT technologies, in particular mobile applications, digital stethoscopes, and online medical monitoring systems, the condition of patients is constantly monitored. This process allows medical staff to monitor the patient's heart activity remotely. Also, medical data is securely stored and transmitted to doctors for rapid analysis through cloud technologies.

Algorithms created using artificial intelligence are widely used in processes such as monitoring heart rhythm, controlling blood pressure, and predicting the risk of heart attack. Cloud technologies and database systems also allow for real-time analysis of patient health data. In conclusion, modern information technologies and artificial intelligence create unparalleled opportunities for early detection of cardiovascular diseases, improving the quality of treatment, and digitizing medical services. In the future, this area will be further improved and will acquire significant scientific and practical importance in maintaining human health.

Keywords: cardiovascular diseases, artificial intelligence, information technology, diagnostics, telemedicine, Big Data, ECG analysis.

Introduction. Cardiovascular diseases are among the most dangerous and widespread diseases of the 21st century. According to the World Health Organization, about 18 million deaths are associated with cardiovascular diseases every year. Therefore, early detection of these diseases,

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assessment of risk factors, development of effective prevention and treatment methods are a priority for global health policy. The rapid development of digital technologies, information systems and artificial intelligence is leading to the emergence of new diagnostic approaches in cardiology. Today, there are algorithms that automatically analyze ECG signals, neural networks that detect vascular narrowing, sensors that constantly monitor heart activity through mobile devices, as well as mathematical models that accurately predict the risk of disease.

The goal is to scientifically substantiate the role of modern IT and artificial intelligence in diagnosis, analyze existing technologies and show their practical significance.

1.1 The prevalence of cardiovascular diseases.

The epidemiology of cardiovascular diseases shows that these diseases are increasingly common not only in older people, but also in younger people. Poor nutrition, low physical activity, stress, hereditary factors, various harmful habits of the population lead to an increase in the number of cases.

1.2 Limitations of classical diagnostic methods

In traditional ECG, UTT or CT studies:

*high human error

*complex interpretation of images+

*changes in the early stages often go unnoticed.

This requires the implementation of modern technologies.

2.1. Digital diagnostic systems

Digital ECG, UTT and MRI devices accurately record heart activity. Current generation ECGs record signals with nanosecond accuracy, which creates a rich database for artificial intelligence.

2.2. Cloud technologies and Big Data

Thousands of clinical data are stored on a single platform using cloud databases. Big Data analysis identifies disease development trends, risk groups, hidden correlations and correct clinical solutions.

3.1. Machine learning algorithms

The main pillar of artificial intelligence is machine learning. It finds patterns independently of data.

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The main ML models used in cardiology are: Random Forest, Support Vector Machine, Gradient Boosting, Logistic Regression, etc. They can detect arrhythmias from ECG signals with an accuracy of more than 95%.

3.2. Deep Learning: CNN and RNN Models

Convolutional neural networks are very effective in image analysis and detect pathologies in heart tissue from CT and MRI images. Recurrent neural networks are used to analyze time-series signals - ECG, pulse, HRV.

3.3. Predictive models

These models predict the risk of disease by learning information about the patient's health. These include the risk of myocardial infarction, the development of heart failure, and risks associated with blood pressure.

4.1. Mobile health technologies

With the help of smart watches, fitness trackers, heart sensors, the patient is monitored 24 hours a day. These devices detect: sudden changes in heart rate, oxygen deficiency and hidden arrhythmias.

4.2. Opportunities for remote areas

The following are carried out remotely through telemedicine; ECG transmission, sending UTT images to an expert system, cardiologist consultations. This helps to significantly reduce mortality in rural areas.

5.1. Clinical decision support systems

CDSS is an intelligent system that helps doctors, reducing human error in making a diagnosis. It checks the interaction of drugs, integrates laboratory and instrumental results, and at the same time recommends the most optimal treatment protocols for the patient. In cardiology, such systems determine the risk of angina, arrhythmia, ischemia based on ECG and laboratory results.

6.1. Advantages, problems and prospects of IT and Artificial Intelligence

Advantages: diagnostic accuracy increases by 20-40%, arrhythmias are detected at an early stage. Personalized medicine is formed, clinical errors are reduced and patient monitoring is improved.

Problems: data security problems, certification processes of SI systems are complicated. Doctors are not sufficiently trained to work with SI. Medical data is not sufficiently standardized.

6.2. Development prospects: cardiology based on genetic data, fully automated ECG analysis, robotic cardiologists and portable diagnostic devices with special SI processors.

7.1. Clinical examples

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Detection of silent ischemia through ECG analysis. A model based on a combination of CNN and RNN trained on a large clinical database detects very subtle changes in ECG signals and predicts cases of silent ischemia that are not detected by human experts during clinical examination. Based on this, patients were referred for rapid coronary tomography and laboratory testing, and early treatment was initiated.

Remote monitoring of arrhythmias When continuous ECG monitoring is performed using a smartwatch and a device, the SI algorithm detects paroxysmal atrial fibrillation and alerts the patient to the doctor. As a result, timely anticoagulant therapy has been introduced to prevent thromboembolic complications.

7.2. Clinical trials and scientific research

In recent years, a number of randomized and observational studies have shown high sensitivity and specificity of SI systems in ECG, UTT and MRI analyses. However, many studies need to be validated in large and geographically diverse data sets.

8.1. Ethical, legal and regulatory issues

Data privacy and security: medical data are very sensitive. SI systems require encryption, anonymization and strict access control when storing and transmitting patient identifiers, clinical images and genomic data. It is necessary to comply with international and national legislation on data flow and storage.

8.2. Responsibility and accountability

Who should be held responsible if an SI system makes an incorrect diagnosis – the developer, the medical institution or the clinician – is a matter of debate. Therefore, SI solutions should be clinically validated, certified and used under the supervision of a physician.

8.3. Legal regulations and certification

Many countries require specific certification for medical software and SI systems. Clear standards should be developed by regulators to ensure their effectiveness, safety and fair operation.

9.1. Affordable and effective technologies

In remote areas, it is effective to introduce mobile applications and inexpensive sensor-based solutions instead of expensive equipment. Mobile ECG cloud analysis and remote consultation models will increase the quality of diagnostics in these areas.

9.2. Education and support for healthcare workers

Provide practical training, distance learning courses and clinical protocols for doctors and nurses on how to use AI. In addition, simple and understandable user interfaces should be developed.

10.1. Multimodal models

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In the future, the accuracy and predictive capabilities will increase significantly by integrating ECG, CT scan, MRI, genomic data and electronic health records into a single multimodal model.

It is important for doctors and patients to understand the reasons for AI decisions and increase their confidence.

10.2. Personalizing cardiology

Developing individual treatment and prevention plans based on genetic, biomarker and lifestyle data.

AI systems, when fully integrated into hospital workflows, support real-time decision-making, thereby improving patient outcomes.

11.1. The role of artificial intelligence in reducing safety and errors in cardiology

Artificial intelligence systems significantly reduce errors that can occur due to the human factor in the process of diagnosing cardiovascular diseases. When analyzing radiological images, doctors often fail to see some signs due to fatigue, lack of experience or poor image quality. AI algorithms conduct analysis with high accuracy, consistent quality and constant attention. As a result, in the diagnostic process: the probability of making an incorrect diagnosis is reduced. The possibility of detecting changes in the heart at an early stage increases and dangerous situations are prevented.

12.1. Telecardiology and remote cardiac monitoring

Innovations in the field of telemedicine have facilitated the process of continuous monitoring of heart diseases.

Telecardiology allows patients to monitor their heart function without having to go to the hospital. Remote monitoring systems include: transmission of ECG readings through smart watches and sensors, real-time transmission of heart rate and blood pressure. Automatic alerting when the patient's condition worsens. These technologies are especially convenient for the elderly, patients with heart failure, and those undergoing rehabilitation.

Conclusion. The rapid development of modern information technologies and artificial intelligence in the process of diagnosing cardiovascular diseases is taking the field of cardiology to a qualitatively new level. The shortcomings of traditional diagnostic methods due to time, human factors, technical limitations or subjective approaches are now effectively filled by SI algorithms and digital systems. Intellectual programs that automatically analyze images such as ECG, ECHO, CT and MRI significantly increase the efficiency of doctors with their high accuracy, speed and the ability to simultaneously process large amounts of information.

Research shows that artificial intelligence is not only able to diagnose existing diseases, but also creates risk models that can accurately predict the likelihood of a patient developing heart failure, arrhythmia, heart attack or stroke in the future. This further strengthens the preventive approach of medicine in addition to active treatment. Telemedicine, remote monitoring, smart devices and big data are completely digitizing cardiology and making it possible to monitor the

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patient's condition in real time. In general, artificial intelligence and modern IT technologies are fundamentally changing the methods used to combat cardiovascular diseases. In the future, it is expected that technologies such as fully autonomous diagnostics, AI-based identification of genetic risks, nano-sensor implants and virtual cardiologist assistants will appear. Therefore, IT and artificial intelligence have become an integral part of cardiology and are one of the strategic main directions of modern medicine.

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