

## THE ROLE AND FUNCTIONS OF MODERN COMPUTER TECHNOLOGIES IN THE DIAGNOSIS OF ARTERIAL HYPERTENSION DISEASES

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**Abstract:** *Arterial hypertension is a chronic disease characterized by a blood pressure of 140/90 mmHg or higher in the arteries. This pathology is widespread worldwide and negatively impacts the functioning of vital organs such as the heart, blood vessels, and kidneys. The causes of hypertension are divided into two main types: primary (essential) and secondary. Among the primary risk factors, poor nutrition, sedentary lifestyle, genetics, and stress play a significant role. In the early stages of the disease, noticeable symptoms may not be observed, but symptoms such as headaches, dizziness, and palpitations can develop. Timely diagnosis and treatment, including adopting a healthy lifestyle, are crucial in preventing severe complications of hypertension. Modern computer technologies play an important role in diagnosing and managing hypertension. They ensure early detection of the disease, improve treatment quality, and enhance the quality of life for patients. Expanding the use of these technologies in medicine could significantly reduce hypertension-related complications in the future.*

**Keywords:** *Arterial hypertension, blood pressure, essential hypertension, secondary hypertension, stress.*

**Аннотация:** *Артериальная гипертензия – хроническое заболевание, характеризующееся артериальным давлением в артериях 140/90 мм рт.ст. и выше. Эта патология широко распространена во всем мире и негативно влияет на работу жизненно важных органов, таких как сердце, сосуды и почки. Причины гипертензивной болезни делятся на два основных типа: первичные (эссенциальные) и вторичные. Среди первичных факторов риска значительную роль играют неправильное питание, малоподвижный образ жизни, генетика и стресс. На ранних стадиях заболевания заметных симптомов может не наблюдаться, но могут развиваться такие симптомы, как головные боли, головокружение, сердцебиение. Своевременная диагностика и лечение, включая здоровый образ жизни, имеют решающее значение для предотвращения тяжелых осложнений гипертензии.*

*Современные компьютерные технологии играют важную роль в диагностике и лечении гипертонии. Они обеспечивают раннее выявление заболевания, улучшают качество лечения и повышают качество жизни пациентов. Расширение использования этих технологий в медицине может значительно снизить осложнения, связанные с гипертонией, в будущем.*

**Ключевые слова:** Артериальная гипертензия, артериальное давление, эссенциальная гипертензия, вторичная гипертензия, стресс.

## INTRODUCTION

Arterial hypertension (AH) is one of the most common chronic diseases related to the cardiovascular system, affecting a large portion of the global population. This pathology is primarily characterized by consistently high blood pressure in the arteries. Normal blood pressure should be around 120/80 mmHg. However, when it consistently exceeds 140/90 mmHg, the diagnosis of hypertension is made. This condition damages the cardiovascular system, kidneys, brain, and other vital organs. Arterial hypertension has become one of the global health problems today. According to the World Health Organization (WHO), more than 1 billion people worldwide suffer from hypertension. Over 9.4 million deaths annually are attributed to hypertension-related diseases. Although this disease is widespread in developed countries, statistics are also increasing in developing regions. Arterial hypertension not only affects individual health but also has negative economic and social impacts. It leads to a decrease in work capacity, an increase in medical expenses, and a decline in the quality of life. Hypertension complications, such as stroke, heart attack, kidney failure, and vision impairment, are among the leading causes of death and disability globally.

### The Essence of Arterial Hypertension

Arterial hypertension is characterized by sustained high pressure inside the blood vessels. Blood pressure is measured by two main indicators:

Systolic pressure - the pressure when the heart contracts and pumps blood into the arteries.

Diastolic pressure - the pressure when the heart is at rest.

Normally, these indicators should be around 120/80 mmHg. When blood pressure is high, it increases the load on the heart and blood vessels, leading to the thickening of blood vessel walls and the loss of their elasticity over time.

Arterial hypertension is classified into two main types:

Primary (essential) hypertension: The exact cause is unknown. This type accounts for 90-95% of cases. Genetic predisposition, unhealthy lifestyle, and environmental factors can contribute to primary hypertension.

Secondary hypertension: Associated with a specific cause, such as kidney diseases, endocrine disorders, hormonal imbalance, or side effects of certain medications.

### Causes of Arterial Hypertension

Various factors can contribute to the development of arterial hypertension. These factors can be categorized into two groups:

Controllable factors: Poor nutrition, harmful habits, sedentary lifestyle.

Uncontrollable factors: Genetic predisposition, aging, gender differences.

Other major risk factors include:

Poor nutrition: Consuming foods high in salt and fat increases blood pressure.

Lack of physical activity: A sedentary lifestyle leads to metabolic disorders.

Harmful habits: Smoking and alcohol consumption constrict blood vessels and reduce their elasticity.

Stress: Chronic psychological stress increases the levels of stress hormones (adrenaline and cortisol), leading to higher blood pressure.

Age: As people age, blood vessels lose their elasticity.

Arterial hypertension (AH) is one of the most common cardiovascular diseases, and if not diagnosed or managed in time, it can lead to serious complications, such as stroke, infarction, and kidney failure. Modern computer technologies are crucial in the diagnosis, treatment, and monitoring of AH. Below are their main roles and functions:

Artificial Intelligence (AI) algorithms: These improve the speed and accuracy of AH detection. For example, AI analyzes heart rhythm, blood pressure dynamics, and other physiological data to predict the risk of hypertension.

Telemedicine platforms: These enable remote collection of blood pressure and other biometric indicators from patients, which is especially convenient for patients in remote areas.

Blood pressure monitoring devices: Modern "smart" tonometers store blood pressure readings and transmit them to cloud servers. These data can be monitored remotely by doctors.

Mobile applications: These encourage patients to track their health and regularly monitor their blood pressure. For example, through reminders for medication intake.

Big Data technologies: These analyze large volumes of epidemiological and genetic data to detect the likelihood of developing hypertension.

Algorithmic models: These are used to predict the development dynamics of the disease. For example, an individual treatment plan can be created based on a patient's lifestyle, genetic data, and medical history.

Biomarker analysis: AI systems help identify and research biomarkers for hypertension.

Virtual clinical trials: Computer models assess the effectiveness of new drugs.

Virtual reality (VR) and simulation technologies: These are used for training doctors in diagnosing and treating AH.

Interactive platforms: These provide the public with information about the disease and offer advice on reducing risk factors.

Relevance of the Problem Arterial hypertension is not only a threat to human health but also a significant burden on the global economy. This disease reduces

production capacity, increases medical costs, and lowers the overall quality of life. Particularly in developing countries, hypertension is poorly controlled, leading to increased mortality and the spread of the disease. Due to the severe complications of the disease, timely diagnosis and treatment of hypertension are of crucial importance. Regular blood pressure measurements and the assessment of risk factors are necessary for diagnosis. This article discusses in detail the causes, clinical manifestations, diagnostic methods, and treatment approaches for arterial hypertension. Interactive platforms provide information about the disease to the public and offer advice on how to reduce risk factors. Relevance of the Issue Arterial hypertension is not only dangerous for human health but also continues to be a heavy burden on the global economy. The disease leads to reduced productivity, higher medical costs, and lower overall quality of life. Particularly in developing countries, hypertension is poorly controlled, leading to an increase in deaths and diseases.

Timely diagnosis and treatment of hypertension are crucial due to its severe complications. Regular blood pressure measurements and risk factor assessment are necessary for diagnosis. This article elaborates on the causes, clinical manifestations, diagnostic methods, and treatment options for arterial hypertension. This introductory section constitutes a large portion of the article. Please let me know if you would like to expand on any particular areas or emphasize specific aspects.

#### Hypertension (High Blood Pressure) and Its Relevance

Hypertension (high blood pressure) is a widespread and chronic condition that poses a risk to both physical and mental health. It is one of the leading causes of many physical and mental diseases, including heart disease, stroke, and kidney failure. The relevance of hypertension is related to several factors:

**Rapidly Growing Disease:** Hypertension is a condition affecting many people worldwide, and it is prevalent in both men and women. Medical statistics show that the number of people suffering from hypertension is increasing every year. **Main Risk Factors:** Factors such as stress, poor diet, excess weight, lack of physical activity, alcohol consumption, and smoking can lead to hypertension. Genetics also play a role.

**High Blood Pressure and Health Problems:** Hypertension can lead to cardiovascular diseases, stroke, kidney failure, and many other serious health issues. If left untreated, hypertension can be life-threatening. **Need for Early Diagnosis and Treatment:** Early detection and effective treatment of hypertension help prevent the development of related diseases. Hypertension typically does not show noticeable symptoms, which is why regular blood pressure checks are extremely important.

For these reasons, the relevance of hypertension is of great importance both for the healthcare system and for society. Proper prevention and treatment approaches allow for effective management of the disease.

Many studies show that hypertension is widespread globally and varies based on factors such as age, gender, race, or geographical location. Studies indicate that stress, excess weight, high salt intake, lack of physical activity, and genetics are the main risk

factors that lead to hypertension. Other studies provide significant information on factors such as genetic influences and the increase in blood pressure during menopause in women.

The failure to treat or incorrectly managing hypertension can lead to severe conditions such as heart disease, stroke, and kidney failure. Studies have shown that uncontrolled high blood pressure over time can be life-threatening. Early detection and treatment of hypertension help prevent its progression in many cases. Statistics emphasize the importance of early screenings and preventive approaches in managing high blood pressure.

However, results may vary across regions and treatment methods, which is why medical research and new methods are constantly being conducted.

There are several methods for managing arterial hypertension (high blood pressure). These methods depend on the condition of the selected patient, other health issues, and the doctor's recommendations. The main methods are as follows:

Medications: Diuretics - These drugs help remove excess fluid through the kidneys and reduce blood pressure. ACE inhibitors - They block the angiotensin-converting enzyme and help dilate blood vessels. Beta-blockers - They slow down the heart rate and reduce blood pressure. Potassium channel blockers - They help dilate blood vessels and reduce blood pressure. Angiotensin II receptor blockers (ARBs) - They have similar effects to ACE inhibitors but may have fewer side effects.

Weight management: Excess weight increases arterial pressure. Losing weight through a healthy diet and physical activity helps manage blood pressure.

Healthy lifestyle: Physical activity: Inactivity can increase blood pressure. It is recommended to engage in moderate-intensity physical activity for at least 150 minutes per week.

Modern technologies have significantly changed the approach to diagnosing arterial hypertension (AH), making it more accurate, accessible, and effective. The development of digital technologies, artificial intelligence, and telemedicine has not only improved diagnostic methods but also introduced innovative ways of monitoring and preventing the disease.

One of the key advancements in AH diagnosis is the widespread use of digital blood pressure monitors and ambulatory blood pressure monitoring (ABPM) systems. These devices provide more accurate and objective data on blood pressure fluctuations throughout the day, helping to detect hidden forms of hypertension, such as nocturnal hypertension or white coat syndrome. Moreover, modern blood pressure monitors with automatic analysis functions can detect signs of arrhythmia and other cardiovascular disorders, making diagnostics more comprehensive.

Telemedicine technologies and mobile applications also play a crucial role in diagnosing and monitoring hypertension. They enable patients to keep a digital blood pressure diary, which can be automatically transmitted to their healthcare provider. This facilitates a more precise analysis of disease dynamics and personalized therapy

selection. Furthermore, artificial intelligence and big data technologies help predict the risk of complications, such as myocardial infarction or stroke, by analyzing thousands of parameters, including genetic, physiological, and behavioral factors.

Another significant achievement is the integration of wearable devices, such as fitness trackers and smartwatches, equipped with sensors for measuring blood pressure and heart rate. These technologies allow users to monitor their health in real-time, promptly identifying deviations and taking measures to prevent complications.

Thus, modern technologies not only enhance the accuracy of arterial hypertension diagnosis but also make the monitoring process more convenient and accessible. Their application contributes to the early detection of the disease, personalized treatment approaches, and a reduced risk of serious complications. In the future, further advancements in artificial intelligence, telemedicine, and wearable devices will open new horizons in the diagnosis and treatment of hypertension, making healthcare even more efficient and personalized.

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