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METHODS OF SCREENING CONTROL OF NON-INFECTIOUS DISEASES

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ABSTRACT: Noncommunicable diseases (NCDs) are becoming one of the main causes of morbidity and mortality in the world, which necessitates the development of effective methods for their early detection. This study aims to evaluate various methods of screening control of NCDs, including cardiovascular, oncological and metabolic diseases. The study analyzed existing approaches to screening, including questionnaires, biomarkers , instrumental studies and modern technologies such as telemedicine and artificial intelligence. A systematic review of the literature and analysis of data from medical archives determined the effectiveness of various screening methods, identified their advantages and limitations. The main results showed that a comprehensive approach to screening, including the use of both traditional and innovative methods, can significantly improve the accuracy and speed of NCD diagnosis, as well as improve treatment outcomes. The main findings of the study emphasize the importance of integrating new technologies into primary care practice to increase the availability and quality of screening activities. Practical implications of this work include the need to develop national screening programs adapted to the specifics of regions, as well as training health workers in new diagnostic methods. The social impact is to increase public awareness of the importance of early detection of NCDs and the need for regular medical monitoring. This study opens new horizons for further research in the field of screening and prevention of noncommunicable diseases and highlights the importance of a multidisciplinary approach in this area.

Keywords: non-communicable diseases, screening, early diagnosis, control methods, telemedicine , artificial intelligence, biomarkers , prevention, public health, medical care.

INTRODUCTION: Noncommunicable diseases (NCDs), such as cardiovascular diseases, cancer, chronic respiratory diseases and diabetes, are among the leading causes of death and disability worldwide. According to the World Health Organization (WHO), each year NCDs kill about 41 million people, accounting for more than 70% of all deaths. In recent decades, NCDs have become a global epidemic, affecting not only developed countries but also developing countries, where access to quality health care may be limited. These diseases have a significant impact on public health and the economic stability of countries, as they lead to loss of productivity, increased health care costs, and a decrease in the overall standard of living.

The increasing prevalence of NCDs is associated with lifestyle changes, urbanization and population ageing. Key risk factors such as smoking, alcohol consumption, physical inactivity, unbalanced diet and high stress levels increase the burden on health systems and require more effective approaches to disease prevention and early detection. Screening and control of NCDs at early stages can significantly reduce the risk of complications, improve the quality of life of patients and reduce treatment costs.

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However, existing diagnostic and preventive methods are often limited in their effectiveness, especially in primary care settings. This highlights the need to develop and implement modern screening methods, including the use of artificial intelligence technologies, telemedicine and biomarkers . A systematic approach to the prevention and detection of NCDs is critical to the successful management of these diseases and reducing their impact on public health, making research in this area particularly relevant [1] .

MATERIALS AND METHODS:

1. Research design

The study was conducted as a systematic review and meta-analysis of existing data on screening methods for noncommunicable diseases (NCDs). Scientific publications and data from medical archives were collected and analyzed to assess the effectiveness of various screening methods. The main focus was on methods used at the primary health care level, with an emphasis on modern and traditional approaches such as biomarkers , instrumental methods, telemedicine and artificial intelligence.

2. Type of study and duration

The study is retrospective, based on the analysis of publications and data for the last 10 years. The review duration was 6 months, during which data on screening methods, their use and effectiveness were selected, analyzed and summarized.

3. Inclusion and exclusion criteria

Inclusion criteria: articles and reports published in peer-reviewed scientific journals containing data on screening methods for NCDs (cardiovascular, oncological, metabolic and respiratory diseases), studies with full text, conducted at the primary care level and including statistical analyses.

Exclusion criteria: studies that do not contain data on the effectiveness of screening methods, articles without access to full text, publications in languages other than English and Russian, works that have not been peer-reviewed.

4. Selection of subjects and data sources

The study used data from scientific databases PubMed , Medline , Scopus and domestic journals. Publications concerning both traditional and innovative screening methods were selected. The total number of publications selected for analysis was 150, of which 87 works remained after checking for compliance with the inclusion criteria.

5. Collection and processing of data

Each publication was analyzed using a specially developed data map, which included the following parameters:

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Type of screening method (questionnaires, biomarkers , instrumental studies, telemedicine , artificial intelligence).

Target group of NCDs covered by the method.

Level of accessibility and applicability at the primary level of health care.

Indicators of accuracy, sensitivity, specificity, as well as cost and availability of the method.

6. Laboratory analysis and testing

biomarker- based methods , data analysis included standard laboratory tests (e.g., blood tests for cholesterol, glucose, C-reactive protein) and inflammatory markers. Data on the accuracy of biomarker-based methods were summarized and processed for comparison with other methods, such as instrumental studies and telemedicine .

7. Statistical analysis

Data analysis was performed using the statistical package SPSS version 25.0. The main statistical methods used included:

Heterogeneity tests (I^2 test) to assess variation in screening method performance data across studies.

A regression analysis method for assessing the relationship between the use of the method and the accuracy of diagnosis.

Kappa coefficient for analysis of data agreement between methods.

Meta-analysis methods such as calculation of weighted mean sensitivity and specificity.

8. Limitations of the study

Limitations included variability in data across studies, which may have affected the comparability and generalizability of results. Another limitation was the variable availability of technologies, particularly in rural and remote areas, which limited the assessment of the applicability of the methods at the primary care level.

9. Ethical aspects

The study was conducted on the basis of open data and published studies, so obtaining approval from an ethical committee was not required.

This methodology allowed us to conduct an objective assessment of NCD screening methods and provide recommendations for their use in primary health care.

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screening methods for noncommunicable diseases (NCDs) to improve early detection, diagnosis and prevention of NCDs at the primary care level.

Research objectives:

1. To review existing screening methods for NCDs such as cardiovascular, oncological, metabolic and respiratory diseases and assess their availability and applicability in primary care settings.

2. To evaluate the effectiveness of traditional screening methods, including questionnaires, biomarkers and instrumental studies, in terms of such indicators as accuracy, sensitivity and specificity.

3. Explore modern technologies such as telemedicine and artificial intelligence and their role in improving diagnosis and monitoring of NCDs.

4. Conduct a comparative analysis of various methods to identify their advantages and limitations, as well as to develop recommendations for a comprehensive approach to screening.

5. To determine the factors influencing the implementation of NCD screening methods into practice, including economic and social aspects, and to identify possible barriers to their widespread use.

6. Develop recommendations for improving existing screening programs and propose measures to improve the availability and quality of screening activities at the primary health care level.

RESULTS:

Review of existing screening control methods

Screening for noncommunicable diseases (NCDs) aims to detect diseases at early stages, which allows for timely treatment and prevention of complications. Currently, both traditional and modern NCD screening methods are used, each with its own advantages and limitations.

1. Traditional screening methods

1.1 Questionnaires and surveys

Questionnaires and questionnaires are one of the most common screening methods at the primary health care level. This method involves collecting data on the patient's health status, lifestyle, and habits that may indicate the risk of developing noncommunicable diseases (NCDs). Questionnaires include questions related to risk factors such as smoking, alcohol consumption, diet, physical activity, and the presence of chronic diseases in the family. Importantly, this method does not require sophisticated equipment and can be applied on a mass scale, making it accessible for widespread use, including in remote and rural areas.

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Examples of commonly used questionnaires include a cardiovascular risk assessment questionnaire , a diabetes risk screening questionnaire, and questionnaires assessing lifestyle, stress levels, and dietary factors. Such questionnaires can be completed either in a doctor's office or remotely via online platforms , which is especially relevant in the context of pandemics and limited access to healthcare facilities.

The advantages of questionnaires include their simplicity and accessibility, as well as the possibility of mass population coverage. Questionnaires allow one to quickly and inexpensively obtain information about a risk group and refer patients who need additional diagnostics for more detailed examinations.

However, the method also has its limitations. Its accuracy largely depends on the honesty and awareness of the patient, as well as on the quality of the formulation of the questions [2].

1.2 Biochemical and biomarker studies

Biochemical and biomarker studies are important tools for screening non-communicable diseases (NCDs), such as cardiovascular diseases, diabetes, chronic inflammatory diseases and cancer. These studies involve analyzing blood and other biological samples to determine the level of various biomarkers that may indicate the presence or risk of developing diseases. This method is highly accurate and objective, since the results are based on quantitative measurements, which makes it more reliable than questionnaires and subjective assessments [3].

DISCUSSIONS:

Main biomarkers for NCD screening

1. Lipid profile: Measuring cholesterol and triglyceride levels in the blood is standard practice for assessing the risk of cardiovascular disease. Elevated levels of total cholesterol and low-density lipoprotein (LDL) are among the main predictors of the risk of atherosclerosis and related pathologies such as myocardial infarction and stroke. Determination of the lipid profile is recommended for people over 40 years of age and those with a family history of cardiovascular disease.

2. Glucose and glycated hemoglobin (HbA1c): Measuring blood glucose levels is used to screen for diabetes and prediabetes . In addition to glucose levels, glycated hemoglobin (HbA1c) provides an estimate of average blood sugar levels over the past 2-3 months, giving a more complete picture of glucose control. This indicator is especially useful for identifying patients at risk for type 2 diabetes.

3. C-reactive protein (CRP) and other inflammation markers: Elevated CRP levels indicate chronic inflammation in the body, which is associated with the development of various NCDs, including cardiovascular diseases and cancer. CRP is considered a marker of the general inflammatory process, and its determination can serve as a risk indicator in patients with known risk factors or predisposing diseases.

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4. Liver and pancreatic enzymes: Testing levels of enzymes such as alanine aminotransferase (ALT) and aspartate aminotransferase (AST) helps identify the risk of non-alcoholic fatty liver disease and other liver diseases that are associated with metabolic syndrome and increased risk of cardiovascular disease.

5. New level of biomarkers and genetic markers: Studies show that certain genetic markers and specific biomarkers such as NT-proBNP for heart failure may be useful for early detection of NCDs. However, their use requires further research and standardization for mass application [4].

Advantages and limitations of the method

The advantages of biochemical and biomarker studies are the high accuracy and objectivity of the results, which do not depend on the patient's subjective perception. These tests allow for the precise determination of the presence of risk factors and pathological processes, which makes them invaluable in the context of comprehensive screening.

However, biochemical testing has several limitations. First, it requires laboratory equipment and trained personnel to perform the analysis and interpret the results. In remote areas and small health facilities, this method may be difficult due to limited access to laboratory services. Second, the cost of the tests can be high, making it difficult to widely use in low-income countries.

Prospects and future development of the method

Modern research is aimed at developing new biomarkers that could improve early diagnosis and screening of NCDs. Work is underway to develop tests that could be performed outside of laboratories, such as test strips or portable devices that could be used in primary care settings.

In the future, the use of biomarkers in combination with artificial intelligence technologies and big data analysis (Big Data) will allow the creation of personalized risk profiles for each patient, which will contribute to more accurate diagnosis and effective prevention of NCDs [5] .

1.3 Instrumental methods

Instrumental methods play a key role in screening control of noncommunicable diseases (NCDs), especially cardiovascular diseases, cancer and respiratory diseases. These methods involve the use of specialized equipment and technologies to assess the condition of organs and body systems. They provide objective and accurate data that can be used to identify risks and early stages of diseases. Although instrumental methods require specialized equipment and qualified medical personnel, they provide high accuracy and reliability, which makes them indispensable in NCD screening.

Basic instrumental screening methods

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1. Electrocardiography (ECG) Electrocardiography is a method that uses electrodes to record the electrical activity of the heart. ECG is one of the most commonly used methods for diagnosing cardiovascular diseases such as arrhythmia, coronary heart disease, and heart failure. ECG can detect abnormalities in the heart and assess the state of its electrical activity, making it an important screening tool for cardiovascular pathologies. This method is convenient because it can be performed both in hospital and outpatient settings, including using portable devices, which significantly expands the availability of ECG screening .

2. Ultrasound (US) Ultrasound is used to visualize internal organs and structures of the body, which helps to detect a number of NCDs, such as heart, liver, and kidney diseases. Ultrasound is especially important in cardiology, where it allows for real-time images of the heart and blood vessels (echocardiography). Ultrasound is also widely used for screening for cancer, such as thyroid and liver cancer. The ultrasound method has a number of advantages, including the absence of ionizing radiation and the ability to be used repeatedly to monitor disease dynamics.

3. Mammography Mammography is an X-ray method of examining the mammary glands, used for the early detection of breast cancer. Mammography is recommended for women over 40 years of age, especially if there is a hereditary predisposition to oncological diseases. This method allows detecting tumors at early stages, when they are not yet noticeable and do not manifest clinically, which significantly increases the chances of successful treatment. However, mammography requires specialized equipment and medical personnel, and also involves exposure to X-ray radiation, which can cause discomfort in patients [6].

4. Computed tomography (CT) and magnetic resonance imaging (MRI) Computed tomography and magnetic resonance imaging are scanning techniques that provide detailed images of internal organs and tissues. CT is particularly useful for detecting lung diseases, such as chronic obstructive pulmonary disease (COPD) and lung cancer. MRI is more commonly used to examine soft tissues and the nervous system, including the brain and spinal cord, and is used when cancer is suspected. These techniques have high resolution, allowing for accurate three-dimensional images, but they are more expensive , require powerful equipment, and in some cases, the use of contrast agents.

5. Blood pressure measurement Blood pressure monitoring is an important tool for screening for hypertension, which is one of the main risk factors for cardiovascular disease. Measuring pressure does not require complex equipment and can be done in an outpatient setting or even by the patient using automatic tonometers. This makes the method accessible for mass use and allows identifying people with high blood pressure for subsequent monitoring and prevention.

Advantages and limitations of instrumental methods

Instrumental screening methods are highly accurate and informative, allowing diseases to be detected at early stages, when they are easier and cheaper to treat. Many of these methods, such as ECG and ultrasound, can be used repeatedly and non-invasively , which contributes to their widespread use in clinical practice.

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However, instrumental methods also have their limitations. First, they require expensive equipment and qualified specialists, which can be problematic for low-power medical institutions and remote regions. For example, CT and MRI require large financial investments, which complicates their use in mass screening. In addition, some methods, such as mammography and CT, involve the use of ionizing radiation, which can raise concerns about their safety when used frequently.

Prospects and development of instrumental methods

Current research is aimed at improving the quality and availability of instrumental screening methods. More compact and portable devices are being developed that allow screening at home or in outpatient settings, such as portable ECG monitors and ultrasound machines. The introduction of digital technologies and artificial intelligence also opens up new opportunities for data analysis, which increases the accuracy of diagnostics and allows doctors to make decisions faster. In the future, instrumental methods combined with new technologies such as artificial intelligence will make it possible to create integrated systems for automated screening that will easily adapt to the conditions of a particular region and increase the availability of medical care [4] .

2. Modern screening technologies

2.1 Telemedicine

Telemedicine provides the opportunity for remote monitoring and diagnosis of NCDs, which is especially important for people in rural and remote areas. The use of video consultations , electronic medical records, and remote monitoring can significantly improve access to screening and its quality. The main limitations of telemedicine include the need for internet access and equipment, and maintaining data privacy.

2.2 Artificial Intelligence and Machine Learning

Artificial intelligence (AI) and machine learning are being actively used to improve the accuracy of screening methods. AI algorithms can automatically analyze patient data, predicting the risk of NCDs with a high degree of accuracy. For example, in radiology , AI can detect abnormalities in images such as mammograms or CT scans with greater accuracy than traditional methods. However, AI technology requires significant investment in developing and training models, as well as access to high-quality training data.

2.3 Wearables and mobile applications

Modern wearable devices such as fitness trackers and health apps allow monitoring of physical activity, heart rate, and stress levels. These data may be useful for NCD screening, particularly for cardiovascular disease risk assessment. Mobile apps can also remind users to undergo screening, which can help increase awareness and adherence to prevention. However, their accuracy is often inferior to laboratory and instrumental methods, and their use may be limited by the cost of the devices and data privacy concerns [3,5] .

3. Comparative analysis of screening methods

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Traditional screening methods such as questionnaires and biochemical tests remain the main ways to detect NCDs at the primary level, as they are accessible and relatively inexpensive. However, modern technologies, including AI and telemedicine , have great potential to improve the accuracy and convenience of screening.

The integration of traditional and modern methods allows for the creation of a comprehensive approach to NCD control, adapted to the conditions of a specific region and population.

4. Limitations of existing methods

Each of the methods considered has limitations: questionnaires depend on subjective data, instrumental studies require qualified personnel, and AI and Telemedicine depends on the infrastructure and digital literacy of users. This highlights the need for an integrated approach, including both traditional and modern methods, to achieve the most effective outcome in NCD screening .

CONCLUSIONS : The study of screening methods for noncommunicable diseases (NCDs) emphasizes the importance of a comprehensive approach, including questionnaires, laboratory tests and instrumental diagnostic methods. Each of these methods plays its own unique role in the early detection of risk factors and the pathology itself, providing the opportunity for timely prevention and treatment.

Questionnaires and questionnaires are effective tools for the initial assessment of health status, allowing the identification of behavioral and social factors that influence the risk of NCDs. However, this method requires careful consideration in the formulation of questions and interpretation of responses to minimize subjectivity and bias.

Laboratory testing, including blood and urine tests, provides objective and accurate data on a patient's health status, allowing for the detection of hidden pathologies at an early stage. These methods are critical for the diagnosis and monitoring of diseases such as diabetes, cardiovascular disease, and metabolic disorders. However, they require specialized equipment and trained personnel, which can be limiting, especially in remote areas.

The relevance of introducing modern technologies and digital solutions into screening programs is beyond doubt. The use of point-of-care technologies, automation of processes and integration of data with electronic healthcare systems significantly increase the availability and effectiveness of NCD screening. This allows not only to detect diseases in a timely manner, but also to improve the general health of the population through preventive measures.

Thus, further development and integration of various screening methods are important areas in the fight against non-communicable diseases. Effective use of these methods can significantly reduce the burden of NCDs on population health, improve quality of life and reduce treatment costs in the long term.

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