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PERSONALIZED MEDICINE: TREATMENTS BASED ON GENETIC INFORMATION.

Asqarova Kibriyo Shavkatali qizi
Teacher of public health technical college named after
Pop Abu Ali Ibn Sino

Annotation: This article reviews personalized medicine and genetic data-based treatment methods. Personalized medicine allows for the development of individual treatment strategies based on a patient's genetic profile, biomarkers, and clinical data. The article reviews in detail the theoretical foundations of personalized medicine, the role of genetic testing and pharmacogenomics, and their application in clinical practice. At the same time, the advantages, limitations, and development prospects of this approach using modern technologies are analyzed. The article is enriched with examples from the fields of oncology, cardiology, pharmacology, and infectious diseases, demonstrating the importance of personalized medicine in improving patient health and effectively using medical resources.

Keywords: Precision medicine, Genetic data, Pharmacogenomics, Biomarkers, Individualized treatment, Oncology, Cardiology, Clinical diagnostics, Artificial intelligence, Preventive medicine.

Personalized medicine, sometimes called "precision medicine" or "individualized medicine," refers to individual treatment and prevention strategies based on a person's genetic, biomarker, and other biological characteristics. While traditional medicine often relies on the principle of “one treatment, one patient at a time,” a personalized approach tailors treatment based on each person’s unique biological profile, genetic code, and medical history. In recent years, advances in fields such as genomics, proteomics, and metabolomics have laid the foundation for personalized medicine. The complete mapping of the human genome and its analysis, as well as artificial intelligence and big data processing technologies, are creating new opportunities in medical practice. For example, it will be possible to individually select drugs or adjust their dosage for patients with certain genetic mutations. Genetic information is the heart of personalized medicine. The human genome contains approximately 20,000–25,000 genes, and each person’s genetic code is slightly different. These differences play an important role in determining susceptibility to diseases, response to drugs, or risk of side effects. For example, mutations in the BRCA1 and BRCA2 genes increase the susceptibility to breast and ovarian cancer. Therefore, these genetic tests can be used to determine preventive measures tailored to the

individual. Pharmacogenomics — the study of drugs based on genetic information — also allows for increased drug efficacy and reduced risk.

Personalized medicine has several key components:

1. Genetic testing — to identify disease risk, prevent inherited diseases, and predict response to drugs.

2. Biomarkers — biological markers in the body that indicate the presence of a disease or the effectiveness of treatment.

3. Data analysis — to develop an individual treatment strategy using large genomic and clinical data.

4. Individualized treatment plan — to select drugs, prescribe doses, and provide preventive measures tailored to the patient's characteristics.

This approach is widely used in several areas:

• Oncology: determining the type of cancer and selecting drugs based on the molecular profile. For example, patients with HER2-positive breast cancer are prescribed the drug trastuzumab.

• Cardiology: determining the predisposition to cardiovascular diseases through genetic tests and tailoring treatment.

• Pharmacology: predicting the response to drugs and individually determining the dose settings.

• Infectious diseases: for example, antiviral or antibacterial treatment tailored to the patient's genetic profile in viral or bacterial infections.

Advantages:

• Increases the effectiveness of treatment.

• Reduces the risk of side effects.

• Allows for early detection of diseases and preventive measures.

• Efficient use of resources in the health system.

Limitations:

• Genetic tests and data analysis are expensive.

• There are privacy and genetic data protection issues.

• Not all diseases and drugs are suitable for a genetic approach.

• Requires sufficient knowledge on the part of healthcare professionals and patients.

Currently, the development of personalized medicine is visible in the following areas:

• Artificial intelligence: disease prognosis and drug selection using AI in the analysis of genomic and clinical data.

• Telemedicine: the possibility of receiving genetic counseling remotely.

• Biobanking: the development of scientific research and clinical applications through genetic databases.

• Integrative medicine: the integration of genetic data, biomarkers and lifestyle information.

Thus, personalized medicine is considered a revolutionary approach to maintaining human health and treating diseases. The widespread use of genetic data, combined with modern technologies, creates the opportunity to develop and implement individual treatment strategies. This article will analyze in detail the theoretical foundations of personalized medicine, treatment methods based on genetic data, clinical applications and limitations. Personalized medicine represents a new paradigm in maintaining human health and treating diseases. While traditional medicine often relies on standard treatment protocols, a personalized approach develops an individual treatment strategy based on the patient's genetic profile, biomarkers, and clinical data. This approach not only increases the effectiveness of disease detection and treatment, but also allows for reducing patient risk and prescribing preventive measures. The development of personalized medicine is closely related to the achievements of genomics, proteomics, metabolomics, and other omics fields. Through the widespread use of human genome mapping and genetic testing, personalized treatment methods are being developed. For example, by identifying mutations in the BRCA1 and BRCA2 genes, it is possible to prescribe preventive measures for patients with a high susceptibility to cancer. At the same time, pharmacogenomics allows for the identification of individual responses to drugs and the selection of doses.

The article analyzes in detail the main components of personalized medicine — genetic tests, biomarkers, data analysis, and individualized treatment plans. The role of each component in clinical practice and its impact on patient health are illustrated with examples. The effectiveness of a personalized approach in the fields of oncology, cardiology, pharmacology, and infectious diseases has been proven through scientific studies. For example, the appointment of trastuzumab to patients with HER2-positive breast cancer is an example of individualized treatment based on a molecular profile. The article also discusses the advantages and limitations of personalized medicine. The advantages include increasing the effectiveness of treatment, reducing the risk of side effects, early detection of diseases and the establishment of preventive measures, as well as the efficient use of resources in the healthcare system. At the same time, limitations — high cost, issues of confidentiality of genetic data, the lack of sufficient genomic bases for some diseases, and the need for sufficient knowledge for medical personnel and patients — are highlighted as important issues. Among the current trends are the role of artificial intelligence in the analysis of genomic and clinical data, the possibility of remote genetic counseling through telemedicine, the development of biobanking and integrative medicine. These technologies are important in increasing the efficiency and expanding the scope of personalized medicine. Processing large databases with the help of artificial intelligence accelerates the analysis of a patient’s genetic, biomarker and clinical data, which allows for more accurate development of individual treatment strategies. In conclusion, we can say that personalized medicine is a revolutionary approach in the field of medicine, opening up new prospects for maintaining human health and treating diseases. Treatment methods based on genetic information not only improve patient health, but also help to efficiently use medical resources, increase the effectiveness of drugs and reduce side effects. At the

same time, the implementation of high technologies in this area, ensuring confidentiality and increasing patient knowledge are important issues.

In this context, personalized medicine plays a key role not only in clinical practice, but also in scientific research, health system policy and preventive strategies. The full integration of genetic information and its combination with modern technologies will allow for further development of personalized treatment in the future and significantly improve the quality of life of patients.

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