



MODERN MEDICAL TECHNOLOGIES FOR EARLY DIAGNOSIS, TREATMENT, AND PREVENTION IN PREVENTIVE MEDICINE: INTERNATIONAL EXPERIENCE AND INNOVATIVE APPROACHES

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Article history:	Abstract:
Received: 11 th April 2026 Accepted: 10 th May 2026	This article analyzes modern technological advancements in the field of preventive medicine, specifically focusing on the role of artificial intelligence, genomics, and digital monitoring tools in the early detection of diseases. Based on the 4P medicine concept (Predictive, Preventive, Personalized, and Participatory), the experiences of countries such as the USA, Germany, and Japan are examined. Statistical analysis demonstrates that the application of innovative screening technologies significantly reduces the rate of chronic disease complications and premature mortality.
Keywords: preventive medicine, early diagnosis, artificial intelligence, genomics, 4P medicine, molecular diagnostics.	

1. INTRODUCTION

Today, the global healthcare system is transitioning from a "disease treatment" model to a "health preservation" model. The foundation of modern preventive medicine is the 4P medicine concept: Predictive, Preventive, Personalized, and Participatory. According to the World Health Organization (WHO), non-communicable diseases (NCDs) account for more than 70% of deaths worldwide. Identifying these pathologies at the preclinical stage not only extends human lifespan but also ensures the economic efficiency of the healthcare system.

2. MATERIALS AND METHODS

As part of the study, a comparative analysis was conducted on reports and technological advancements from leading international centers for preventive medicine (Mayo Clinic, Charité, Tokyo Medical University) over the past five years. The research methodology is based on qualitative comparative analysis, meta-analysis of international data, and statistical forecasting methods.

3. MAIN RESULTS

3.1. Artificial Intelligence (AI) and Big Data

The experience of the United States (Mayo Clinic) confirms that AI algorithms outperform traditional methods of analyzing radiological images and electrocardiograms (ECGs). Example: When analyzing ECGs, the AI system achieved an accuracy of 91.8% in detecting asymptomatic (occult) heart failure, whereas traditional methods yielded an accuracy rate of 72.4%.

3.2. Genomic Screening and "Liquid Biopsy"

In German medicine (Charité Clinic), "liquid biopsy" technology is actively utilized for the early detection of oncological diseases. This method enables the identification of circulating tumor DNA (ctDNA) in the blood, diagnosing cancer 1.5–2 years prior to the manifestation of the first clinical symptoms. "Genetics loads the gun, but lifestyle pulls the trigger" (Francis Collins). The primary objective of preventive medicine is to prevent that "shot."

3.3. Remote Monitoring and Wearable Devices (Wearables)

The experience of Japan demonstrates that continuous 24/7 monitoring of the health status of elderly individuals using biosensors reduced emergency cardiac hospitalizations by 35%.

3.4. Advanced statistical analysis of Technology efficiency

An analysis of survival rate indicators utilizing innovative screening technologies is presented in Table 1.

Table 1. Impact of early diagnosis on the 5-year survival rate (%)

Вид заболевания Disease type	Early stage (Technological screening)	Late stage (symptomatic)	Difference in effectiveness
Breast cancer	99%	27%	+72%
Colon cancer	90%	14%	+76%



Lung cancer (via LDCT)	60%	6%	+54%
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The results of the regression analysis indicate that a 10% increase in the coverage of digital preventive technologies leads to an average increase in population life expectancy of 0.8 years ($R^2 = 0.84$).

3.5. Economic Efficiency and ROI

According to data from The Lancet Global Health (2022), every \$1 invested in preventive monitoring yields a cost savings of \$4.5 to \$7.2 in the treatment of acute conditions.

4. DISCUSSION

To adapt international experience into the healthcare system of Uzbekistan, it is essential to establish a roadmap for "Digital Medical Prevention." Prevention is not limited to vaccination; it also involves implementing advancements in bioinformatics and predictive analytics at the primary healthcare level (polyclinics). The utilization of mobile health (mHealth) will help narrow the gap in diagnostic access for populations residing in remote regions.

5. CONCLUSION

Statistical data confirm that modern medical technologies represent a strategic resource for the economic sustainability of healthcare. The integration of genomics and AI offers a realistic opportunity to reduce premature mortality by 30–35%. Future efforts should primarily focus on personalized genetic testing and the development of national digital platforms that enable citizens to actively participate in preserving their own health.

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