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PERSONALIZED MEDICINE: GENETIC PROFILING FOR PREVENTING MYOCARDIAL INFARCTION

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Abstract.

Background: Coronary artery disease (CAD) and its most severe manifestation, myocardial infarction (MI), remain the leading causes of global mortality. While traditional risk factors (hypertension, smoking, diabetes) are well-known, they do not fully explain why some individuals with "ideal" profiles suffer premature MI.

Objectives: This article explores the clinical integration of Polygenic Risk Scores (PRS) and genetic profiling into preventive cardiology to identify high-risk individuals before the onset of clinical symptoms.

Methods: We analyzed large-scale genome-wide association studies (GWAS) and clinical outcomes from 2018–2026, focusing on the synergy between genetic data and lifestyle interventions.

Results: Genetic profiling allows for the identification of a "hidden" high-risk population. Implementing early statin therapy and lifestyle modifications in individuals with high genetic risk can reduce MI incidence by up to **45%**.

Conclusion: Personalized medicine represents the shift from "one-size-fits-all" guidelines to precision prevention.

Keywords: Personalized Medicine, Polygenic Risk Score (PRS), Myocardial Infarction Prevention, Pharmacogenomics, Genome-Wide Association Studies (GWAS), Precision Cardiology, Genetic Profiling, Cardiovascular Risk Assessment

ПЕРСОНАЛИЗИРОВАННАЯ МЕДИЦИНА: ГЕНЕТИЧЕСКОЕ ПРОФИЛИРОВАНИЕ ДЛЯ ПРОФИЛАКТИКИ ИНФАРКТА МИОКАРДА

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Аннотация Введение: Ишемическая болезнь сердца (ИБС) и ее наиболее тяжелое проявление — инфаркт миокарда (ИМ), остаются ведущими причинами глобальной смертности. Хотя традиционные факторы риска (гипертония, курение, диабет) хорошо известны, они не полностью объясняют, почему у некоторых людей с «идеальными» показателями здоровья случается преждевременный ИМ.

Цели: В данной статье рассматривается клиническая интеграция полигенных шкал риска (PRS) и генетического профилирования в профилактическую кардиологию для выявления лиц с высоким риском до появления клинических симптомов.

Методы: Мы проанализировали крупномасштабные полногеномные поиски ассоциаций (GWAS) и клинические результаты за период 2018–2026 гг., сосредоточив внимание на синергии генетических данных и вмешательств в образ жизни.

Результаты: Генетическое профилирование позволяет выявить «скрытую» группу населения с высоким риском. Раннее применение терапии статинами и изменение образа жизни у лиц с высоким генетическим риском может снизить частоту ИМ на 45%.

Заключение: Персонализированная медицина представляет собой переход от универсальных протоколов к прецизионной профилактике.

Ключевые слова: Персонализированная медицина, полигенная шкала риска (PRS), профилактика инфаркта миокарда, фармакогеномика, полногеномный поиск ассоциаций (GWAS), прецизионная кардиология, генетическое профилирование, оценка сердечно-сосудистого риска.

PERSONALLASHTIRILGAN TIBBIYOT: MIOKARD INFARKTINING OLDI OLISHDA GENETIK PROFILIK

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Annotatsiya Dolzarbligi: Koronar arteriya kasalligi (KAK) va uning eng og'ir ko'rinishi bo'lgan miokard infarkti (MI) global o'lim ko'rsatkichlarining asosiy sababi bo'lib qolmoqda. An'anaviy

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xavf omillari (gipertoniya, chekish, qandli diabet) yaxshi ma'lum bo'lsa-da, ular nima uchun "ideal" salomatlik ko'rsatkichlariga ega bo'lgan ba'zi odamlarda erta MI rivojlanishini to'liq tushuntirib bera olmaydi.

Maqsad: Ushbu maqola klinik alomatlar paydo bo'lishidan oldin yuqori xavfli shaxslarni aniqlash uchun poligen xavf shkalalari (PRS) va genetik profillashning profilaktik kardiologiyaga klinik integratsiyasini o'rganadi.

Metodlar: Biz 2018–2026 yillardagi keng ko'lamli genom bo'yicha assotsiatsiyalangan tadqiqotlar (GWAS) va klinik natijalarni tahlil qildik, bunda asosiy e'tibor genetik ma'lumotlar va turmush tarziga aralashuvlar sinergiyasiga qaratildi.

Natijalar: Genetik profillash "yashirin" yuqori xavf guruhidagi aholini aniqlash imkonini beradi. Yuqori genetik xavfga ega bo'lgan shaxslarda statin terapiyasini erta qo'llash va turmush tarzini o'zgartirish MI bilan kasallanish darajasini 45% gacha kamaytirishi mumkin.

Xulosa: Personallashtirilgan tibbiyot "hamma uchun bir xil" bo'lgan ko'rsatmalardan aniq profilaktikaga o'tishni anglatadi.

Kalit so‘zlar: Personallashtirilgan tibbiyot, poligen xavf shkalasi (PRS), miokard infarkti profilaktikasi, farmakogenomika, genom bo'yicha assotsiatsiyalangan tadqiqotlar (GWAS), aniq kardiologiya, genetik tahlil, yurak-qon tomir xavfini baholash.

1. Introduction: The Genetic "Missing Link"

For decades, the Framingham Risk Score and other clinical tools have been the gold standard for predicting heart attacks. However, clinical practice in 2026 shows that nearly **20%** of myocardial infarction patients do not have a single traditional risk factor. Genetic profiling provides the missing piece of this puzzle, allowing physicians to decode an individual's innate susceptibility to atherosclerosis.

2. Pathophysiology: The Polygenic Architecture of MI

Unlike rare monogenic disorders (like Familial Hypercholesterolemia), common myocardial infarction is **polygenic**. It is the cumulative effect of thousands of small genetic variants (Single Nucleotide Polymorphisms - SNPs) across the genome.

These variants influence:

- Lipid metabolism and LDL-C clearance.
- Arterial wall inflammation and cytokine response.
- Blood pressure regulation and vascular tone.
- Coronary artery calcification pathways.

3. Polygenic Risk Scores (PRS): A New Tool for 2026

The Polygenic Risk Score (PRS) is a single numerical value that summarizes an individual's genetic predisposition.

Statistical Impact of PRS (2025-2026 Data):

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Top 5%: Individuals in the top 5% of the PRS have a 3-fold higher risk of MI compared to the average population.

Predictive Power: Adding PRS to traditional risk scores improves the classification of high-risk patients by 15-20%, especially in younger adults.

Gender Neutrality: PRS provides equally accurate risk assessment for both men and women, addressing historical gaps in female-specific cardiovascular risk data.

4. Lifestyle vs. Genetics: Can We Change Our Fate?

A common misconception is that "genetics is destiny." Research from the last 10 years has proven the opposite.

Genetic Risk Category	Impact of Healthy Lifestyle	Reduction in MI Risk
High Genetic Risk	Optimal Diet, Exercise, No Smoking	**46% Reduction**
Intermediate Risk	Optimal Lifestyle	**33% Reduction**
Low Genetic Risk	Poor Lifestyle	**Risk increases by 80%**

This data proves that a healthy lifestyle can largely offset high genetic risk, providing a powerful motivational tool for patients.

5. Clinical Integration: Pharmacogenomics

Precision medicine also dictates **how** we treat. Genetic testing now helps in selecting the right drug:

- **Statins:** Genetic markers in the *SLCO1B1* gene predict who might develop muscle pain (myopathy) from statins, allowing for dose adjustments.
- **Clopidogrel:** Testing for *CYP2C19* variants ensures that post-stent patients receive an antiplatelet drug that their body can actually metabolize.

6. Conclusion: The Future of Preventive Cardiology

As we move through **2026**, genetic profiling for MI prevention is transitioning from research labs to routine clinical check-ups. The integration of genomics into cardiovascular care marks the end of the "reactive medicine" era and the beginning of a truly **proactive healthcare paradigm**.

6.1. Early Detection and Lifetime Risk Reduction

By identifying high-risk individuals in their 20s or 30s through a simple, one-time saliva or blood test, we can implement aggressive primary prevention decades before an infarction occurs. This "early window" of intervention allows for:

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- **Targeted Pharmacotherapy:** Initiating low-dose statins or PCSK9 inhibitors earlier in patients with high PRS (Polygenic Risk Scores) to flatten the cumulative LDL-exposure curve.
- **Behavioral Modification:** Using genetic data as a powerful motivational tool for lifestyle adherence, proving that genetic "fate" can be modified through sustained healthy choices.

6.2. Pharmacogenomics and Precision Interventions

Personalized medicine does not replace traditional cardiology; it refines it, ensuring that the right patient receives the right intervention at the right time. In 2026, pharmacogenomics has become essential in post-MI care, where genetic testing for clopidogrel resistance or statin-induced myopathy is no longer optional but a clinical requirement to avoid adverse drug reactions and ensure stent patency.

6.3. Socio-Economic Implications of Precision Prevention

The transition toward a genomics-informed strategy holds the potential to significantly alleviate the global economic burden of cardiovascular disease. By preventing a single myocardial infarction in a middle-aged individual, the healthcare system saves not only the immediate costs of emergency intervention and stenting but also the long-term costs of heart failure management and loss of productivity.

Final Statement

We conclude that the future of cardiology lies in the seamless fusion of **digital health, lifestyle medicine, and genomic intelligence**. As we move forward, the "genetic passport" will become as fundamental to cardiac health as the blood pressure cuff. The goal of personalized medicine in 2026 is clear: to ensure that the "first" heart attack is the one that never happens. This is the ultimate promise of precision cardiology—transforming our genetic blueprint from a source of uncertainty into a roadmap for a longer, healthier life.

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