PROPHET TOOLBOX FACTSHEET#5

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Bottlenecks for the implementation of Personalized Prevention Approaches

PROPHET

a PeRsOnalized Prevention roadmap for the future HEalThcare

Advances in genomics and multi-omics technologies have created new opportunities for prevention tailored to individual biological profiles. Yet, the integration of personalized prevention into healthcare remains limited.

Within the PROPHET project, **a scoping review** of reviews was conducted to map the barriers to the implementation of personalized prevention, **complemented by expert interviews and a stakeholder survey** to further explore how these bottlenecks are perceived across different sectors of the healthcare ecosystem. Together, this work provided an overview of the obstacles affecting personalized prevention, which were organized into key thematic categories, reflecting organizational, ethical, and practical challenges that healthcare professionals face when translating personalized prevention into routine practice.

Key evidence from the scoping review of reviews

Across 37 reviews, 283 barriers were identified and grouped into six major domains:

- **Healthcare Professionals**: limited training and workload concerns.
- **Research**: factors limiting scientific advancements and robust evidence generation.
- **Public:** limited health literacy among citizens and patients, and skepticism toward personalized prevention.

- **Organizational aspect:** challenges regarding the integration of personalized approaches into healthcare and the practical translation of personalized prevention in real-world context.
- **Ethical, Legal, Social Issues:** ethical and legal concerns, including privacy, consent, and equity.
- **Financial concerns:** economic hurdles, such as high costs and funding limitations for the implementation of personalized prevention approaches.

The first two domains are particularly critical for health professionals, as they influence clinical readiness and willingness to adopt personalized prevention. However, all domains are interconnected and require a systemic approach to ensure equitable, efficient, and sustainable implementation.

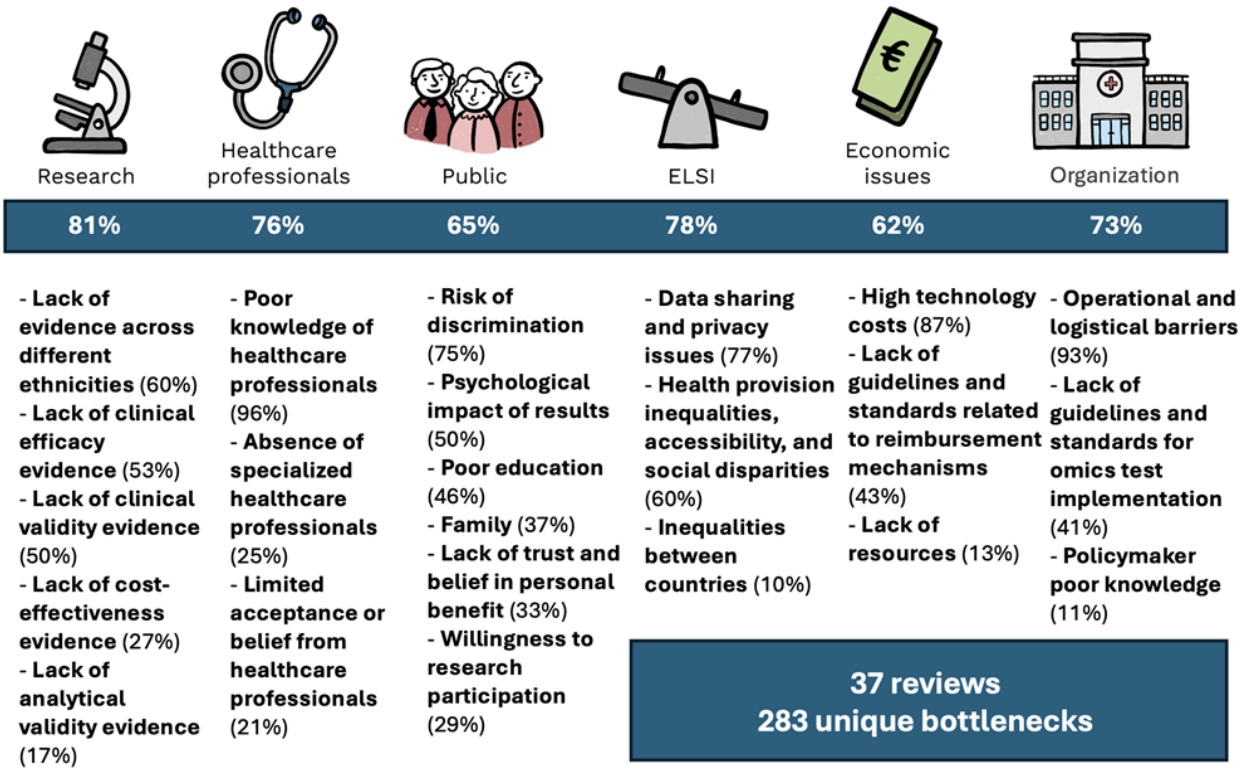

Fig. 1: From the 37 included reviews, 283 barriers were extracted and summarized into six major domains from the thematic analysis.

Healthcare professionals's barriers

Barriers related to healthcare professionals were reported in 76% of studies (28 reviews), highlighting their central role in implementation success. Key obstacles include:

- **Limited knowledge of healthcare professionals (96%):** lack of education in genomics and omics-based prevention, leading to misinterpretation of results and poor translation into clinical recommendations.
- **Absence of specialized healthcare professionals (25%):** insufficient number of genetic counsellors and experts in omics fields, particularly within primary care and preventive services.
- **Limited acceptance or belief from healthcare professionals (21%):** some clinicians perceive genomics as outside their expertise or question its clinical utility, resulting in hesitancy to adopt personalized prevention tools.

Insufficient literacy, limited workforce capacity, and skepticism among healthcare professionals represent key barriers to integrating personalized prevention into everyday clinical practice.

Research barriers

Research-related limitations are among the most frequent obstacles, reported in over 80% of studies (30 reviews). Main issues include:

- **Lack of evidence across different ethnicities (60%):** most genomic data derive from populations of European ancestry, reducing generalizability to other ethnic groups.

- **Lack of clinical efficacy evidence (53%):** few large-scale or long-term trials demonstrate preventive benefit after omics testing.
- **Lack of clinical validity evidence (50%):** scarce robust and validated biomarkers or diagnostic tools.
- **Lack of cost-effectiveness evidence (27%):** economic evaluations are limited, hindering policy and investment decisions.
- **Lack of analytical validity evidence (17%):** lack of systems to process and integrate complex multi-omics data.

Evidence gaps and methodological weaknesses slow translation from research to real-world preventive care.

Public related barriers

Barriers related to citizens and patients were reported in 65% of studies (24 reviews), highlighting the crucial role of public perception and engagement.

- **Risk of discrimination (75%):** fears of misuse of genetic information in employment, insurance, or social contexts.
- **Psychological impact of results (50%):** anxiety, stress, or distress caused by genetic risk communication.
- **Poor education (46%):** limited understanding of omics technologies and their benefits.
- **Family (37%):** difficulties communicating genetic risk to relatives, lack of family involvement, and potential conflicts.

- **Lack of trust and belief in personal benefit (33%):** skepticism toward the utility or necessity of testing.
- **Willingness to research participation (29%):** insufficient awareness and engagement with genomic studies reduce participation and data diversity.

Psychological concerns, social inequalities, and limited genomic literacy hinder public acceptance and equitable uptake of personalized preventive strategies.

Organizational barriers

Organizational challenges were reported in 73% of studies (27 reviews), reflecting difficulties in the practical uptake of personalized prevention. Main challenges include:

- **Operational and logistical barriers (93%):** inadequate data systems, limited interoperability between omics and clinical data, and poor integration across care settings.
- **Lack of guidelines and standards for omics test implementation (41%):** absence of harmonized protocols for omics testing, sample handling, data storage, or sharing; unclear legal and professional frameworks.
- **Policymaker poor knowledge (11%):** insufficient understanding of genomic medicine's potential and requirements for prevention.

These gaps hinder coordination and standardization, slowing adoption of personalized prevention in health systems.

Ethical, Legal and Social Barriers

Ethical, legal, and social issues (ELSI) were reported in 78% of studies (29 reviews), reflecting concerns about trust, fairness, and governance in personalized prevention. Main issues include:

- **Data sharing and privacy issues (77%):** unclear rules for data access, storage, and sharing; risk of misuse of sensitive genetic information.
- **Health provision inequalities, accessibility and social disparities (60%):** unequal access to omics-based services across socioeconomic and ethnic groups.
- **Inequalities between countries (10%):** disparities in infrastructure, resources, and regulatory capacity to adopt genomic technologies.

These issues highlight the urgent need for harmonized data governance, ethical oversight, and equity-driven policies to ensure that personalized prevention benefits all populations.

Financial barriers

Financial constraints were identified in 62% of studies (23 reviews), representing a major obstacle to large-scale implementation and equitable access.

- **High technology costs, including insurance coverage and reimbursement mechanisms (87%)**: expensive omics platforms and limited insurance coverage restrict access.

- **Lack of guidelines and standards related to reimbursement mechanisms (43%):** absence of clear policies and standards for cost recovery and coverage of genomic testing.

- **Lack of resources (13%):** insufficient budgets, funding mechanisms, and support teams to sustain genomic services.

High costs and weak reimbursement systems undermine affordability and sustainability, slowing the adoption of personalized prevention and reinforcing health inequities.

For those who want to read the paper, it is available at: https://doi.org/10.1371/journal.pone.0335444

Insights from expert interviews and a stakeholder survey

1 *Health professionals' perspective*

Insights from the PROPHET stakeholder consultation illustrate how health professionals perceive the limitations hindering the adoption of personalized prevention. Their responses highlight recurring challenges across all macro-level domains identified in the literature, reflecting the central role of healthcare professionals in translating policy and evidence into routine care.

- **Insufficient funding and strategic direction:** limited government investment and lack of a cohesive national strategy hinder implementation of personalized prevention.

- **Data protection and ethical issues:** concern over citizens' and patients' insufficient understanding of how their personal health data are managed.

- **Low awareness across stakeholders:** policymakers, patients, and citizens lack adequate information on personalized prevention options and benefits.

- **Knowledge and skills gaps:** lack of a clear understanding of personalized prevention, particularly in the use of genetics and genomics.

- **Training deficiencies:** few opportunities for professional education and for learning effective communication strategies with patients.

- **Limited public engagement:** insufficient information provided by professionals to support citizens' enrolment in preventive programs.

2 *Professional priorities and recommendations*

- **Expand training and education** by embedding genomics, data interpretation, and communication skills within medical and public health curricula.

- **Improving the availability and usability of clinical guidelines and decision-support tools** that translate omics evidence into routine preventive practice while ensuring ethical and legal compliance.

- **Enhance data literacy and patient communication** by strengthening professionals' ability to handle personal data and to communicate risks and benefits to patients.

- **Foster multidisciplinary collaboration** among clinicians, genetic counsellors, data scientists, and public health experts to implement prevention effectively.

- **Support evidence generation** through engagement in inclusive, real-world research that validates omics-based tools across diverse populations and clinical contexts.

Healthcare professionals play a pivotal role in advancing personalized prevention. Clinical readiness depends on sustained investment in education, guidelines, and infrastructure. Strengthening multidisciplinary collaboration and ethical practice, will enable health professionals to drive innovation and contribute to more equitable and effective preventive care.

Bibliography

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