

Health

Transition to Preventive and Personalised Medicine



Institute for Statistical Studies and Economics of Knowledge (ISSEK) HSE presents the results of a study of human potential trends. The research methodology includes methods of big data mining based on the iFORA system created at HSE ISSEK, as well as expert sessions and the Delphi survey with the participation of more than 400 leading foreign and Russian scientists in the field of human potential.

The project is implemented within the framework of the activities of the [World-Class Human Capital Multidisciplinary Research Centre](#) and the UNESCO Chair on Future Studies (UNESCO Futures Literature Chairs network). The full list of trends is available in a unique open-access database https://ncmu.hse.ru/chelpoten_trends.

Key subtrends

▶ Development of genomic technologies

Progress in genomic and cellular technologies and medical bioinformatics, and the active application of information technology (IT) in medicine allowed to move on towards a new medical care model based on personalised approach to the patient. The high proportion of preventable deaths caused by cardiovascular diseases, diabetes, chronic obstructive pulmonary disease (COPD), obesity, and some infectious diseases determines the need to shift the modern healthcare priorities from treating diseases to preserving human health, primarily through timely prevention of pathological processes.

▶ Development of early diagnosis technologies

The key elements of preventive medicine aimed at preventing the development of diseases include early diagnosis systems, detecting individual risks of diseases, vaccination, and regular monitoring of certain health parameters with the help of wearable devices. Such practices will significantly reduce preventable deaths, and the burden on the healthcare system. E.g. timely vaccination saves 2-3 million lives worldwide every year (excluding COVID-19). According to experts, the transition to preventive medicine will help reduce the burden on primary healthcare systems by at least 20%, and on the high-technology sector by 60%.

▶ Accumulation of large amounts of medical data, improvement of techniques for its in-depth analysis

Key estimates

2.8 billion USD

will reach global personalised medicine market in 2022 (1.3 billion USD in 2015)

Effective prevention of infectious diseases reduces antibiotic resistance (which World Health Organization named among major public healthcare challenges) by curbing the spread of antibiotic-resistant bacterial strains, and reducing antibiotic consumption. Analysis of specific biomarkers may reveal the onset of pathological changes in the body, the risk of developing a disease or its initial stage (which often happens without clinical symptoms). Early diagnosis increases the chances of a successful cure, and sometimes even allows to avoid the disease altogether. Molecular genetic analysis can reveal individual predispositions to certain diseases, which will help take timely steps to prevent them. The evolution of biostatistics,

90–100%

are the chances of successfully curing cancer detected at the zero or first stage

epidemiology, and new vaccine technologies will reduce the proliferation of infectious diseases. Regular monitoring will make it possible to assess the effectiveness of the measures taken, and if necessary adjust them.

The rapidly generated large amount of biodata, and the new methods of processing and interpreting it (including AI-based systems) lead to a deeper understanding of the relationship between individual genes (and their mutations) and the risks of developing specific diseases. The patient's genetic data is used to select the best treatment strategy, which reduces the time and costs of therapy, and the number of possible side effects.

Molecular diagnostics allow to identify individual predispositions, and develop personalised prevention and treatment plans. Putting in place the adequate infrastructure for collecting and analysing biological data is particularly important for further progress in this area, including creating biobanks and accumulating

clinically significant knowledge about the association of various biomarkers with the manifestation of specific pathologies. Plus, new bioinformatics and biostatistics techniques will provide a high level of data processing for the purposes of genomic, proteomic, and transcriptomic analysis.

Trend's characteristics



Impact on human potential

1

2

3



Weak signal²

Cases of children born with altered DNA



Strongest manifestation period

After 2030



Wild card³

Preventing all genetic diseases even before the birth of the child, in the womb



Effect of COVID-19 pandemic

Strengthened the trend



Consequences of wild card

Opportunity for major improvement of cognitive and physical abilities



Level of occurrence in Russia

Comparable to world

¹ 1 – weak influence, 2 – medium, 3 – strong.

² Weak signal is an event that has a low degree of significance (mention, popularity), but indicates a radical trend transformation in the future.

³ Wild card is an unpredictable event, which, if realized, can have a significant impact on the trend development.

Drivers and barriers



Drivers

- High preventable mortality rate
- Demand for high-quality medical care, people's increased concern about their health
- Development of genomic technologies and molecular diagnostics
- Gradual reduction in DNA diagnostics costs
- Collection of data on genome, the relationships between individual genes (and their mutations) and human health, improved technologies for processing large data arrays
- National programmes and strategies to advance preventive and personalised medicine
- Prospects to significantly reduce treatment costs due to timely diagnosis and personalised treatments



Barriers

- Problems with changing the existing healthcare system
- Delayed effect from the introduction of preventive technologies (may fully manifest only in 15-20 years' time)
- Less-than-perfect legal framework for the development and application of personalised medicine products, complex registration procedures
- Lack of qualified medical personnel, need to change the healthcare professionals training system
- High requirements for the protection of personal medical data
- Issues with registering property rights for genes and biomarkers
- Growing anti-vaccine sentiment
- Tendency to seek medical attention only when severe symptoms appear, which often signal an already advanced disease

Effects



Opportunities

- Reduced mortality and morbidity rates
- Scientific substantiation of the relationship between individual biomarkers and the development of diseases, and creating effective diagnostics and treatment techniques on this basis
- Reduced overall treatment costs due to choosing more effective therapy strategies



Threats

- Unpredictable consequences of changing the genetic profile of living organisms due to the use of genomic technologies
- The risk of overdiagnosis which can cause more harm than good, among other things due to increased time and costs, and a negative impact on the patient's psyche
- Possible discrimination of certain groups of people based on genomic analysis results