What if a small blood sample could predict and prevent organ failure?

04

Organ Map

| Within Reach | **Transitional** | Visionary |

Advances in mass spectrometry and plasma proteomics make it possible to identify – with a small blood sample – organ-specific age, enabling personalised medicine and early health interventions.

UNCERTAINTIES

Systems, Technology

MEGATREND (Most significant)

Advanced Health and Nutrition

TRENDS

Communicable
  & Non-Communicable Diseases
Longevity & Vitality
Precision/Personalised Medicine
Proteomics

TECHNOLOGIES

Analytical Methods & Technologies
Genomics
Open Data

SECTORS IMPACTED

Cyber & Information Security
Data Science, AI, & Machine Learning
Health & Healthcare
Insurance & Reinsurance

KEYWORDS

Biomarkers
Mass Spectrometry
Organ Ageing
Preventative Healthcare
Proteomics

Ageing organs can increase mortality risk by

5.5X ➔ 29X

times, depending on the **number of affected organs**

WHY IT MATTERS TODAY
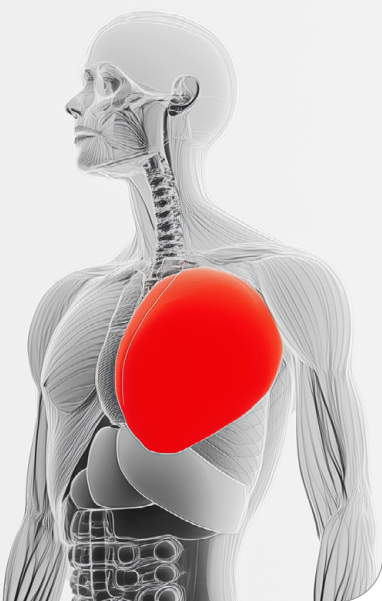
Global life expectancy has been steadily increasing.[523] As people live longer, the focus is growing on not just extending lifespan but also actively improving healthspan – the period of life spent in good health.[524] The COVID-19 pandemic has increased public awareness of health vulnerabilities, particularly in relation to age.[525,526] This has led to greater interest in preventative healthcare and the role of individual risk factors.[527] In 2022, Ipsos surveyed 1,160 people across the United States to predict how well-being might change in a post-pandemic world. They found that, for 62% of Americans, their health was more important to them than before the pandemic[528] and in 2024, their top concerns are affordability, quality and future pandemics.[529]

Organ ageing rates vary and influence mortality risk, yet methods to assess organ-specific ageing[530] and predicting disease risk remain limited.[531] Two plasma proteomics studies based on 45,000 and 50,000 samples (respectively) from the UK Biobank found that certain proteins have a connection to organ ageing.[532, 533] Ageing organs can increase mortality risk by 5.5 to 29 times, depending on the number of affected organs.[534] In a further study at Stanford University, researchers used machine learning to analyse blood plasma proteins from adults to estimate the biological age of 11 organs and body systems including the arteries, brain, heart, intestines, kidneys, liver and pancreas. It found that almost 20% of the participants showed accelerated ageing in a single organ, while around 2% had multiple ageing organs.[535] People with accelerated heart ageing had more than double the risk of heart failure over the next 15 years. For most other organs, accelerated ageing led to a 15–50% greater risk of death from any cause, while indicators of brain and artery ageing were linked to a higher risk of Alzheimer's disease and cognitive decline.[536]

As people live longer, the focus is shifting **from lifespan to healthspan** – the period of life spent in good health

THE OPPORTUNITY

Further understanding of proteins enables the use of plasma protein-based biomarkers to assess the biological age of specific organs, creating a personalised organ ageing map. Through a simple blood test, these biomarkers enable targeted therapies. Combined with individual genetic testing, this provides powerful insights,[537] leading to a fully personalised, organ-focused prevention and treatment plan.

Proteins play a critical role in cellular functions and remain important in drug discovery. While large-scale human studies on proteins have so far been limited, new research provides insights into previously unclear protein origins and functions.[538] Advances in mass spectrometry are starting to enable more accurate protein measurements, addressing the current inaccuracy rate of up to one-third in current methods currently used for protein analysis.[539]

BENEFITS

Personalised healthcare and improved preventative medicine; increased longevity; early disease intervention; non-invasive approach to disease identification for many diseases.

RISKS

Psychological stress from health predictions; reduced focus on overall well-being; high potential to widen the inequality gap between countries; errors in testing.

Through a simple blood test, plasma protein-based biomakers help assess the biological age of specific organs, allowing a fully personalised, organ-focused prevention and treatment plan