Swiss Re Institute

Mortality improvement: understanding the past and future trends

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Agenda

Recent trends in mortality

Drivers of slowing mortality improvements

Genomic technology

Open discussion

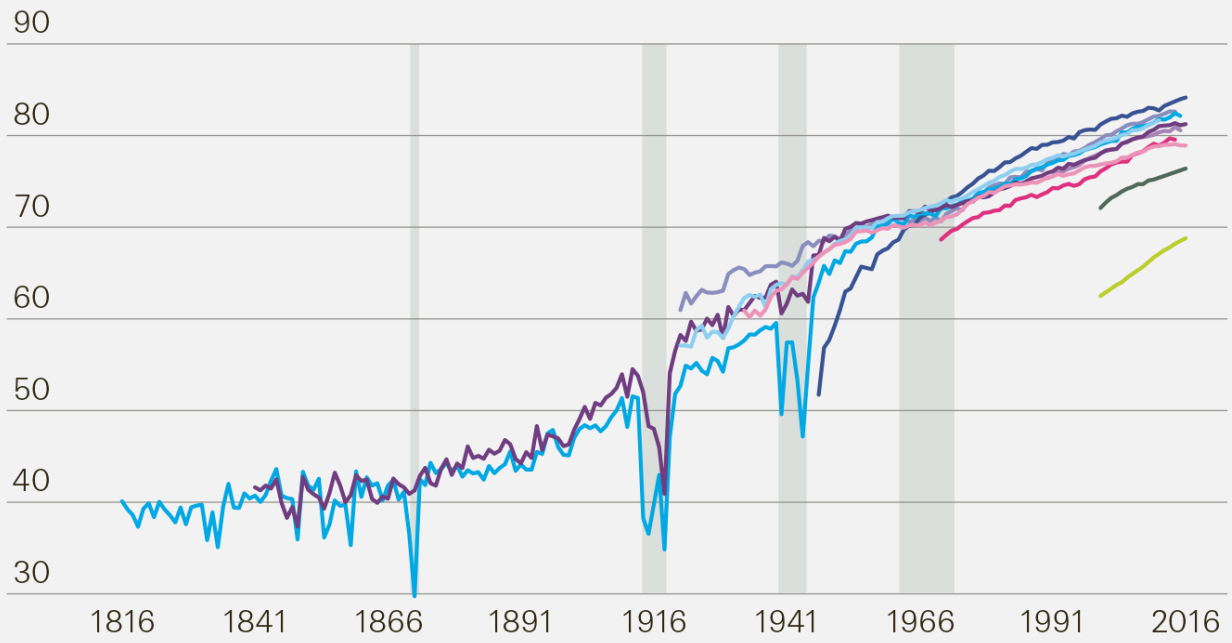
Recent trends in mortality

We have had a long-run of increases in life expectancy

Life expectancy has risen since the early 20th century driven by advances in living conditions, medicine and technology

Life expectancy at birth

In years, both sexes



Japan	84.2 years
Australia	82.6 years
France	82.2 years
Canada	81.7 years
England & Wales	81.3 years
Germany	80.6 years
Taiwan	79.6 years
United States	78.9 years
China	76.4 years
India	68.8 years

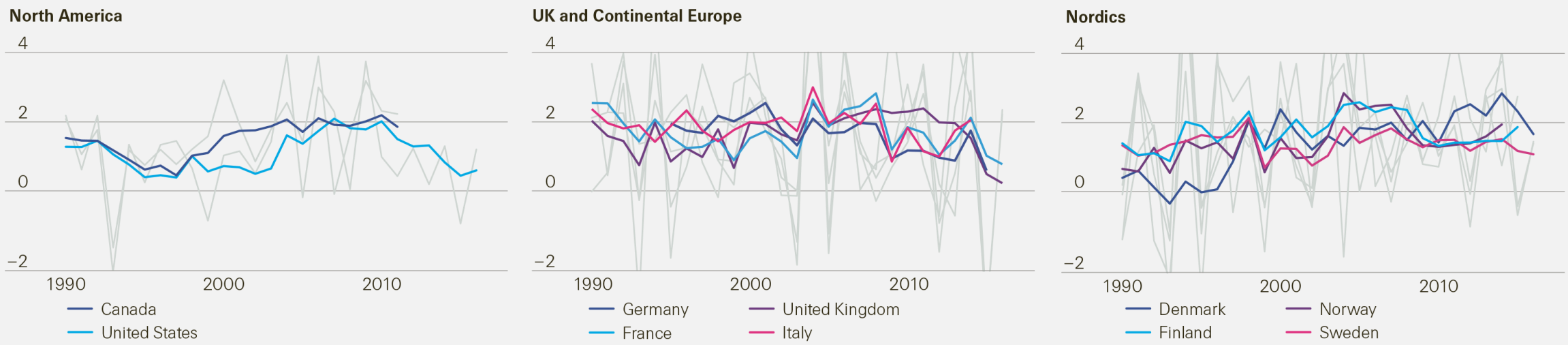
Notes: Life expectancy (in 2016 or latest available) shown in the legend. Grey areas indicate periods of war.
Source: Human Mortality Database (HMD), University of California at Berkeley and Max Planck Institute for Demographic Research, www.mortality.org (accessed 28 August 2018), World Health Organization.

Mortality improvements slowed recently

There are signs that mortality improvements have slowed recently in many countries... but not everywhere

5-year backward-looking moving averages of annual improvements in mortality rates

In percent, age-standardised rates



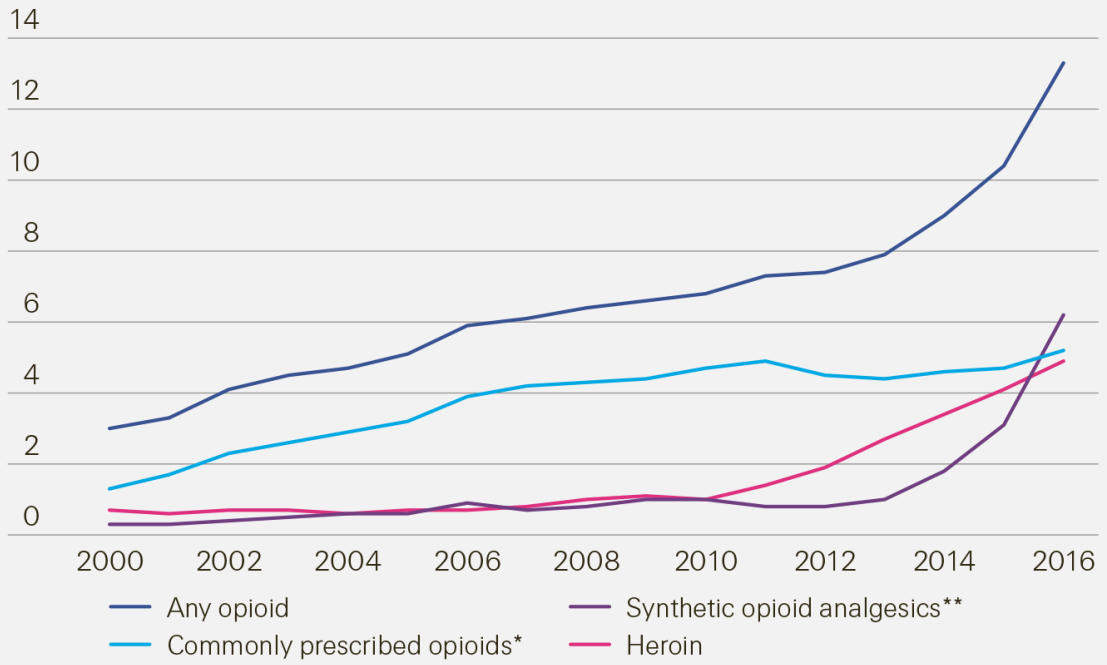
Notes: Coloured lines are 5-year backward-looking moving averages. Grey lines show the high volatility of annual rates of improvement. Rates were standardised using the US population in 2016.
Sources: Swiss Re Institute, Human Mortality Database

Opioid epidemic in US also influential

The US is in the midst of an opioid crisis with deaths from misuse of opioids rising sharply since 2000

Overdose deaths involving opioids in the US

Standardised mortality rates, per 100 000



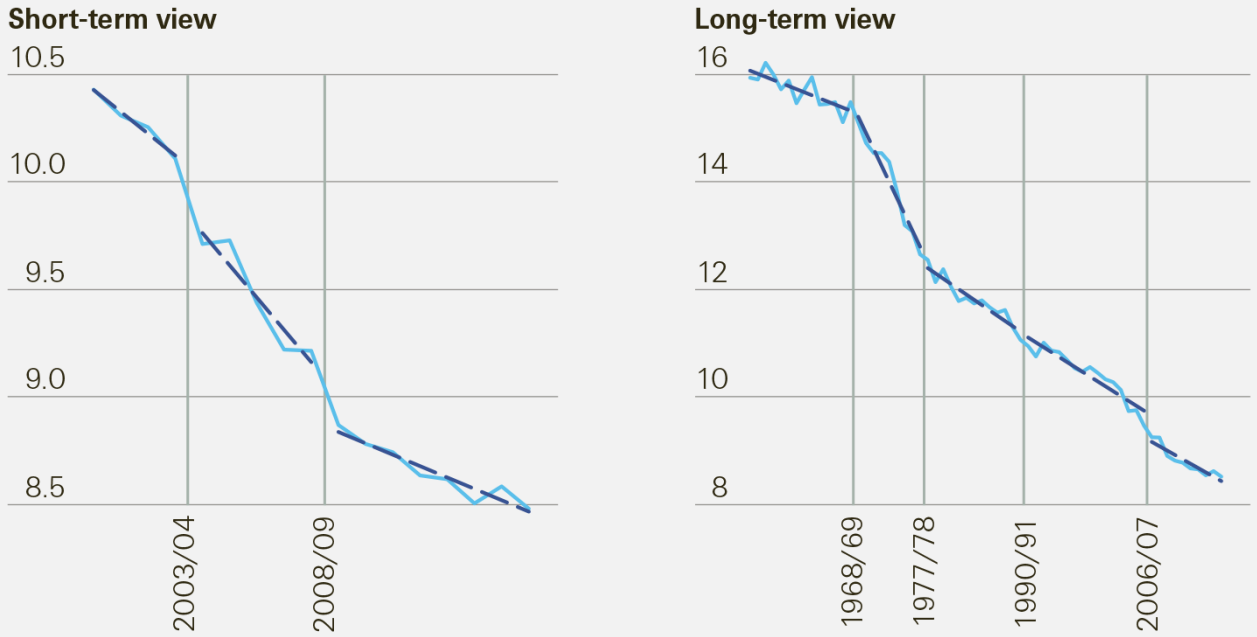
Notes: * Natural and semi-synthetic opioids and methadone. ** Excluding methadone.
Source: Centers for Disease Control and Prevention (CDC): www.cdc.gov/drugoverdose/data/analysis.html

Change in trend of just volatility?

Annual mortality rates are highly volatile and developments need to be assessed over a long time period

US all-cause mortality rates

Short-term and long-term perspectives



Note: Vertical lines indicate possible structural breaks in the piecewise linear relationship.
Sources: Swiss Re Institute, Human Mortality Database

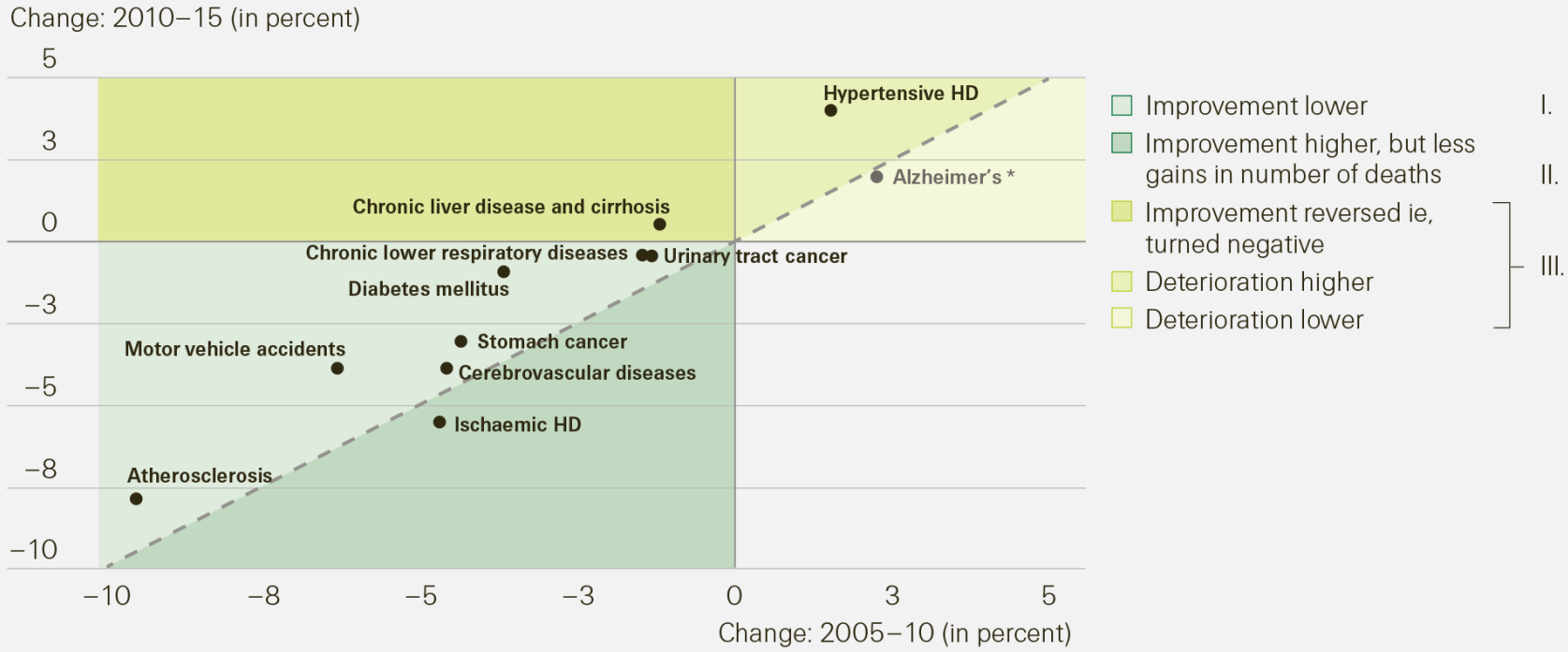
Drivers of slowing mortality improvement

Swiss Re Institute

Leading contributory causes of the recent slowdown

Developments in cerebrovascular disease, diabetes mellitus and ischeamic heart disease were key drivers

Average annual change in mortality rates
2005-10 vs 2010-15

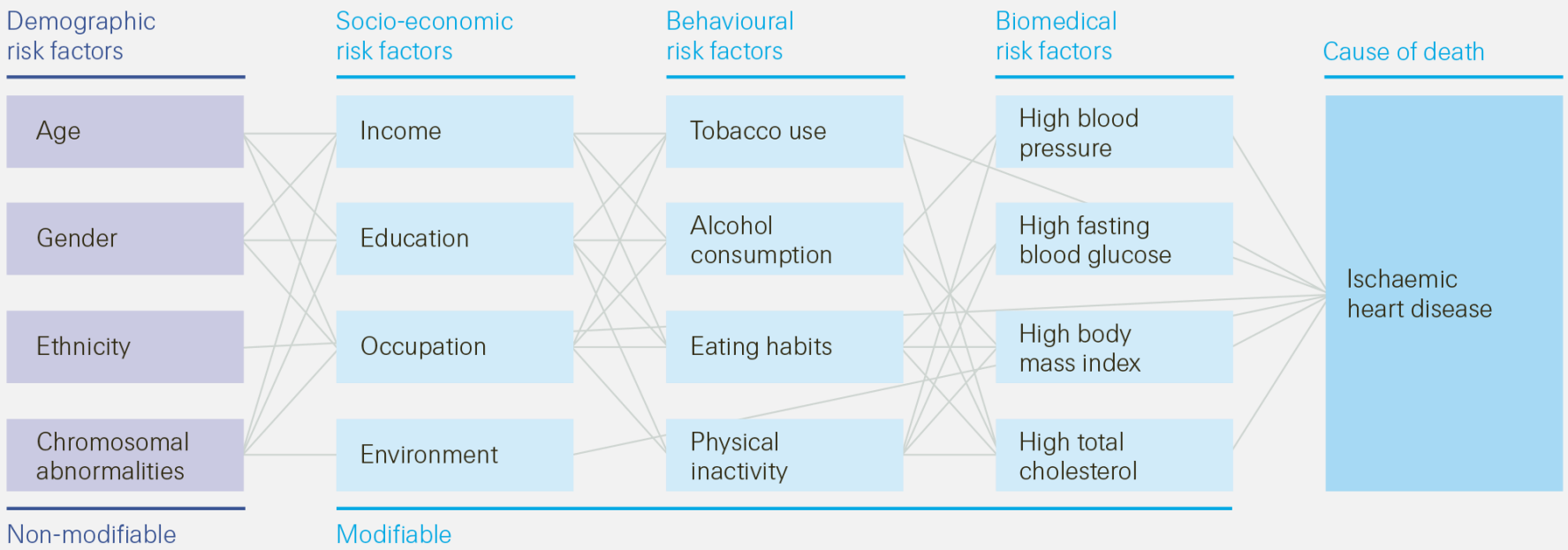


Note: Based on 11 countries that experienced a recent slowdown in mortality improvement.
Sources: Swiss Re Institute, WHO (mortality) and UNDP (vital) data

Underlying risk factors can be complex

A risk factor is anything that affects the chance of a disease/injury causing death, but does not necessarily cause death

Example of a causal chain of risk factors leading to death from heart failure



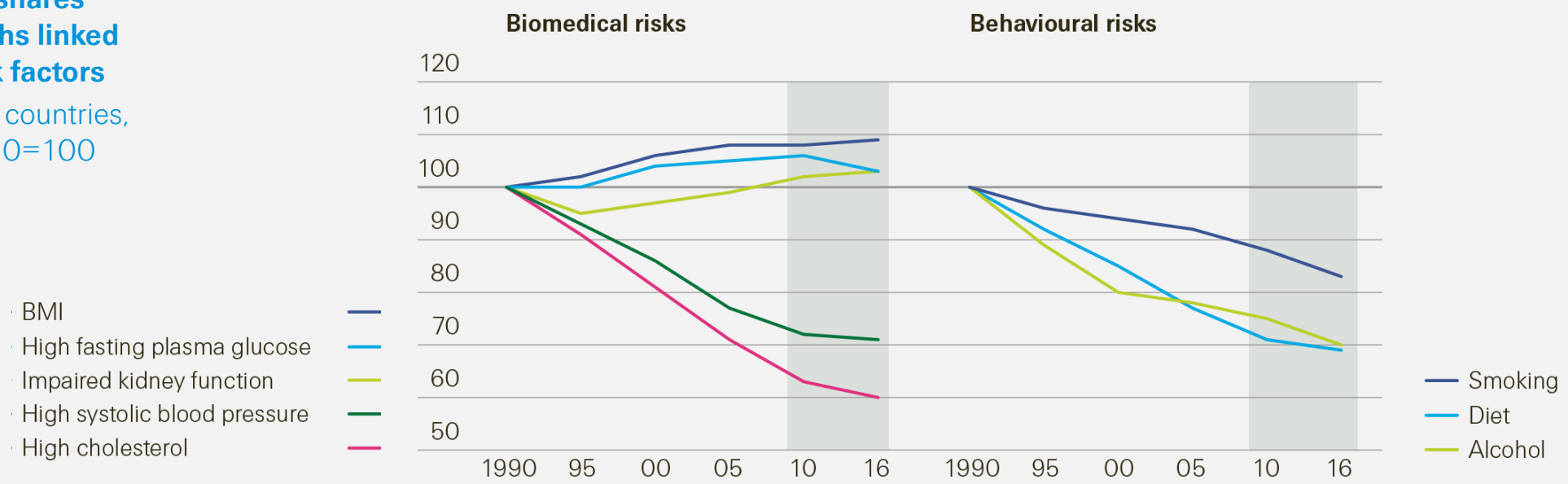
Note: Lines indicate some of the (dual-directional) interactions between risk factors that may lead to death.
Sources: Swiss Re Institute based on *«Global health risks: mortality and burden of disease attributable to selected major risks»,* World Health Organization, 2009.

Explaining mortality improvement slowdown

Lifestyle choices over diet and physical exercise are more likely explanations rather than smoking or alcohol

Changes in shares of total deaths linked to major risk factors

High-income countries, indexed: 1990=100



Sources: Institute for Health Metrics and Evaluation (IHME), Swiss Re Institute calculations

Socio-economic risks play crucial role too

Biomedical and behavioural risk factors alone do not fully explain different mortality experience

Socio-economic risks

Reduction in healthcare spending

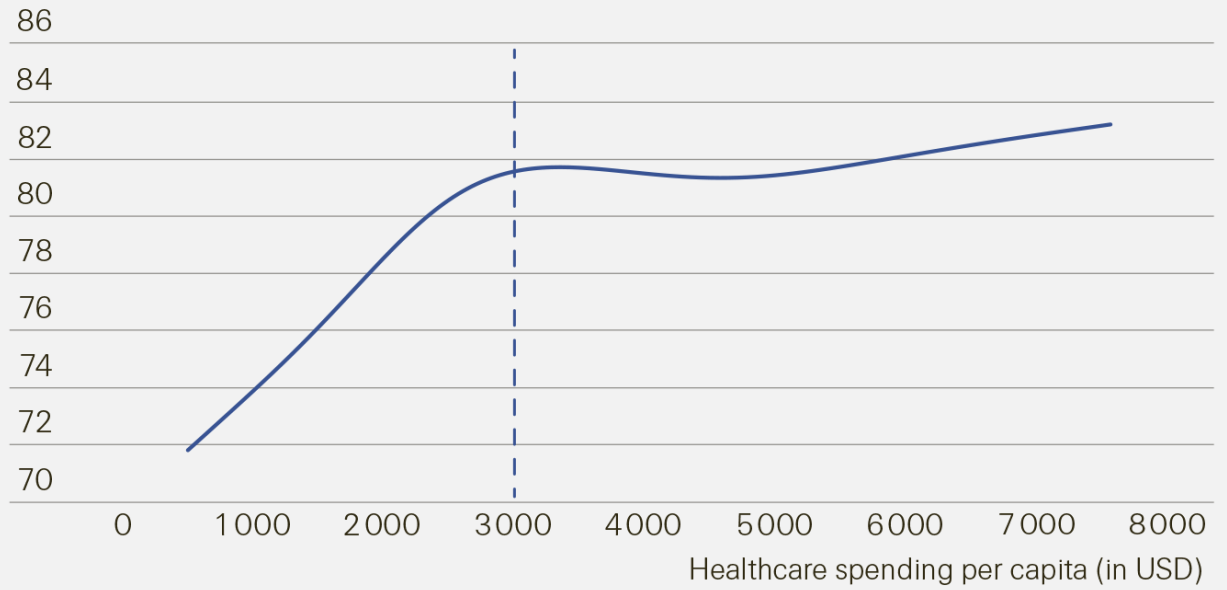
- Quality of healthcare
  eg, compromise of service provision

Economic and social inequality

- Access to healthcare
  eg, introduction of Medicare/Medicaid
- Financial troubles
  eg, increased incidents of intentional self-harm, deaths of despair in the US
- Others
  eg, lower education

Life expectancy at birth (in years)

at different levels of total healthcare spending per capita



Note: Based on 31 countries (United States is an outlier and was not considered).
Source: Swiss Re Institute estimates combining Human Mortality Database and OECD data

Framing the future: genomic technology

What is Genetic Testing?

"Genetic testing looks for alterations in a person's genes or chromosomes to identify heritable or acquired mutations related to disease and health"

Diagnostic / confirmatory genetic testing

Identifies or confirms a specific genetic condition in a symptomatic individual

Pharmacogenomic testing

Guides individual drug dosage, selection and response

Direct-to-consumer (DTC) genetic testing

Genetic tests marketed directly to consumers without involving healthcare professionals

New-born screening

Identifies highly penetrant genetic disorders that can be treated early in life

Predictive and pre-symptomatic genetic testing

Estimates the risk of developing adult-onset disease or predicting future disease onset

Nutrigenomic testing

Studies the effect of genetic variations in relation to the interaction between diet/nutrition and health

Liquid biopsy testing

Detects molecular biomarkers in blood & other body fluids for diagnosis, prognosis and treatment

Trends and prospects in genetic testing

Over the past year, personal genetic testing has gone mainstream with exponential growth driven by affordability, accessibility and consumer curiosity.

Cost massively decreasing

Declining sequencing costs and advances in computing capability in the last decade have massively increased the availability and affordability of genetic testing

Clinical utility increasing

Increasing use of medical genetic testing provides **health-care professionals** a valuable tool in prevention, diagnosis & treatment of disease, which improves health outcomes and increase life expectancy

Demand for lifestyle advice increasing

A rapid growth of a **direct-to consumer (DTC)** genetic testing market provides individuals with a broad range of health, ancestry, and lifestyle information

Genetic testing consumer survey

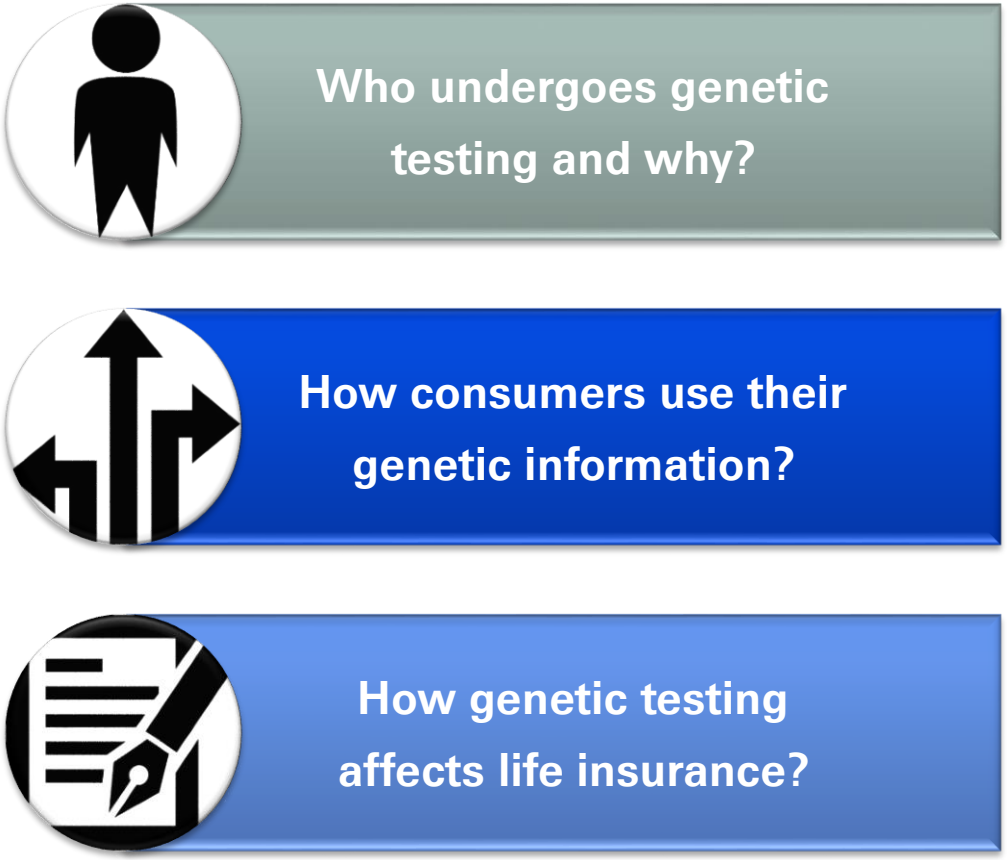
Surveyed markets

23,000 US citizens aged 18 and over and another 13,000 in four additional markets

3,000* US individuals who underwent genetic testing completed an extensive consumer research survey to explore their insurance and health behaviours

Note: *500 individuals for other markets

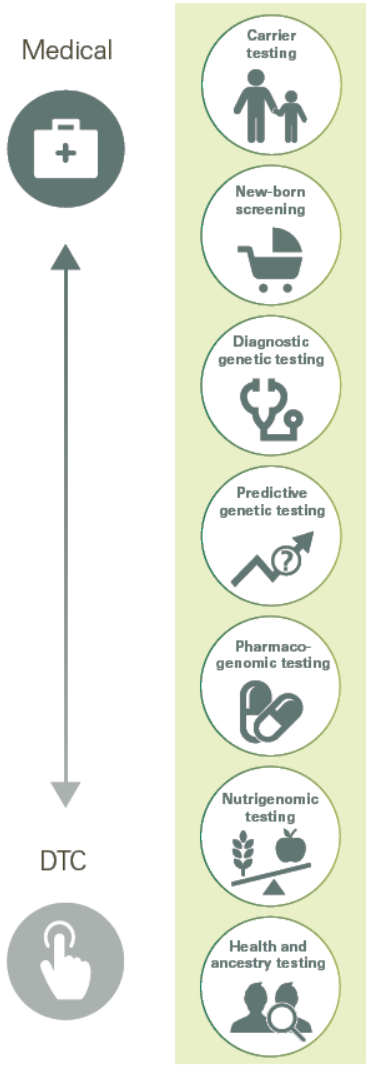
Survey objectives

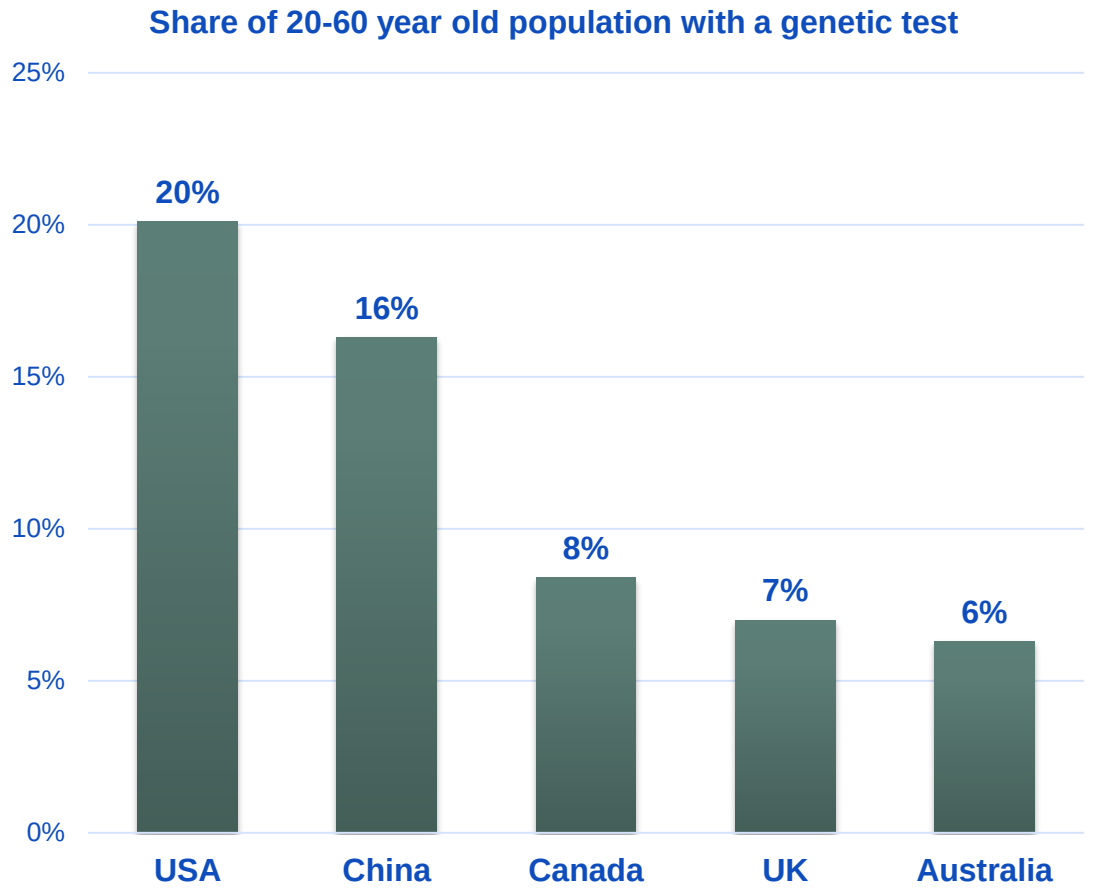


Genetic testing categories and consumer adoption rates

Medically prescribed tests with clinical validity and utility to diagnose or predict disease

Direct-to-consumer (DTC) kits purchased online or in stores by those who want to learn more about their ancestry and health





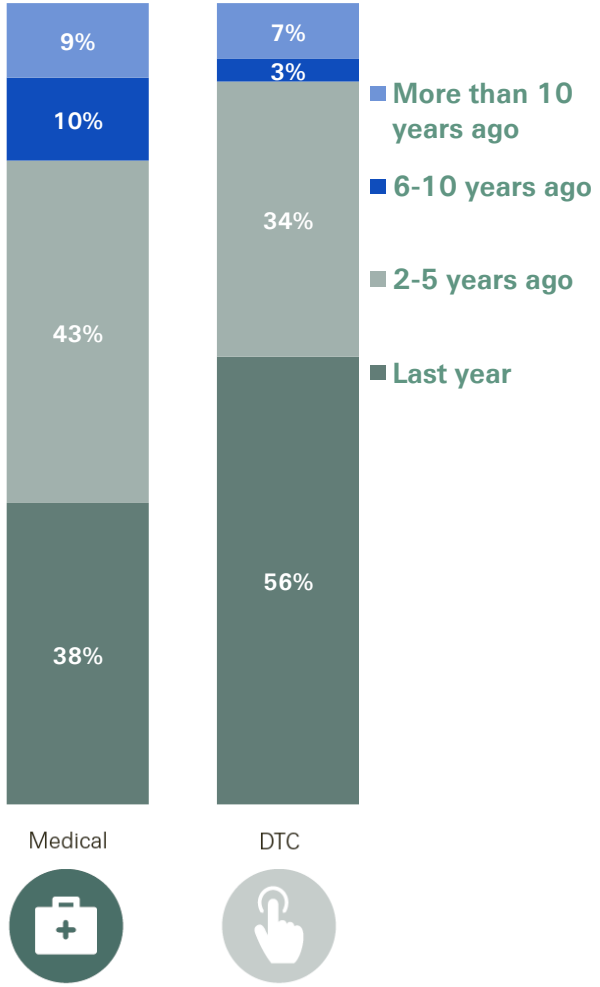
Source: Can life insurance pass the genetic test? SRI 2019

US genetic testing rates and consumer demographics

US testing rates

Source: Can life insurance pass the genetic test? SRI 2019

When tested?



US genetic testing rates and consumer demographics

Who gets tested?

Gender	Male **25%**	Female 16%
Age	20-39y **26%**	40-60y 14%
Salary	<$75K 17%	>$75K **26%**
Education	College or less 16%	Post-graduate **25%**

20% overall

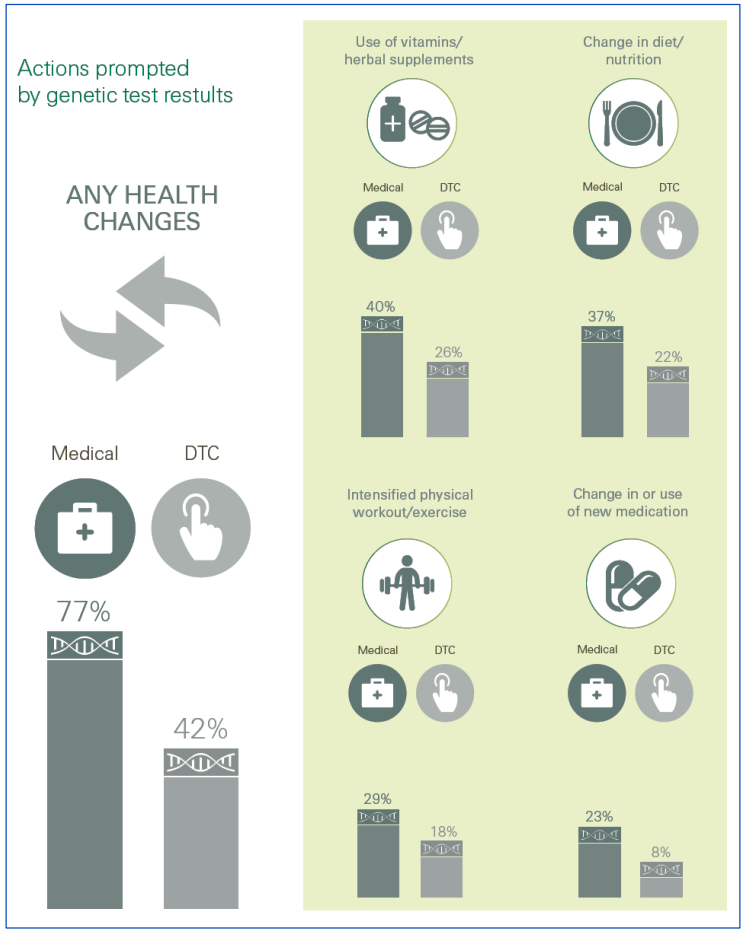
Target for life insurer

Genetic test consumers tend to be highly educated and well-to-do men between age 20 to 40

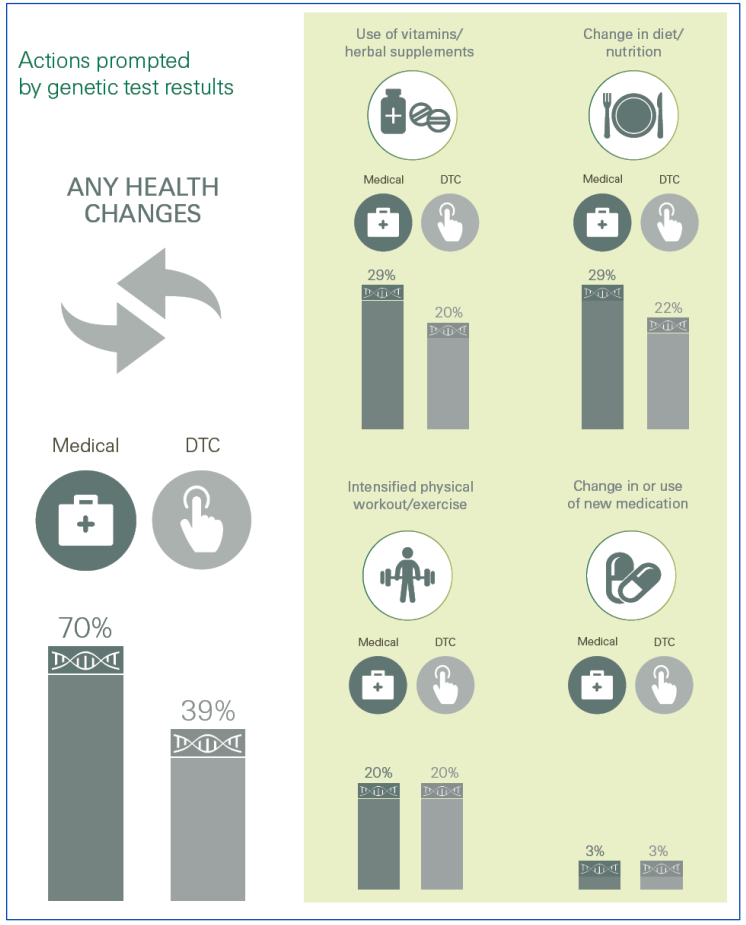
Source: Can life insurance pass the genetic test? SRI 2019

Genetic testing motivates people to be healthier

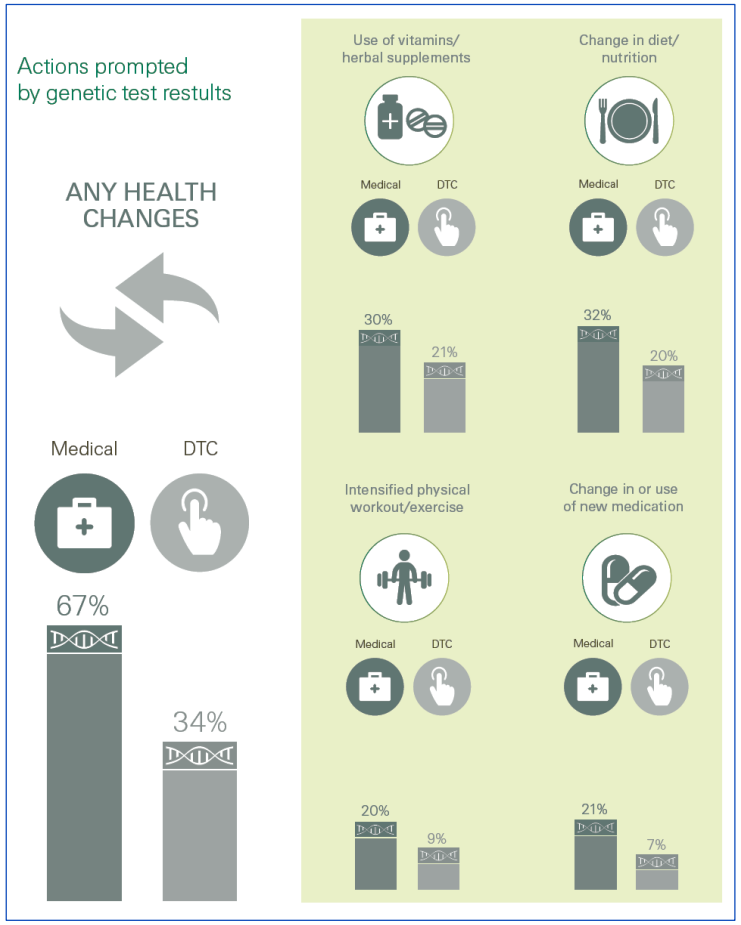
US



Canada



UK



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Open discussion

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