CLUB VITA
Ahead of the *longevity* curve

Thank you for joining us – the webinar will start shortly

Looking to the horizon:
How should we set long term longevity improvement rates?

Wednesday November 9th, 2022

8am PT / 11am ET / 4pm UK

linkedin.com/company/club-vita

@ClubVita

Looking to the horizon:
How should we set long term longevity improvement rates?

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(Chair)
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Partner, LCP; Chair, Actuaries Response Group; ExCo member, CMI

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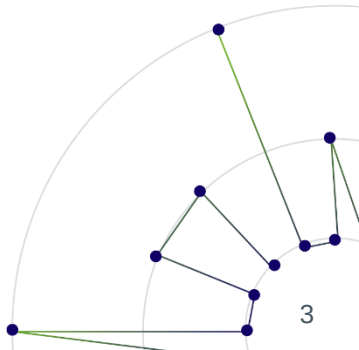
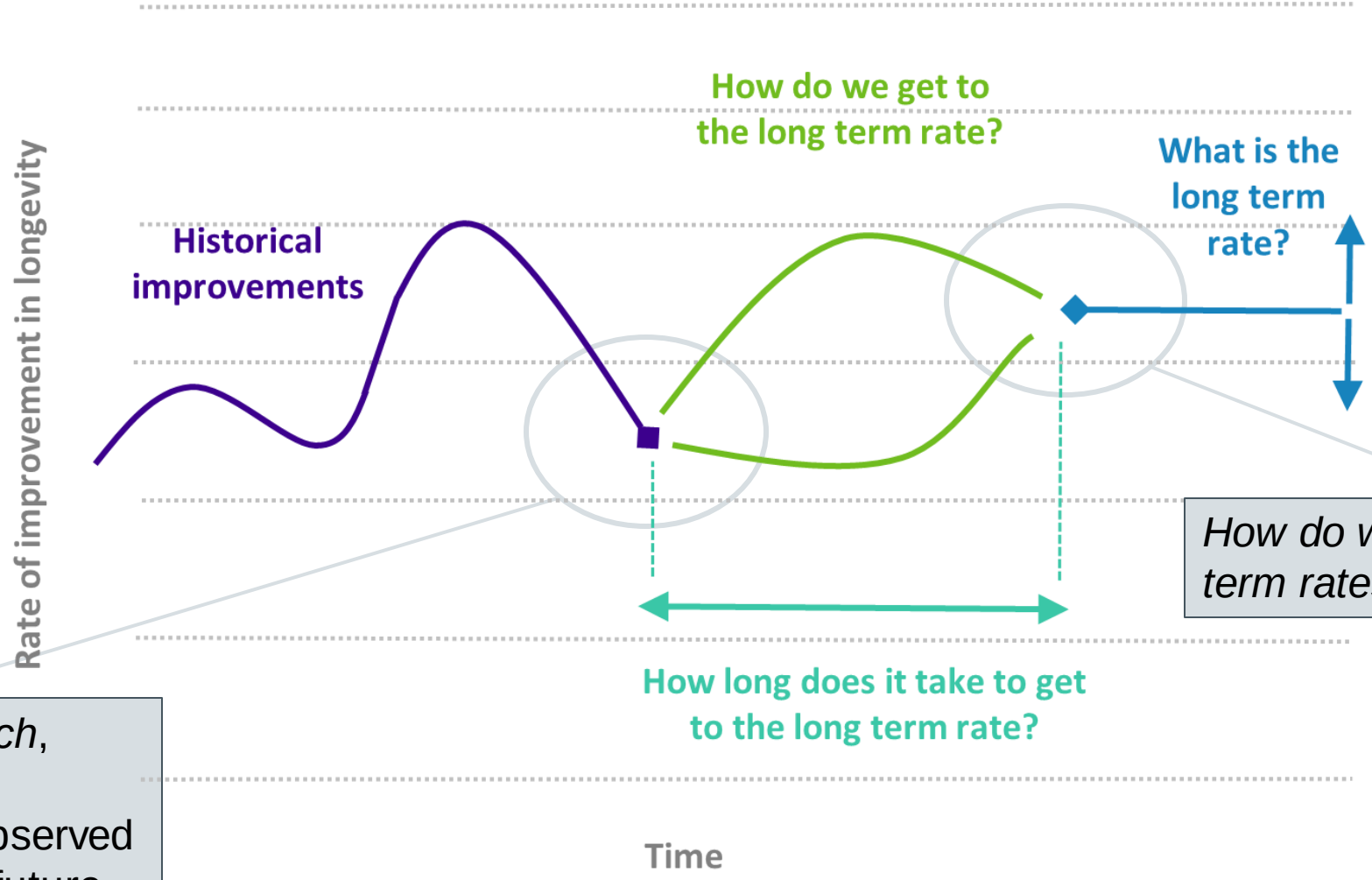
Agenda

1. Background and Theory
2. What happens in practice?



Background
Shantel Aris

Projecting mortality into the future



How do we calculate long term rates?

Regression approach, commonly used to projecting recent observed rates into the near future

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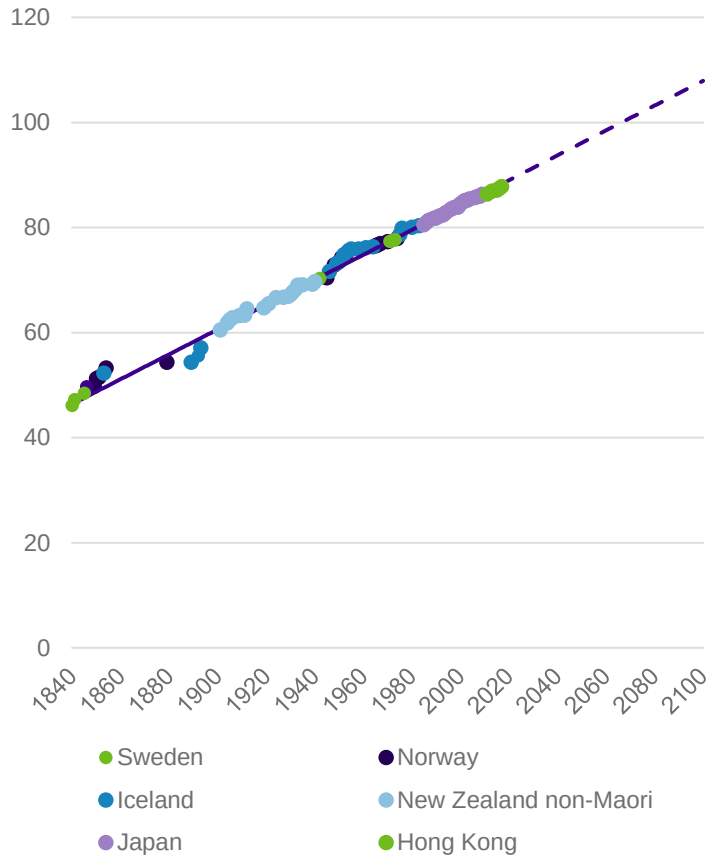
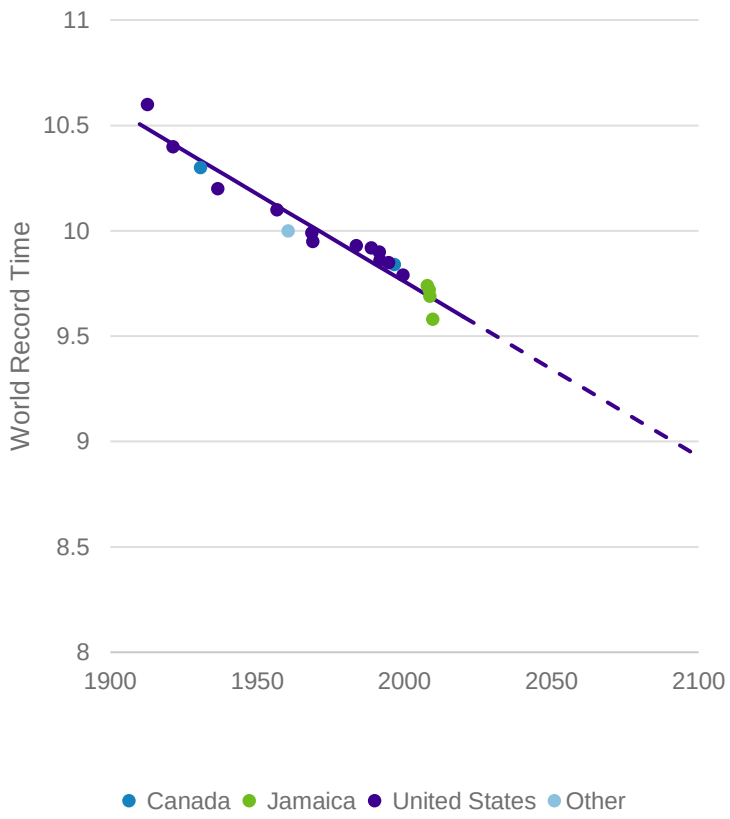
Oeppen & Vaupel observation (extended)

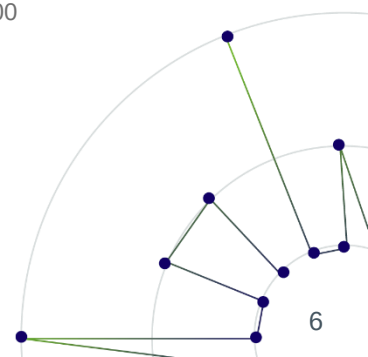
World records for period life expectancy at birth (women)



Reasonable to expect this trend to continue?

World records for the 100m sprint (men)

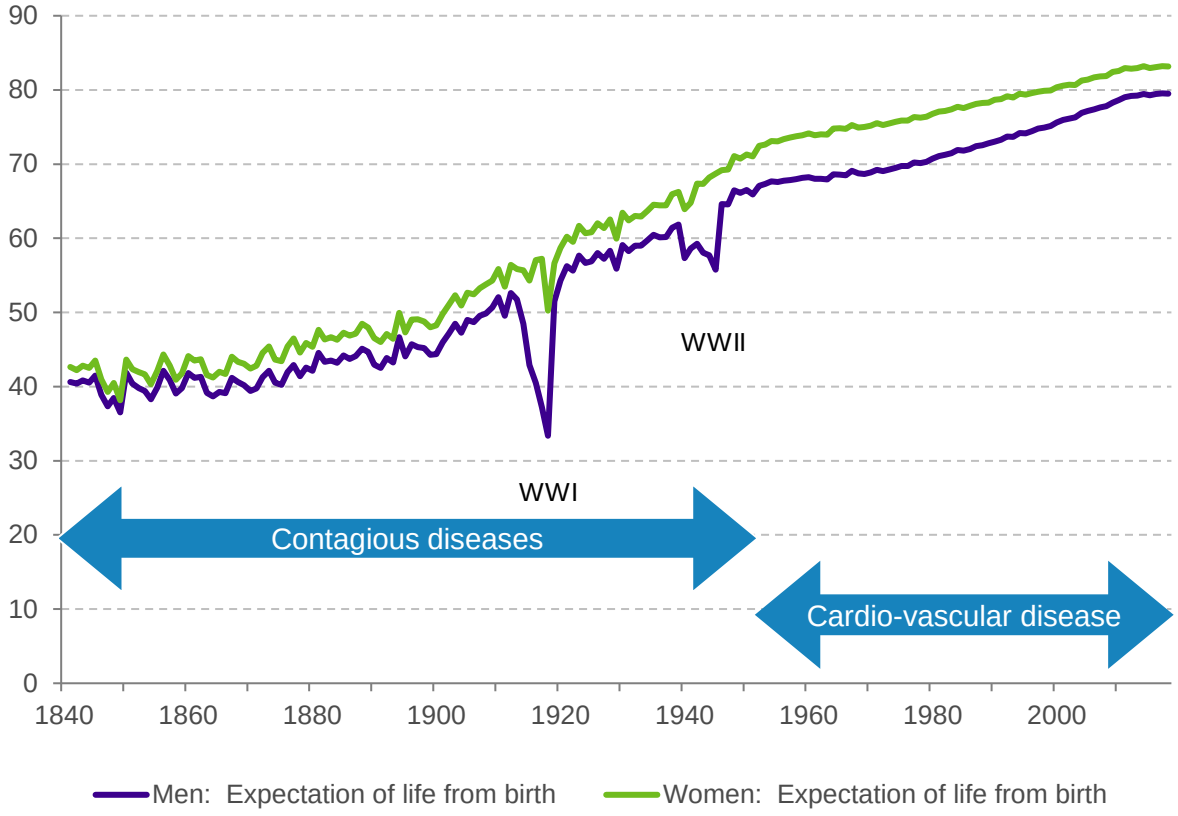




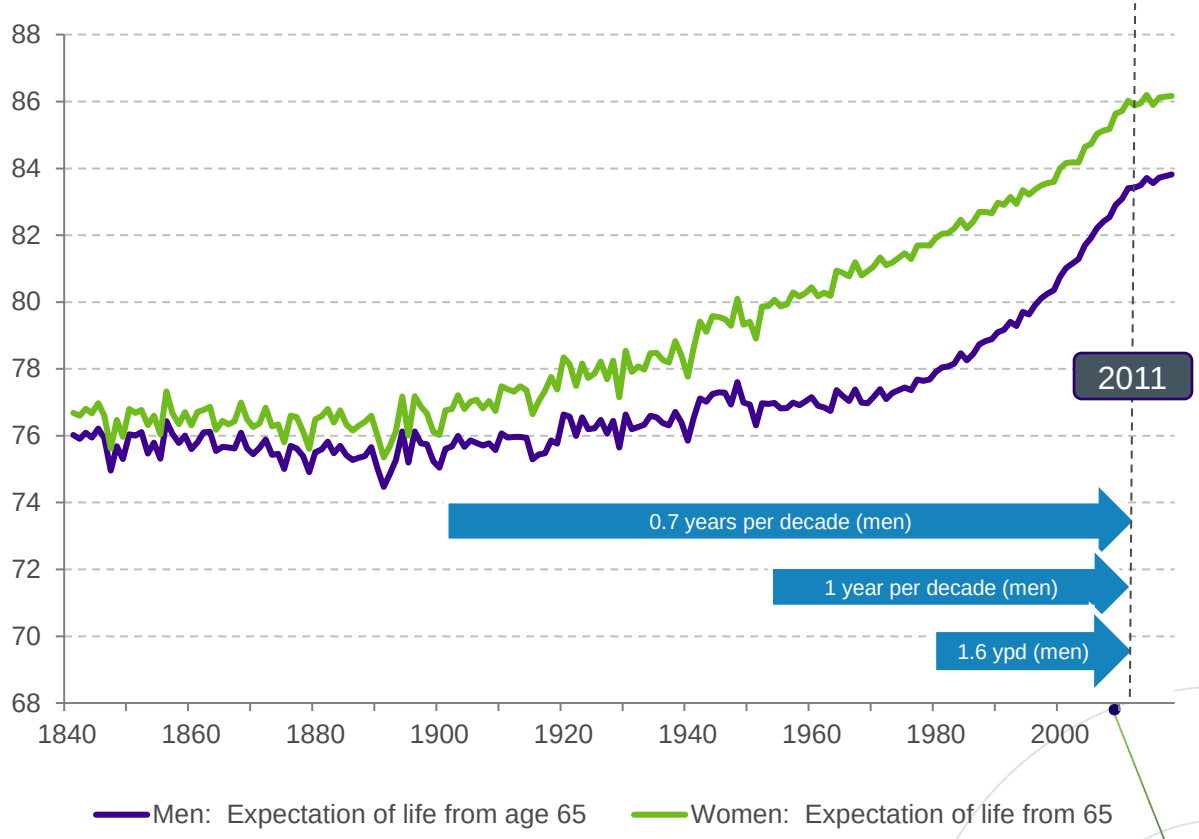
Sources: Club Vita analysis of the Human Mortality Database dataset. University of California, Berkeley (USA), and Max Planck Institute for Demographic Research (Germany). Available at www.mortality.org or www.humanmortality.de (data downloaded on 16 July 2021); Club Vita presentation of the IAAF men's 100m ratified world records

Progression of longevity over time (pre pandemic)

(Period) life expectancy at birth



(Period) life expectancy at age 65



Have different groups experienced these trends differently?

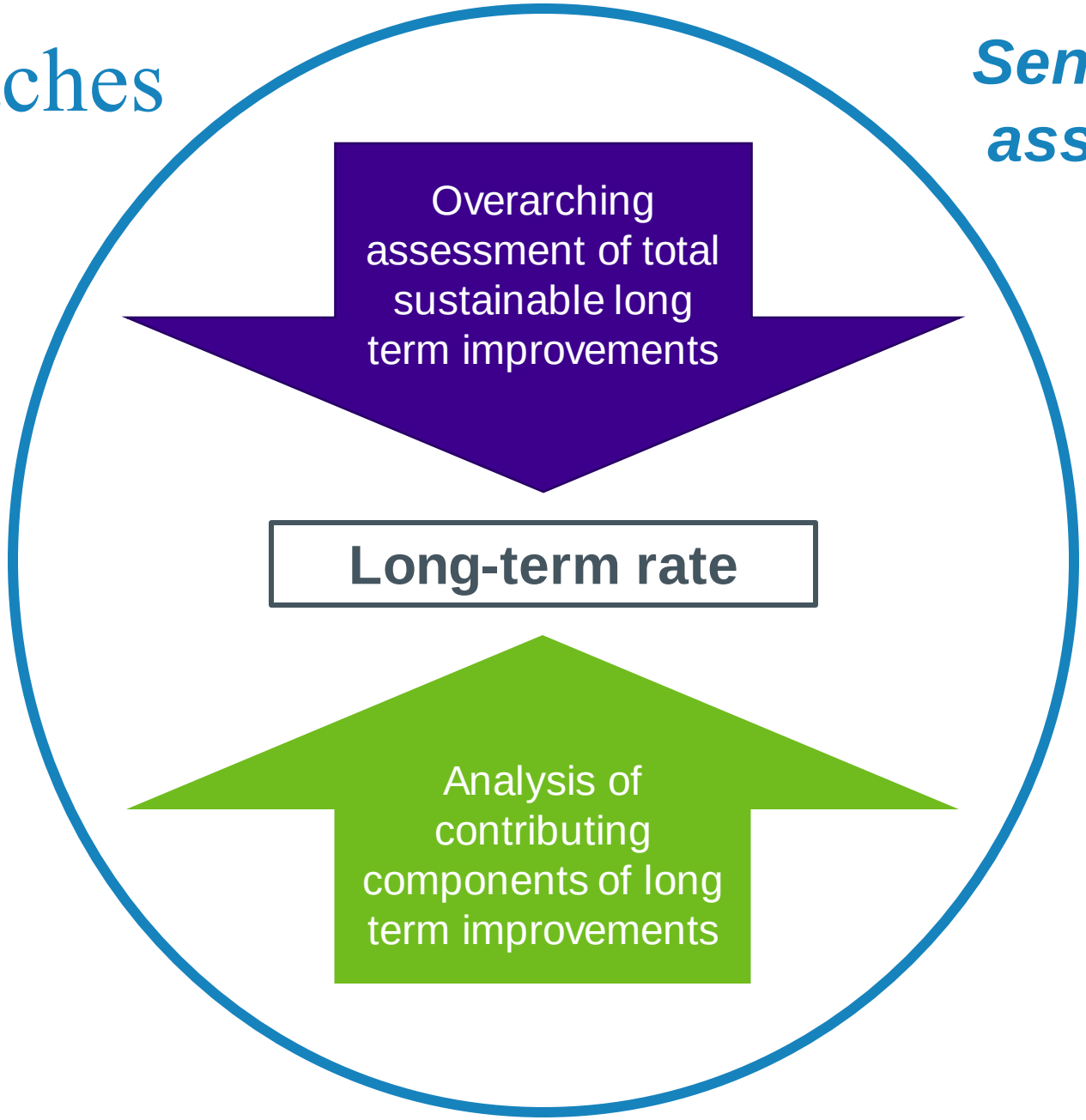
Methods for calculating long term improvements

Shantel Aris

Different approaches

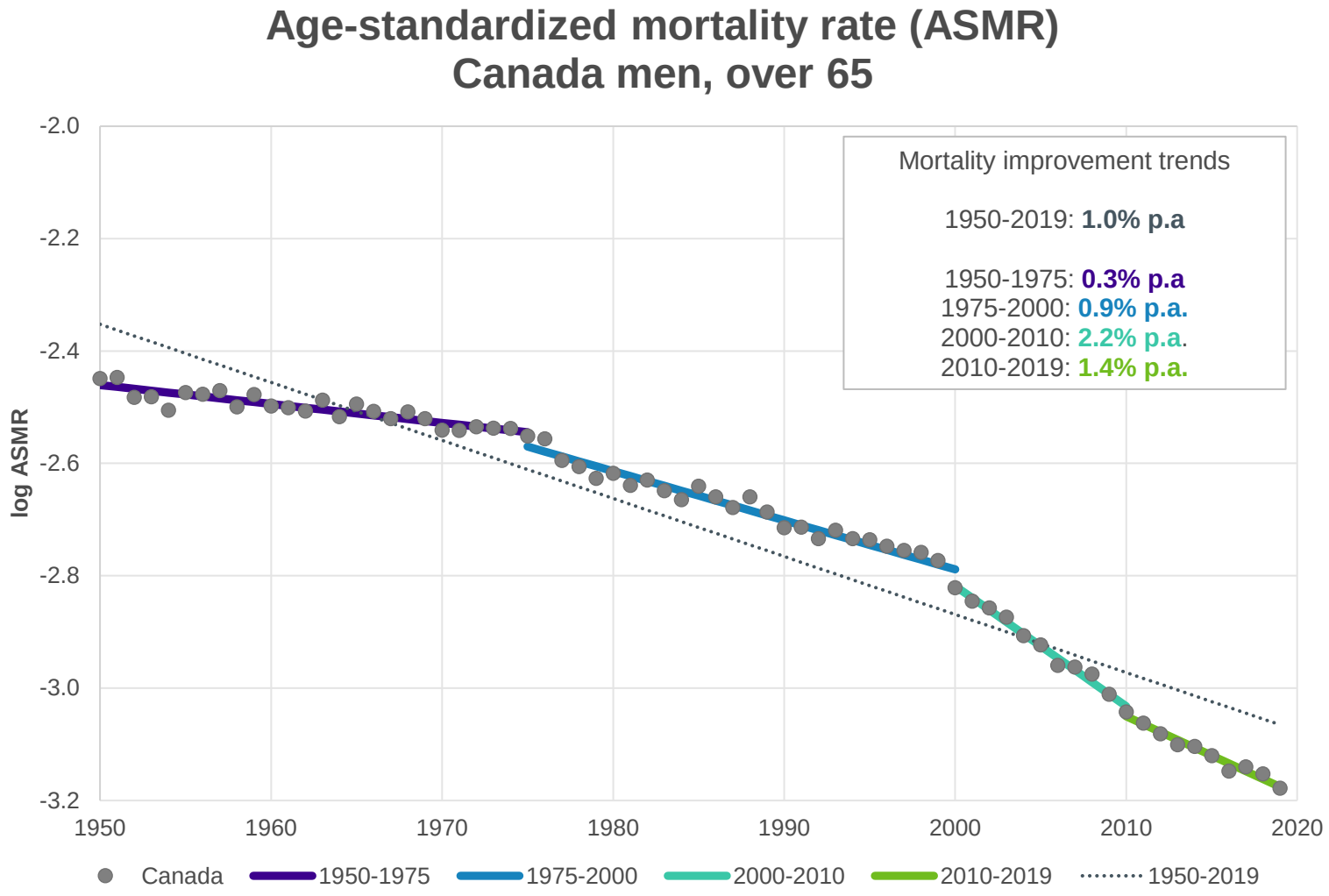
"Top Down" approach

"Bottom Up" approach

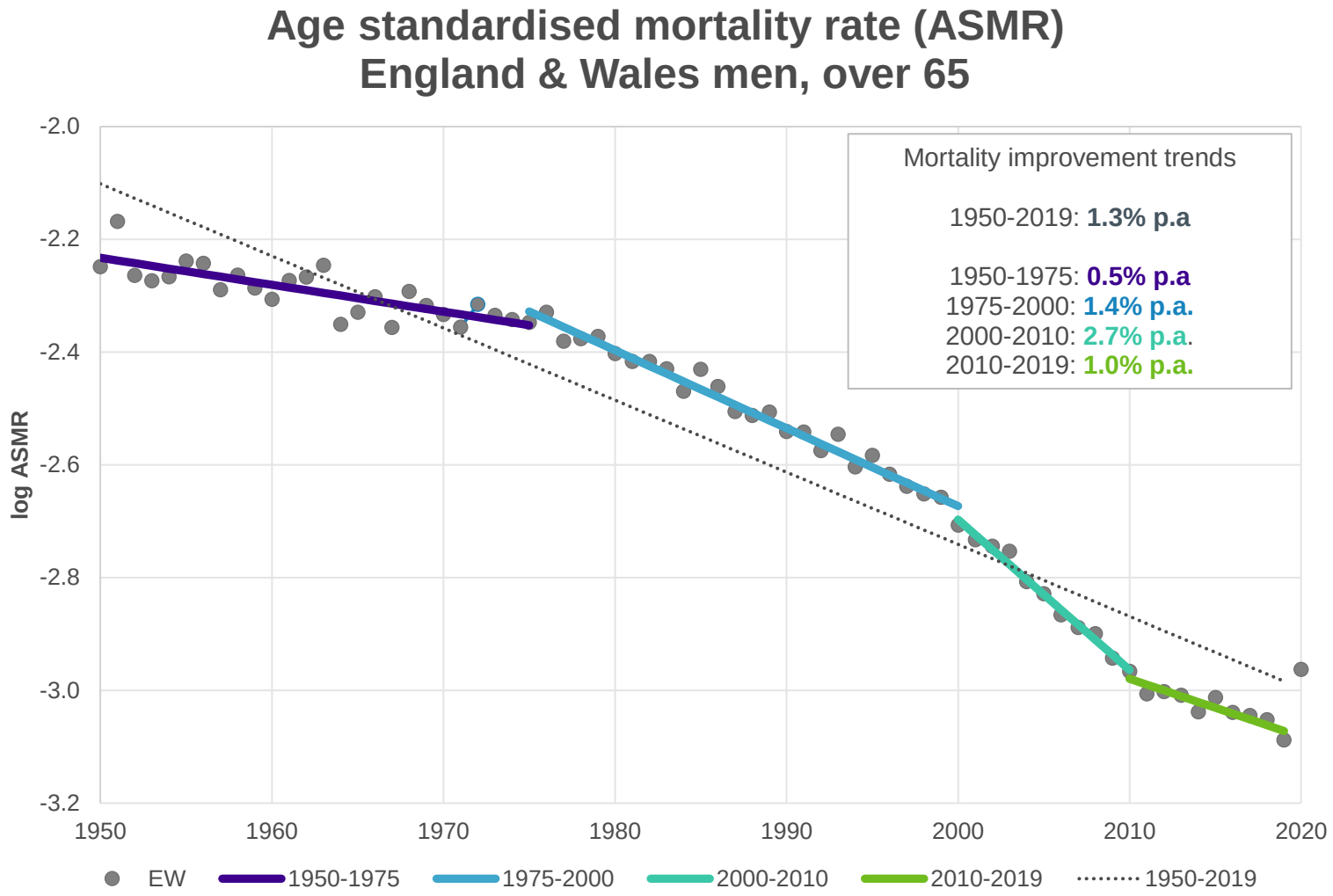


Sense check assumption

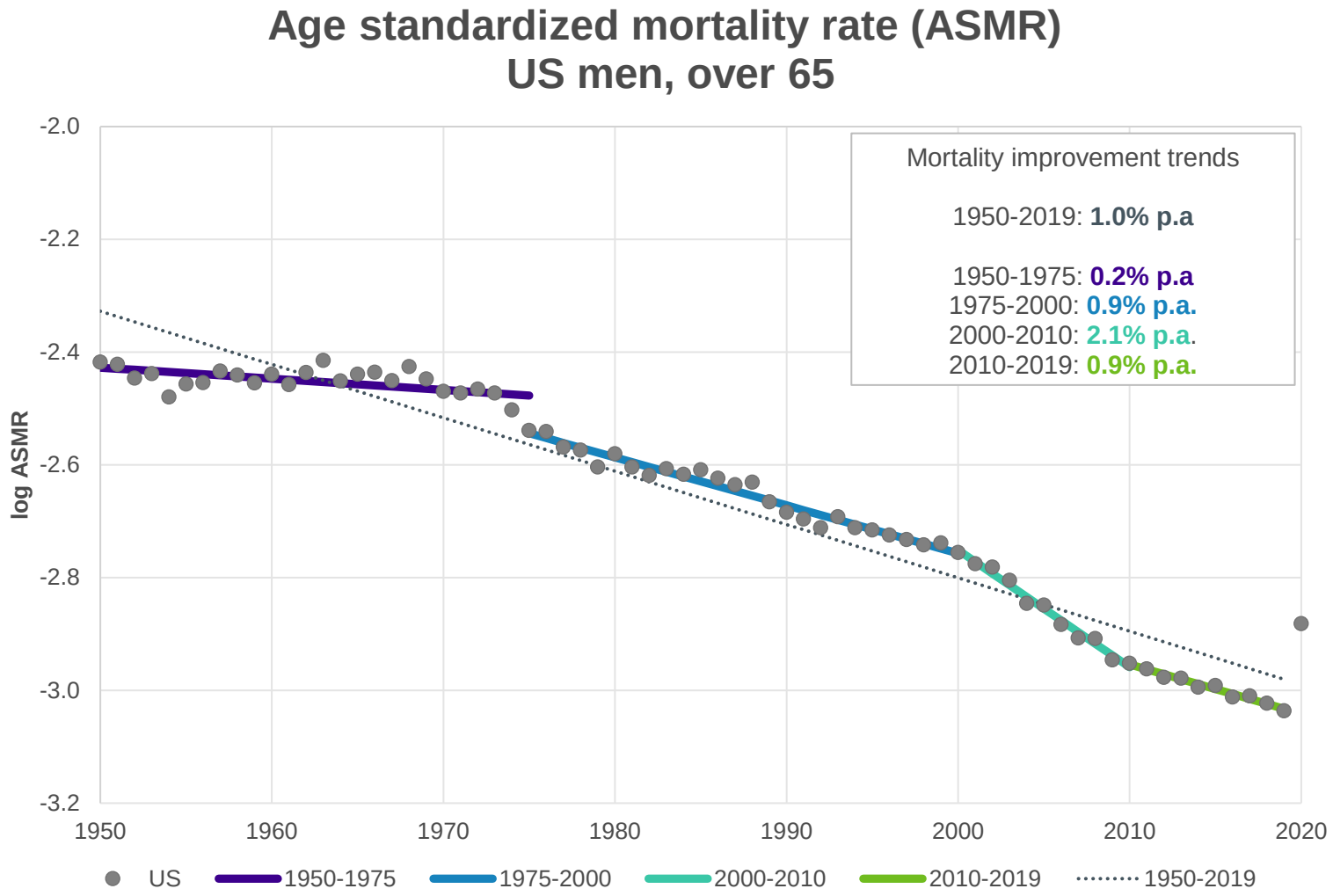
Top down:
Improvements observed over the long term



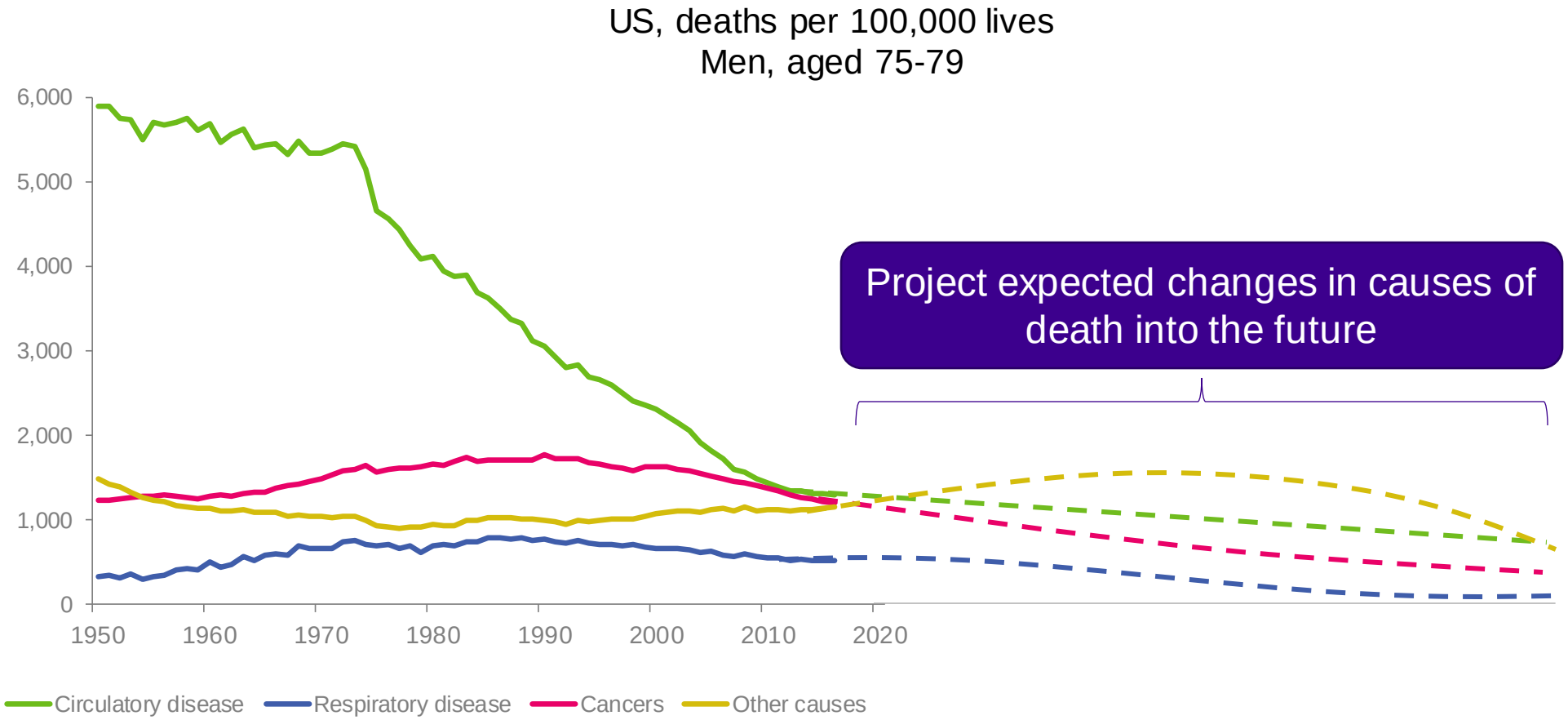
Top down:
Improvements observed over the long term



Top down:
Improvements observed over the long term

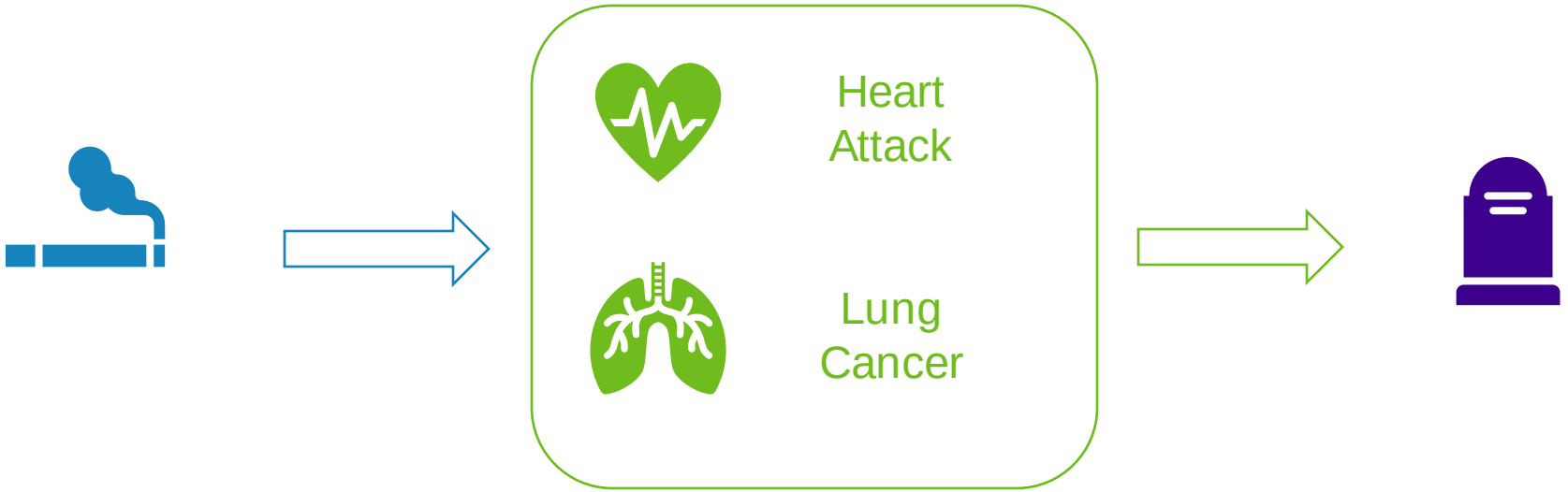


Bottom up:
Projecting mortality by cause of death



Own calculations based upon data from World Health Organisation (WHO) and United Nations (UN). Figures are shown as deaths per 100,000 lives.

Bottom up:
*Projecting mortality by **cause of** cause of death*



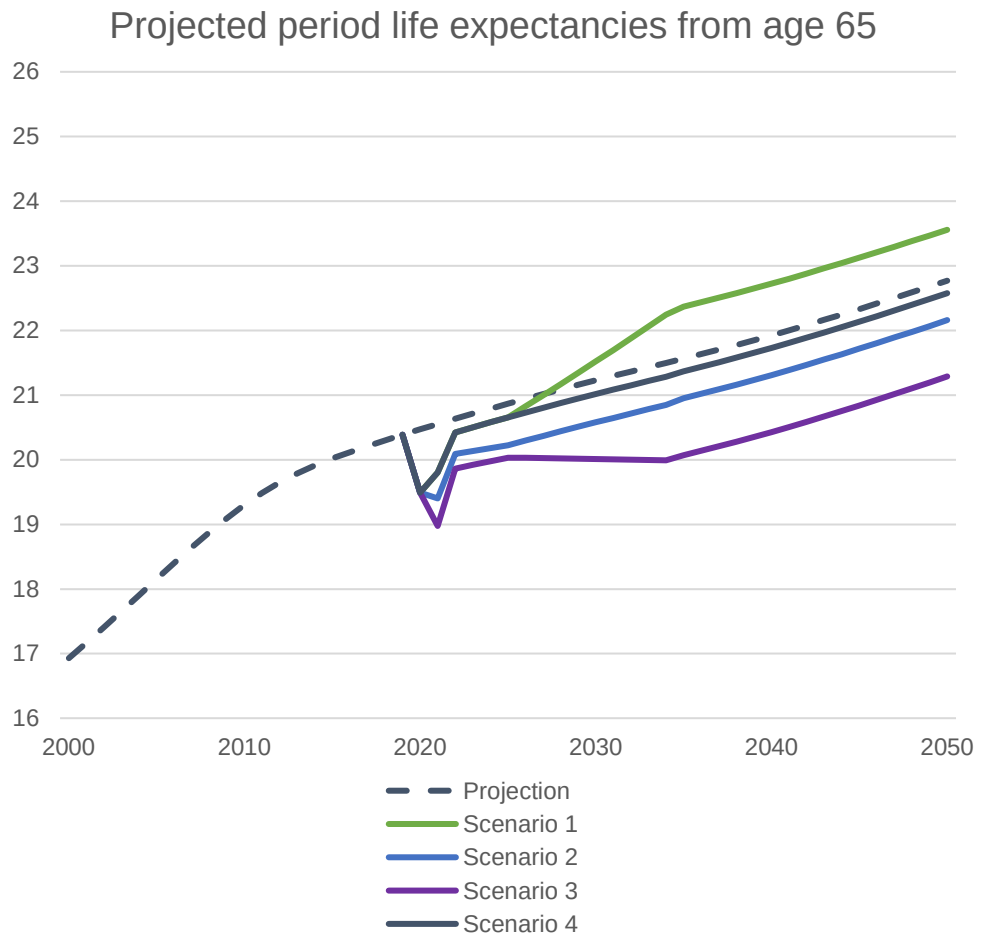
How have smoking patterns changed by generation? What will these be in future years?

What will the impact be of these changes on different causes of death?

How will **overall** mortality rates change as a consequence?

Sense checking:
Scenario analysis & expert judgement

Scenario analysis



Expert judgement

Heath Cascade?

Extended Youth?

"Cure" for Cancer?

What happens in practice?

Tim Geddes

SOA – RPEC:
Methodology of
Long-Term Rate Development

SOA's Mortality Improvement Analysis

The SOA's RPEC has produced a series of mortality improvement scales beginning with the MP-2014 scale released in October 2014. More recently, the SOA's Longevity Advisory Group has released and maintained MIM-2021, which is a more general mortality improvement model.

RPEC Mortality Tables

The Society of Actuaries' (SOA) Retirement Plans Experience Committee (RPEC) produces pension-specific mortality tables

- The RPEC collects data from pension sponsors, plan administrators, actuarial consulting firms, and pension risk transfer insurers to produce pension-specific mortality tables.
- Separate mortality studies are performed for public- and private-sector pension plans
- Within each study, tables are further separated based on indications of gender, employee vs. annuitant, work-type, salary / benefit amount, and disability status.

RPEC Mortality Improvement Scales

The RPEC's first improvement scale was released in October 2014.

- The RPEC utilizes data published by the Social Security Administration (SSA) as the foundation for its mortality improvement analysis.
- To reduce the lag time in reflecting emerging improvement data, the most recently available data is compiled by the RPEC itself from the same data sources as those used by the SSA using the SSA's graduation methodology.
- The RPEC had released an Excel-based improvement model along with the annual scales from 2014 through 2020 to permit actuaries to use alternatives to the committee-selected assumption set.

SOA Longevity Advisory Group

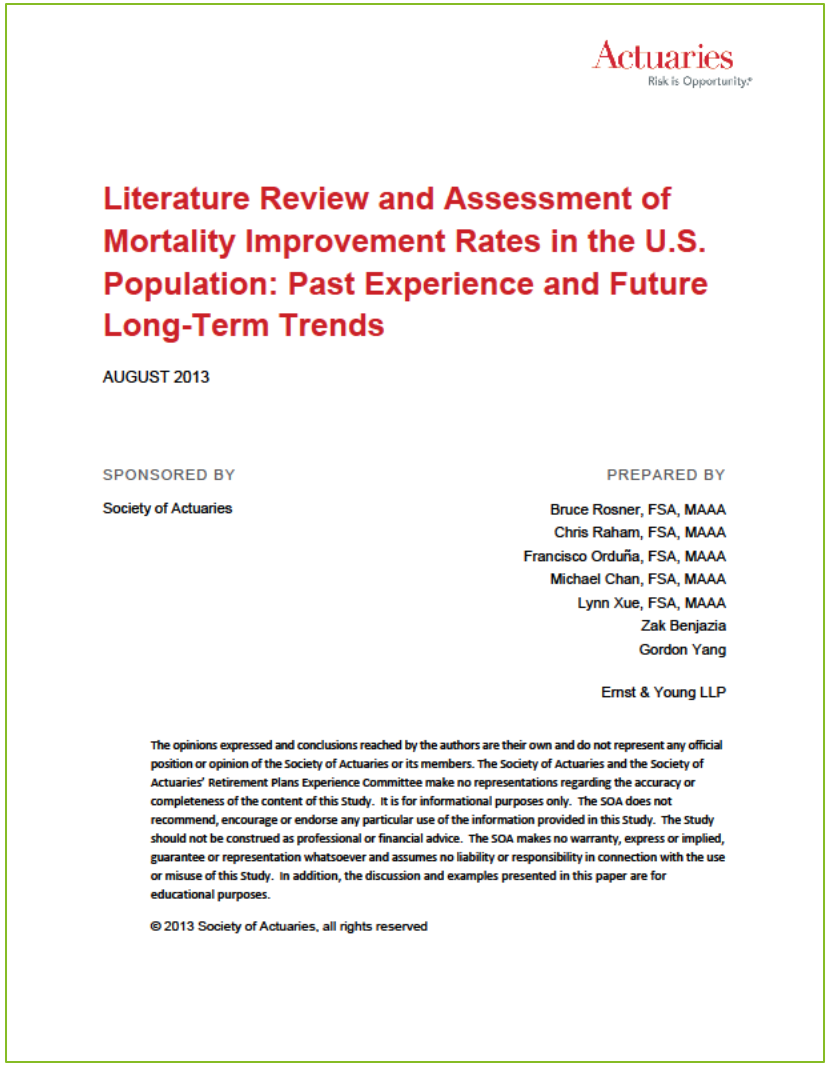
The Longevity Advisory Group (Advisory Group) is a cross-discipline committee of the SOA, which focuses on developing a common mortality improvement model.

- The Advisory Group produced the Mortality Improvement Model, MIM-2021, in April 2021
- MIM-2021 incorporates the data utilized for the MP-20xx scales. The MIM-2021-v2 model replaces the RPEC_2014 Excel-based tool.
- The MIM-2021 model includes choices for the user as to the underlying dataset
  - The same SSA data used in the RPEC's model
  - Data from the National Center for Health Statistics (NCHS) which can be separated by county-level socioeconomic deciles or quintiles

Mortality Improvement Rate Literature Assessment

In 2013, the SOA commissioned a research project at the RPEC's request to identify past longevity trends and opinions on future expectations. The paper found divergent opinions on the possible trajectory of long-term improvement.

Structure of Improvement Models	• Often based on gender, age, period, and cohort effects • Discussed seminal work by Ronald Lee and Lawrence Carter on improvement • Referenced the G-A-P-C models constructed by CMI
Principal Forecasting Techniques	• Extrapolative: Projecting past trends into the future • Process-based: Explicit forecasting of causes of death • Explanatory: Use contributing factors to explain changes in future mortality (e.g., smoking prevalence)
Commentary on Long-Term Historical Observations	• Compression theory / squaring of mortality curve • Olshansky's practical limits theory • Identifies the Oeppen and Vaupel study with "record" life expectancies
Summary on Long-Term Rate	• Cite Social Security and Technical Panel suggestions for improvement rates • Provides a number of other sources for maximum life expectancies (Fries, Vaupel, White, Olshansky, Manton) • Few experts translate longevity limits to expected improvement rates • Highlight tendency for opinions to polarize to extremes



Actuaries
Risk is Opportunity®

Literature Review and Assessment of Mortality Improvement Rates in the U.S. Population: Past Experience and Future Long-Term Trends

AUGUST 2013

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Society of Actuaries

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Source:
Note:

RPEC_2014 Mortality Improvement Model Framework

Since the original issuance of the MP-2014 scale, the scales have been produced with committee-selected parameterizations of the RPEC_2014 improvement model. The model is built around a 3-part framework.

Use of Recent Experience

Recently observed experience is deemed the best predictor of future, near-term mortality rates

Ultimately Reach Long-Term Rates

Long-term rates of mortality improvement should be based on "expert opinion" and analysis of long-term improvement patterns.

Smooth Transition to Long-Term Rate

Near-term rates should transition smoothly into the assumed long-term mortality improvement rates over appropriately selected convergence periods.

MP-2014 Long-Term Rates

A number of factors led to the selection of the 1% long-term improvement assumption used in the MP-2014 through MP-2019 scales.

- The RPEC considered average long-term data on improvement rates
- The average improvement rate between 1900 and 2010 was found to be roughly 1%
- The average over the period 1982 to 2010 was calculated at 0.95%

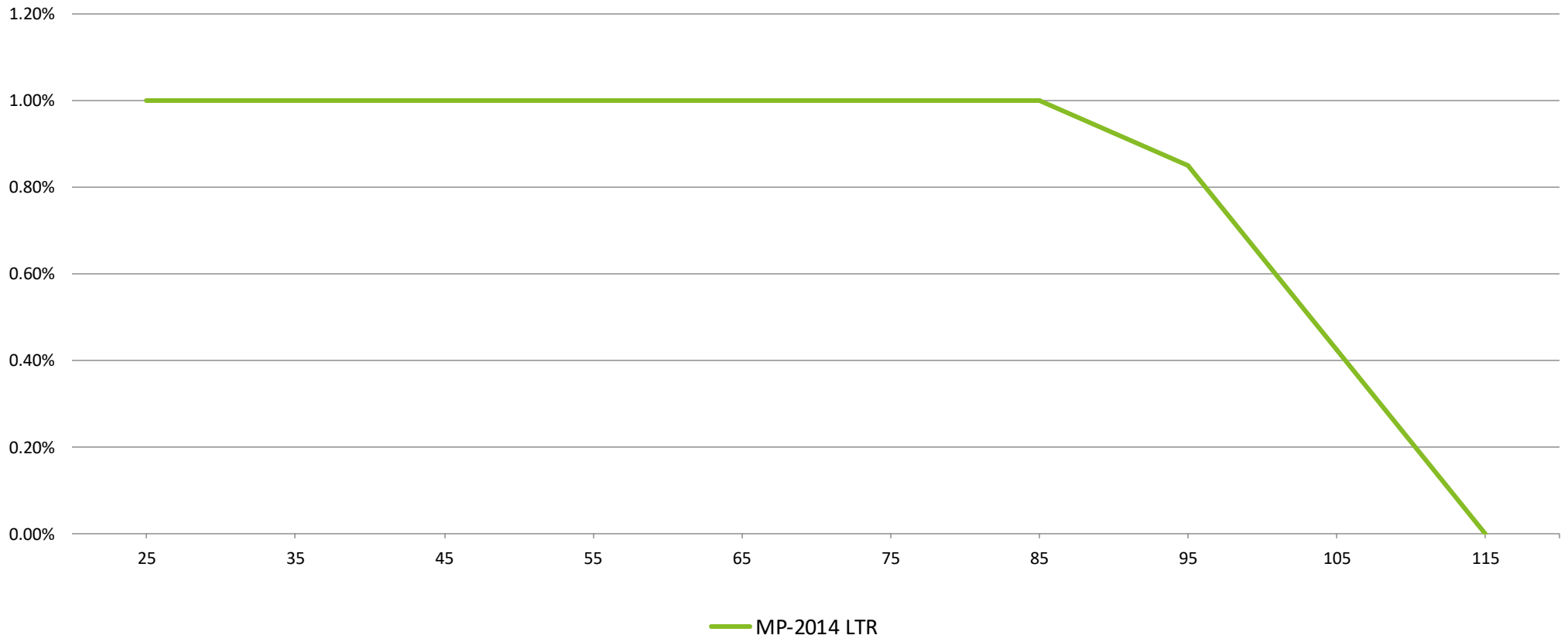
- The 2007 Technical Panel recommended that the average rate in the intermediate cost projection be updated to 1.0%
- The 2011 Technical panel recommended higher life expectancies consistent with an improvement rate of 1.26%

- The Congressional Budget Office increased its long-term improvement rates to 1.16% in September 2013

- The Social Security Administration's Trustees Report included rates that varied by age for the period 2010-2088
- The long-term improvement rates were roughly 1.1% for 50 – 64
- That rate declined to 0.88% for 65-84
- The rate declined further to 0.55% for 85+

MP-2014 Long-Term Improvement Rates

In 2014, the RPEC selected the long-term improvement as a flat 1% for ages under 85. The rates graded slowly to 0.85% at age 95 and then linearly to 0.00% at age 115.



Source:
Note:

Changes to RPEC's Long-Term Rates

The RPEC revised the committee-selected assumptions with the release of the MP-2020 scale. The result was to increase the long-term rate at younger ages and decrease it at older ages.

The Social Security Technical Panel once again discussed the long-term rate in 2019

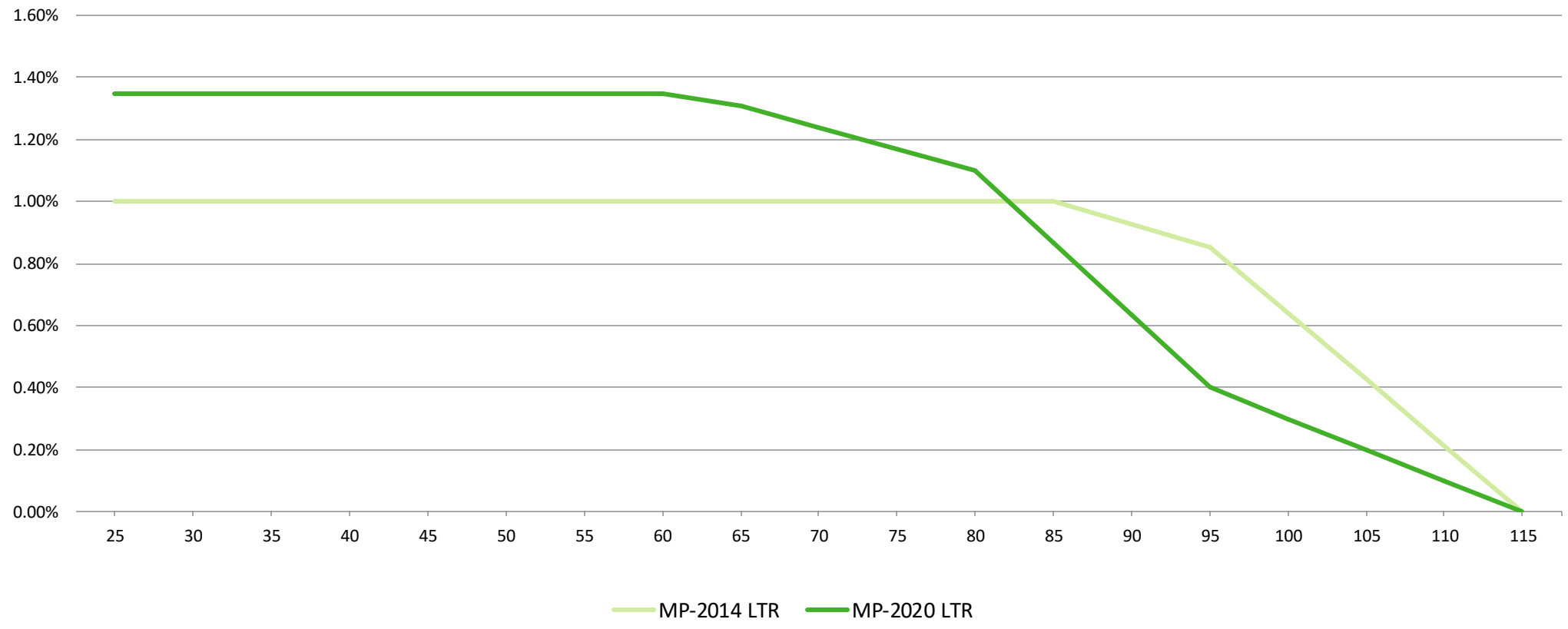
- Pointed toward a long-term rate at all ages around 1%
- Highlighted a lower rate around 0.8% for ages 65+

The committee calculated long-term averages of Social Security Administration data on age-sex-adjusted death rates for various long-run periods

Time Period	Under 65	65 and Over
1940 – 2019	1.39%	0.94%
1950 – 2019	1.33%	0.94%
1960 – 2019	1.39%	0.98%
1970 – 2019	1.35%	0.90%
1980 – 2019	1.15%	0.87%
1940 – 1980	1.37%	0.95%
1950 – 1990	1.31%	1.00%
1960 – 2000	1.58%	1.02%
1970 – 2010	1.56%	0.85%

Revised Long-Term Rates in MP-2020

Beginning with the MP-2020 report, the RPEC revised its committee-selected long-term rate to reflect a higher rate at younger ages, an earlier commencement of the grade-down, and a faster grade-down after age 80.



Source:
Note:

What happens in practice?

Assia Billig

Looking to the horizon: how should we set long-term longevity improvement rates?

Club Vita webinar

Assia Billig, Chief Actuary

Office of the Chief Actuary, OSFI , Canada

November 9, 2022

OSFI BSIF

Canada

Projections context

- Canadian population mortality
- Long-term projections: 75+ years
- No advantage of discounting
  - Open group projections
  - Focus on cash flow, not on liability
- Focus on older population
  - Mortality rates at younger ages are low

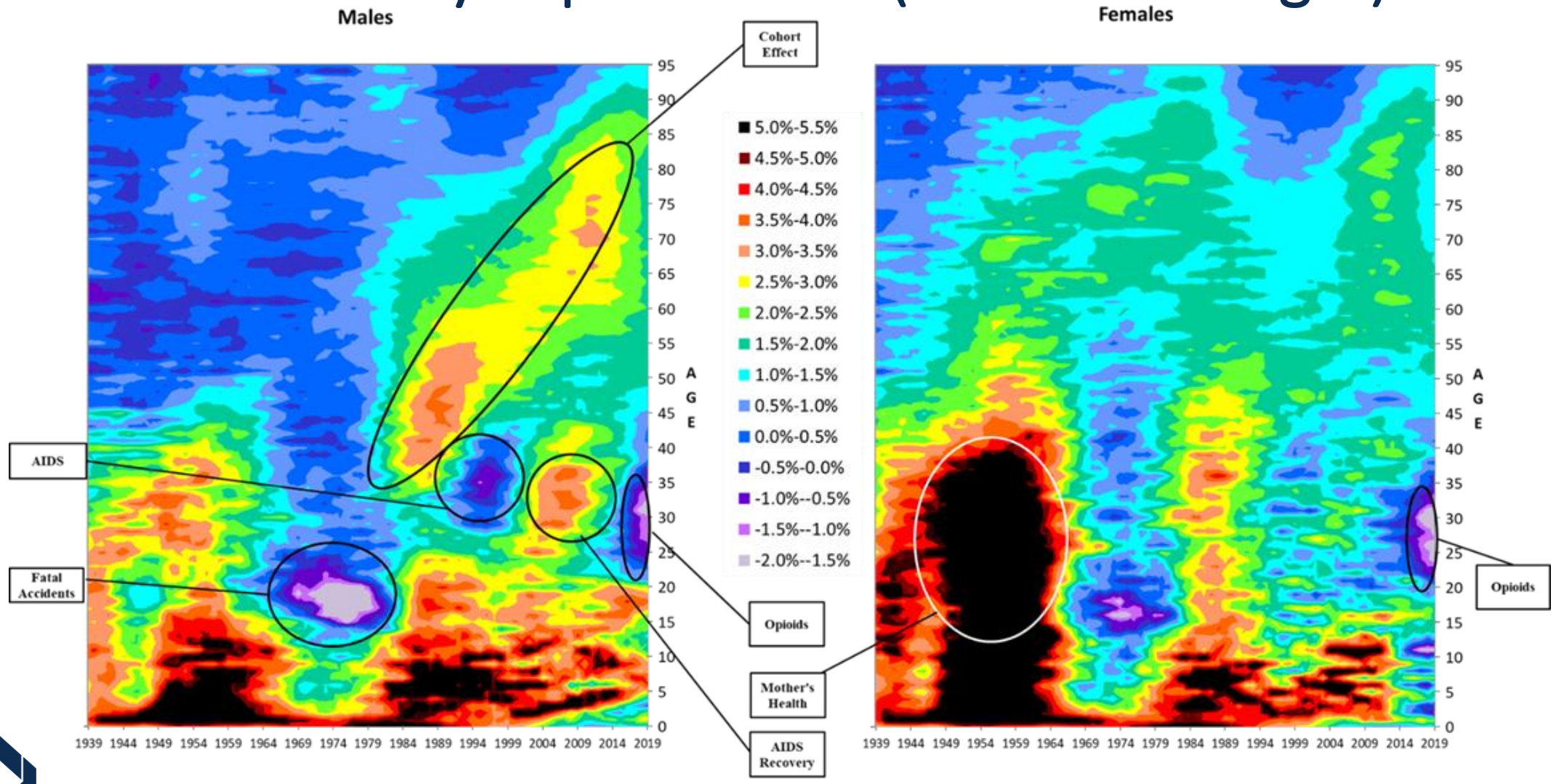
CPP methodology

- Developed using a combination of backward- and forward-looking approaches and best judgement
- What happened in the past?
- What are potential trends?
- Reasonableness tests

Past – is it repeatable?

OSFI
BSIF

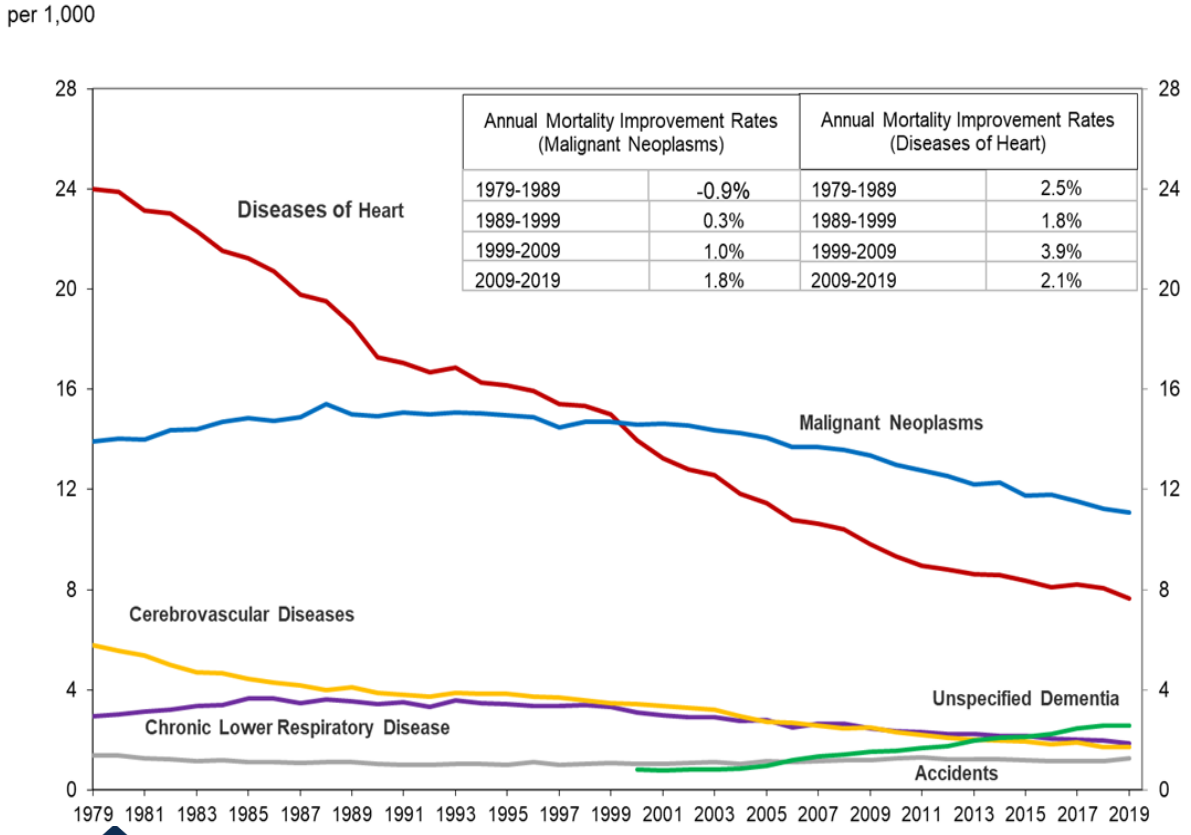
Historical Mortality Improvements (15-Year Averages)



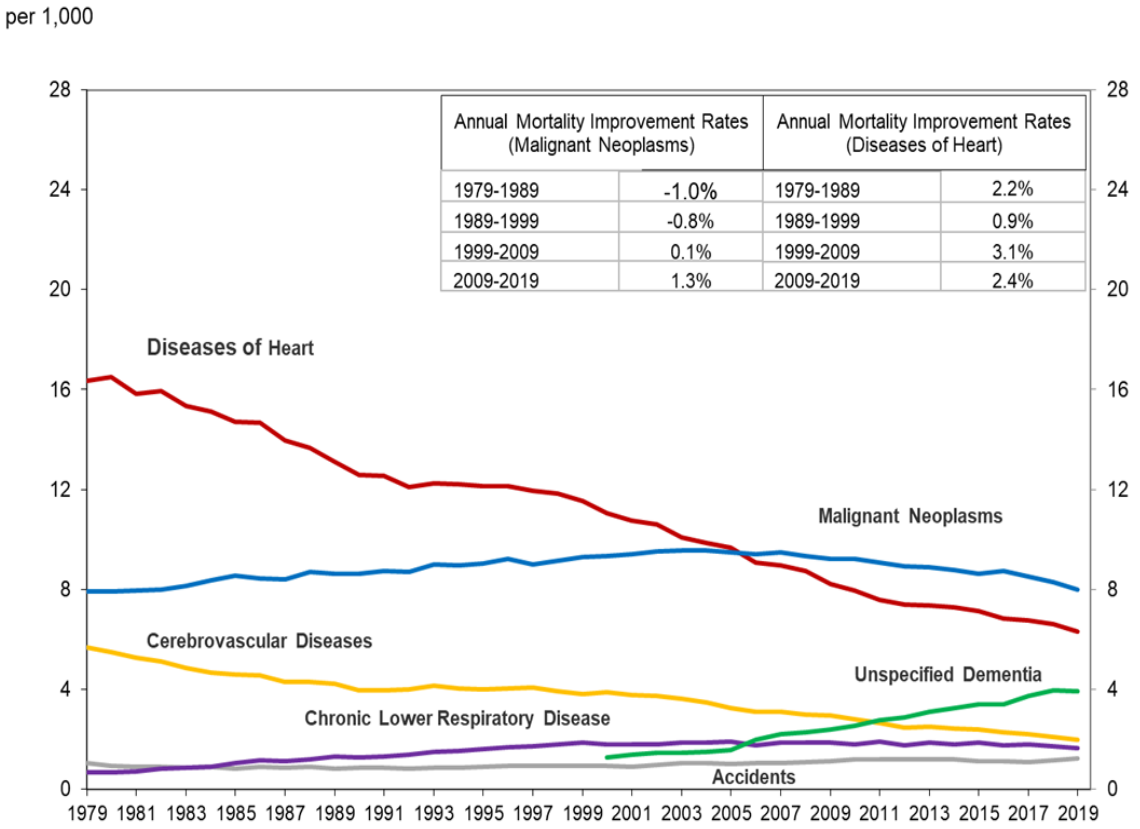
Source: Mortality Projections for Social Security Programs in Canada, Actuarial Study No. 21, OCA

Mortality Rates by Cause of Death (65+)

Males



Females

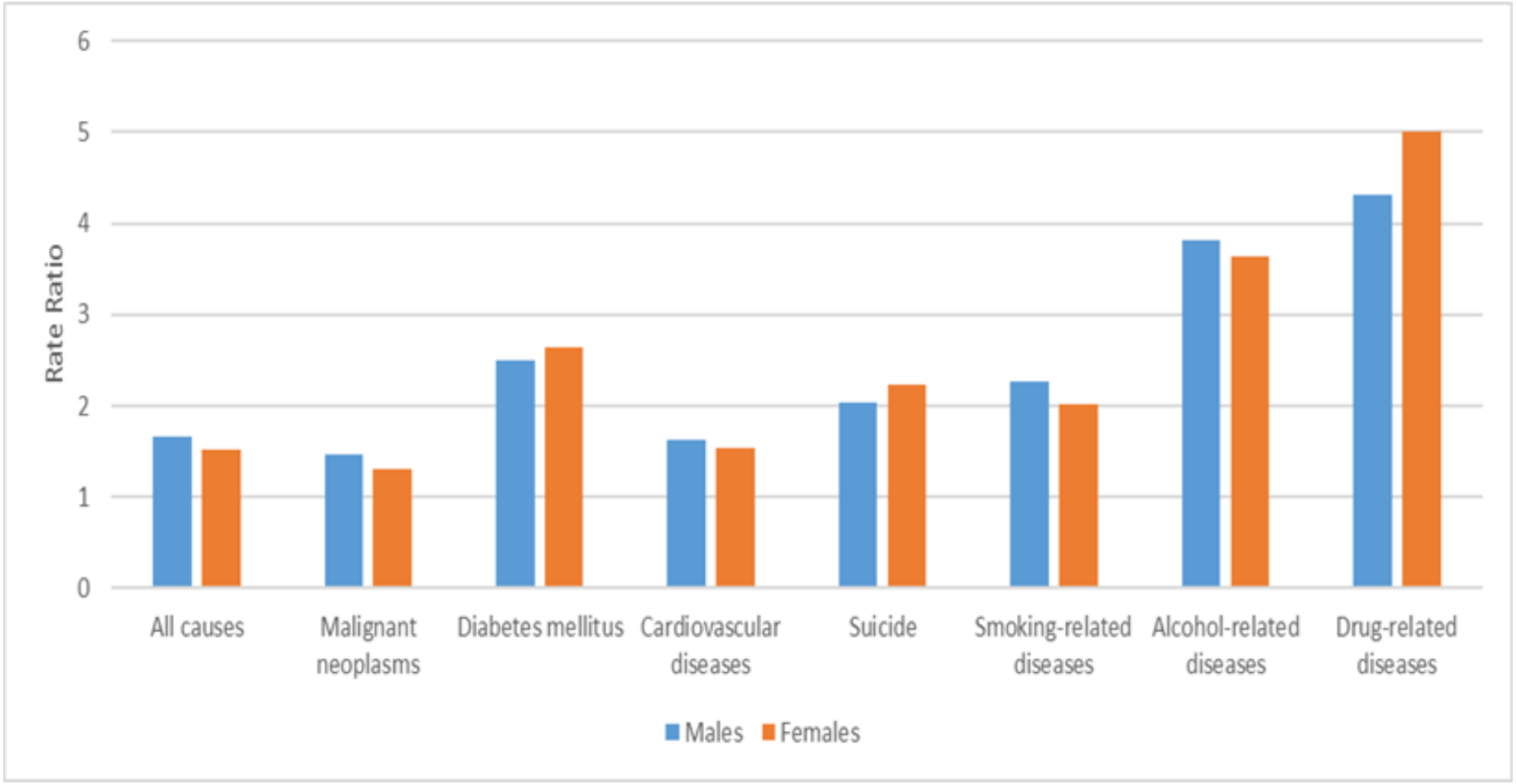


Future – may take an educated guess for the next 20 -30 years

Future potential drivers of mortality

- Potential drivers of longevity
  - lifestyle,
  - environment,
  - healthcare systems,
  - medical technologies, etc.
- Structure of the Canadian population is changing
- Mid- and short-term uncertainty
  - Effects of pandemics
  - Opioid crisis

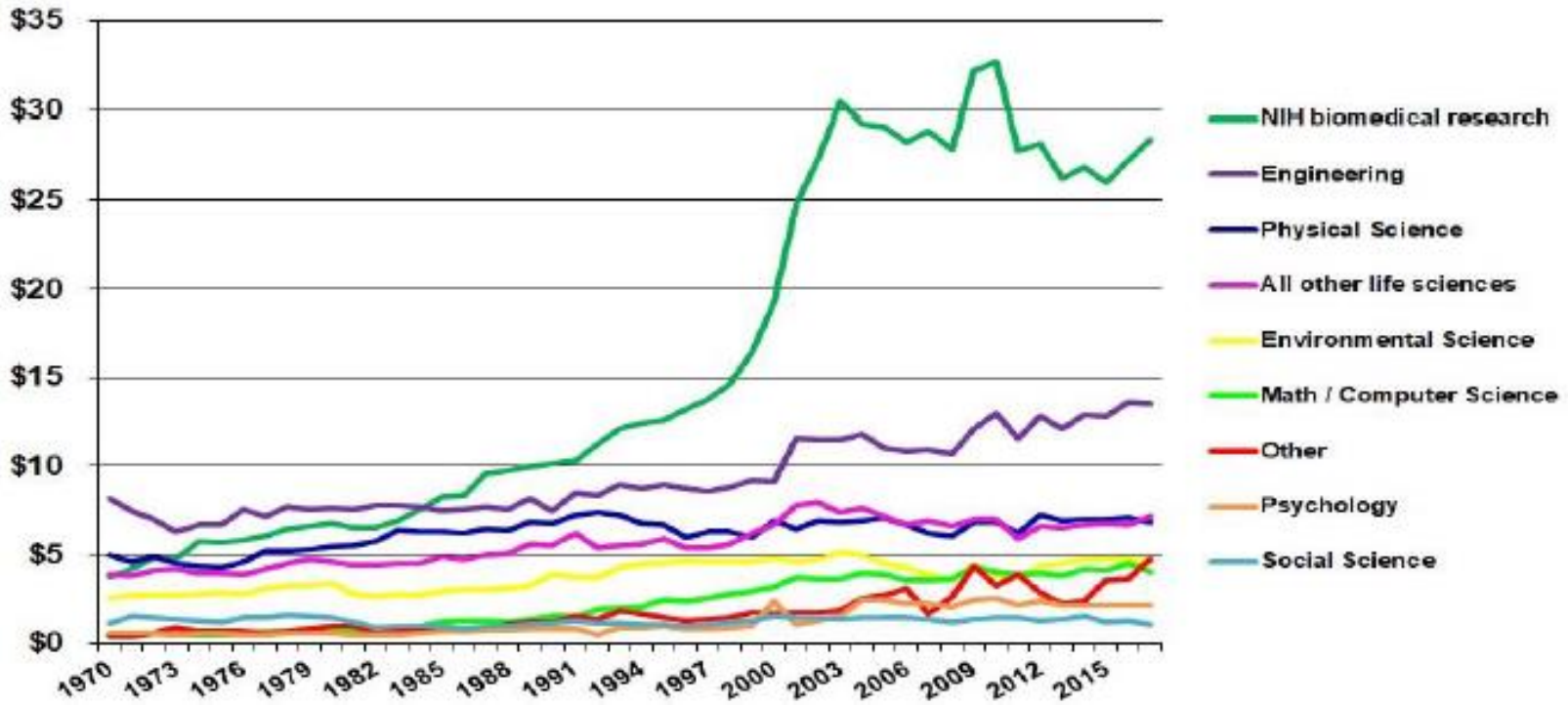
Ratio of Mortality Rates between Lowest and Highest Income Quintiles, All Ages, 1991-2006, Canada



Source: (Tjepkema, M., 2013), Health Reports, Vol. 24, no. 7, pp. 14-22, July 2013 • Statistics Canada, Catalogue no. 82-003-X Cause specific mortality by income adequacy in Canada: A 16-year follow-up study • Research Article.

Medical advancements

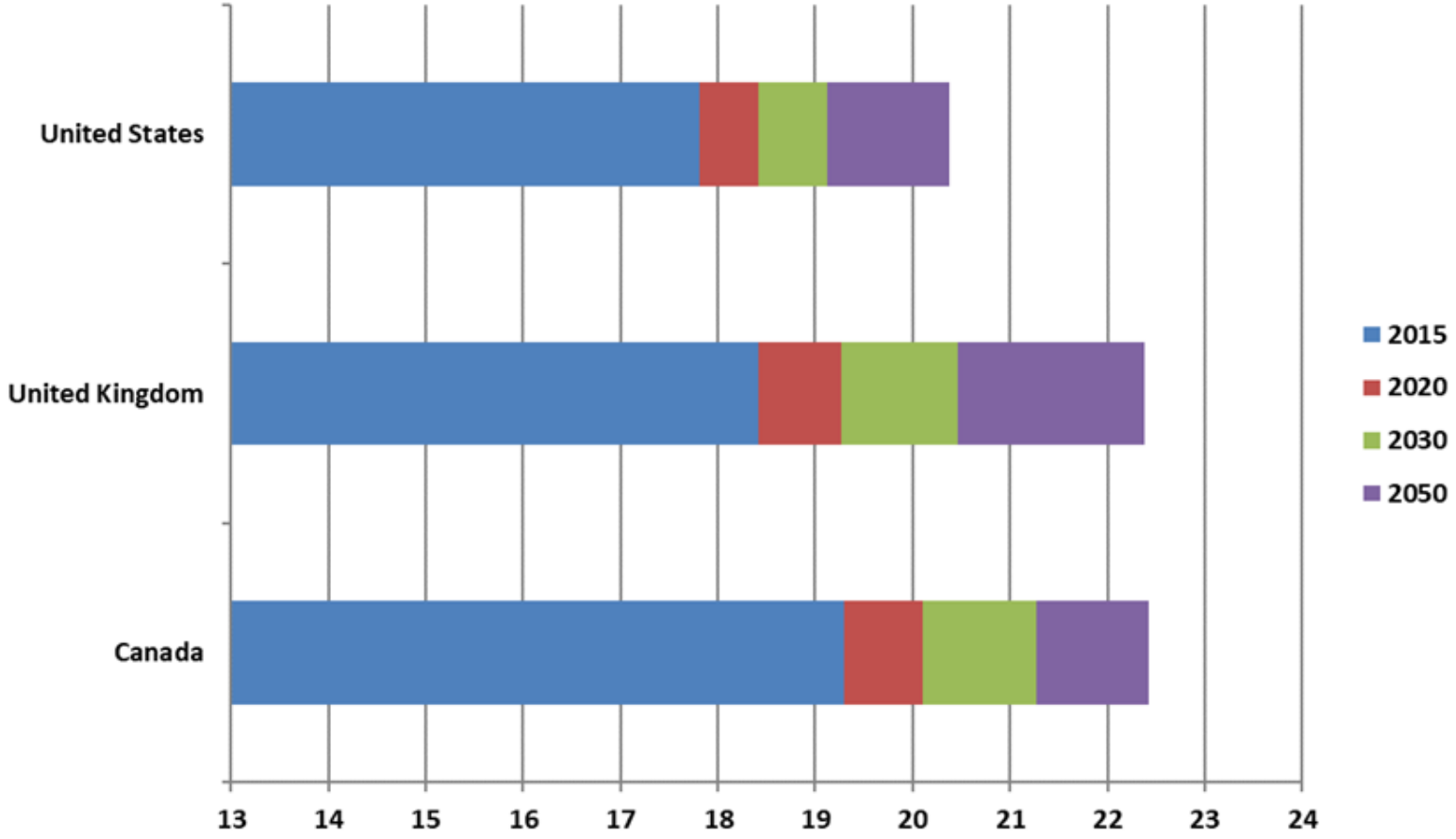
Trends in Federal Research by Discipline, FY 1970-2017, in Billions of Constant Fiscal Year 2019 US Dollars



Source: NSF Federal Funds for Research and Development series, Constant-dollar conversions based on OMB's GDP deflators. 2019 AAAS

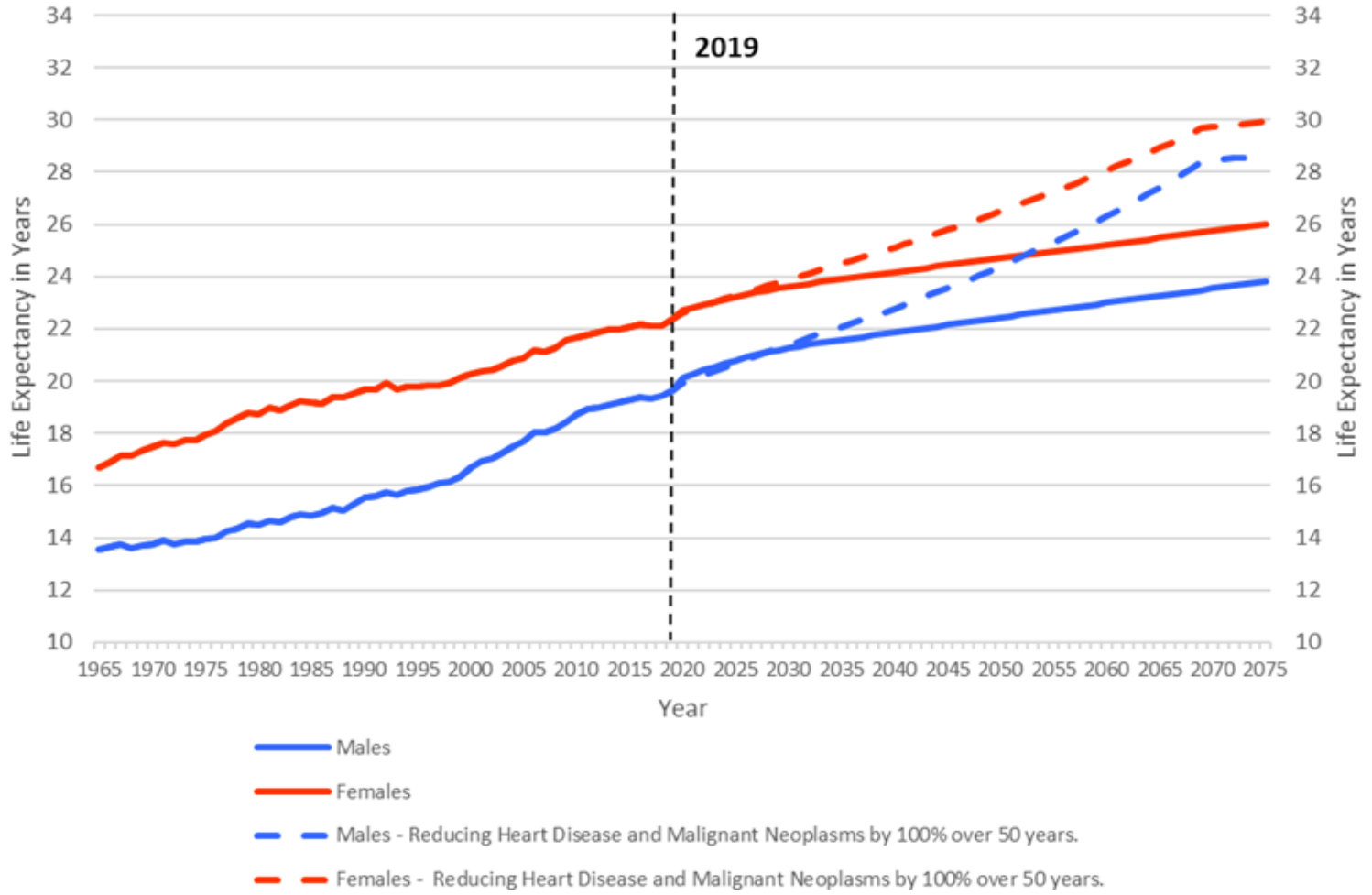
Reasonableness tests

International Comparisons Period Life Expectancy at Age 65, Males



Source: Mortality Projections for Social Security Programs in Canada, Actuarial Study No. 21, OCA

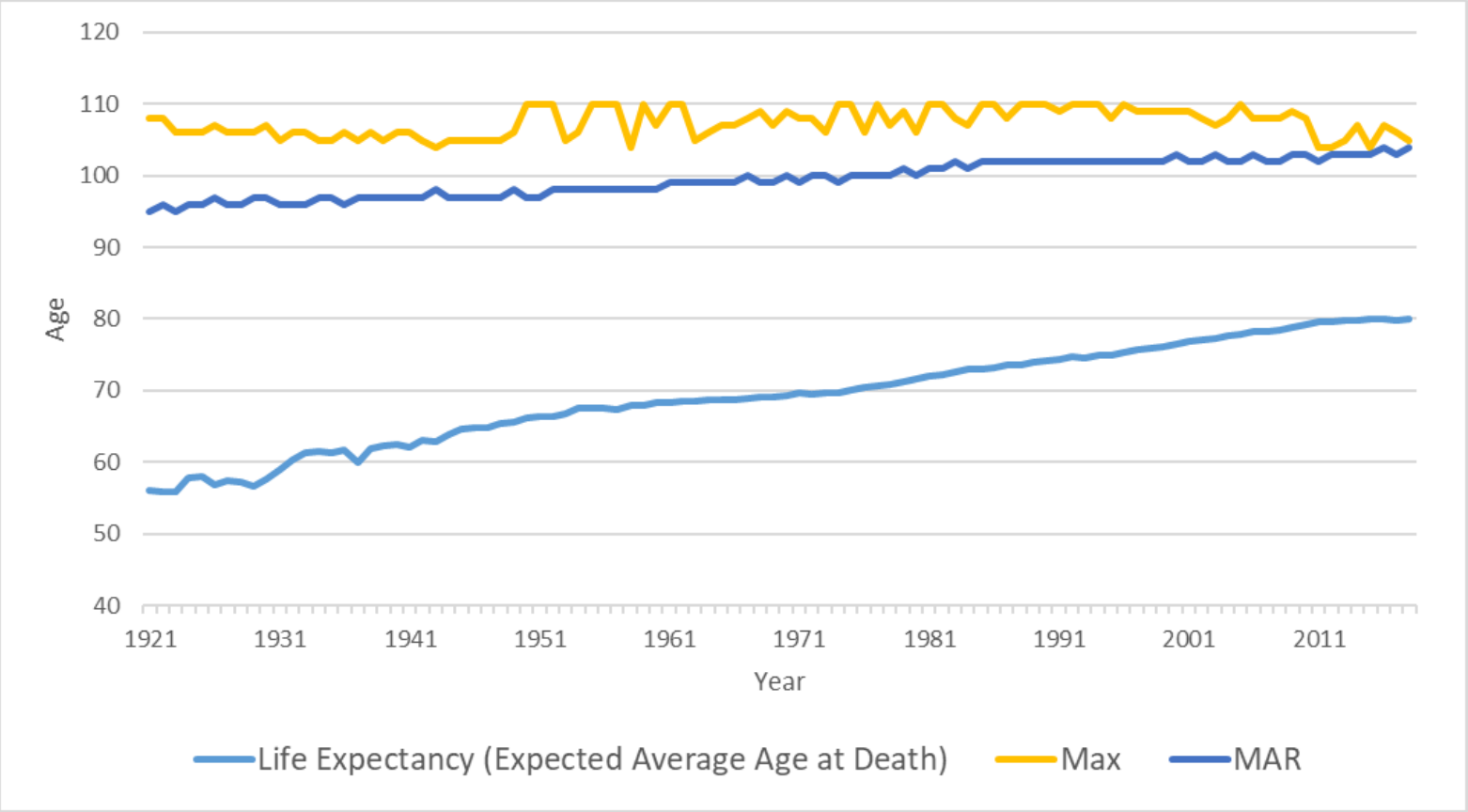
Impact of Removing Mortality from Malignant Neoplasms and Heart Diseases over 50 Years on Period Life Expectancy at Age 65



Source: Mortality Projections for Social Security Programs in Canada, Actuarial Study No. 21, OCA

Living to advanced ages - Measures of Longevity

Measures of Age at Death – Males



Source: Mortality Projections for Social Security Programs in Canada, Actuarial Study No. 21, OCA

Conclusion

- Past is not always a predictor of future
  - Mathematical models are mainly based on the past
- We may take an educated guess over the next few decade
  - Trends' breaks happen (e.g. COVID-19)
- Wide spread of views of the future
- Long-term MIRs are often dictated by actuarial practice considerations

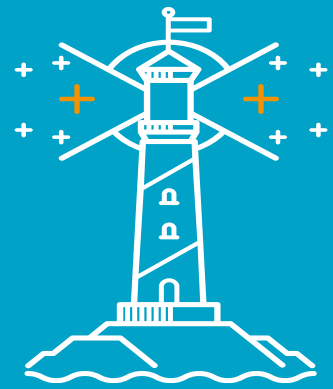
What happens in practice?

Stuart McDonald

Long term mortality improvements

What are people doing to form a view and how do approaches compare internationally?

7 November 2022



Stuart McDonald MBE
Partner - Head of Longevity and Demographic Insights

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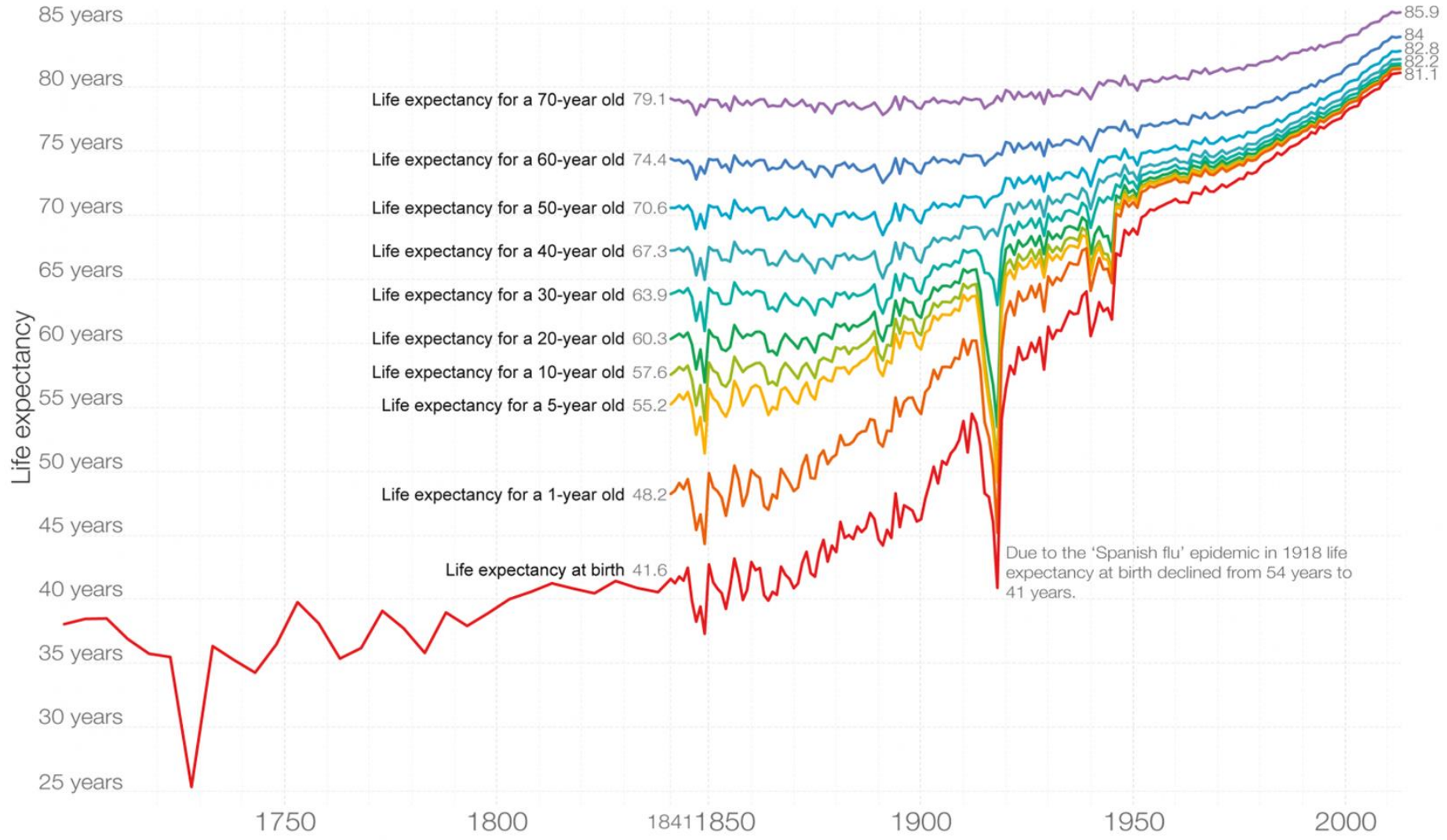
Life expectancy by age in England & Wales

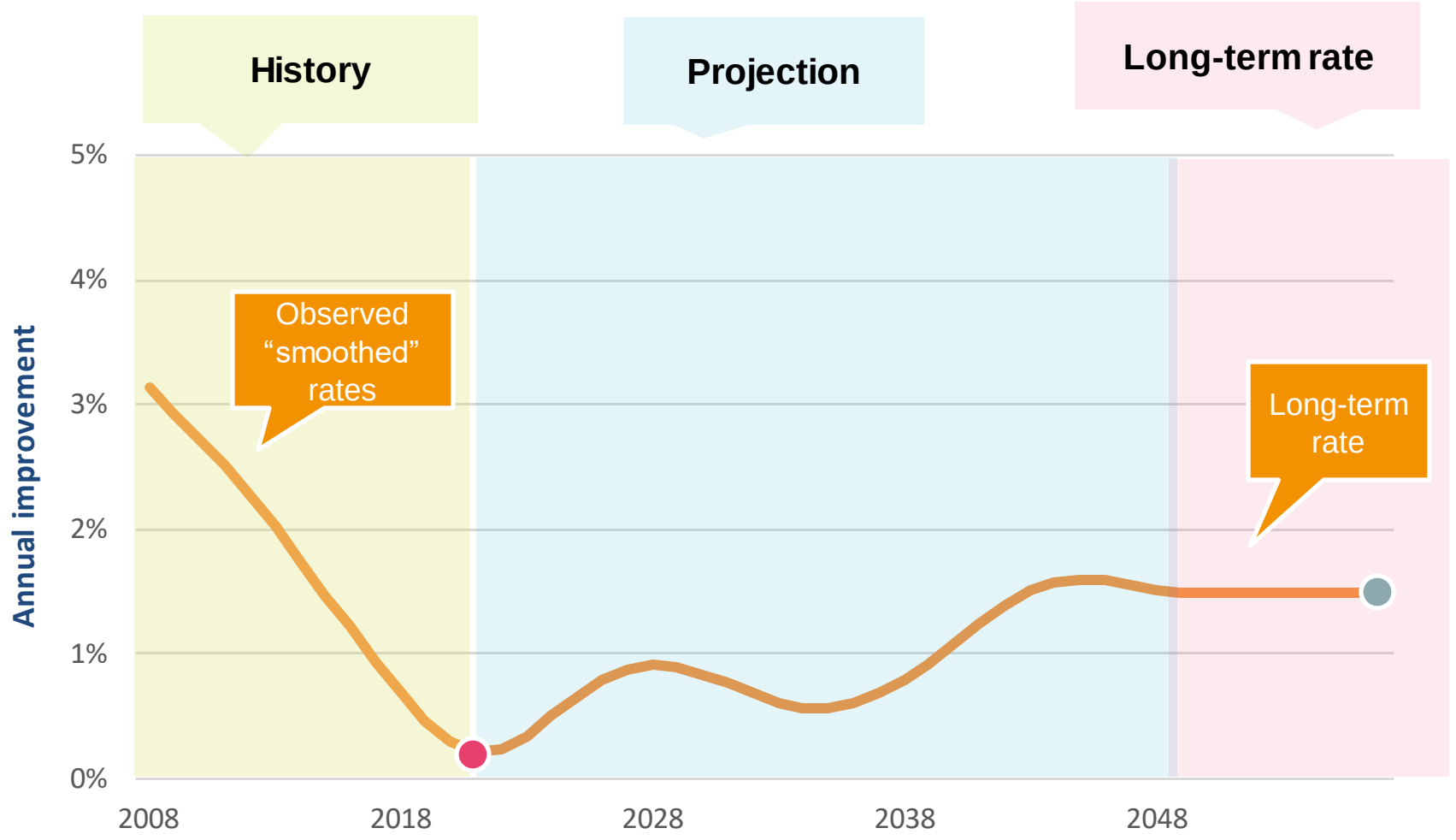
Life expectancy given that a person reached a certain age since 1700



Data source: Life expectancy at birth Clio-Infra. Data on life expectany at age 1 and older from the Human Mortality Database.
OurWorldinData.org – Research and data to make progress against the world's largest problems.

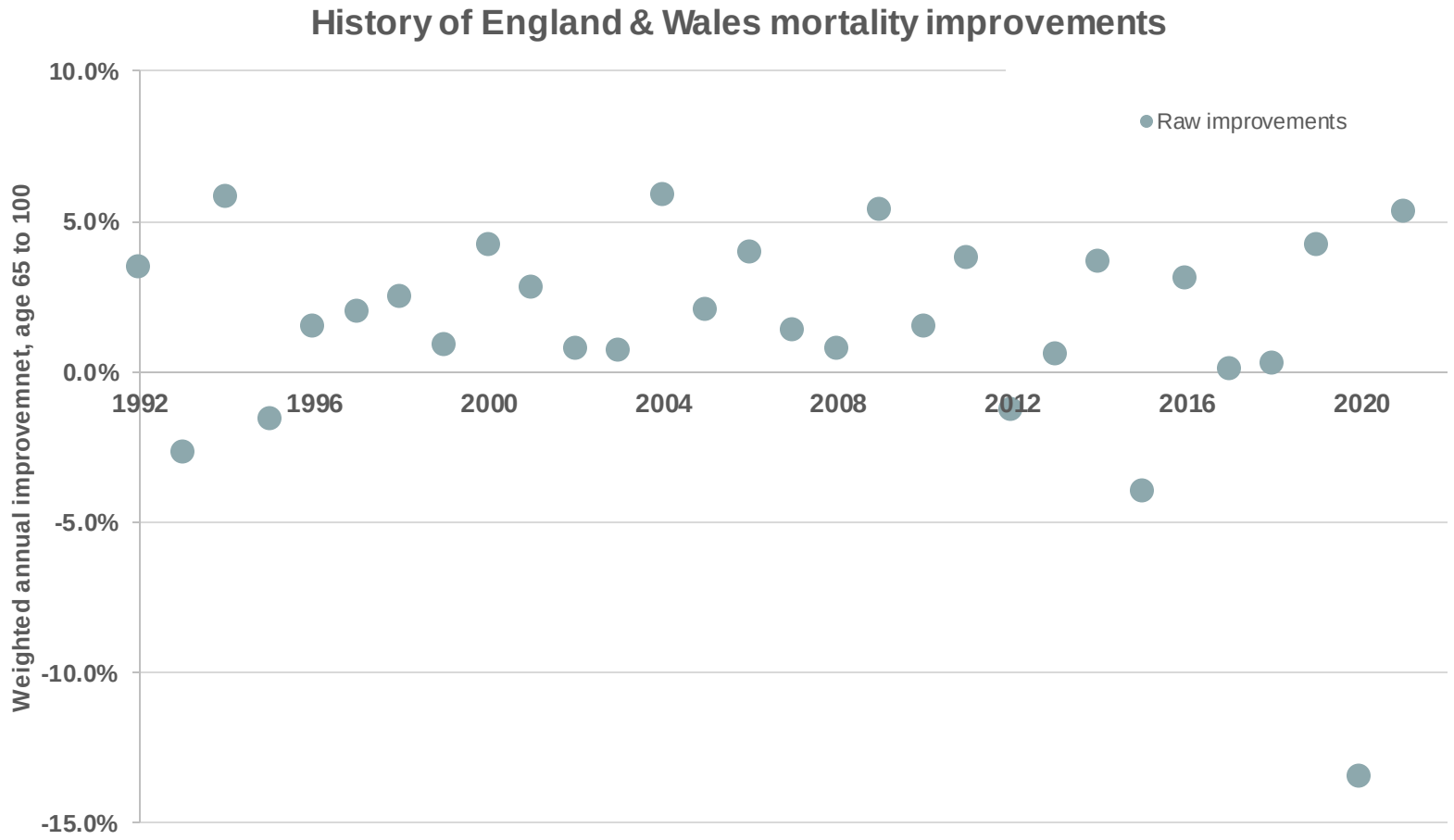
The CMI model

Typical example



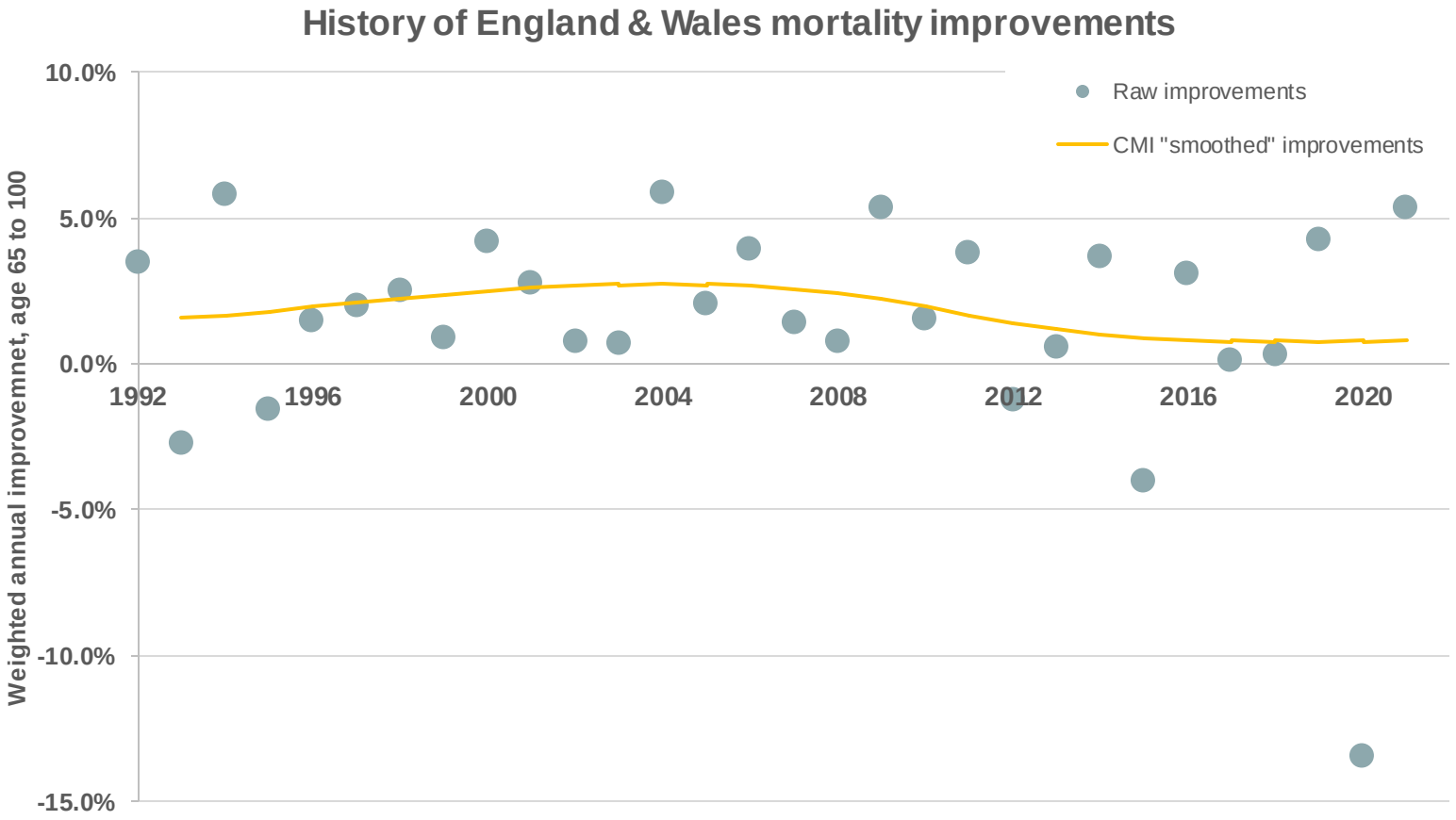
The CMI model

Raw improvement rates since 1992



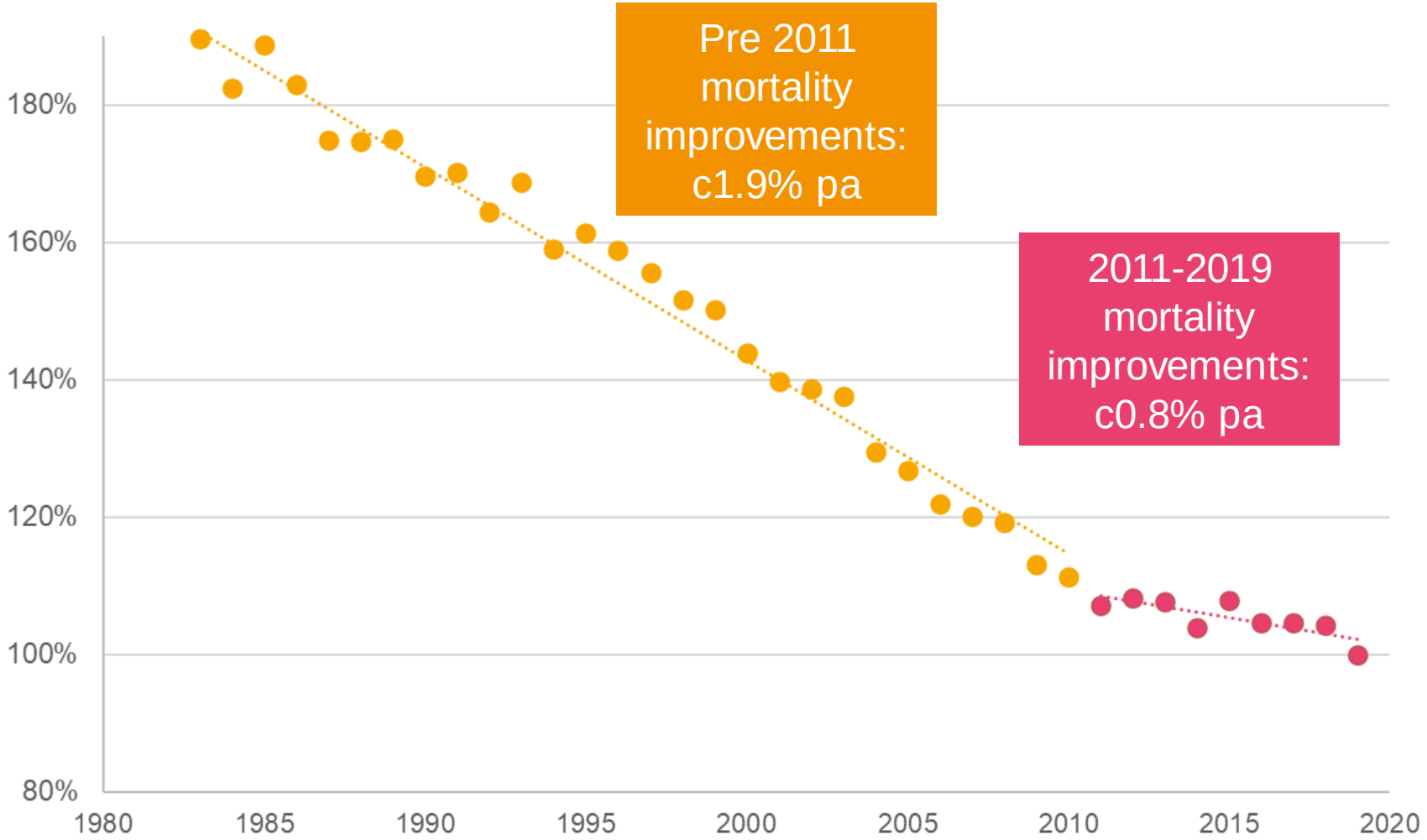
The CMI model

Smoothing for past experience



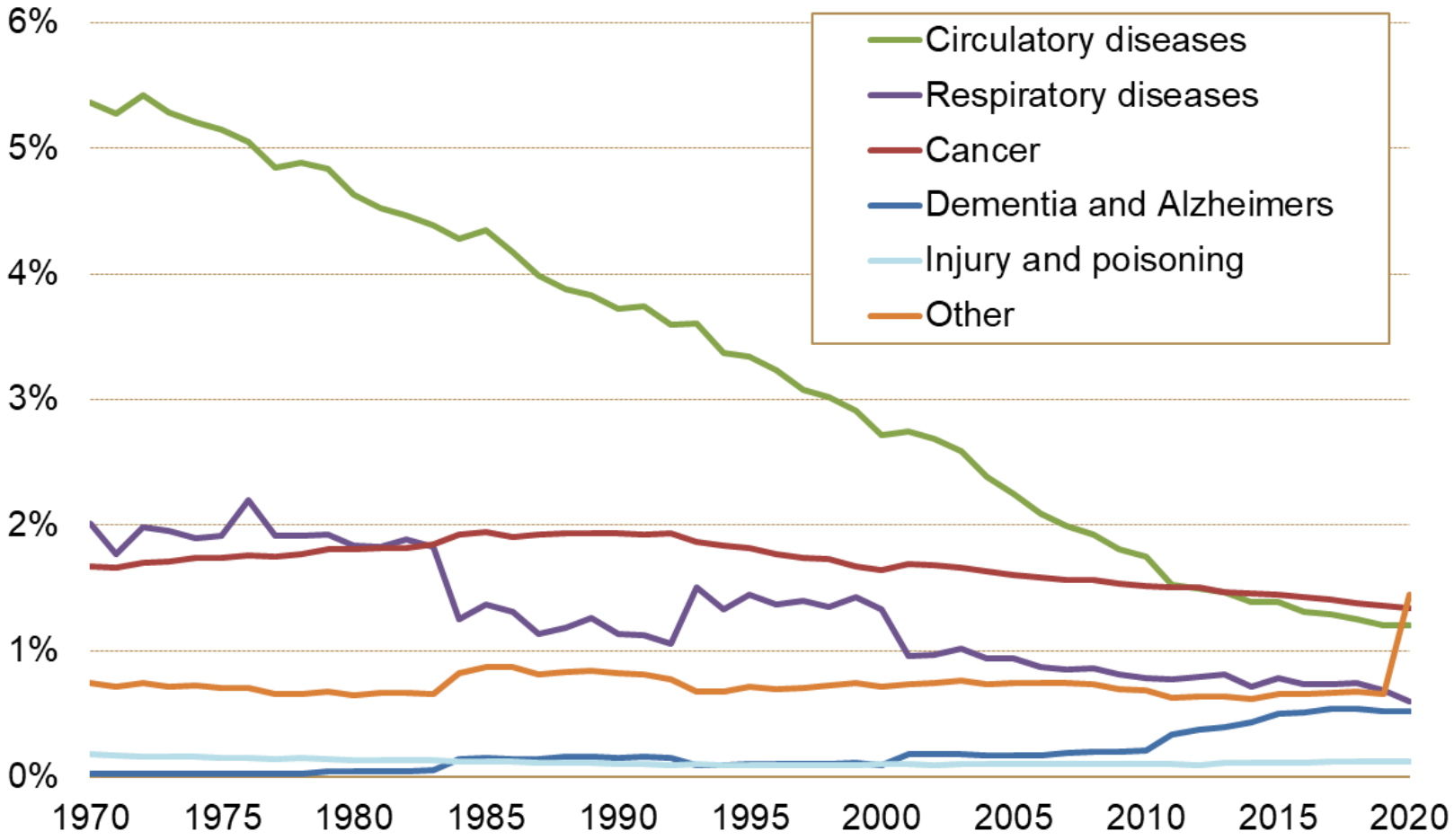
Mortality rates relative to 2019

Mortality improvements have slowed since 2011, ages 65-100



UK male mortality by cause

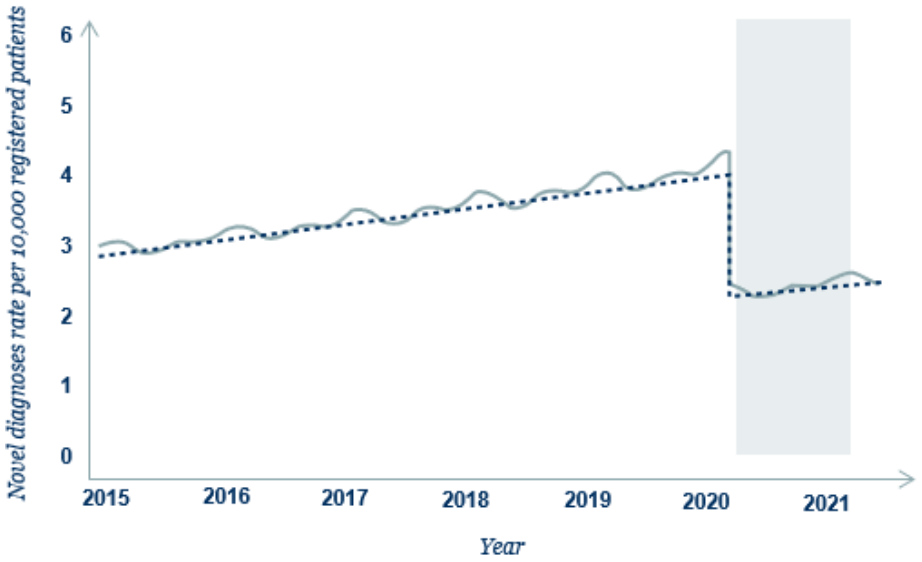
Trend in age-standardised mortality rates from selected causes of death
England and Wales males, over age 65



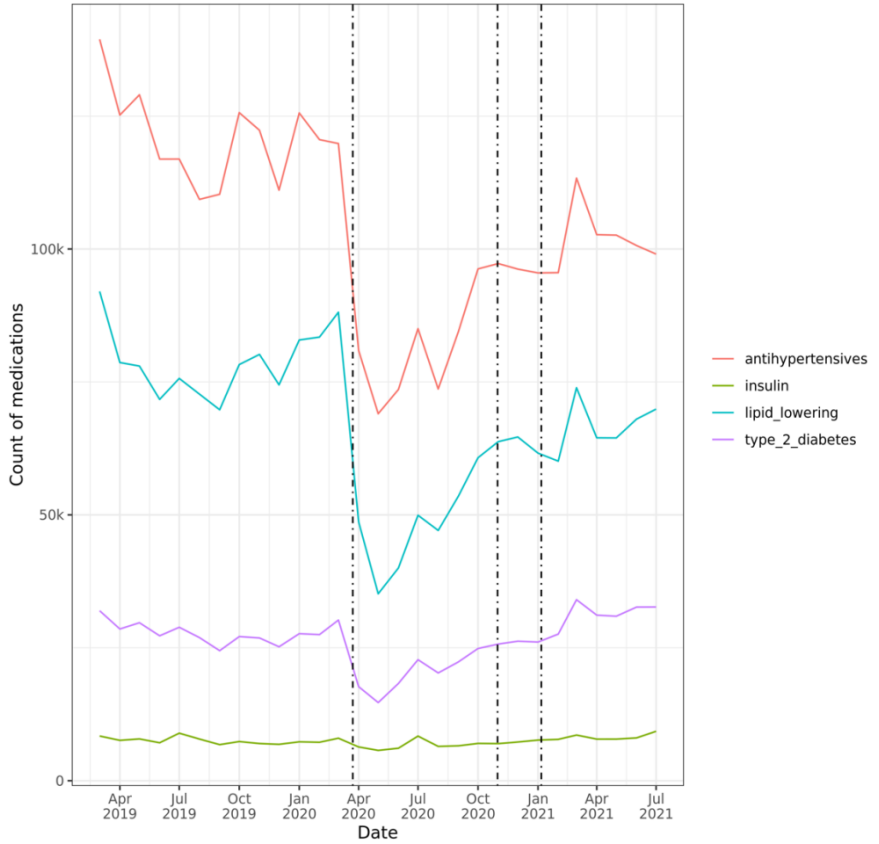
Source: LCP analysis of ONS data

Short to Medium Term Impacts

Missing diagnoses and prescriptions



Pearson-Stuttard et al, in submission



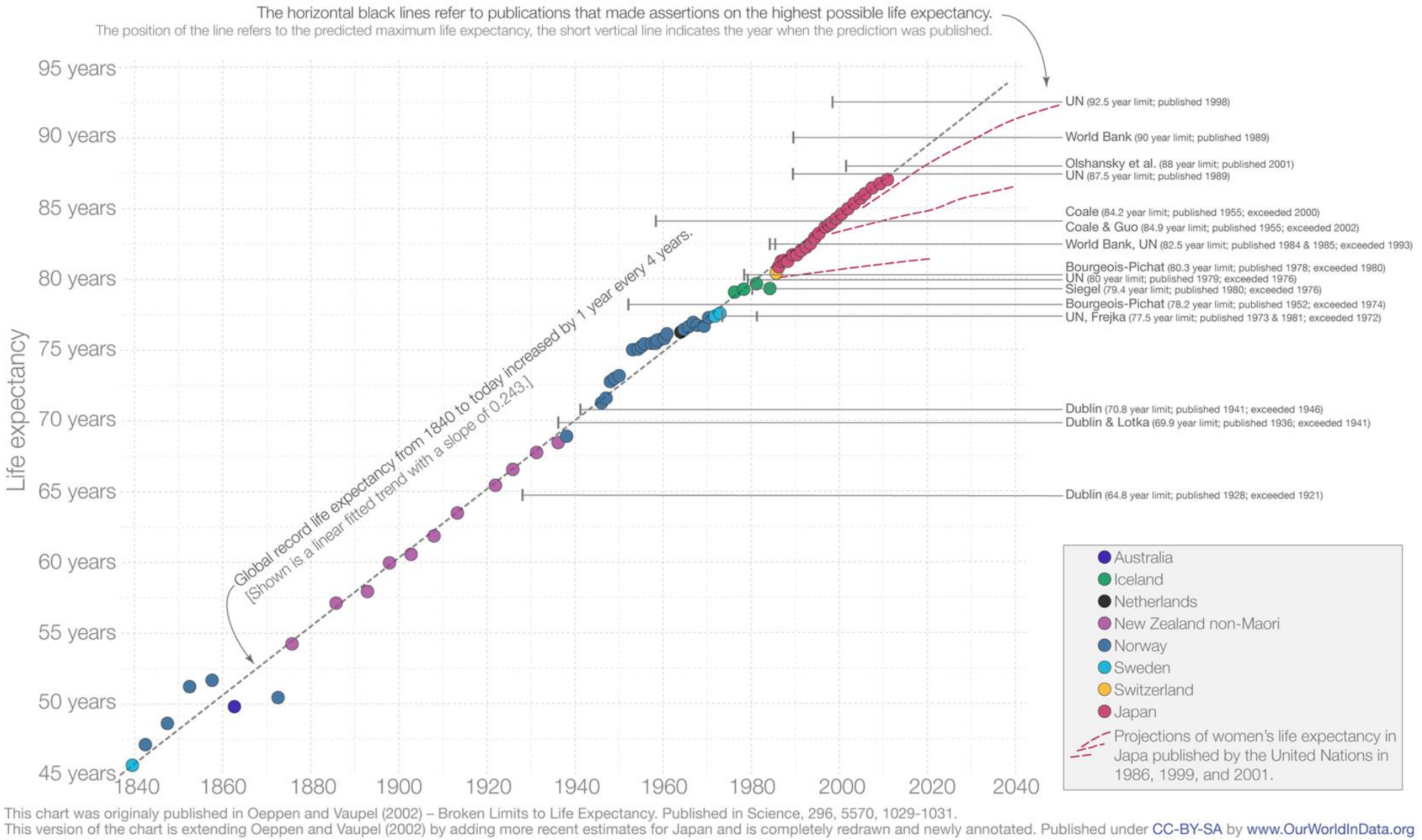
Dale et al, medrxiv, Jan 2022

57% fewer Type II Diabetes Diagnoses.

Half a million fewer people initiated anti-hypertensive treatments.

Record life expectancy of women

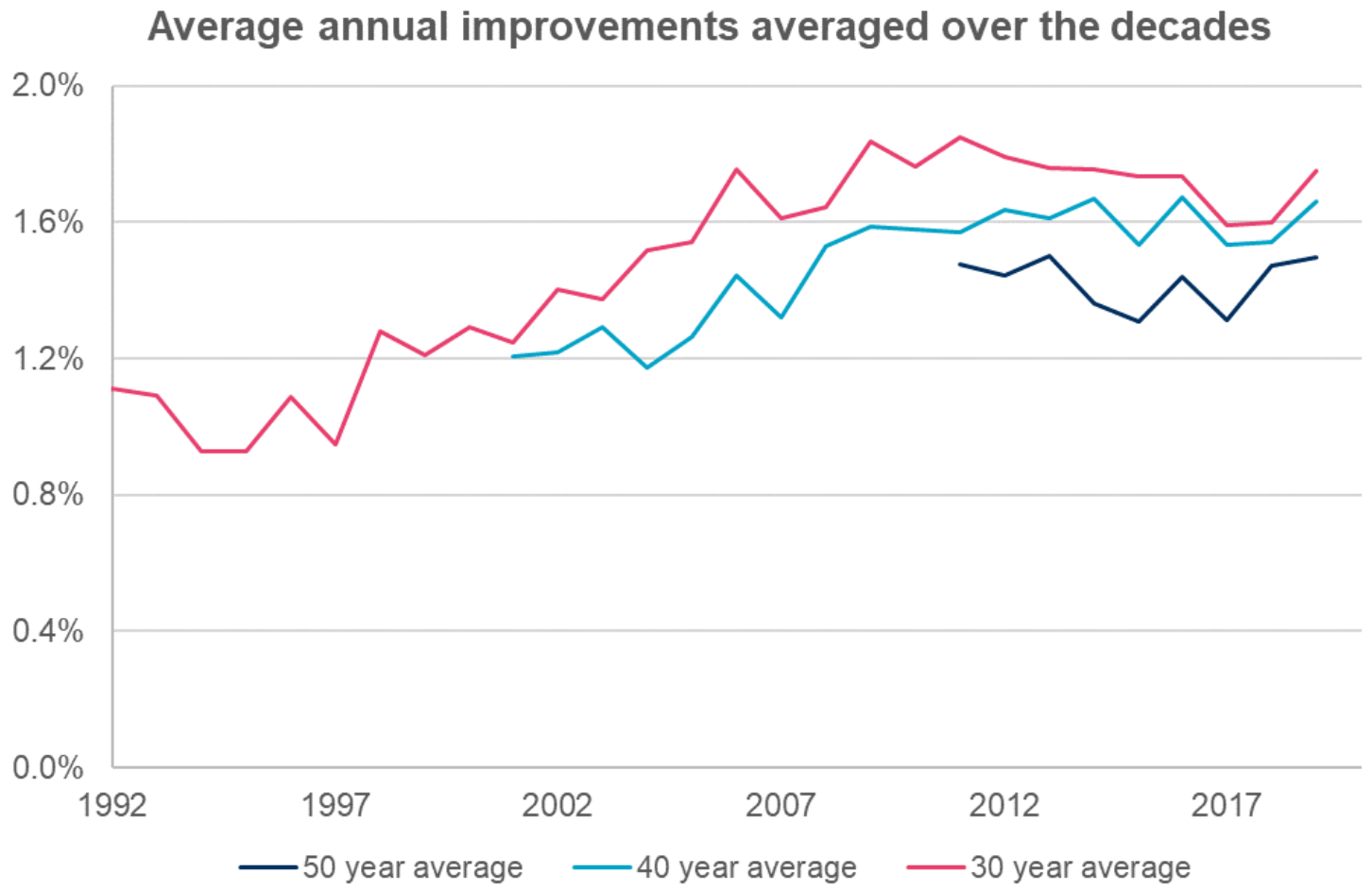
The chart shows the country with the highest life expectancy for a woman since 1840



Source: Oeppen and Vaupel, Broken Limits to Life Expectancy

Longer-term view on improvements

Age standardised over ages 65-100, pre-pandemic

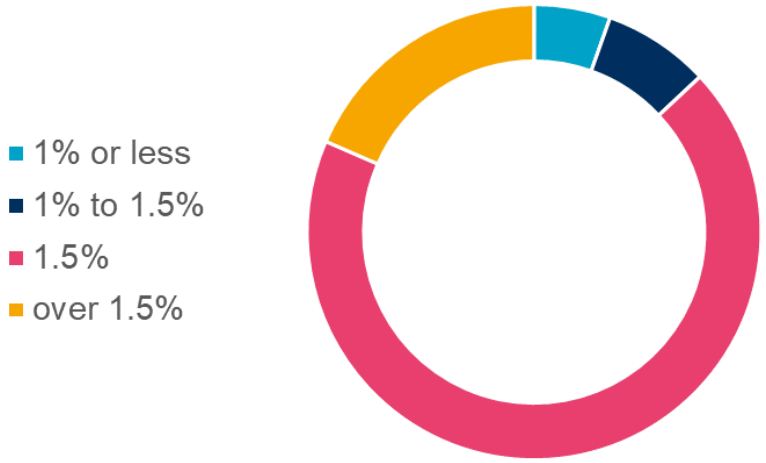


Averaging over 30, 40 and 50 years lead to a past long-term annual rate of improvement of c1.5% pa

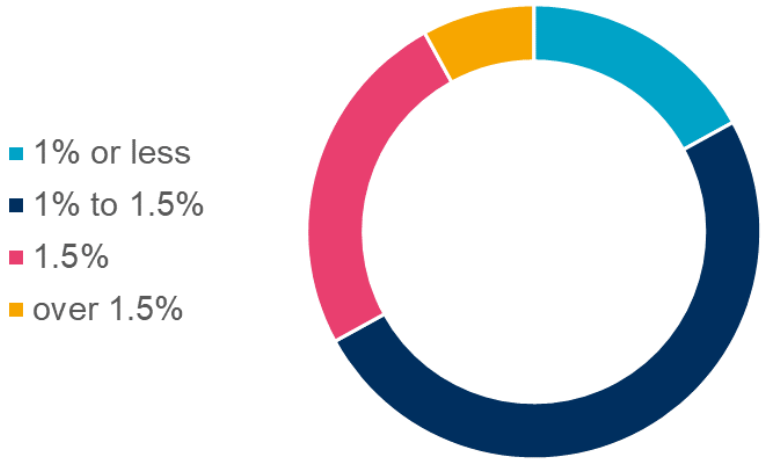
Benchmarking the long-term rate

Long-term rates used by different pension schemes

Prudent funding assumption:



Best-estimate accounting assumption:

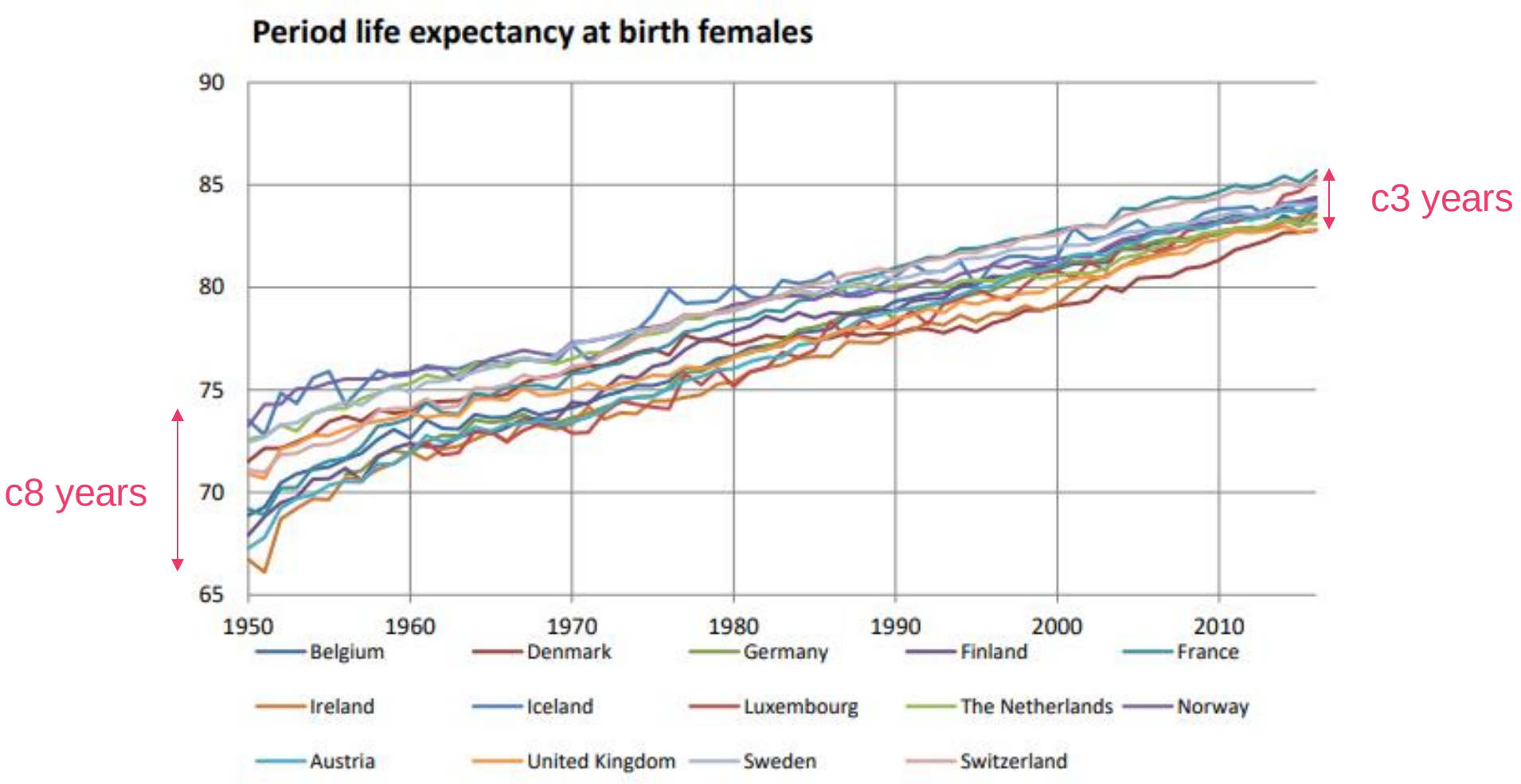


Pension schemes have herded towards a long-term rate assumption of 1.25-1.5% pa

Source: Pensions Regulator Scheme Funding Statistics (July 2022), LCP's accounting for pensions report 2022, FTSE 100 publicaccounts

European comparisons of period life expectancy

Convergence of period life expectancies in a number of European countries



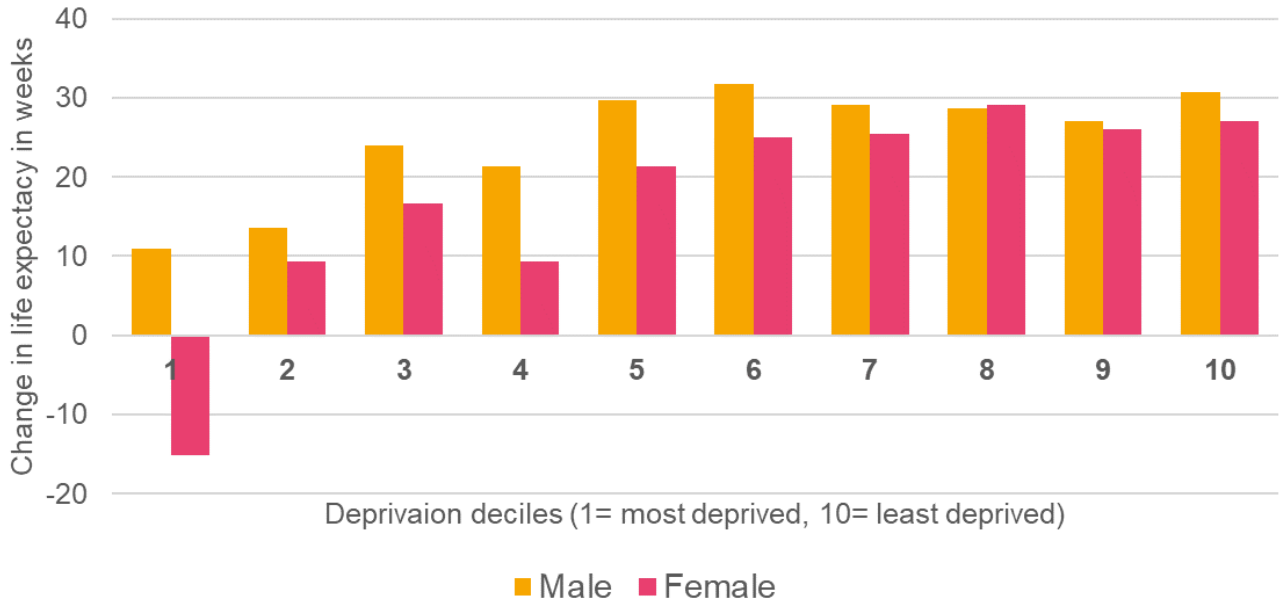
Source: https://w ww.ag-ai.nl/view/39421-Projection+Table+AG2018.pdf

Increasingly different life expectancies at 65

Some sub-populations have seen declines in life expectancy

Difference in 2013 between IMD 1 and 10:
Males: 9.1 years
Females: 6.9 years

Difference in 2019 between IMD 1 and 10:
Males: 9.4 years
Females: 7.7 years



Questions?

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Thank you