

# SOCIOECONOMIC FACTORS DRIVING MORTALITY IMPROVEMENT GAPS

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Mark Spong, FSA, CERA, MAAA  
Senior Consultant

# Today's approach

## Overview of research into mortality improvement differences driven by socioeconomic factors and the implications on our industry

- 1. What and why** – Origin and motivation for the research
- 2. Data and methods** – Challenges for the industry, potential opportunities to use public data sources and research approach
- 3. Results** – Differentials for key socio-economic splits
- 4. Next steps** – Practical issues for setting assumptions and next steps for research
- 5. Bonus** – Annual meeting highlights



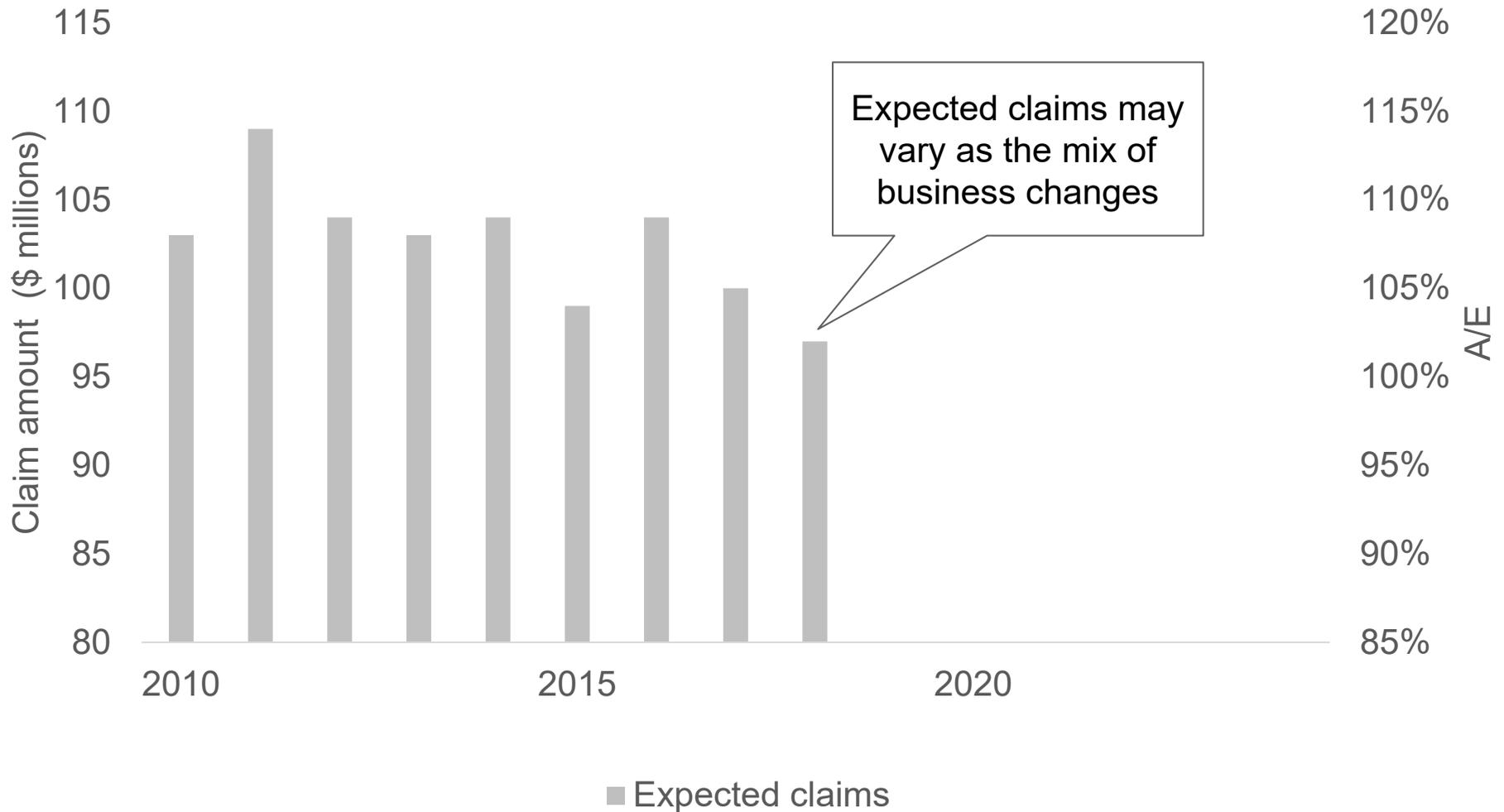


# 1 | What and why



# What is mortality improvement?

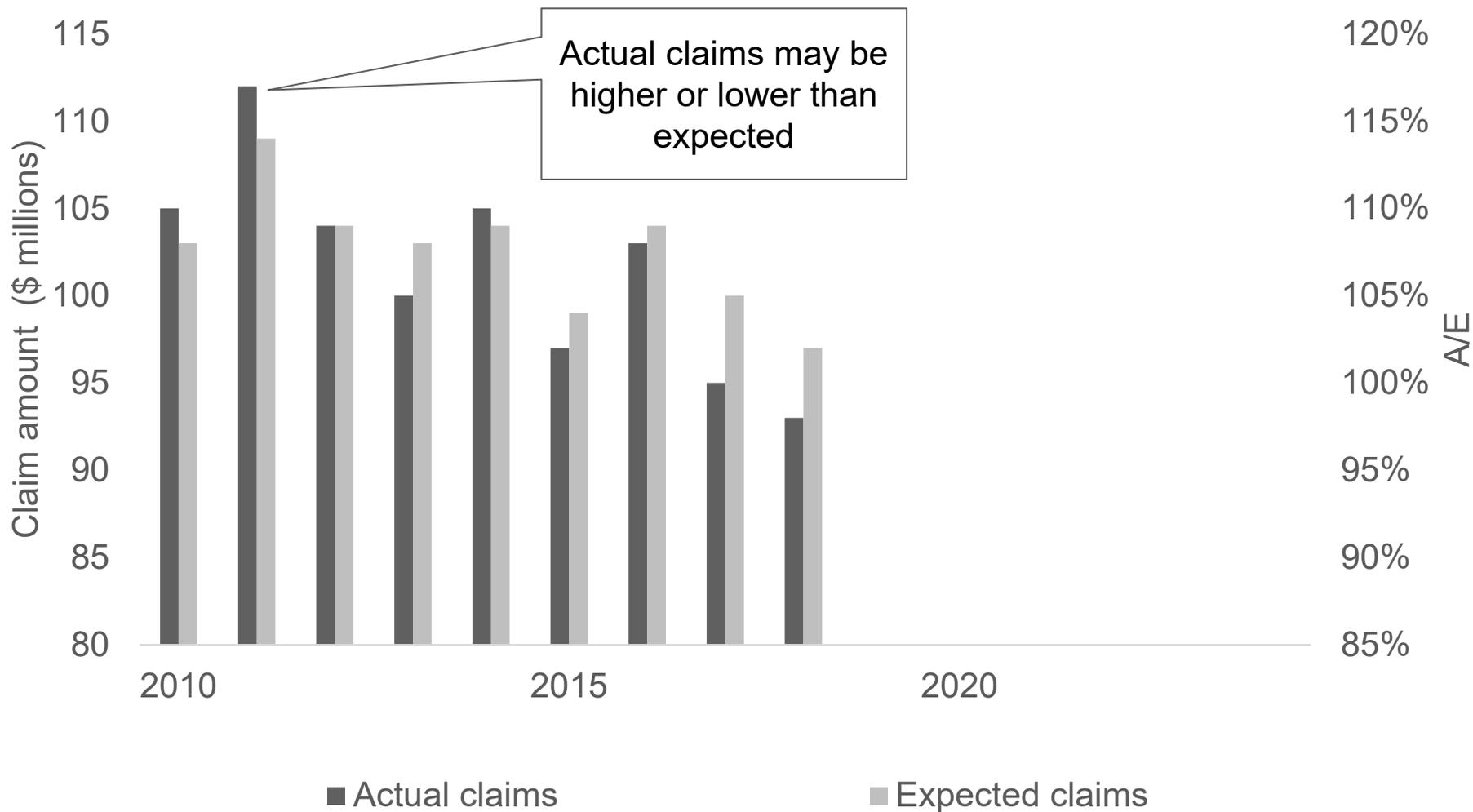
Mortality improvement is a method to capture long-term mortality trends in actuarial models





# What is mortality improvement?

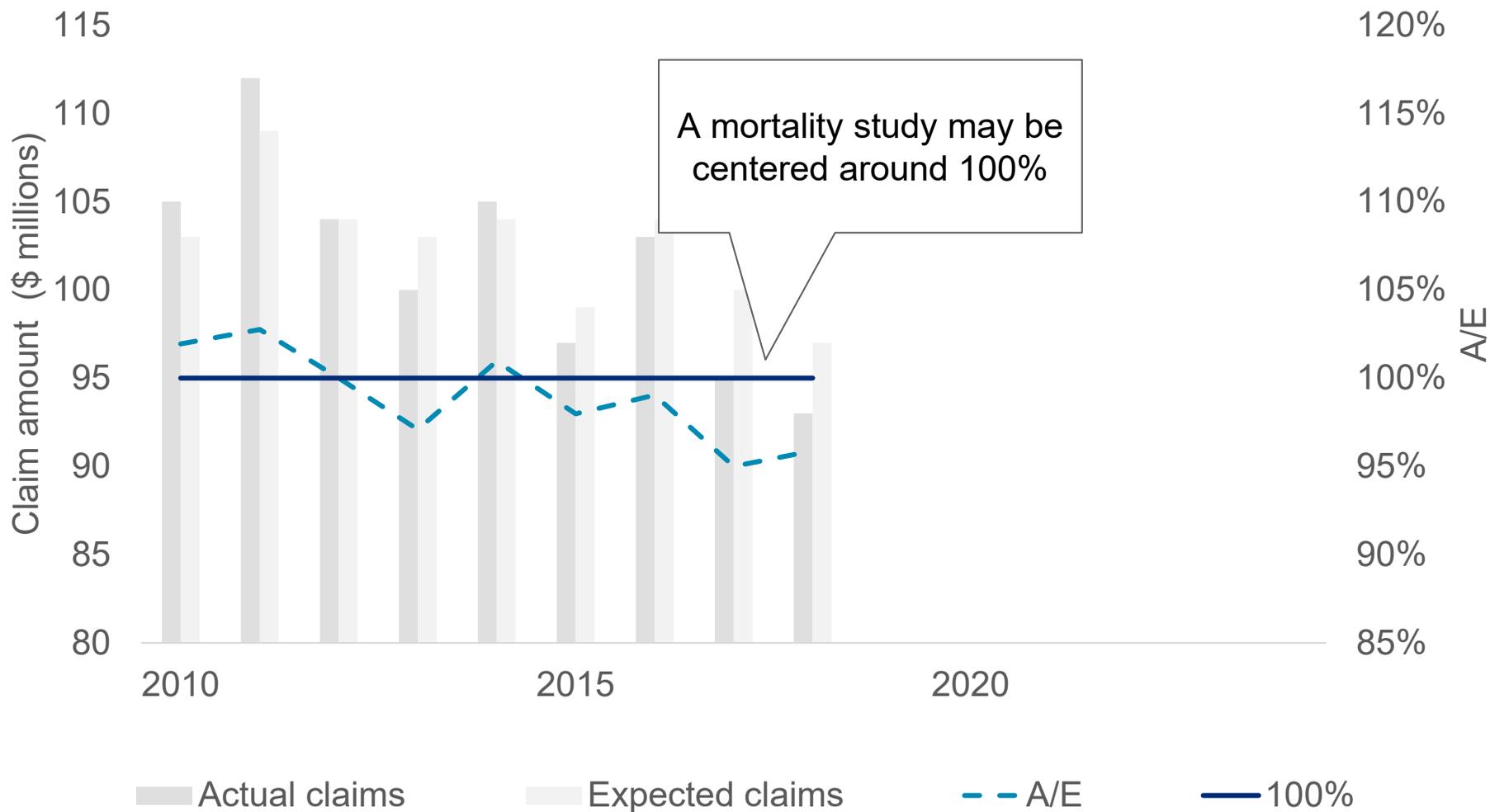
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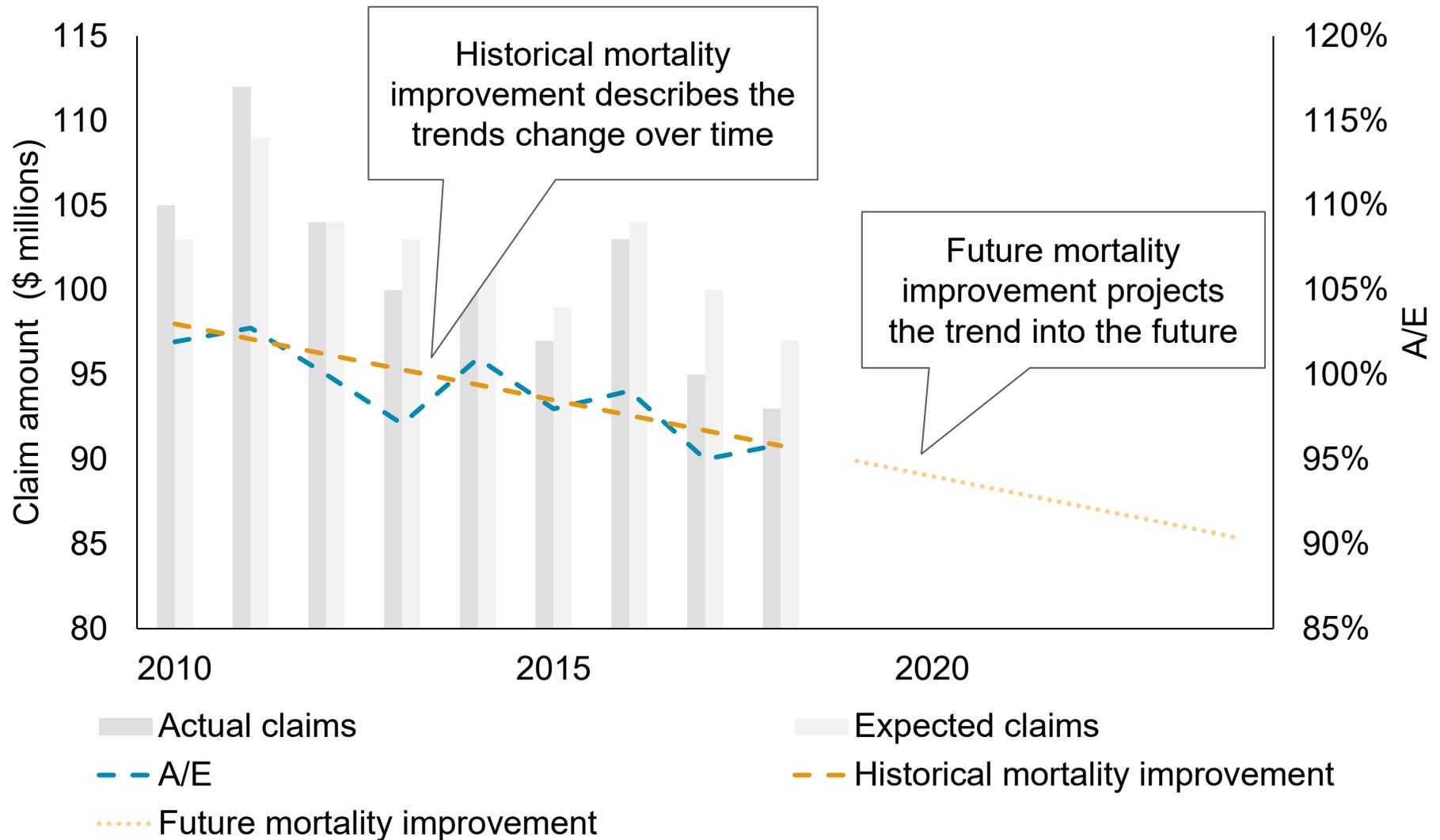
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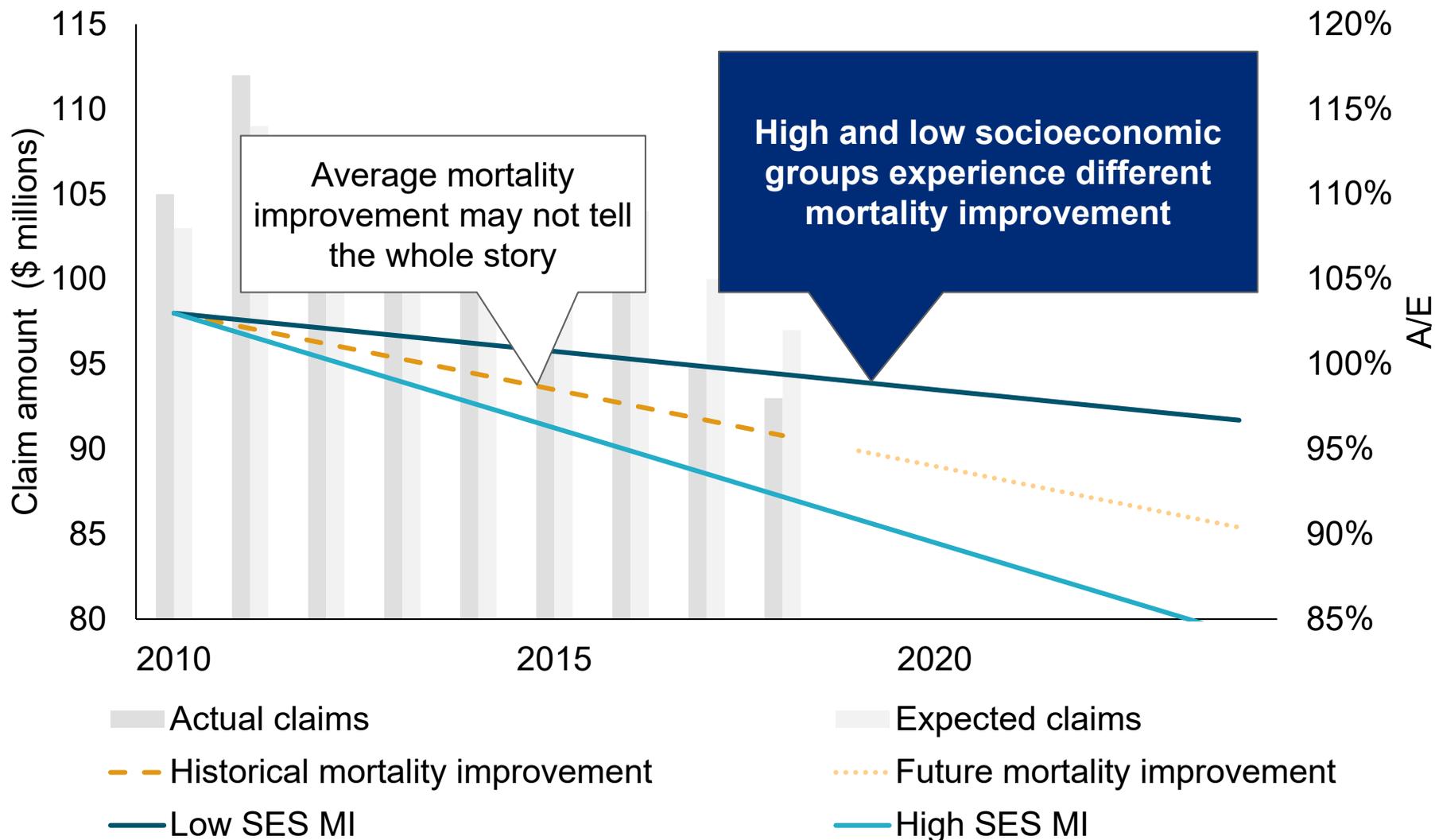
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# What is mortality improvement?

Mortality improvement is a method to capture long-term mortality trends in actuarial models





# State of the industry

Socioeconomic factors are known to be key drivers of mortality improvement and the gap is expected to widen

...**the most important driver** affecting U.S. mortality past the next 10 years [is] socioeconomic status inequity<sup>1</sup>

Recent evidence indicates that inequities in life expectancy in England have not only widened, but are **forecasted to widen further**.<sup>2</sup>



This study finds a difference in **both the level and the rate of change** in mortality improvement over time by socioeconomic status...<sup>3</sup>

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...mortality inequality is increasing highlights a **growing relationship** between [socioeconomic status] and life expectancy.<sup>4</sup>

AR ANNUAL  
REVIEWS

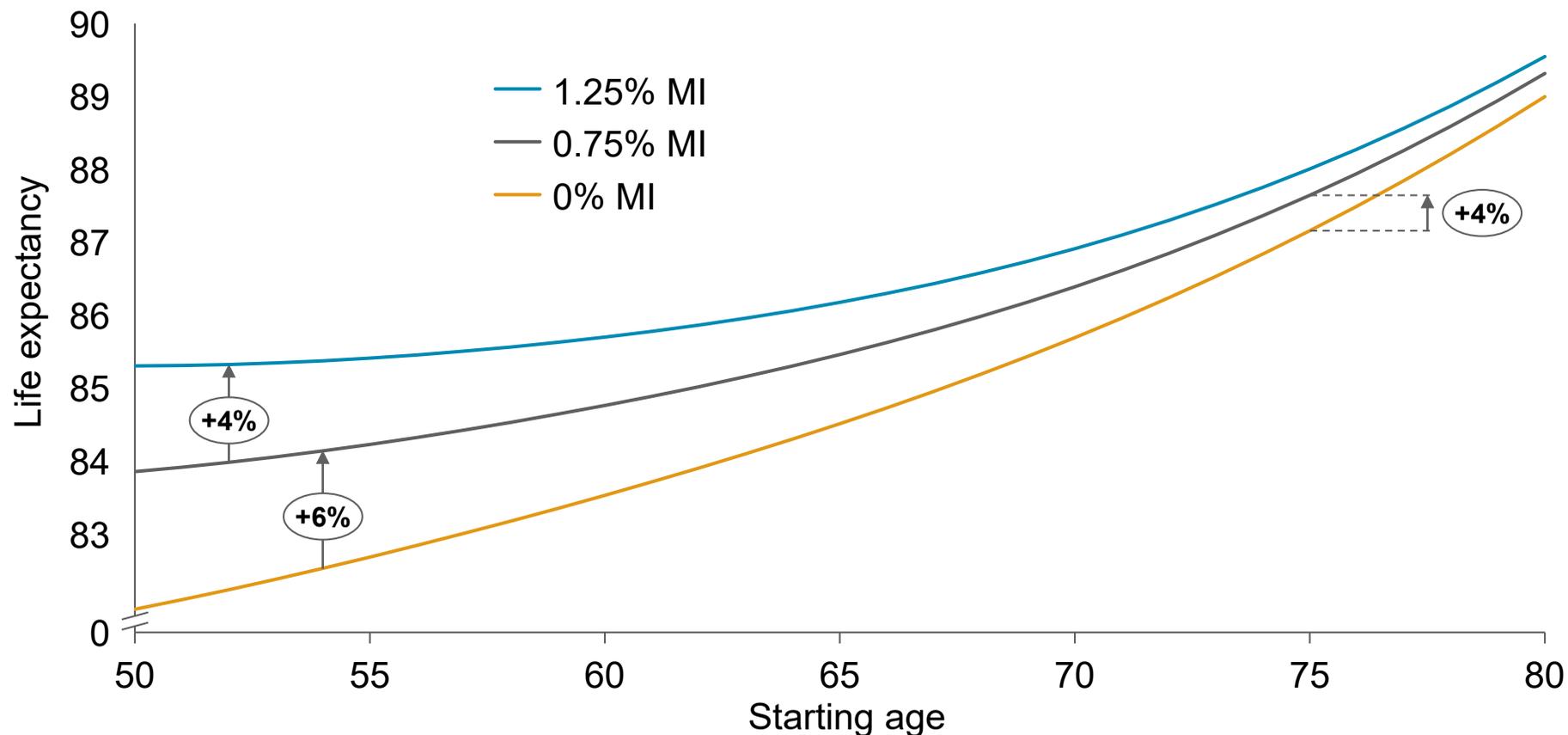
... a major increase in the availability of data ... showing not only the existence of large inequities in the risk of death between those at the top and those at the bottom of the socioeconomic distribution, but also that **the gaps have been growing**.<sup>5</sup>

1. SOA - Drivers of U.S. Mortality Improvement Expert Panel Forum Report, January 2019
2. Living to 100 - Causal Mortality by Socioeconomic Circumstances: A Model to Assess the Impact of Policy Options on Inequalities in Life Expectancy
3. Social Security Administration - Trends in Mortality Differentials and Life Expectancy, 2007
4. Center for Retirement Research at Boston College – Rising Inequality in Life Expectancy by Socioeconomic Status, 2017
5. Annual Review of Public Health – Increasing Disparities in Mortality by Socioeconomic Status, April 2018



# Mortality improvement has a large impact on life expectancy

## Moderate differentials in mortality improvement change remaining life expectancy by years, not months

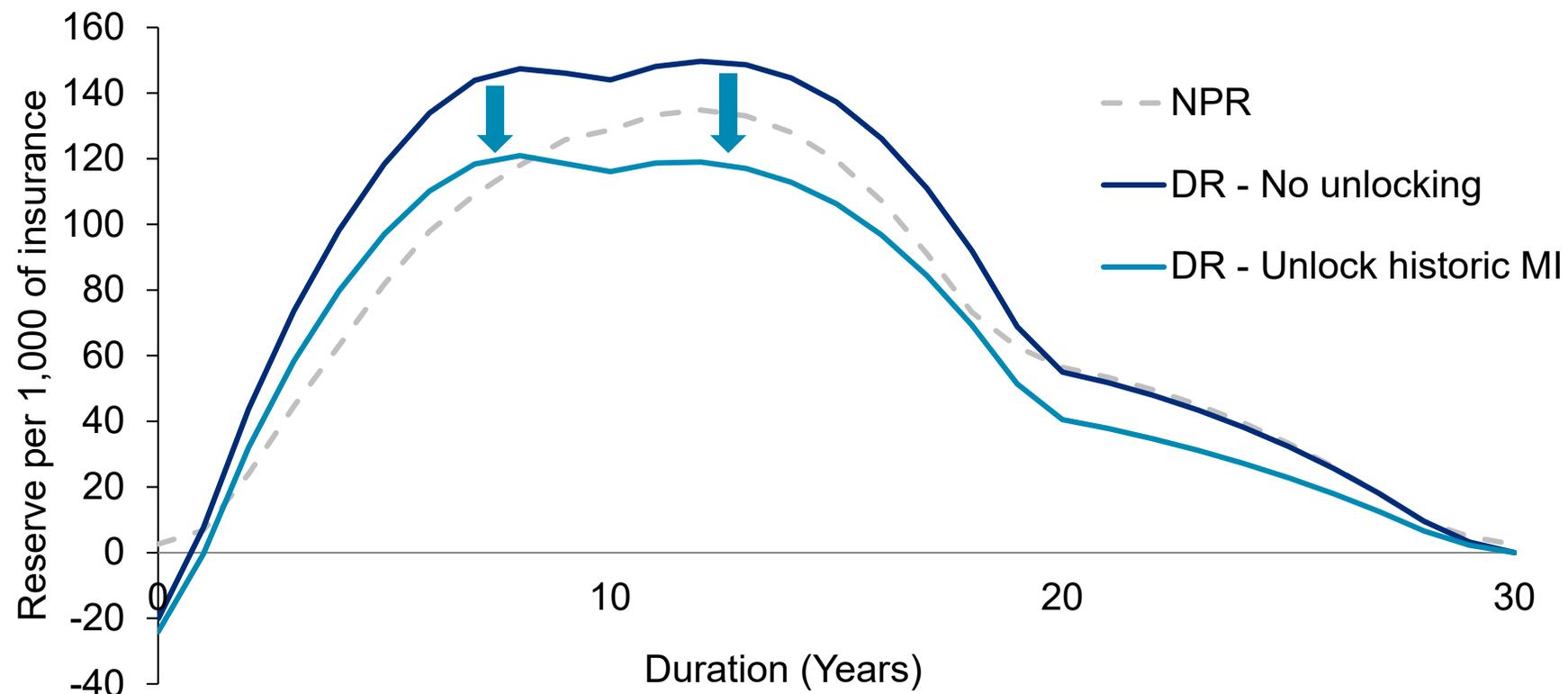


Mortality improvement is a small assumption but has a large impact; getting it right is not merely an exercise in 'sharpening the pencil'



## PBR case study

The impact of unlocking the mortality assumption is material



DR with no unlocking creates the highest reserve. With unlocking, the NPR begins to take over at most durations.



## State of the industry

Mortality improvement assumptions have become more sophisticated over time because longevity gains are not evenly distributed

	Degree of sophistication 		
	BASIC (G2 2012)	ADVANCED (MP 2018)	NEXT GEN
Age	✓	✓	✓
Gender	✗	✓	✓
Calendar Year	✗	✓	✓
Income	✗	✗	✓
Education	✗	✗	✓
Occupation	✗	✗	✓

The next generation of mortality improvement assumptions will be further refined to differentiate by socioeconomic and other demographic variables

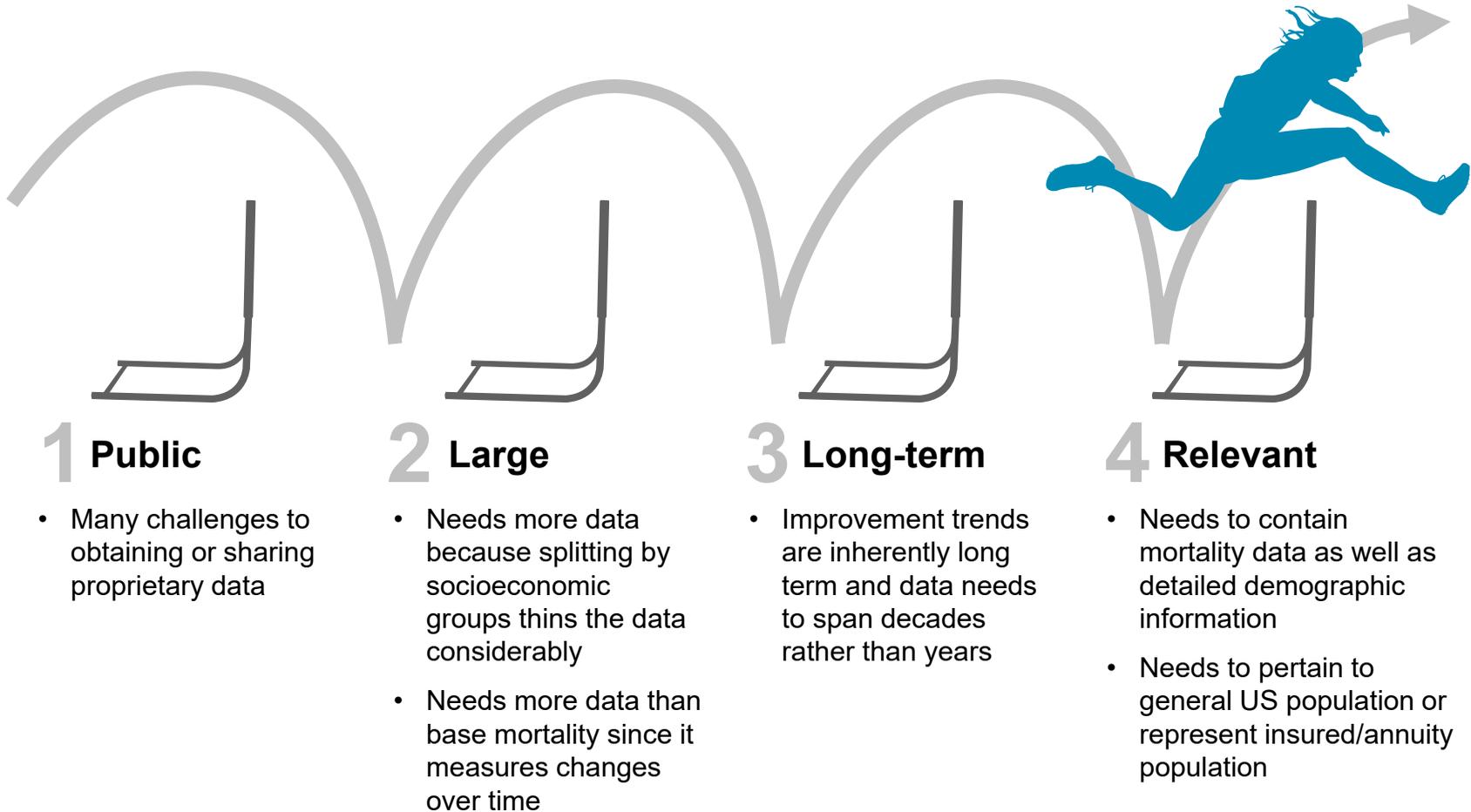


## 2 | Data and methods



# Data

Getting the right data has been a major barrier for reinsurers and direct writers





# Data

Successfully obtained data from U.S. Census/CDC spanning 1980-2005 with 3.8 million records and over 550,000 deaths



**DEATH, CAUSE OF DEATH**



**GEOGRAPHY**



**CITIZENSHIP, VET STATUS**



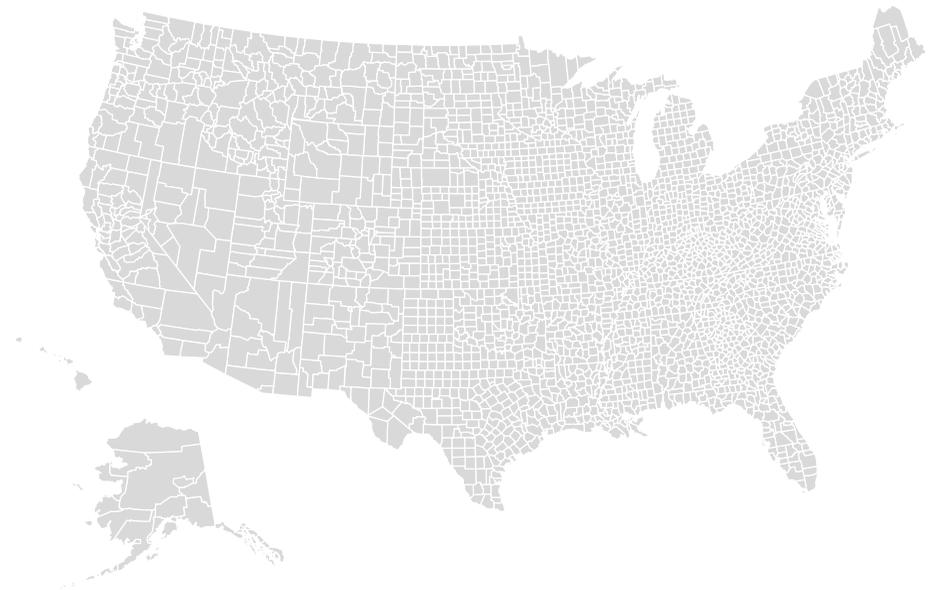
**AGE, GENDER, RACE, TOBACCO**



**OCCUPATION, INDUSTRY**



**INCOME, EDUCATION**



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Dataset is explicitly for studying the effects of differentials in demographic and socioeconomic characteristics on mortality

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# Statistical tools and user interface

~/IC/Mortality Research/Working folder - Shiny  
http://127.0.0.1:7513 | Open in Browser | Publish

## Experience Tables

- Mortality
- Smooth Mortality
- Mortality Improvement
- Smooth Mortality Improvement
- Graphs

### About

The data used in this app is the National Longitudinal Mortality Study Public Use Data. It has been filtered to exclude records that do not contain a social security number and are below the age of 40. Please contact the current owner, Mark Spong, with any questions.

Previous owner: Lisa Grieco

Gender	+	Urban/Rural	+	Education	+
Income	+	Region	+	Occupation	+

Mortality Table Run

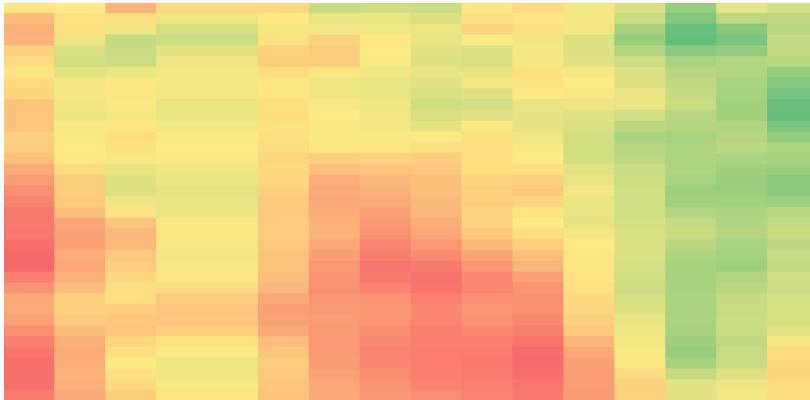
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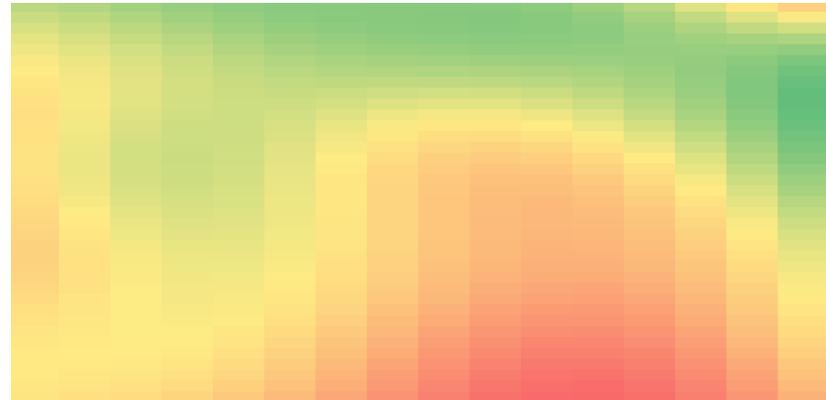
# Dynamic validation vs MP-2018

## Data follows general trend of MP tables

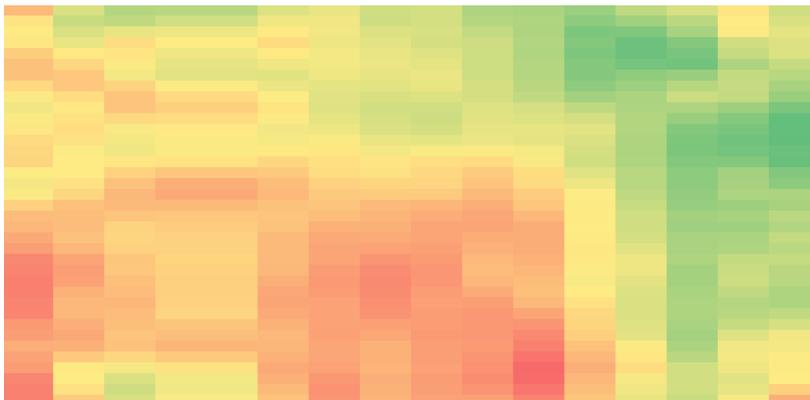
Female Data MI Rates



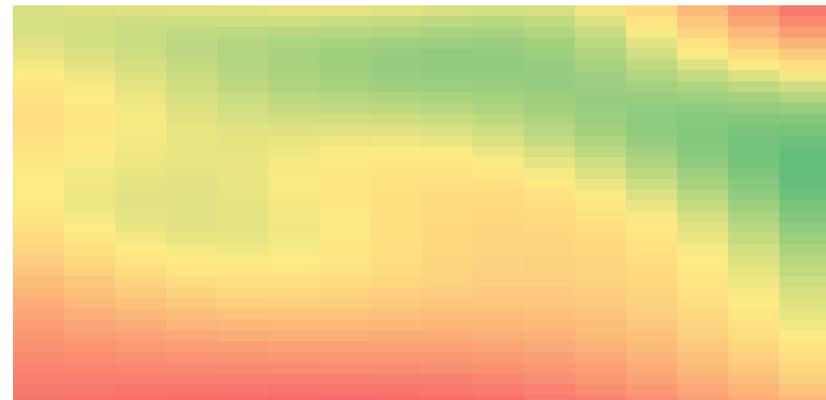
Female MP MI Rates



Male Data MI Rates



Male MP MI Rates

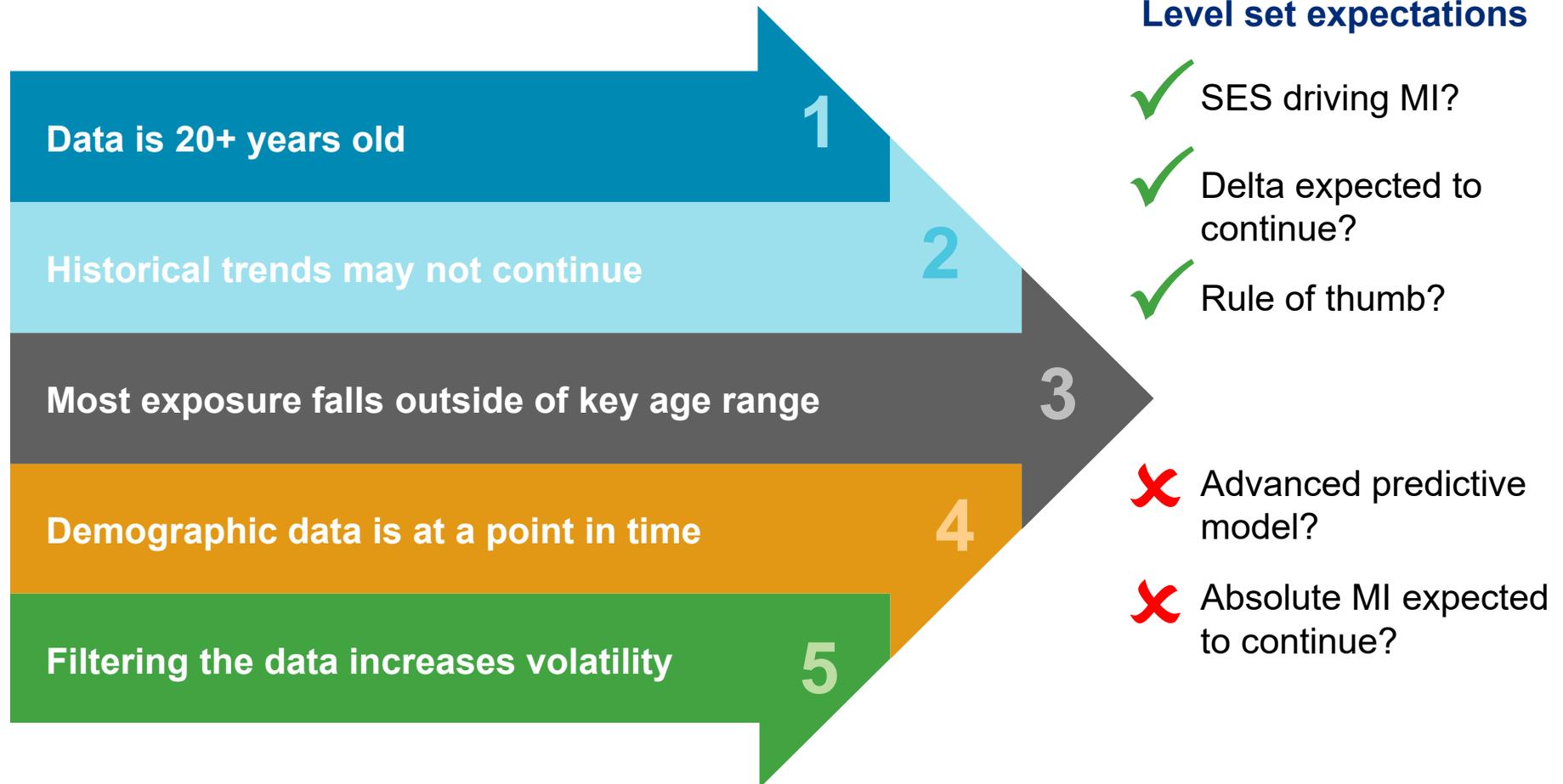




# 3 | Results



# What can the data actually tell us?



Absolute levels of future mortality improvement may vary, but evidence shows a delta between socioeconomic groups that we can reasonably expect to persist



# Summary of results

## A 'rule of thumb' approach shows deltas without getting lost in the weeds

### Mortality improvement from 1987-1998, ages 60-80



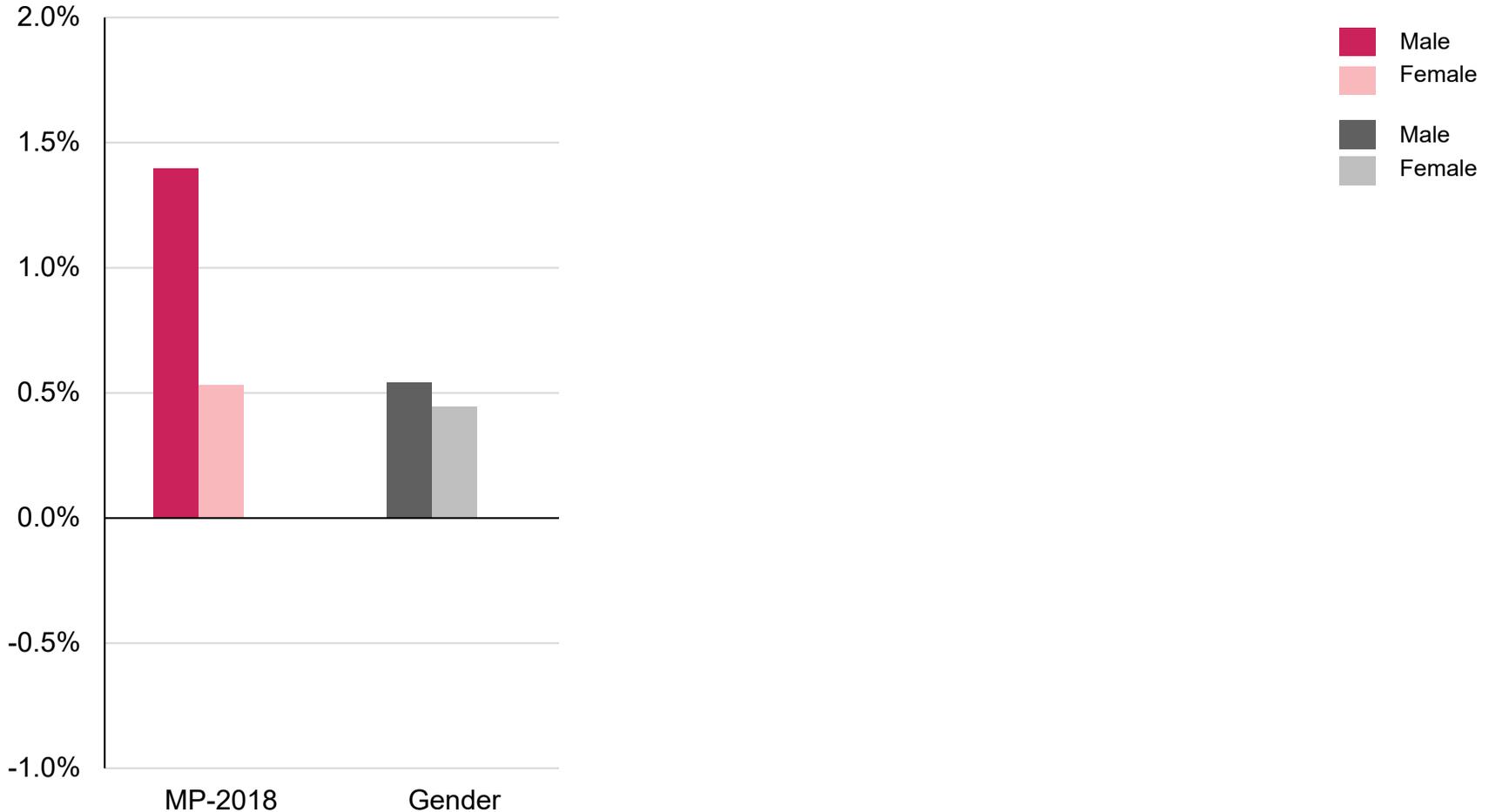
\* Note: Rates shown above are the geometric average of year over year improvement rates from 1987-1998, updated since 2019 Reinsurance Seminar



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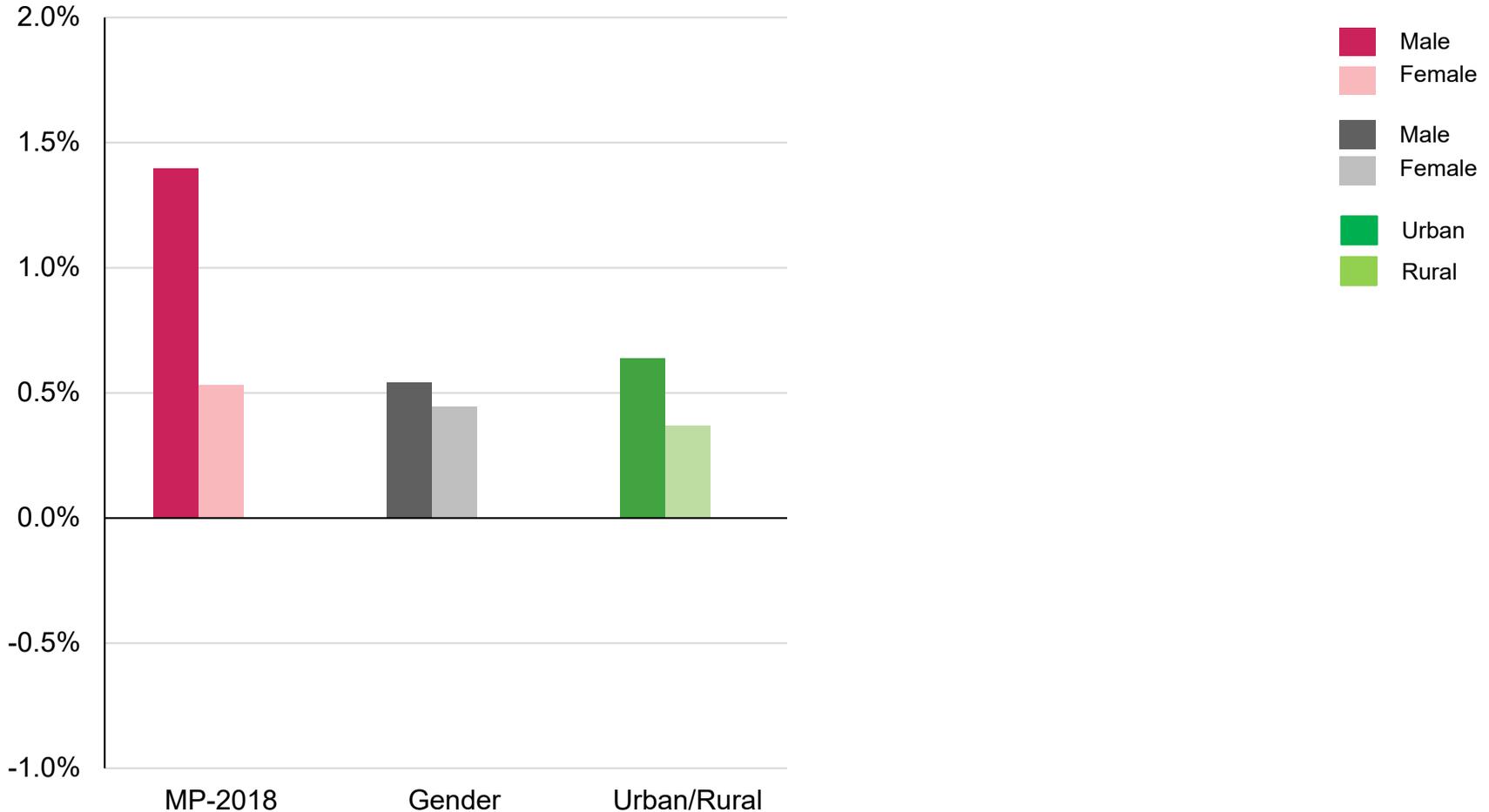
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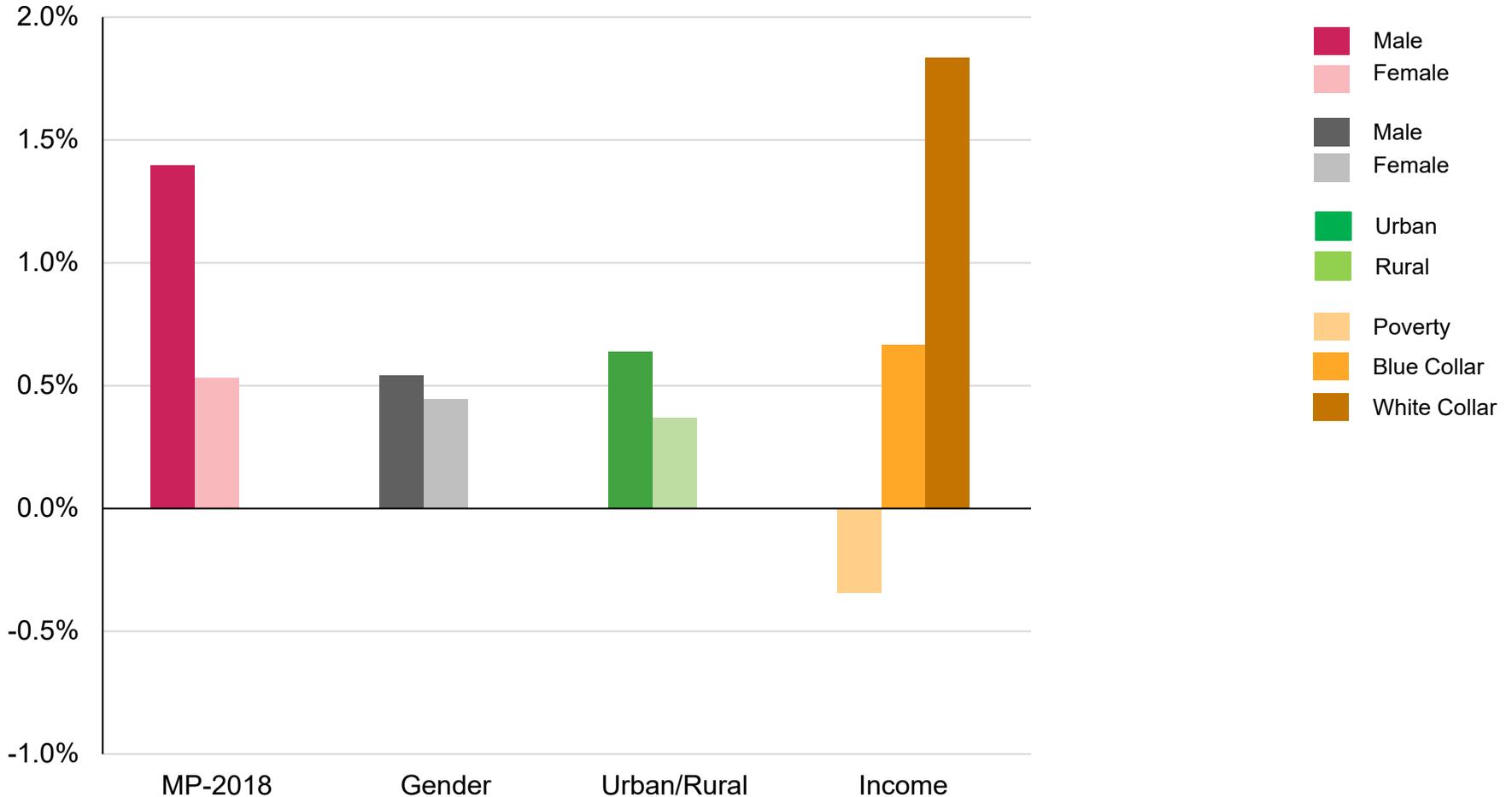
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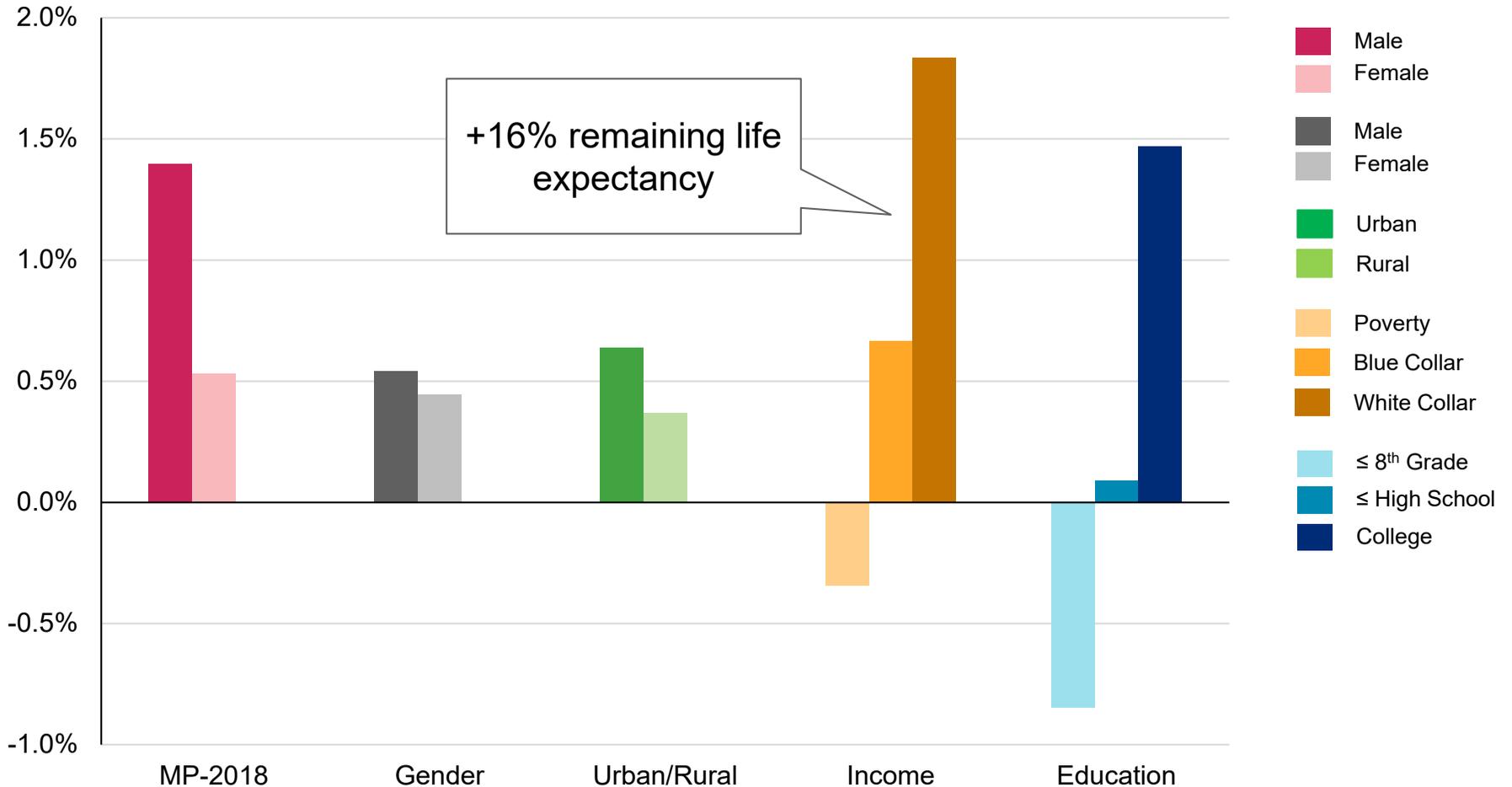
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## 4 | Next steps



## Next steps



### Support implementation

- Determine haircut or delta in a given context
- Overcome practical challenges of modeling structure



### Push for consistency

- Avoid spurious precision or unsupported granular assumptions
- Check for reasonability of differentiating MI set at the product level
- Address perception that MI is secondary with small impact



### Research

- Access more recent dataset
- Address basis risk (e.g. general population vs insured population)
- Layer on a cause of death analysis



Bonus | Annual meeting highlights

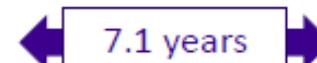


# Club Vita - Factor based modeling

## Men, life expectancy from age 65 based on socioeconomic “factor modeling”<sup>1</sup>

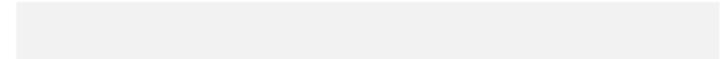


**Total Spread**



Retirement health

2½ - 3 years



“Normal” health annuitants



Lifestyle

c. 4¼ years

c. 2¾ years

c. 3¼ years

Affluence

c. 3½ years

c. 2 years

c. 3¼ years

Occupation

c. ¼ year

c. 1¼ year

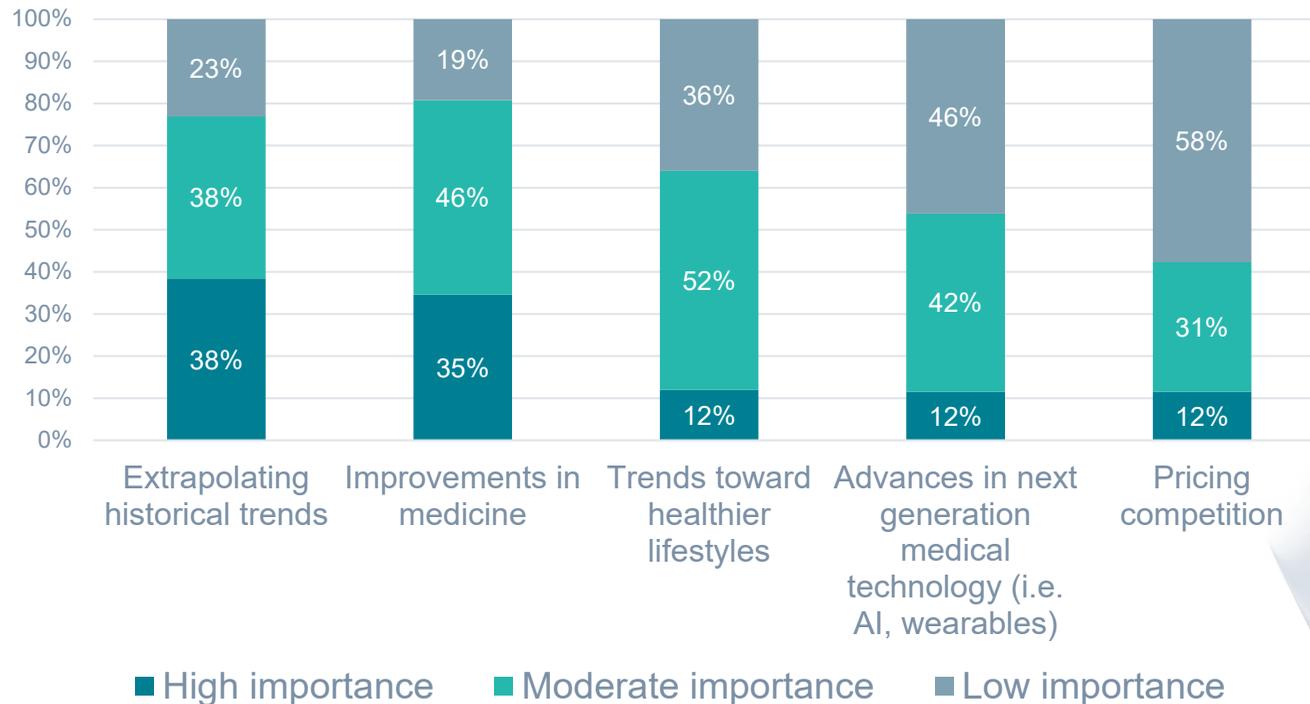
c. 1¼ year

Based on over 100 US pension plans, effects shown are the impacts of changing one rating factor in isolation.

1. Source: Steven Baxter at Club Vita – SOA Annual Meeting Session 113 – Mortality Gaps by Socioeconomic Status, October 29, 2019

# Munich Re US – Mortality Improvement Pulse Survey

*Q: Please rate the importance of the following justifications for using future MI assumptions.*



## Top Selections:

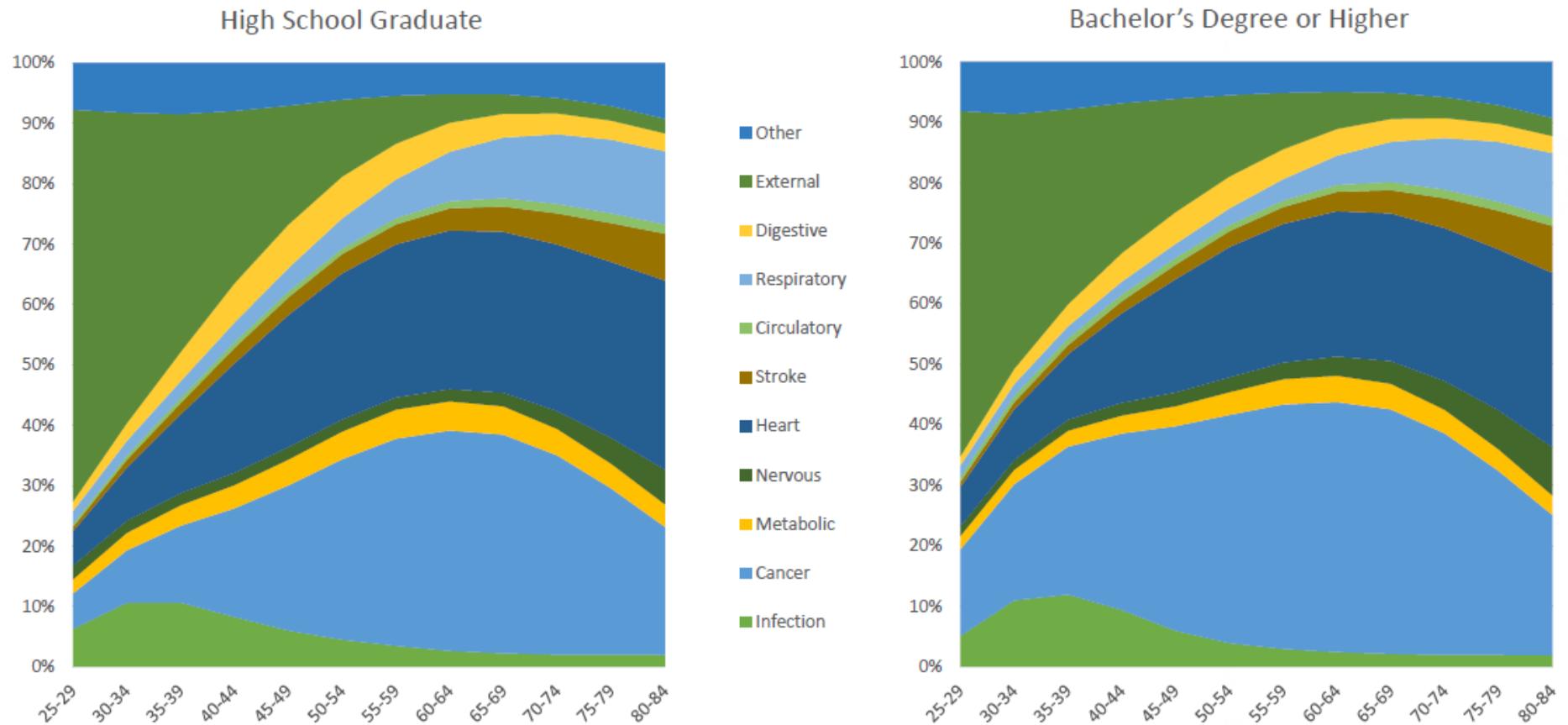
- Extrapolating historical trends
- Improvements in medicine
- Trends toward healthier lifestyle
- Advances in next generation technology
- Pricing competition

## Munich Re Mortality Improvement Pulse Survey

- Munich Re has acknowledged survey participants that survey results may be shared to help public study
- Only generic & high-level survey result is released to the public
- Survey participants get a detail report

# Relative Risk by Cause of Death

## Cause of Death Distributions

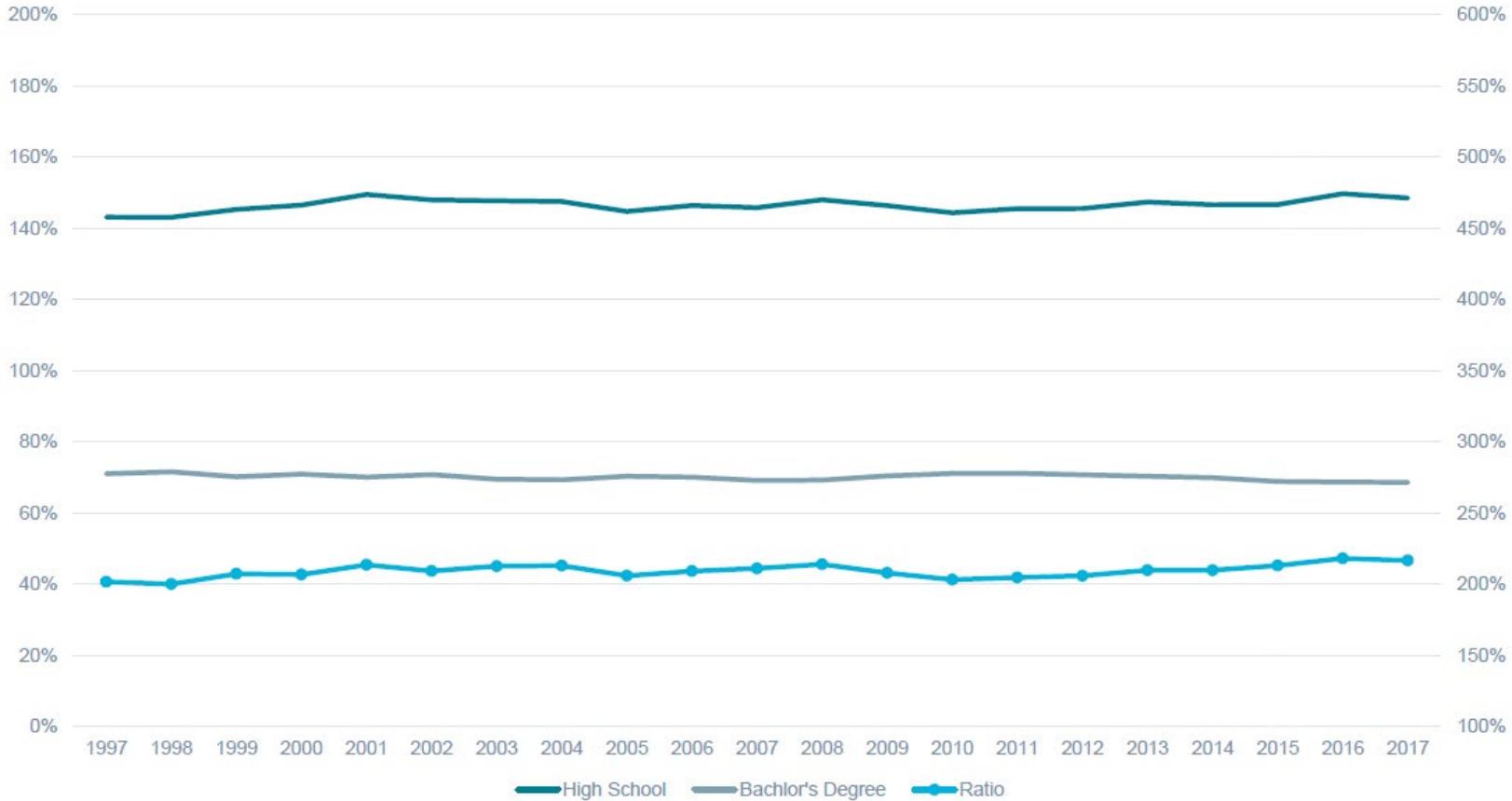


## Heart Disease



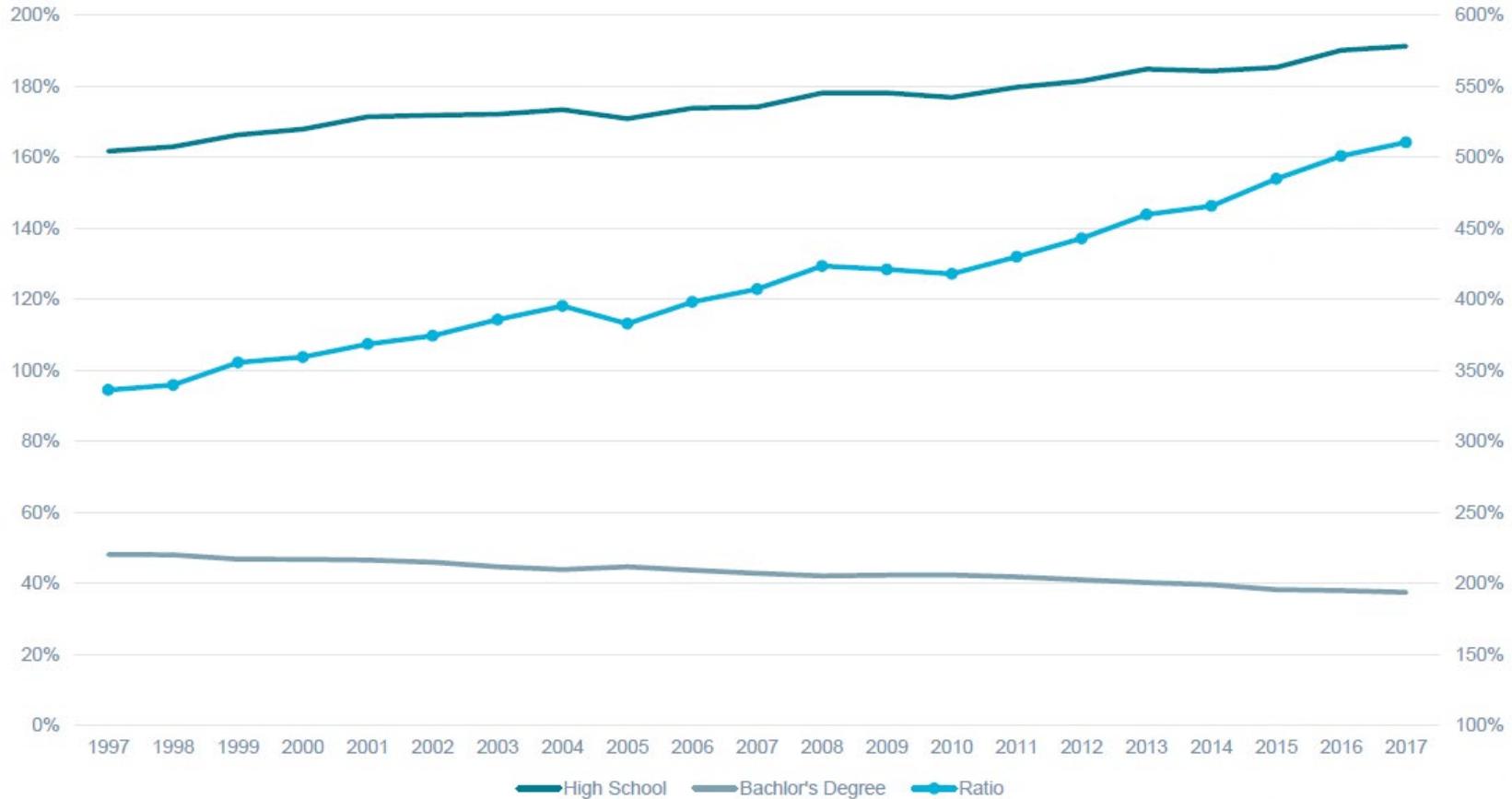
# Drivers of Socioeconomic Segmentation

## Cancer (Non-Lung)



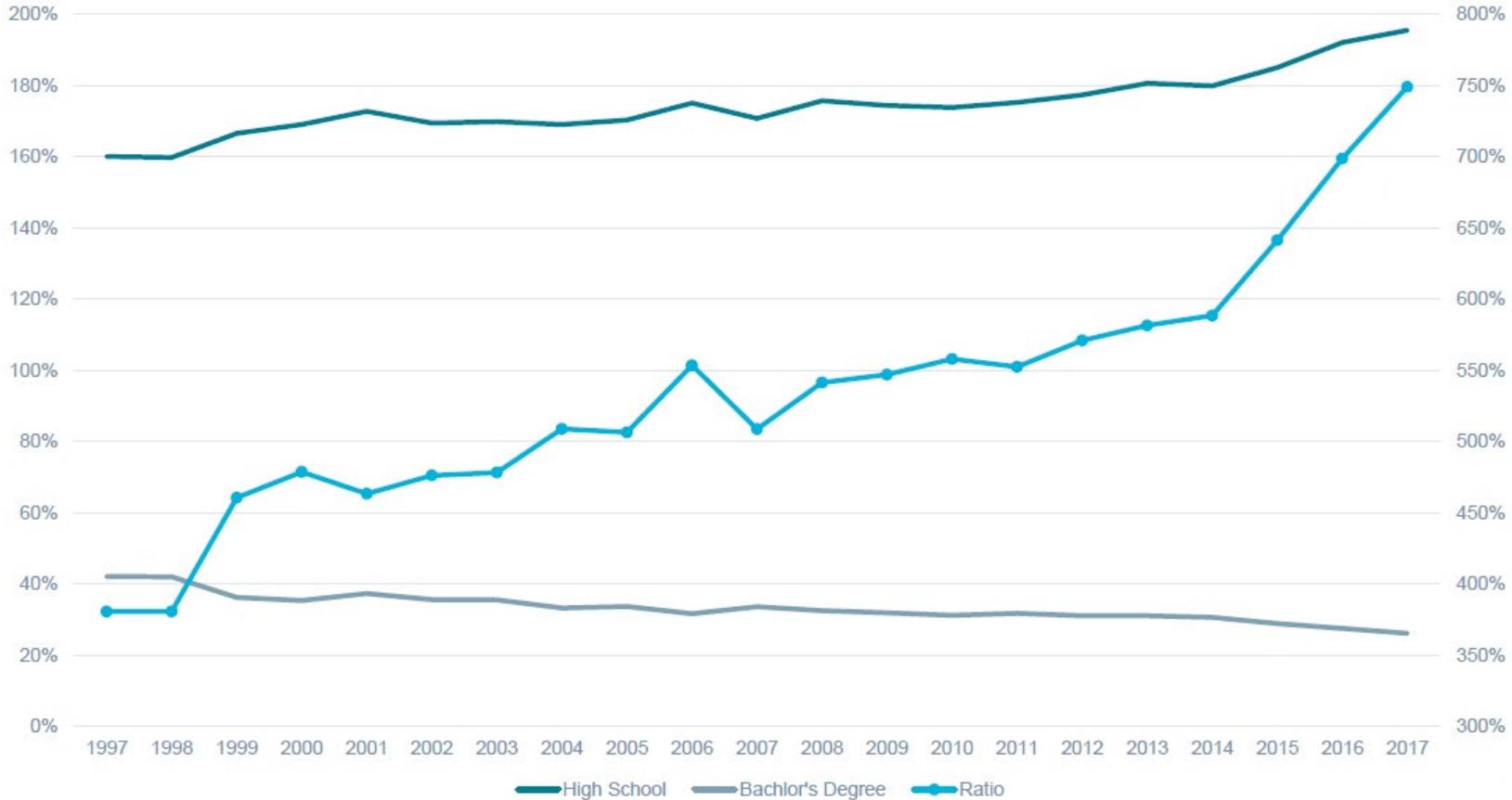
# Drivers of Socioeconomic Segmentation

## Smoking Related Conditions



# Drivers of Socioeconomic Segmentation

## Alcohol and Drug Related Conditions





# A short history of the overdose epidemic<sup>1</sup>

## Magali Barbieri and the Human Mortality Database

<b>Year</b>	<b>Milestone</b>
1996	Publication of an article on the low risk of addiction from medical prescription of opioid-based painkillers
1996-2000	The pharmaceutical industry develops aggressive campaigns to promote opioid-based painkillers (oxycodone, hydrocodone, meperidine, hydromorphone and propoxyphene)
2000	Government directive to reduce the prescription of opioid-based painkillers
2013	The black market is invaded by synthetic opioids (fentanyl, tramadol)
2017	Record-high number of deaths from drug overdoses (70,000)
2018	The monthly death count reached a peak in November and the increase appears to have stopped since then

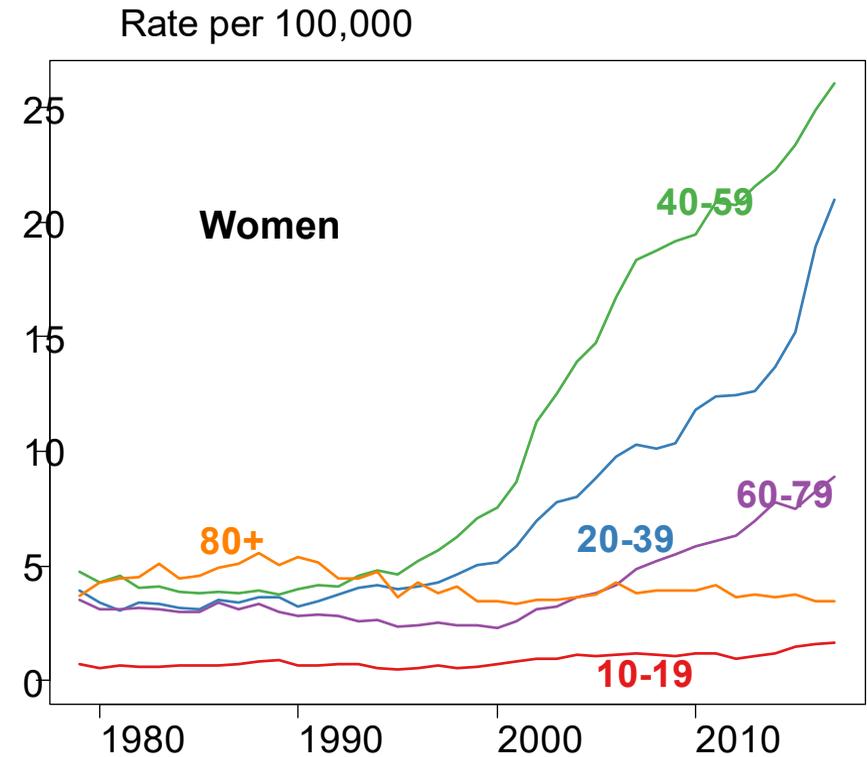
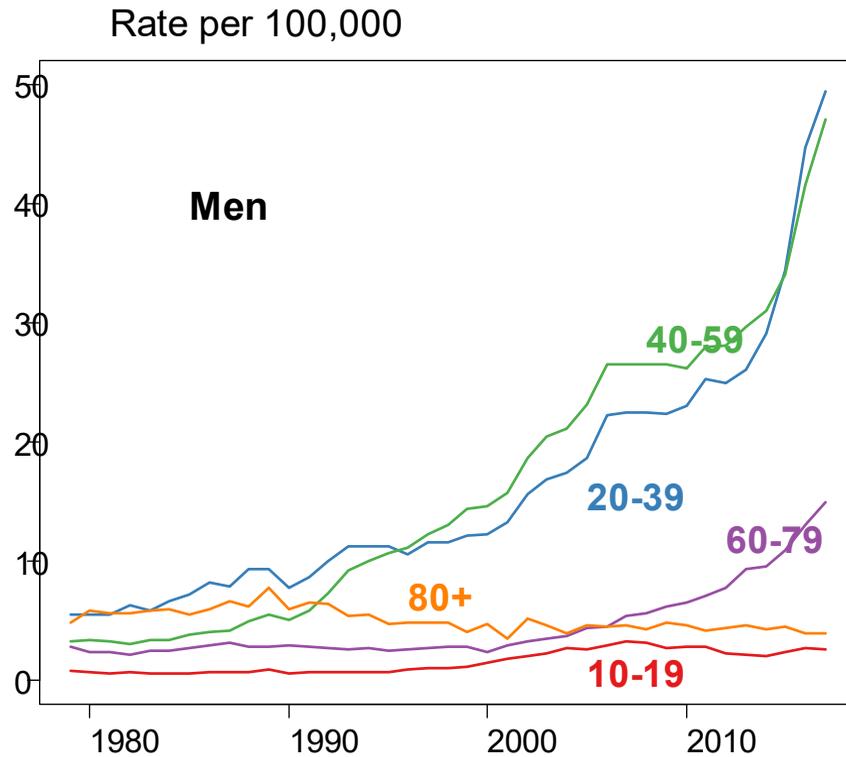
[www.mortality.org](http://www.mortality.org)

1. Source: Magali Barbieri, Associate Director, Human Mortality Database, University of California, Berkeley, and French Institute for Demographic Research – SOA Annual Meeting Session 171 – International perspectives on US mortality trends, October 30, 2019



# An exponential increase in mortality from drug overdoses since 1980<sup>1</sup>

## Magali Barbieri and the Human Mortality Database

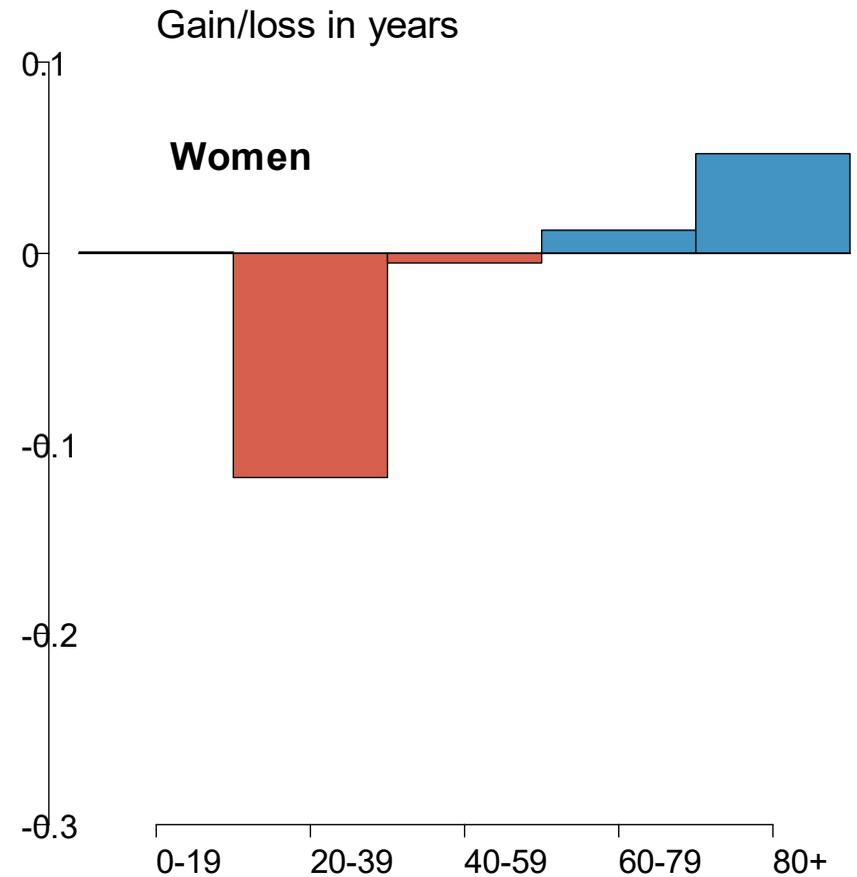
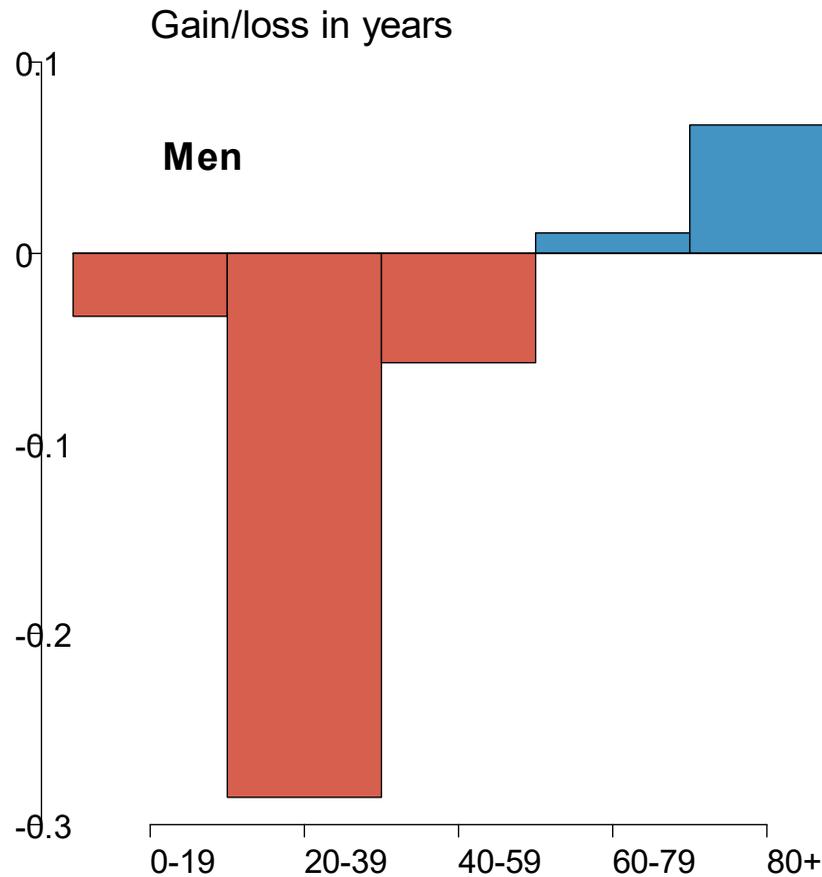


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# Contribution of age groups to the decline in life expectancy in the US between 2014 and 2017: Ages 20-40 years most affected<sup>1</sup>

Magali Barbieri and the Human Mortality Database

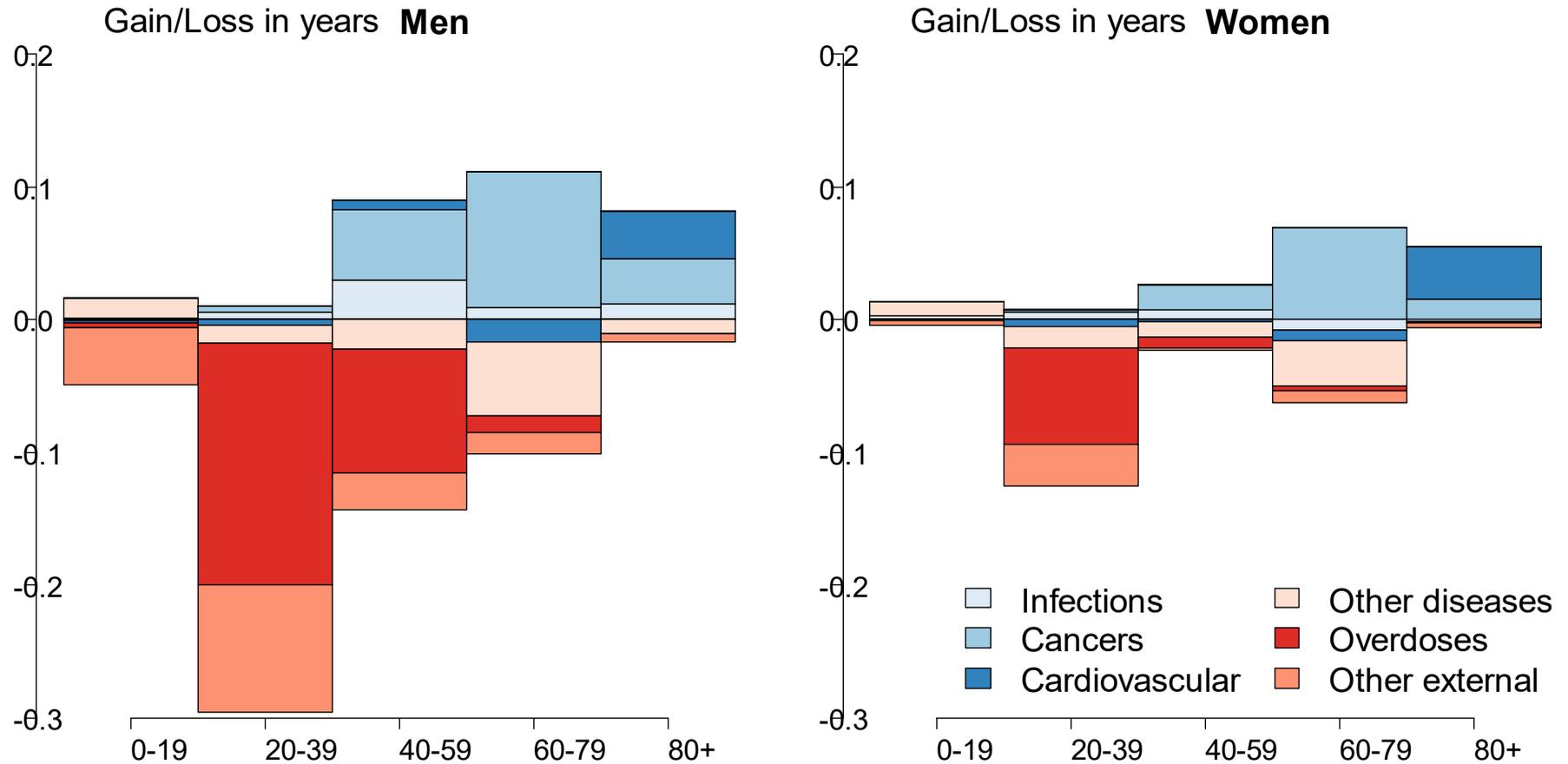


1. Source: Magali Barbieri, Associate Director, Human Mortality Database, University of California, Berkeley, and French Institute for Demographic Research – SOA Annual Meeting Session 171 – International perspectives on US mortality trends, October 30, 2019



# Major role of drug overdoses and, to a smaller extent, other external causes (suicide)<sup>1</sup>

Magali Barbieri and the Human Mortality Database



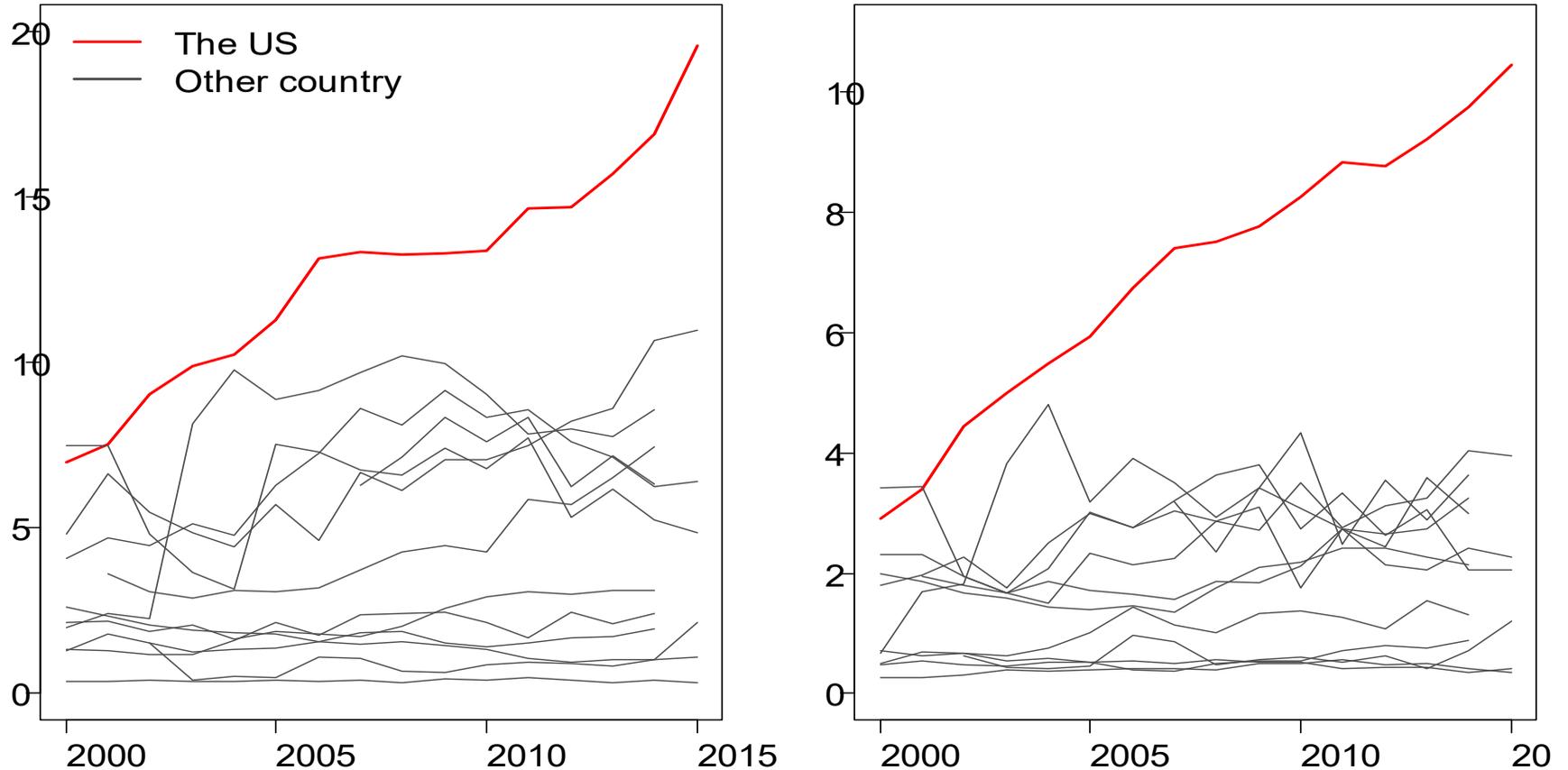
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# Drug-related age-standardized mortality rate in the US and 12 other high-income countries, 2000-2015<sup>1</sup>

Magali Barbieri and the Human Mortality Database

Age-standardized death rate p. 100,000



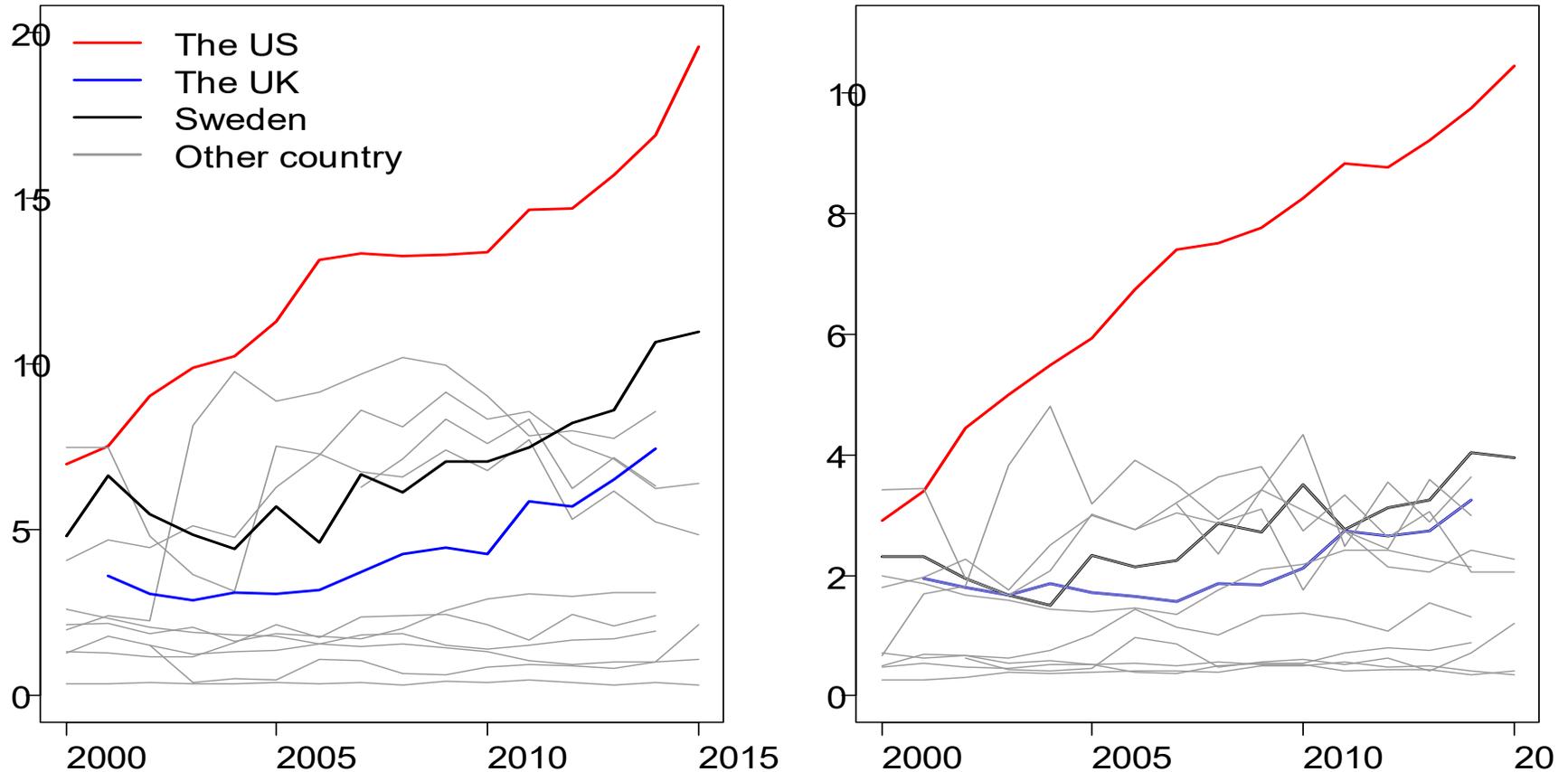
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