Session 107: Mortality Improvement Series Part 2: What is the Latest Research?

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Session 107

Mortality Improvement Series Part 2: What is the latest research?

October 2019 SOA Annual Meeting – Toronto

Jim Filmore, FSA, MAAA
Vice President
Munich Re Life US

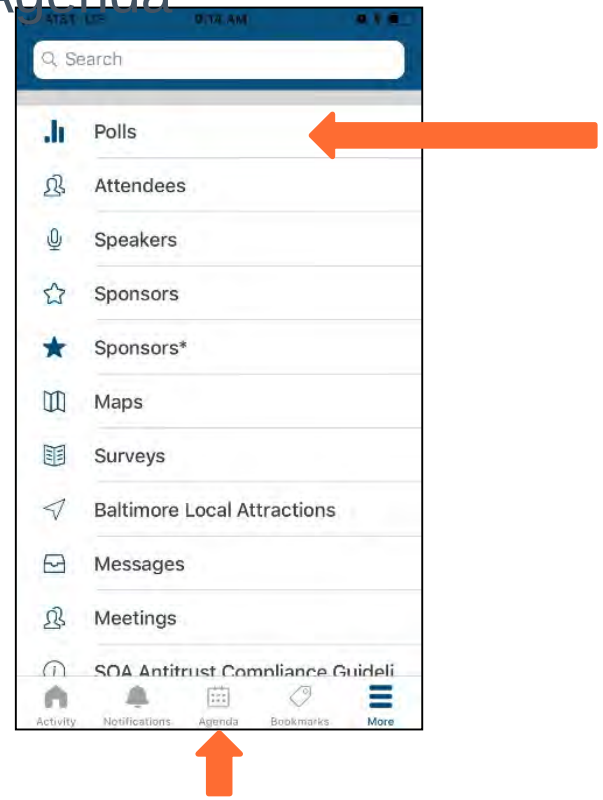
Agenda

1. Polling of Audience
2. Headlines in the News
3. Digging Deeper Into the Data
4. Your Product & Target Market
5. Predicting the Future
6. Questions?

Polling of Audience

To Participate, look for Polls in the SOA Event App or visit **annual.cnf.io** in your browser

Find The Polls Feature (including Social Q&A) Under **More** In The Event App or Under This Session in the Agenda



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Polling Question #1

1) For what insurance products are you most interested in mortality improvement trends?

   A. Individual Life
   B. Group Life
   C. Annuity/Longevity
   D. Disability
   E. Long-Term-Care
   F. Other

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Live Content Slide

When playing as a slideshow, this slide will display live content

Poll: For what insurance products are you most interested in mortality improvement trends?

Polling Question #2

2) What interest do you hear from actuaries today regarding mortality improvement trends as compared to how much you heard in the past?

A. More interest in mortality improvement trends currently
B. More interest in mortality improvement trends previously
C. Same level of interest

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Live Content Slide

When playing as a slideshow, this slide will display live content

Poll: What interest do you hear from actuaries today regarding mortality improvement trends as compared to how much you heard in the past?

Polling Question #3

3) Have you heard any questions or comments over the past year either within your company or on the news regarding changes in mortality trends in the United States?

A. Yes
B. No

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Live Content Slide

When playing as a slideshow, this slide will display live content

Poll: Have you heard any questions or comments over the past year either within your company or on the news regarding changes in mortality trends in the United States?

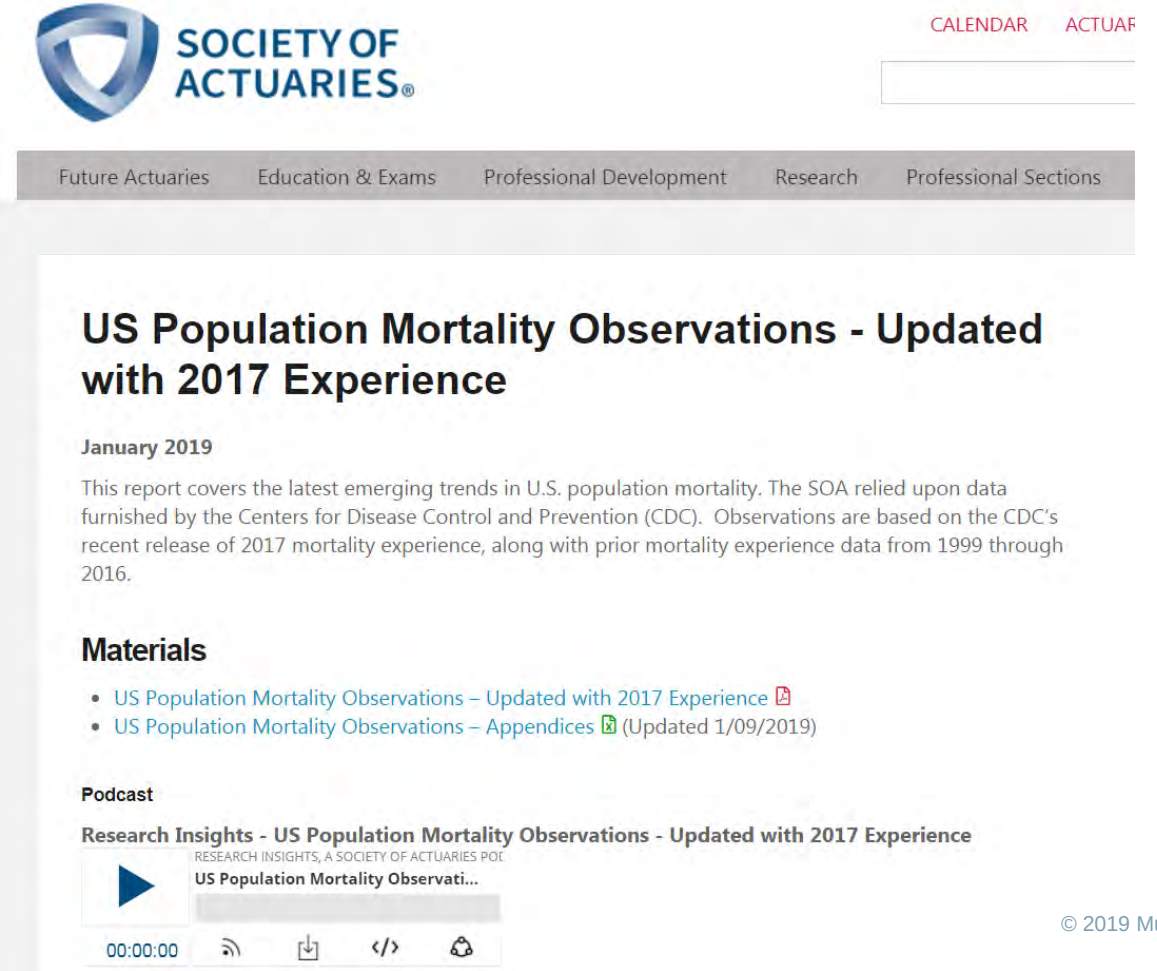
Headlines in the News

Headlines in the News

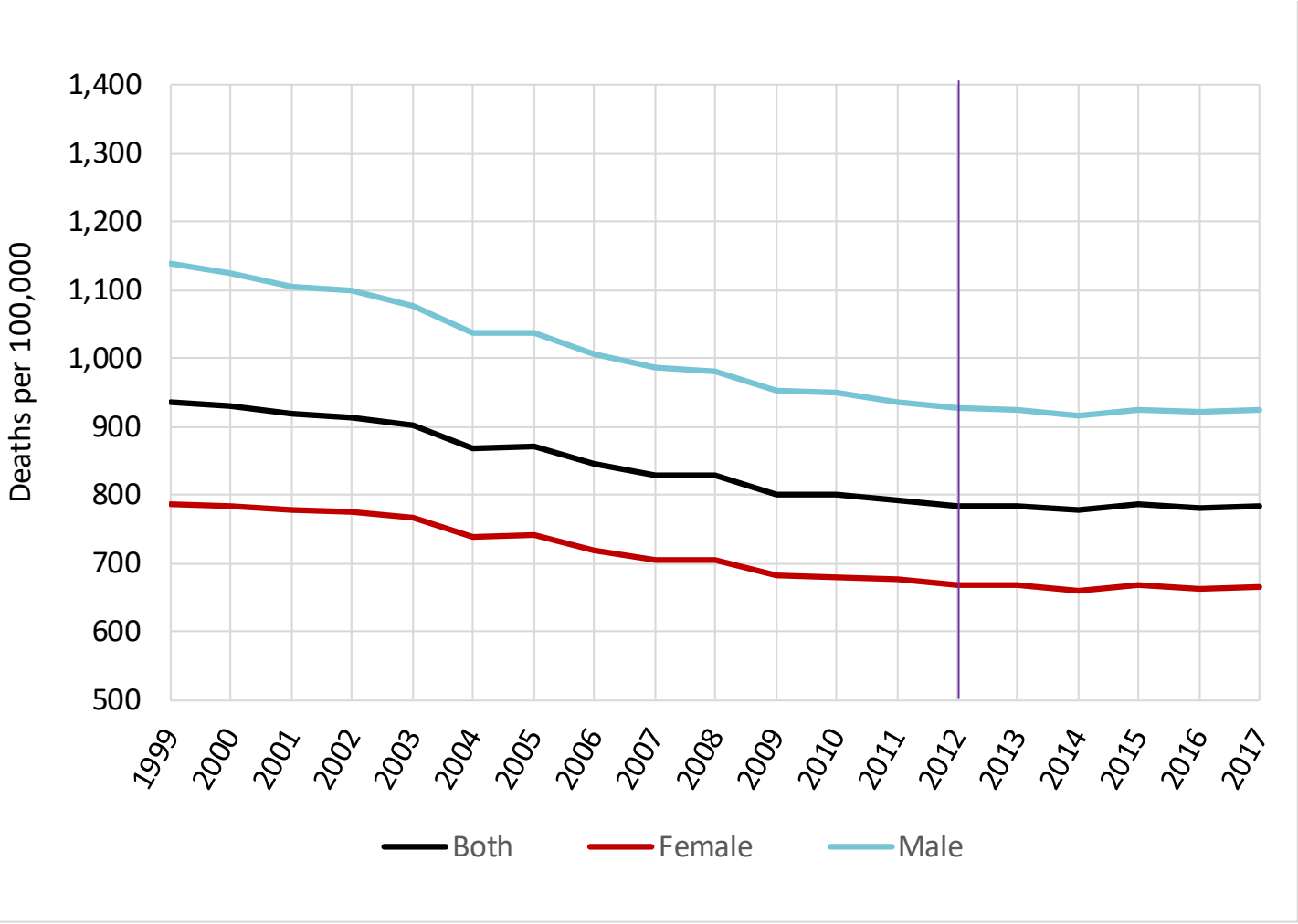
Digging Deeper Into the Data

Overall Population Trend from SOA Study

https://www.soa.org/resources/research-reports/2018/population-mortality-observations/



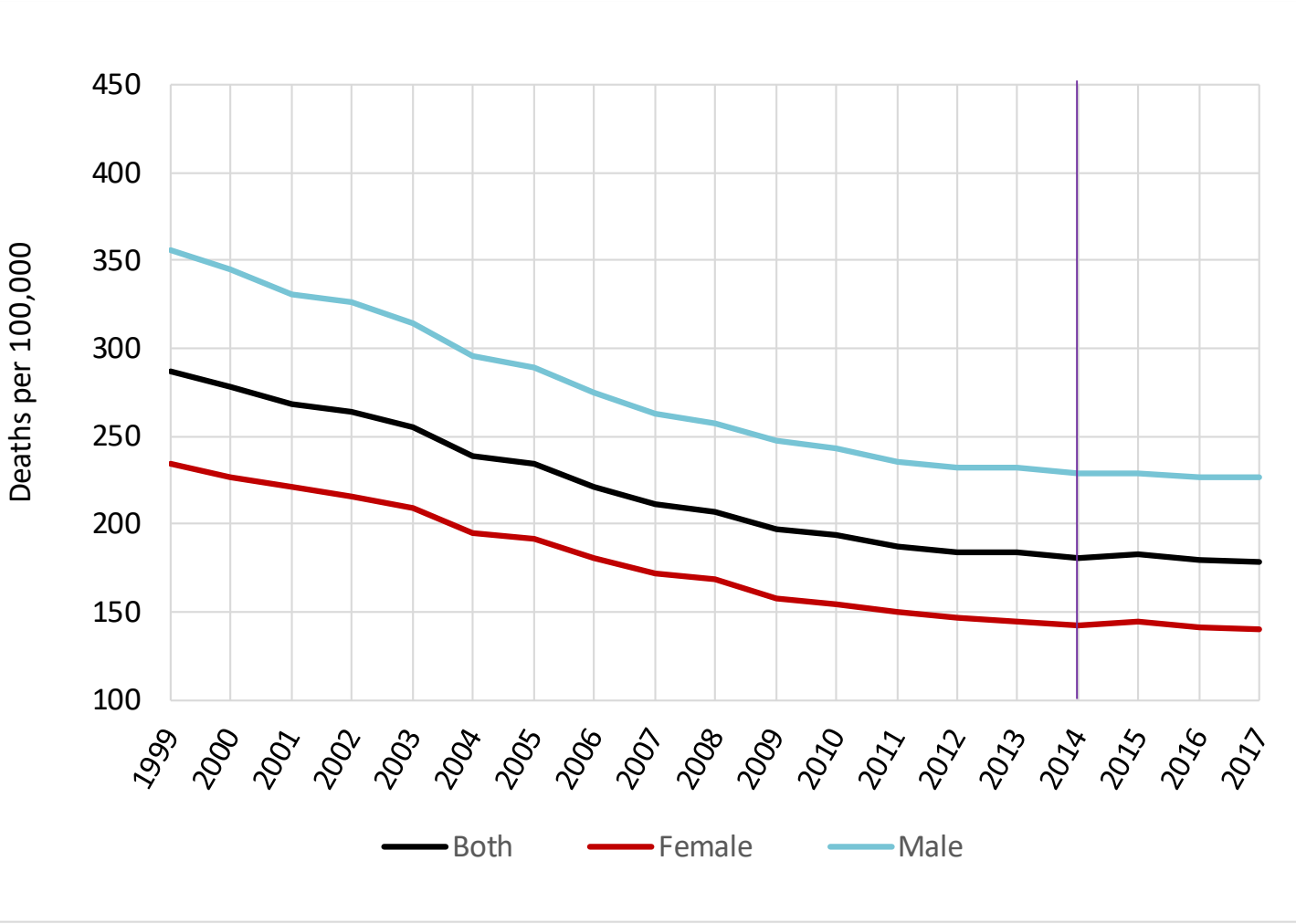
Overall Population Trend from SOA Study



All Ages	Annual Improvement 1999-2017	2012-2017	2016-2017
Both	1.0%	0.0%	-0.4%
Female	0.9%	0.1%	-0.4%
Male	1.1%	0.0%	-0.4%
Age Group*			
< 1	1.4%	1.1%	2.8%
1 - 4	1.9%	1.6%	4.3%
5 - 14	1.7%	-1.4%	-1.2%
15 - 24	0.4%	-2.2%	1.1%
25 - 34	-1.5%	-4.7%	-3.0%
35 - 44	0.1%	-2.7%	-1.6%
45 - 54	0.2%	0.2%	1.0%
55 - 64	0.7%	-0.7%	-0.2%
65 - 74	1.7%	0.1%	-0.1%
75 - 84	1.4%	0.9%	0.0%
85+	0.8%	0.2%	-1.4%

*includes both genders

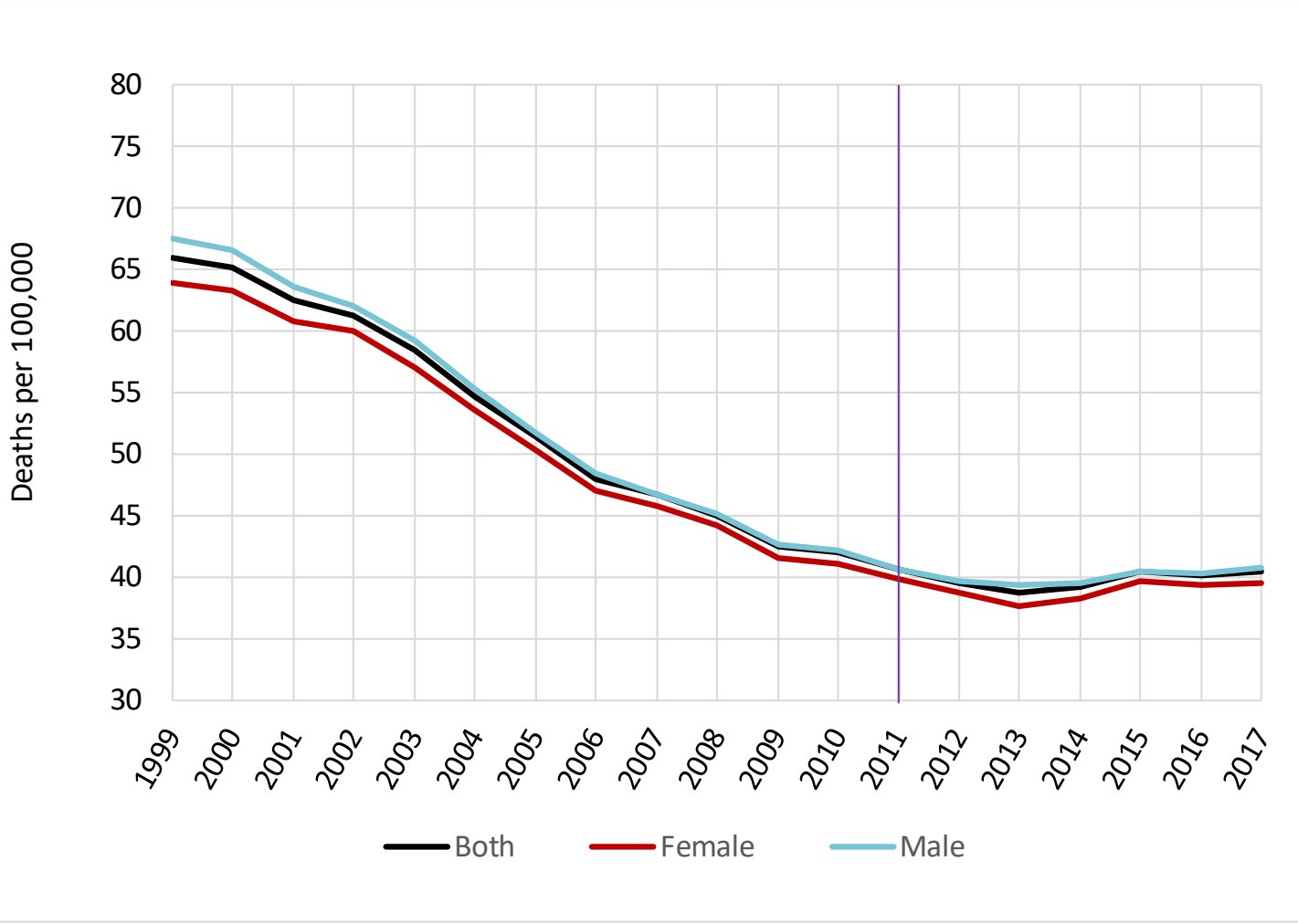
Heart Disease Population Trend from SOA Study



All Ages	Annual Improvement 1999-2017	2012-2017	2016-2017
Both	2.6%	0.6%	0.2%
Female	2.8%	0.8%	0.5%
Male	2.5%	0.5%	0.0%
Age Group*			
< 1	3.2%	1.9%	-4.2%
1 - 4	2.2%	3.7%	-7.3%
5 - 14	2.4%	-0.5%	4.9%
15 - 24	1.5%	0.6%	3.2%
25 - 34	-0.3%	-1.2%	-5.3%
35 - 44	0.9%	0.3%	1.7%
45 - 54	1.2%	0.7%	3.1%
55 - 64	1.9%	-0.7%	-0.6%
65 - 74	3.2%	-0.2%	-0.1%
75 - 84	3.2%	1.4%	0.8%
85+	2.4%	0.8%	-0.2%

*includes both genders

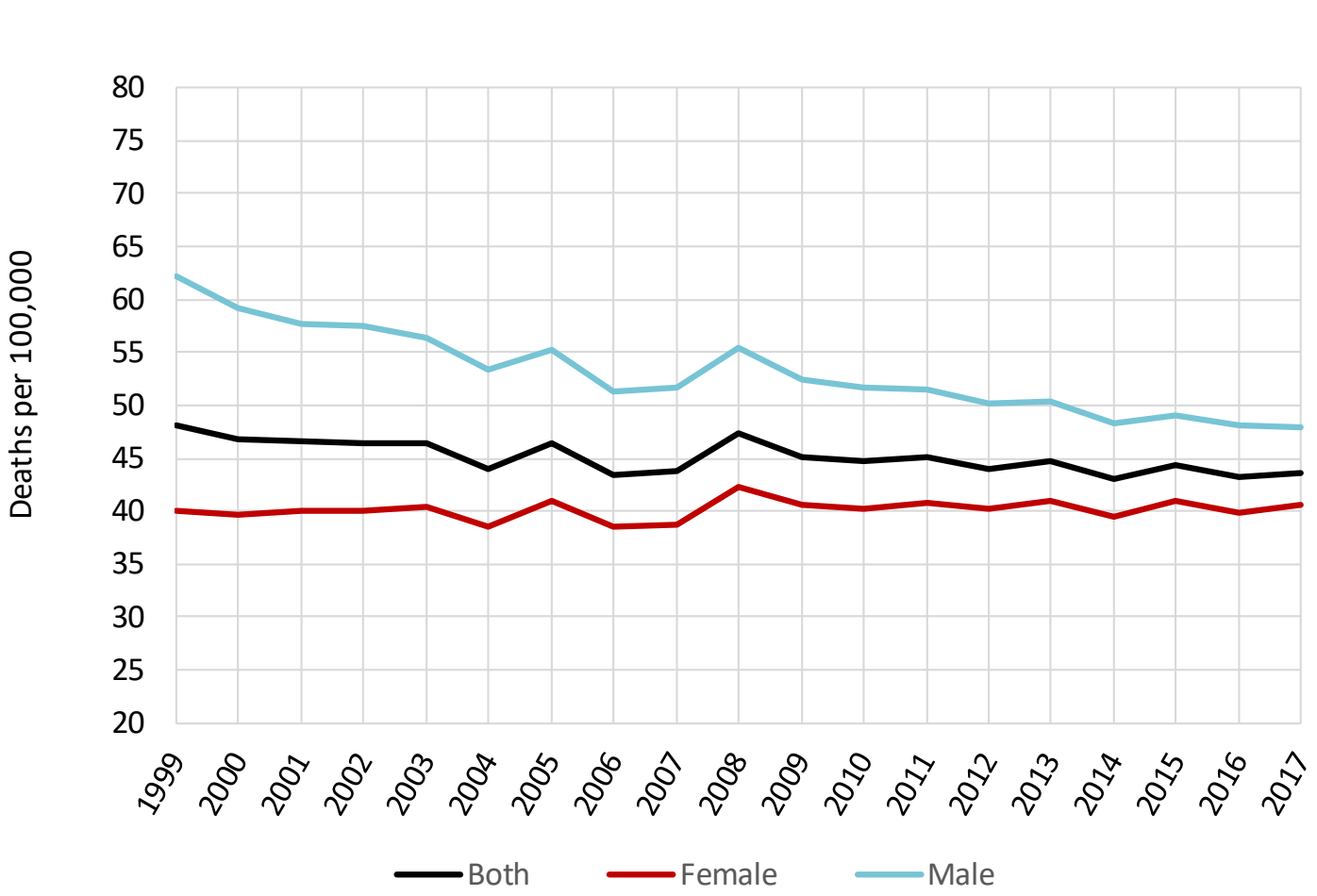
Stroke Population Trend from SOA Study



All Ages	Annual Improvement 1999-2017	2012-2017	2016-2017
Both	2.7%	-0.5%	-0.8%
Female	2.7%	-0.4%	-0.4%
Male	2.8%	-0.5%	-1.4%
Age Group*			
< 1	0.4%	0.4%	18.7%
1 - 4	-1.8%	-3.4%	-19.7%
5 - 14	-2.2%	-2.7%	-10.1%
15 - 24	1.5%	3.0%	-5.4%
25 - 34	0.5%	-0.7%	-1.6%
35 - 44	1.4%	-0.7%	3.1%
45 - 54	1.2%	0.8%	2.0%
55 - 64	1.6%	-1.1%	-1.9%
65 - 74	2.9%	-0.2%	-0.5%
75 - 84	3.2%	0.7%	0.9%
85+	2.7%	-1.3%	-2.1%

*includes both genders

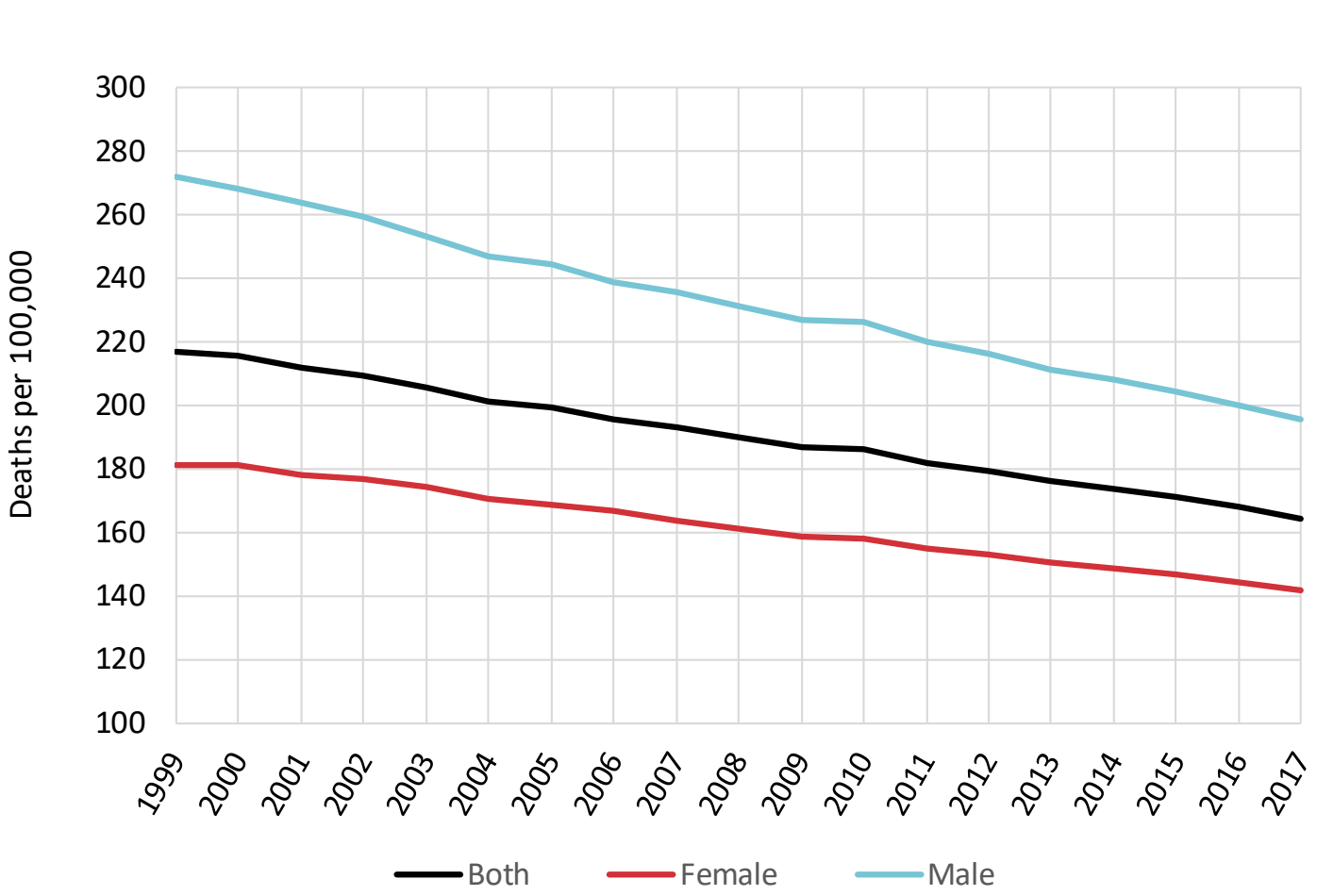
Pulmonary Population Trend from SOA Study



All Ages	Annual Improvement 1999-2017	2012-2017	2016-2017
Both	0.5%	0.2%	-1.0%
Female	-0.1%	-0.3%	-2.1%
Male	1.4%	0.9%	0.1%
Age Group*			
< 1	5.3%	6.9%	49.6%
1 - 4	3.3%	9.4%	39.4%
5 - 14	0.2%	-2.4%	6.4%
15 - 24	1.2%	-6.0%	8.2%
25 - 34	0.6%	-1.4%	7.3%
35 - 44	0.7%	1.0%	-2.0%
45 - 54	-0.5%	1.7%	6.8%
55 - 64	0.4%	-2.4%	-3.5%
65 - 74	1.6%	0.9%	0.3%
75 - 84	0.7%	0.9%	-0.1%
85+	-0.5%	-0.4%	-3.5%

*includes both genders

Cancer Population Trend from SOA Study



All Ages	Annual Improvement 1999-2017	2012-2017	2016-2017
Both	1.5%	1.7%	2.1%
Female	1.4%	1.5%	1.9%
Male	1.8%	2.0%	2.4%
Age Group*			
< 1	1.2%	2.0%	14.3%
1 - 4	1.6%	3.6%	14.0%
5 - 14	1.0%	1.3%	2.9%
15 - 24	1.9%	2.4%	3.4%
25 - 34	1.2%	1.7%	6.0%
35 - 44	1.8%	1.0%	1.0%
45 - 54	1.8%	3.1%	4.0%
55 - 64	1.7%	1.4%	2.6%
65 - 74	2.1%	2.1%	1.9%
75 - 84	1.3%	1.8%	2.0%
85+	0.7%	0.7%	1.2%

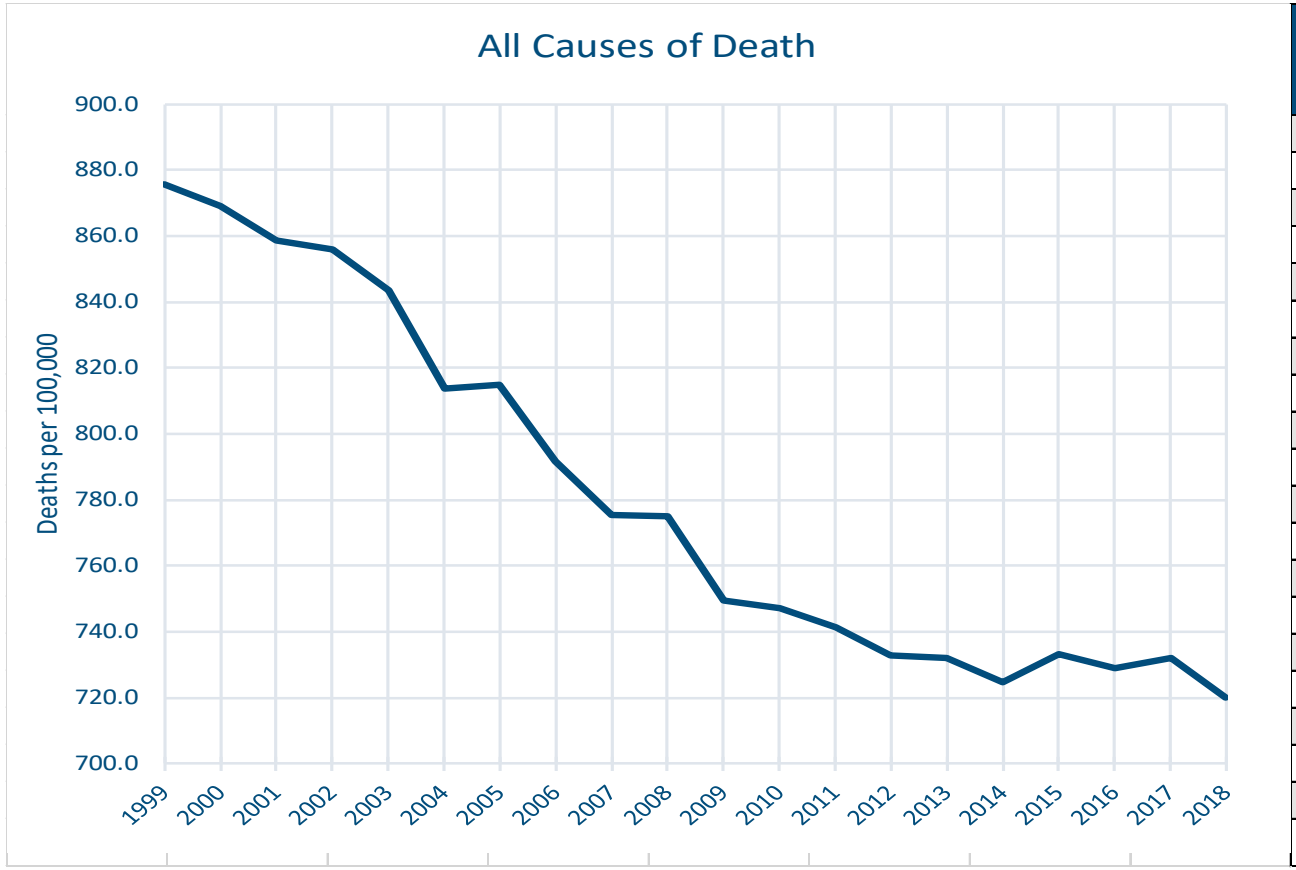
*includes both genders

1-year trend by Cause of Death from SOA Study

2017 U.S. Population Mortality by COD		
Cause of Death	%	Age-Adjusted One Year Trend
Heart Disease	23.00%	0.20%
Cancer	21.30%	2.10%
Alzheimer's/Dementia	8.50%	-1.30%
Accidents	6.00%	-4.10%
Pulmonary	5.70%	-1.00%
Stroke	5.20%	-0.80%
Diabetes	3.00%	-2.10%
Suicide	1.70%	-3.90%
Liver	1.50%	-1.40%
Assault	0.70%	-0.20%
Other	23.40%	-1.50%
All COD	**100%**	**-0.40%**

- A negative MI here means that mortality increased over the year!

Hot off the press…2018 U.S. Population Mortality



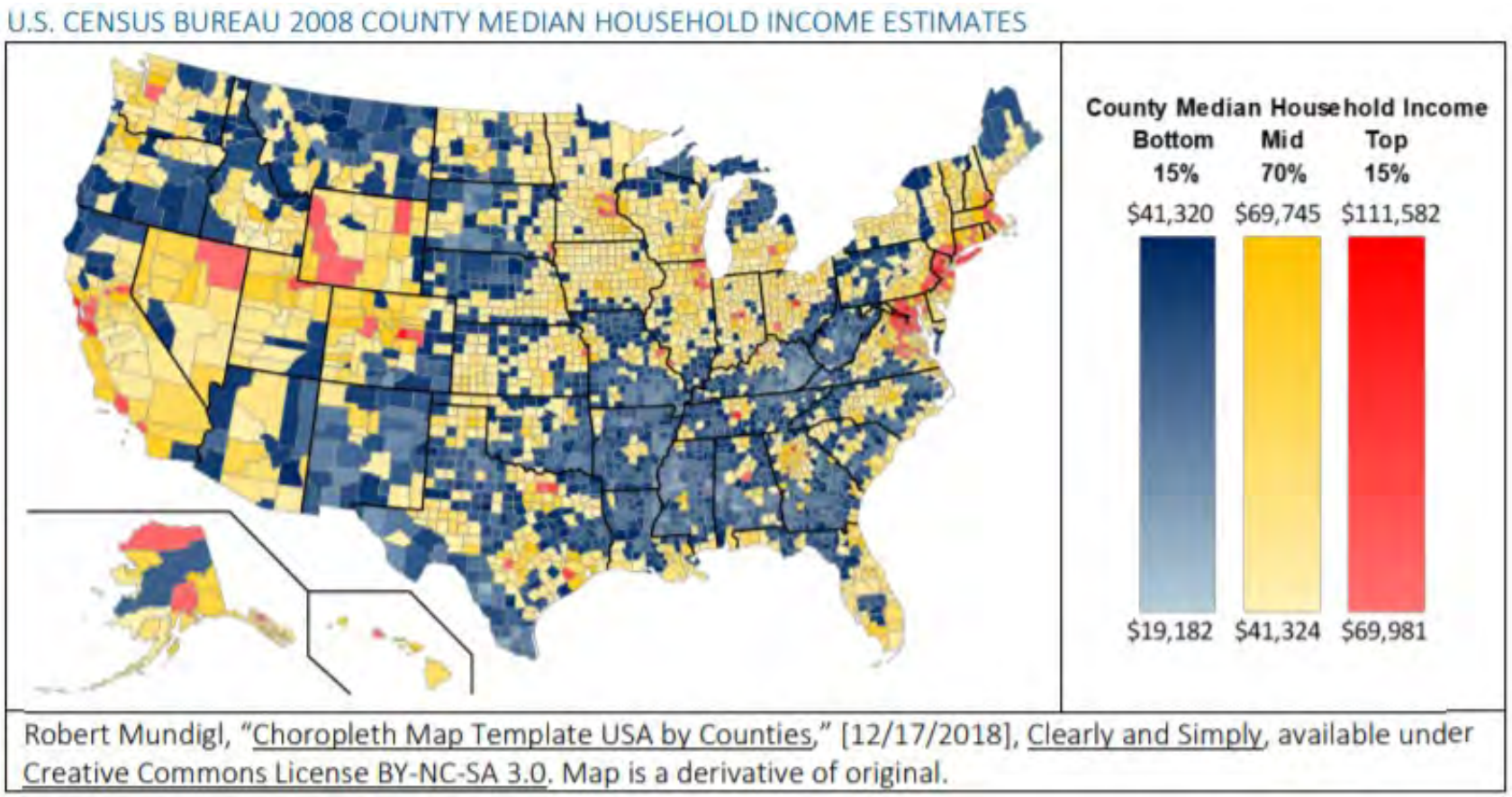
Year	Deaths per 100,000	Year over Year % Change
1999	875.6	n/a
2000	869.0	-0.8%
2001	858.8	-1.2%
2002	855.9	-0.3%
2003	843.5	-1.4%
2004	813.7	-3.5%
2005	815.0	0.2%
2006	791.8	-2.8%
2007	775.3	-2.1%
2008	774.9	-0.1%
2009	749.6	-3.3%
2010	747.0	-0.3%
2011	741.3	-0.8%
2012	732.8	-1.1%
2013	731.9	-0.1%
2014	724.6	-1.0%
2015	733.1	1.2%
2016	728.8	-0.6%
2017	731.9	0.4%
2018	**720.2**	**-1.6%**

- In 2018, the U.S. Population returned to improving mortality.
- On this slide, a negative change in mortality is a positive mortality improvement.

Mortality Level: Socio-economic impact

County level income

The SOA study used county level median household income

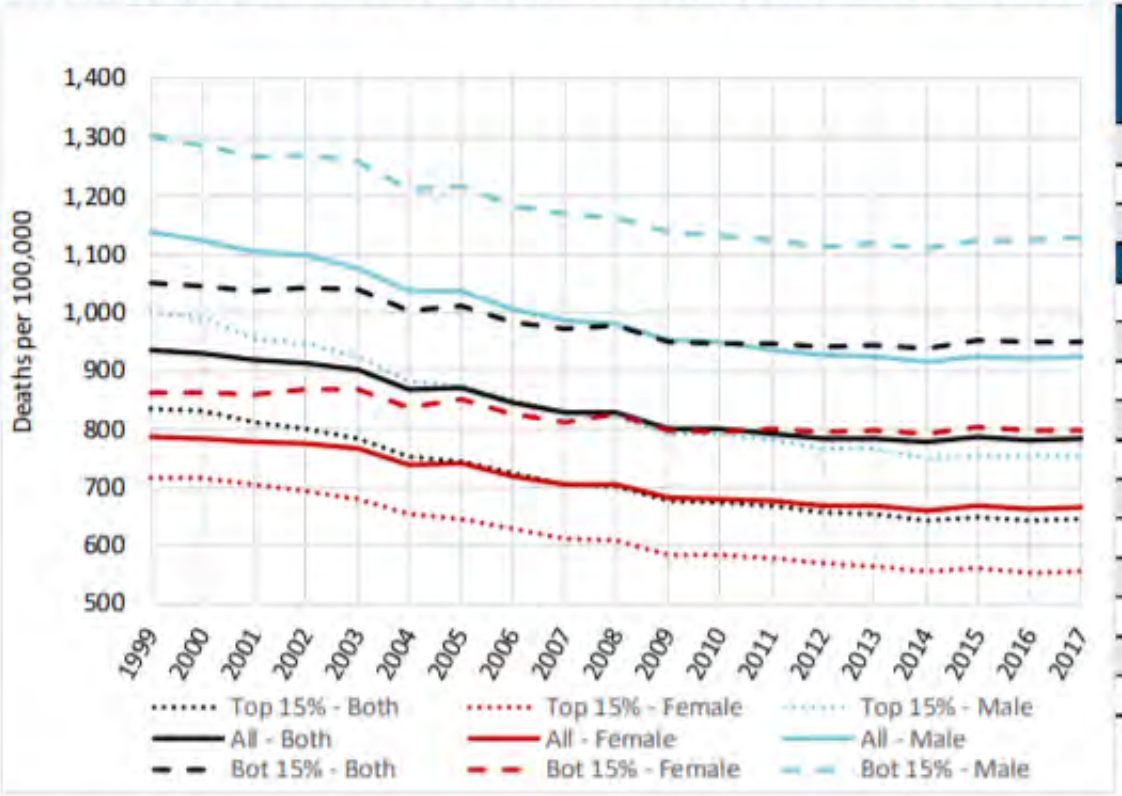


County level income – mortality improvement

The SOA study used county level median household income

4.2 Income Analysis

AGE-ADJUSTED MORTALITY 1999-2017 – TOP 15%, BOTTOM 15% VS. ALL COUNTIES – ALL CAUSES OF DEATH



Annual Improvement 1999-2017			
All Ages	Bot 15%	All	Top 15%
Both	0.6%	1.0%	1.4%
Female	0.4%	0.9%	1.4%
Male	0.8%	1.1%	1.6%
Age Group*			
< 1	1.4%	1.4%	1.8%
1 - 4	1.2%	1.9%	2.3%
5 - 14	1.7%	1.7%	1.8%
15 - 24	0.8%	0.4%	0.1%
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85+	0.8%	0.8%	0.8%

*includes both genders

Your Product & Target Market

Your Product and Target Market

- Does one high-level Mortality Improvement assumption work?
- What about the demographics of your business?
  - Mix of business by age?
  - Mix of business by gender?
  - Mix of business by income?
  - Mix of business by education level?
- What are the drivers for historical mortality improvement for your target market?
- Do you anticipate that those MI drivers will continue?
- What is the impact of improvements or slowdown in mortality trend by certain causes of death?

Predicting the Future

Predicting the Future: SOA MI “By Cause” Research

- “All Cause” Mortality Improvement vs “By Cause” Mortality Improvement models
  - The SOA is currently conducting research on this topic.
  - I’m Chairperson of that Project Oversight Group (POG) and we anticipate that a report will be published soon.
- The report will help you to better understand the historical drivers of mortality improvement by cause.
- The tool will help you to better understand the impact of changes in mortality trend by cause and their impact on future mortality improvement (or dis-improvement) rates.

Predicting the Future: SOA MI “By Cause” Research

- The tool will help you to better understand the impact of changes in mortality trend by cause and their impact on future mortality improvement (or dis-improvement) rates.
  - Will the historical sources of MI continue? If so, then for how long and at what rate?
  - Will the opioid crisis continue or accelerate?
  - What is the impact of break-points in MI trend by cause of death?
  - Does your product rely upon short-term MI predictions or long-term ones?

Predicting the Future: Cause of Death (COD) Data

- Human Cause of Death Database (HCD)
  "The main goal of the Human Cause-of-Death Database (HCD) is to provide access to detailed high-quality data on cause-specific mortality to a broad audience of users. In contrast to other existing databases on causes of death, the HCD provides time series with constant classification of causes."

- Available data:
  - Full list: many COD's [use of various **ICD** codes varies by country]
  - Intermediate list: 104 COD's [same for all countries]
  - Short list: 16 COD's [same for all countries]

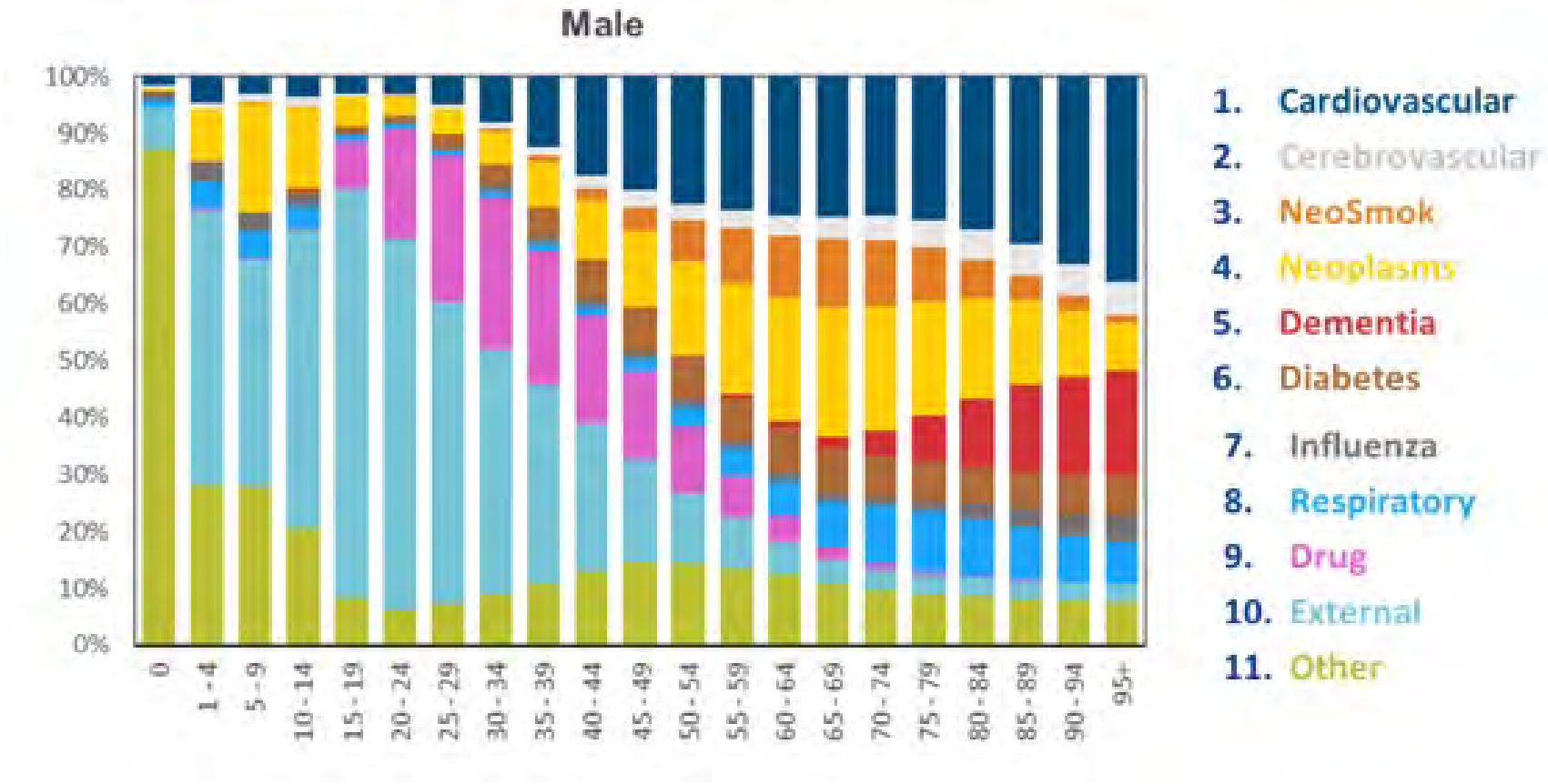
- **ICD-10** is the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD). It is a medical classification list by the World Health Organization (WHO). It contains codes for diseases, signs and symptoms, abnormal findings, complaints, social circumstances, and external causes of injury or diseases..

Predicting the Future: Grouping Causes of Death

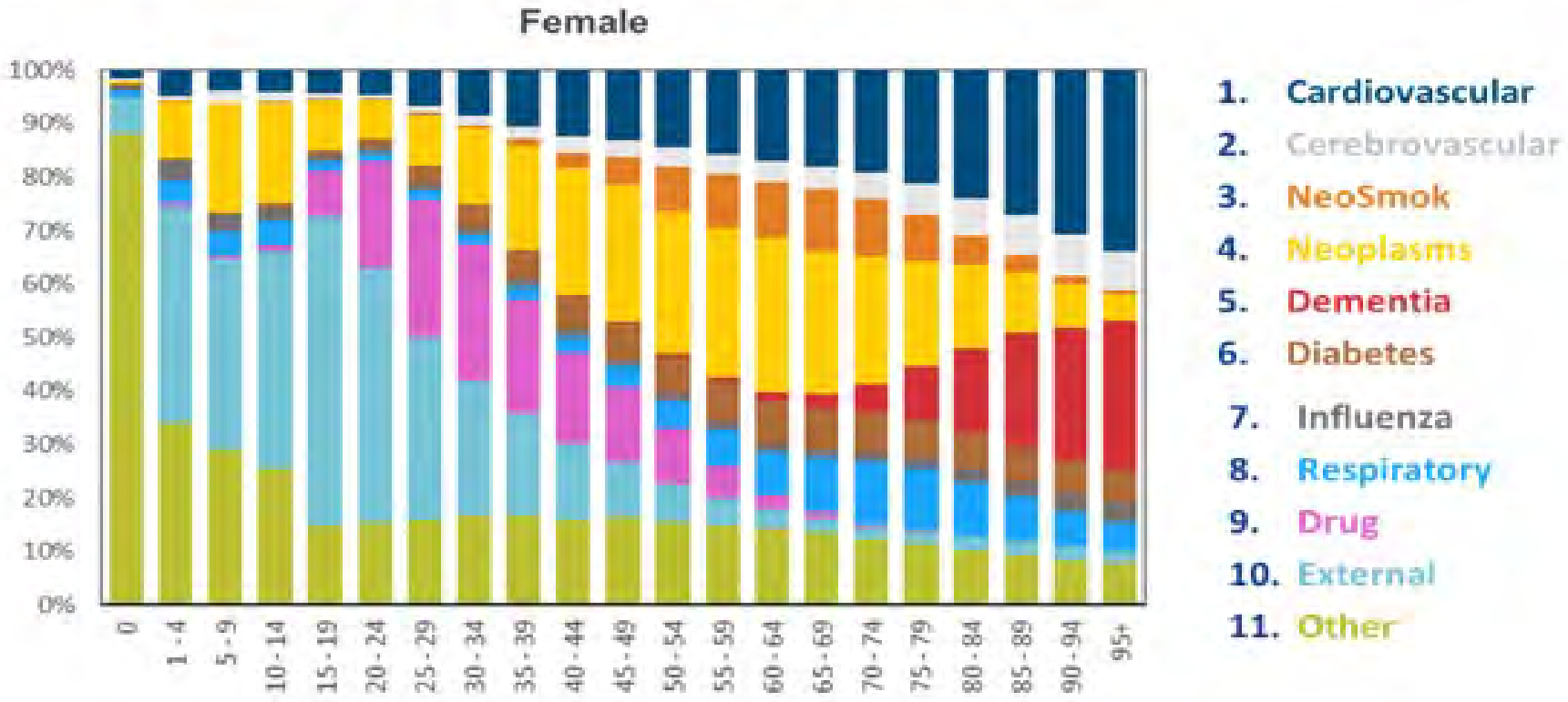
Below is the Cause of Death grouping agreed upon for this latest SOA research:

Cause of Death Category	Description
1	Cardiovascular diseases
2	Cerebrovascular diseases
3	Neoplasms directly induced by smoking (“Neosmok”)
4	Neoplasms (not directly induced by smoking)
5	Dementia
6	Diabetes
7	Influenza
8	Respiratory diseases
9	Drug abuse
10	External causes
11	Other

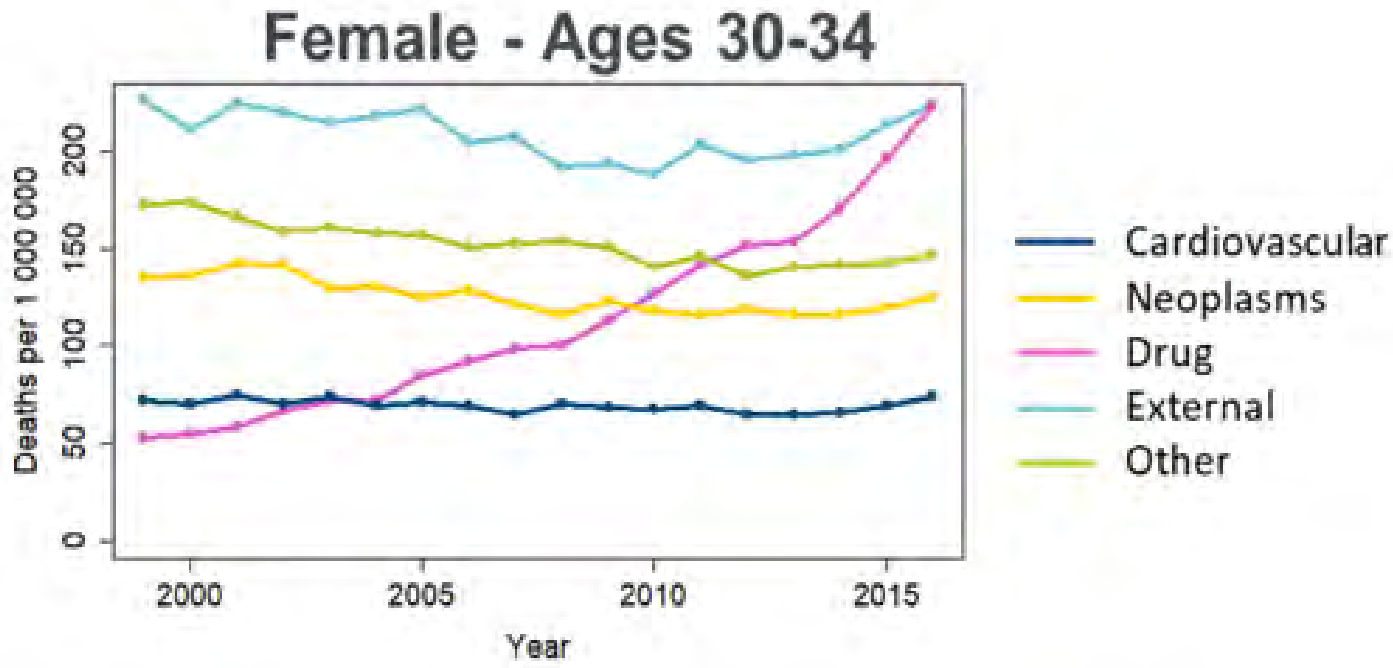
Male U.S. Causes of Death by Age in 2016



Female U.S. Causes of Death by Age in 2016

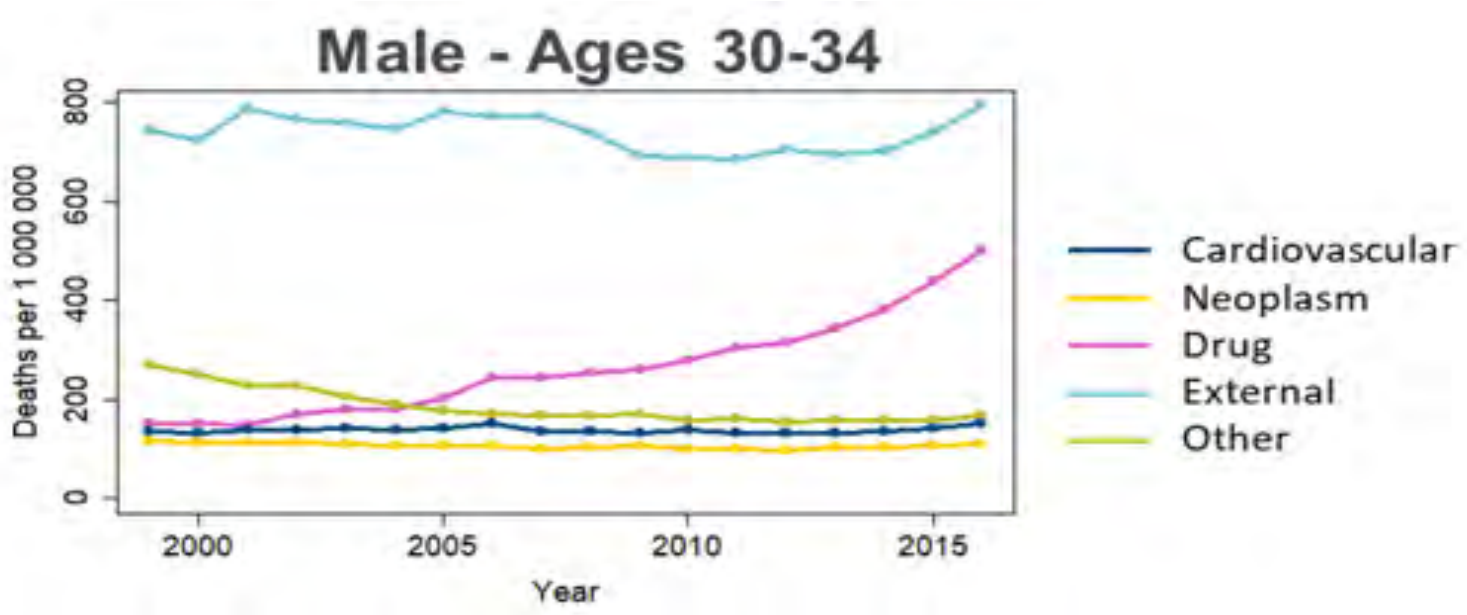


Female Ages 30-34 U.S. COD Trend by Cause



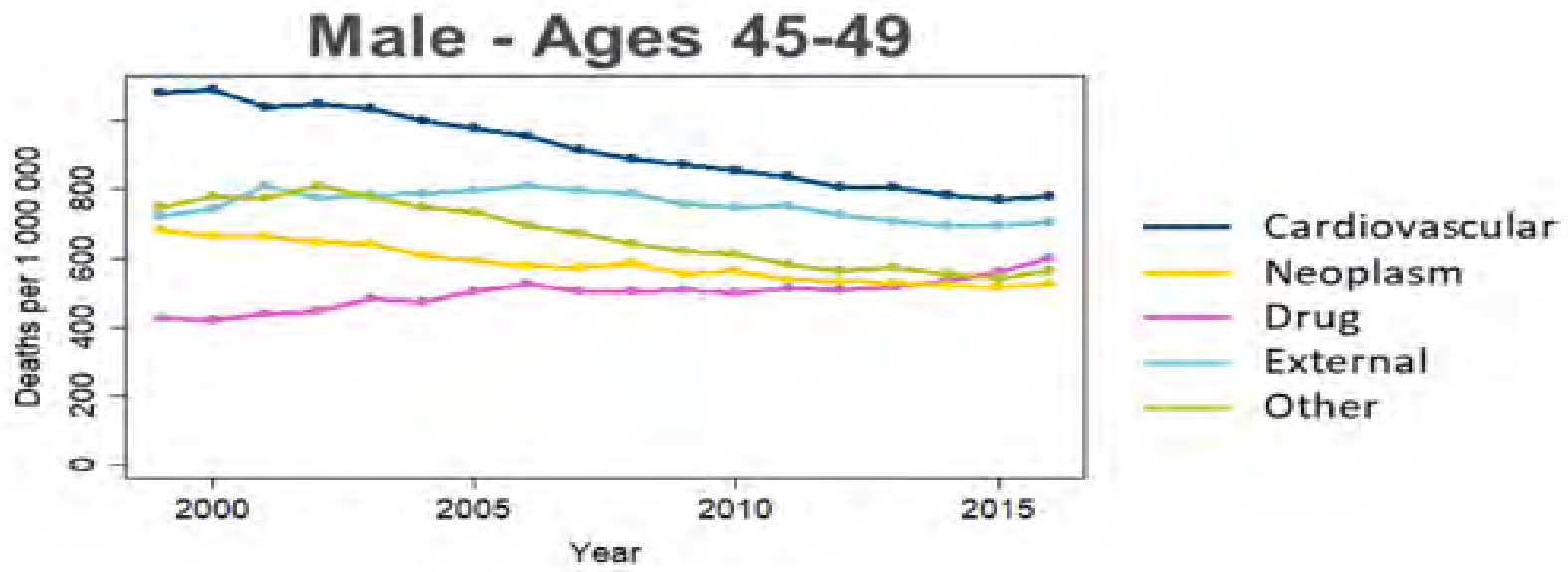
- The trend for deaths due to drugs is materially different than that of other causes.
- What to assume prospectively?

Male Ages 30-34 U.S. COD Trend by Cause



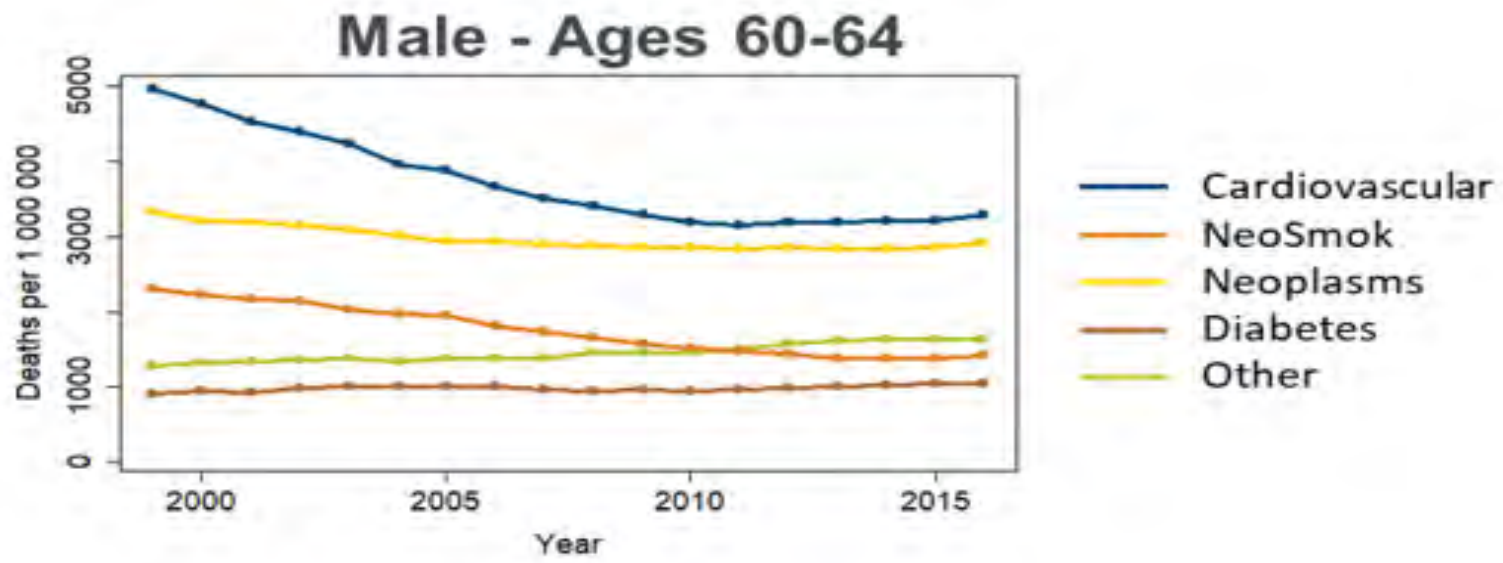
- The trend for deaths due to drugs is materially different than that of other causes.
- What to assume prospectively?

Male Ages 45-49 U.S. COD Trend by Cause



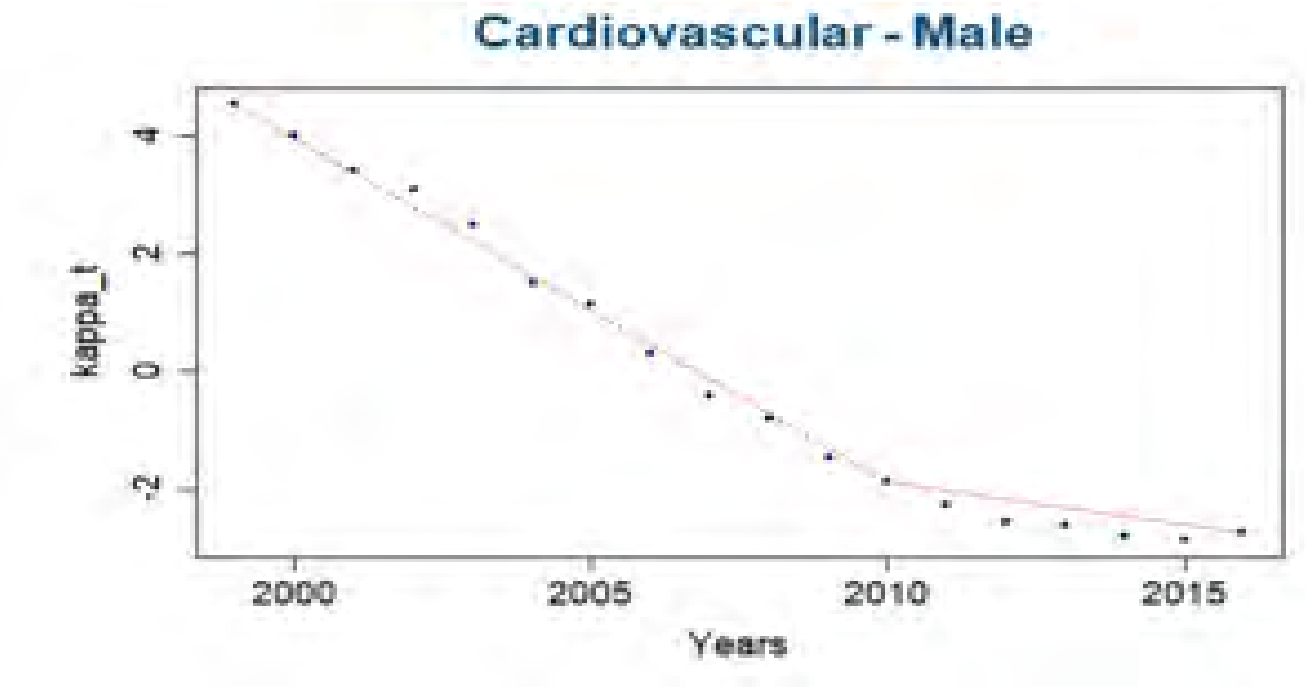
- Decreases in Cardiovascular deaths have been driving the historical MI.
- What to assume prospectively?

Male Ages 60-64 U.S. COD Trend by Cause



- Decreases in Cardiovascular deaths have been driving the historical MI, but have flattened out recently for males ages 60 to 64.
- What to assume prospectively?

Breakpoints in the mortality trend: Cardiovascular Male



- There appears to be a breakpoint (slowdown) in the male cardiovascular MI trend
- What to assume prospectively?

The Cause of Death Projection Tool

- Will the past be predictive of the future?
- Which past? Since last breakpoint or longer trend?
- Do you anticipate any future trends?
  - Change in the trend for deaths due to drugs?
  - What to assume for cardiovascular trends?
  - What to assume for cancer trends?

The SOA Cause of Death Projection Tool

- Illustration of the tool
- We anticipate the SOA hosting a demo of the tool via a podcast after the report and tool are officially published on the SOA website.

Questions?

Thank You!

Analysis of Historical U.S. Population Mortality Improvement Drivers: An Age-Period-Cohort Decomposition

Madhavi Bajekal, **Steven Haberman**, Andrés Villegas, Luke Zhou
University College London, Cass Business School, UNSW Sydney

29th October 2019, SOA Annual Meeting, Toronto

Outline

- Background and objectives
- Data
- Age-Period-Cohort Modelling
- Visualising APC decomposition with Mortality Improvement Stripes
- APC Decomposition of Cause of Death improvements for USA males
- Conclusions

Background

- Expand upon the results of SOA-sponsored study "Components of Historical Mortality Improvement" (https://www.soa.org/resources/research-reports/2017/2017-comp-hist-mort-impr/) that analised age-period-cohort (APC) mortality improvement models.
- This previous study produced an allocation of historical gender-specific mortality improvement trend experience in the US between 1950 and the present into separate age, period, cohort, and residual components.

Objectives of this new study

- Identify significant drivers of US population mortality improvement/deterioration since 1950 in each appropriate APC component.
- Use cause-of-death and other relevant data sources to quantify the likely degree of causality between each APC mortality improvement component and the relevant extrinsic driver.

Data

- Coverage: All of the USA
- Period: 1959-2016
- Age range: 0-100+ by single year of age. Focus today on 50+
- Cause of death: 3 digit ICD

Regime	Year	Source	Comment
ICD-7	1959-1967	HMD Cause of Death Source File	- Based on Downloadable Public Use Datafiles (NCHS) - Mortality Multiple Cause - No coding change adjustment
ICD-8	1968-1978		
ICD-9	1979-1998	Human Cause of Death database preliminary files	- Provided by Magali Barbieri - Adjusted for coding changes
ICD-10	1999-2016		

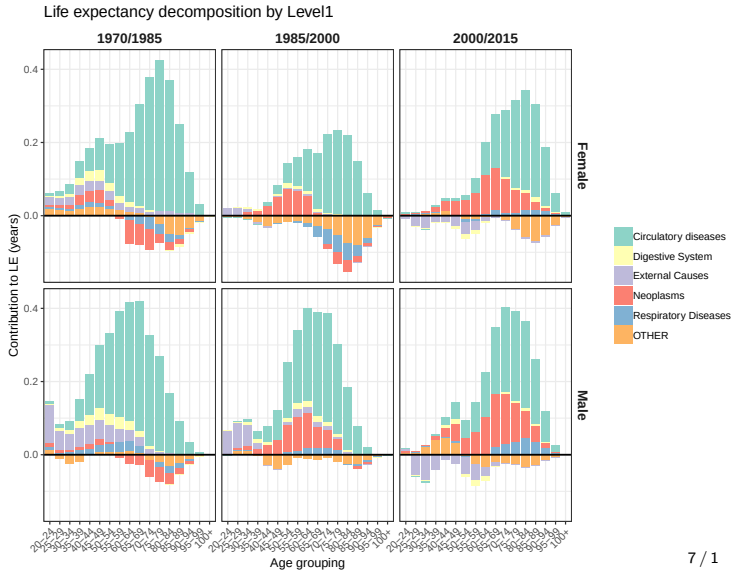
- Population denominators: Human Mortality Database

ASDR per 100,000 males 0-100+ and US 2010 Std.Pop.

Level 1	Level 2	1959	1990	2016
		1508	1119	788
Circulatory diseases		883	466	237
	ISCHAEMIC HEART DISEASE	500	301	116
	Other circulatory system disease	214	101	88
	CVD/STROKE	169	64	33
Digestive System		55	40	32
	Other Digestive system diseases	24	20	16
	CHRONIC LIVER DISEASE	18	17	15
	ULCERS (GASTRIC AND DUODENAL)	13	3	1
External Causes		114	91	97
	External - Other	49	37	56
	TRAFFIC ACCIDENTS	36	17	10
	SELF-HARM AND INTERPERSONAL VIOLENCE	28	36	31
Neoplasms		223	278	180
	Neoplasms-Other	67	86	65
	Other Digestive organ cancer	48	33	27
	LUNG CANCER	44	89	45
	BOWEL CANCER	31	29	16
	PROSTATE CANCER	25	34	17
	LIVER CANCER	7	6	11
	BREAST CANCER	0	1	0
OTHER		149	148	170
	OTHER -Other	114	87	94
	DIABETES + OBESITY	19	22	27
	AIDS/TB	12	20	3
	SUBSTANCE USE (MENTAL & BEHAVIORAL DISRODERS)	3	5	6
	DEMENTIA AND OTHER MENTAL DISORDERS	1	7	21
	ALZHEIMER'S	0	8	19
Respiratory Diseases		84	97	71
	INFLUENZA & PNEUMONIA	51	29	14
	CHRONIC LOWER RESPIRATORY DISEASE	22	52	40
	Other respiratory disease	10	15	17

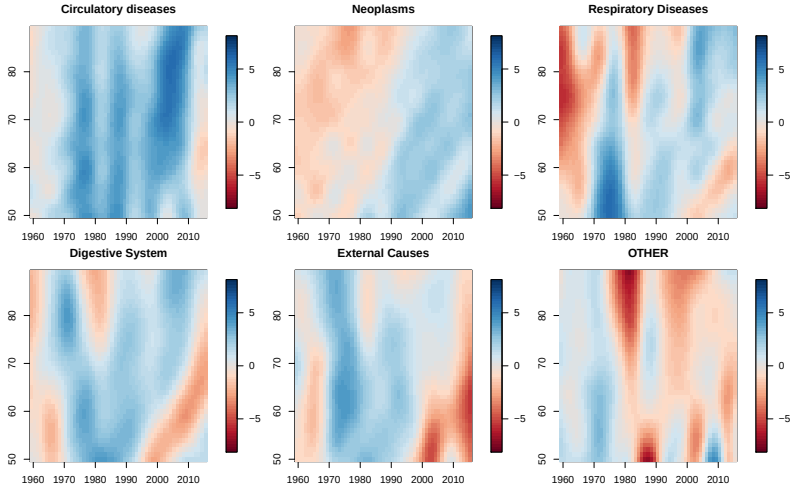
Contribution of Level 1 causes to Life Expectancy change at age 20

- The overall improvement is dominated by circulatory diseases in all periods
- Neoplasms and respiratory diseases contributed to a decline in life expectancy in 1970-85 for males and females aged 65+.
- External causes contributed negatively in the period 2000-2015 especially at younger ages

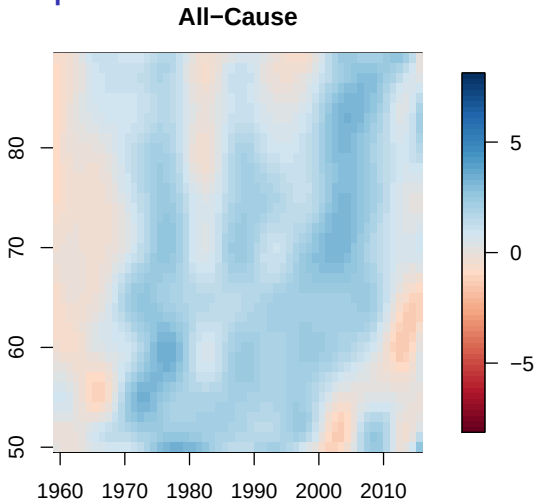


Level 1 male - Heatmap of mortality improvements

- **Age**: Not as important as the other effects
- **Period**: Important for Circulatory, Respiratory and Other
- **Cohort**: Important for Digestive and Respiratory



How to decompose mortality improvements into Age-Period-Cohort patterns?



The APCi model

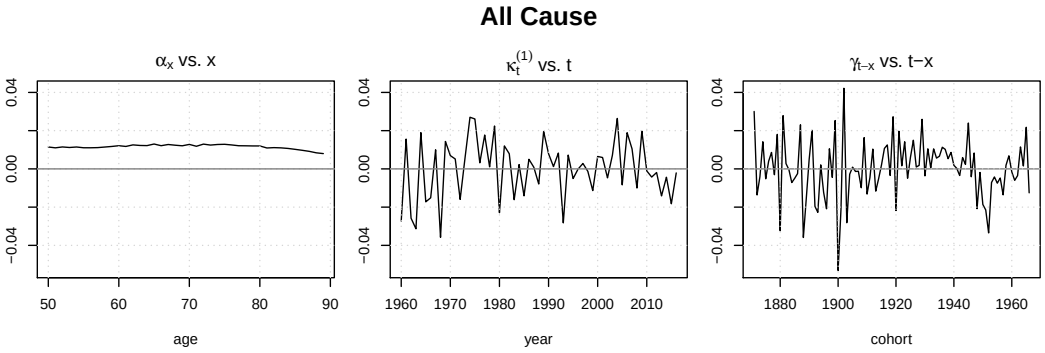
We consider the APCi model for our analysis which corresponds broadly to the new CMI approach:

$$-\log \frac{\mu_{xt}}{\mu_{x,t-1}} = \alpha_x + \kappa_t + \gamma_{t-x}$$

Standard constraints: remove the level and linear trends from the **cohort** effects

$$\sum_t \kappa_t = 0, \sum_c \gamma_c = 0, \sum_c c\gamma_c = 0$$

Visualising APC decompositions: Traditional plots

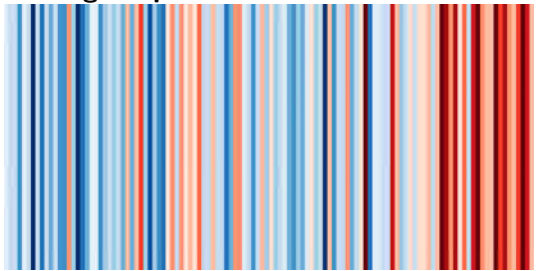


- α_x represents the average improvement rate over the period at age x
- κ_t and γ_{t-x} represent deviations from this average
  - values above 0 imply above average improvements
  - values below 0 imply below average improvements.
- These plot present all the numerical results but the perception of period or cohort patterns is difficult to grasp.

Visualising APC decompositions: Mortality Imp. Stripes

- Use "mortality improvement stripes" in resemblance to the "warming stripes"" designed by Ed Hawkins (http://www.climate-lab-book.ac.uk/2018/warming-stripes/)

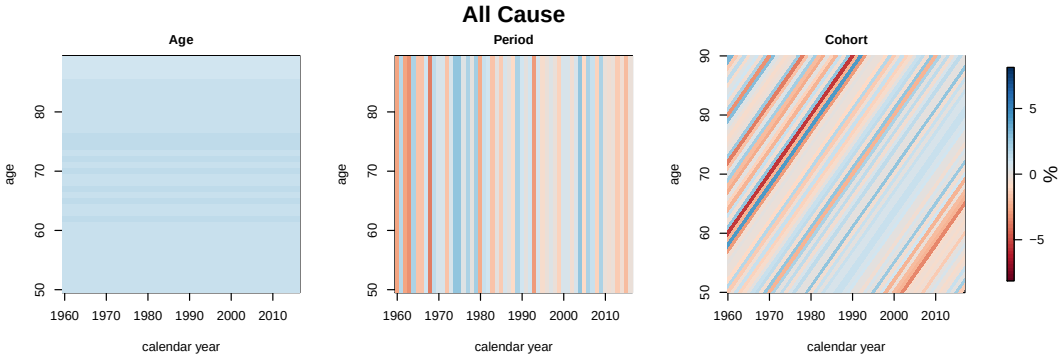
Warming Stripes for Canada from 1901-2018



Source: https://showyourstripes.info

Data: Annual average temperatures for Canada from 1901-2018 using data from Berkeley Earth.

Visualising APC decompositions: Mortality Imp. Stripes

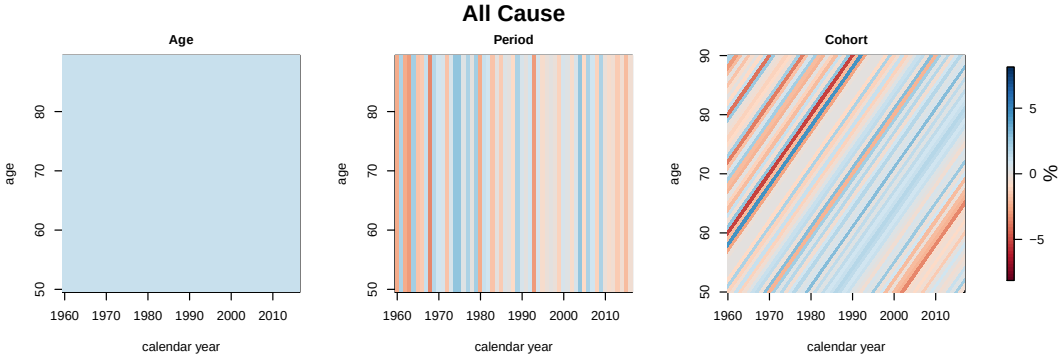


- **horizontal patterns** are **age effects**, **vertical patterns** are period effects, and **diagonal patterns** are cohort effects
- These stripe plots are easy to interpret. For instance,
  - Positive overall improvements
  - Clear deceleration of improvements between 2010 and 2015
  - Slower improvements for the cohorts centred in 1950

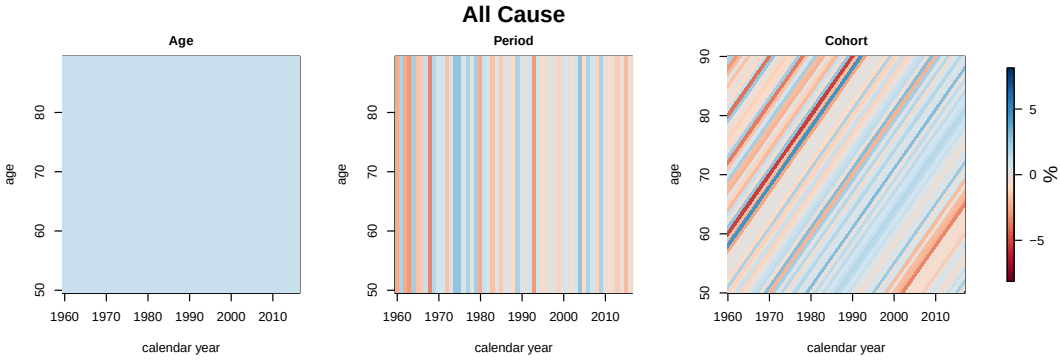
Visualising APC decompositions: Mortality Imp. Stripes

To avoid identifiability issues consider the simpler period cohort improvement (PCi) model:

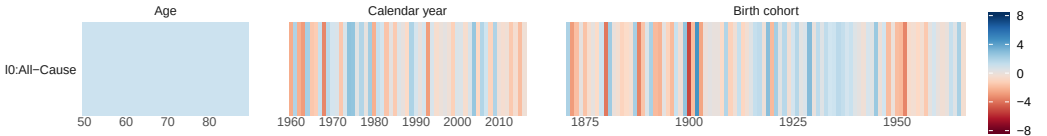
$$-\log \frac{\mu_{xt}}{\mu_{x,t-1}} = \alpha + \kappa_t + \gamma_{t-x}$$



Visualising APC decompositions: Minimalist Stripes

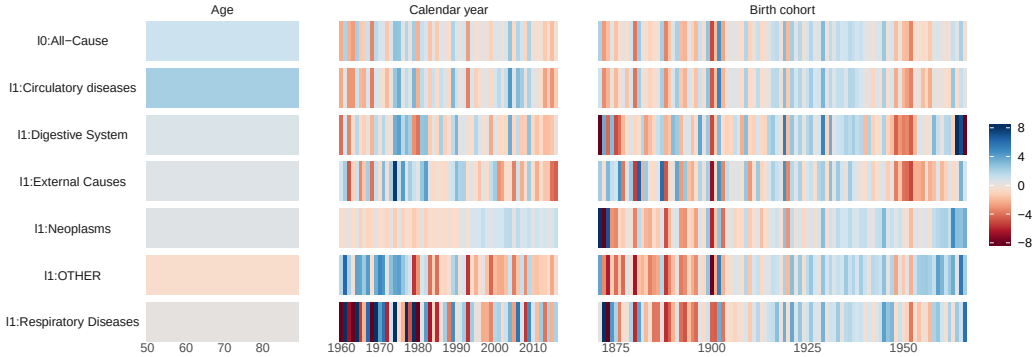


We can further simplify the plots by presenting everything as vertical stripes



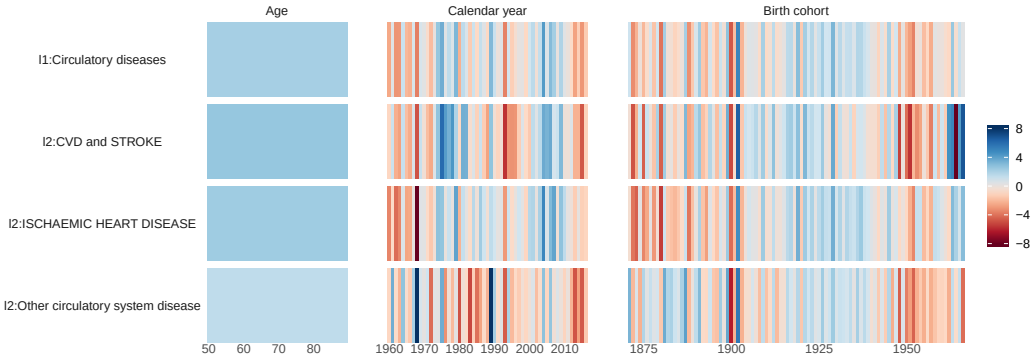
Male results

Level 1



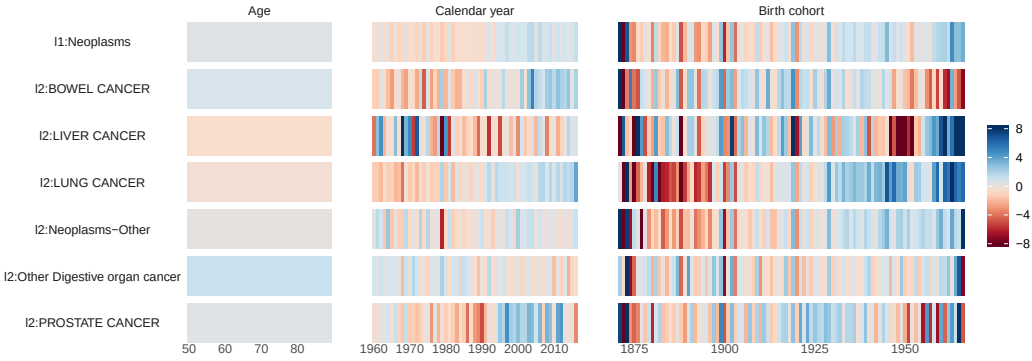
- Circulatory diseases have by far the highest improvements
- Clear negative period effect after 2010 for circulatory diseases, digestive system, external causes and other causes
- Positive period effect for circulatory between 2000 and 2010
- Strong negative cohort effect for cohorts centred in 1950 for digestive and external causes

Circulatory Diseases



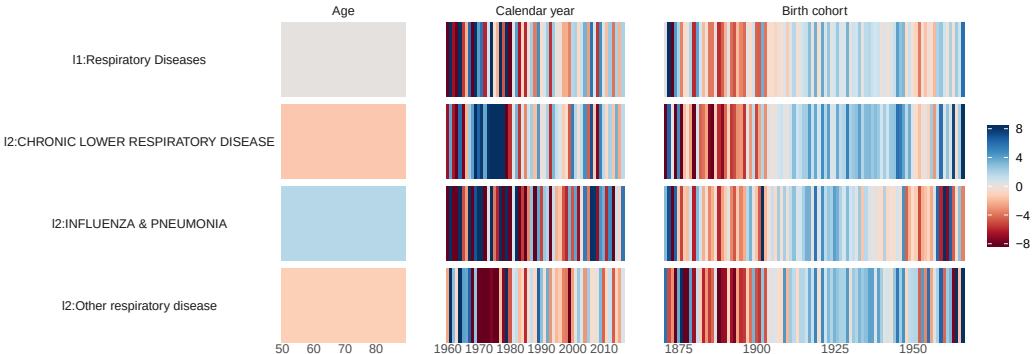
- Clear negative period effect after 2010 for all three causes albeit milder for IHD.
- Strong negative cohort effect for cohorts centred in 1950 for CVD and Stroke
- Positive cohort effect for IHD and other circulatory diseases for birth cohorts 1920-1937

Neoplasms



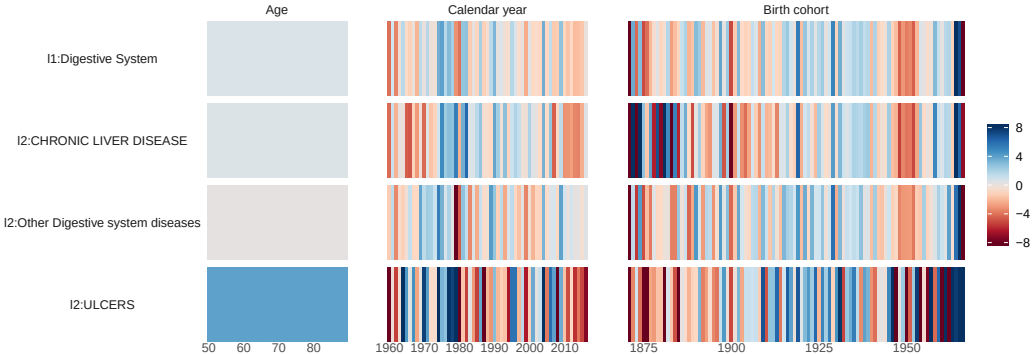
- General improvement for bowel, digestive and prostate cancer
- With the exception of prostate cancer, cohort effects seem to dominate
- Very negative effect for liver cancer for the cohort 1940-1950 cohorts
- Mild negative effect for lung cancer for the cohort 1950-1955 cohorts
- Positive effect for lung cancer for the cohort 1927-1949 cohorts
- Improvement of lung cancer for the period post 1990

Respiratory Diseases



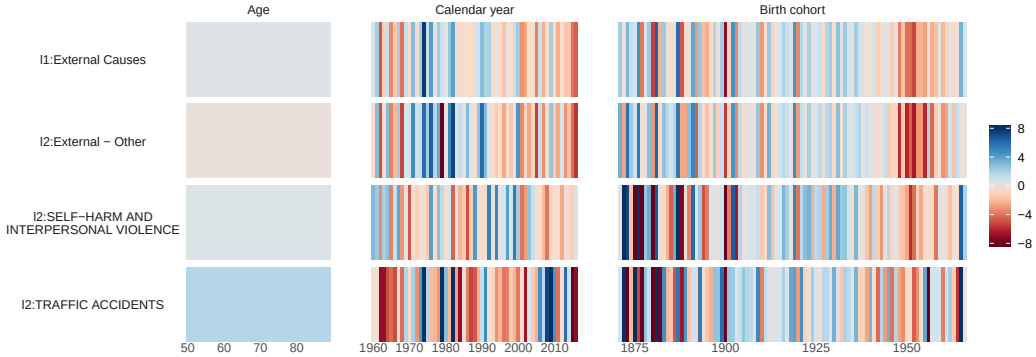
- Both period and cohort effects appear to be important
- Negative cohort effects for CLRD for the 1948-1952 cohort
- Positive cohort effects for CLRD for the 1920-1947 cohort

Digestive System



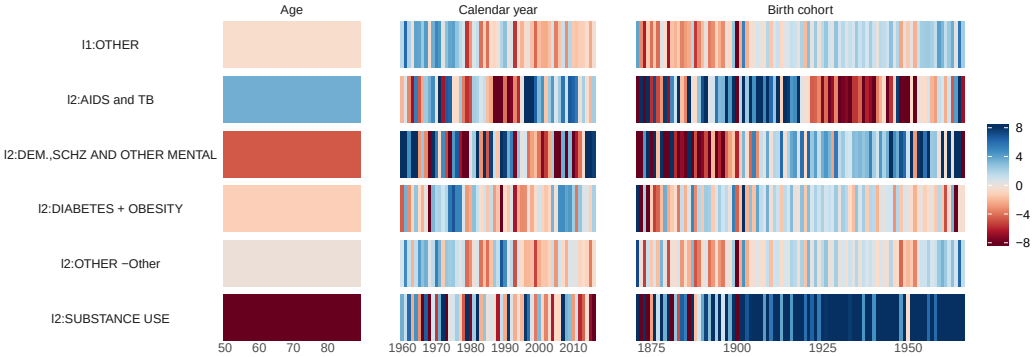
- Very strong negative cohort effect for cohorts centred in 1950 for liver disease and other digestive diseases.
- Very strong negative period effect post 2010 for liver disease

External Causes



- Negative period effect post 2000 for external-other and Self-Harm and Interpersonal Violence
- Very strong negative cohort effect for cohorts centred in 1950 for external-other and Self-Harm and Interpersonal Violence

OTHER



- Period effects: Diabetes and Obesity (↑ 1970-1980, ↑ 2005-2010), AIDS/TB (↑ 1995-2010), Substance Use (↓ 2010+)
- Cohort effects: OTHER-other (↓ 1947-1952), AIDS/TB (↓ 1920-1950)

Summary and conclusions

- Analysis of APC decomposition for broad causes and more granular causes
- Period and cohort effects are present
- Once decomposed by cause, age seems to be less important

Summary and conclusions (Males)

- Period effects present for:
  - Circulatory disease ($\downarrow$ 1960-1970, $\uparrow$ 2000-2010, $\downarrow$ 2010+)
  - Prostate cancer ($\downarrow$ 1995+)
  - Influenza, Chronic Lower Respiratory Disease (1959-1979)
  - External-other, Traffic accidents, Self-Harm and Interpersonal Violence ($\downarrow$ 2005+)
  - Diabetes and Obesity ($\uparrow$ 1970-1980, $\uparrow$ 2005-2010), AIDS/TB ($\uparrow$ 1995-2000), Substance Use ($\downarrow$ 2010+)
- Cohort effects present for:
  - Lung ($\uparrow$ 1945-1950, $\downarrow$ 1950-1960), Bowel, Liver ($\downarrow$ 1940-1955) cancer
  - Chronic Lower Respiratory Disease ($\downarrow$ 1950-1960)
  - Chronic liver disease ($\downarrow$ 1942-1952) and other digestive diseases ($\downarrow$ 1942-1952)
  - OTHER-other ($\downarrow$ 1942-1952), AIDS/TB ($\downarrow$ 1920-1940)

Summary and conclusions (Females)

- Period effects present for:
  - Circulatory disease ($\downarrow$ 1960-1970, $\downarrow$ 1990-2000, $\uparrow$ 2000-2010, $\downarrow$ 2010+)
  - Influenza, Chronic Lower Respiratory Disease (1959-1979)
  - External-other, Traffic accidents ($\downarrow$ 2005+)
  - Diabetes and Obesity ($\uparrow$ 1970-1980, $\uparrow$ 2005-2010), AIDS/TB ($\uparrow$ 1995-2000), Substance Use ($\downarrow$ 2010+)
- Cohort effects present for:
  - Lung ($\uparrow$ 1940-1960, $\downarrow$ 1950-1960), Breast ($\downarrow$ 1920-1930), Bowel, Liver ($\downarrow$ 1940-1955) cancer
  - Chronic Lower Respiratory Disease ($\downarrow$ 1950-1960)
  - Chronic liver disease ($\downarrow$ 1945-1960)

Next steps

- Extend results to risk factor markers (Alcohol, Smoking, Obesity, etc.)
- Report summarising results of the research coming up later this year
- Help inform the setting of assumptions for mortality projections

Thank you!

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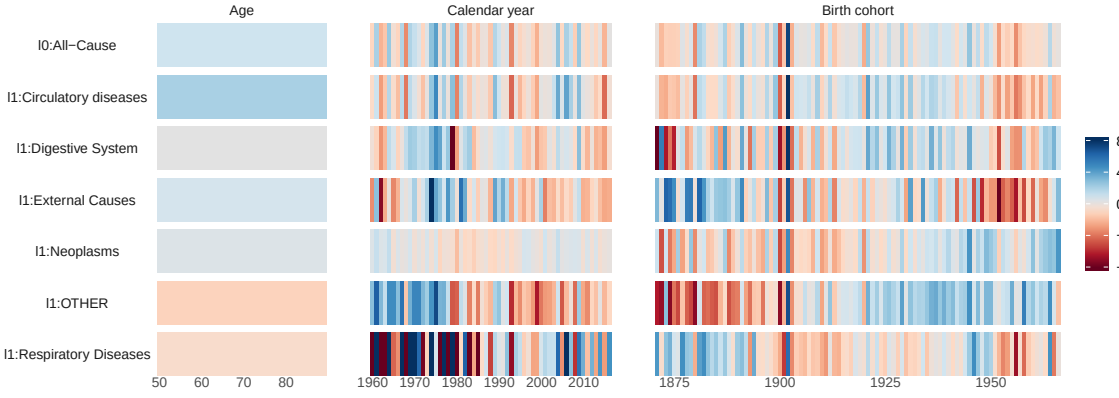
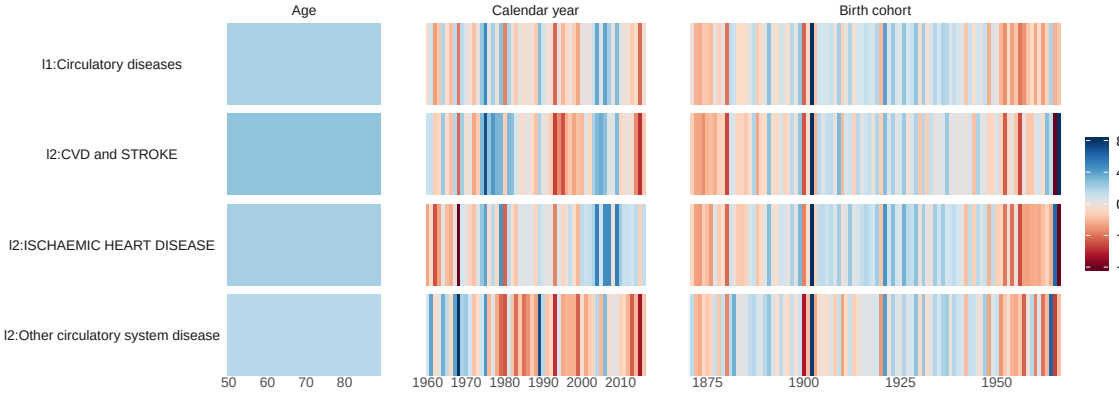
Appendix: Female results

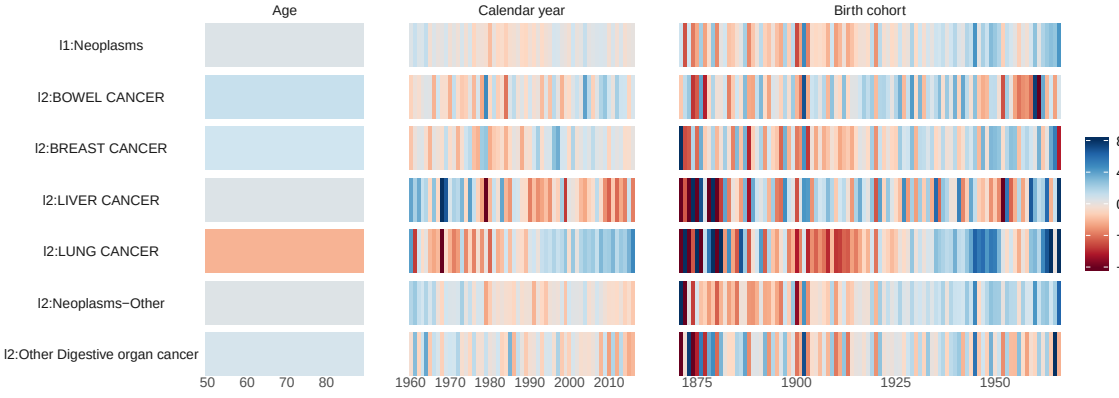
Level 1


Age
Calendar year
Birth cohort
I0:All−Cause
I1:Circulatory diseases
I1:Digestive System
I1:External Causes
I1:Neoplasms
I1:OTHER
I1:Respiratory Diseases
50
60
70
80
1960
1970
1980
1990
2000
2010
1875
1900
1925
1950

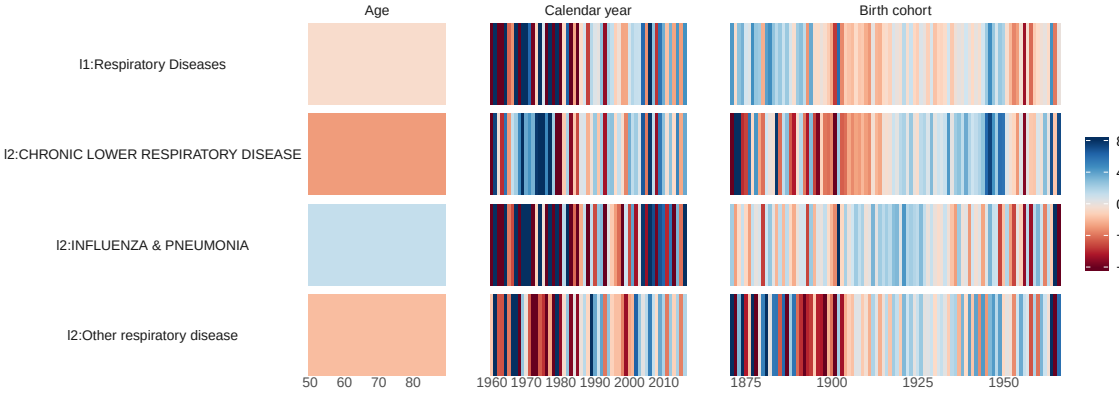
Circulatory Diseases



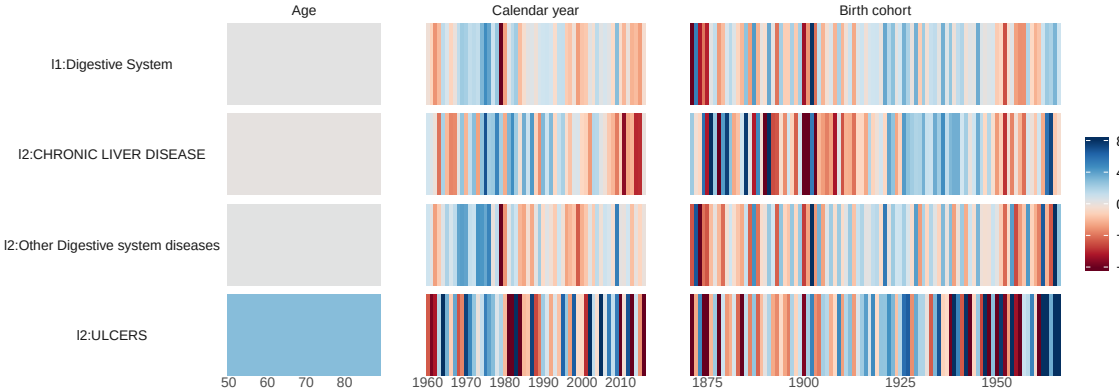
Neoplasms


Age
Calendar year
Birth cohort
I1:Neoplasms
I2:BOWEL CANCER
I2:BREAST CANCER
I2:LIVER CANCER
I2:LUNG CANCER
I2:Neoplasms−Other
I2:Other Digestive organ cancer
50
60
70
80
1960
1970
1980
1990
2000
2010
1875
1900
1925
1950

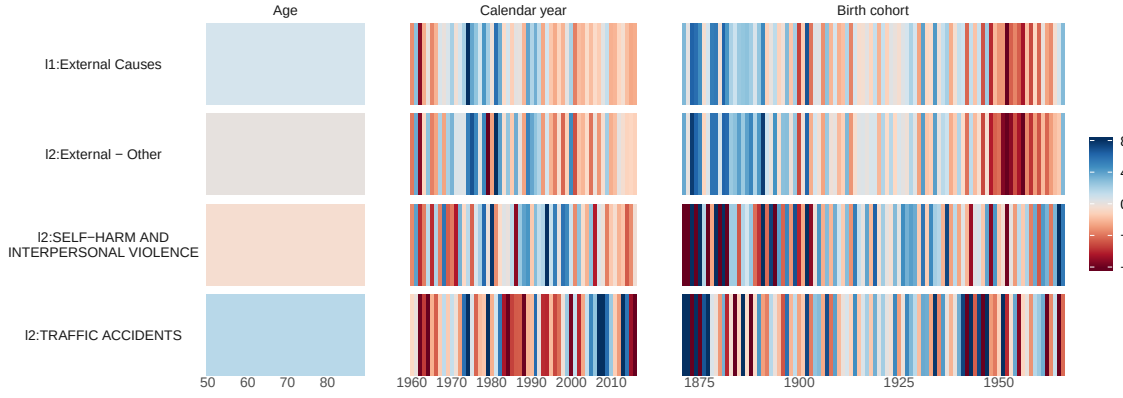
Respiratory Diseases



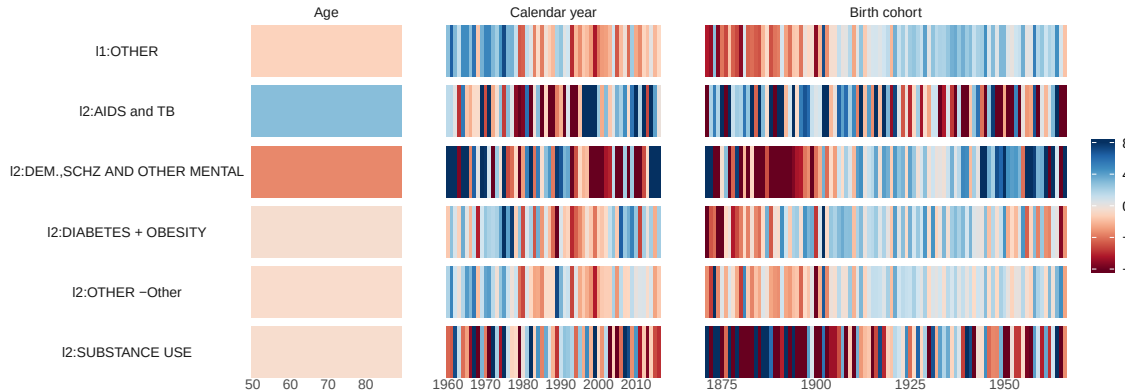
Digestive System



External Causes



OTHER


Age
Calendar year
Birth cohort
I1:OTHER
I2:AIDS and TB
I2:DEM.,SCHZ AND OTHER MENTAL
I2:DIABETES + OBESITY
I2:OTHER −Other
I2:SUBSTANCE USE
50 60 70 80
1960 1970 1980 1990 2000 2010
1875 1900 1925 1950