

Causes of Death: Patterns in the Insured Population, the Opioid Crisis and Deaths of Despair

- Presenters:** **Dr. Donald Sampson**, *Munich Re, Actuarial Associate, Biometric Research, Ph.D.*
- Jean-Marc Fix**, *Gen Re, VP, Actuarial R&D, FSA, MAAA*
- Anji Li**, *Munich Re, Assistant Actuary, Biometric Research, FSA, CERA, MAAA*
- Moderator:** **Nick Kocisak**, *RGA Reinsurance Company, Senior Actuarial Assistant, Global Research & Data Analytics*

4 May 2020



SOCIETY OF ACTUARIES

Antitrust Compliance Guidelines

Active participation in the Society of Actuaries is an important aspect of membership. While the positive contributions of professional societies and associations are well-recognized and encouraged, association activities are vulnerable to close antitrust scrutiny. By their very nature, associations bring together industry competitors and other market participants.

The United States antitrust laws aim to protect consumers by preserving the free economy and prohibiting anti-competitive business practices; they promote competition. There are both state and federal antitrust laws, although state antitrust laws closely follow federal law. The Sherman Act, is the primary U.S. antitrust law pertaining to association activities. The Sherman Act prohibits every contract, combination or conspiracy that places an unreasonable restraint on trade. There are, however, some activities that are illegal under all circumstances, such as price fixing, market allocation and collusive bidding.

There is no safe harbor under the antitrust law for professional association activities. Therefore, association meeting participants should refrain from discussing any activity that could potentially be construed as having an anti-competitive effect. Discussions relating to product or service pricing, market allocations, membership restrictions, product standardization or other conditions on trade could arguably be perceived as a restraint on trade and may expose the SOA and its members to antitrust enforcement procedures.

While participating in all SOA in person meetings, webinars, teleconferences or side discussions, you should avoid discussing competitively sensitive information with competitors and follow these guidelines:

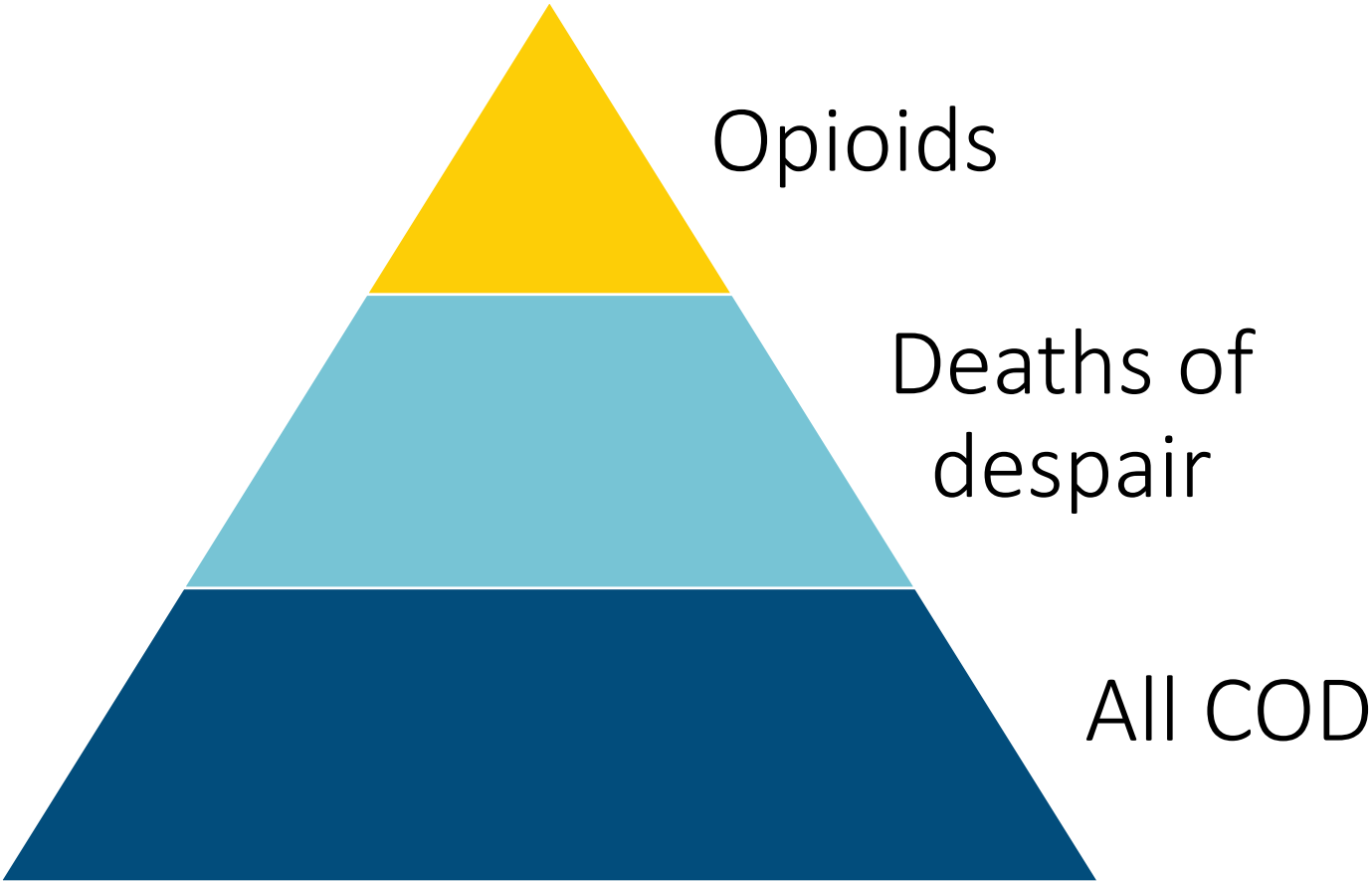
- **Do not** discuss prices for services or products or anything else that might affect prices
- **Do not** discuss what you or other entities plan to do in a particular geographic or product markets or with particular customers.
- **Do not** speak on behalf of the SOA or any of its committees unless specifically authorized to do so.
- **Do** leave a meeting where any anticompetitive pricing or market allocation discussion occurs.
- **Do** alert SOA staff and/or legal counsel to any concerning discussions
- **Do** consult with legal counsel before raising any matter or making a statement that may involve competitively sensitive information.

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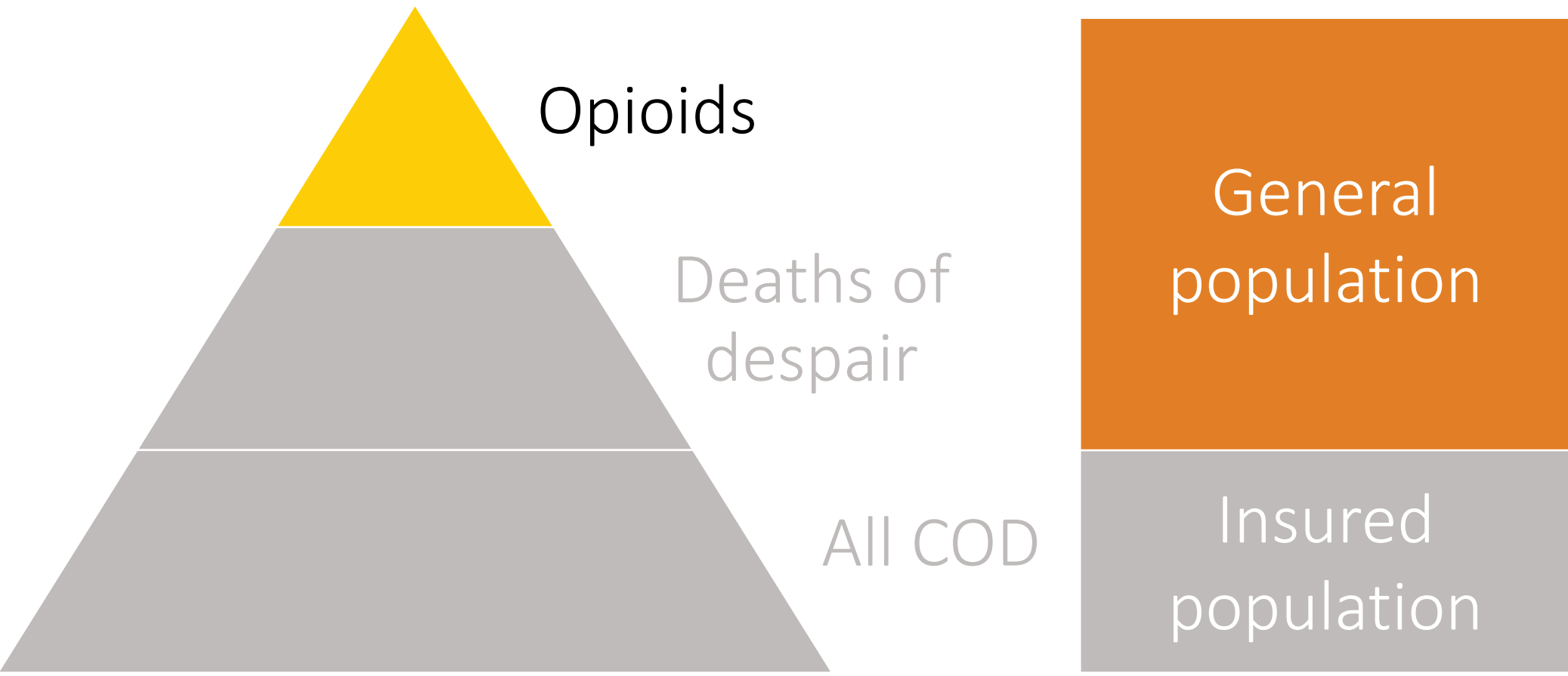
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Today's discussion



Today's discussion



Updates on the Opioid Epidemic

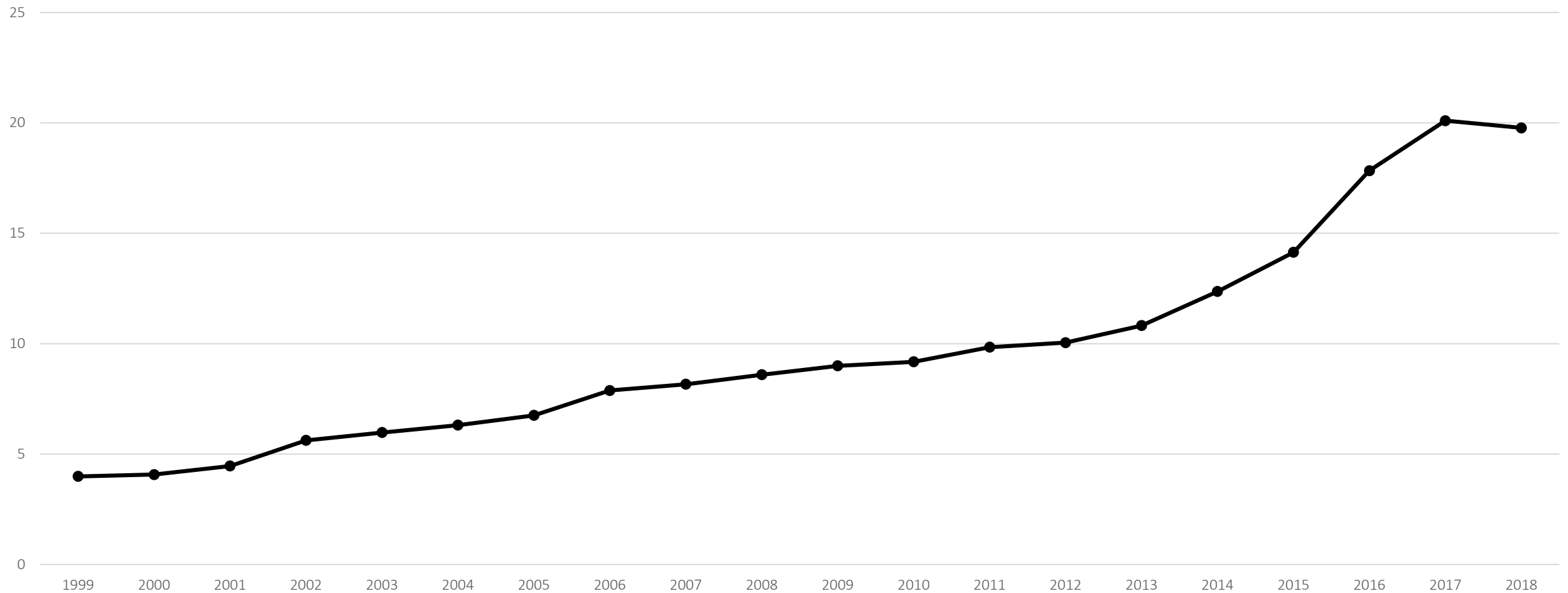
Dr. Donald Sampson, Ph.D.

4 May 2020



Opioid Abuse and Overdose

Opioid Abuse and Overdose Deaths per 100,000: Ages 25-84



How Are Deaths Recorded?

Mortality Multiple Cause-of-Death Public Use Record

- Maintained by the National Center for Health Statistics (NCHS) at the CDC
- Created from all death certificates filed in the US
- Includes algorithm-interpreted 'underlying cause of death'
- Secondary or contributing conditions recorded on the death certificate are also reported
- All conditions are recorded using ICD codes (currently ICD-10)

How Are *Opioid* Deaths Recorded?

Overdoses

- Drug poisoning is reported in four different varieties:
 - Accidental (X40-44)
 - Suicide (X60-64)
 - Assault (X85)
 - Undetermined (Y10-14)

Abuse

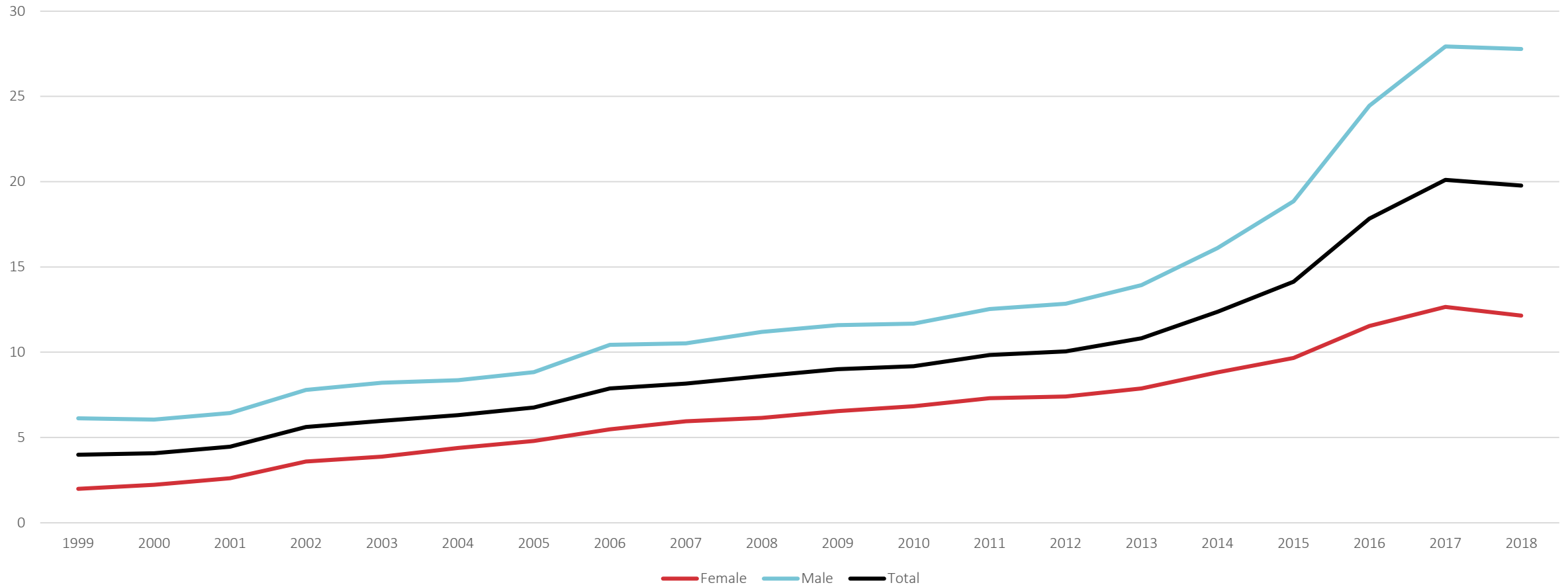
- Drug deaths were sometimes reported as a severe consequence of intoxication, instead of poisoning
- Mental and behavioral disorders due to psychoactive substance use (F10-19)
- Appears to be corrected after 2006

How Are *Opioids* Recorded?

- Aside from general categories, underlying causes do not report the *type* of drug involved. These are recorded as secondary conditions
- Poisoning by narcotics and psychodysleptics [hallucinogens] (T40):
 - T40.0 Opium
 - T40.1 Heroin
 - T40.2 Other opioids
 - Codeine
 - Morphine
 - T40.3 Methadone
 - T40.4 Other synthetic narcotics (Fentanyl)
 - T40.6 Other and unspecified narcotics
- Using secondary conditions alone leads to false signals from palliative, hospice, and end of life care.

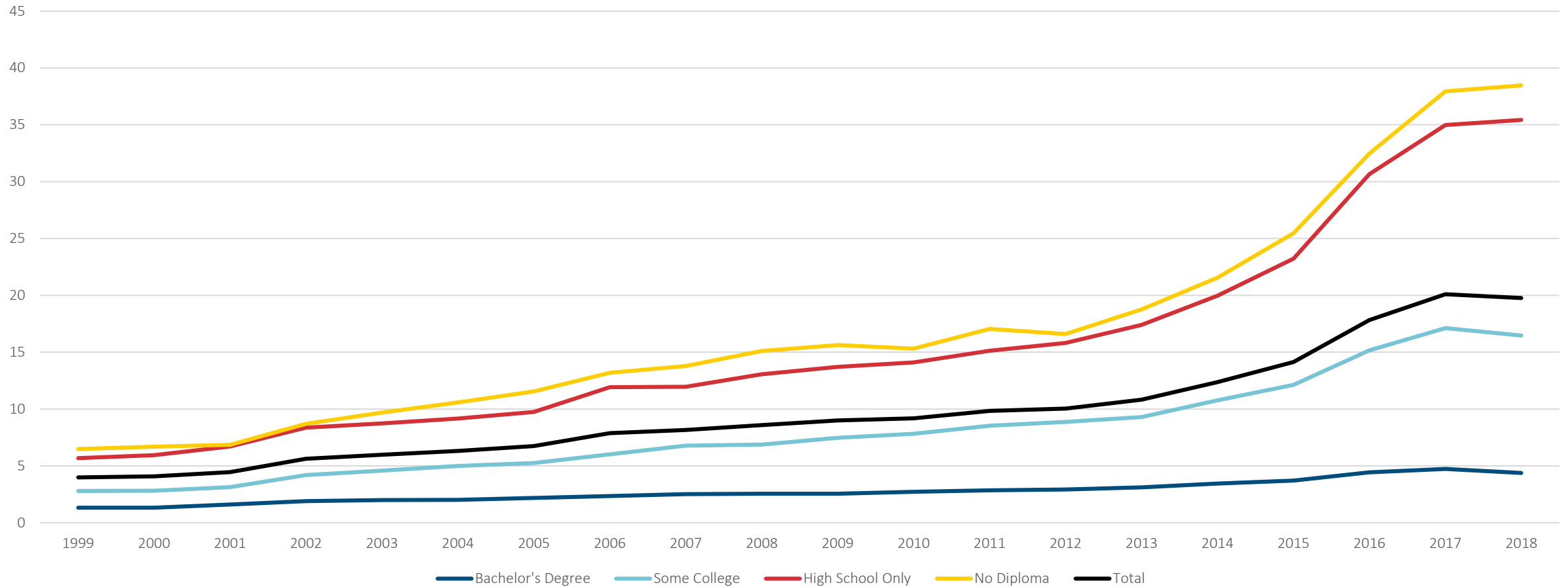
Opioid Deaths by Gender

Drug Abuse and Overdose Deaths per 100,000 by Gender: Ages 25-84



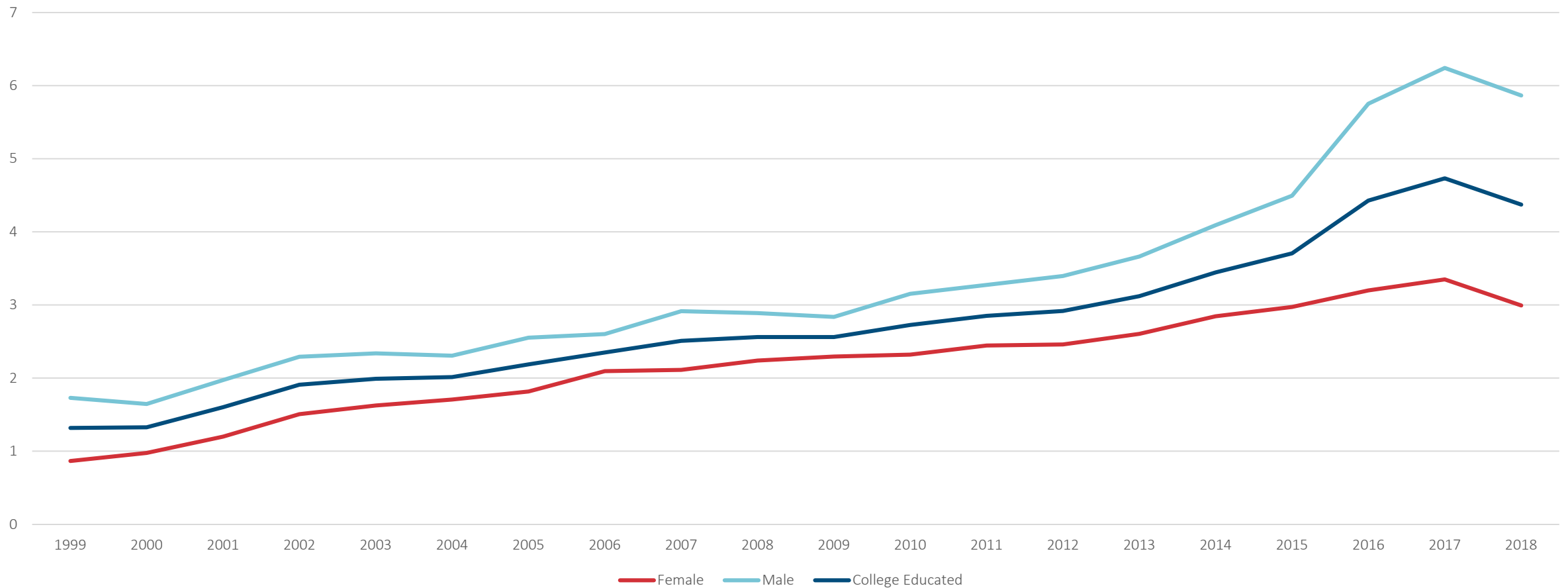
Opioid Deaths by Education

Drug Abuse and Overdose Deaths per 100,000 by Education: Ages 25-84



College Educated Opioid Deaths by Gender

Drug Abuse and Overdose Deaths per 100,000 by Gender: Ages 25-84



Opioids by Type

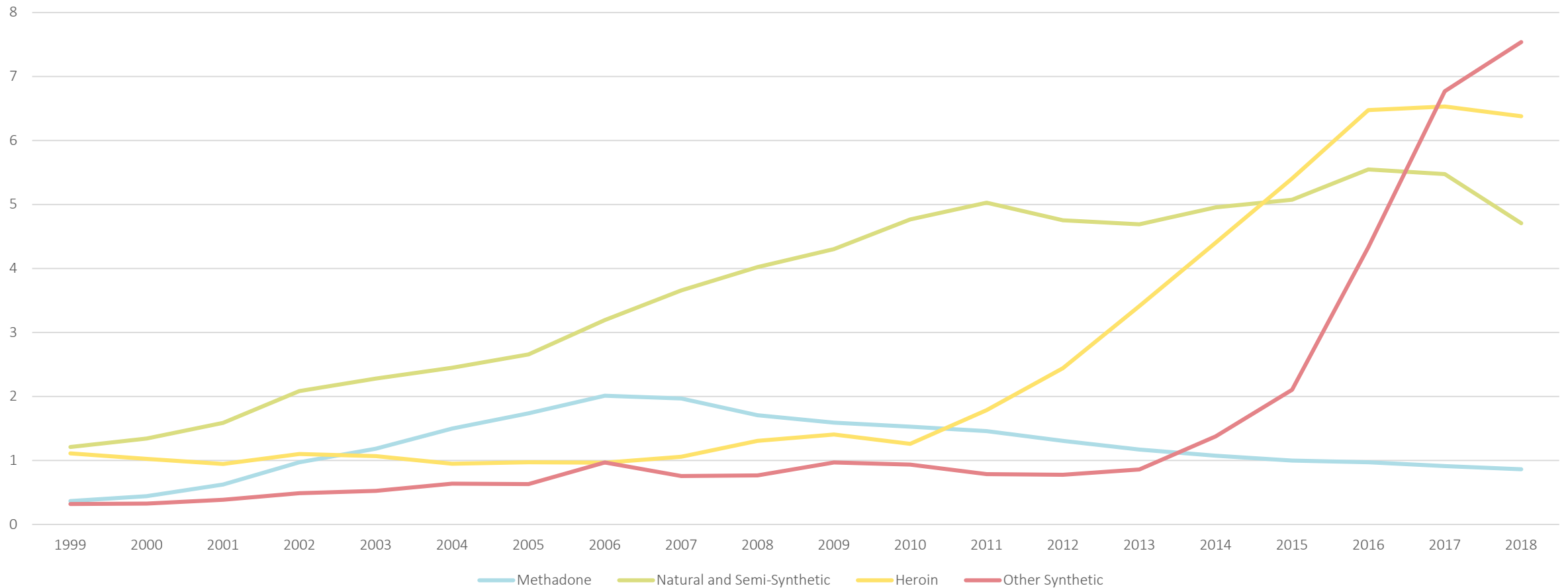


Categories and potency of opioids

| Opioid | Type | Strength Comparison |
|-------------------------|------------------------|---------------------|
| Codeine | Natural Opiate | 0.15 |
| Morphine | Natural Opiate | 1 |
| Hydrocodone* | Semi-synthetic | 1 |
| Oxycodone* | Semi-synthetic | 1.5 |
| Hydromorphone | Semi-synthetic | 5 |
| Methadone* | Synthetic | 3 |
| Heroin | Illegal Semi-synthetic | 2 – 7 |
| Fentanyl | Synthetic | 75-100 |
| Illegally-made fentanyl | Illegal Synthetic | 1000 – 10,000 |

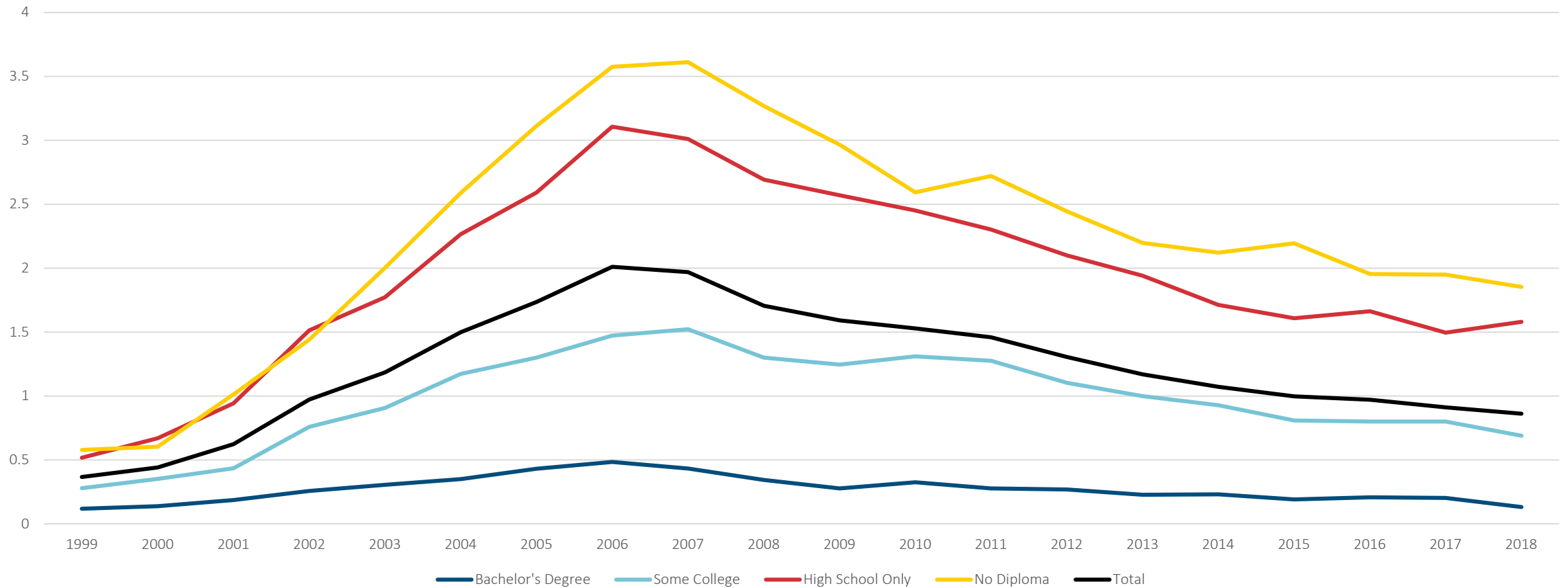
Opioid Deaths by Opioid Type

Drug Abuse and Overdose Deaths per 100,000 by Opioid Type: 25-84



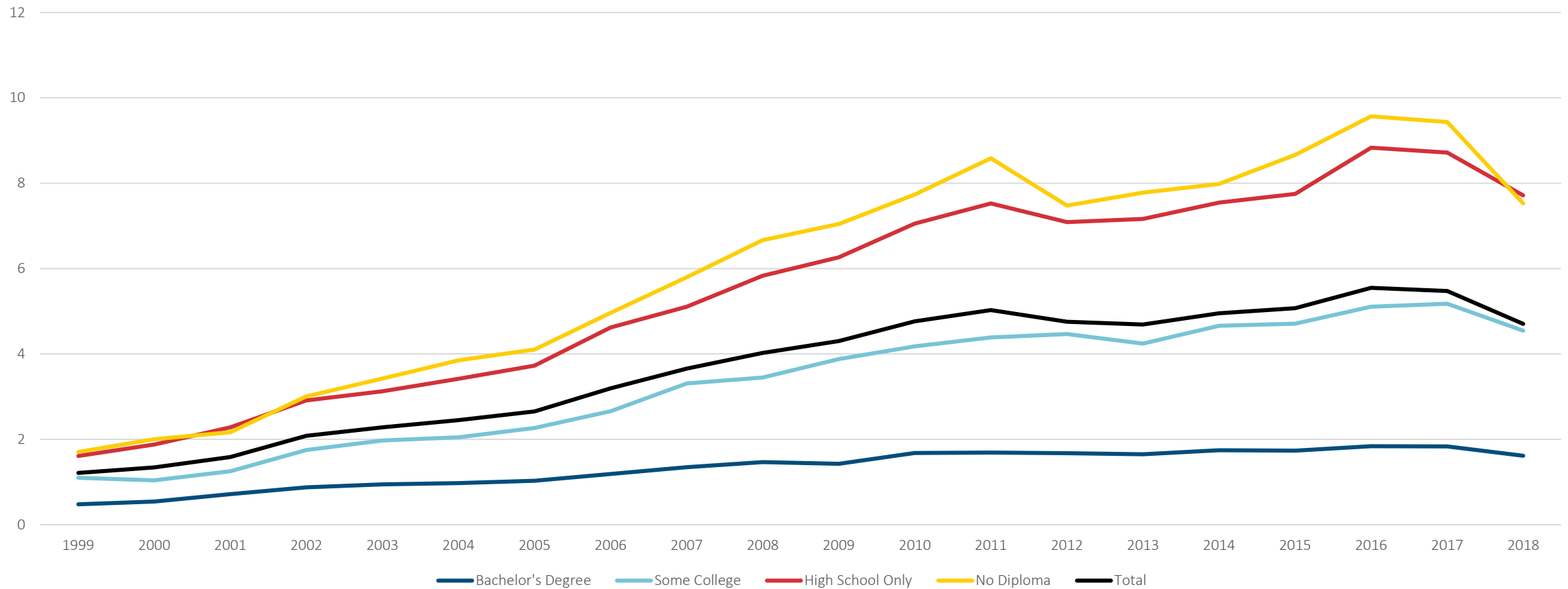
Methadone

Drug Abuse and Overdose Deaths per 100,000 by Education: 25-84



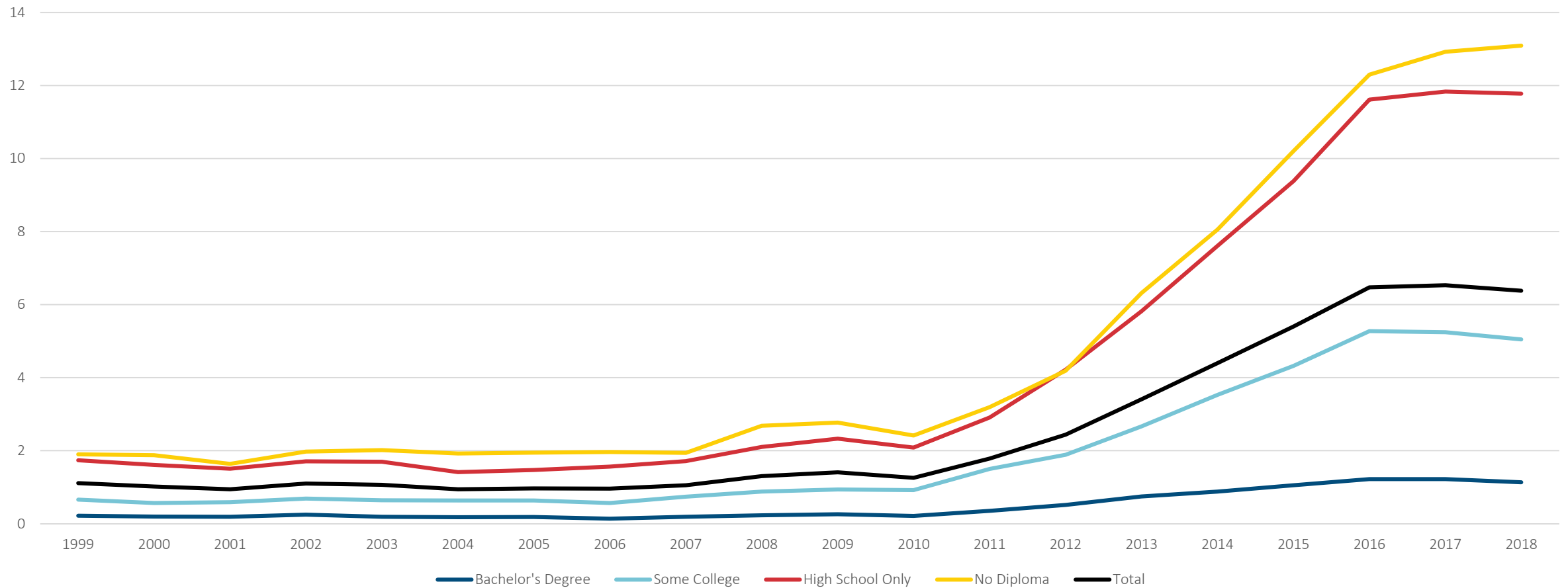
Natural and Semi-Synthetic

Drug Abuse and Overdose Deaths per 100,000 by Education: 25-84



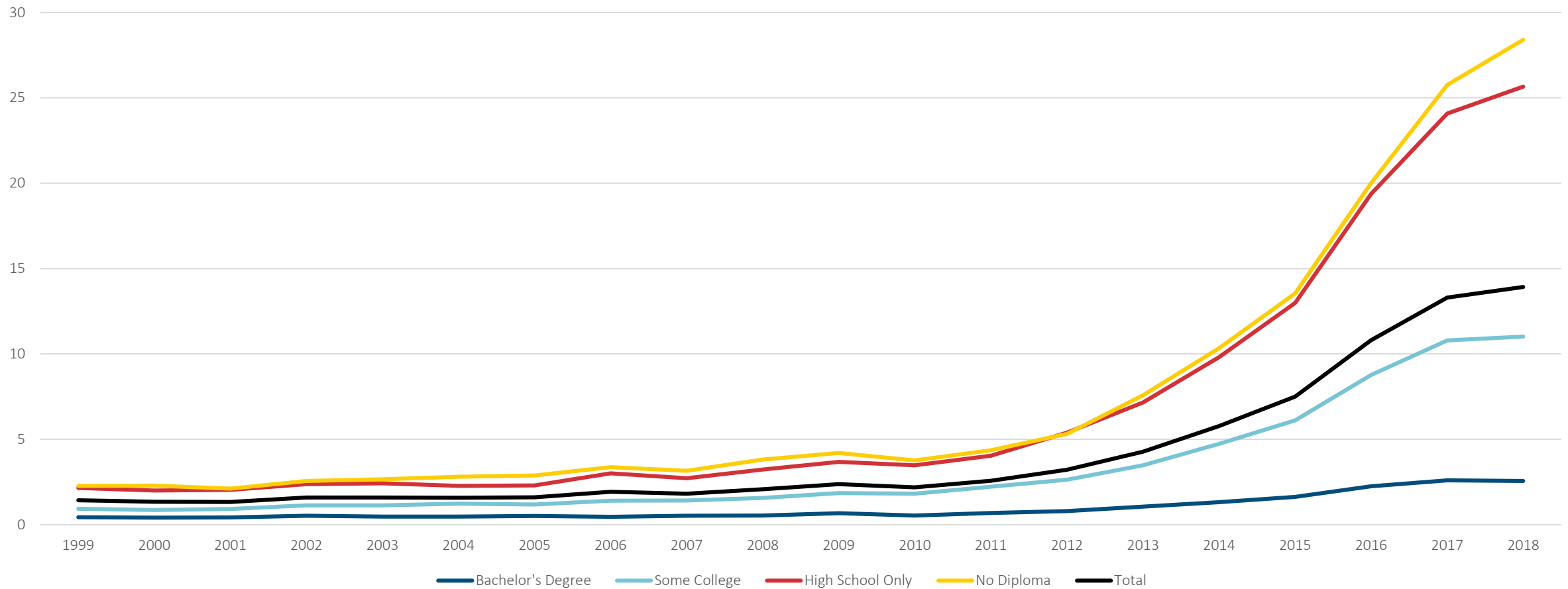
Heroin

Drug Abuse and Overdose Deaths per 100,000 by Education: 25-84



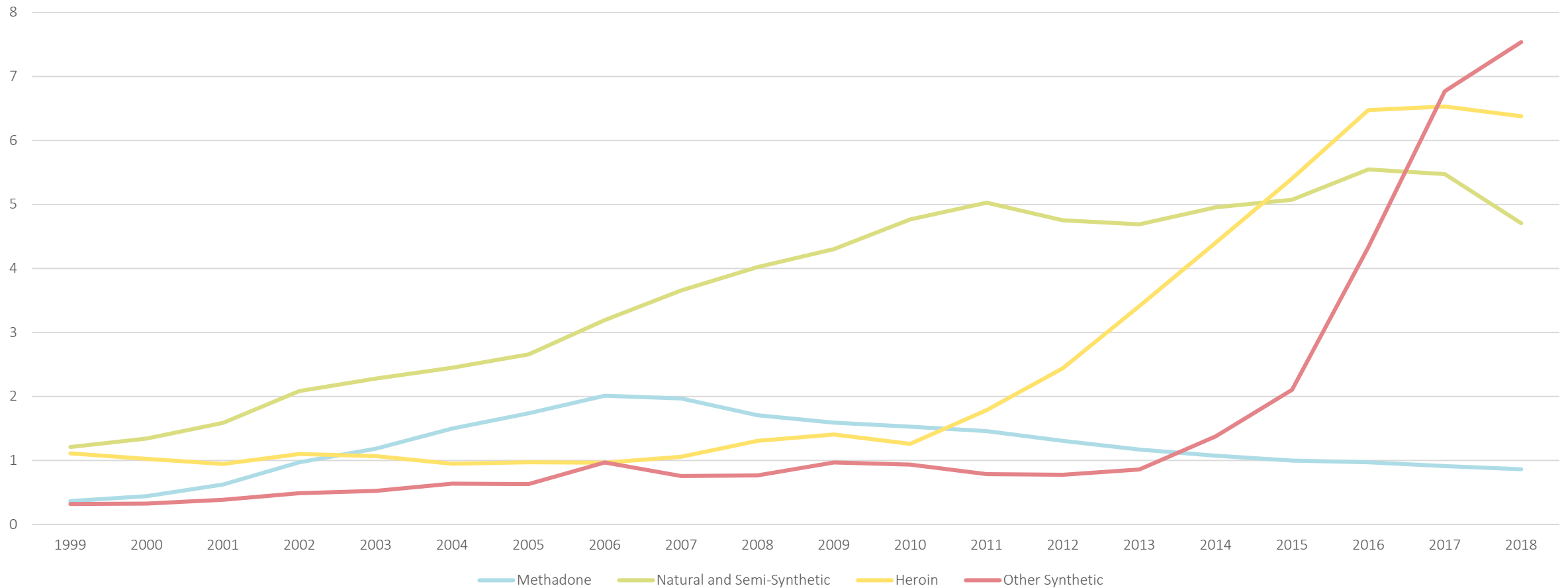
Other Synthetics

Drug Abuse and Overdose Deaths per 100,000 by Education: 25-84



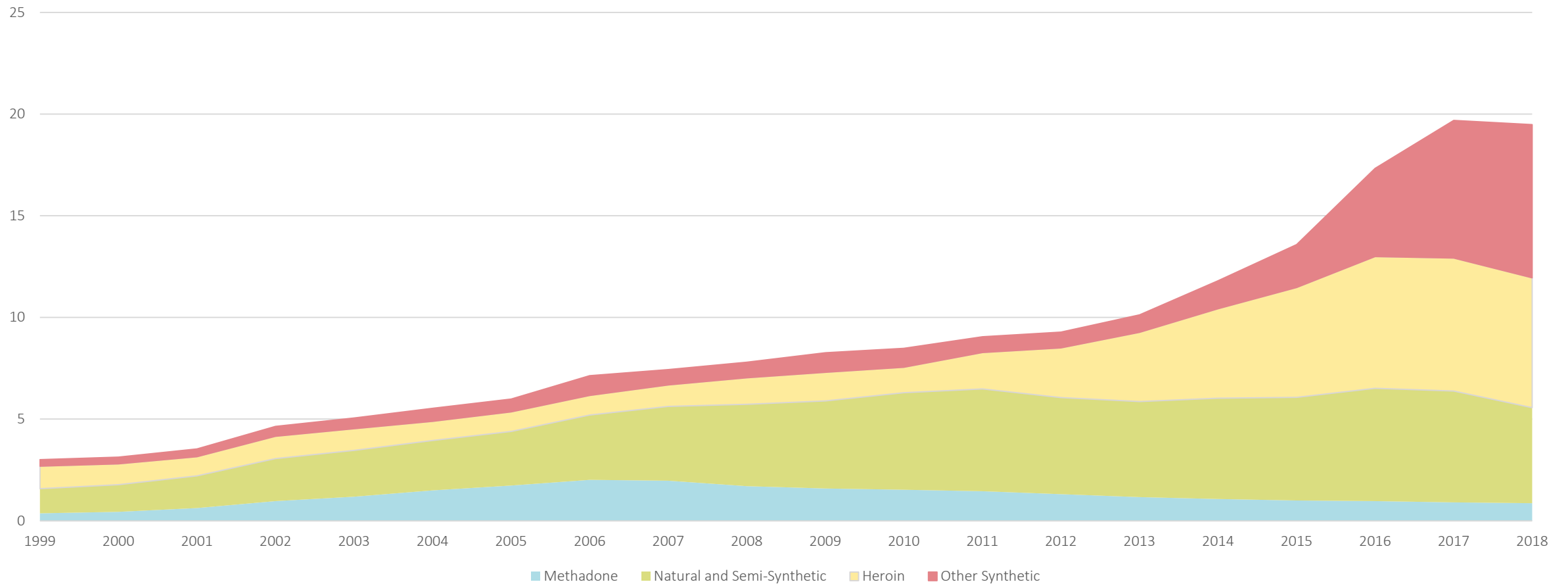
Opioid Deaths by Opioid Type

Drug Abuse and Overdose Deaths per 100,000 by Opioid Type: 25-84



Opioid Deaths by Opioid Type

Drug Abuse and Overdose Deaths per 100,000 by Opioid Type: Ages 25-84

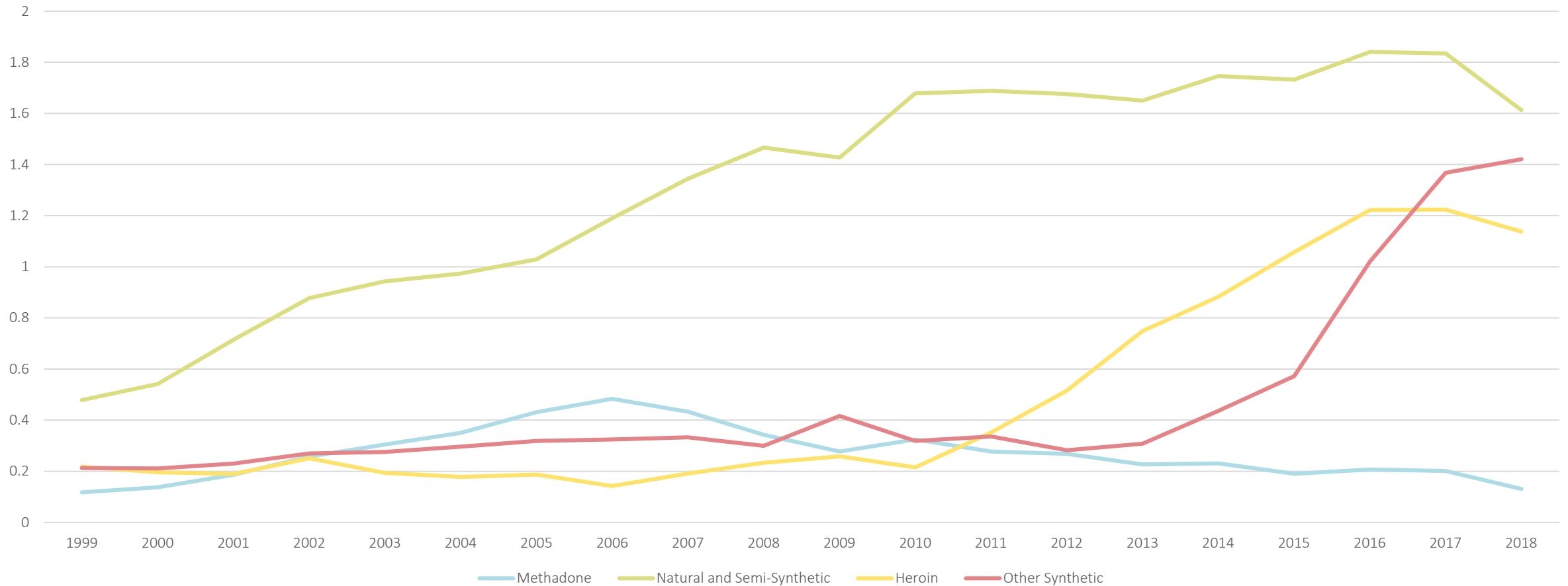


Life Insurance Impacts

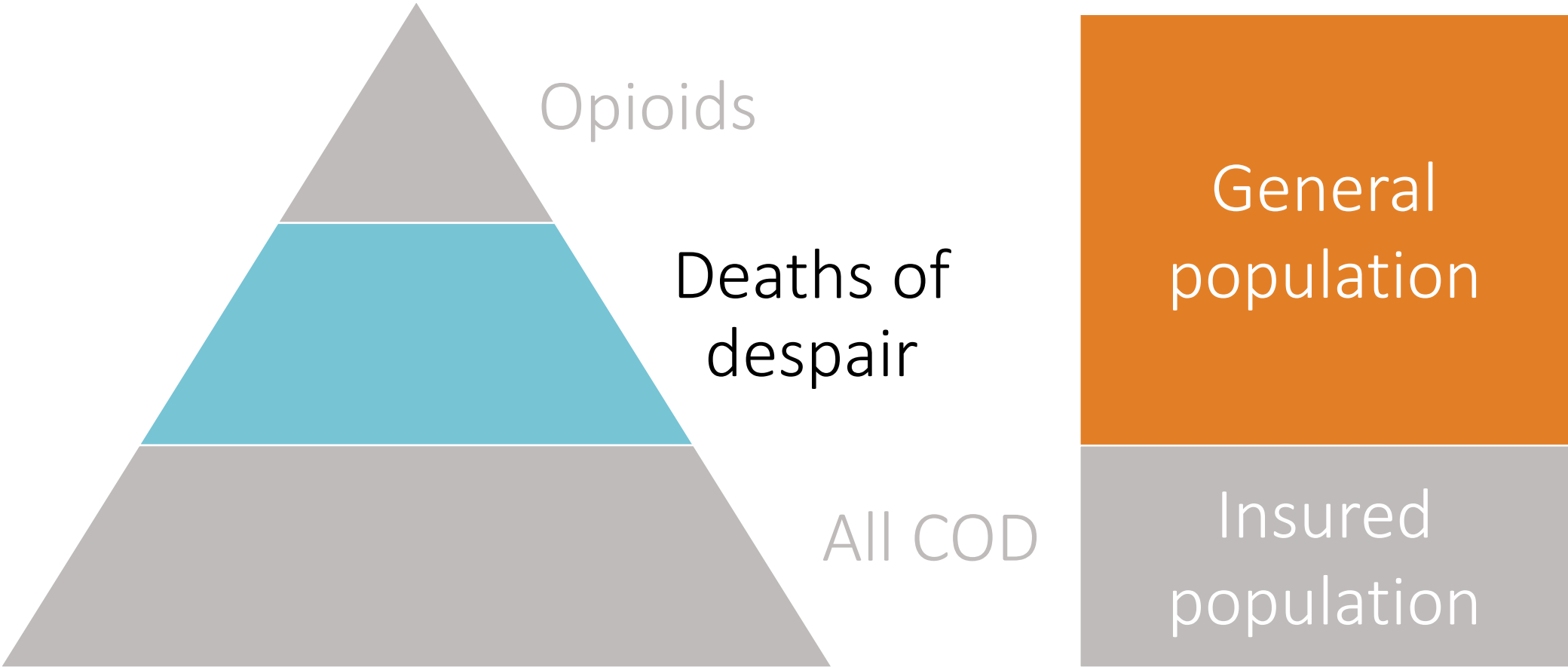


College Educated Opioid Deaths by Opioid Type

Drug Abuse and Overdose Deaths per 100,000 by Opioid Type: 25-84



Today's discussion



Deaths of Despair

Jean-Marc Fix

4 May 2020

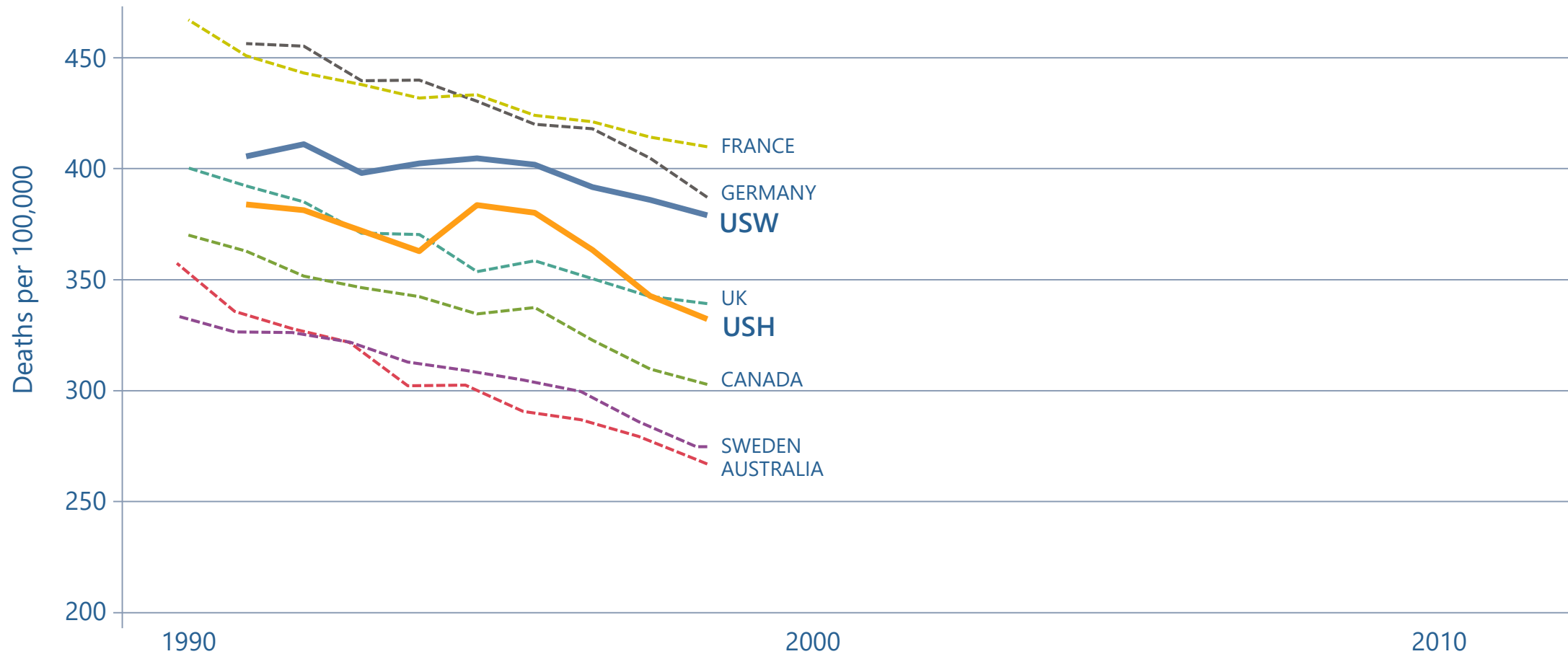


Anne Case and Angus Deaton

- Economists at Princeton
- Sir Angus Deaton won the Nobel Prize in Economy in 2015
- 2 Papers:
 - September 2015: Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century, Proceedings of the National Academy of Sciences of the United States of America
 - Spring 2017: Mortality and Morbidity in the 21st Century, Brookings Papers on Economic Activity, mentioned “Deaths of Despair”

The Data

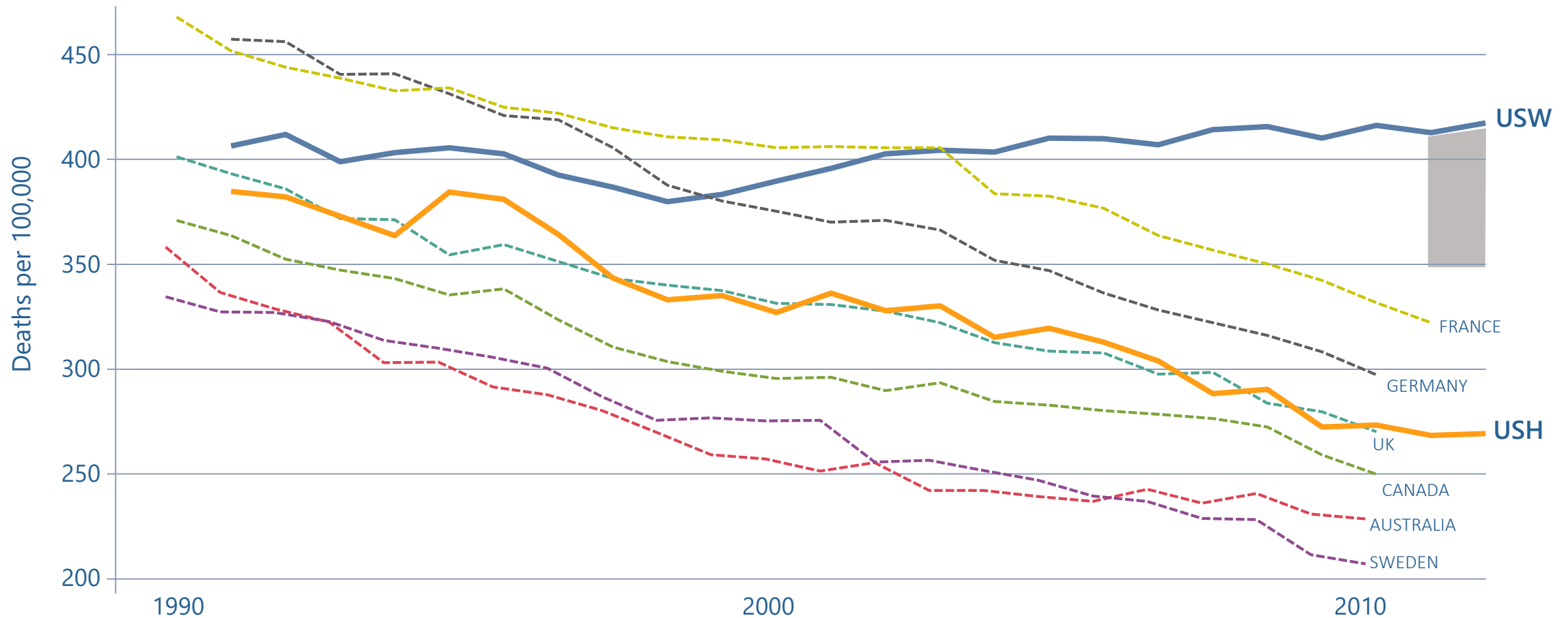
All-cause Mortality, Ages 45–54 for U.S. White Non-Hispanics (USW) and U.S. Hispanics (USH), and Six Comparison Countries



Source: A Case & A Deaton, *Rising morbidity and mortality in midlife among white Non-Hispanic Americans in the 21st century*, PNAS, 12/8/15

The Data

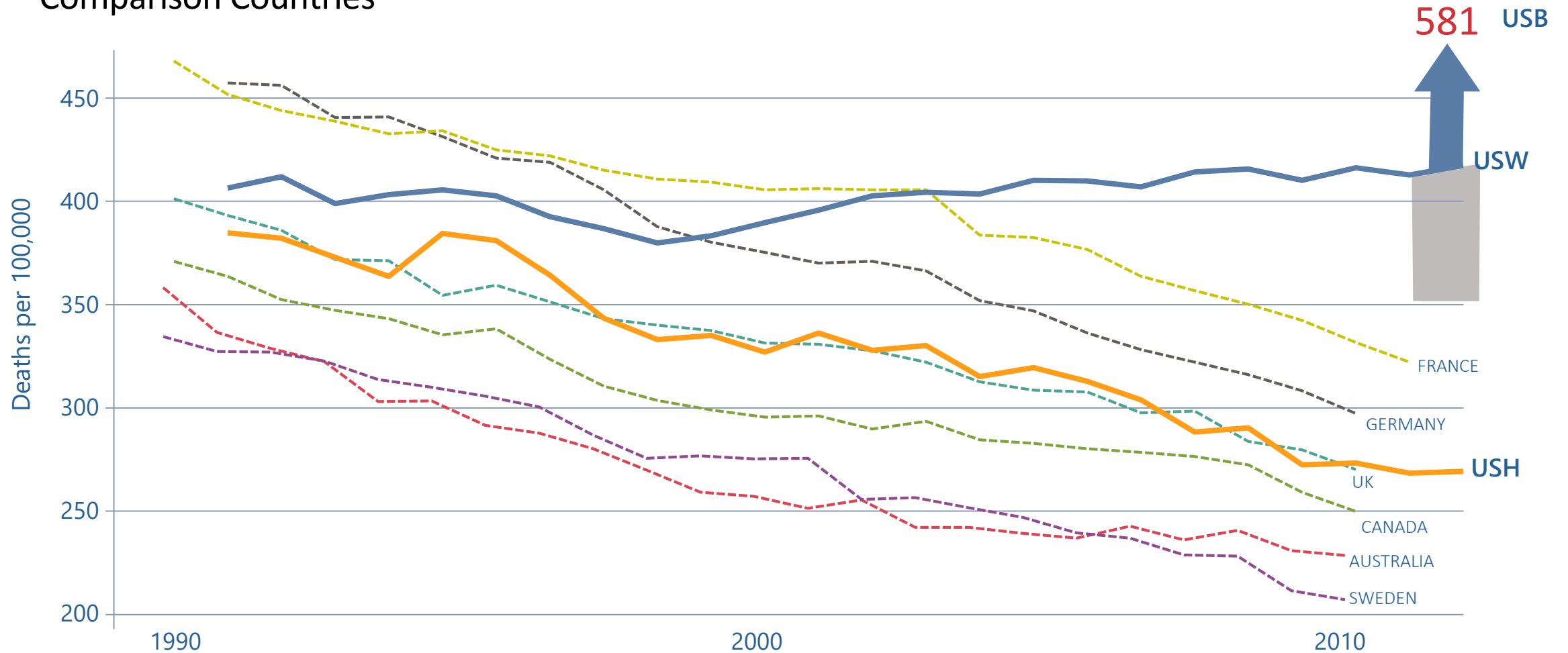
All-cause Mortality, Ages 45–54 for U.S. White Non-Hispanics (USW) and U.S. Hispanics (USH), and Six Comparison Countries



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The Data

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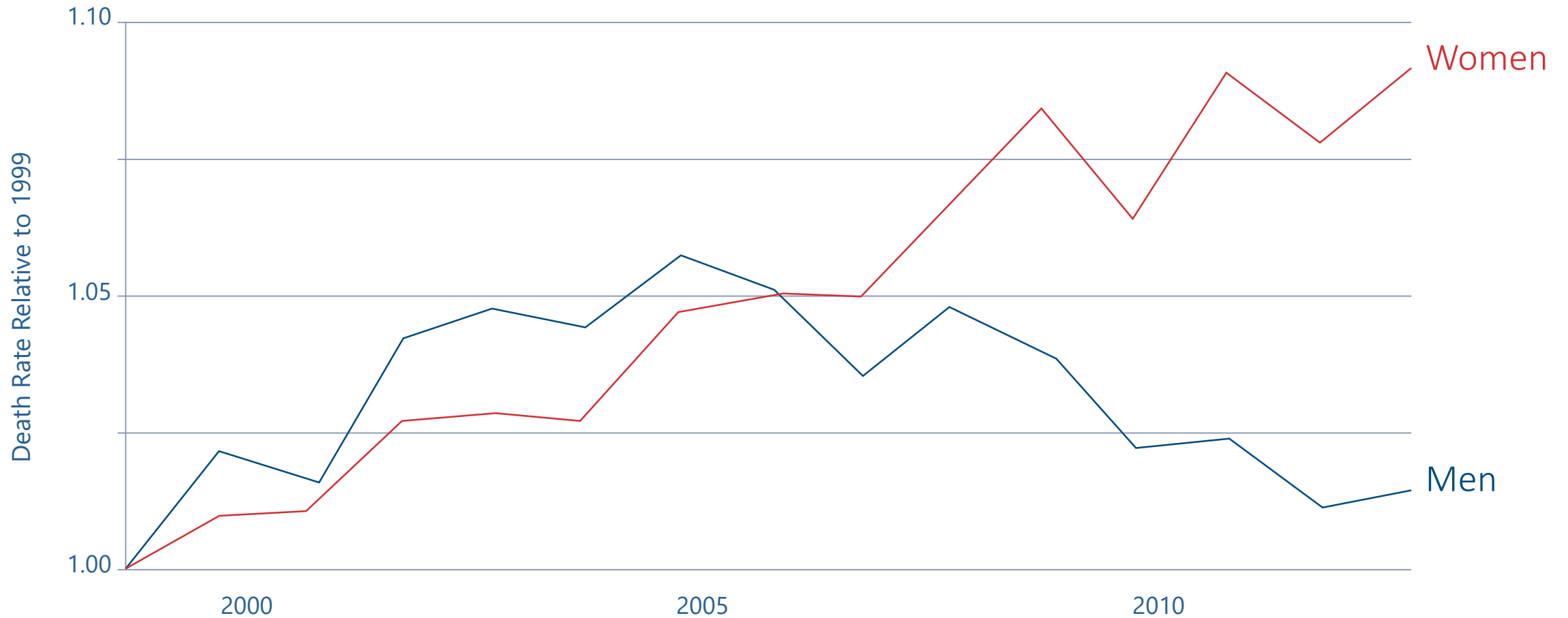
Source: A Case & A Deaton, *Rising morbidity and mortality in midlife among white Non-Hispanic Americans in the 21st century*, PNAS, 12/8/15

Criticism

- Methodology
 - Age distribution has shifted between 1999 and 2013 for such a wide age group
 - Composition of education groups has changed
- Focus
 - Even more dramatic story for women
 - Minimize story for African-American

Trends for White Non-Hispanics

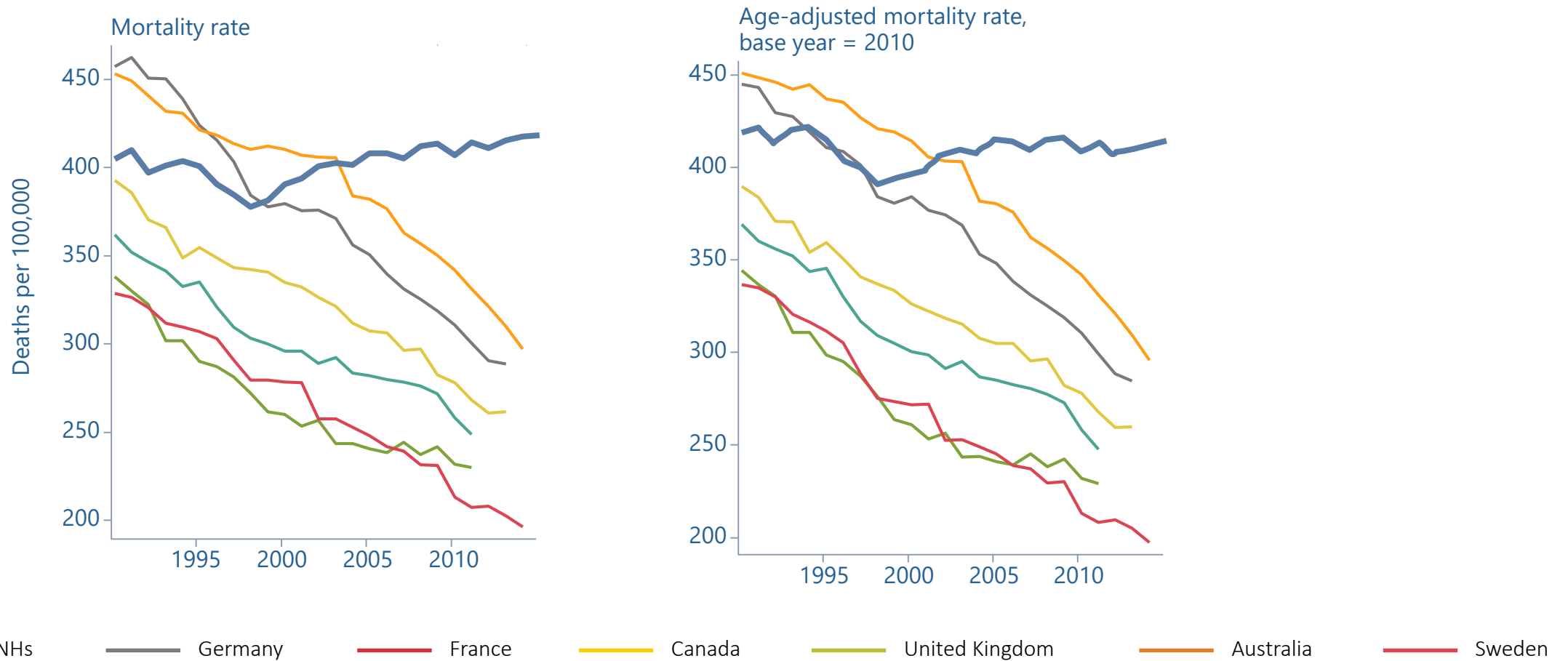
Age-Adjusted Death Rates for Women and Men Aged 45-54



Source: Age aggregation bias in mortality trends, A Gelman and J Auerbach, PNAS Letter 2/16/16

Age Adjustment

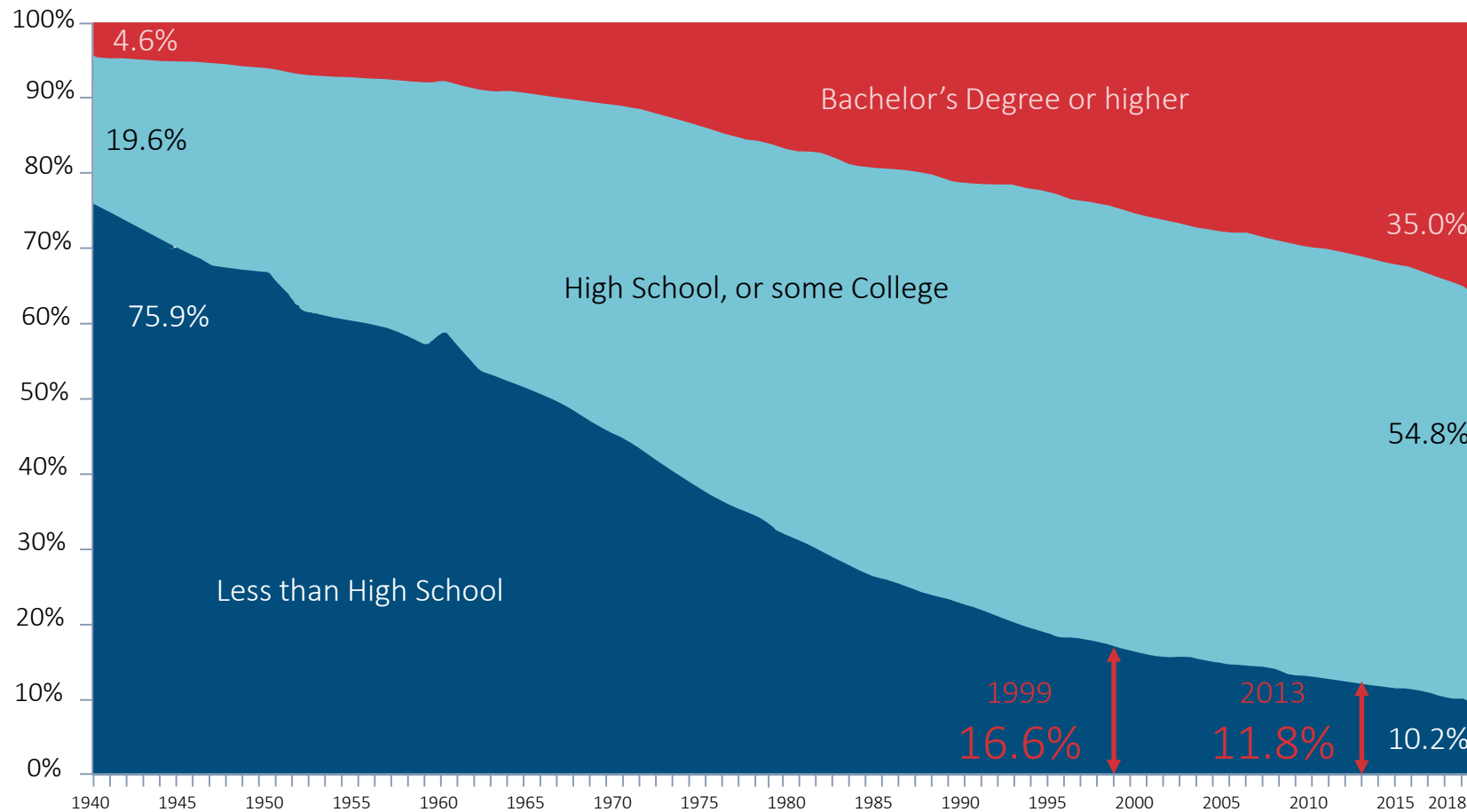
All-Cause Mortality by Country for Age 45-54, 1990-2015



Source: *Mortality and morbidity in the 21st century, Brookings Paper on Economic Activity, Spring 2017*

Group Composition by Education

Percent of Population Age 25 and Over by Educational Attainment: 1940–2018



Source: U.S. Census Bureau, 1947, 1952–2002 March Current Population Survey, 2003–2018 Annual Social and Economic Supplement to the Current Population Survey; 1940–1960 Census Population.

What Are Deaths of Despair?

- Case & Deaton **defined** *deaths of despair* as suicide, alcohol-related liver disease and drug overdoses
- Despair implies a mechanism
- Despair is difficult to define. It is a psychological and sociological issue, not an economic or demographic issue
- Without a rigorous definition of *despair*, hard to really measure *deaths of despair*

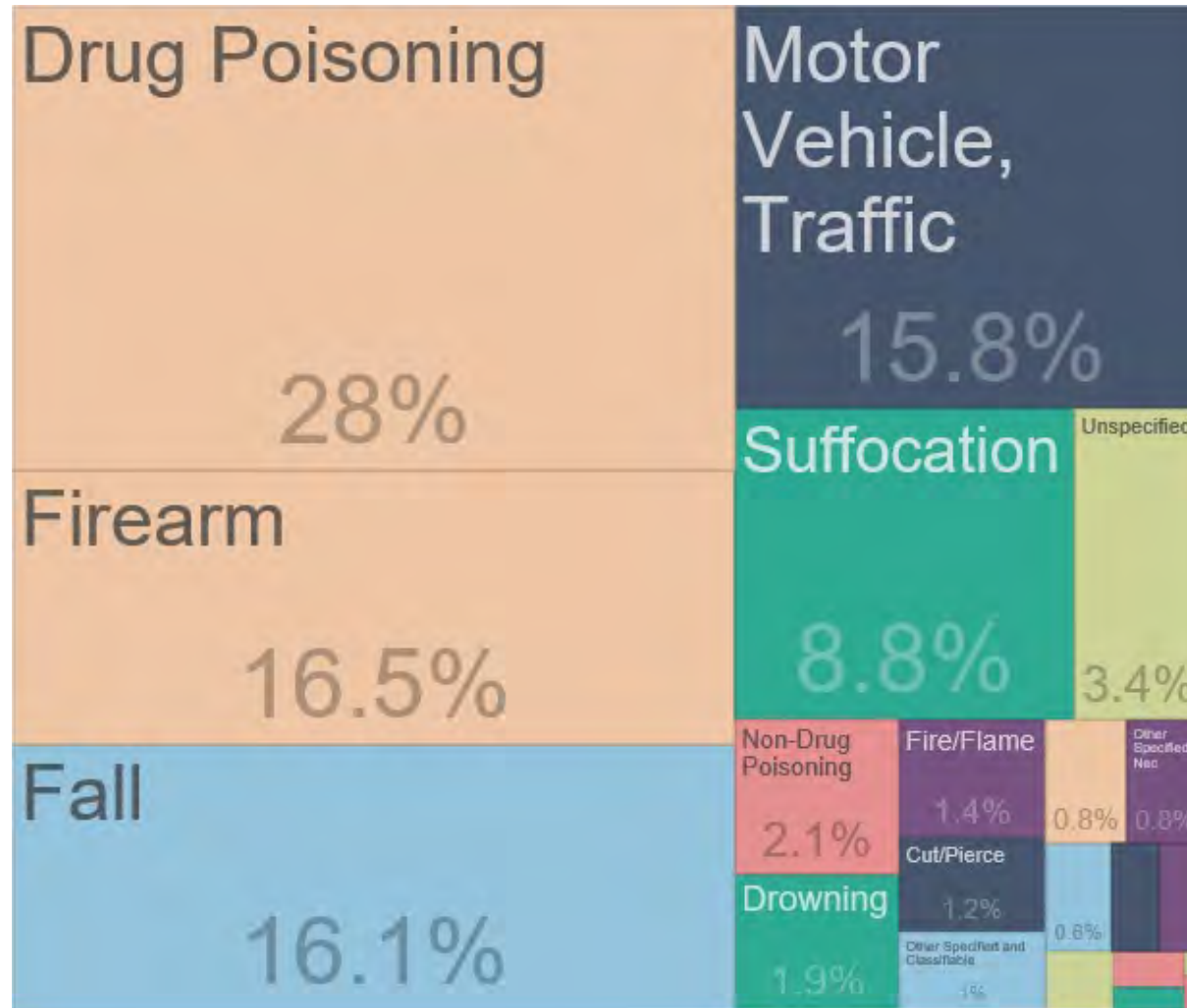
Causes of Death Caveat

- Suspicious of accuracy of causes of death reporting in the U.S.
- Especially for causes with “social” implications (HIV, suicide, drugs, alcohol)

Deaths of Despair: Suicide

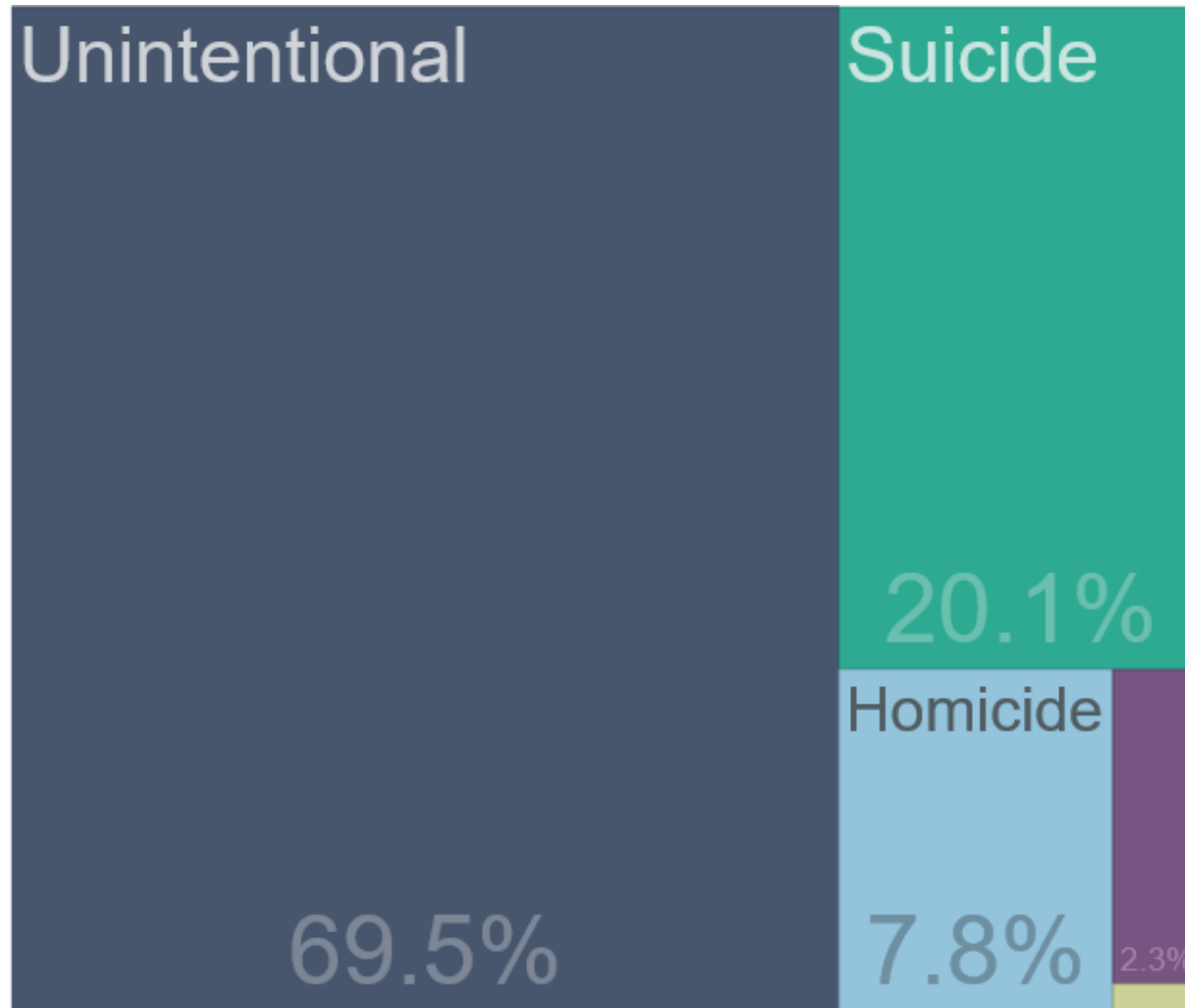


All Accidental Deaths by Means 2001-2018



Source: WISQARS

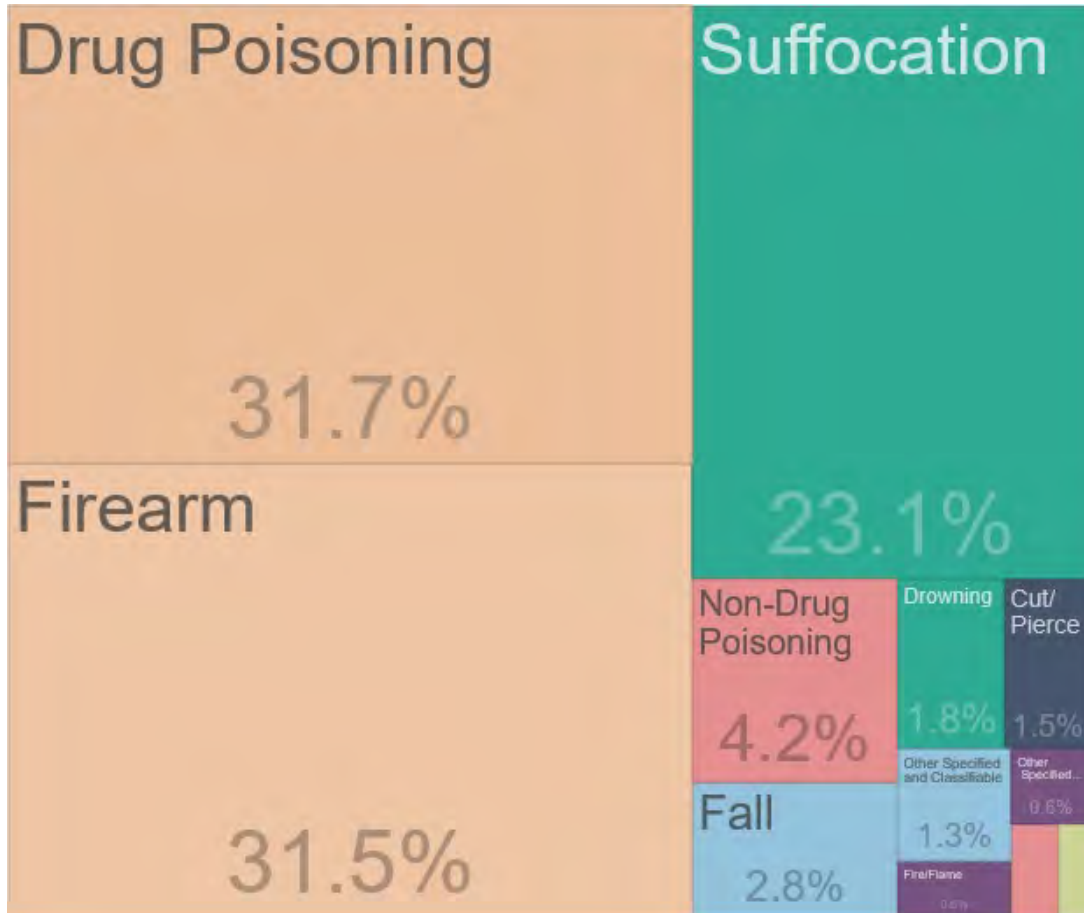
All Accidental Deaths by Intent 2001-2018



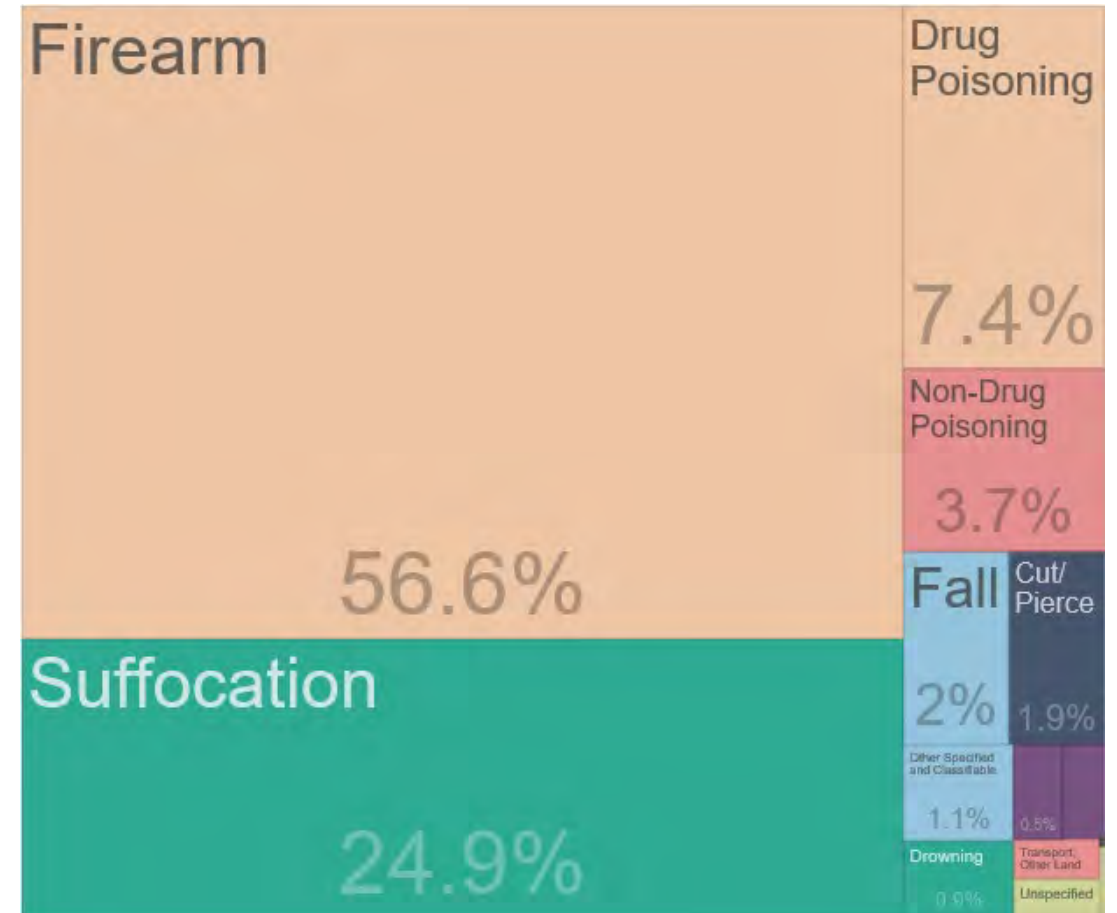
Source: WISQARS

Suicide Means by Gender

FEMALES



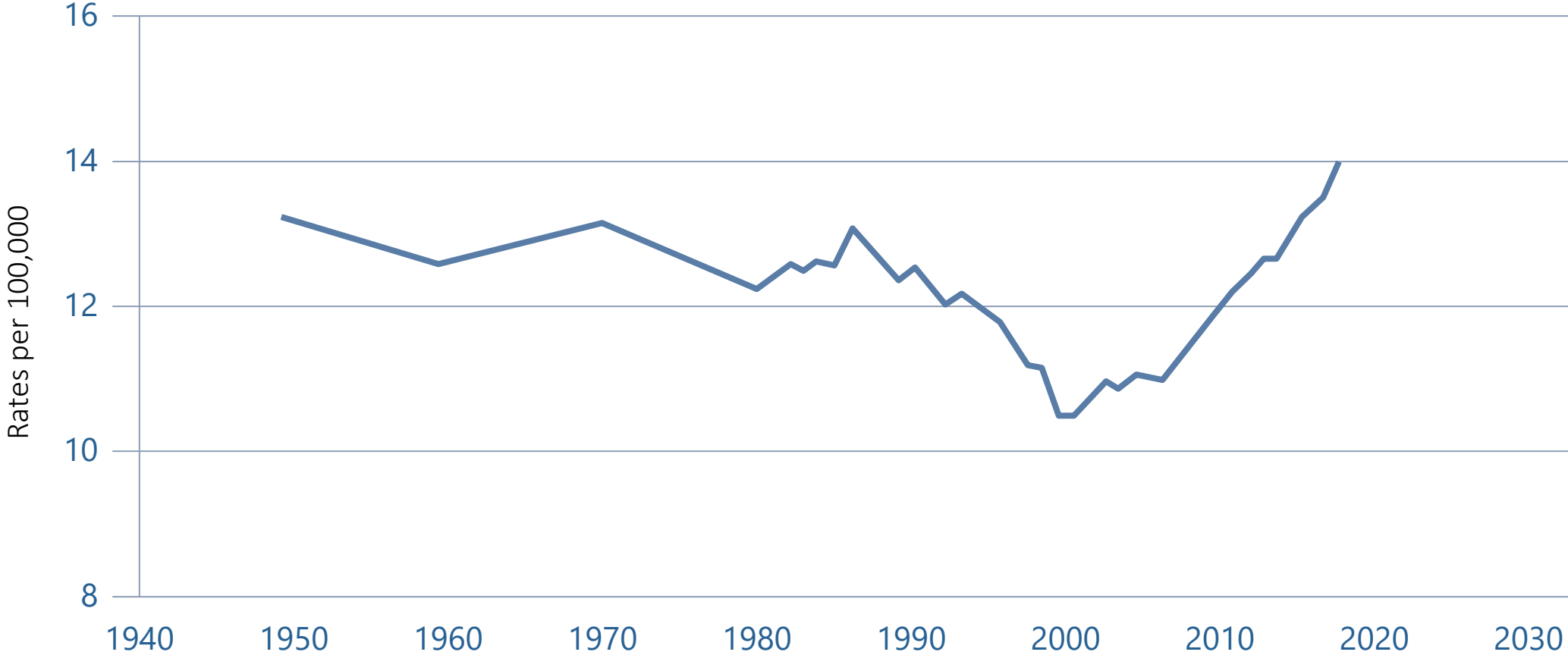
MALES



Source: WISQARS

Historical U.S. Suicide Rates

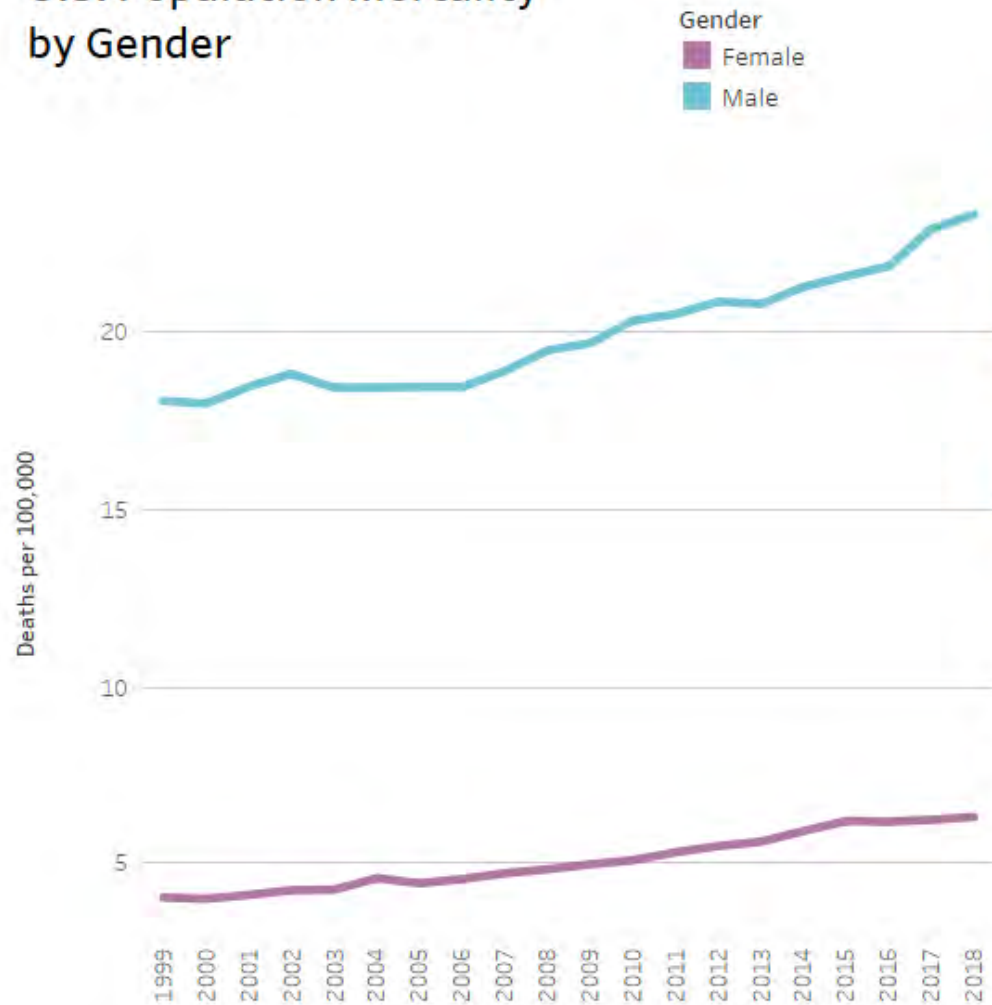
Age Adjusted



Source: Health United States 2018, Data finder Table 9; <https://www.cdc.gov/nchs/hus/contents2018.htm?search=Suicide>

Suicide by Gender

U.S. Population Mortality by Gender



Cause of Death*

Suicide

County Income Group

All

| | Annual Improvement | | |
|-------------------|--------------------|-----------|-----------|
| | 1999-2018 | 2013-2018 | 2017-2018 |
| All Ages | | | |
| All | -1.7% | -2.4% | -1.8% |
| Female | -2.4% | -2.4% | -1.3% |
| Male | -1.4% | -2.3% | -1.8% |
| Age Group+ | | | |
| < 1 year | | | |
| 1-4 years | | | |
| 5-14 years | -4.9% | -9.0% | -15.9% |
| 15-24 years | -1.9% | -5.4% | 0.0% |
| 25-34 years | -1.7% | -3.4% | -0.1% |
| 35-44 years | -1.3% | -2.4% | -1.5% |
| 45-54 years | -1.9% | -0.4% | 0.8% |
| 55-64 years | -2.7% | -2.2% | -6.3% |
| 65-74 years | -1.0% | -1.6% | -4.8% |
| 75-84 years | -0.2% | -1.8% | -3.9% |
| 85+ years | 0.1% | -0.5% | 5.1% |

*See report for Cause of Death definitions

+Includes both genders

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Holman, R. J., C. S. MacDonald, and P. J. Miller. U.S. Population Mortality Observations-Updated with 2018 Experience. Society of Actuaries, March 2020.

Source: <https://www.soa.org/resources/research-reports/2020/population-mortality-observations>

Suicide Males by County Income Group

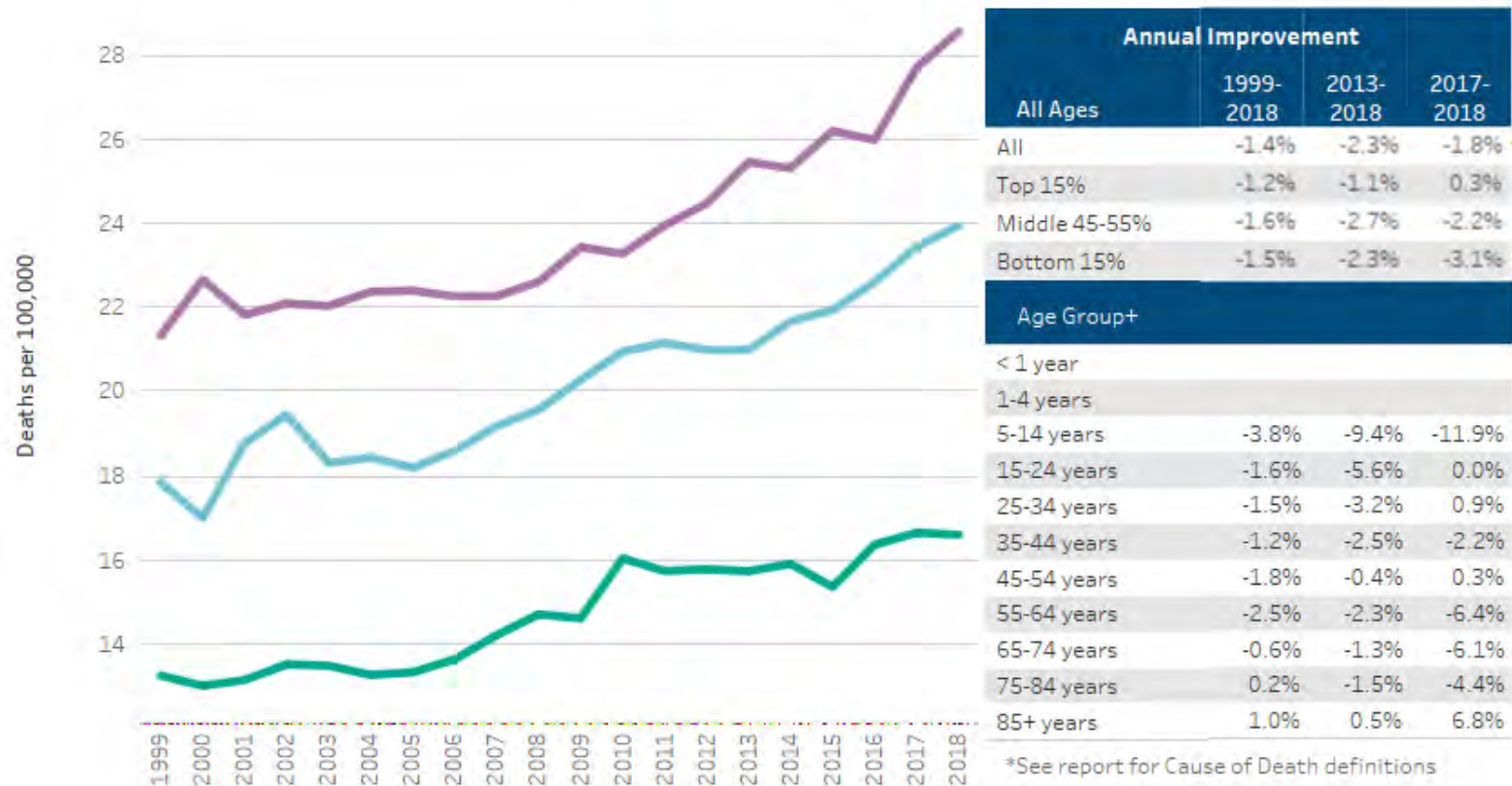
U.S. Population Mortality by County Income Group

County Income Group

- Top 15%
- Middle 45-55%
- Bottom 15%

Cause of Death
Suicide

Gender
Male



| | Annual Improvement | | |
|---------------|--------------------|-----------|-----------|
| | 1999-2018 | 2013-2018 | 2017-2018 |
| All Ages | -1.4% | -2.3% | -1.8% |
| Top 15% | -1.2% | -1.1% | 0.3% |
| Middle 45-55% | -1.6% | -2.7% | -2.2% |
| Bottom 15% | -1.5% | -2.3% | -3.1% |
| Age Group+ | | | |
| < 1 year | | | |
| 1-4 years | | | |
| 5-14 years | -3.8% | -9.4% | -11.9% |
| 15-24 years | -1.6% | -5.6% | 0.0% |
| 25-34 years | -1.5% | -3.2% | 0.9% |
| 35-44 years | -1.2% | -2.5% | -2.2% |
| 45-54 years | -1.8% | -0.4% | 0.3% |
| 55-64 years | -2.5% | -2.3% | -6.4% |
| 65-74 years | -0.6% | -1.3% | -6.1% |
| 75-84 years | 0.2% | -1.5% | -4.4% |
| 85+ years | 1.0% | 0.5% | 6.8% |

*See report for Cause of Death definitions
+Includes all counties

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Holman, R. J., C. S. MacDonald, and P. J. Miller. U.S. Population Mortality Observations-Updated with 2018 Experience. Society of Actuaries, March 2020.

Source: <https://www.soa.org/resources/research-reports/2020/population-mortality-observations>

Suicide Females by County Income Group

U.S. Population Mortality
by County Income Group

County Income Group

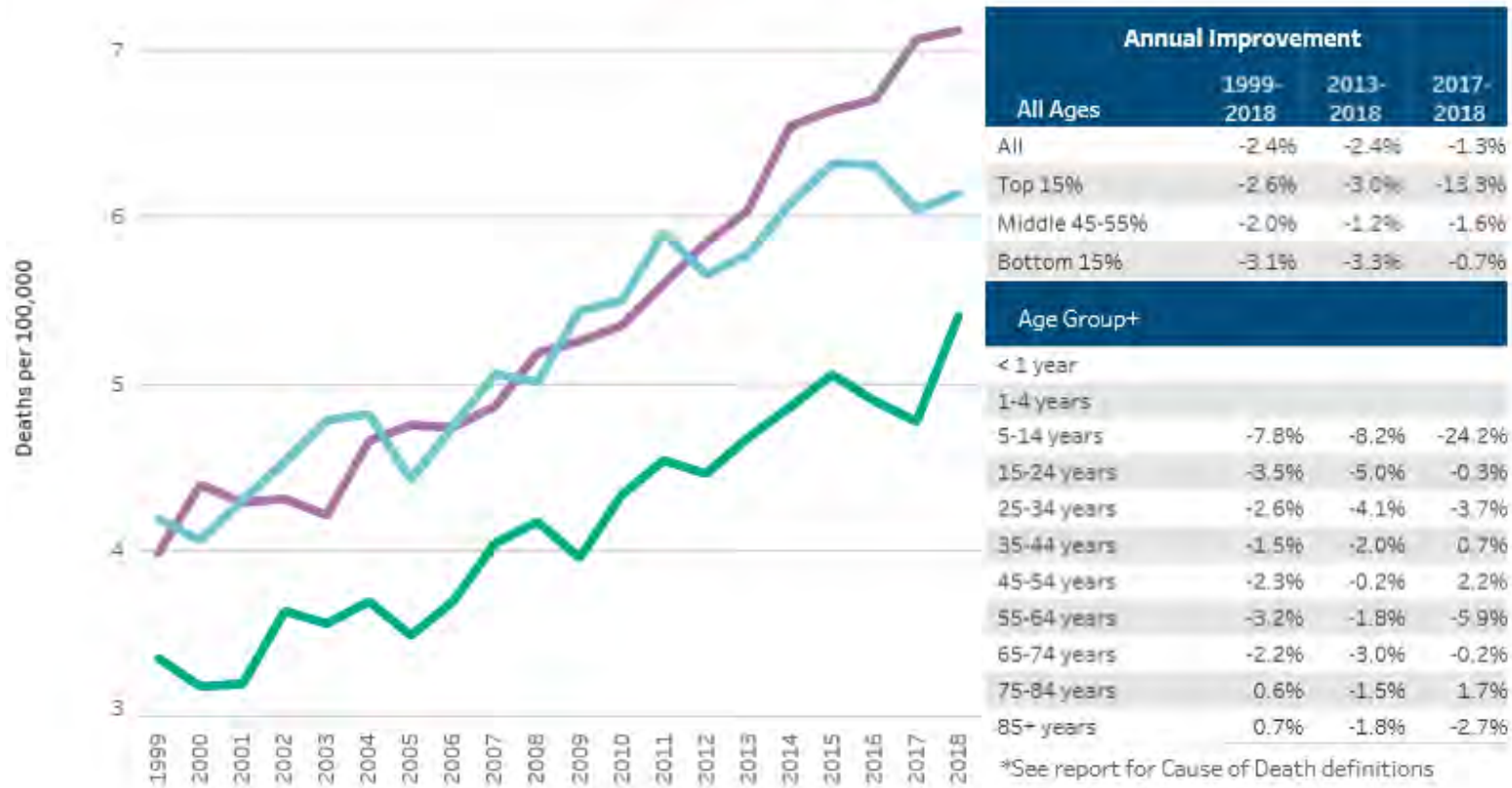
- Top 15%
- Middle 45-55%
- Bottom 15%

Cause of Death

Suicide

Gender

Female



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+Includes all counties

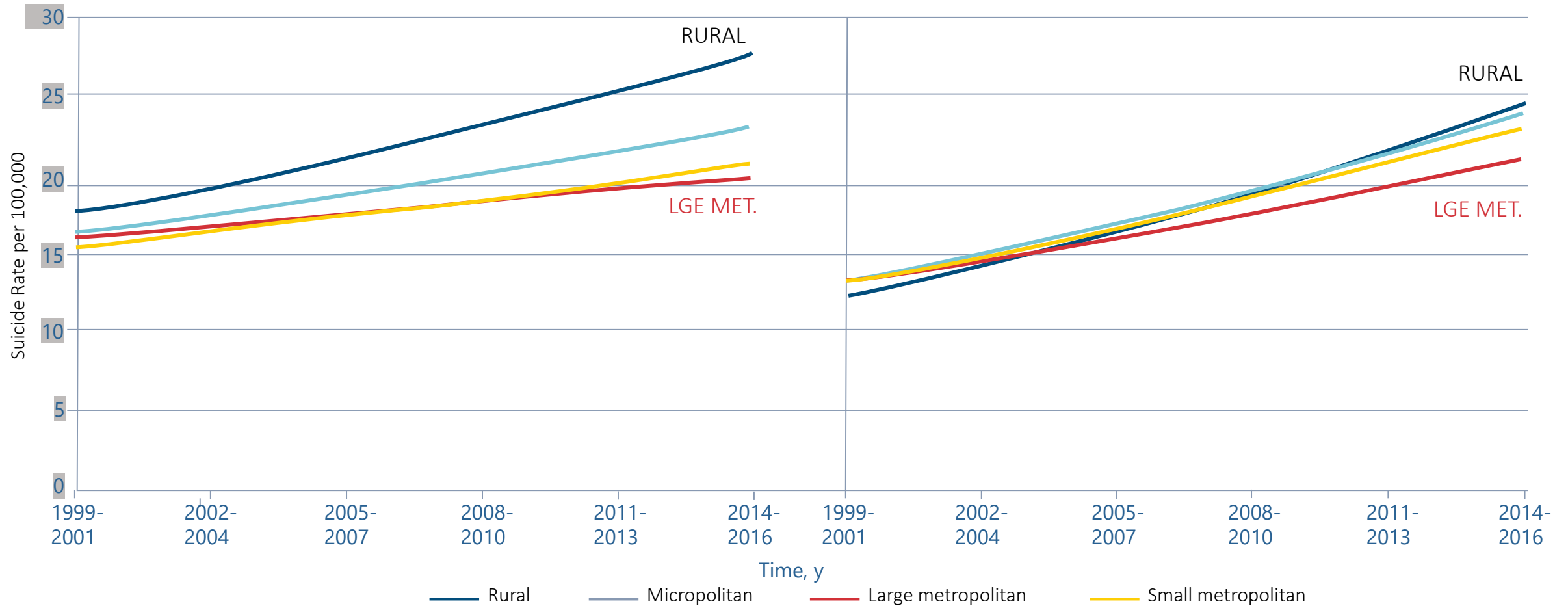
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Source: <https://www.soa.org/resources/research-reports/2020/population-mortality-observations>

Suicide Rates by Urban/Rural

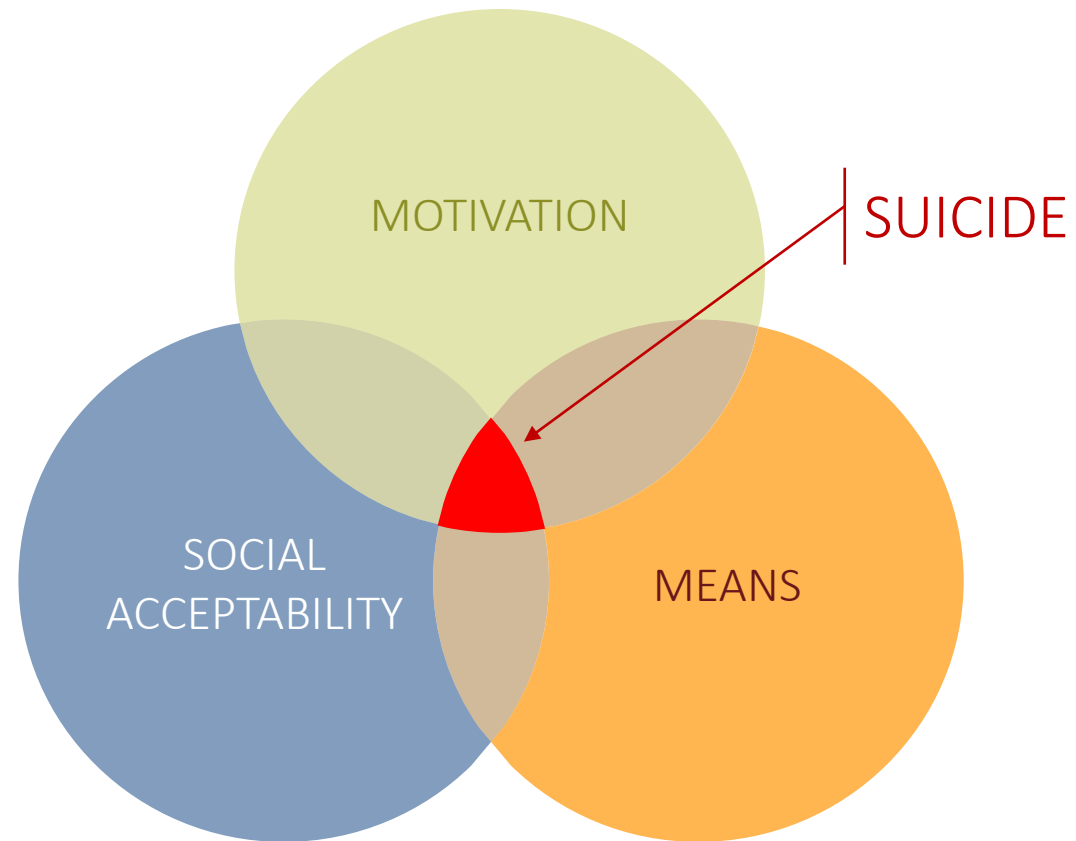
A Suicide rate trajectory for counties with high deprivation

B Suicide rate trajectory for counties with low deprivation



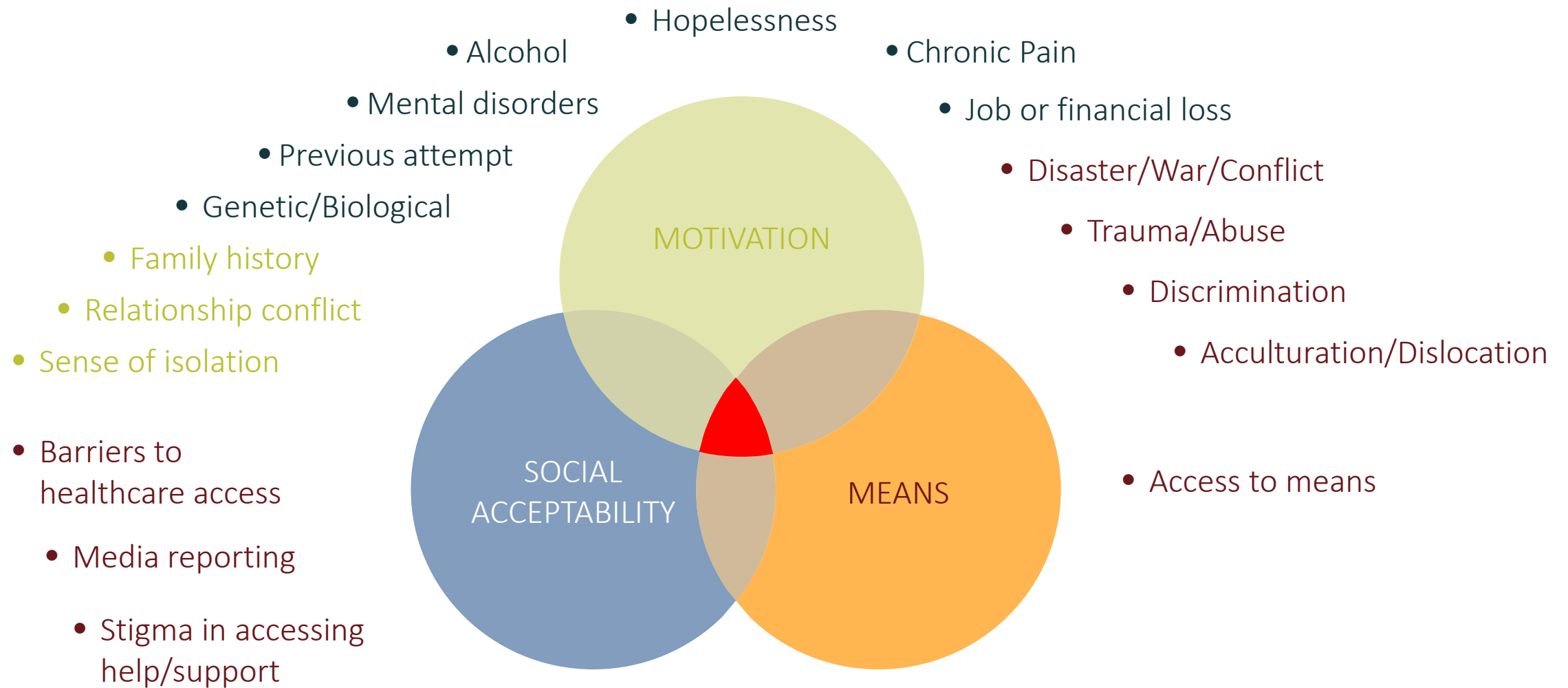
Source: Contextual Factors Associated With County-Level Suicide Rates in the United States, 1999 to 2016, DL Steelsmith et al, JAMA Network Open 9/6/19

Suicide Is Multifactorial



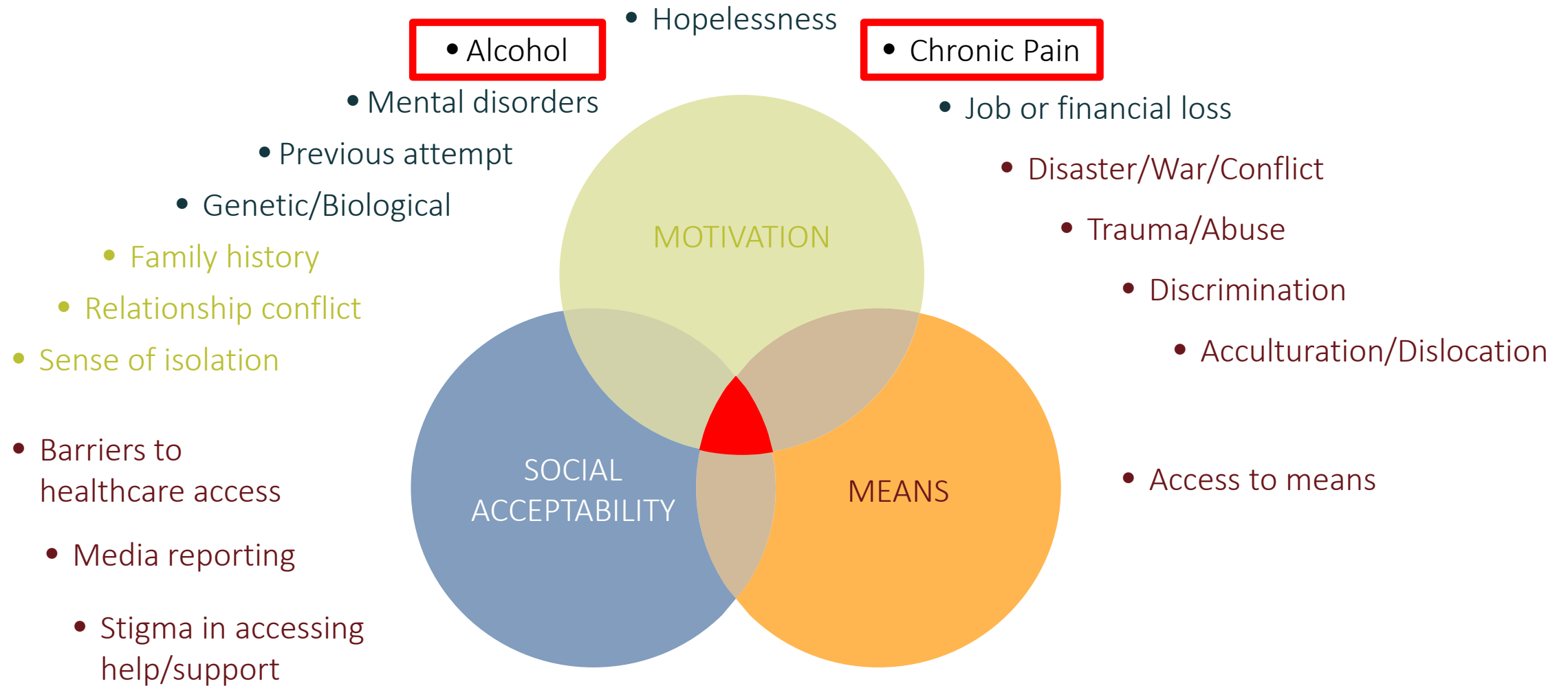
Source: Adapted from *Preventing suicide: A global imperative*, WHO 2014

Suicide Is Multifactorial



Source: Adapted from Preventing suicide: A global imperative, WHO 2014

Suicide Is Multifactorial



Source: Adapted from *Preventing suicide: A global imperative*, WHO 2014

Deaths of Despair: Alcohol



Alcohol-related Deaths by Age

Percentage of Deaths by Category for Each Age-Group

| | Age Group | | | | |
|-------------------------------|------------|------------|------------|------------|------------|
| | 0-19 | 20-34 | 35-49 | 50-64 | 65+ |
| Chronic Causes | | | | | |
| Alcohol dependence syndrome | 0% | 1% | 5% | 7% | 3% |
| Alcoholic liver disease | 0% | 2% | 19% | 29% | 12% |
| Hypertension | 0% | 0% | 1% | 1% | 5% |
| Liver cirrhosis unspecified | 0% | 1% | 5% | 12% | 15% |
| Low birth weight | 5% | 0% | 0% | 0% | 0% |
| Stroke hemorrhagic | 0% | 0% | 1% | 1% | 5% |
| Subtotal Chronic | 5% | 5% | 37% | 63% | 58% |
| Acute Causes | | | | | |
| Fall injuries | 1% | 1% | 2% | 3% | 26% |
| Homicide | 30% | 25% | 9% | 4% | 2% |
| Motor-vehicle traffic crashes | 35% | 35% | 17% | 8% | 3% |
| Poisoning (not alcohol) | 7% | 16% | 16% | 8% | 1% |
| Suicide | 11% | 13% | 12% | 9% | 5% |
| Subtotal Acute | 95% | 95% | 63% | 37% | 42% |

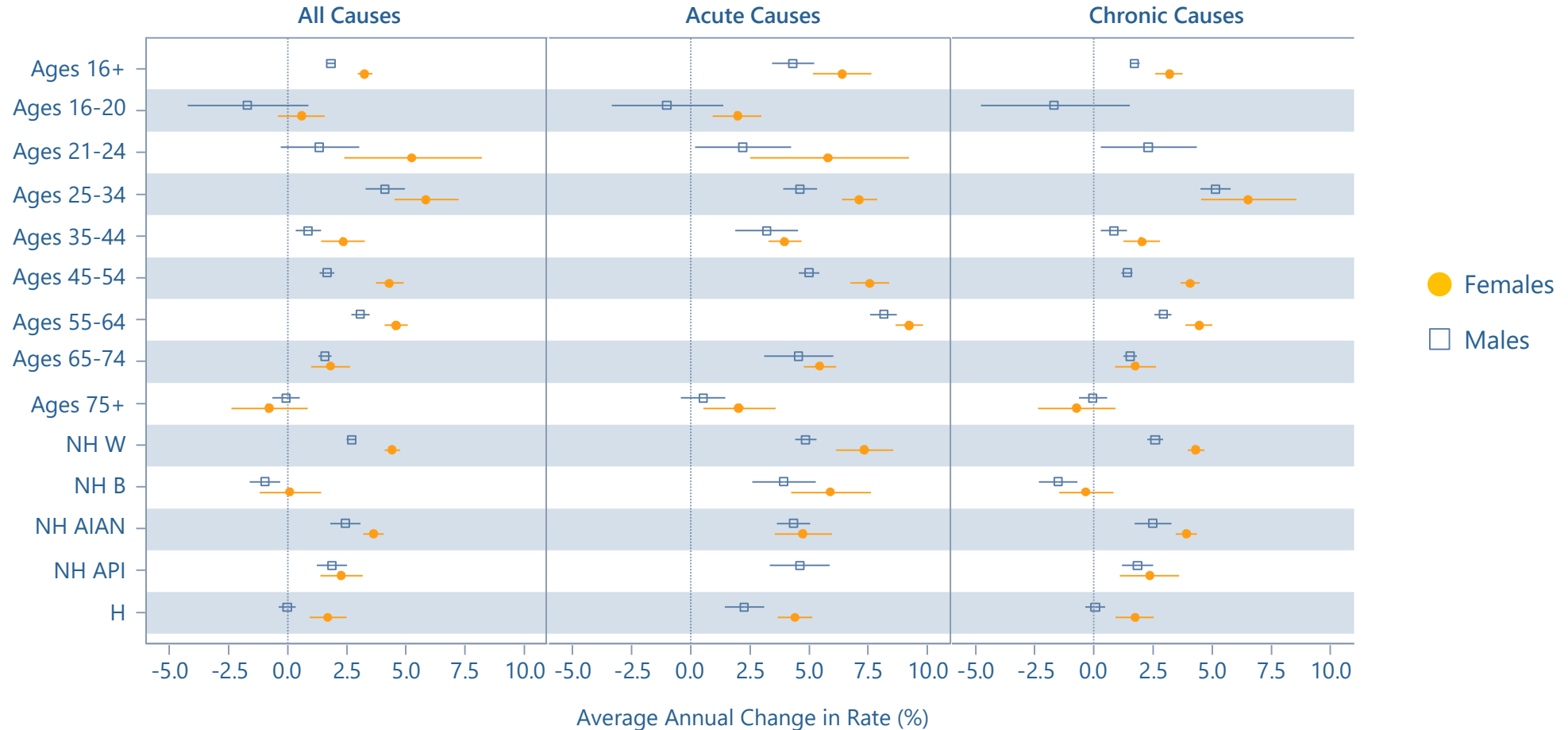
For 2006-2010: average of 88 thousand deaths related to alcohol (about 3% deaths, around 7th or 8th cause of death)

Beneficial: gallstones!

Source: CDC's ARDI: Alcohol and Public Health: Alcohol-Related Disease Impact

Change in Alcohol-Related Death Rates, 1999-2017

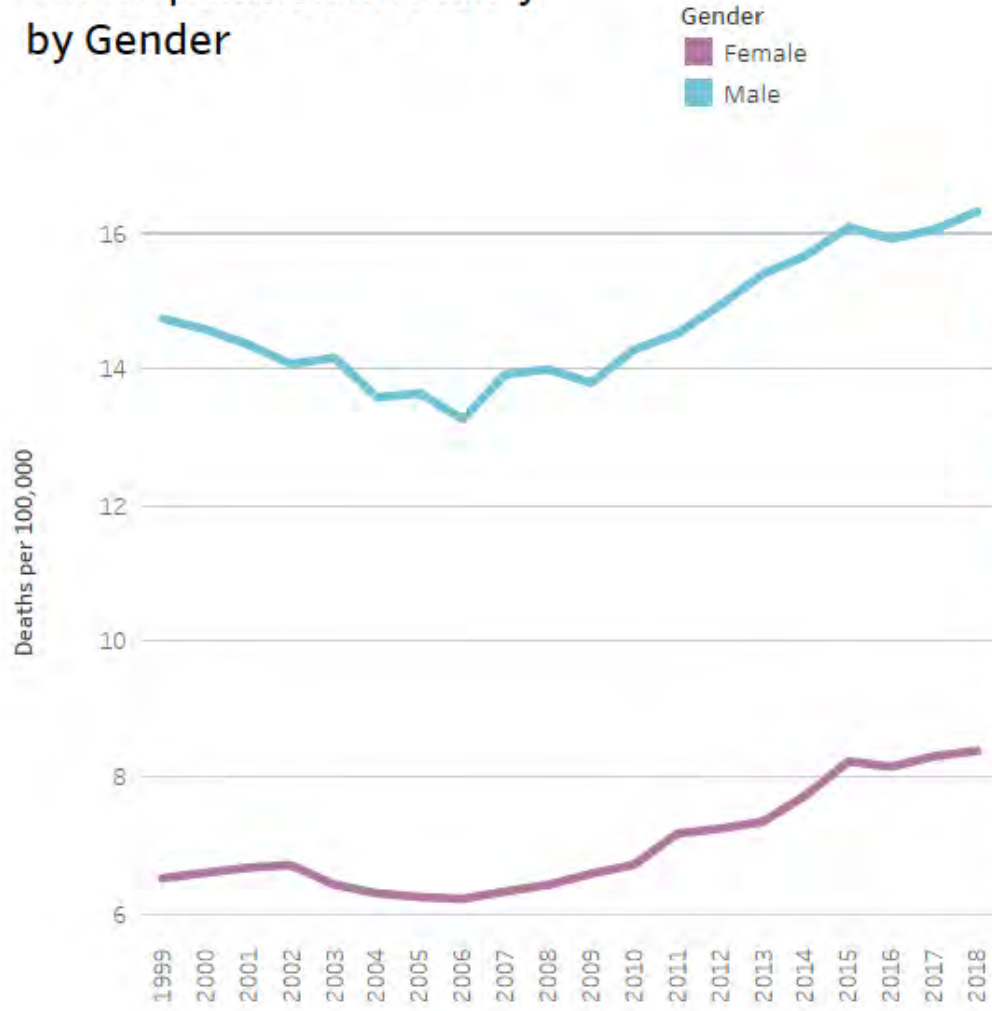
Estimated AAPC in Age-Adjusted or Age-Specific Death Rates by Sex and Age-Group or Race/Ethnicity



Source: Using Death Certificates to Explore Changes in Alcohol-Related Mortality in the United States, 1999 to 2017, AM White et al, Alcoholism: Clinical and Experimental Research 2019

Liver by Gender

U.S. Population Mortality by Gender



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Cause of Death*

Liver

County Income Group

All

| Annual Improvement | | | |
|--------------------|-----------|-----------|-----------|
| All Ages | 1999-2018 | 2013-2018 | 2017-2018 |
| All | -0.8% | -1.6% | -1.4% |
| Female | -1.3% | -2.7% | -0.9% |
| Male | -0.5% | -1.2% | -1.7% |

| Age Group+ | | | |
|-------------|-------|-------|--------|
| < 1 year | | | |
| 1-4 years | | | |
| 5-14 years | | | |
| 15-24 years | -0.5% | -0.5% | -40.0% |
| 25-34 years | -4.2% | -6.9% | -9.0% |
| 35-44 years | -0.1% | -4.1% | -2.6% |
| 45-54 years | -0.6% | 0.5% | 0.1% |
| 55-64 years | -1.8% | -1.6% | -0.8% |
| 65-74 years | -0.3% | -2.9% | -2.6% |
| 75-84 years | -0.1% | -1.7% | -3.7% |
| 85+ years | -0.5% | -2.1% | 5.1% |

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+Includes both genders

Holman, R. J., C. S. MacDonald, and P. J. Miller. U.S. Population Mortality Observations-Updated with 2018 Experience. Society of Actuaries, March 2020.

Source: <https://www.soa.org/resources/research-reports/2020/population-mortality-observations>

Excessive Alcohol Use and Socio-Economic Status

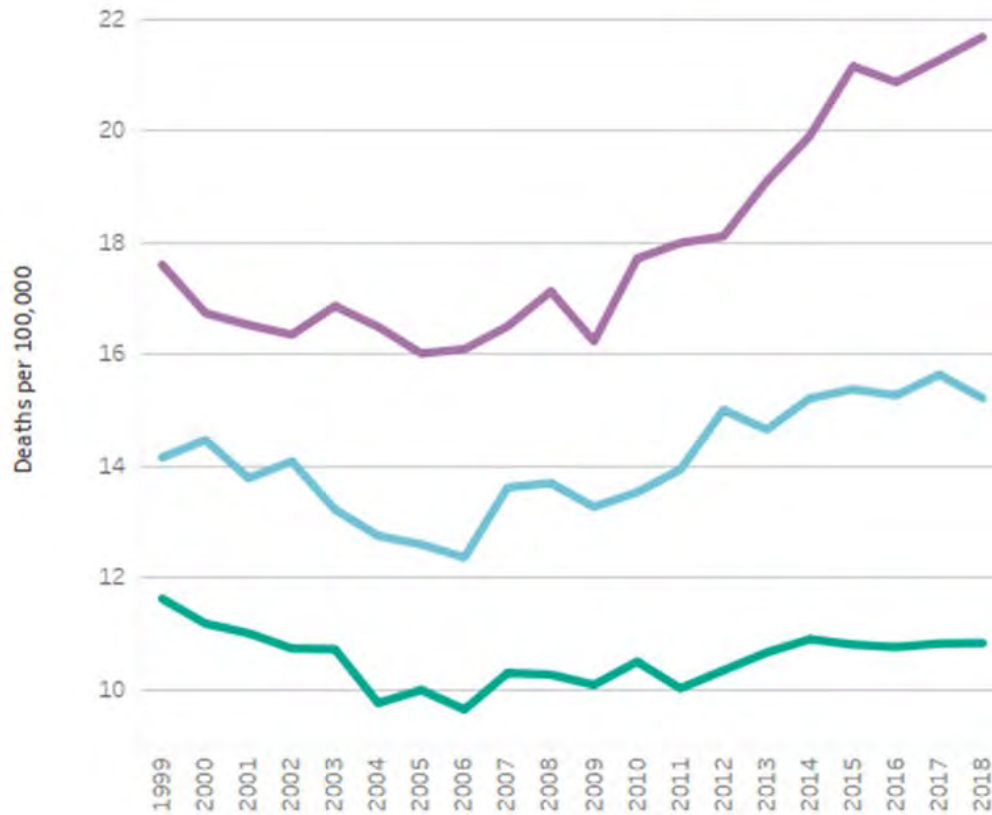
- The Alcohol Harm Paradox: higher income/SES drink more but are less “hurt”
- Not all drinking patterns are as hurtful
 - Heavy drinking: more than 15, for males, and 8, for females drinks, a week
 - Binge drinking: more than 5, for males, and 4, for females, drinks at a sitting
- Alcohol Harm Paradox revisited: for the same drinking pattern higher SES suffer less harm!

Liver Males by County Income Group

U.S. Population Mortality by County Income Group

County Income Group
■ Top 15%
■ Middle 45-55%
■ Bottom 15%

Cause of Death
Liver
 Gender
Male



| Annual Improvement | | | |
|--------------------|-----------|-----------|-----------|
| All Ages | 1999-2018 | 2013-2018 | 2017-2018 |
| All | -0.5% | -1.2% | -1.7% |
| Top 15% | 0.4% | -0.3% | -0.1% |
| Middle 45-55% | -0.4% | -0.8% | 2.7% |
| Bottom 15% | -1.1% | -2.6% | -1.9% |

| Age Group+ | | | |
|-------------|-------|-------|--------|
| < 1 year | | | |
| 1-4 years | | | |
| 5-14 years | | | |
| 15-24 years | -3.6% | -2.3% | -61.3% |
| 25-34 years | -3.7% | -4.6% | -5.0% |
| 35-44 years | 0.5% | -3.2% | -3.4% |
| 45-54 years | 0.2% | 0.9% | -0.7% |
| 55-64 years | -1.5% | -0.6% | -1.5% |
| 65-74 years | -0.3% | -3.0% | -1.8% |
| 75-84 years | -0.2% | -2.3% | -4.2% |
| 85+ years | -0.2% | -2.4% | 3.2% |

*See report for Cause of Death definitions
 +Includes all counties

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Holman, R. J., C. S. MacDonald, and P. J. Miller. U.S. Population Mortality Observations-Updated with 2018 Experience. Society of Actuaries, March 2020.

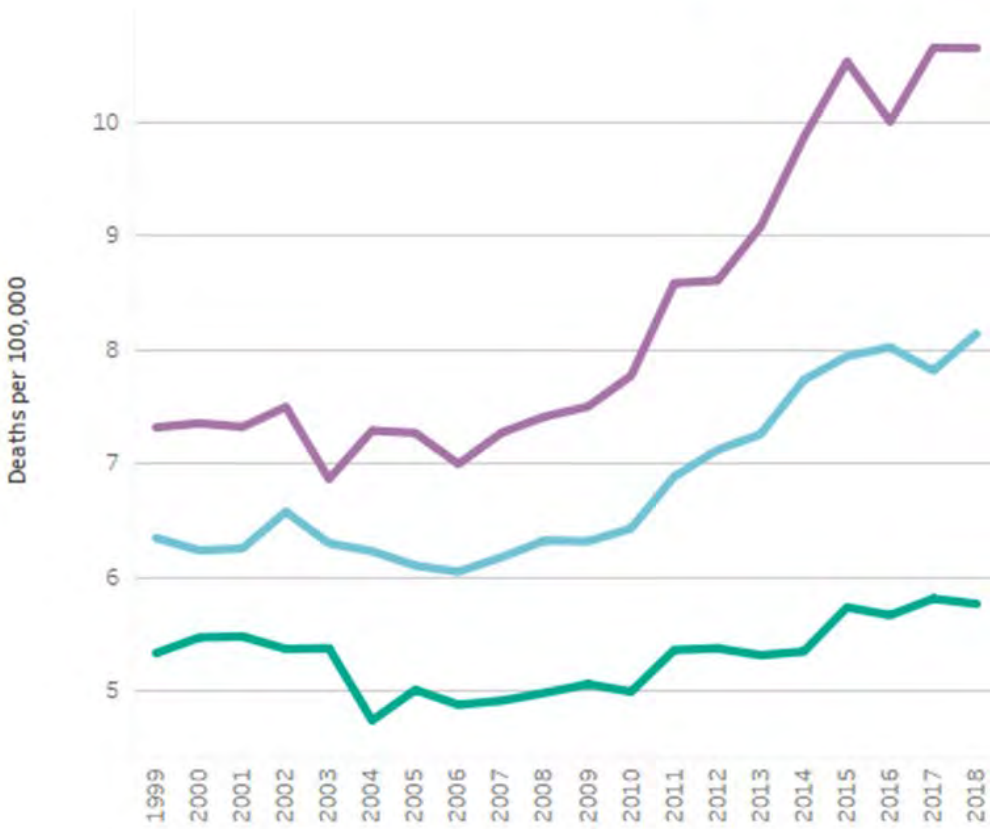
Source: <https://www.soa.org/resources/research-reports/2020/population-mortality-observations>

Liver Females by County Income Group

U.S. Population Mortality by County Income Group

County Income Group
■ Top 15%
■ Middle 45-55%
■ Bottom 15%

Cause of Death
Liver
 Gender
Female



| Annual Improvement | | | |
|--------------------|-----------|-----------|-----------|
| All Ages | 1999-2018 | 2013-2018 | 2017-2018 |
| All | -1.3% | -2.7% | -0.9% |
| Top 15% | -0.4% | -1.6% | 0.8% |
| Middle 45-55% | -1.3% | -2.3% | -4.1% |
| Bottom 15% | -2.0% | -3.2% | 0.0% |

| Age Group+ | | | |
|-------------|-------|--------|--------|
| < 1 year | | | |
| 1-4 years | | | |
| 5-14 years | | | |
| 15-24 years | | | |
| 25-34 years | -5.0% | -10.7% | -14.8% |
| 35-44 years | -1.4% | -5.7% | -1.2% |
| 45-54 years | -2.6% | -0.3% | 1.6% |
| 55-64 years | -2.2% | -4.0% | 0.5% |
| 65-74 years | -0.1% | -2.9% | -4.1% |
| 75-84 years | 0.3% | -0.9% | -2.9% |
| 85+ years | -0.3% | -1.5% | 7.0% |

*See report for Cause of Death definitions
 +Includes all counties

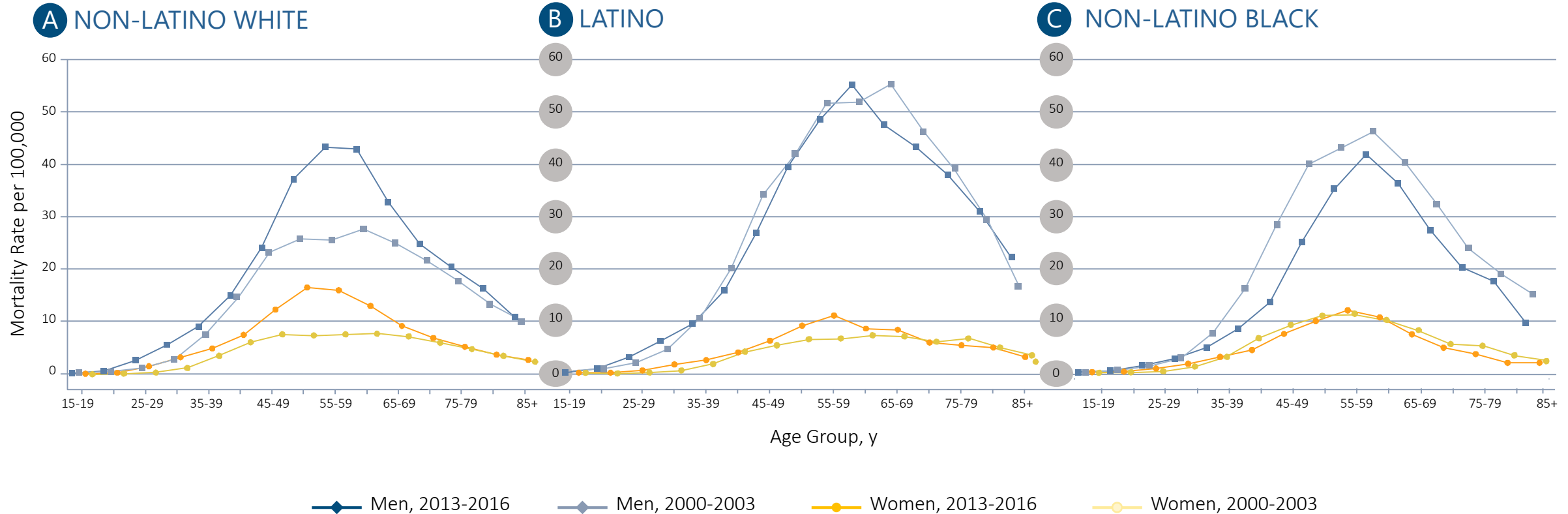
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Holman, R. J., C. S. MacDonald, and P. J. Miller. U.S. Population Mortality Observations-Updated with 2018 Experience. Society of Actuaries, March 2020.

Source: <https://www.soa.org/resources/research-reports/2020/population-mortality-observations>

Alcohol-Induced Deaths by Gender and Race/Ethnicity

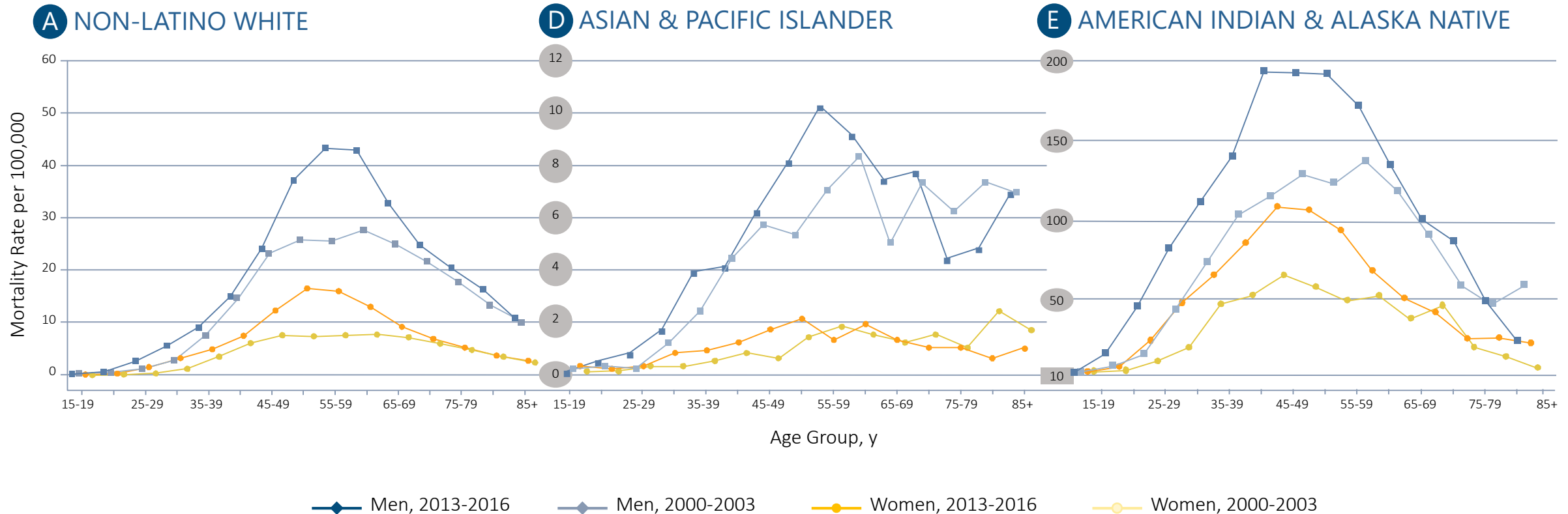
2000–2003 vs. 2013–2016



Source: S Spilane et al, Trends in Alcohol-Induced Deaths in the United States, 2000-2016, JAMA Network Open 2/21/20

Alcohol-Induced Deaths by Gender and Race/Ethnicity

2000–2003 vs. 2013–2016



Source: S Spilane et al, Trends in Alcohol-Induced Deaths in the United States, 2000-2016, JAMA Network Open 2/21/20

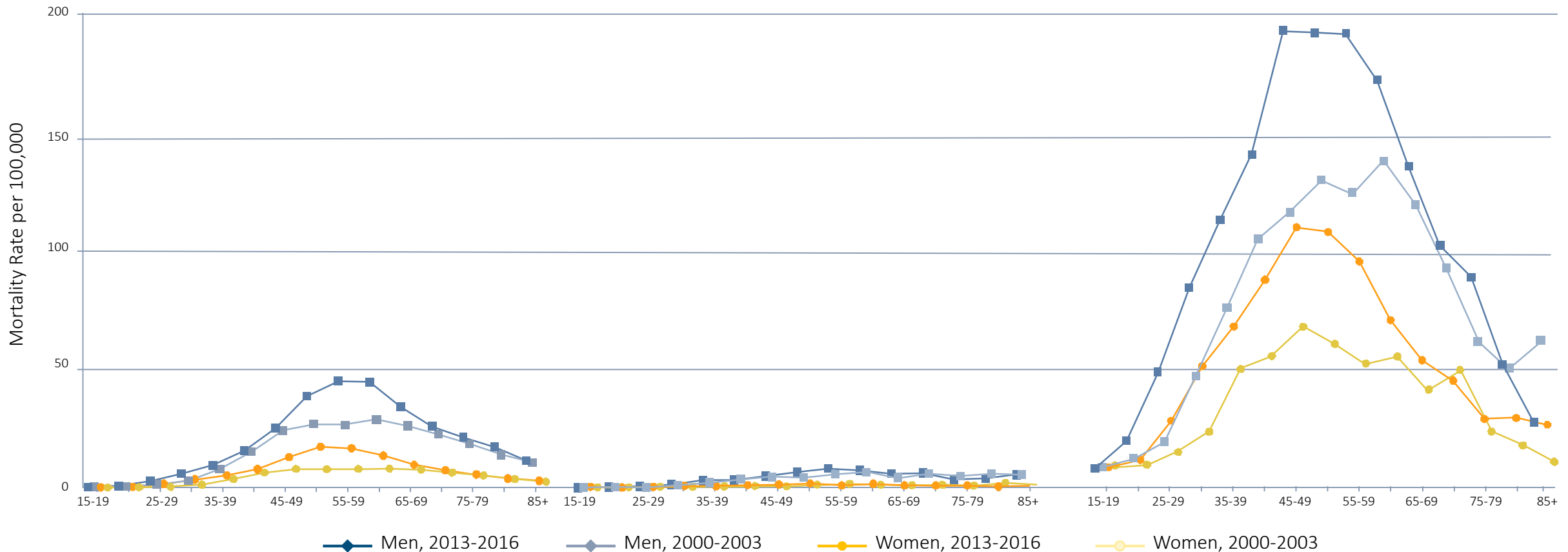
Alcohol-Induced Deaths by Gender and Race/Ethnicity

2000–2003 vs. 2013–2016

A NON-LATINO WHITE

D ASIAN & PACIFIC ISLANDER

E AMERICAN INDIAN & ALASKA NATIVE



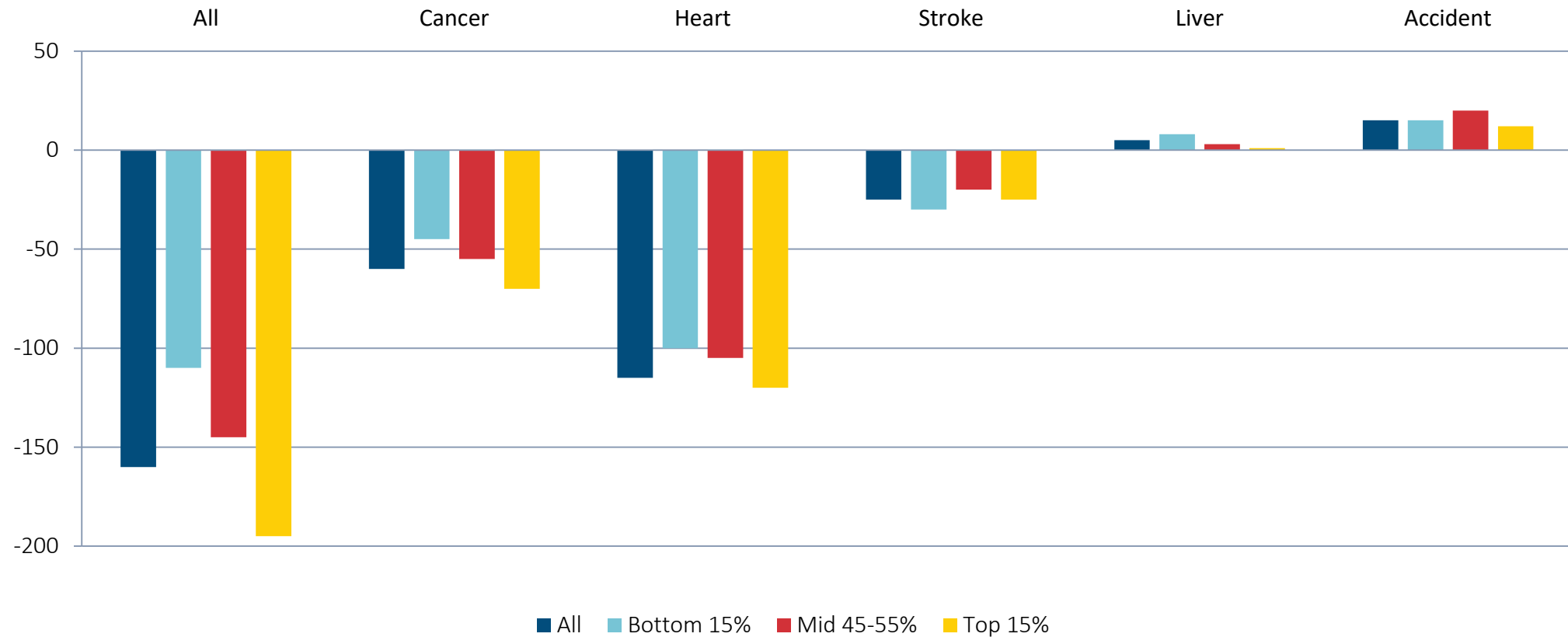
Source: S Spilane et al, Trends in Alcohol-Induced Deaths in the United States, 2000-2016, JAMA Network Open 2/21/20

The Confounders

- Income
- Education
- Geography
- Social class
- Urbanization

The Whole Story

Difference in Age-Adjusted Mortality Rate per 100,000: 1999–2018



Source: <https://www.soa.org/resources/research-reports/2020/population-mortality-observations/>. Based on CDC data.

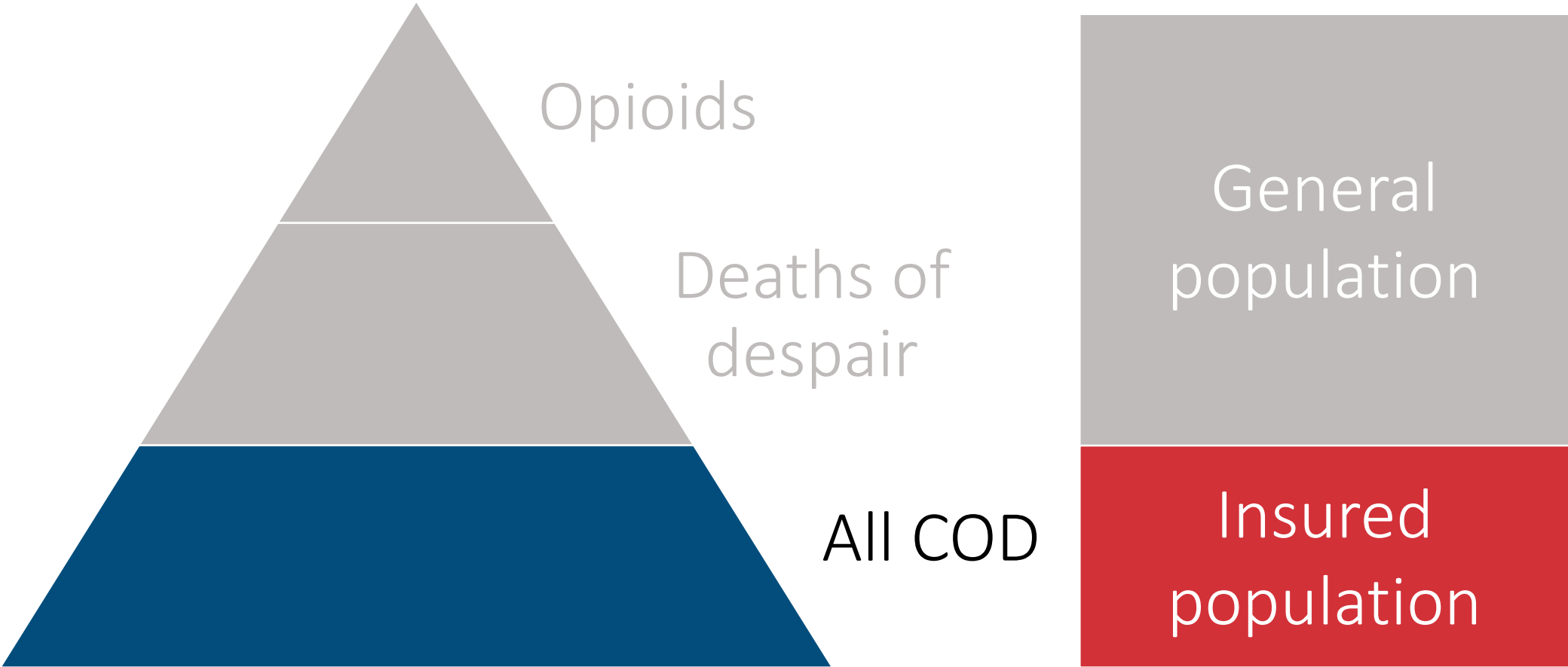
The Key Drivers – Still...

- Smoking
- Obesity

Conclusion

- Suicides, alcohol-related deaths and drug-related deaths have increased, alarmingly in some socio-economic group and particularly for women
- The relative increase in mortality maybe higher in some racial/ethnic groups but those groups have better mortality still
- No definite blame to be placed on “despair”
- Opens our eyes wider on the differences by sub-populations and with the insurance buying population
- From an actuarial perspective, need to look at the whole picture

Today's discussion



COD Observations in the Insured Population

Anji Li, FSA, CERA, MAAA

4 May 2020



Setting up models



Finding a path to COD observations

- What is the question we are looking to answer?
- What is the data available to answer the question?
- What is the method chosen to look at the data?

The question

Given a death has happened,
what is the probability it is _____ vs. all other COD?

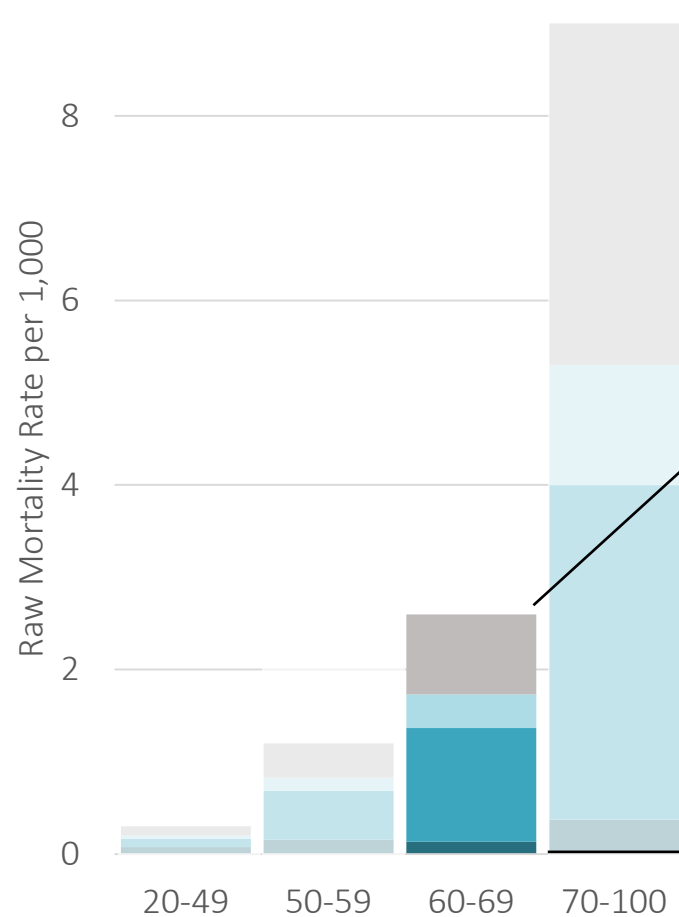
Heart / Cancer / External*

* Includes accidents, suicides, and assaults.

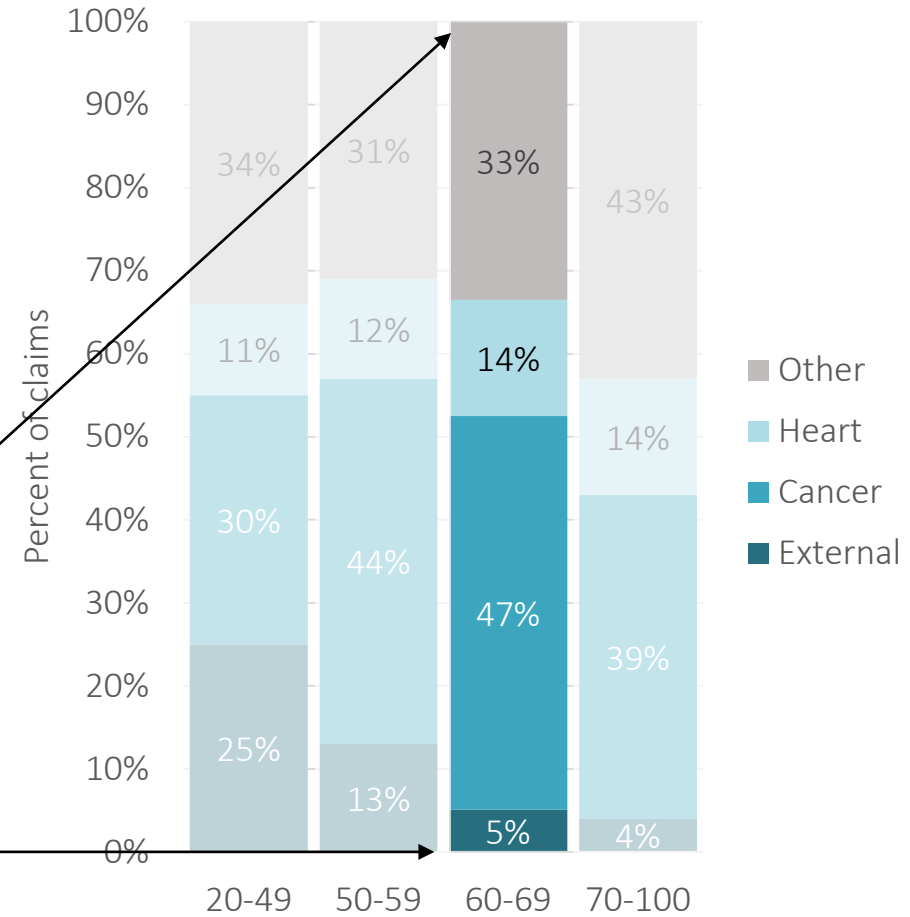
The question

For a given risk attribute, we assess the likelihood of COD *prevalence* in claims

Mortality rate COD contribution
By Attained Age



Claims COD distribution
By Attained Age



The data

Munich Re experience study 2006 – 2017 Q2

- Fully-underwritten single life
- No post-level term, conversions or substandard
- Excludes duration 1 and 2

The method

Logistic GLM

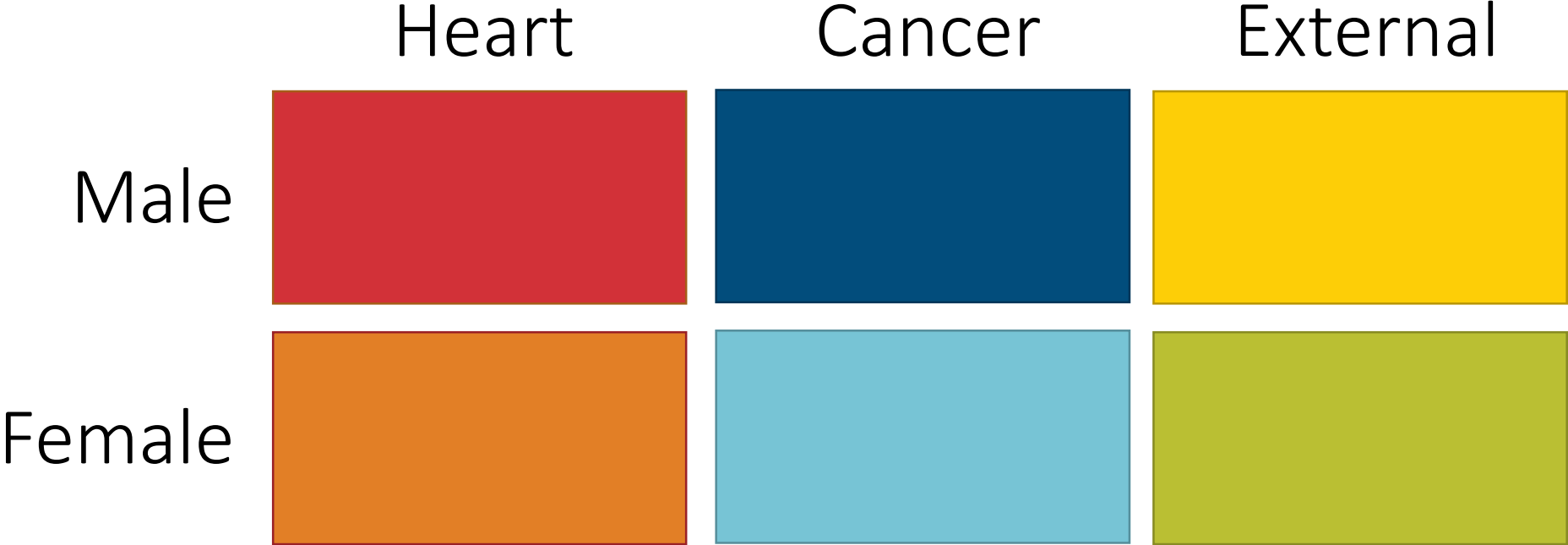
- Attained age
- Duration
- Product
- Face amount
- Smoker status
- LexisNexis® Risk Classifier score

$$\ln\left(\frac{p}{1-p}\right) = y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots$$

Given a death has happened,
what is the probability it is ____ vs. all
other COD?

The method

Six “one vs. all” models



Results: Patterns picked up by the models



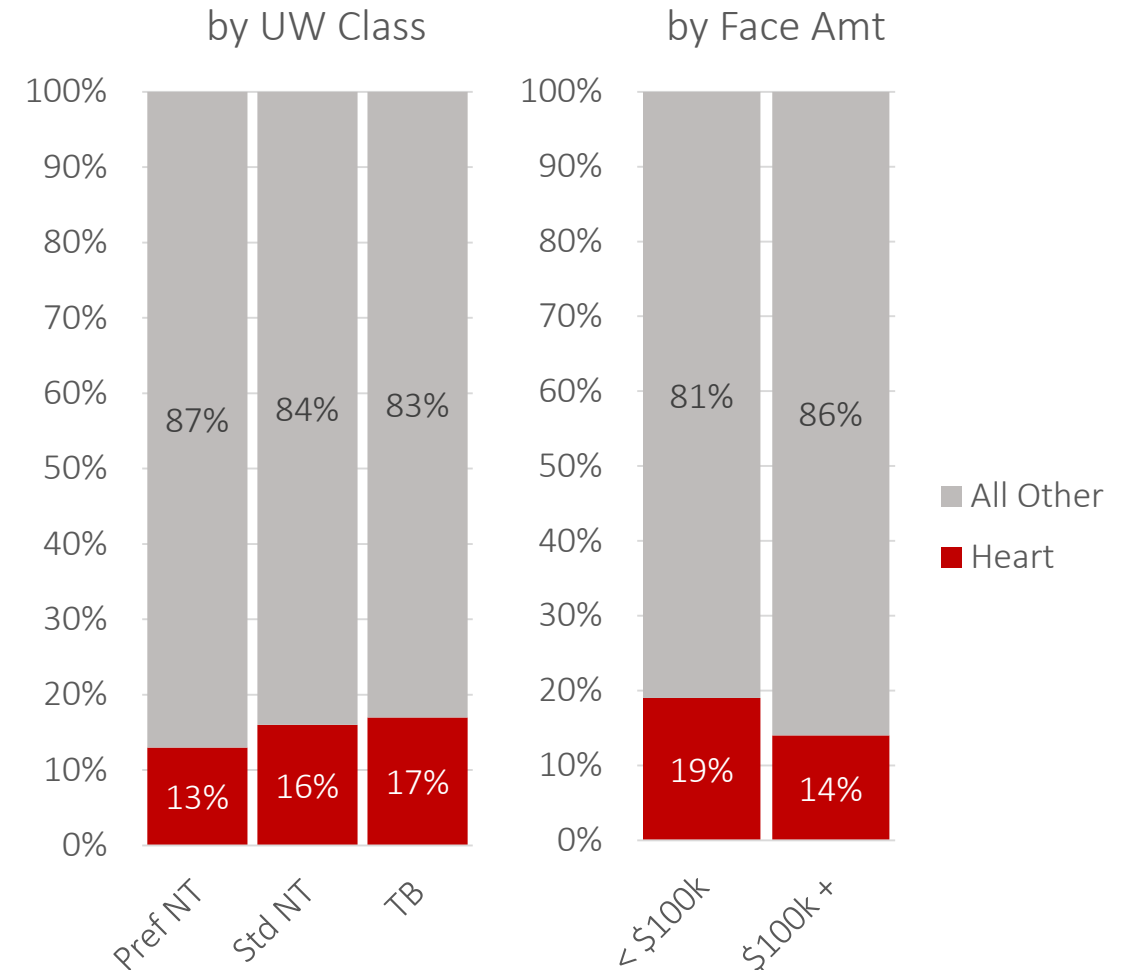
Heart observations

Evidence of underwriting

- Higher likelihood for a claim with FA < \$100K to be Heart COD
- Standard non-smoker claims have higher likelihood of a Heart COD relative to preferred non-smoker claims



Heart Claims Distribution
Males only

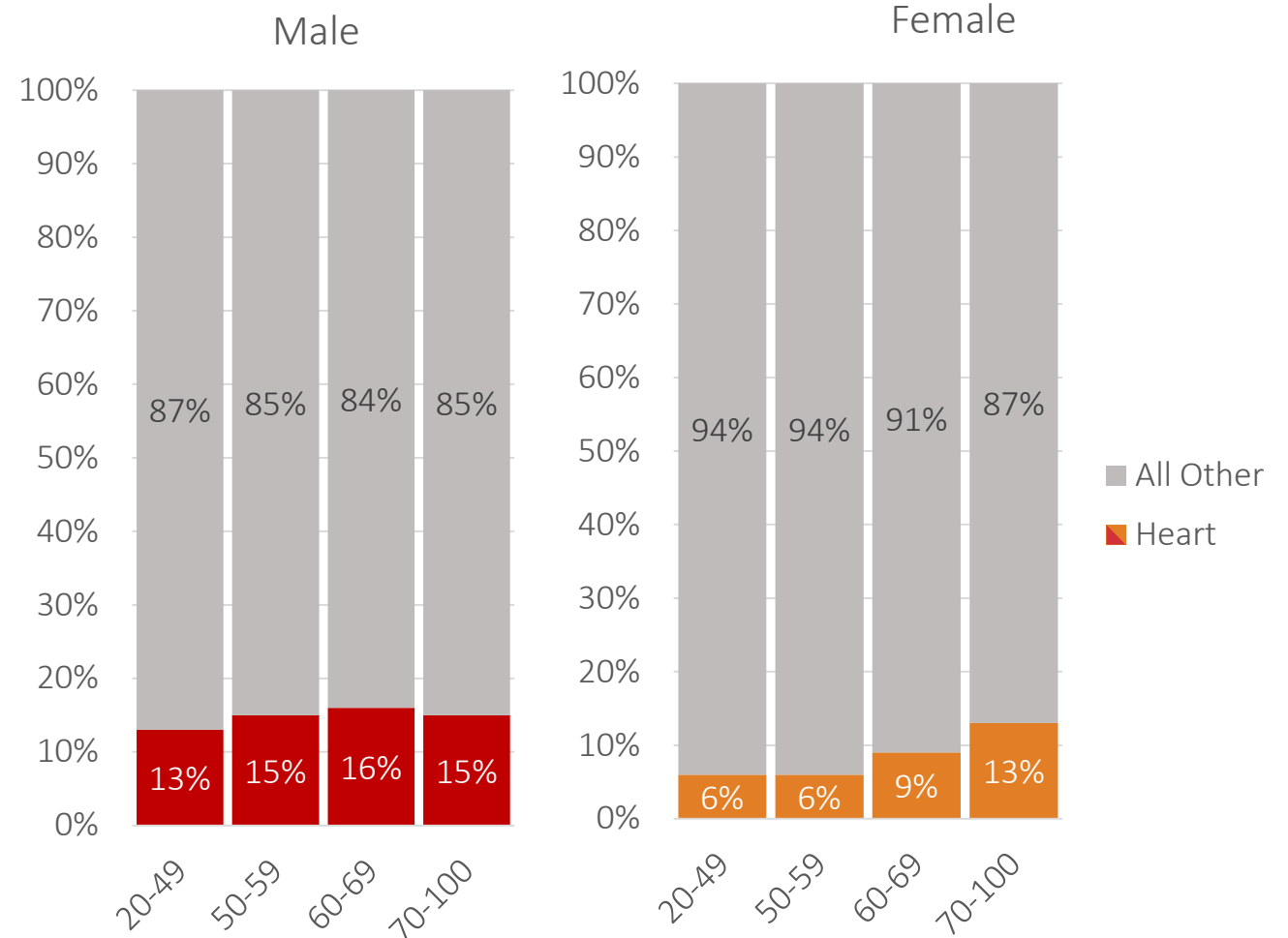


Heart observations

Known medical trends

- Patterns observed by attained age and gender
- Association of smoker claims and the likelihood of a Heart COD

Heart Claims Distribution by Attained Age

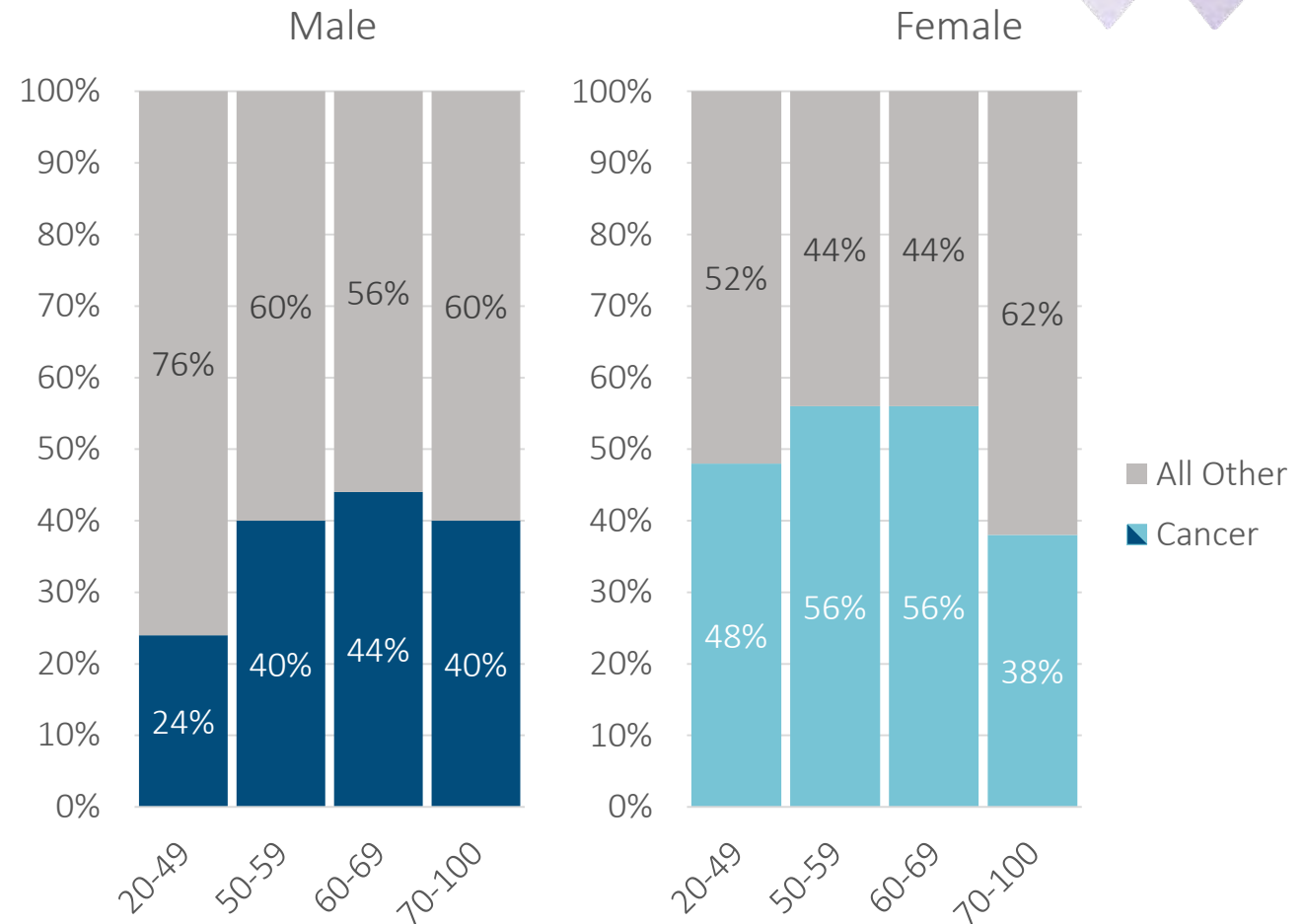


Cancer observations

Demographics

- Patterns observed by attained age and gender
- Impact of smoking varies by gender due to difference in susceptibility to cancer types

Cancer Claims Distribution by Attained Age





External causes

Demographics

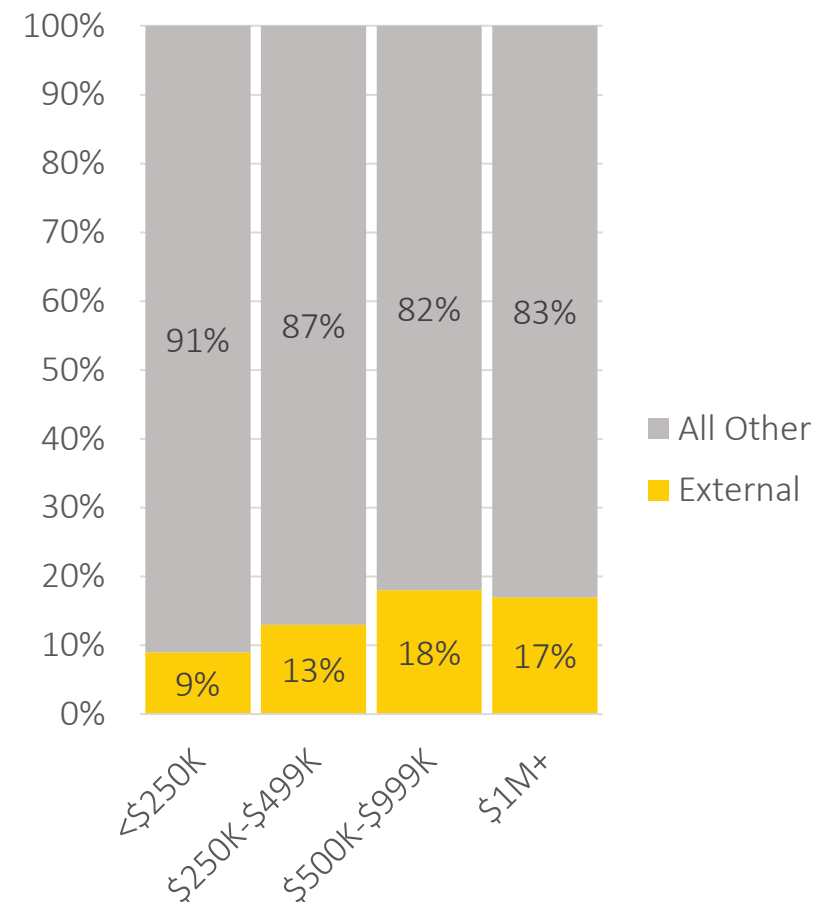
- Patterns observed by attained age and gender, in line with general population

Policyholder attributes

- Claims with FA > \$500K have higher prevalence of External COD

External Claims Distribution Males only

By Face Amt

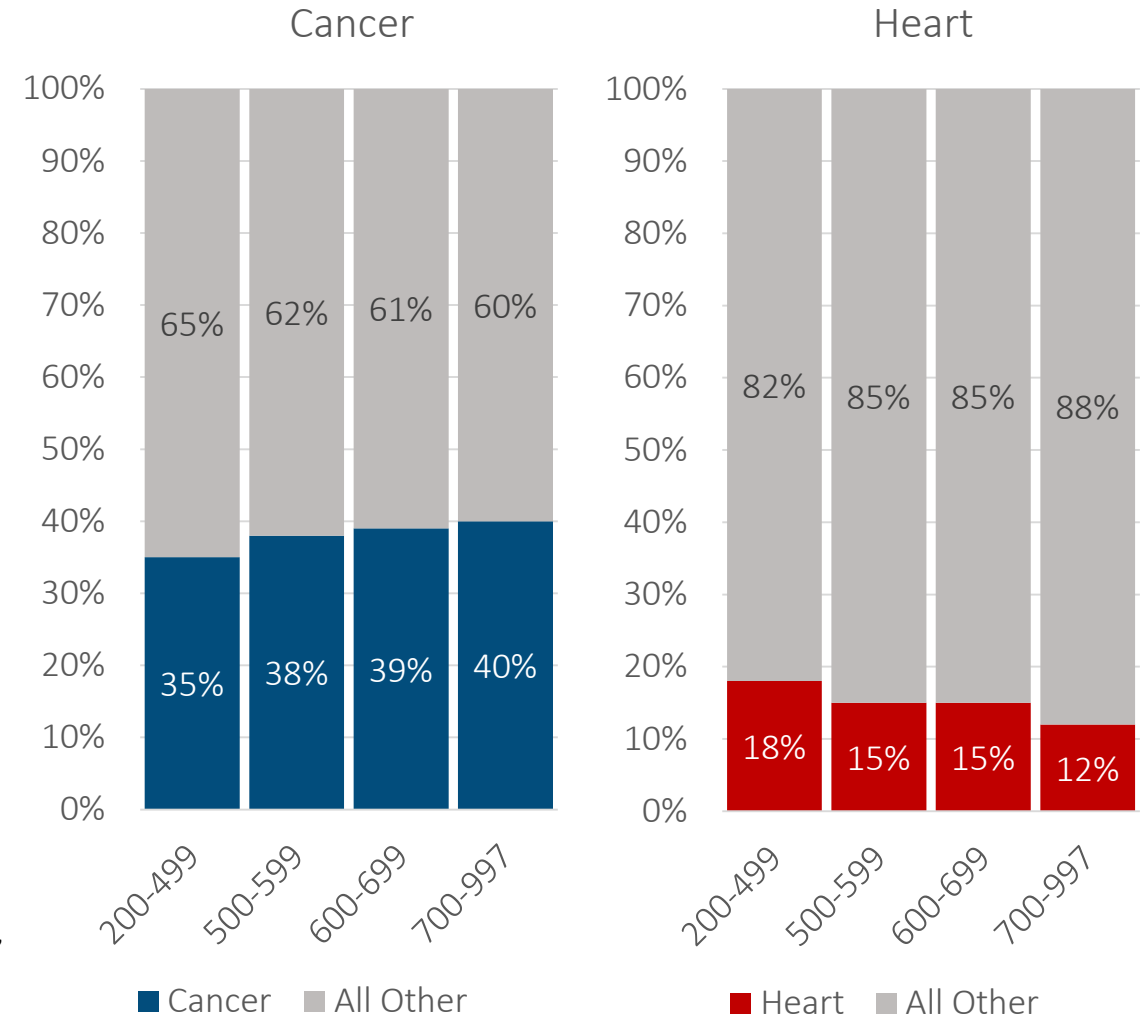


Competing risks

Relation to overall mortality risk*

- Claims from lower overall mortality risks have a higher likelihood of being a Cancer COD or External COD, and a lower likelihood of being a Heart COD

Males Claims Distribution by LNRC score (FA > \$100k)

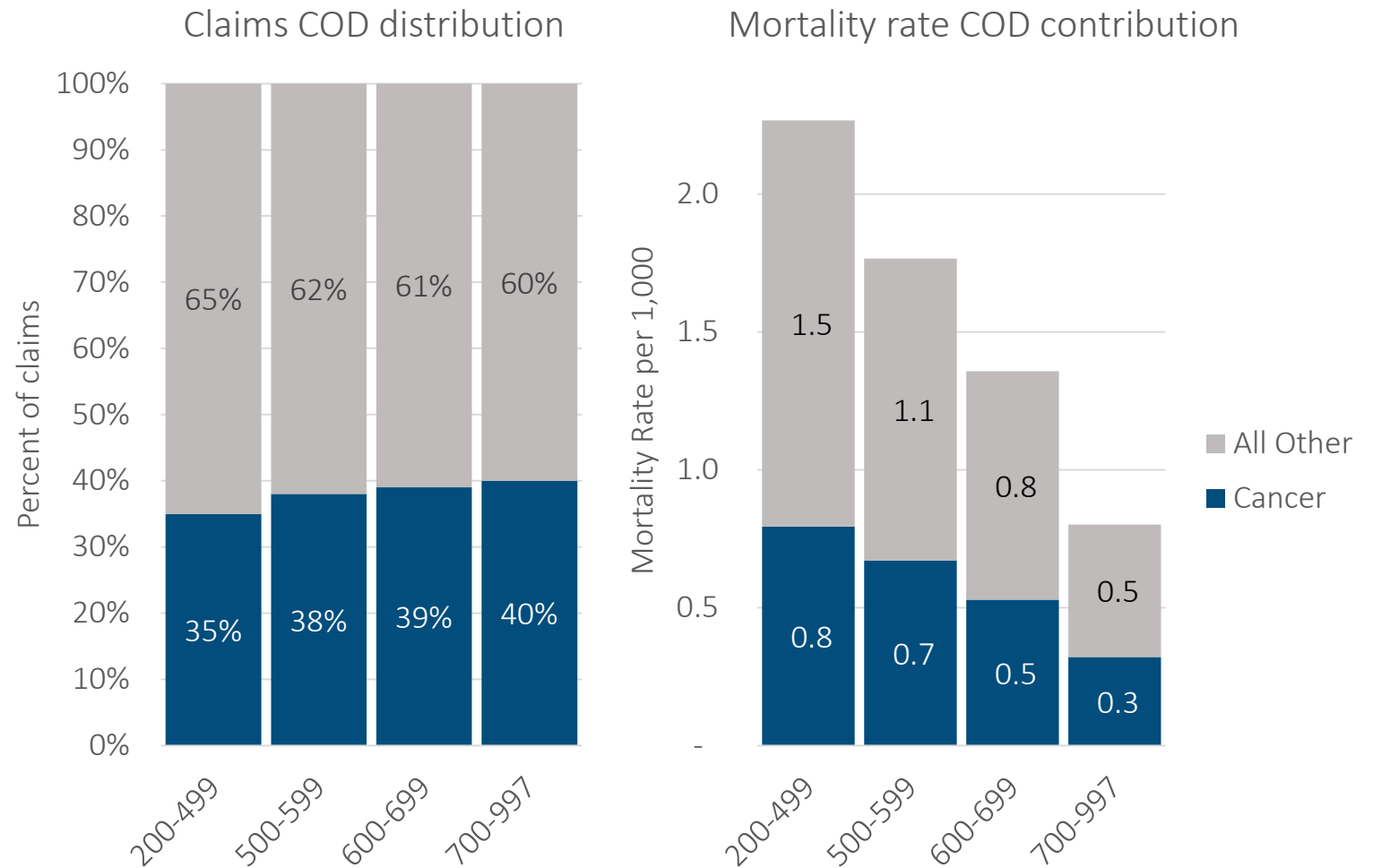


* LexisNexis® Risk Classifier (LNRC) scores as a measure of overall mortality risk, where higher scores are associated with lower overall mortality risk.

Back to the question

COD prevalence
in claims vs.
contribution to
mortality rate

Males Cancer Claims by LNRC score (FA > \$100k)



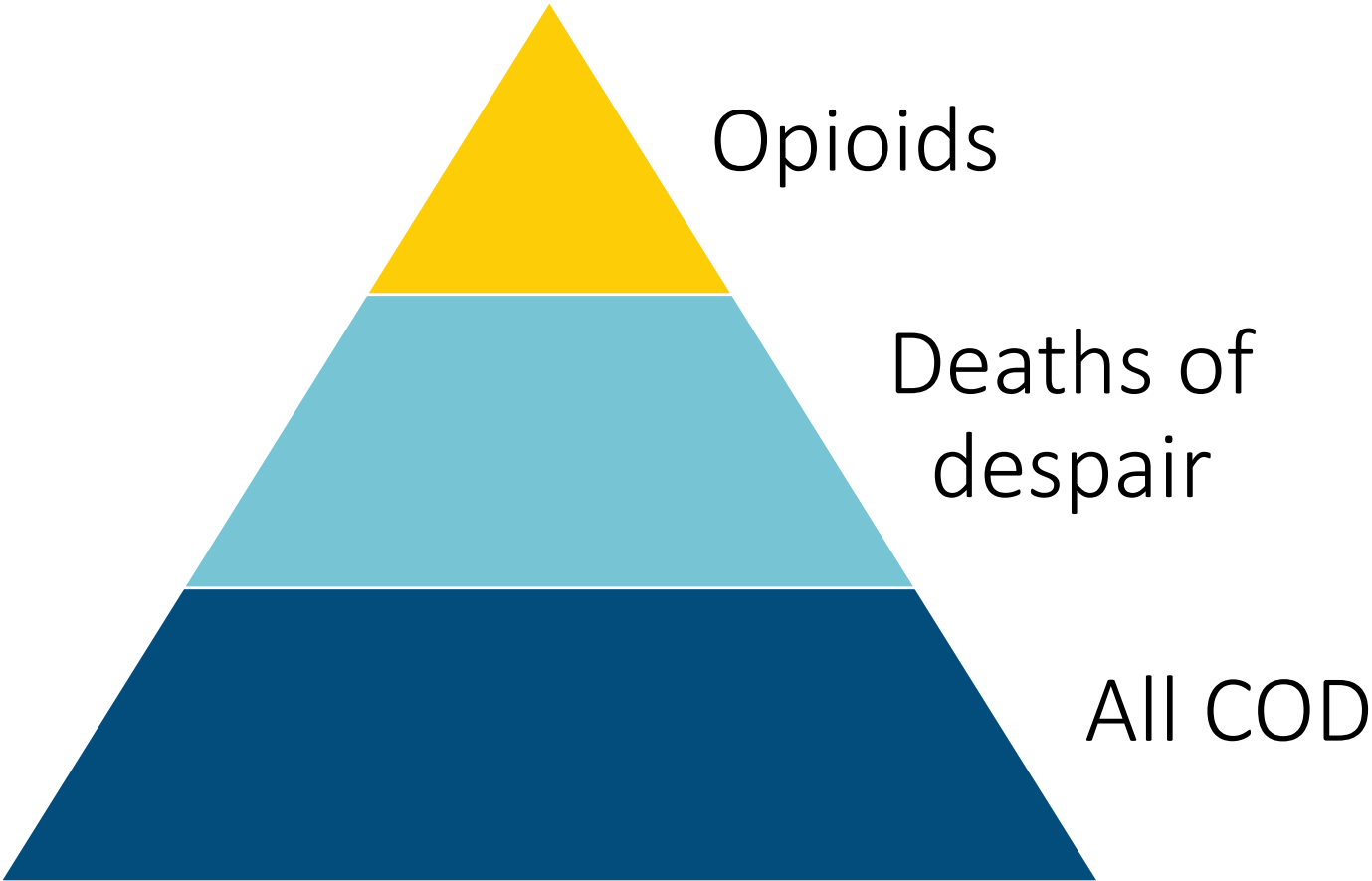
Closing remarks



Lessons learned

- Logistic GLM models affirm COD patterns (Heart, Cancer and External) in the insured population claims
 - Describe historical trends
 - Inform projections of future mortality risk and mortality improvement
- Limitations of the data and methods

Today's discussion





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ANNUITY**
VIRTUAL SYMPOSIUM