Emerging Trends in Mortality

AMERICAN ACADEMY OF ACTUARIES

ANNUAL MEETING AND PUBLIC POLICY FORUM

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Panel

- Arialdi M. Miniño, MPH, Centers for Disease Control and Prevention, National Center for Health
- Stephen C. Goss, MAAA, ASA, Social Security Administration
- Mary J. Bahna-Nolan, EVP, Head of Life R&D, SCOR Global Life

Agenda

- Setting the stage – Mortality trends in the US
- Causes of death and how they differ amongst the population
- Why is the insured population different or is it?
- Q&A

Mortality Trends in the United States

Arialdi M. Miniño

National Center for Health Statistics

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Health Statistics

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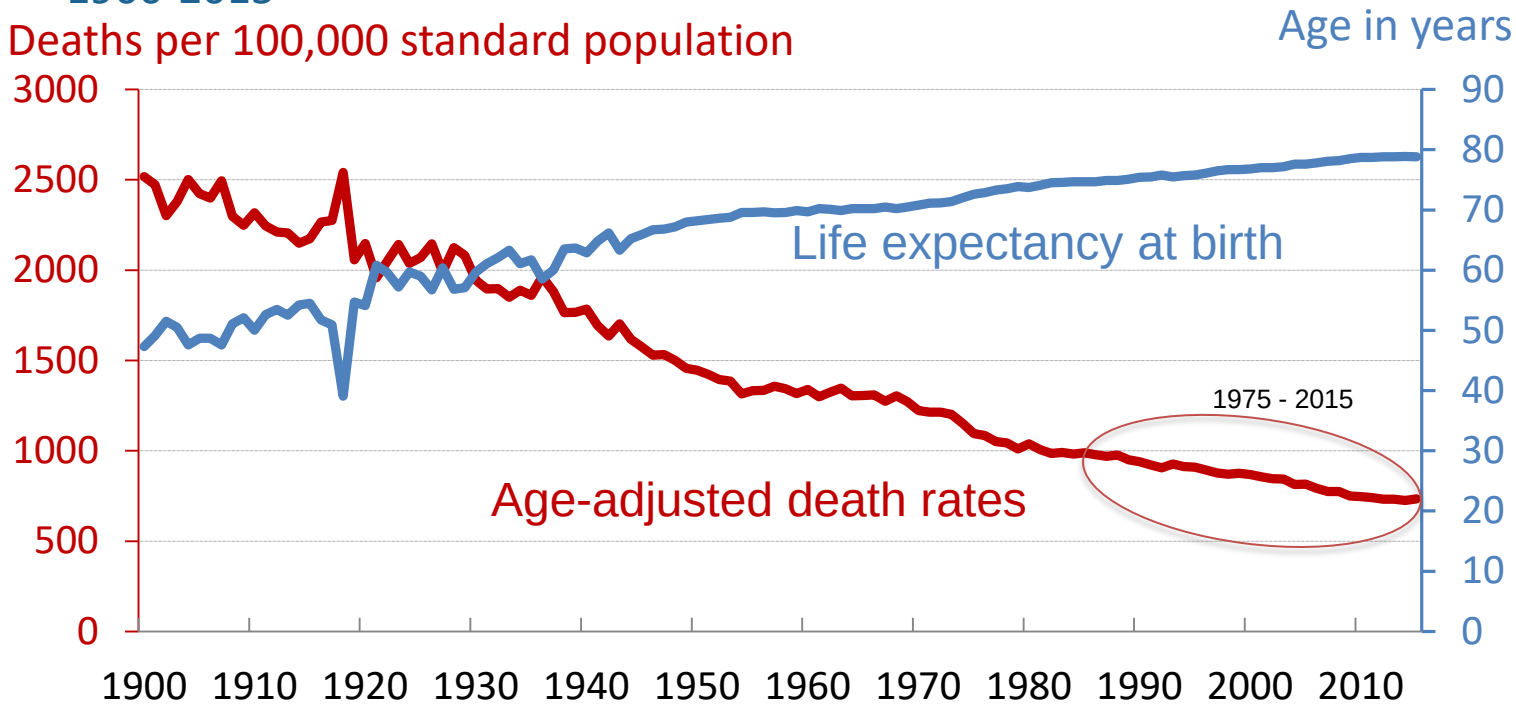
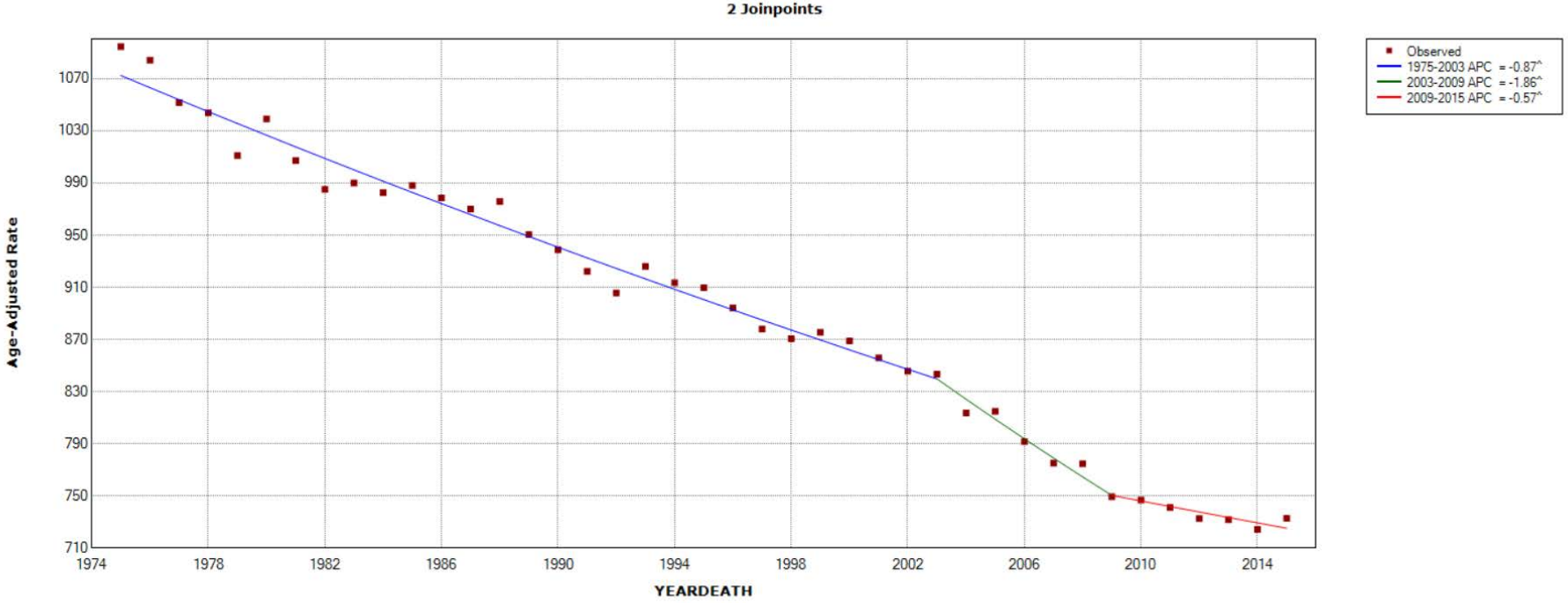
Life Expectancy at Birth and Age-Adjusted Death Rates: United States, 1900-2015



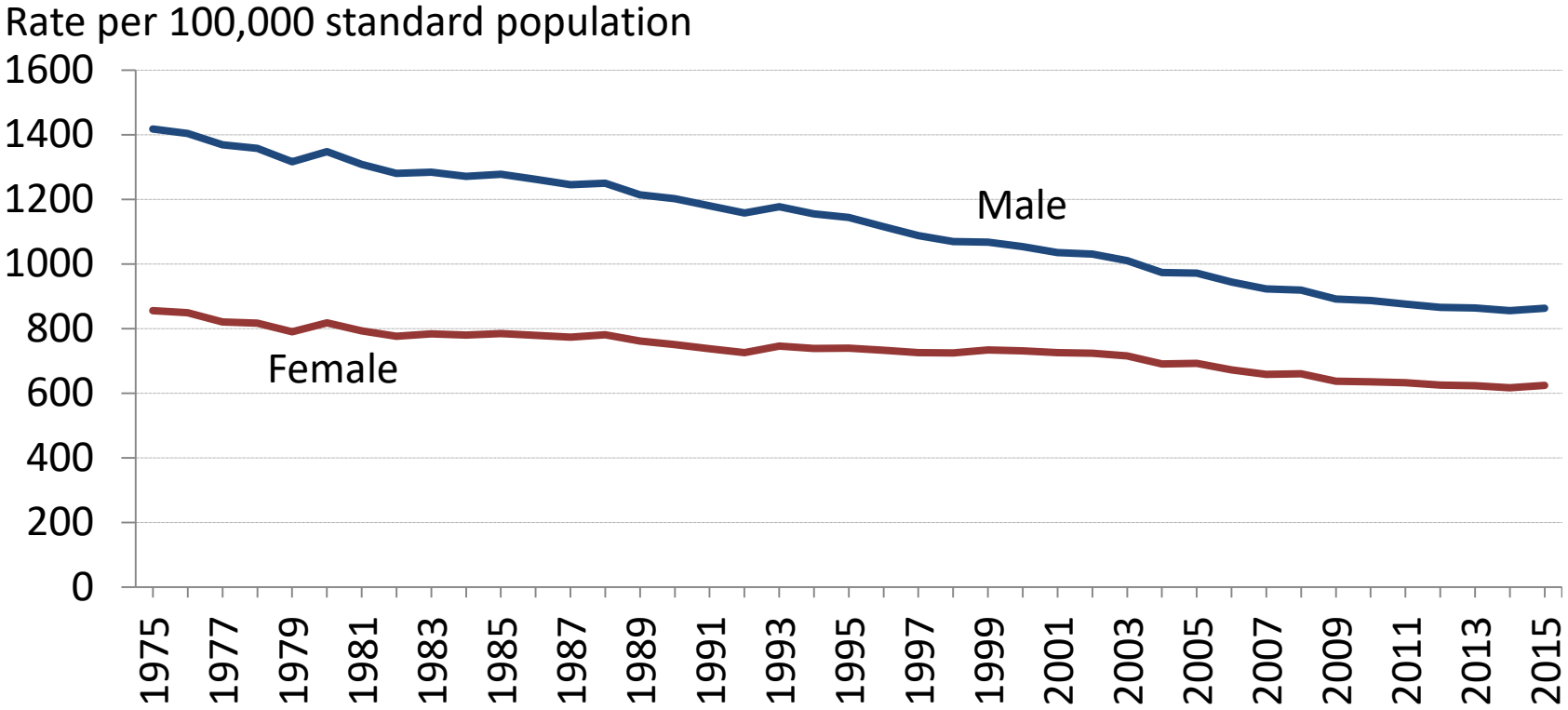
NOTE: Prior to 1933, data are for death-registration States only.

Joinpoint regression analysis age-adjusted death rates, United States 1975-2015



^ The Annual Percent Change (APC) is significantly different from zero at alpha = 0.05

Age-adjusted death rates, by Sex: United States, 1975-2015



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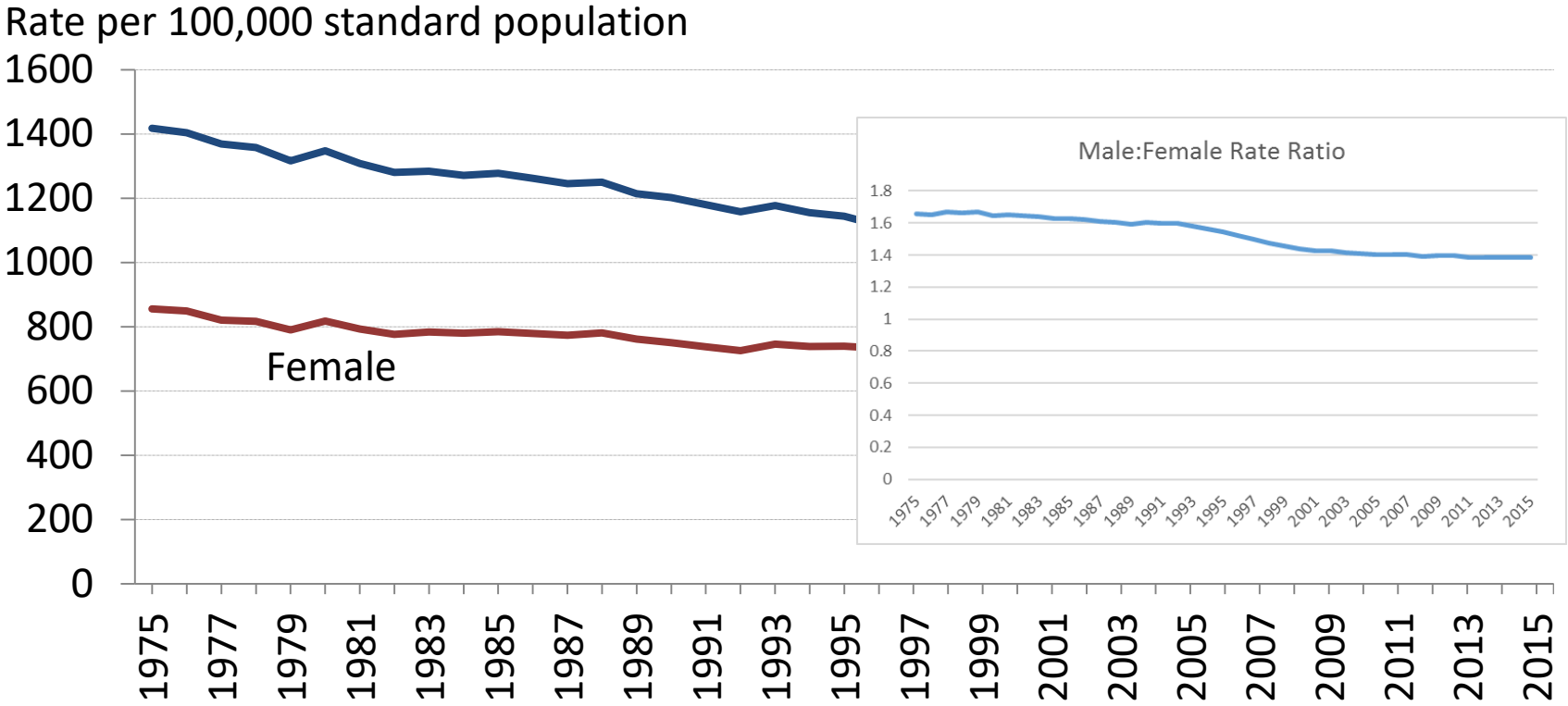
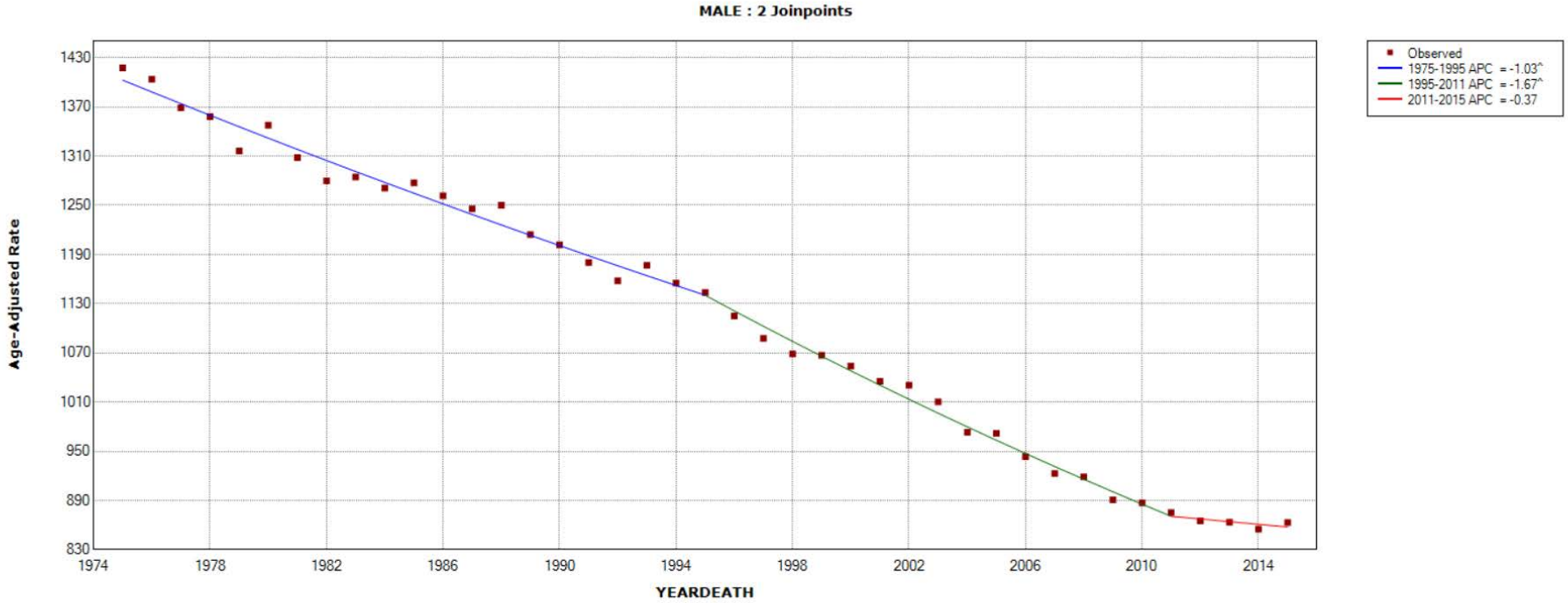


Joinpoint regression analysis age-adjusted death rates, Males United States 1975-2015



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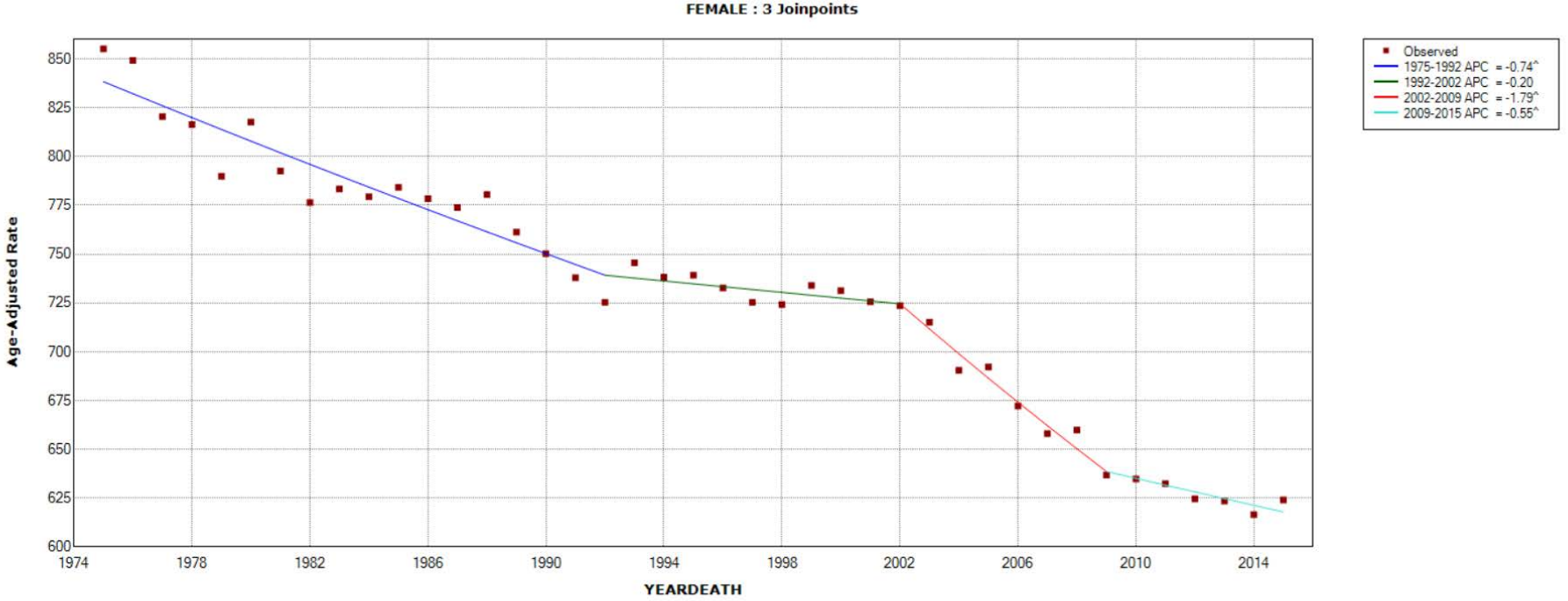
Joinpoint regression analysis age-adjusted death rates, Females United States 1975-2015



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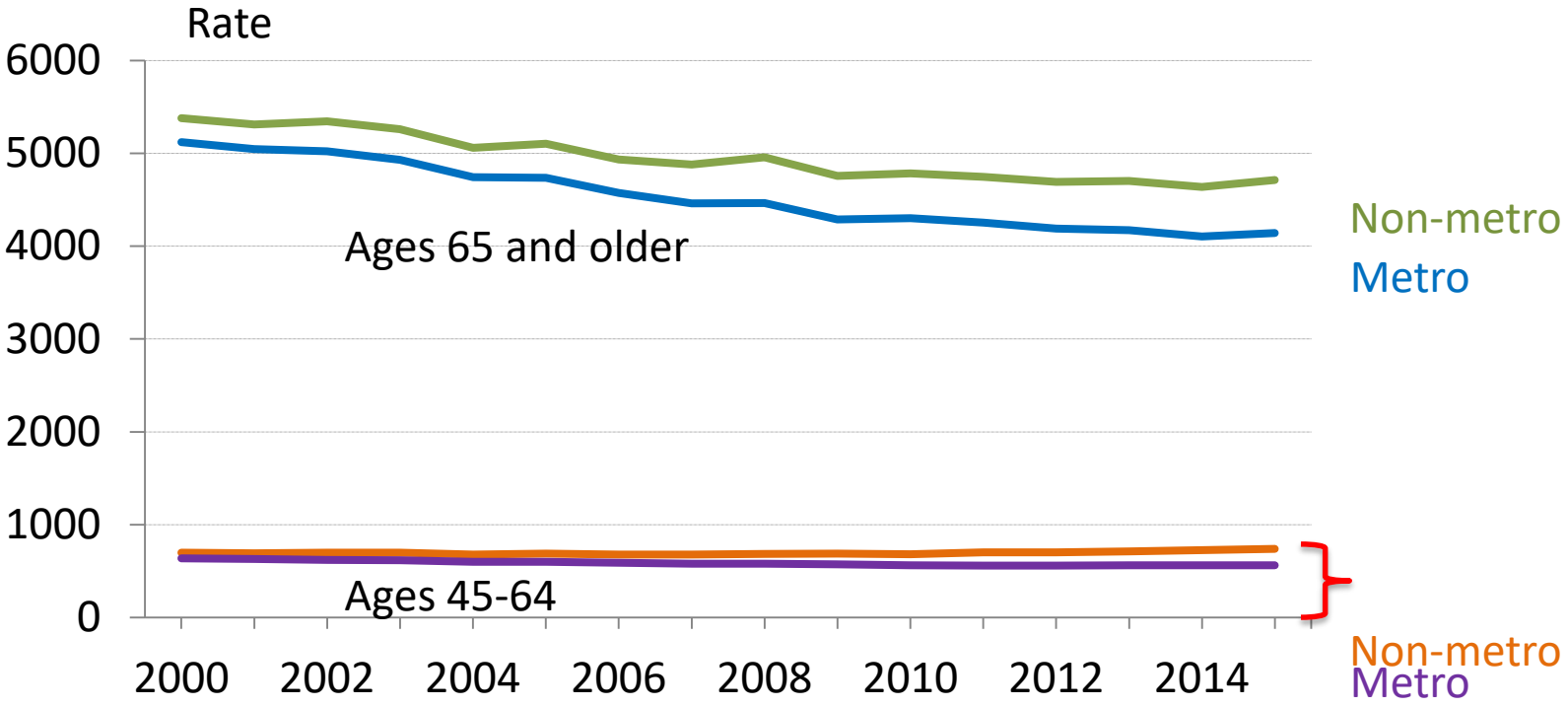
Age-adjusted death rates for metropolitan and non-metropolitan areas by age group: United States, 2000-2015



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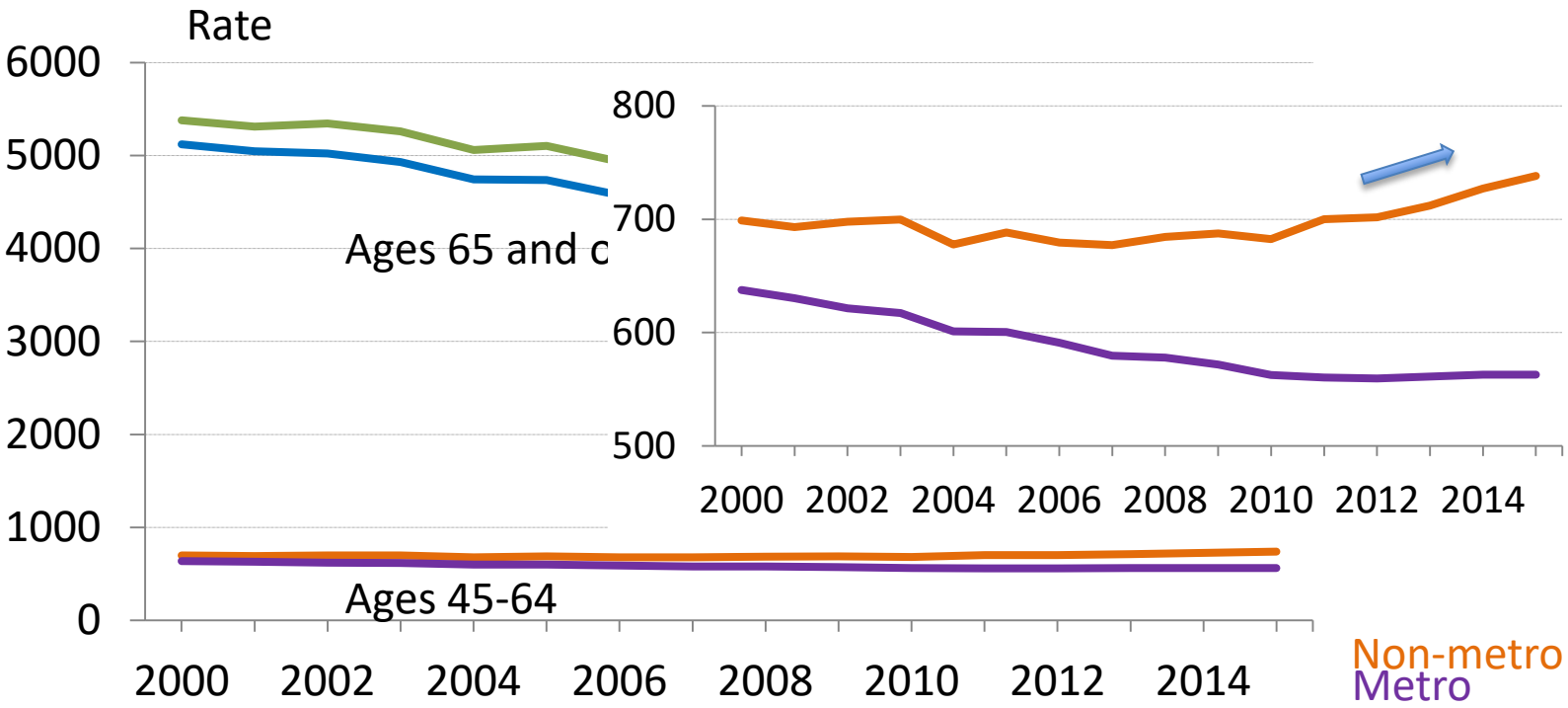
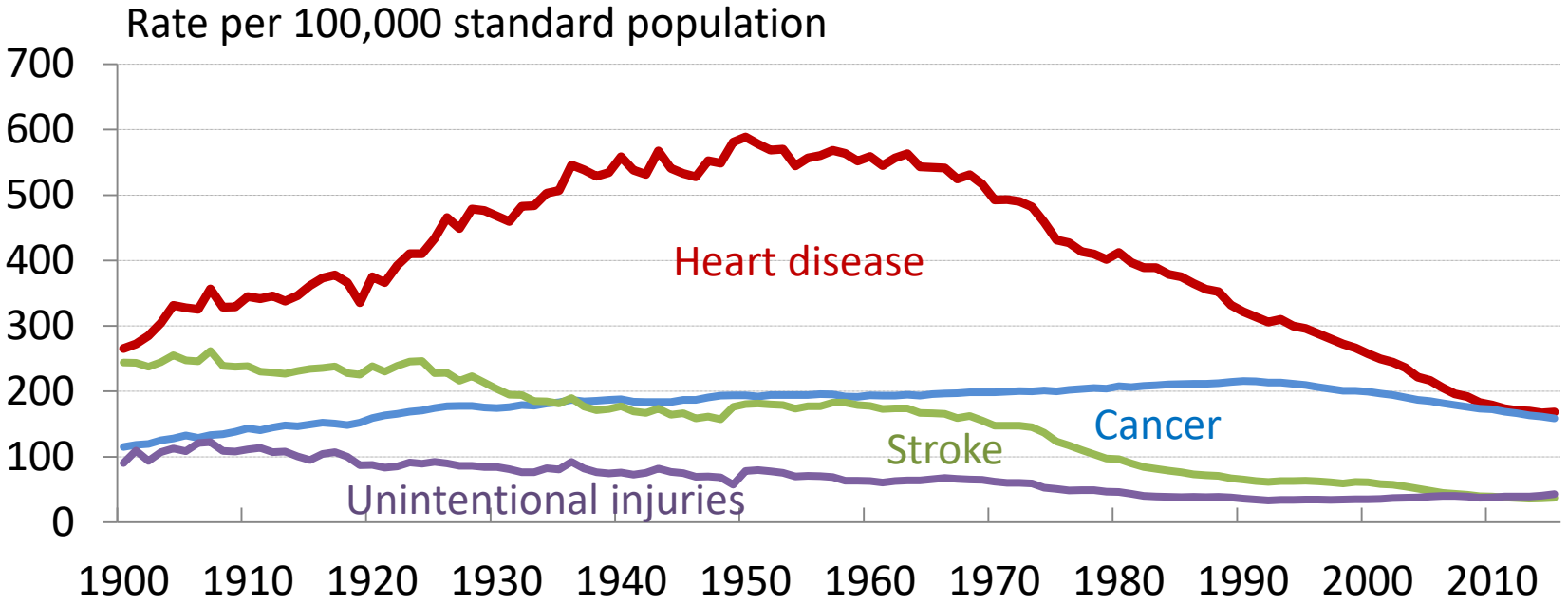


Age-adjusted death rates for heart disease, cancer, stroke and unintentional injuries: United States, 1900-2015



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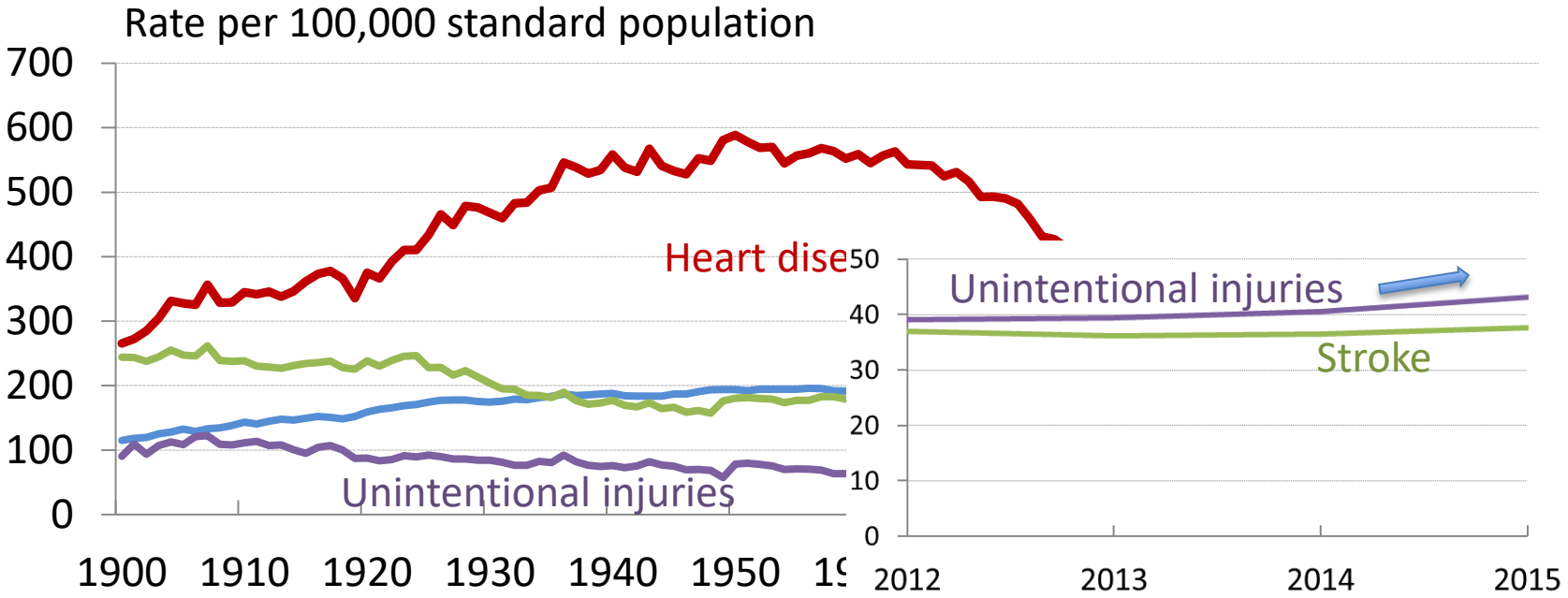

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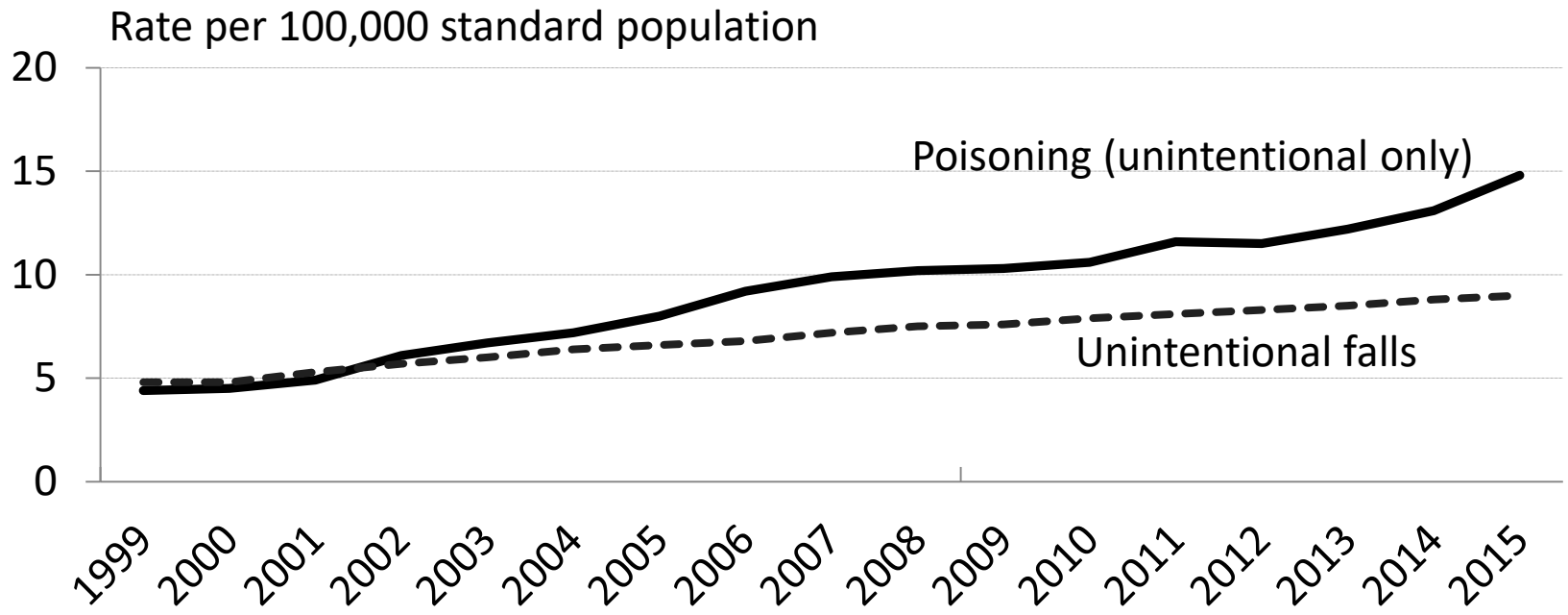
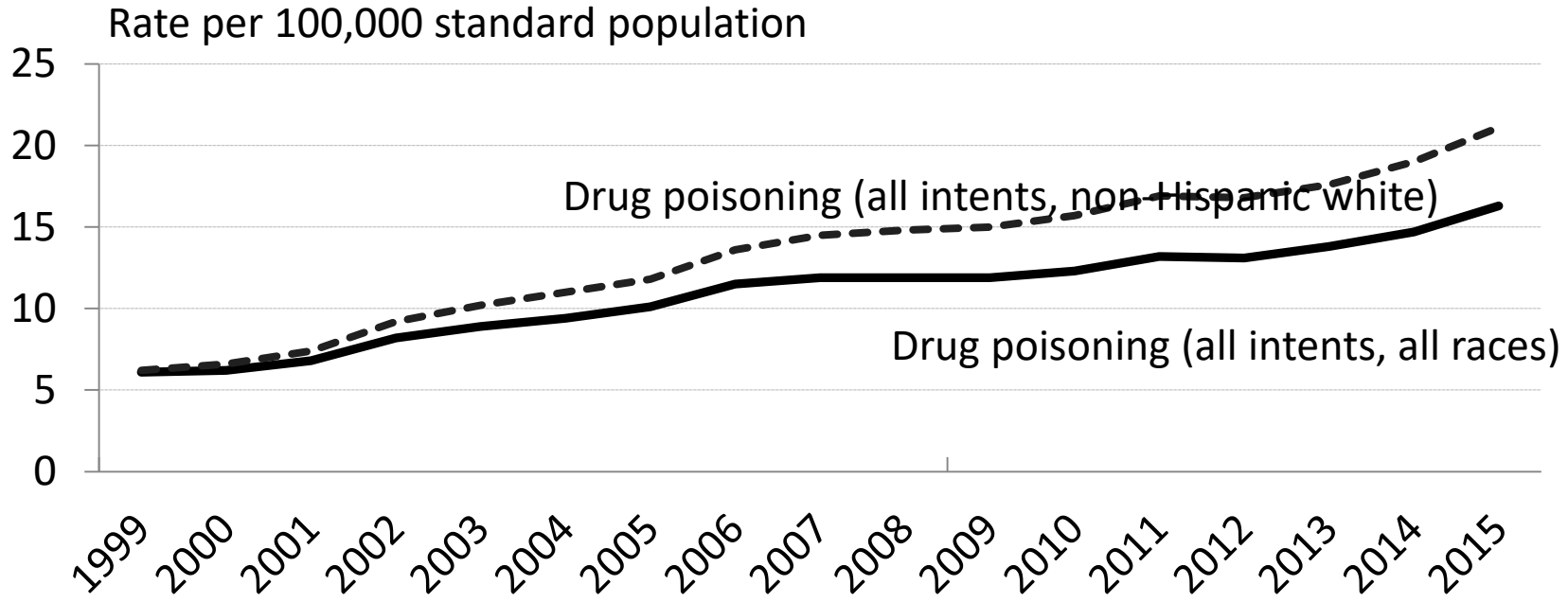
Age-adjusted death rates for Poisoning (unintentional) and Falls (unintentional) United States, 1999-2015



The “causes of death from despair,” and then some, after Case & Deaton

Drug poisoning from all intents: All races; non-Hispanic white

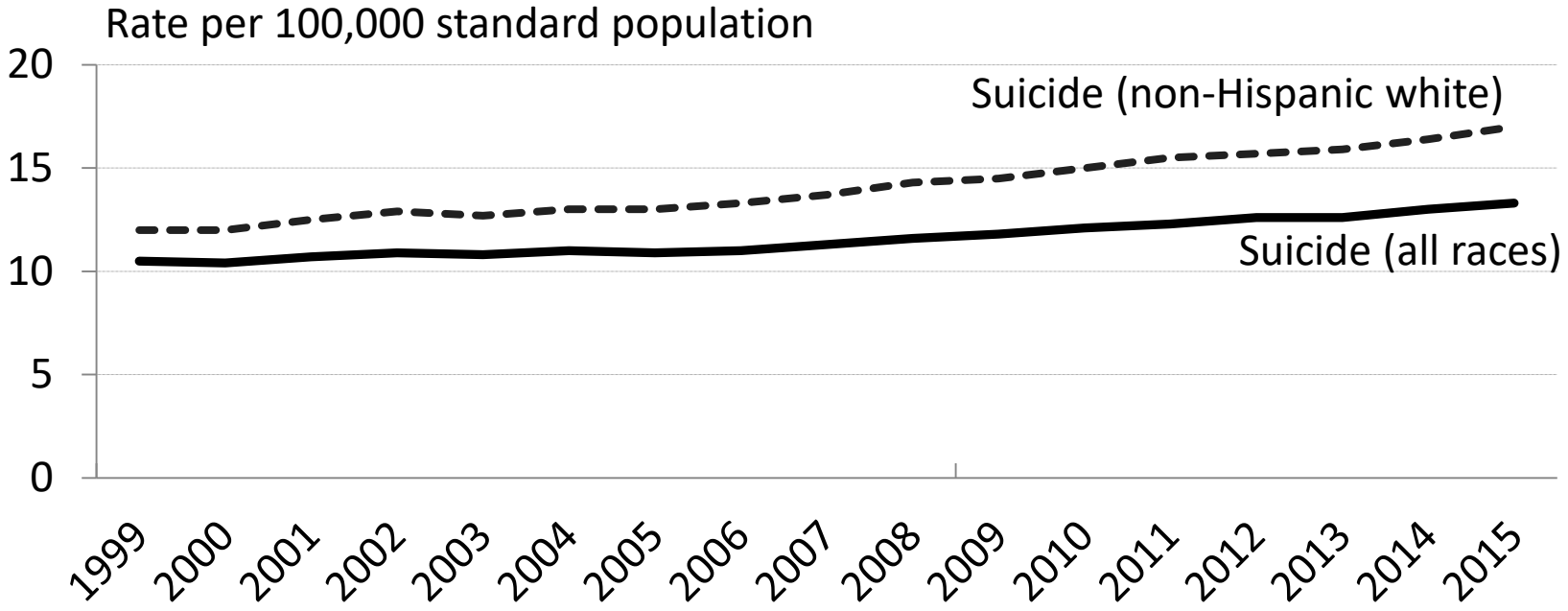
United States, 1999-2015



The “causes of death from despair,” and then some, after Case & Deaton

Suicide: All races; non-Hispanic white

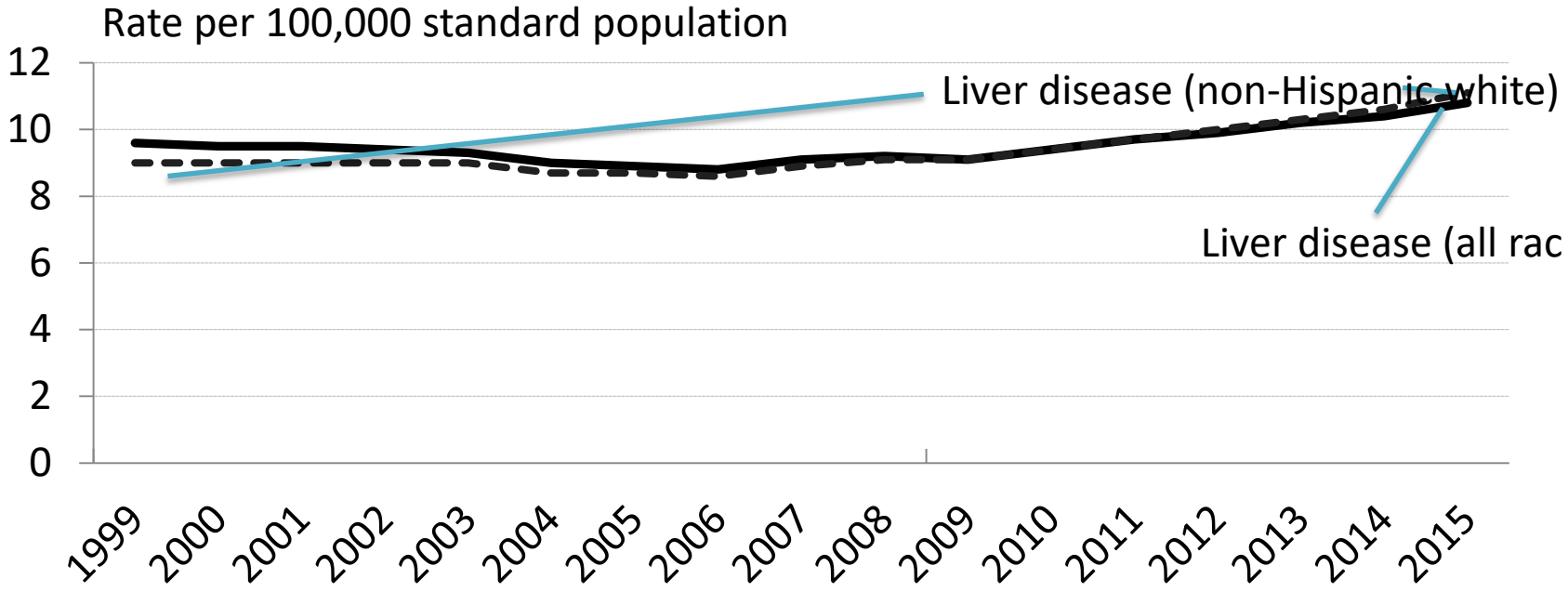
United States, 1999-2015



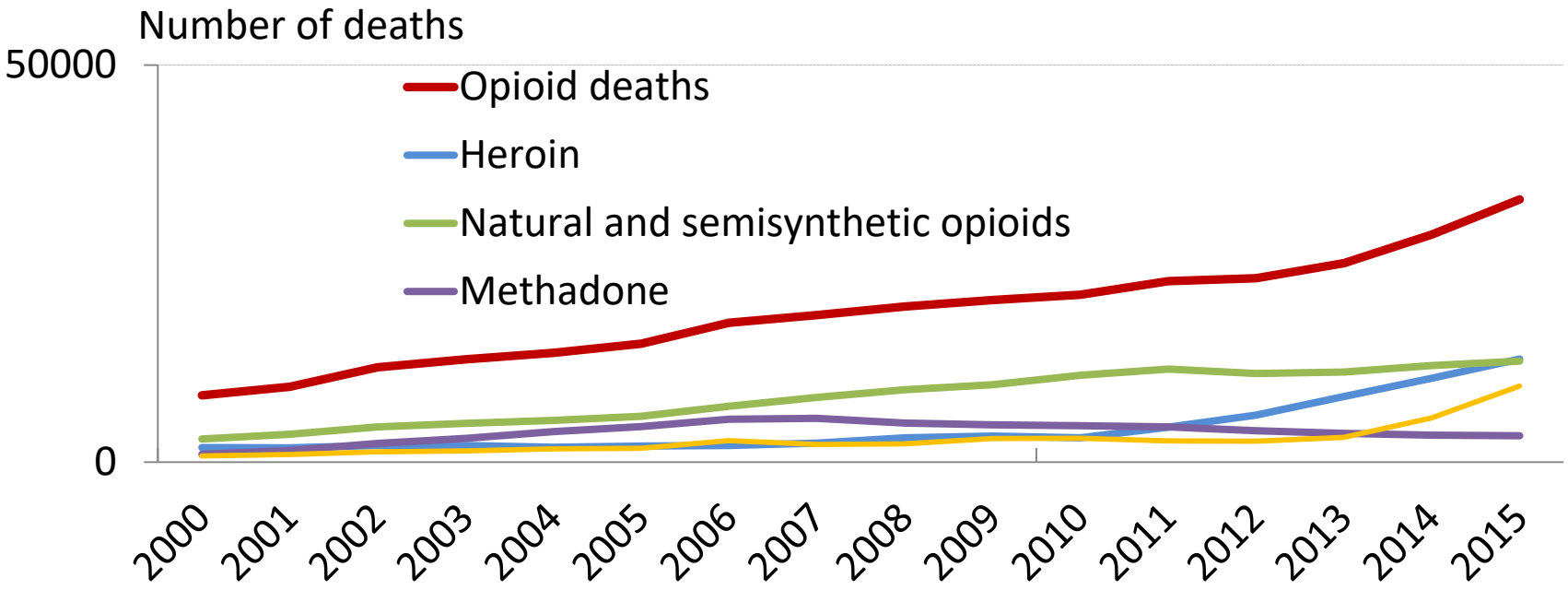
The “causes of death from despair,” and then some, after Case & Deaton

Chronic liver disease, cirrhosis: All races; non-Hispanic white

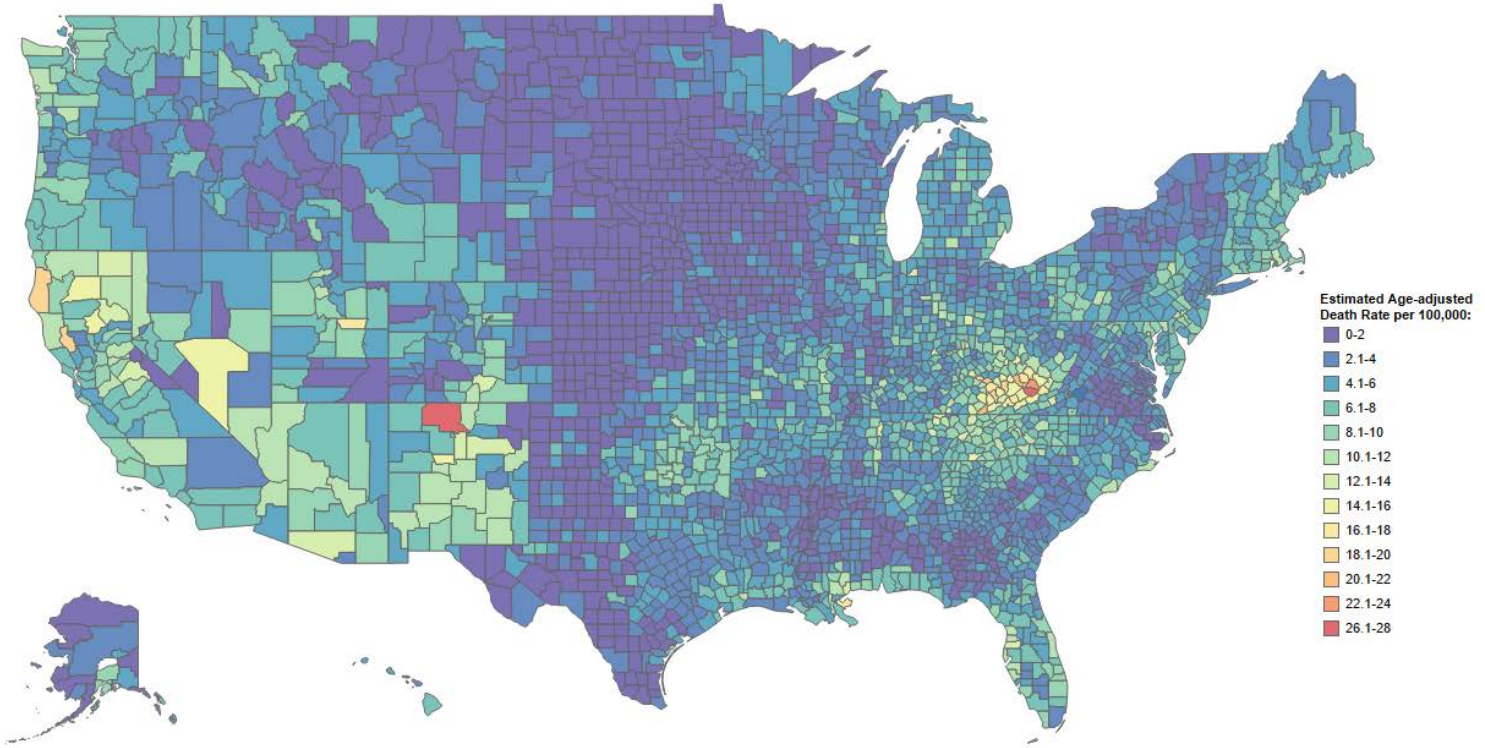
United States, 1999-2015



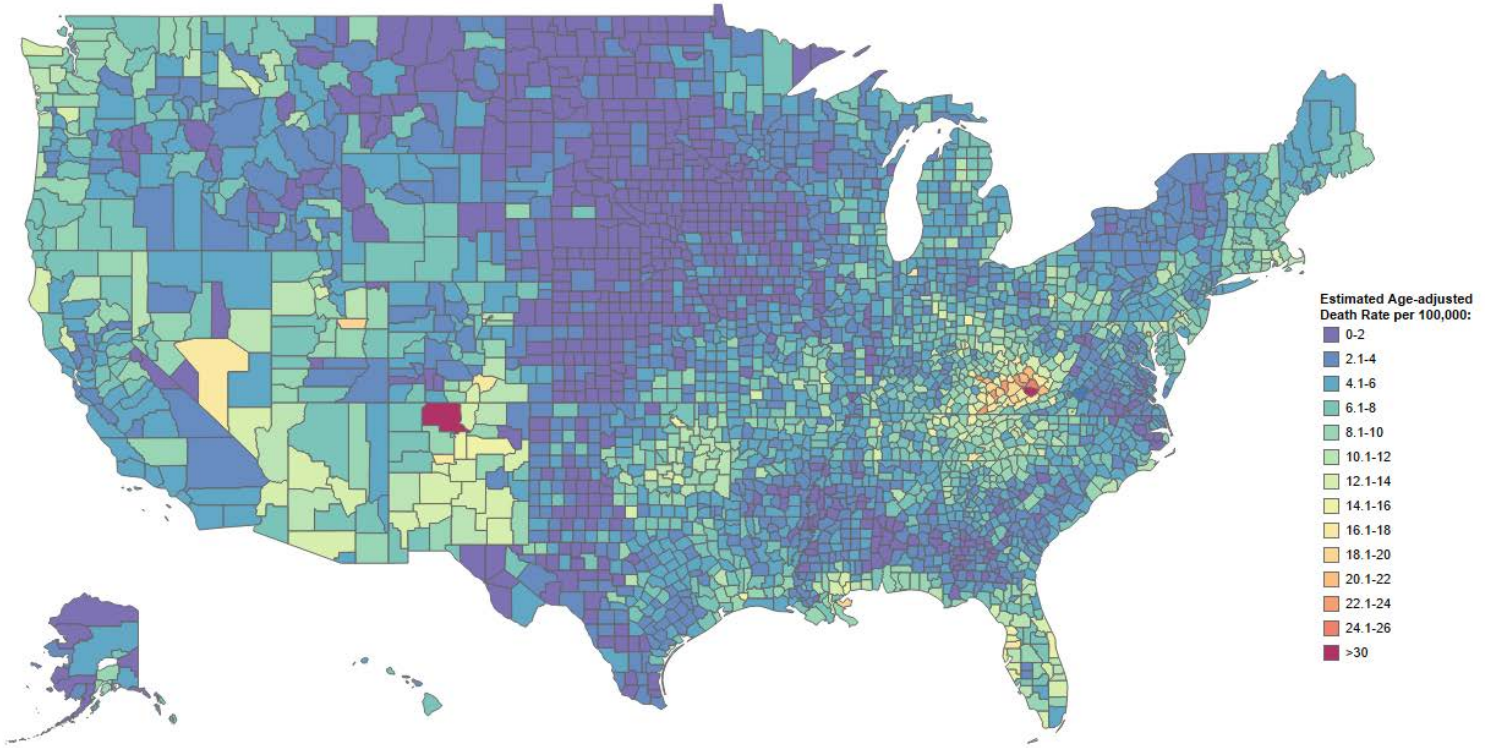
Deaths from selected drug poisoning involving opioids, by drug type
United States, 1999-2015



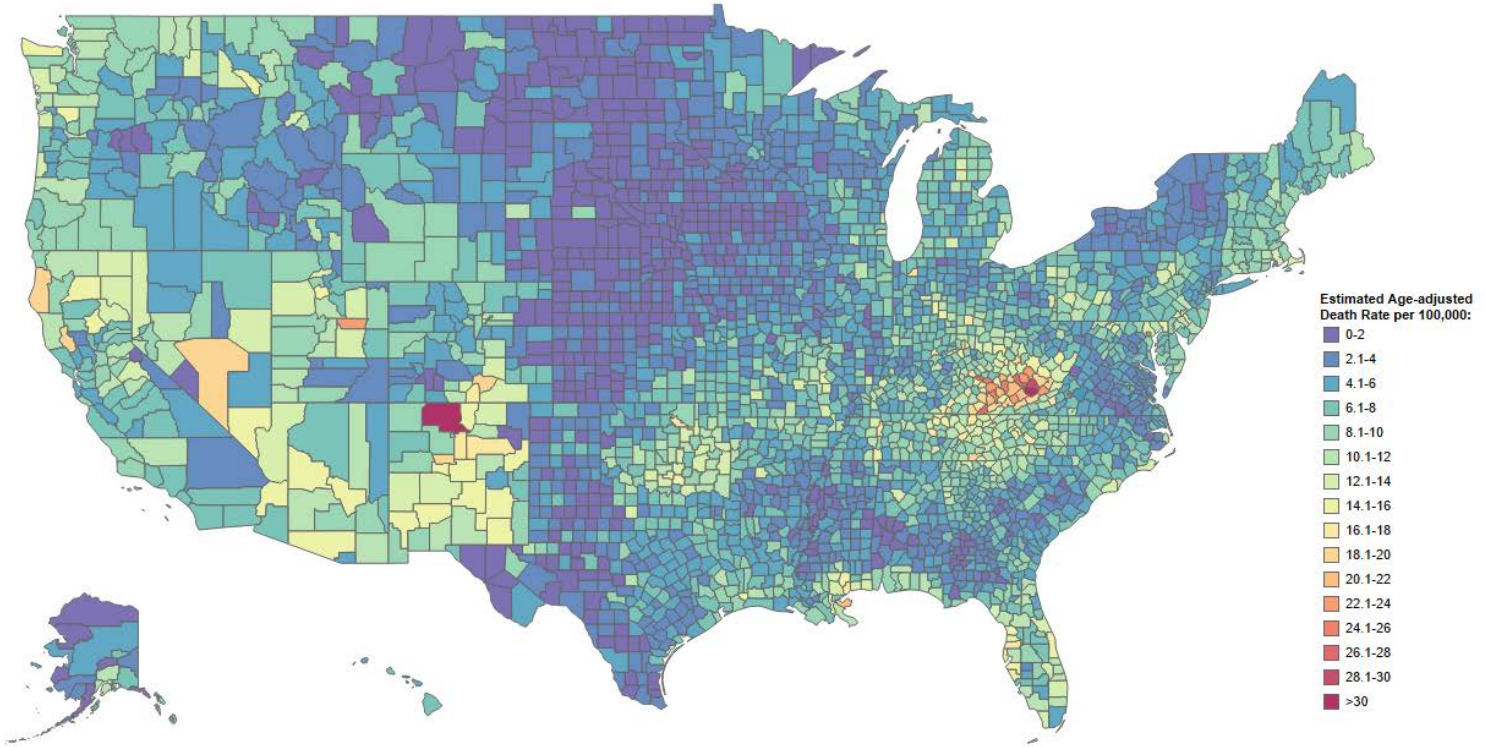
Estimated Age-adjusted Death Rates§ for Drug Poisoning by County, United States: **1999**



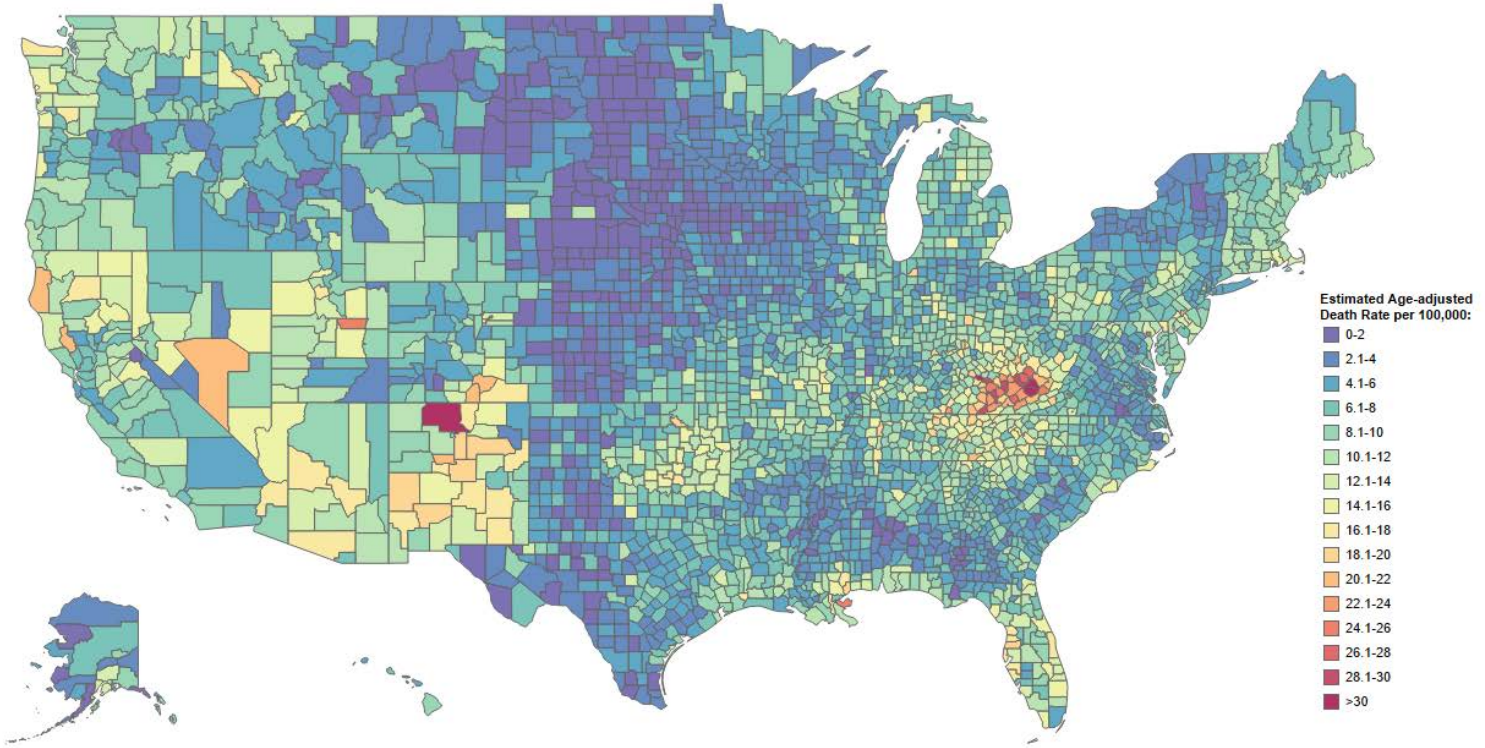
Estimated Age-adjusted Death Rates§ for Drug Poisoning by County, United States: **2001**



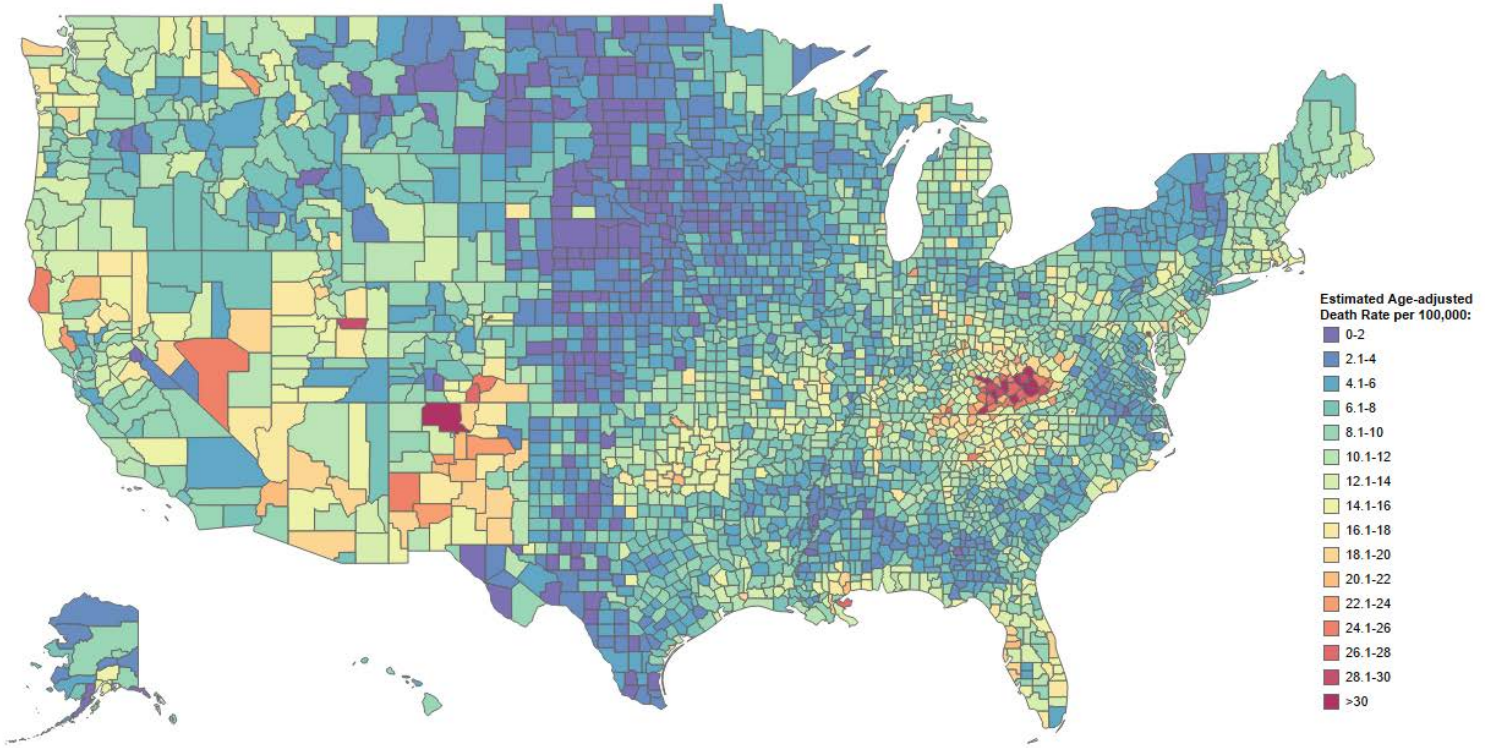
Estimated Age-adjusted Death Rates§ for Drug Poisoning by County, United States: **2003**



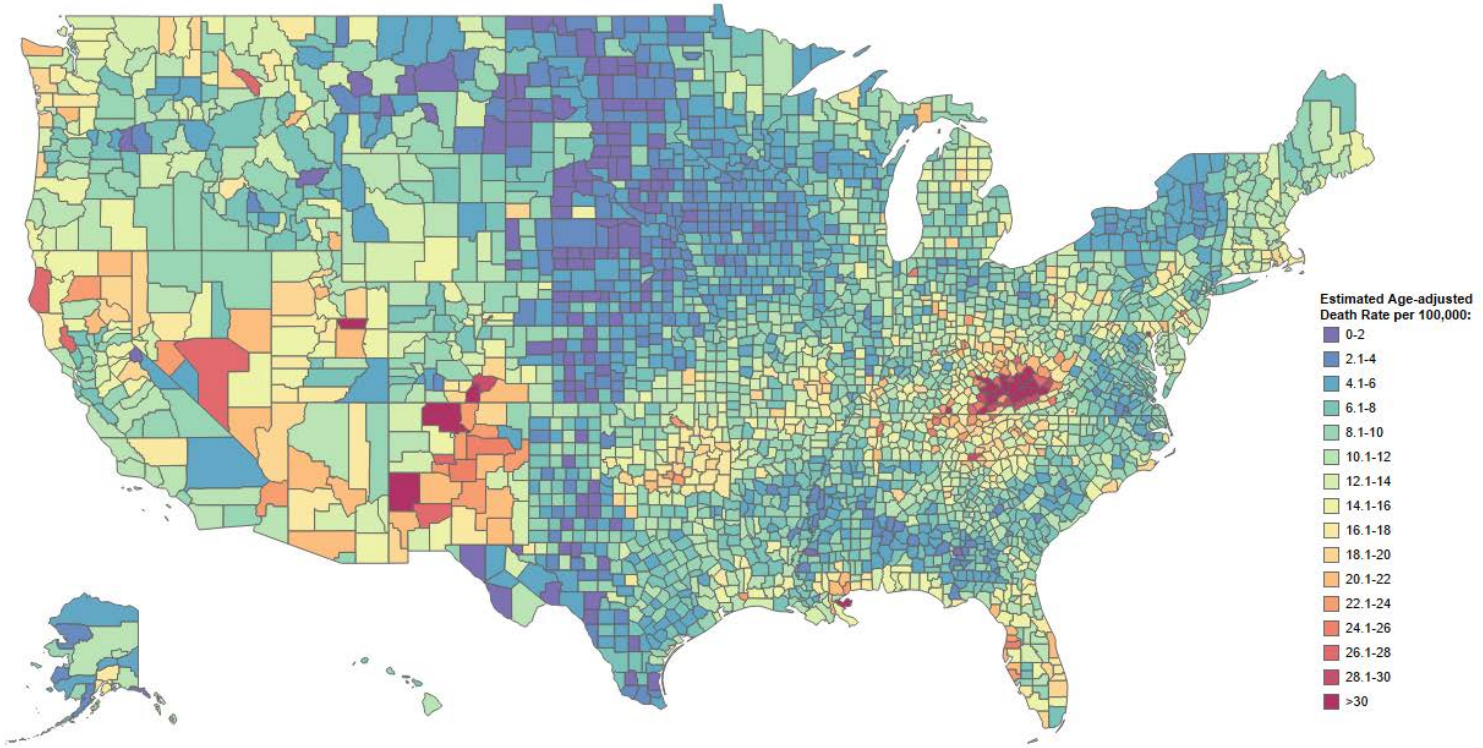
Estimated Age-adjusted Death Rates§ for Drug Poisoning by County, United States: **2005**



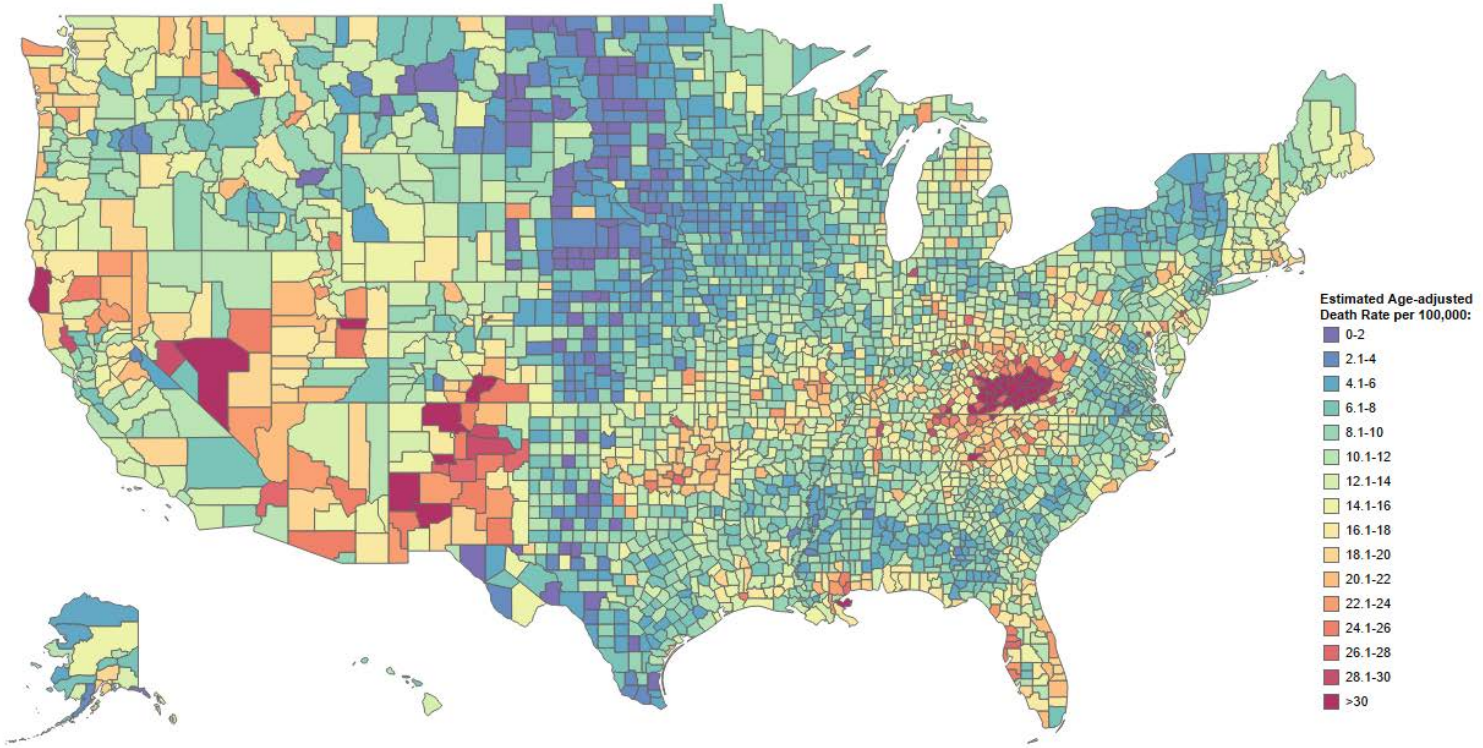
Estimated Age-adjusted Death Rates§ for Drug Poisoning by County, United States: **2007**



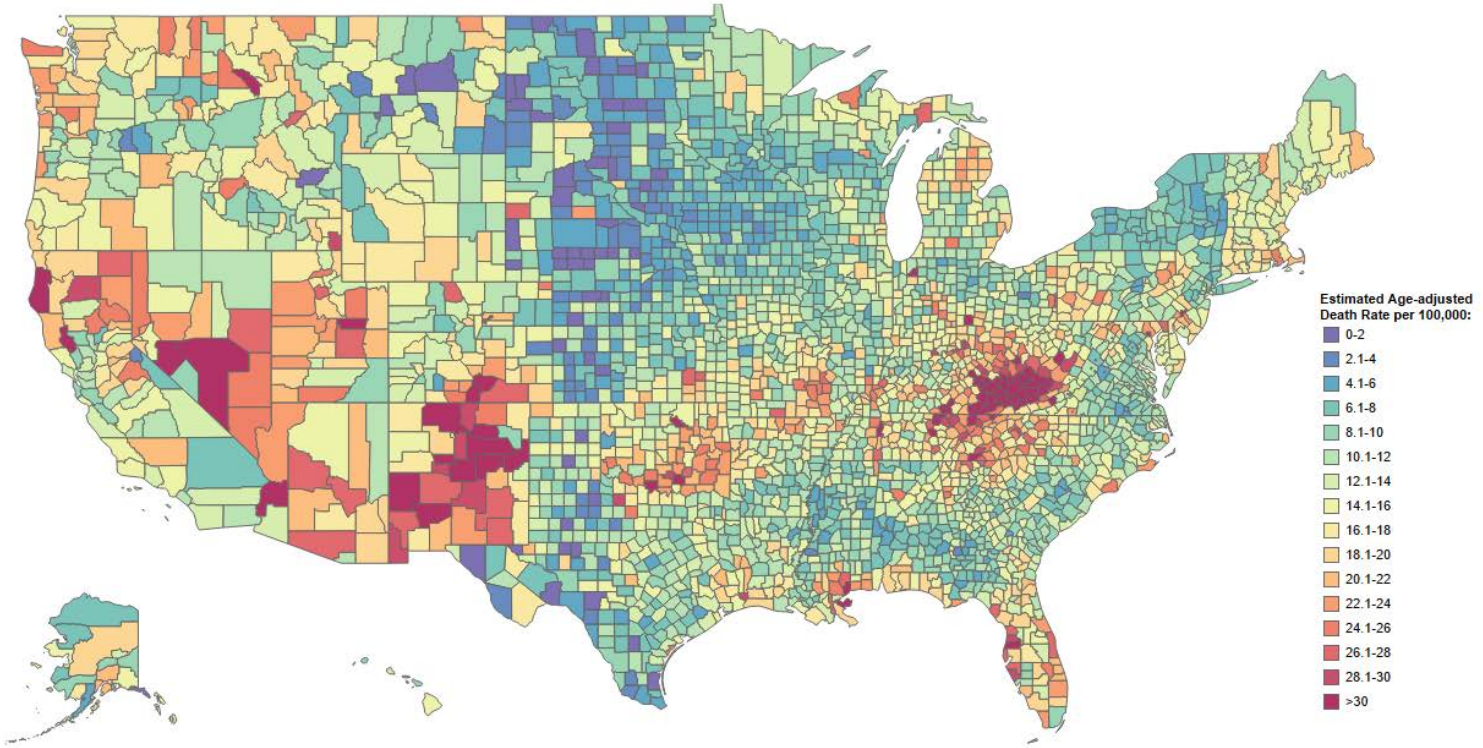
Estimated Age-adjusted Death Rates§ for Drug Poisoning by County, United States: **2009**



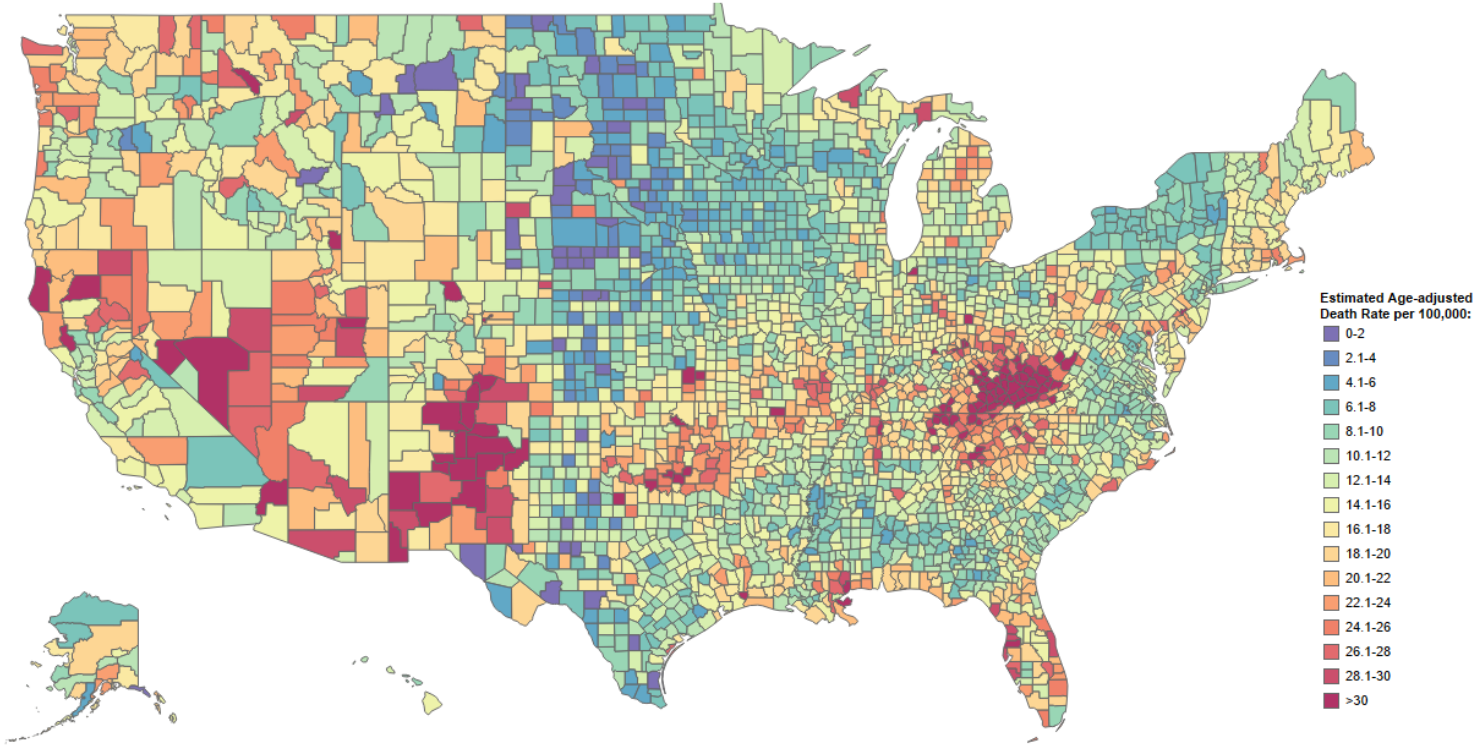
Estimated Age-adjusted Death Rates§ for Drug Poisoning by County, United States: **2011**



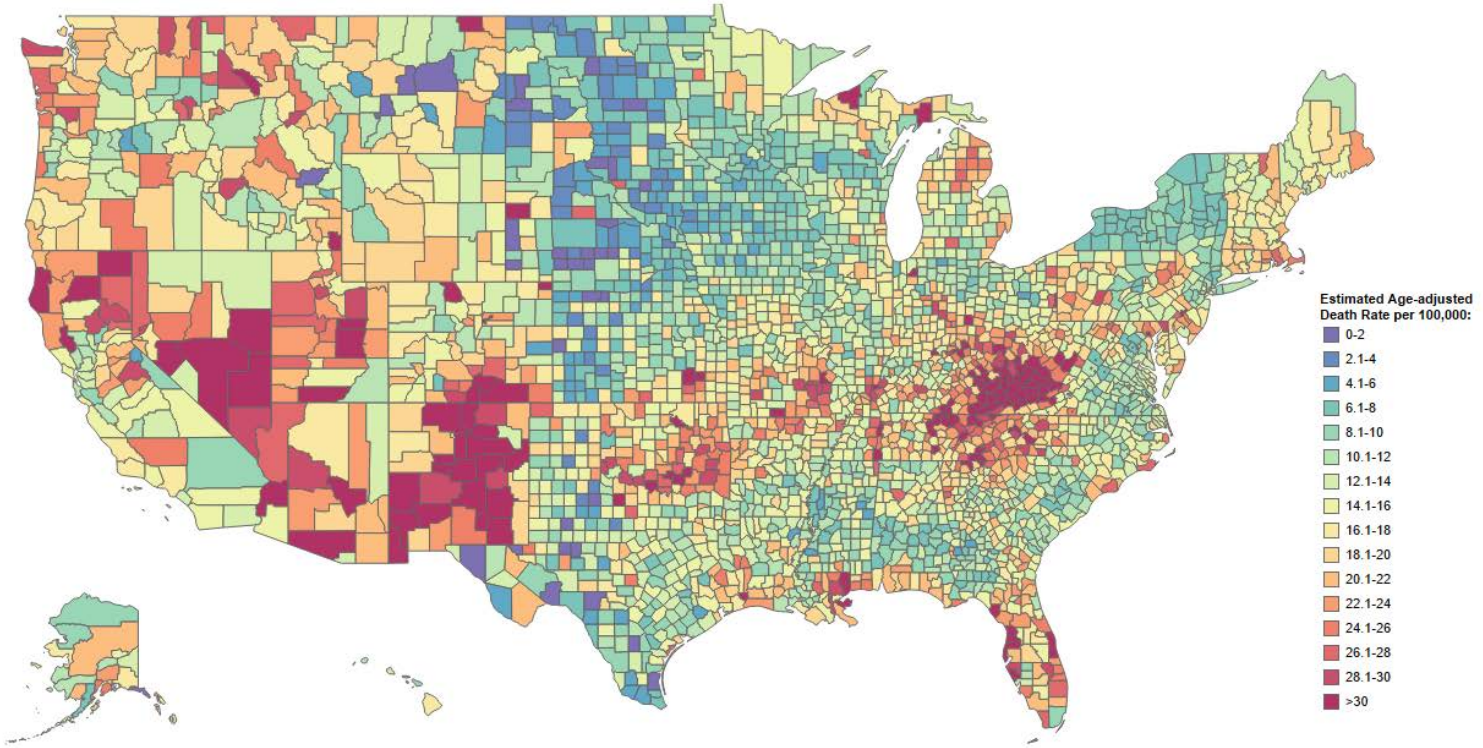
Estimated Age-adjusted Death Rates§ for Drug Poisoning by County, United States: **2013**



Estimated Age-adjusted Death Rates§ for Drug Poisoning by County, United States: **2014**



Estimated Age-adjusted Death Rates§ for Drug Poisoning by County, United States: **2015**



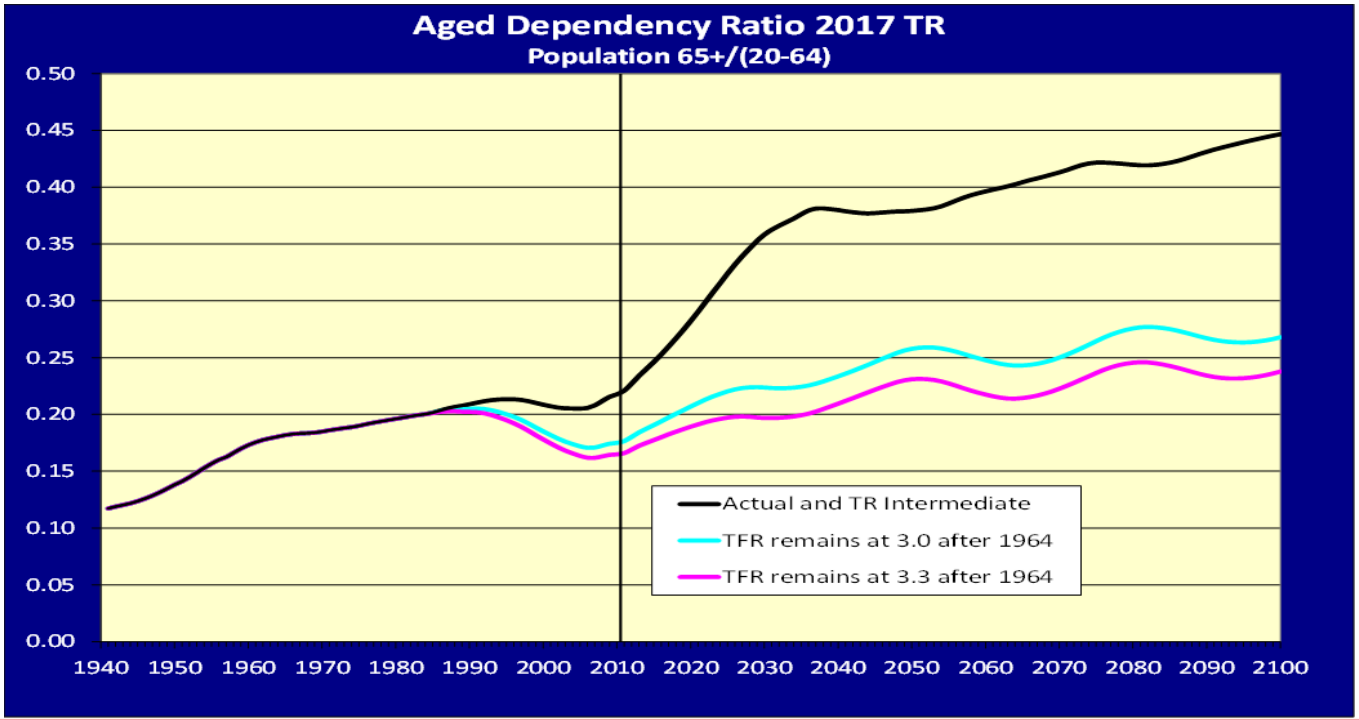
Declining Mortality (Increasing Longevity): At What Rate?

Steve Goss, Office of the Chief Actuary
Social Security Administration

AAA meeting
November 15, 2017

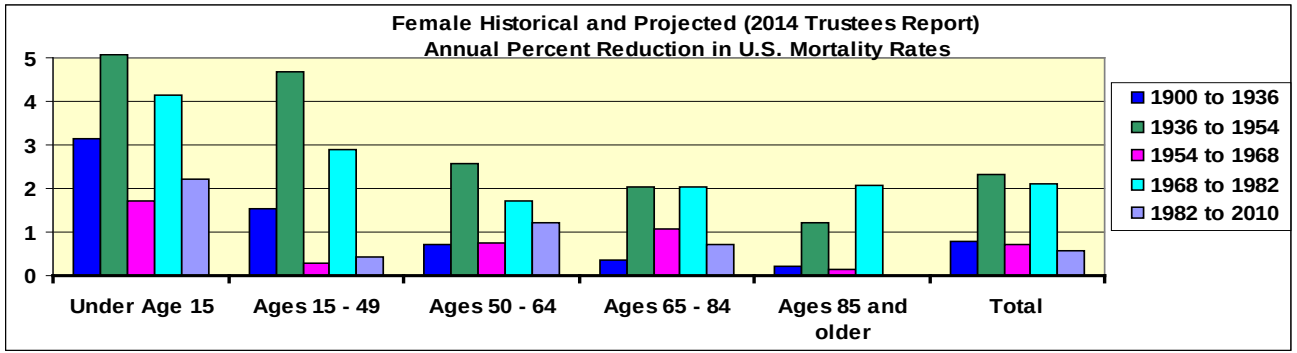
Perspective: “Aging” Not Mainly from Mortality

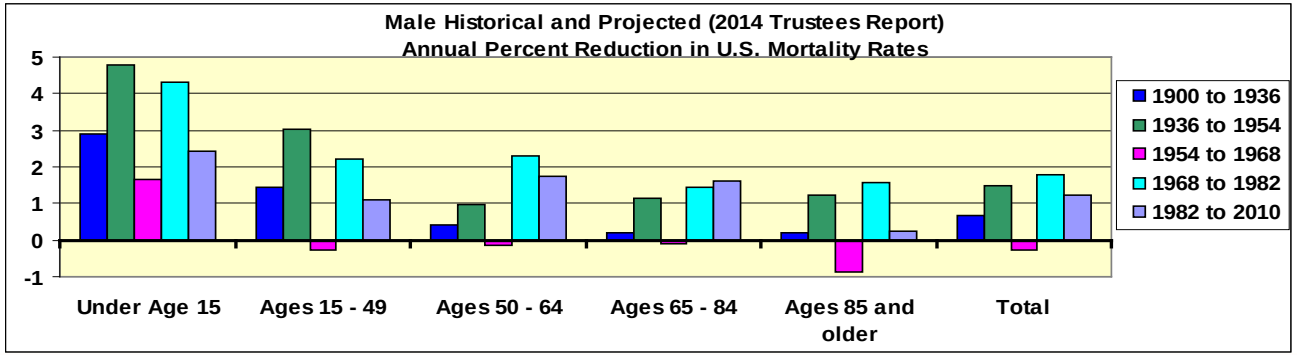
Aging (change in age distribution) mainly due to drop in birth rates



Mortality Decline *Varies* Over Time

Conditions: Antibiotics/economy 1936-54; Medicare/Medicaid 1968-82





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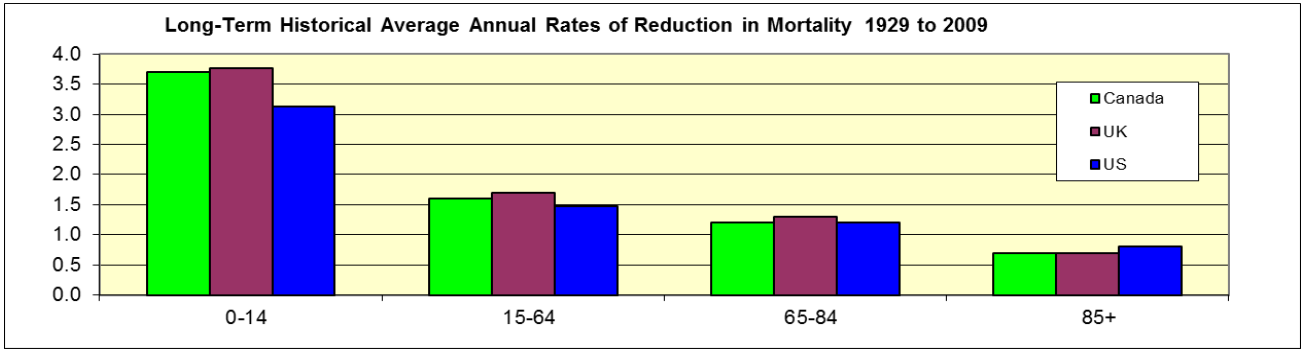
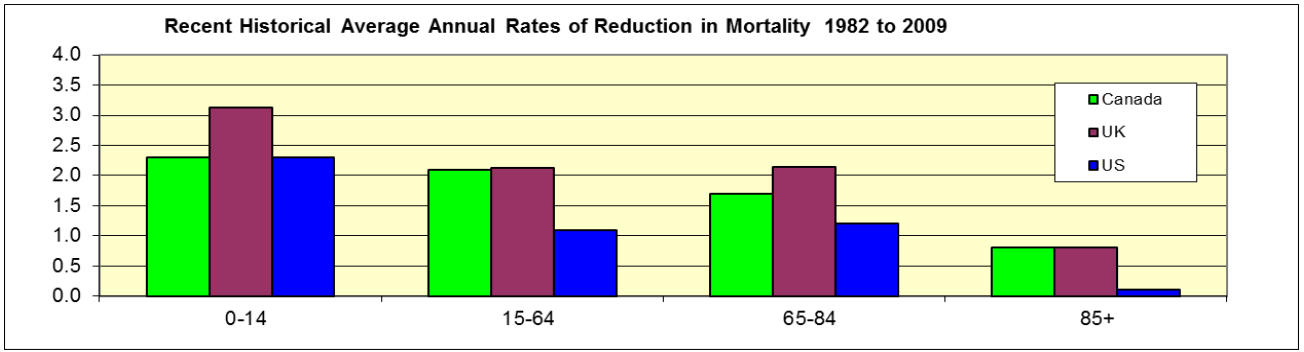
Appropriate Data: by Age Critical

Age-gradient in past reduction is clear





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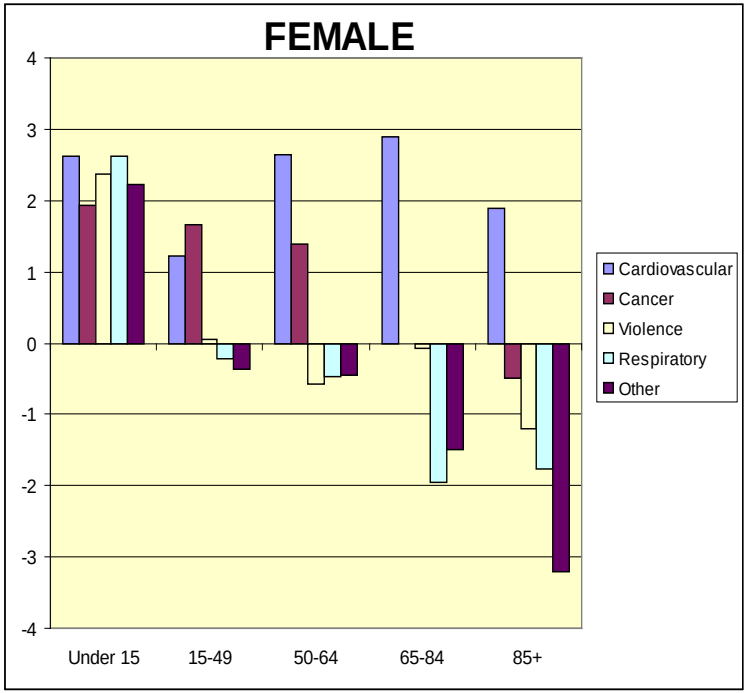
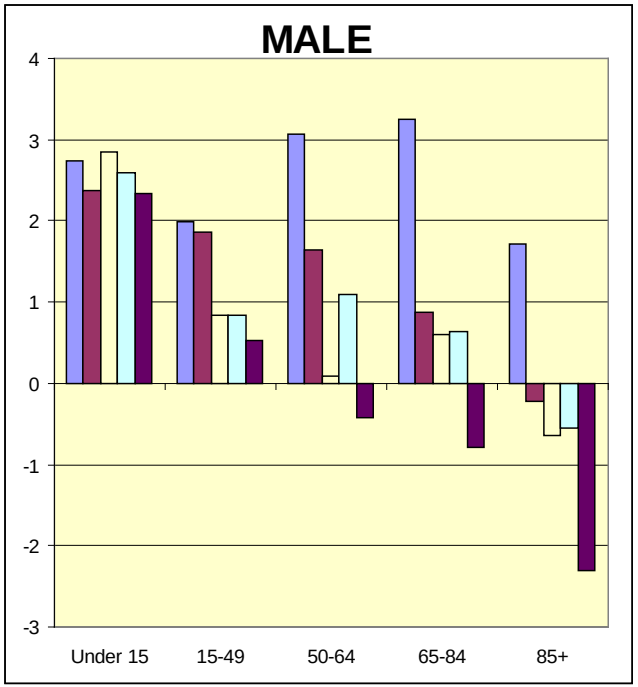
Mortality Decline by *Cause* of Death:

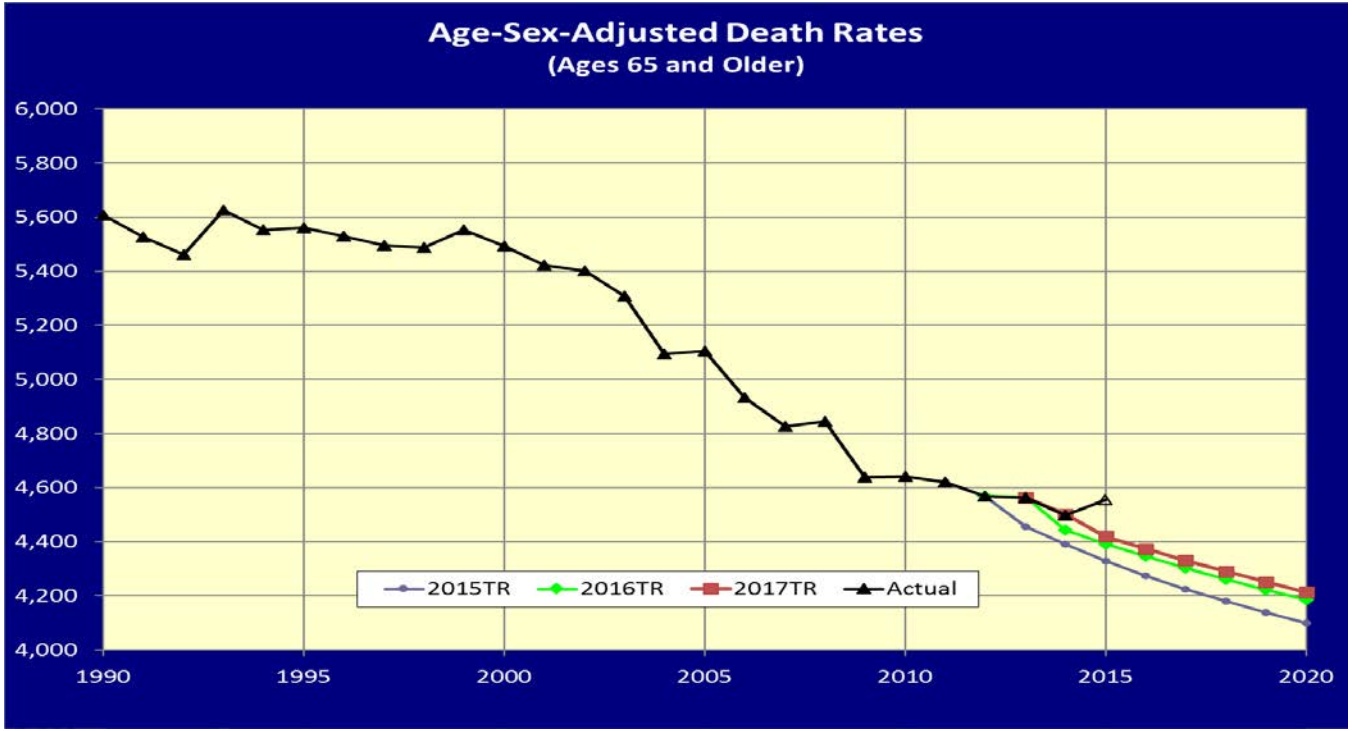
Rate of change from 1979 to 2013





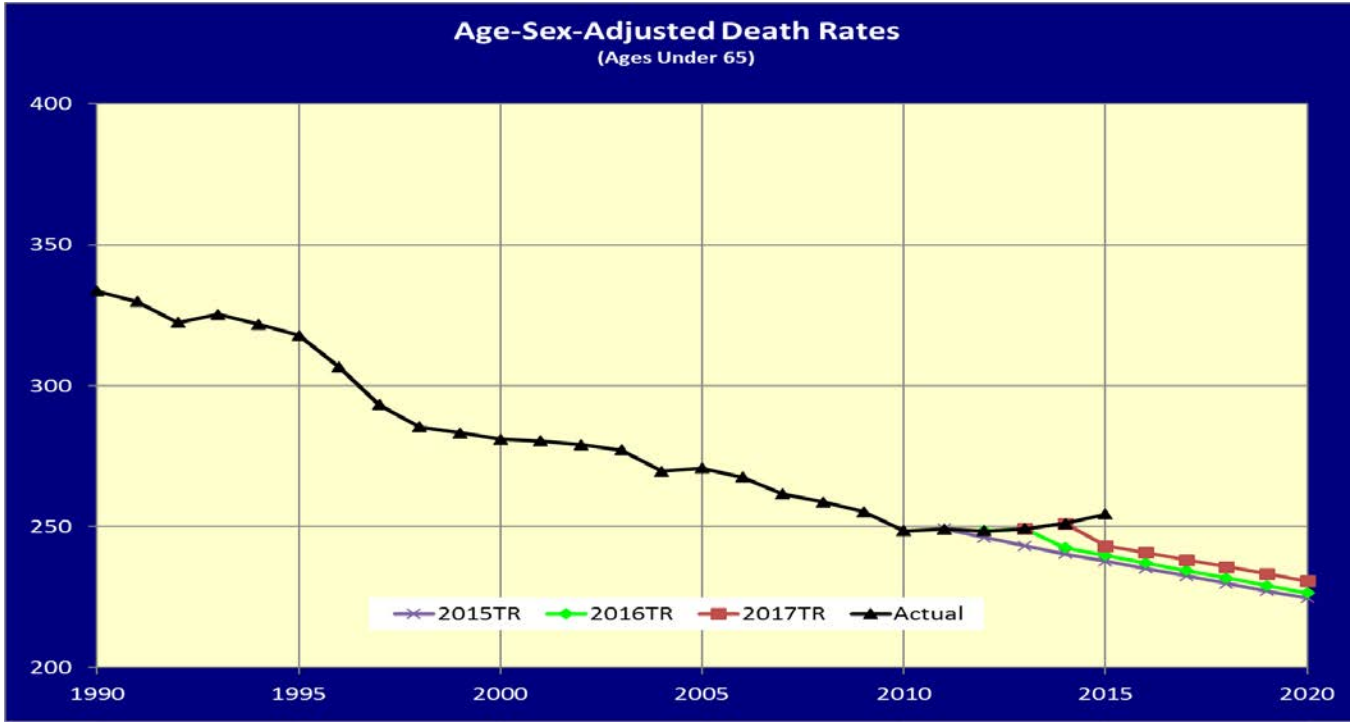
Mortality Experience: Ages 65 and Older

Reductions since 2009 continue to fall short of expectations



Mortality Experience: Ages Under 65

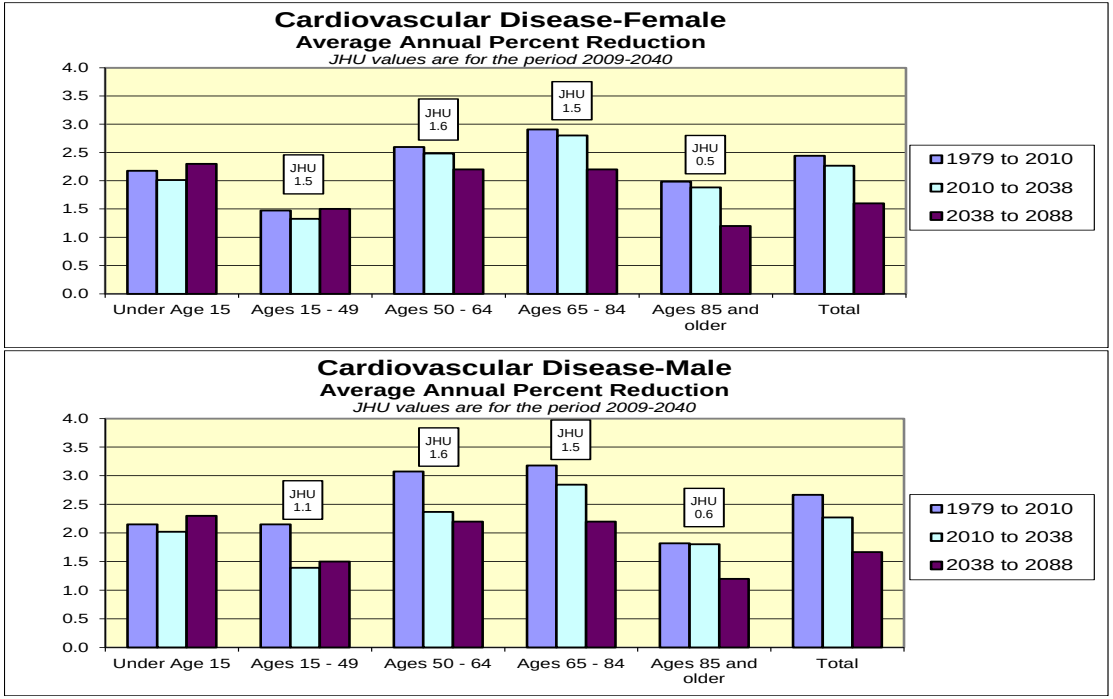
Actual increase since 2010



Developing Assumptions by Cause

- Scientific approach reflecting biology
- Trustees and SSA/OCACT develop in consultation with other experts
- Johns Hopkins (JHU) recent survey of medical researchers and clinicians came to very similar medium term expectations—independently
  - Trustees' medium-term rates by cause had not been published

Cardiovascular: JHU Less Optimistic than Trustees over Age 50 for Next 30 Years



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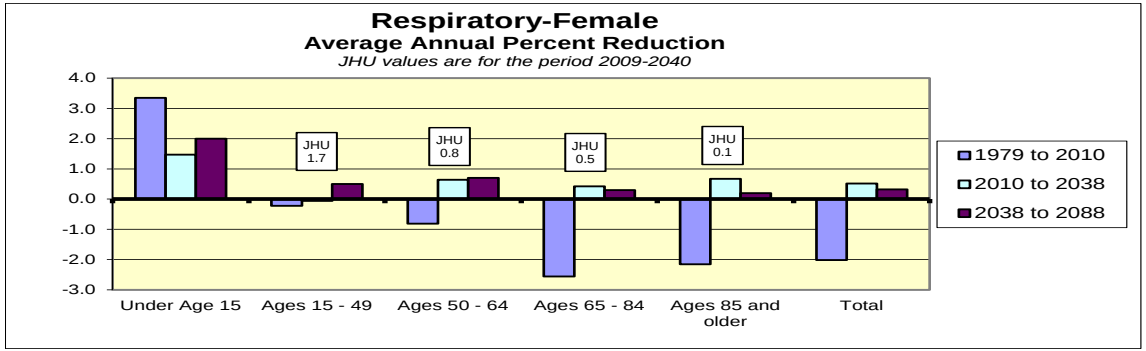
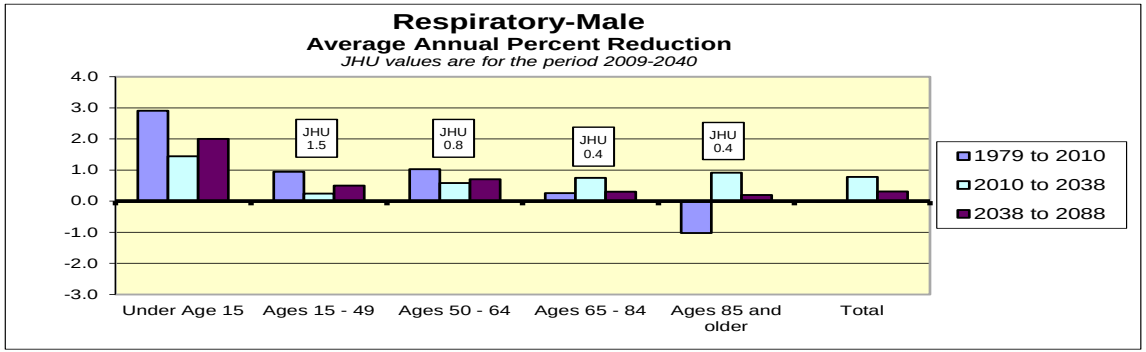
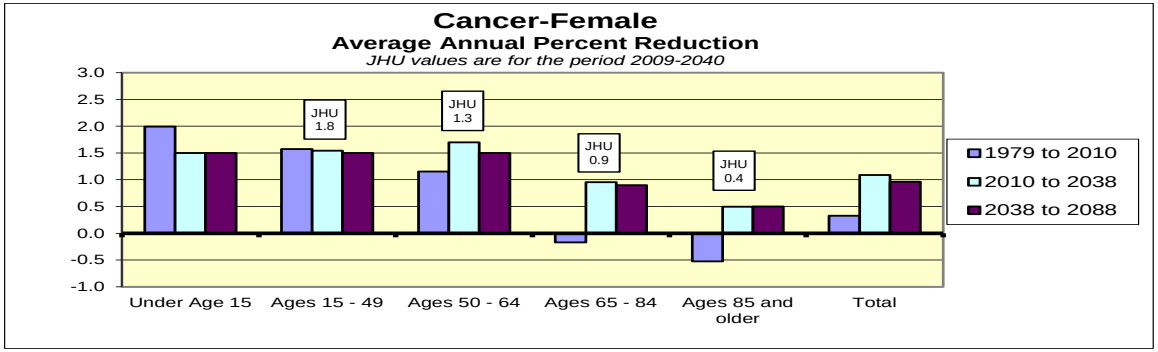
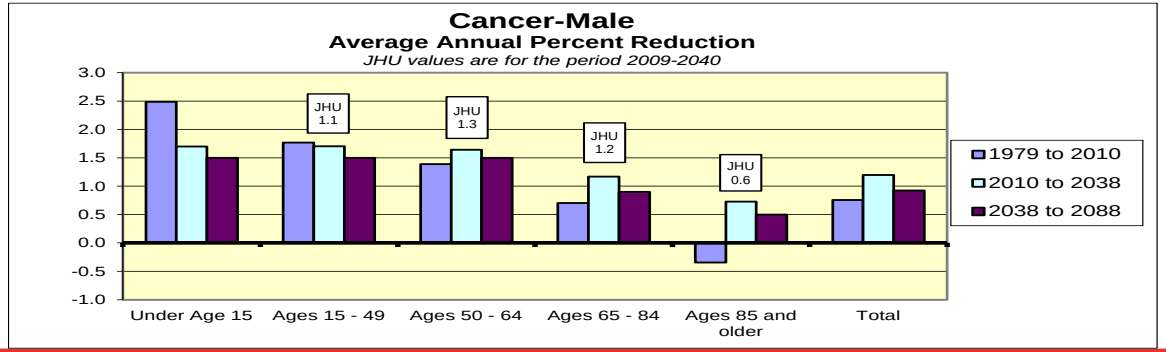
Respiratory: JHU More Optimistic under Age 50, Less Optimistic over Age 85





Cancer: JHU Very Similar to Trustees' Expectations





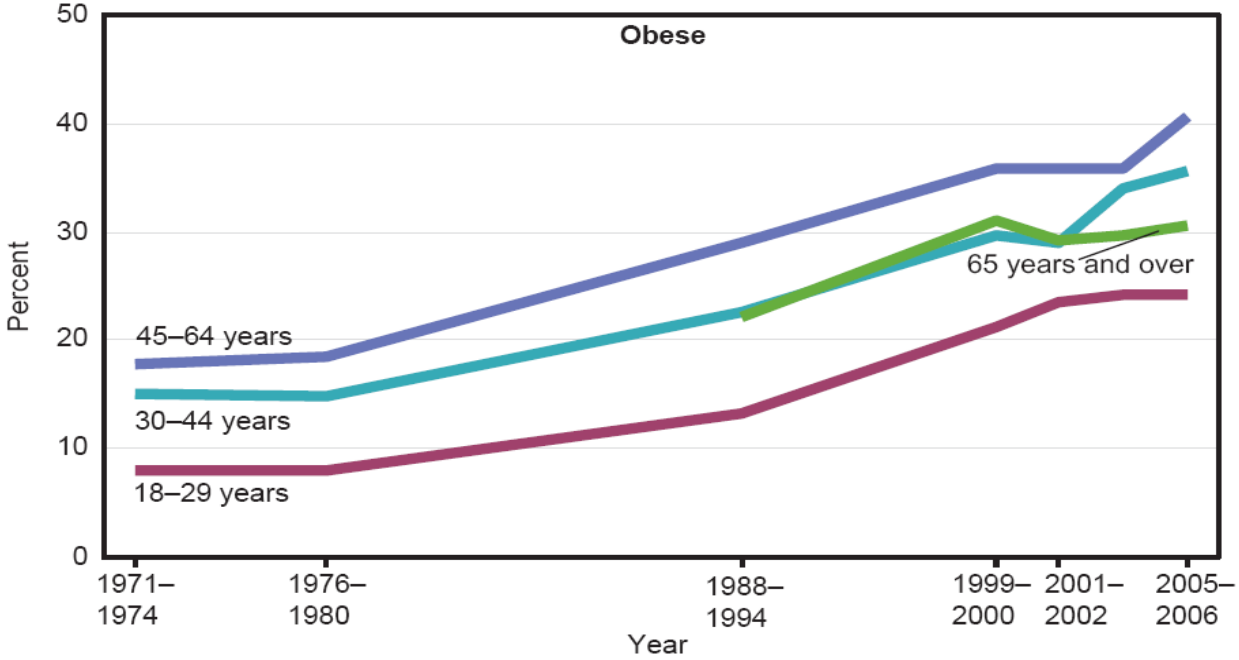
How Future Conditions Might Change

- Smoking decline for women
  - Started and stopped later than men
- Obesity—sedentary lifestyle
- Difference by income/earnings
- Health spending—must decelerate
  - Advances help only if apply to all
- Human limits
  - Increasing understanding of deceleration

Trends in Obesity: US 1971-2006

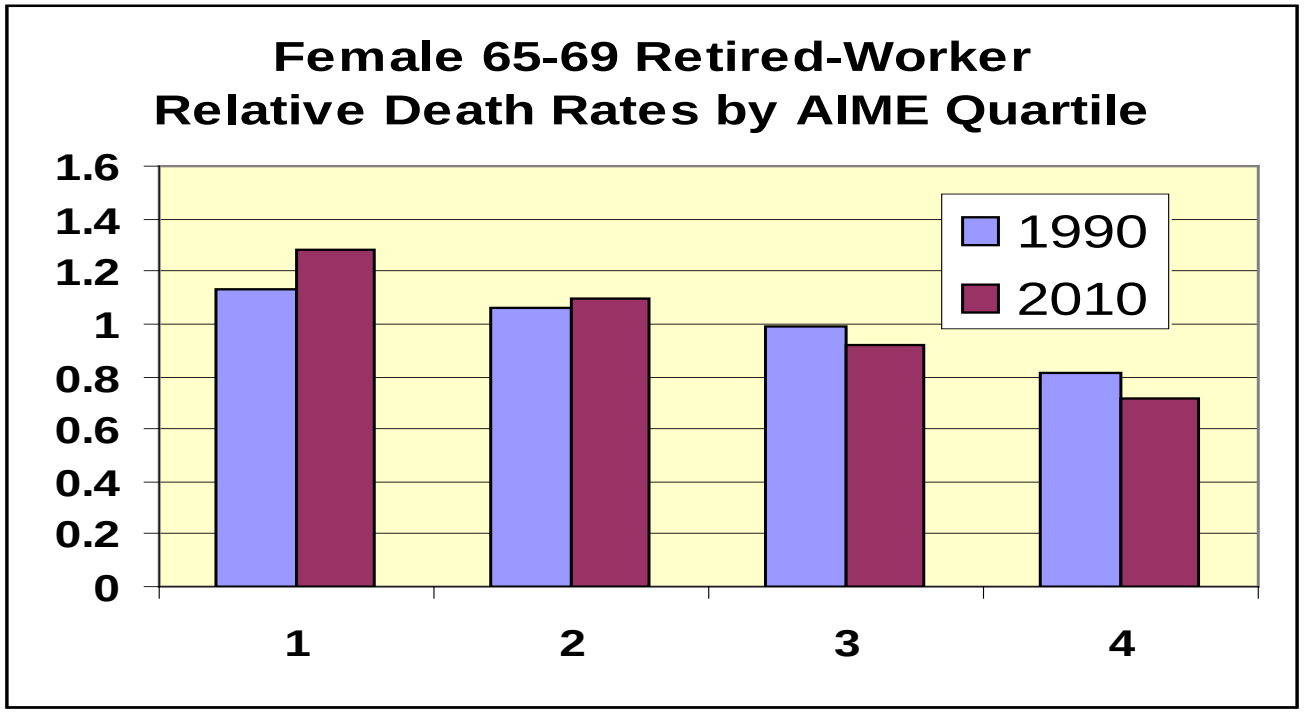
*Sam Preston 2010—must consider **cumulative** effects*

Increasing duration of obesity for aged in future



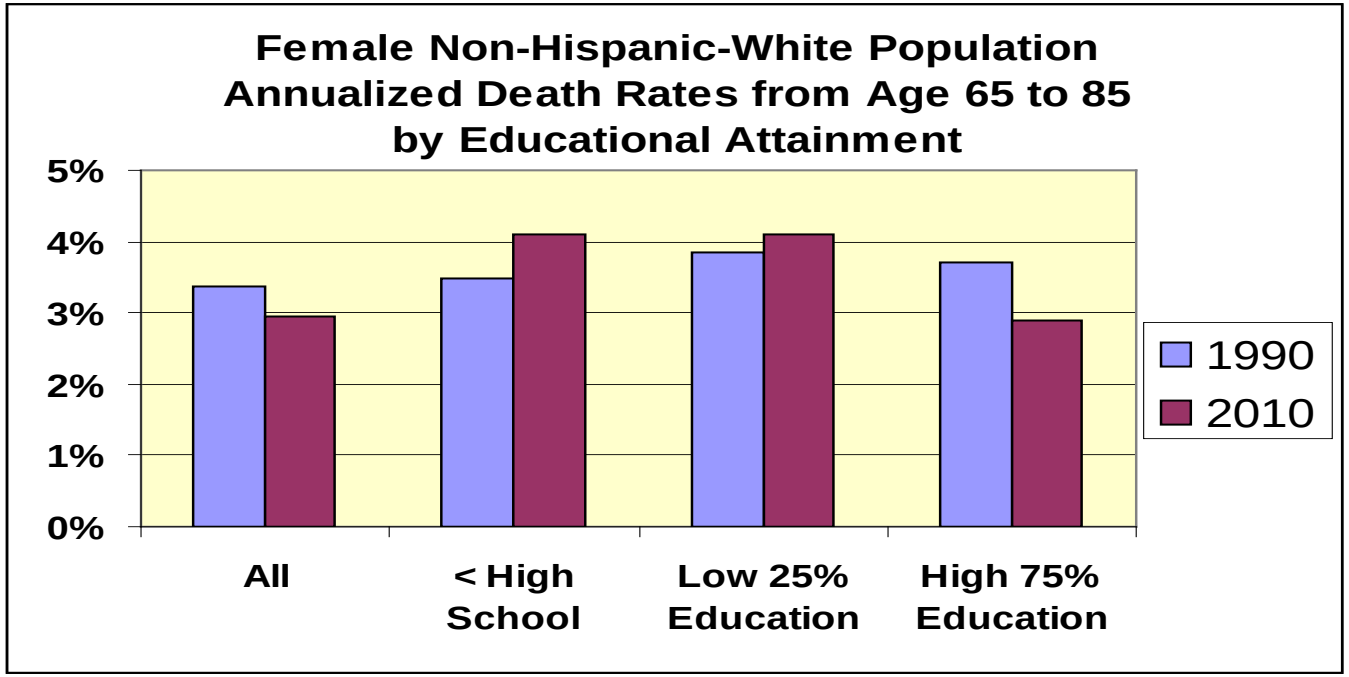
Death Rates Vary by Career Earnings Ranking

Difference has increased



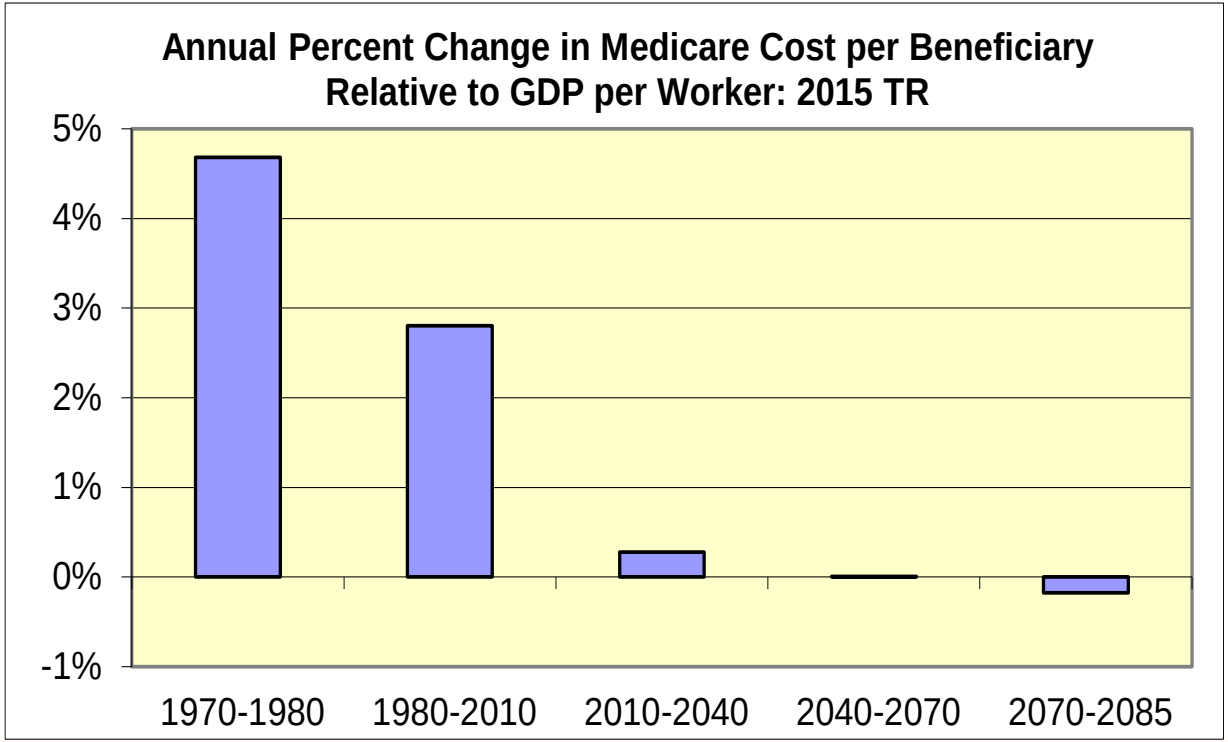
Mortality Decline by Education

Must be careful on changing shares (Bound 2014)



Health Spending Cannot Continue to Rise at Historical Rates

Note Trustees' deceleration



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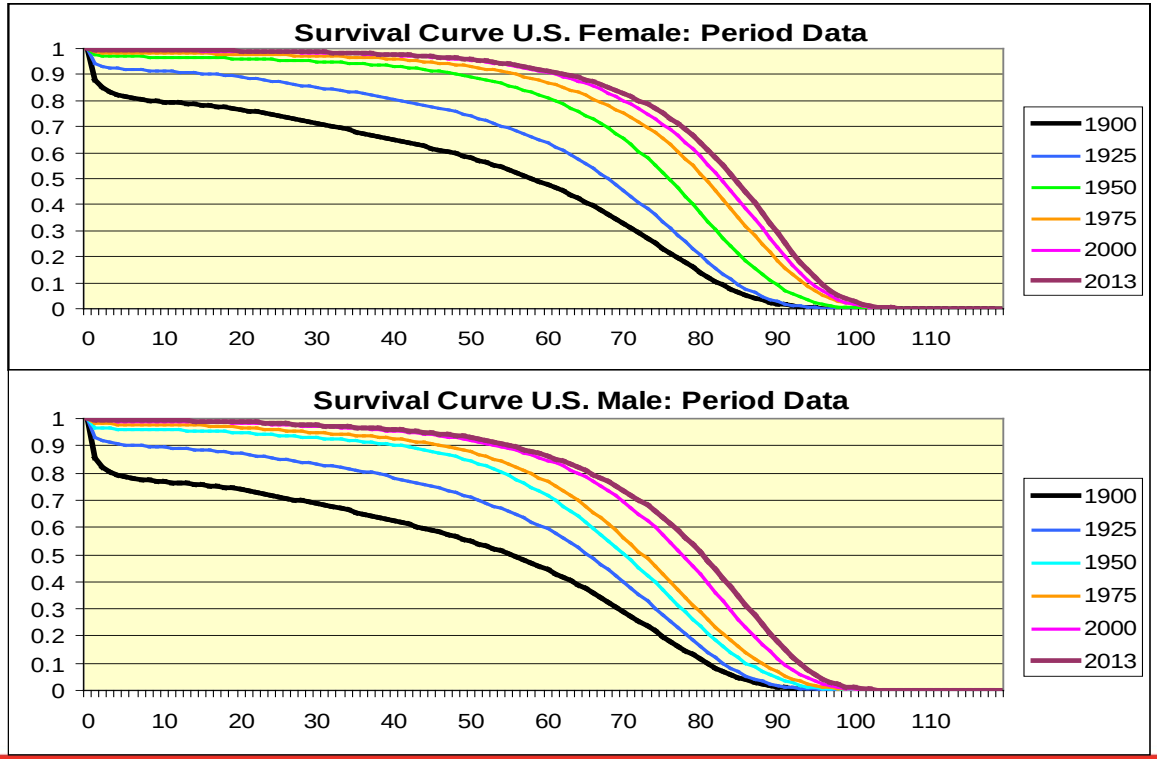
Is There an Omega?

It appears we are rectangularizing the survival curve?



Why is the insured population different? Or is it?

Mary J. Bahna-Nolan, MAAA, FSA, CERA
EVP, Head of Life R&D

News Flash

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

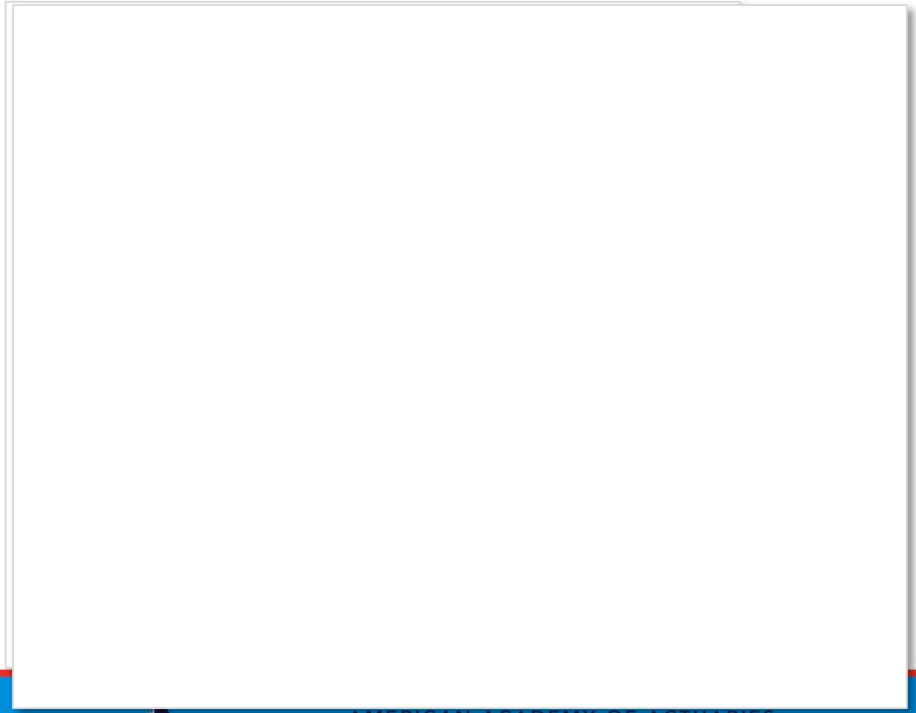
Mortality Trends – CDC 2015

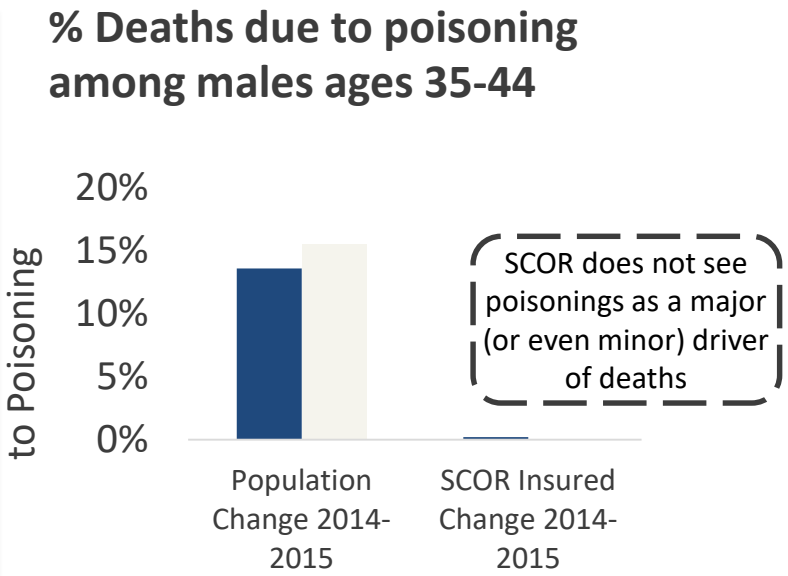
Decreases in Mortality	Increases in Mortality
Heart Disease	Unintentional Injuries
Cancer	Suicide
Stroke	Alzheimer's
Pneumonia	Chronic Liver Disease
	Hypertension

- The Centers for Disease Control and Prevention (CDC) regularly issues news releases regarding current trends in US population mortality.

- In June of 2016, articles in *The Washington Post* and *The Wall Street Journal* cited new CDC data from 2015 which showed a rise in the US mortality rate.
- Other recent research published by Case and Deaton (Princeton University), Truesdale and Jenks (Harvard University) and The Lancet all point to changes in US life expectancy, reduction in improvement and increase in socio-economic divide.

While the US population data shows a slowdown in mortality improvement, the same is not seen in the insured population





Comparing CDC to Insured* – Male/Female Totals Age 20-54

CDC

Cause of Death Category	Male	Female
Alzheimer's Disease	0.0%	0.1%
Blood Diseases	0.2%	0.3%
Circulatory System Diseases	21.3%	17.5%
Congenital Anomalies	0.5%	0.7%
Digestive System Diseases	4.2%	3.8%
Endocrine Diseases	2.7%	2.9%
External Causes	10.1%	5.1%
Genitourinary System Diseases	0.9%	1.2%
Infectious Diseases	3.9%	3.9%
Influenza and Pneumonia	1.0%	1.4%
Motor Vehicle Accidents	7.6%	4.5%
Neoplasms	15.7%	28.3%
Nervous System Diseases	0.0%	0.0%
Other	9.7%	12.0%
Perinatal Period Diseases	0.0%	0.0%
Poisoning	10.1%	9.0%
Pregnancy and Childbirth	0.0%	0.8%
Respiratory System Diseases	2.2%	3.8%
Suicide	9.7%	4.9%

Insured

Cause Of Death Category	Male	Female
Alzheimer's Disease	0.0%	0.0%
Blood Diseases	0.2%	0.3%
Circulatory System Diseases	22.3%	15.7%
Congenital Anomalies	0.1%	0.1%
Digestive System Diseases	2.3%	2.5%
Endocrine Diseases	1.5%	1.5%
External Causes	20.1%	12.2%
Genitourinary System Diseases	0.6%	0.8%
Infectious Diseases	1.4%	1.8%
Influenza and Pneumonia	0.7%	1.2%
Motor Vehicle Accidents	6.9%	3.9%
Neoplasms	26.1%	48.1%
Nervous System Diseases	1.9%	2.1%
Other	1.6%	1.7%
Perinatal Period Diseases	0.0%	0.1%
Poisoning	0.1%	0.1%
Pregnancy and Childbirth	0.0%	0.1%
Respiratory System Diseases	1.7%	2.6%
Suicide	12.4%	5.1%

Causes where insured experience is significantly different from general population

* Insured based on SCOR internal study

Male Risks

Top Causes	CDC	Insured
1	Circulatory (21%)	Neoplasms (26%)
2	Neoplasms (16%)	Circulatory (22%)
3	Poisonings (10%)	External (20%)
4	External (10%)	Suicides (12%)
5	Suicide (10%)	Motor Vehicle Accidents (7%)

Female Risks

Top Causes	CDC	Insured
1	Neoplasms (28%)	Neoplasms (48%)
2	Circulatory (18%)	Circulatory (16%)
3	Other (12%)	External (12%)
4	Poisonings (9%)	Suicide (5%)
5	External (5%)	Motor Vehicle Accidents (4%)

Comparing CDC to Insured* – Male/Female Totals Age 55-89

CDC

Cause of Death Category	Male	Female
Alzheimer's Disease	2.6%	5.5%
Blood Diseases	0.2%	0.2%
Circulatory System Diseases	33.3%	33.0%
Congenital Anomalies	0.1%	0.1%
Digestive System Diseases	1.8%	1.1%
Endocrine Diseases	3.3%	3.0%
External Causes	2.3%	2.0%
Genitourinary System Diseases	2.1%	2.0%
Infectious Diseases	2.6%	2.5%
Influenza and Pneumonia	2.2%	2.3%
Motor Vehicle Accidents	0.7%	0.3%
Neoplasms	26.4%	21.9%
Nervous System Diseases	1.4%	0.9%
Other	11.0%	16.1%
Perinatal Period Diseases	0.0%	0.0%
Poisoning	0.4%	0.3%
Pregnancy and Childbirth	0.0%	0.0%
Respiratory System Diseases	8.6%	8.5%
Suicide	1.0%	0.2%

Insured

Cause Of Death Category	Male	Female
Alzheimer's Disease	0.5%	1.1%
Blood Diseases	0.3%	0.3%
Circulatory System Diseases	25.9%	22.1%
Congenital Anomalies	0.1%	0.1%
Digestive System Diseases	2.6%	2.8%
Endocrine Diseases	2.0%	2.2%
External Causes	10.3%	8.6%
Genitourinary System Diseases	1.6%	1.8%
Infectious Diseases	1.4%	2.0%
Influenza and Pneumonia	1.6%	1.9%
Motor Vehicle Accidents	1.7%	0.9%
Neoplasms	38.7%	44.4%
Nervous System Diseases	3.0%	2.8%
Other	2.3%	2.8%
Perinatal Period Diseases	0.0%	0.1%
Poisoning	0.0%	0.0%
Pregnancy and Childbirth	0.0%	0.0%
Respiratory System Diseases	5.2%	5.6%
Suicide	2.8%	0.8%

* Insured based on SCOR internal study

Male Risks

Top Causes	CDC	Insured
1	Circulatory (33%)	Neoplasms (39%)
2	Neoplasms (26%)	Circulatory (26%)
3	Other (11%)	External (10%)
4	Respiratory (9%)	Respiratory (5%)
5	Endocrine (3%)	Suicide (3%)

Female Risks

Top Causes	CDC	Insured
1	Circulatory (33%)	Neoplasms (44%)
2	Neoplasms (22%)	Circulatory (22%)
3	Other (16%)	External (9%)
4	Respiratory (9%)	Respiratory (6%)
5	Alzheimer's (6%)	Nervous System /Other /Digestive (3%)

The trends over time seem to hold for differences in the causes of death between general population and insured population

CDC

Ages 20-54

Cause of Death Category	2010	2011	2012	2013	2014	2015
Neoplasms	21.6%	21.0%	20.8%	20.3%	19.7%	18.7%
Circulatory System Diseases	20.5%	20.1%	20.0%	19.9%	19.7%	19.3%
Other	10.3%	10.3%	10.5%	10.7%	10.7%	10.8%
Poisoning	8.4%	9.1%	9.1%	9.6%	10.3%	11.5%
External Causes	8.3%	8.4%	8.3%	8.1%	8.0%	8.4%
Suicide	7.7%	7.8%	8.0%	7.9%	8.1%	8.2%
Motor Vehicle Accidents	6.4%	6.4%	6.7%	6.5%	6.4%	6.7%

Ages 55-89

Cause of Death Category	2010	2011	2012	2013	2014	2015
Circulatory System Diseases	34.1%	33.3%	33.1%	32.9%	32.8%	32.9%
Neoplasms	24.6%	24.3%	24.2%	23.8%	24.0%	23.4%
Other	12.8%	13.5%	14.1%	14.2%	13.9%	13.2%
Respiratory System Diseases	8.4%	8.6%	8.5%	8.7%	8.5%	8.7%
Alzheimer's Disease	4.0%	3.9%	3.8%	3.8%	4.1%	4.7%
Endocrine Diseases	3.0%	3.2%	3.1%	3.1%	3.1%	3.2%
Infectious Diseases	2.5%	2.5%	2.5%	2.6%	2.6%	2.6%
Influenza and Pneumonia	2.2%	2.3%	2.2%	2.4%	2.2%	2.3%
External Causes	2.1%	2.1%	2.2%	2.2%	2.3%	2.3%

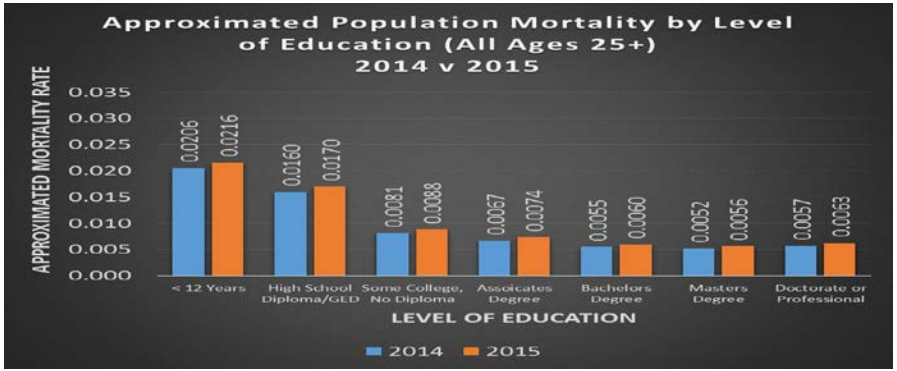
Insured

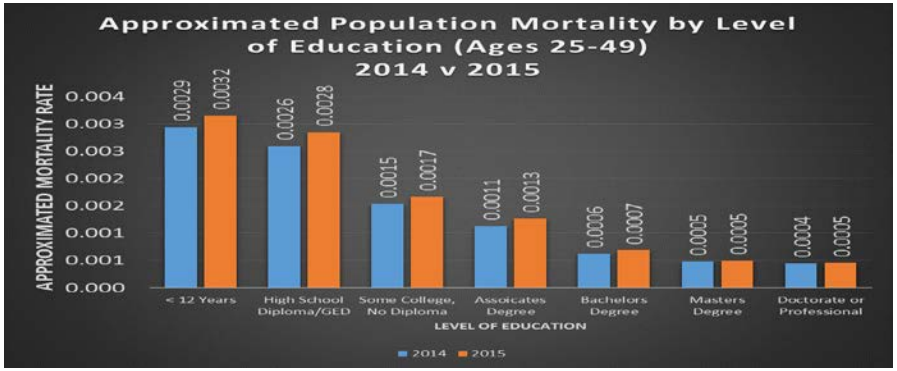
Cause Of Death Category	2010	2011	2012	2013	2014	2015
Neoplasms	34.1%	37.1%	34.3%	33.7%	32.6%	32.6%
Circulatory System Diseases	21.0%	19.8%	19.1%	19.7%	19.2%	20.9%
Other	0.6%	1.4%	2.0%	1.7%	1.8%	2.1%
Poisoning	0.0%	0.1%	0.1%	0.1%	0.2%	0.1%
External Causes	19.8%	17.7%	16.8%	15.8%	17.3%	16.4%
Suicide	9.6%	9.1%	9.9%	10.7%	10.0%	9.3%
Motor Vehicle Accidents	6.9%	5.9%	6.0%	5.6%	4.8%	5.8%

Cause Of Death Category	2010	2011	2012	2013	2014	2015
Circulatory System Diseases	25.0%	24.3%	24.8%	25.7%	24.3%	24.0%
Neoplasms	42.8%	42.7%	41.0%	40.7%	39.2%	39.0%
Other	0.7%	1.5%	3.0%	2.9%	3.0%	2.9%
Respiratory System Diseases	4.1%	4.2%	5.2%	5.4%	5.6%	6.6%
Alzheimer's Disease	0.1%	0.3%	0.8%	0.9%	1.1%	0.8%
Endocrine Diseases	1.2%	1.4%	2.3%	2.4%	2.3%	2.3%
Infectious Diseases	1.2%	1.1%	1.6%	1.6%	1.7%	2.0%
Influenza and Pneumonia	1.0%	1.5%	1.8%	1.7%	2.0%	1.7%
External Causes	15.3%	12.9%	7.9%	7.7%	9.0%	8.2%

Why The Difference Between CDC and Insured?

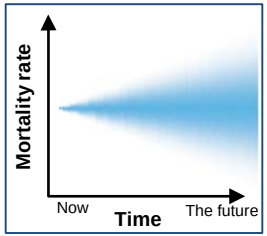
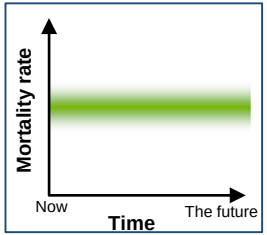
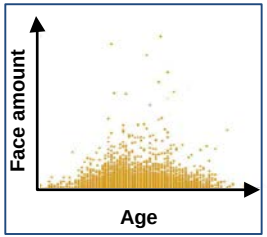
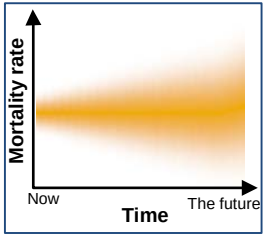
- The make-up of the fully underwritten life insurance policyholder is considerably different than that of the US population (i.e., basis risk) whereas the insured population tends to be of a higher socio-economic group than the general population.
- There are clear differences in mortality by socio-economic class. This can be seen across all age groups in the general population whereby level of attained education is used as a proxy for socio-economic status.
- Although mortality rates increased for the general population for all education levels, mortality continues to be significantly higher for lower educated (i.e., lower socio-economic) groups. This is true across all ages, but even more so at younger age groups.





Why do we care about the general population for insured mortality?

Mortality risk is composed of three components

Trend risk	+	Level risk	+	Volatility risk	=	Total risk
Risk that mortality rates do not improve as expected		Risk of an inaccurate assessment of current mortality rates		Risk of volatile mortality rates[1] due to insufficient mutualisation, heterogeneous portfolio		Combination of all components
						
Mortality Risk Materiality		**High**		**Medium**		**Low**		**High**

For most companies, the trend risk is a significant contributor to the projected value of a policy or a company's inforce value. Population data provided a homogenous dataset vs the insured data.

(1) Pandemic risk considered separately.

Why do we care about population mortality?

Common industry practice to use population data as the basis for the trend assumption

- Insured data is not homogenous from year to year
  - Changes in the underwriting eras, mix of business, and contributing companies cause discontinuities in the data
  - Reinsured data is further challenged in that the client mix changes from year to year

- This creates basis risk, which is difficult to quantify
- The basis risk varies depending on many factors, including:
  - Regional differences
  - Target market & cohort differences
  - Public health policy & access to diagnostic screening and advanced medical care
  - Level of underwriting

Drivers of basis risk

Only those that can afford the higher premiums (i.e., upper/middle income) take the insurance

1. Insured population tends to be issued to individuals in a much higher socio-economic class
   - Access to better health care and living conditions;
   - Access to better health care and living conditions;
   - Make better lifestyle choices.

2. Deaths due to influenza and pneumonia tend to impact the general population more heavily than the insured population.

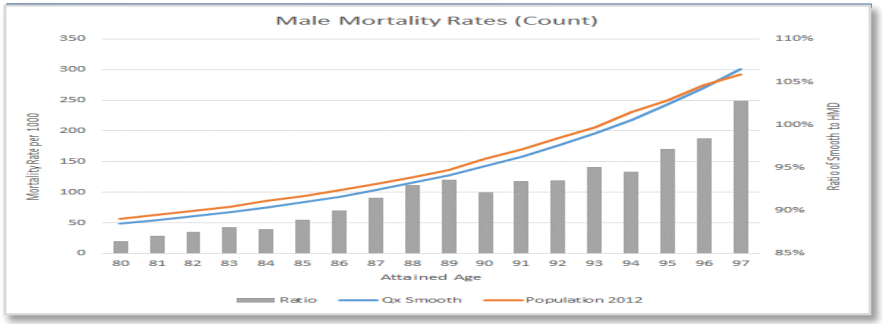
3. Insured population tends to have a lower percentage of tobacco/smoker risks than the general population

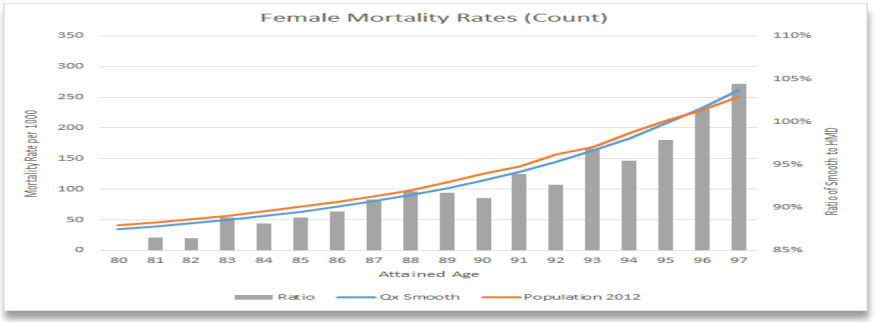
4. The underwriting process is somewhat self-selecting
   - Greater proportion of preferred risks
   - Risks of poor health are declined;
   - Less healthy risks are rated or charged increased premiums/cost of insurance

Changes in the trends by cause of death could and likely do impact the mortality level, especially at the older ages

- The trends and frequency of significant causes of death can be leading indicators for insurance claims;
- Environmental and medical advancement can impact causes of death and change future perspective on mortality, resulting in an impact on future trend and possibly level of mortality
  - Example: Immunotherapies, Alzheimer's, Aging
- Important to examine how an individual COD trend change would affect overall mortality, including trend change by subgroups.

Attained Age Experience* Relative to Population Qx





* Results from SCOR proprietary industry study

Difference Between US and Insured Populations

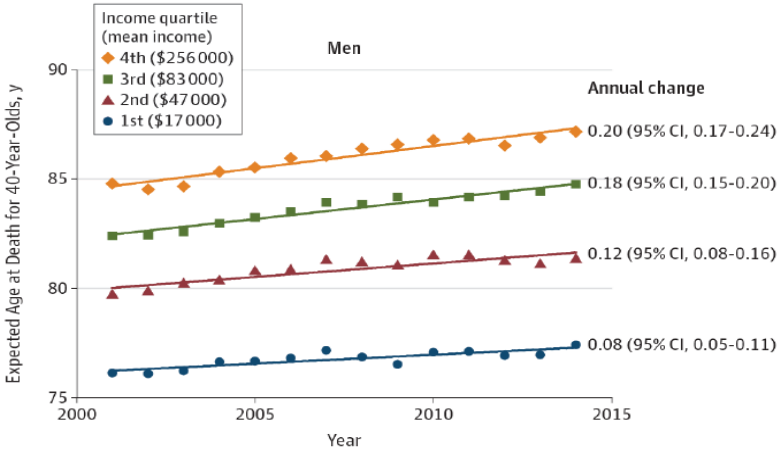
- JAMA (2016)

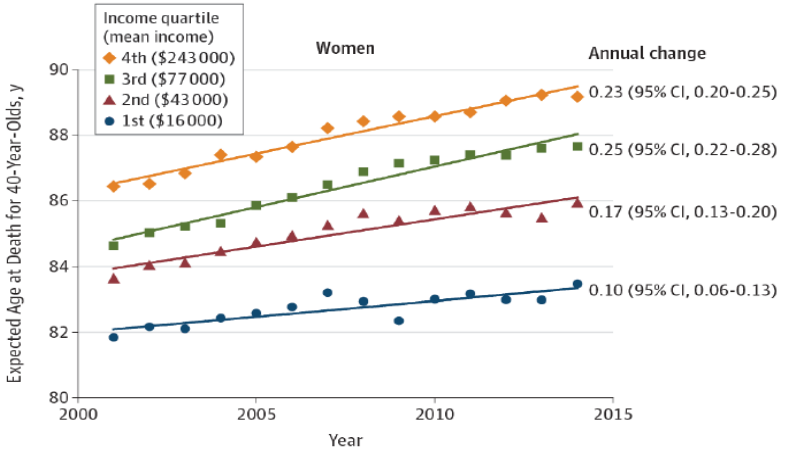
Special Communication

The Association Between Income and Life Expectancy in the United States, 2001-2014

Raj Chetty, PhD; Michael Stepner, BA; Sarah Abraham, BA; Shelby Lin, MPhil; Benjamin Scuderi, BA; Nicholas Turner, PhD; Augustin Bergeron, MA; David Cutler, PhD

A Life expectancy by income quartile by year





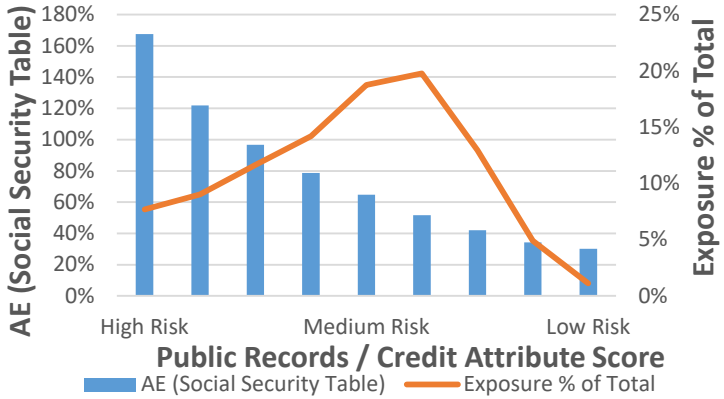
Key Findings of Chetty, Stepner, et al Study

- Life expectancy increased continuously with income.
- Between the top 1% and bottom 1% of the income distribution, life expectancy differed by 15 years for men and 10 years for women.
- There was a larger increase in life expectancy for higher income groups during the 2000's. Between 2001 and 2014, individuals in the top 5% of the income distribution gained around 3 years of life expectancy, whereas individuals in the bottom 5% experienced no gains.
- Most of the variation in life expectancy across various geographic areas [and income levels] was related to differences in health behaviors, including smoking, obesity, and exercise.
- Individuals in the lowest income quartile have more healthful behaviors and live longer in areas with more immigrants, higher home prices and more college graduates.

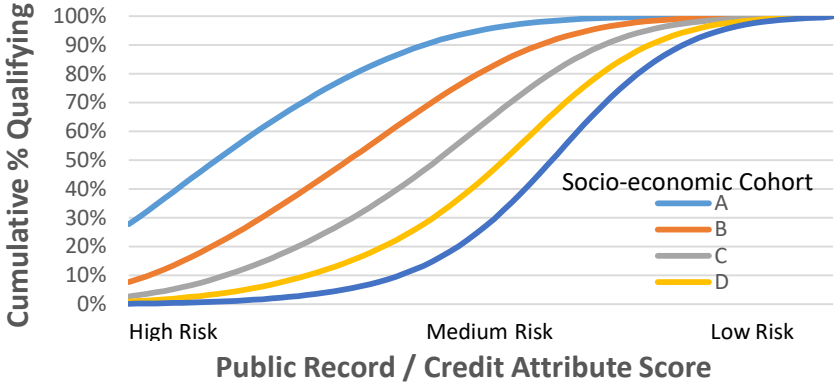
JAMA, April 10, 2016: Raj Chetty,PhD; Michael Stepner, BA; Sarah Abraham, BA: Shelby Lin, MPhil; BenjaminScuderi, BA; Nicholas Turner, PhD; Augustin Bergeron,MA: David Cutler, PhD

Analysis of other data sources such as credit attributes highlights the cohort differential within the population – these must be considered when evaluating mortality impacts and trends between populations

- Traditional A/E methods are often used to understand mortality experience. These methods work well to control for age / gender / duration / tobacco status / UW class in one number



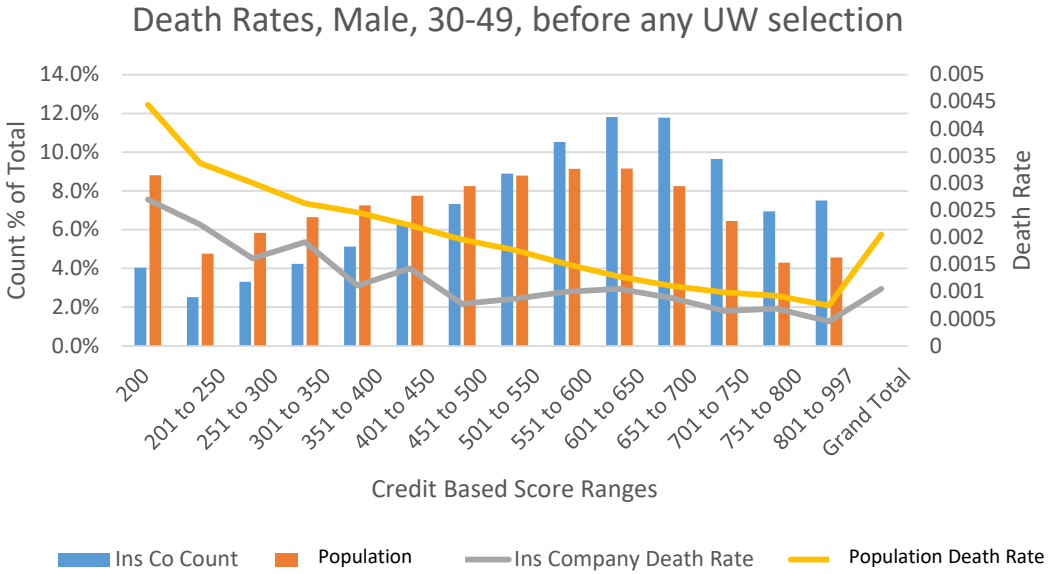
- Disadvantages of traditional A/E
  - Interpreting results requires some knowledge of the underlying table/cohort
  - Basis risk differences between cohorts can be significant – may misinterpret traditional A/E if basis risk not quantified



Source: SCOR proprietary study

Insurance applicants have more favorable mortality, even before any UW selection

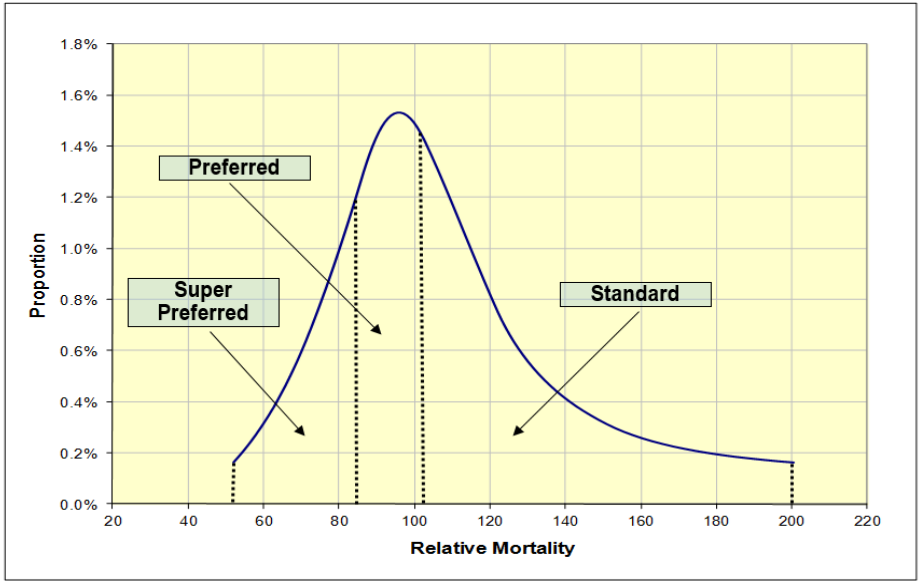
The correlation between mortality and income levels is preserved



Source: Population (LexisNexis Portfolio) vs Insurance Applicants Portfolio from proprietary LexisNexis & SCOR study

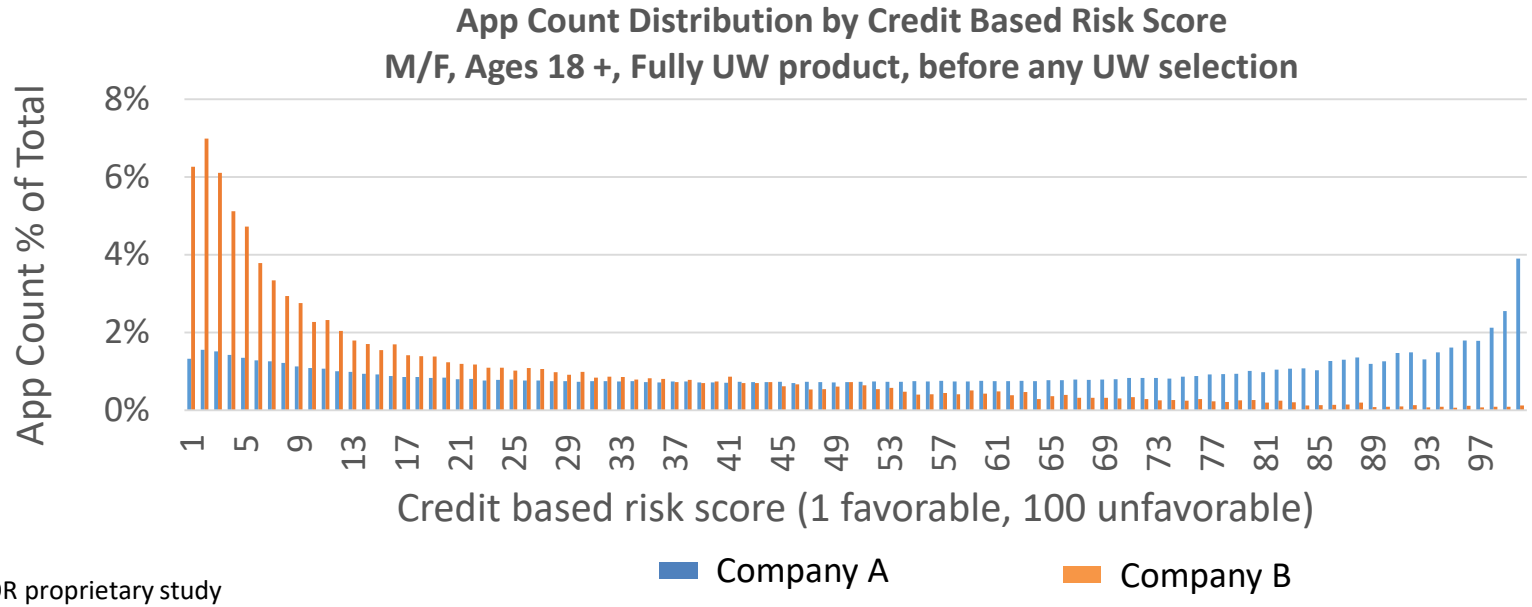
The underwriting process further drives a difference between US and insured populations

- Preferred risk programs increase not-taken rates in the residual classes, resulting in a skewing of placed risks into the best classes.



Important to understand a company's target market

- Two companies with similar underwriting can have a very different customer profile based on target market and distribution, leading to mortality rates with a very different relationship to population mortality between the two



Source: SCOR proprietary study

Conclusions

- There has been much press and scrutiny regarding a decline in expected longevity for the US population relative to other developed nations.
- While these studies have received noted publicity in the press, it is important to recognize that trends in the general population do not necessarily translate to trends in the insured population
- The insured population tends to be in a higher socio-economic class with access to better health care and living conditions and generally make healthier lifestyle choices.
  - For example, the insured population has a lower percentage of tobacco/smoker risks than the general population (less than 5% in the SCOR proprietary industry study) with a significantly increased cost of insurance for tobacco users.

Conclusions, cont'd

- The insurance industry's extensive underwriting process (detailed health questions plus medical exam and/or fluid collection) tends to select risks that are generally in much better health than the average individual in the US population.
  - Poorer risks are declined insurance or are rated as substandard and pay appropriately higher premiums.
  - This tends to result in a greater proportion of preferred risks and, for impaired lives, a higher proportion in the upper and middle income status who can afford an increased cost of insurance.
- As more companies broaden their focus to increase penetration in the middle income market, there will likely by a shift in the drivers of insured mortality towards that of the general population.
- It is important to pay attention to population trends. For example, the increased use of e-cigarettes and vaping, especially in the younger population, is worth further study.

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http://www.cdc.gov/nchs/deaths.htm