International Actuarial Association
Association Actuarielle Internationale

Mortality Projections: A US Perspective on Approaches and Challenges

International Actuarial Association
Mortality Working Group Meeting

Steve Goss, Chief Actuary
Karen Glenn, Deputy Chief Actuary
US Social Security Administration
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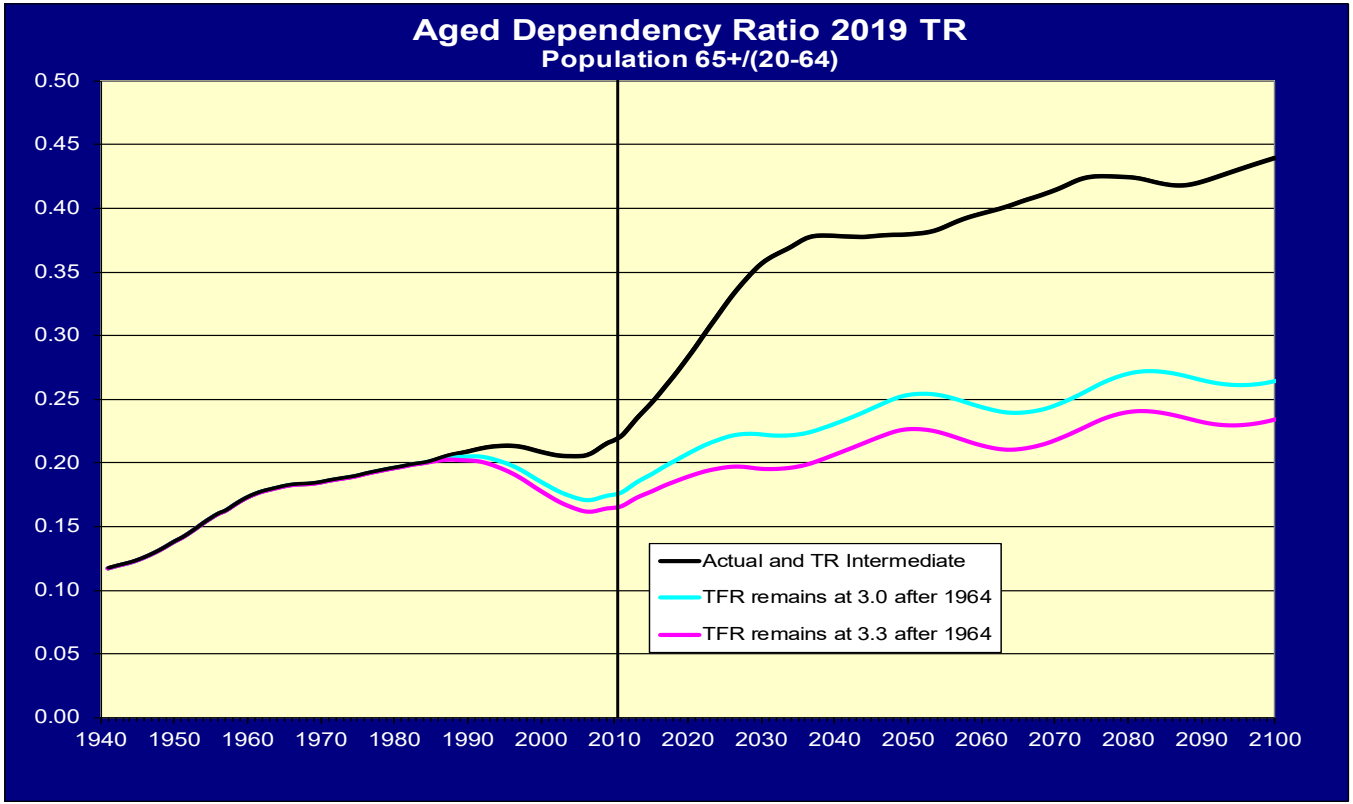
Perspective: “Aging” Not Mainly from Mortality

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



Various Alternative Projection Approaches Using Data

Extrapolating past trends:

1) Age setback *(early method)*
2) Mortality rate by age and sex *(Lee/Carter)*
3) Life expectancy at birth *(Vaupel/Oeppen)*
4) Mortality rate by trend all ages *(2011 Technical Panel, CBO 2013-5)*

Or reflect changing conditions:

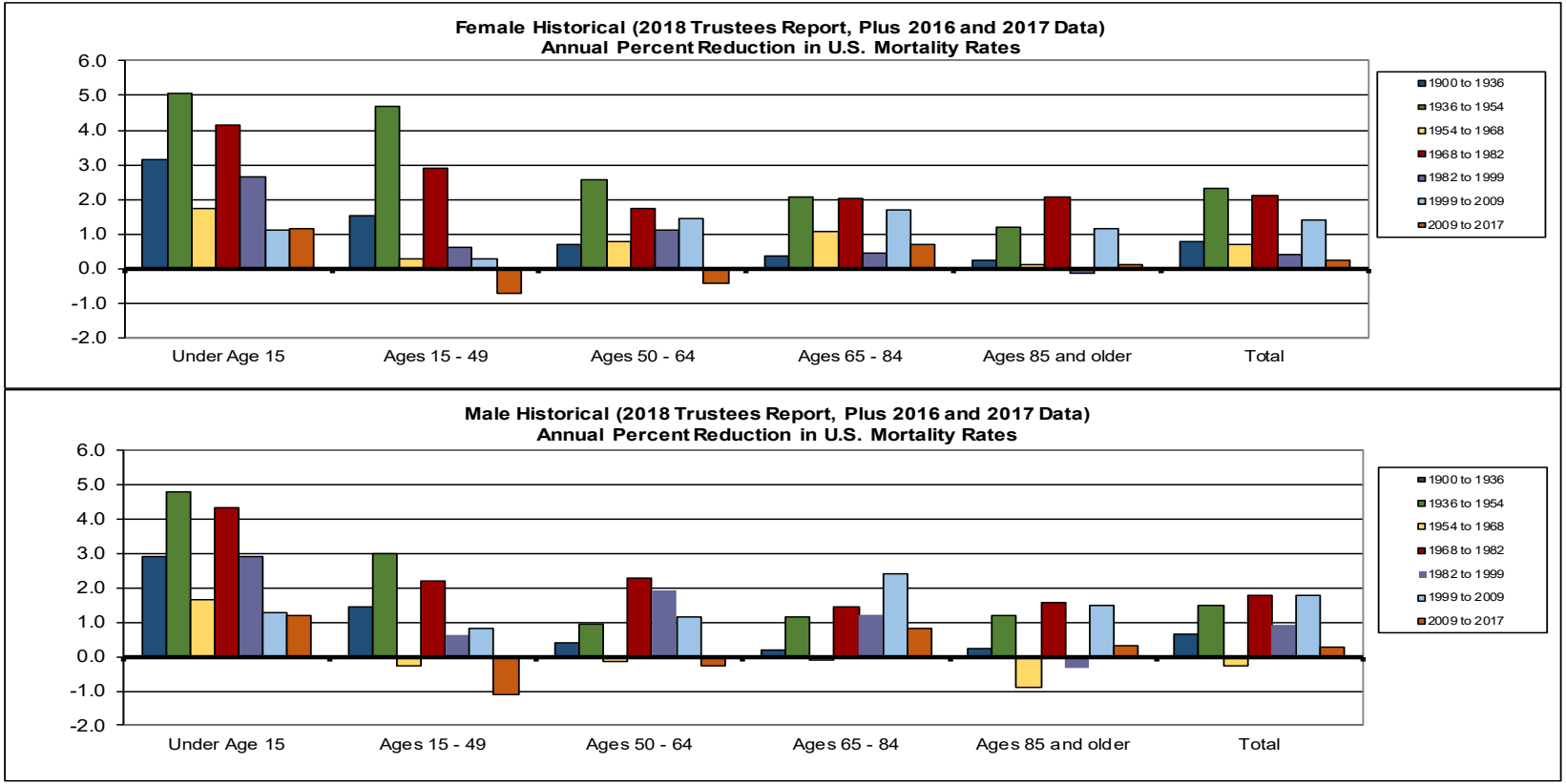
5) Improvement by cohort *(UK CMI, SOA)*
6) Mortality rate by age, sex, cause *(OCACT/TR, 2015 Technical Panel)*

2) Extrapolation by Age and Sex

- Example: Lee and Carter
- Fit the average trend of a selected period
- Future conditions must replicate the past—on average
- Age gradient never changes
- No deceleration in mortality decline

Mortality Decline Varies Over Time

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



3) Will Life Expectancy Rise Linearly?

Vaupel/Oeppen 2002; best nations

- Requires *accelerating* rate of decline in mortality rates if retain age gradient
- LE most affected by lowest ages—only so much gain possible
- Most disagree
  - Vallin/Meslé

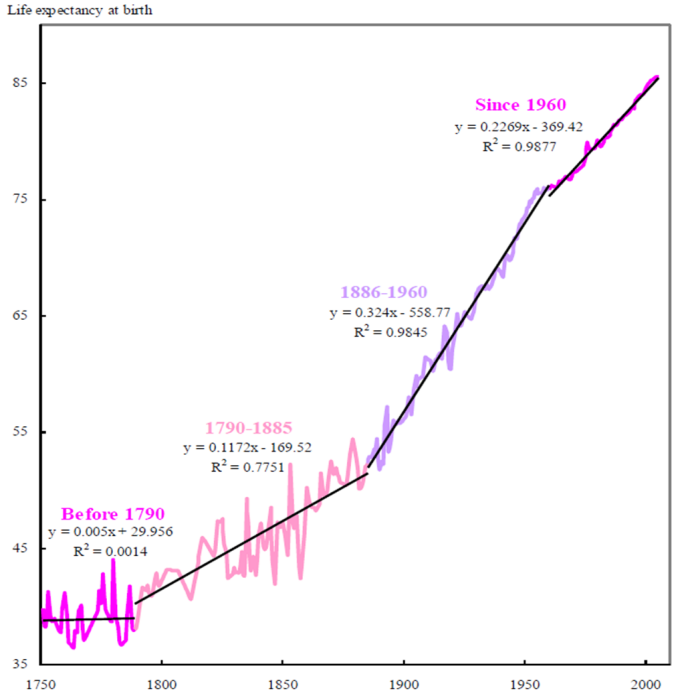


Figure 2. Maximum female life expectancy at birth since 1750 but excluding Norway (until 1866) and New Zealand

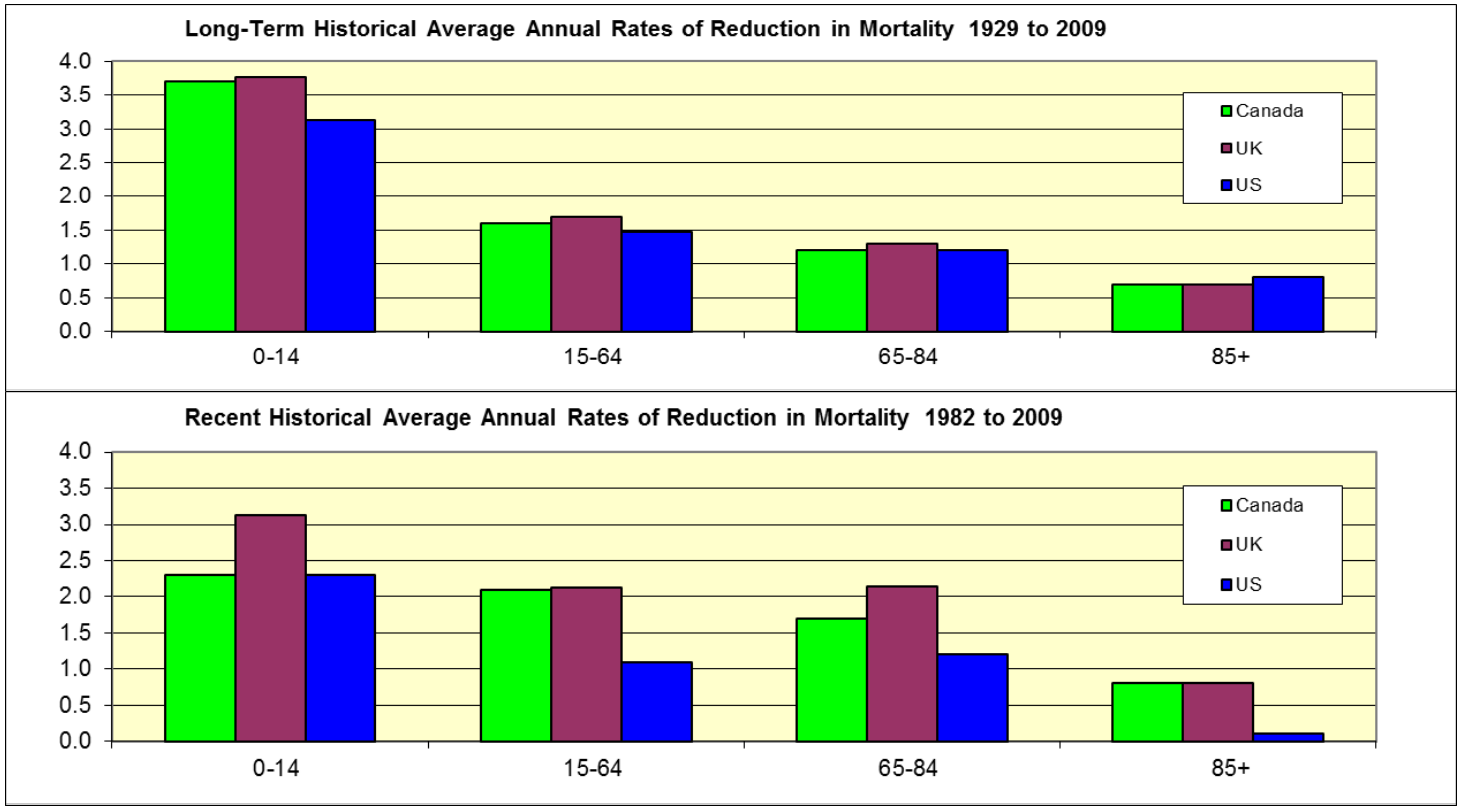
Source: Vallin and Meslé 2008

4) Extrapolate All Ages the Same

- Ignores historical age gradient
- Result:
  - Substantial bias for population age distribution
- Thus, large bias for cost as % of payroll
  - Less mortality decline at young ages raises cost
  - More mortality decline at older ages raises cost

Appropriate Data: by Age Critical

Age-gradient in past reduction is clear



5) Extrapolation by Cohort

- U.K. (& SOA-RPEC): “Phantoms never die” data issues
- Post-WW2 births: antibiotics young, statins later
- What does change up to age x say above age x?
  - Is cohort healthier at x if lower mortality up to x?
  - Or is cohort compromised by impaired survivors?
  - What does one cohort imply for the next cohort?
- Period effects from known changes in conditions are stronger—especially in the U.S.

6) Projection by Age, Sex, Cause

- SSA/OCACT/Trustees Reports (2015 Technical Panel)
- Requires selecting ultimate rates of decline
- Allows change in age gradient
- Results in deceleration in mortality decline

Comparison of Historical, 2015 Trustees Report, and Ron Lee*

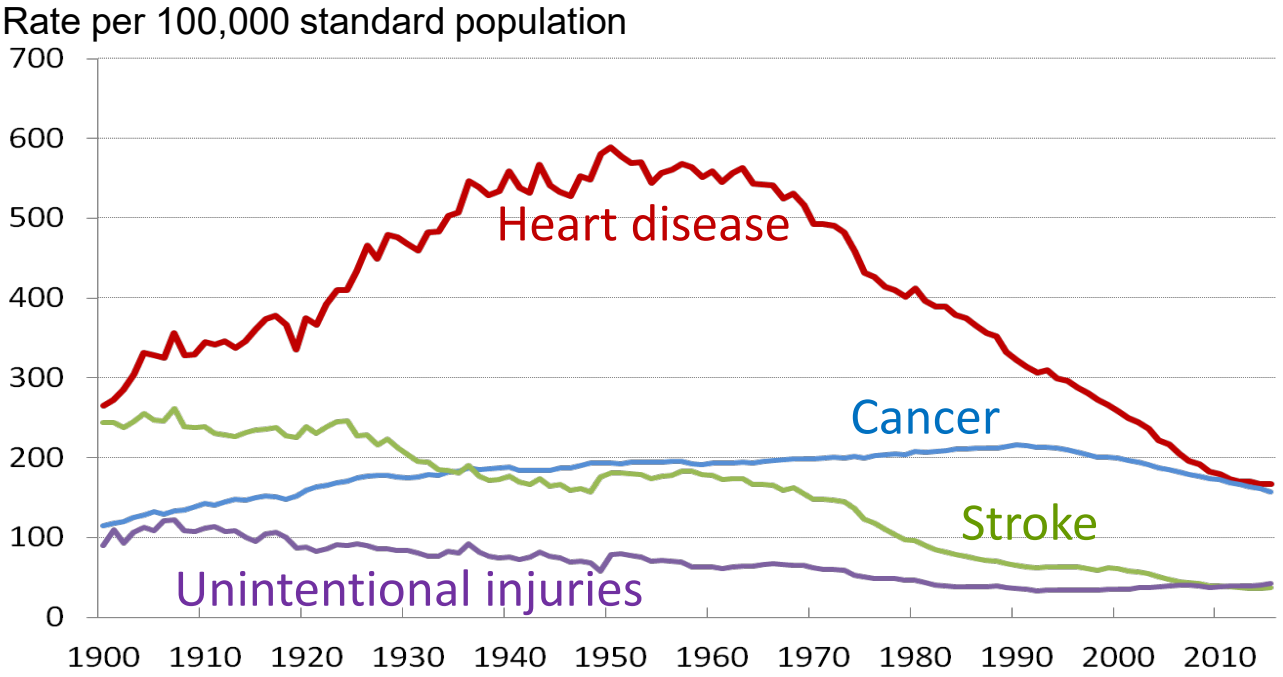
Average Annual Rates of Decline in Age-Sex-Adjusted Death Rates

Historical (Dec 2015 data)			AGE	Ron Lee			2015TR Intermediate		
1982-99	1999-2009	2009-13		2011-39	2011-89	2039-89	2011-39	2011-89	2039-89
2.79	1.22	2.14	0-14	2.77	2.74	2.72	1.58	1.57	1.57
0.63	0.61	1.06	15-49	1.07	1.06	1.05	0.97	0.93	0.90
1.61	1.27	0.05	50-64	1.34	1.34	1.34	1.17	1.09	1.06
0.92	2.11	0.91	65-84	1.06	1.06	1.05	1.09	0.86	0.74
-0.18	1.30	-0.11	85+	0.65	0.64	0.63	0.64	0.53	0.48
0.51	1.78	0.48	65+	0.88	0.86	0.85	0.89	0.71	0.61
0.75	1.59	0.48	Total	0.99	0.96	0.94	0.95	0.80	0.71

* Fit 1950-2011, using Medicare-enrollment data for 65 and over, rather than HMD data
See Actuarial Note 158 https://www.ssa.gov/oact/NOTES/pdf_notes/note158.pdf

Age-adjusted Death Rates for Heart Disease, Cancer, Stroke, and Unintentional Injuries: United States, 1900-2015

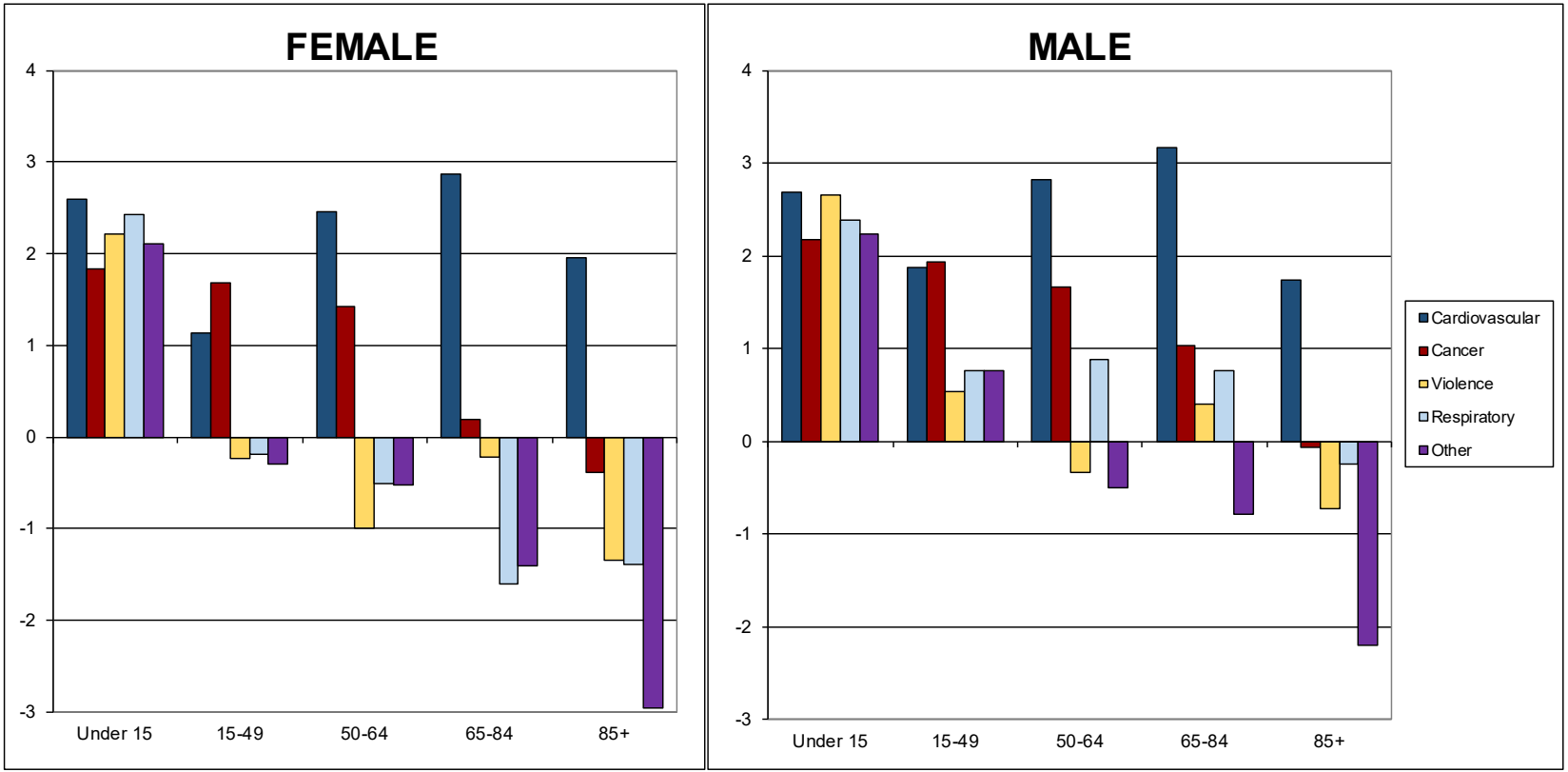
(courtesy Robert Anderson, NCHS)



NOTE: Data prior to 1933 contain death-registration states only. Data for 2015 is provisional.

Mortality Decline by Cause of Death:

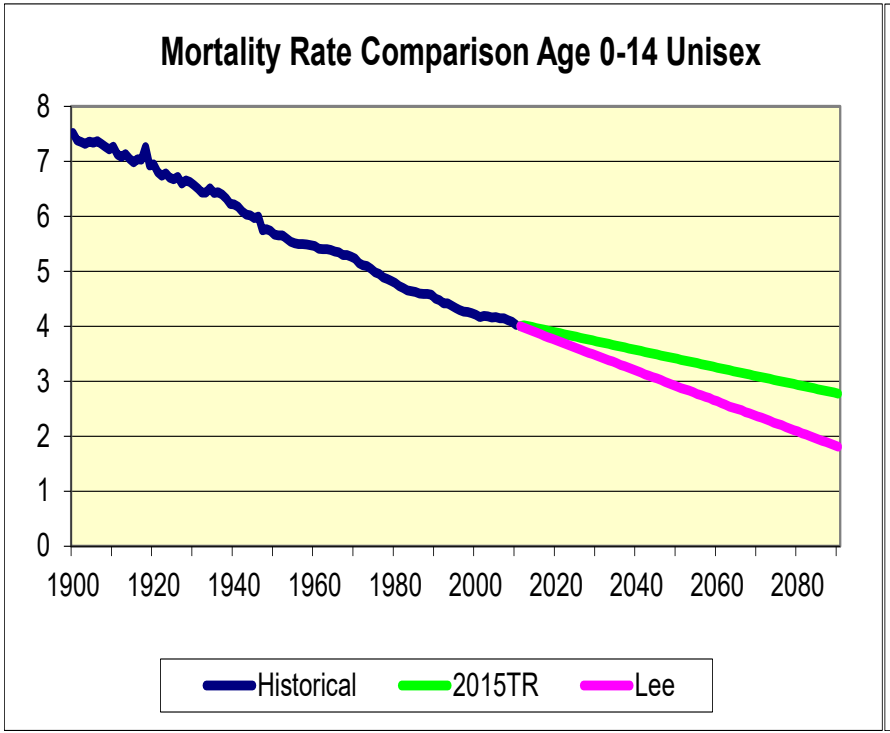
Rate of change from 1979 to 2017

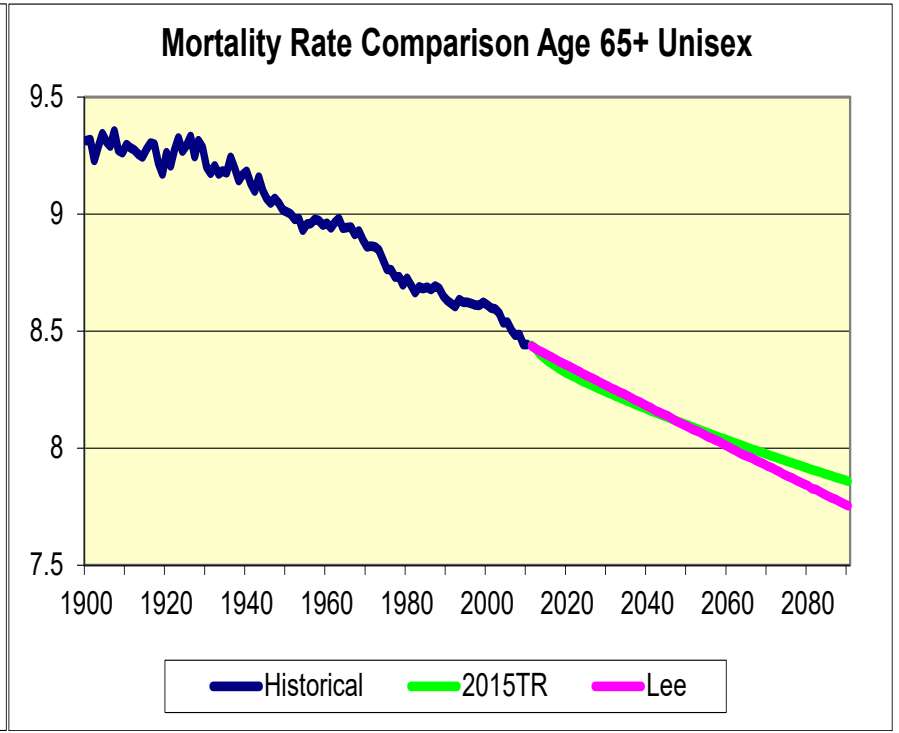


Age-Sex Extrapolation vs. Age-Sex-Cause Projection

Lee maintaining full age-gradient offsets lack of deceleration

Result: OASDI actuarial deficit unchanged using Lee estimates



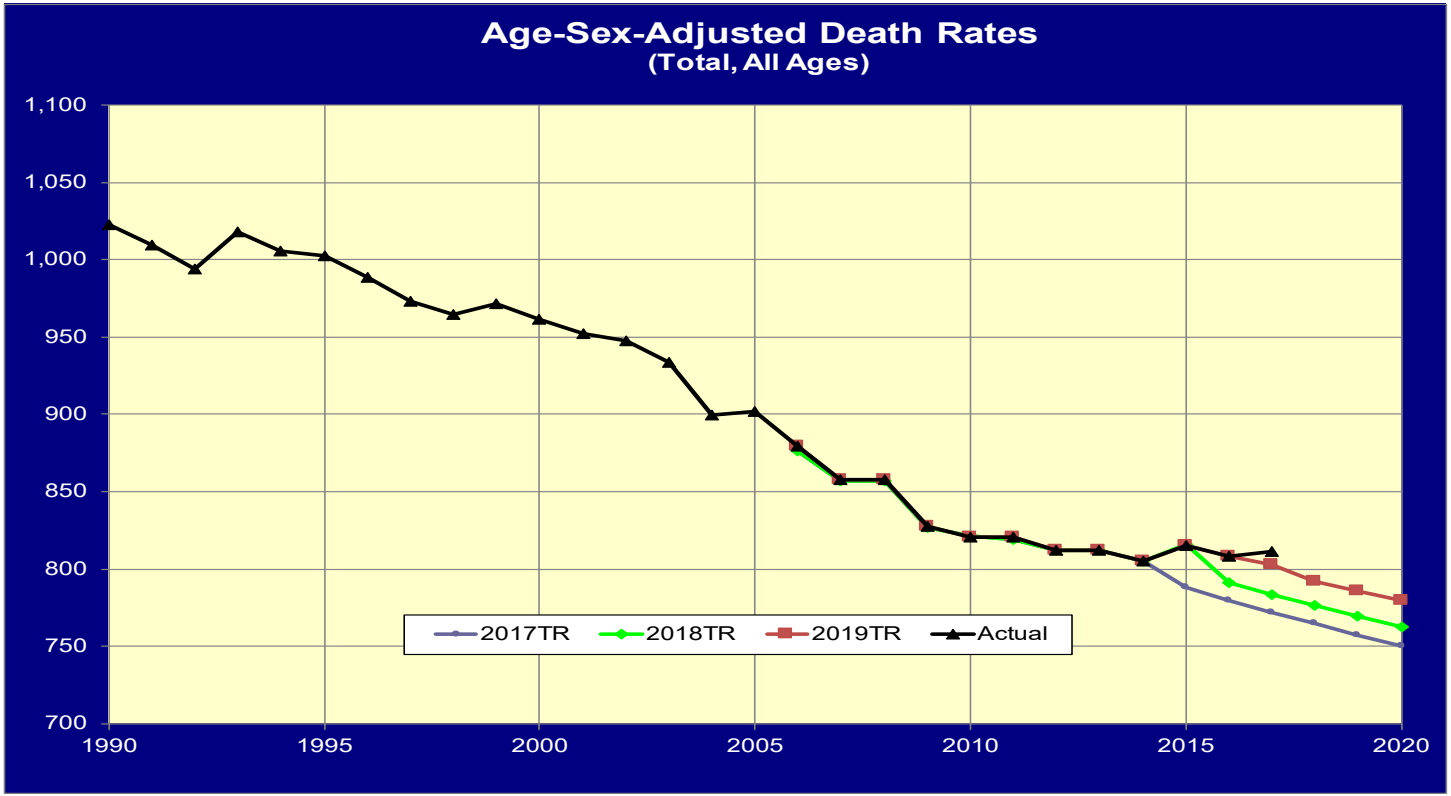


2015 Technical Panel

- Endorsed projections by cause with age-gradient
- Suggested ***average*** age-adjusted 1% annual rate of decline
  - To match average rate since 1950, overall
  - Understood this incorporated deceleration
- Chairperson Alicia Munnell, after TR 2016, said she was glad Trustees did not adopt the 1% rate of decline

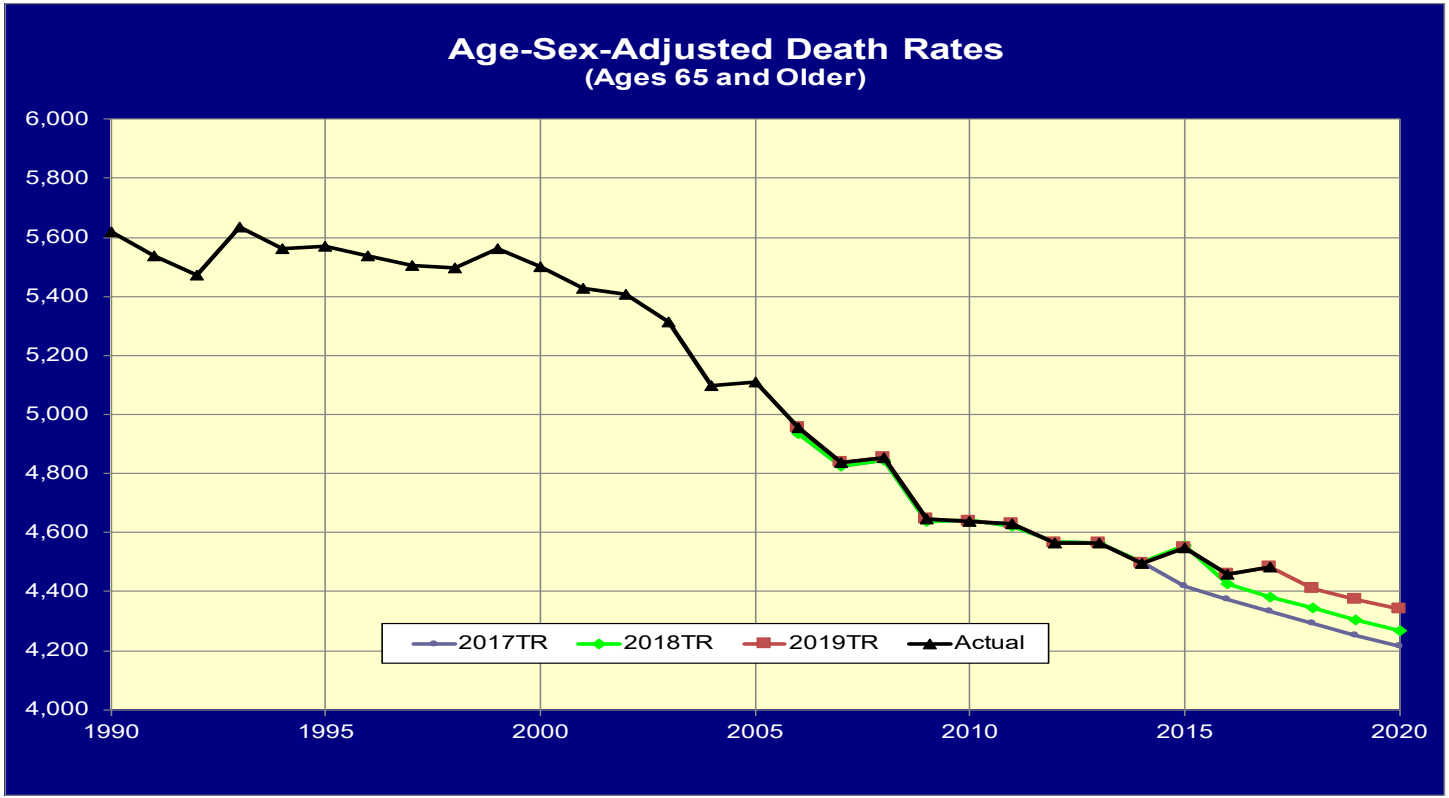
Mortality Experience: All Ages

Reductions continue to fall short of expectations



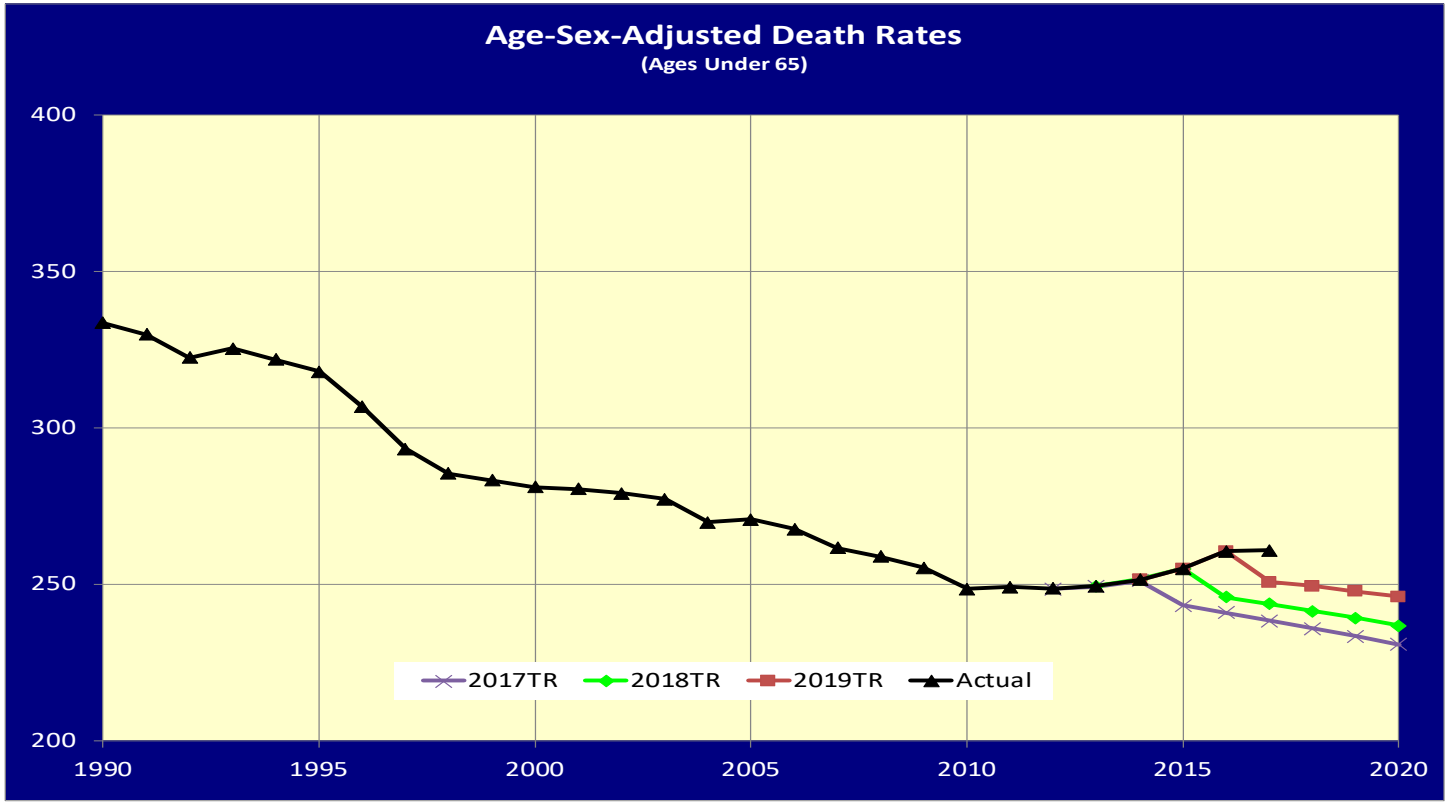
Mortality Experience: Ages 65 and Older

Reductions since 2009 continue to fall short of expectations



Mortality Experience: Ages Under 65

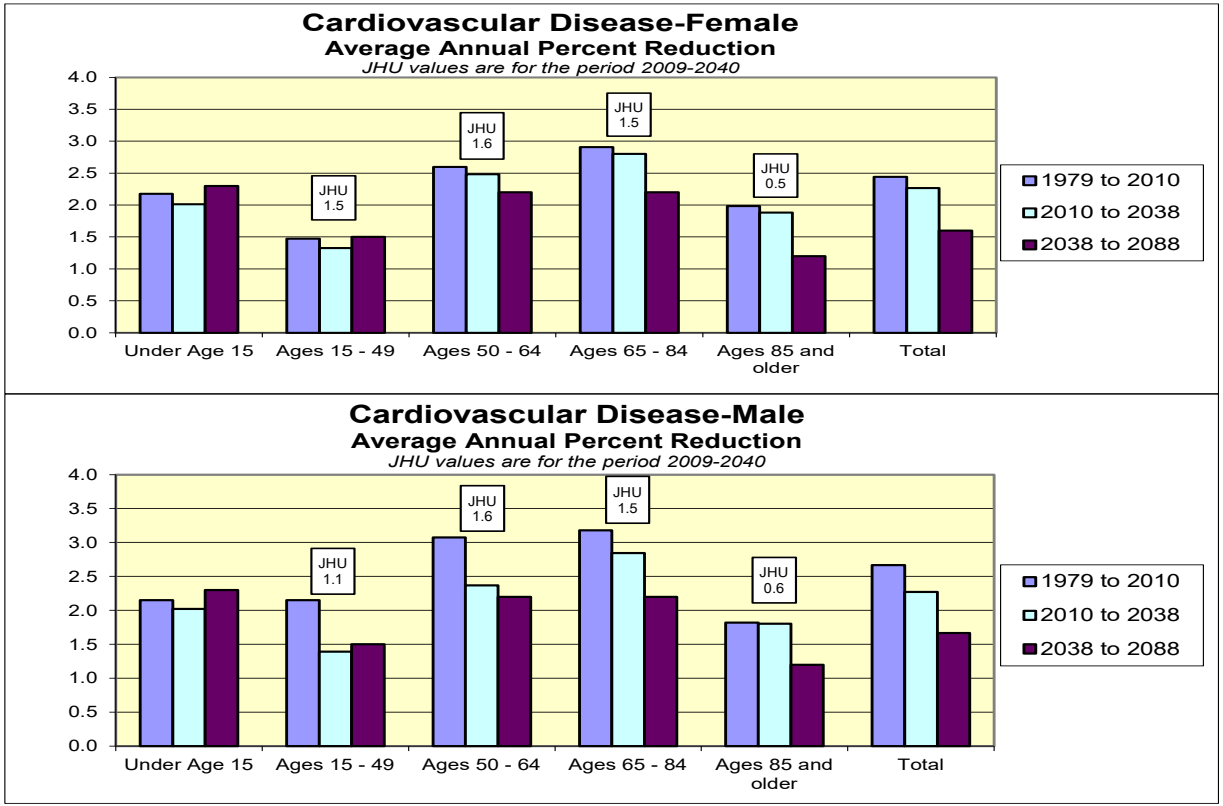
*Actual **increase** since 2010*



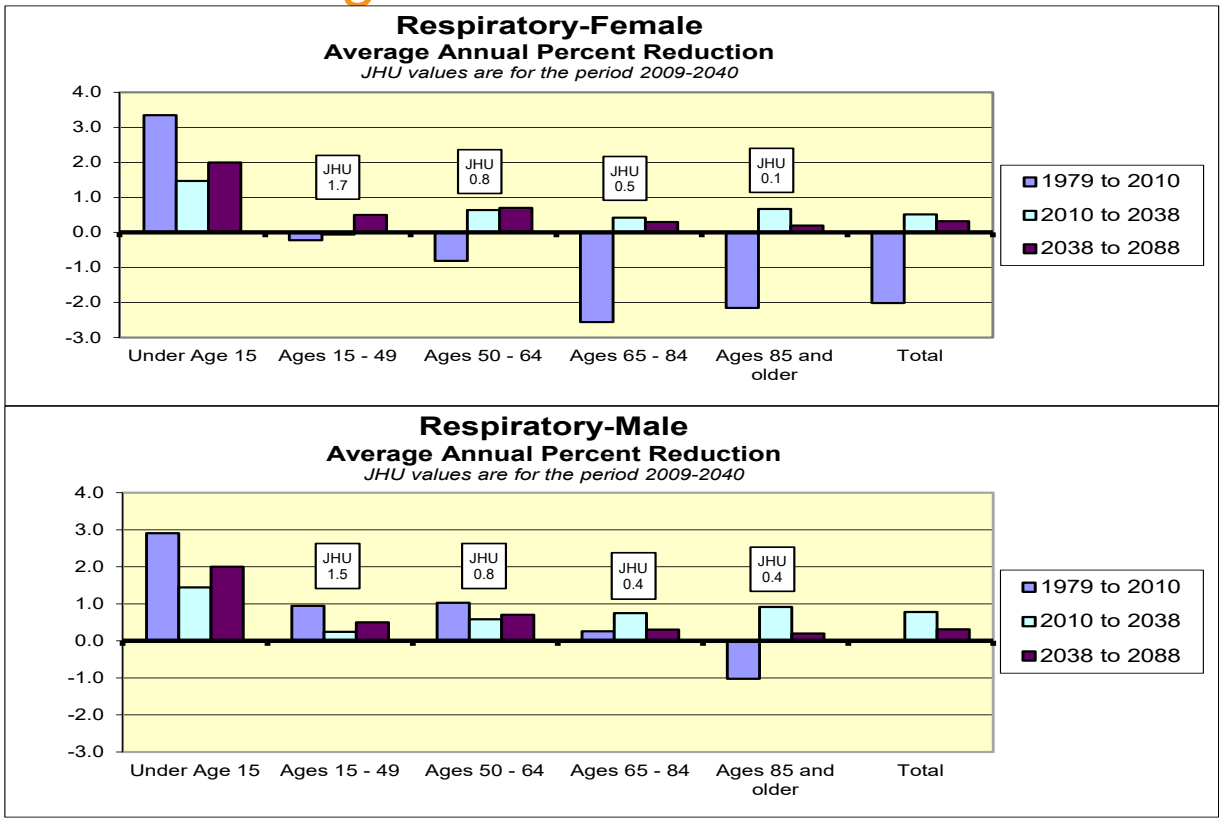
Developing Assumptions by Cause

- Scientific approach reflecting biology
- Trustees and SSA/OCACT develop in consultation with other experts
- Johns Hopkins 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

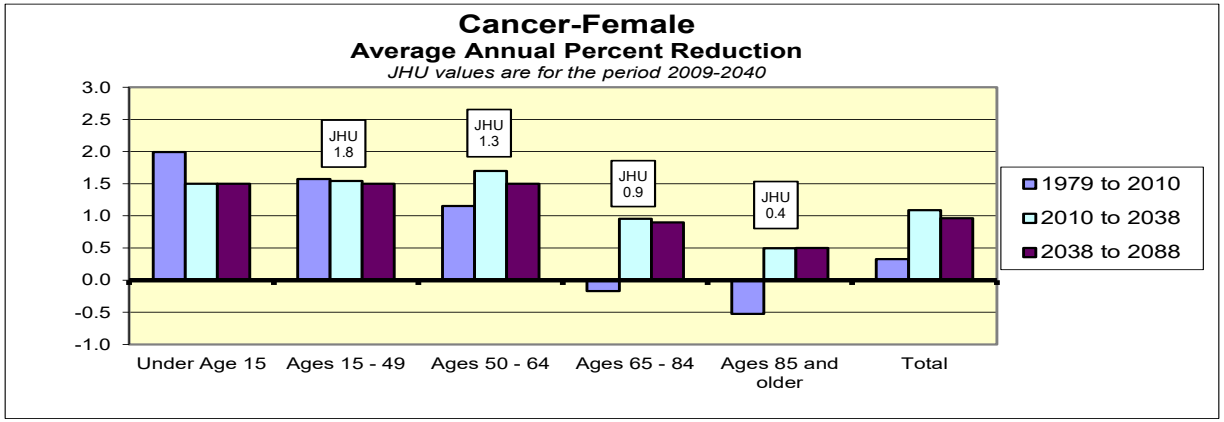
Cardiovascular: JHU Less Optimistic than Trustees over Age 50 for Next 30 Years

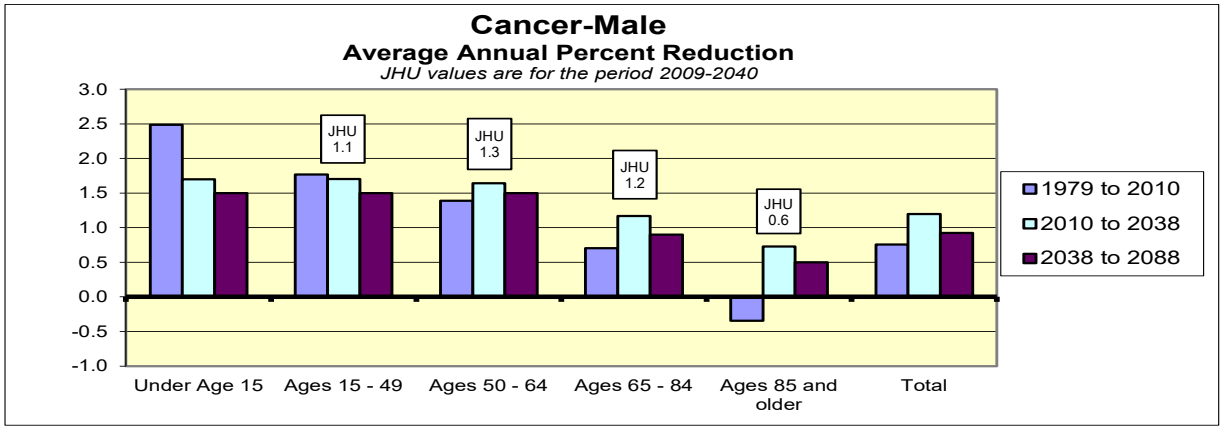


Respiratory: JHU More Optimistic under Age 50, Less Optimistic over Age 85



Cancer: JHU Very Similar to Trustees' Expectations



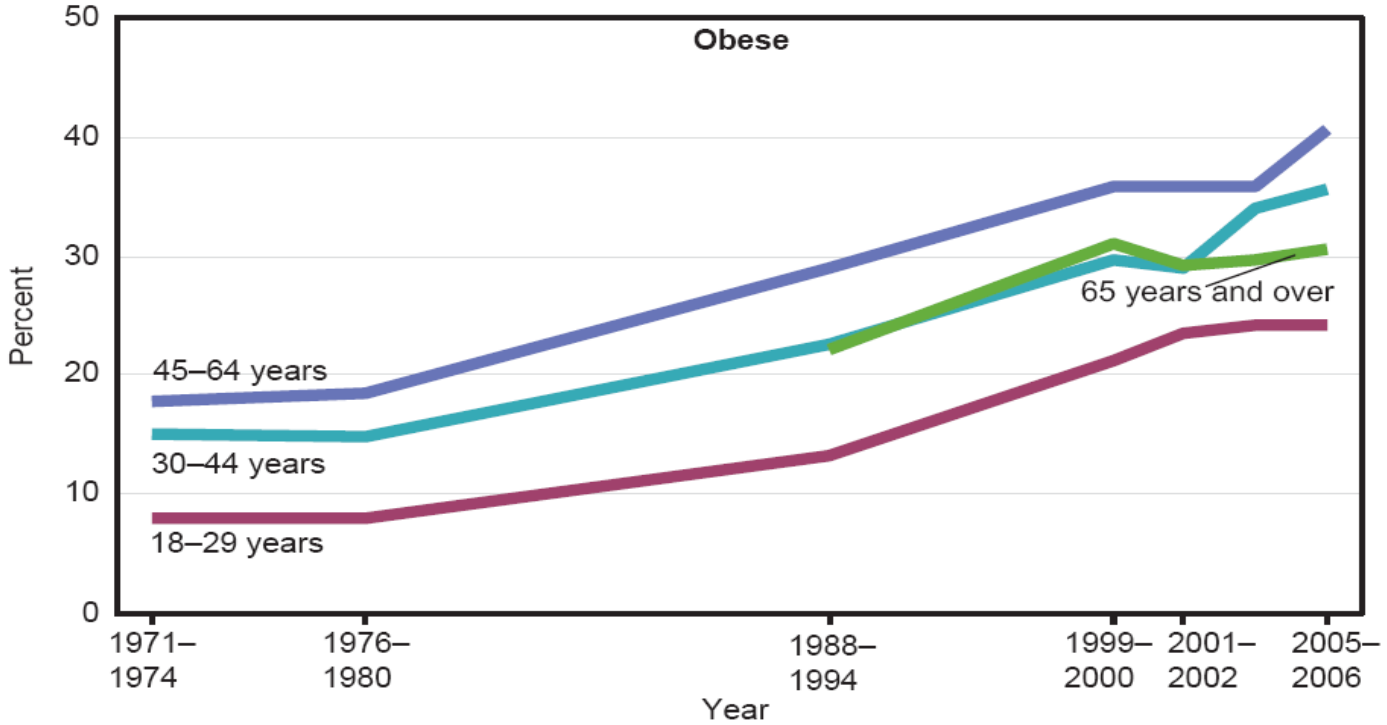


How Future Conditions Might Change

- 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

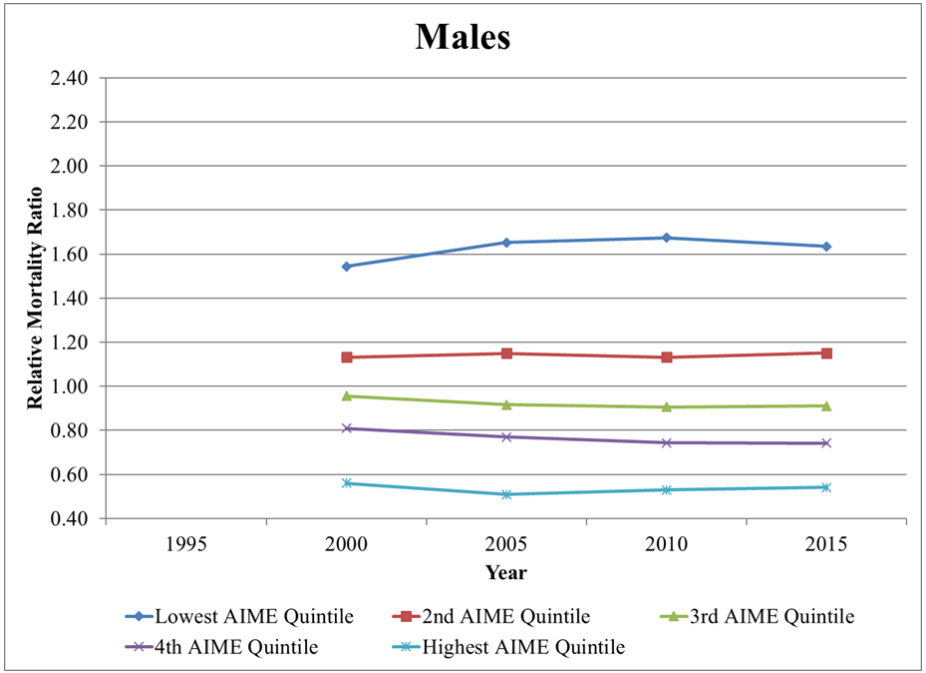
Trends in Obesity: US 1971-2006

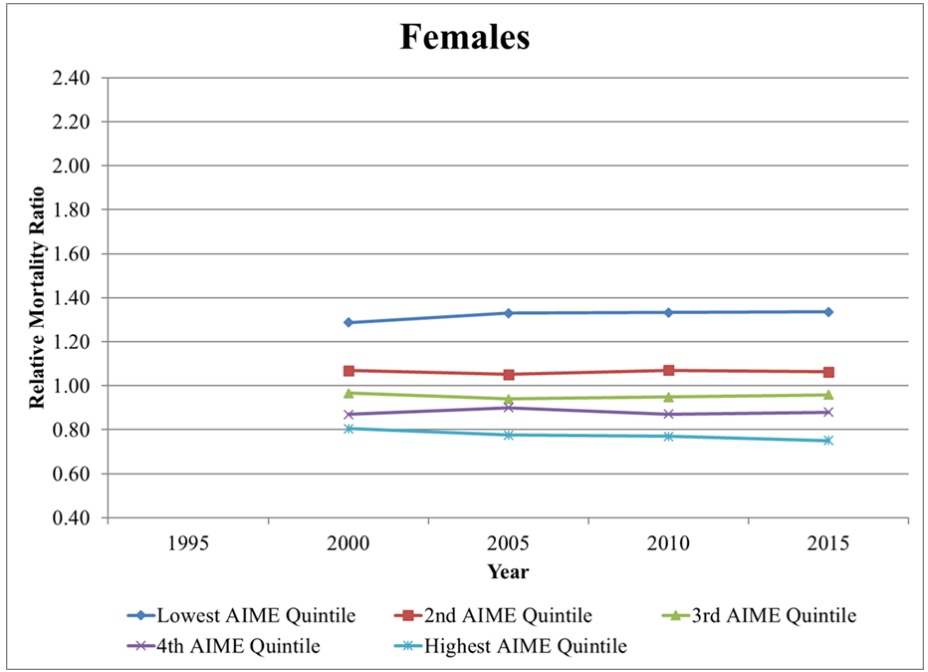
Sam Preston 2010—must consider cumulative effects and increasing duration of obesity for aged in future



Death Rates Vary by Career Average Earnings Quintile

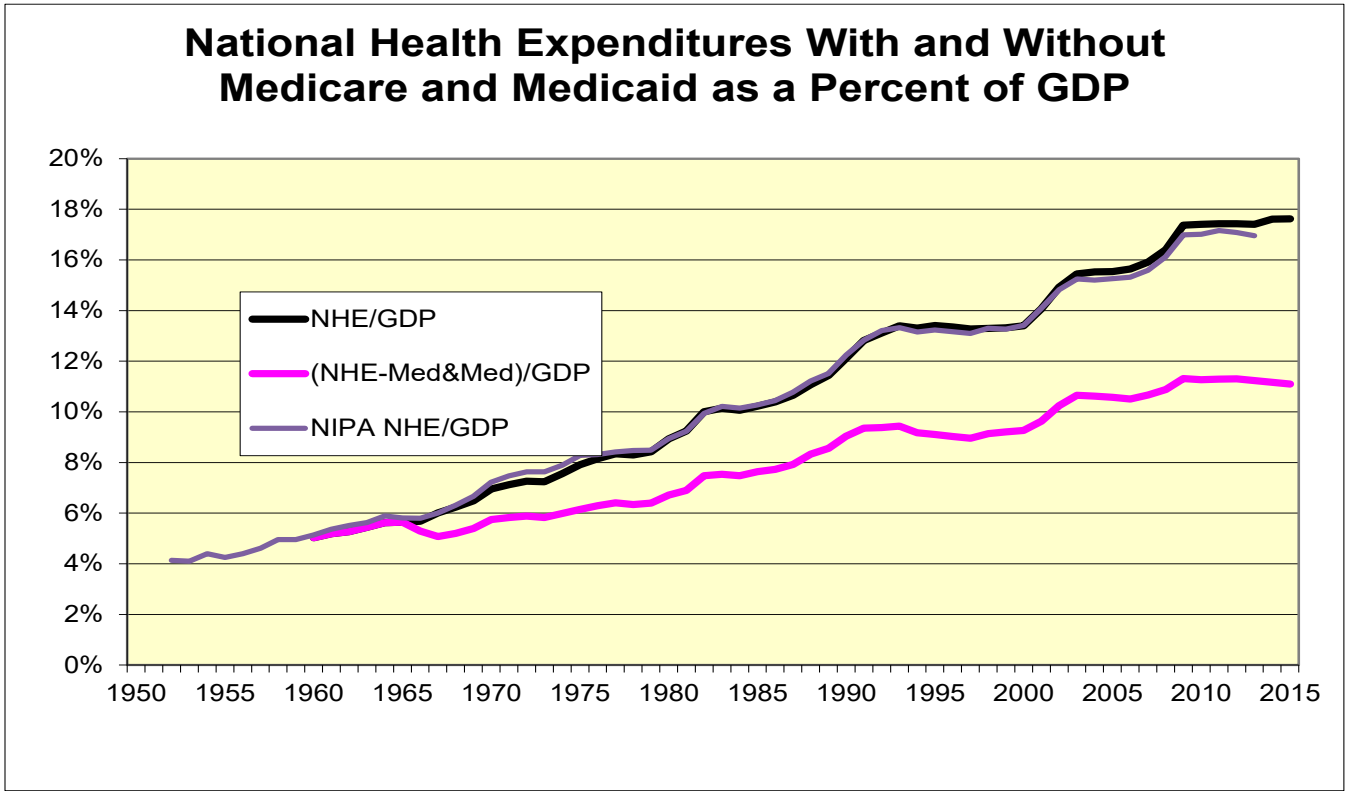
Bosley, Morris, Glenn (2018): have the spreads stabilized? At ages 65-69:





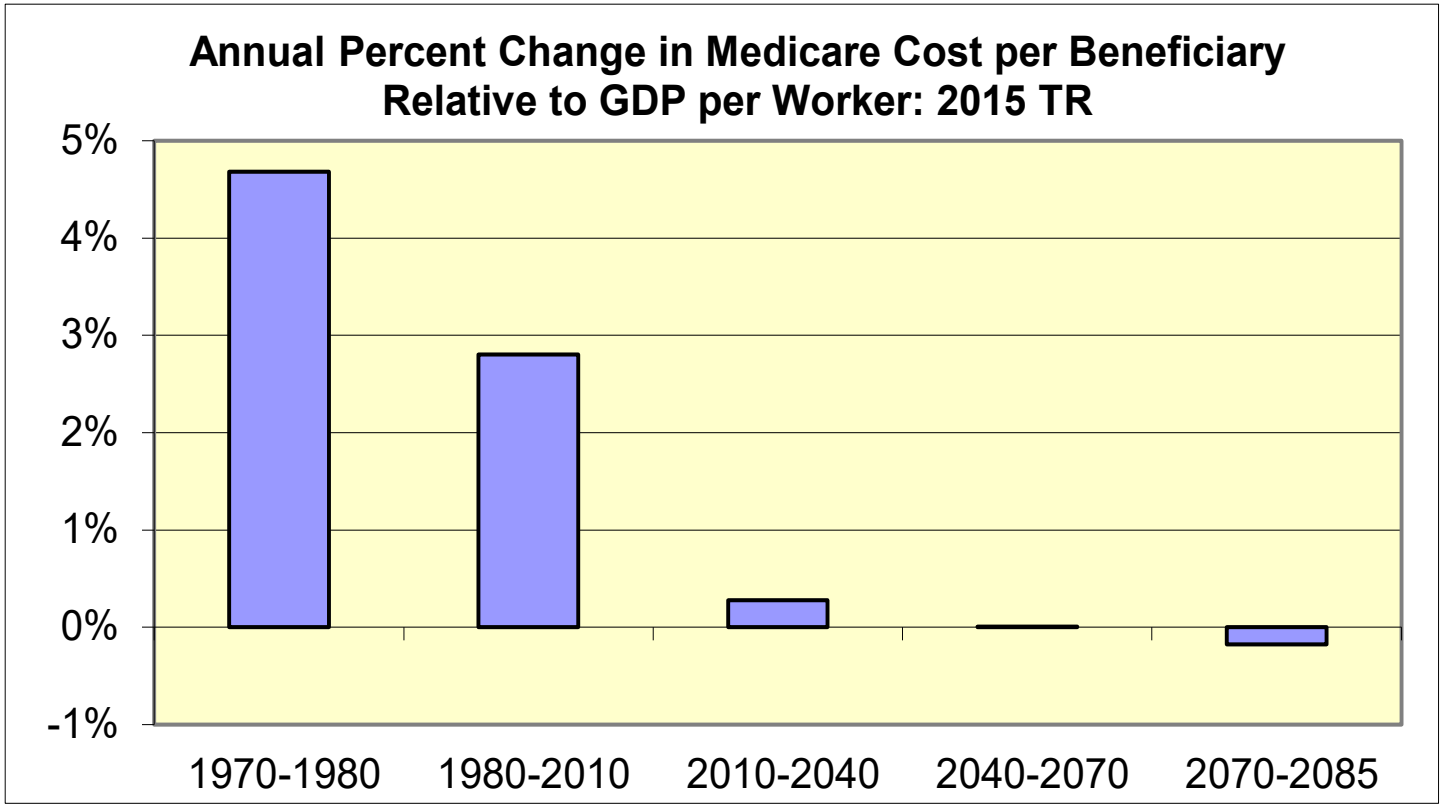
Does Health Spending Affect Mortality?

Note rise, at least through 2009



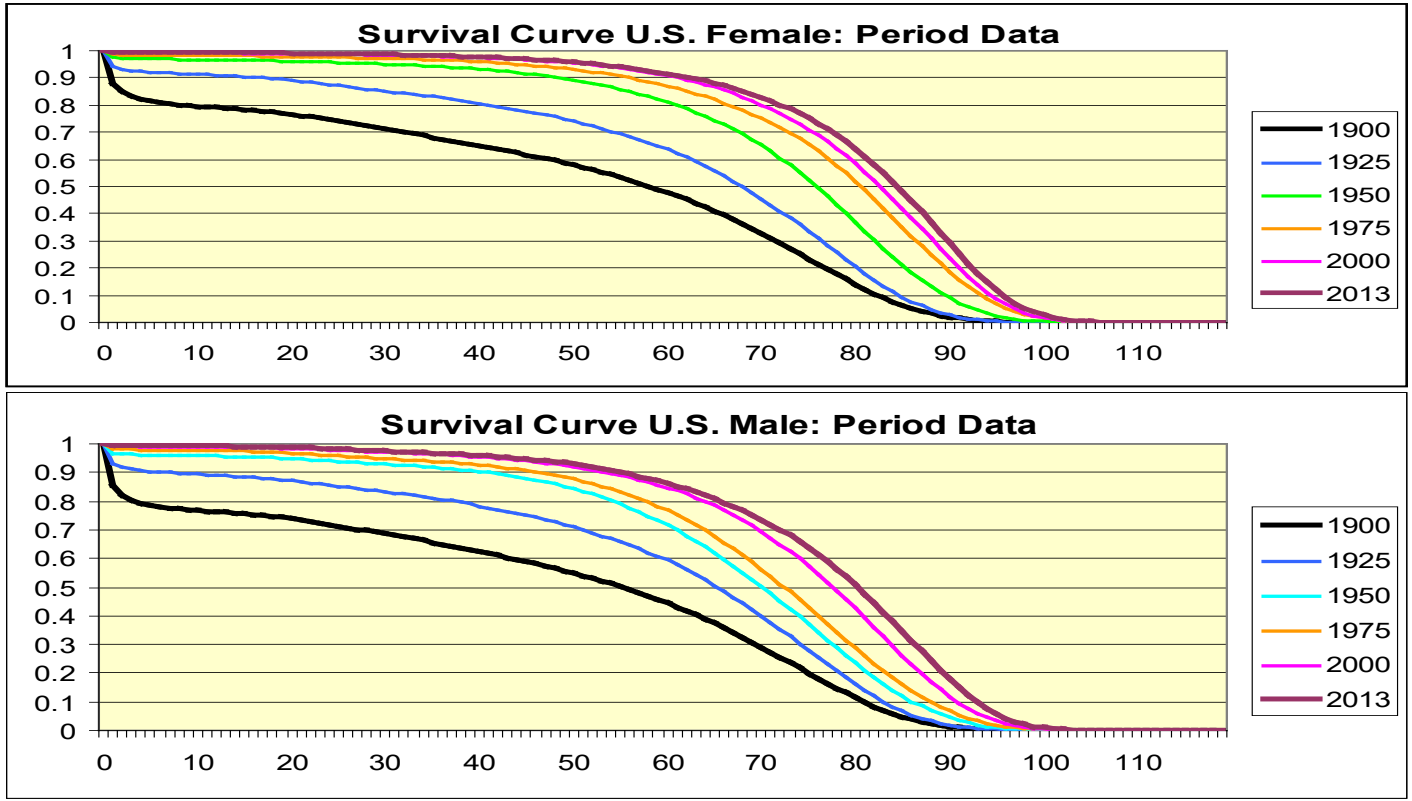
Health Spending Cannot Continue to Rise at Historical Rates

Note Trustees' deceleration



Is There an Omega?

It appears we are rectangularizing the survival curve



Death Rates Will Continue to Decline: But How Fast and for Whom?

- Must understand past and future conditions
  - Persistent historical “age gradient”
  - Avoid simple extrapolation of past periods
  - Cannot ignore changing conditions
    - “Limits” on longevity due to physiology
    - Latter half of 20th century was extraordinary
  - So deceleration seems likely
  - Cause-specific rates allow basis for assumptions
- Results: in the 1982 TR, we projected LE65 in 2013 to be 19.0; actual was 19.1

For More Information…http://www.ssa.gov/oact/

- Documentation of Trustees Report data & assumptions
  https://www.ssa.gov/oact/TR/2019/2019_Long-Range_Demographic_Assumptions.pdf

- Historical and projected mortality rates
  https://www.ssa.gov/oact/HistEst/DeathHome.html

- Annual Trustees Reports
  https://www.ssa.gov/oact/TR/index.html

Thank you

Social Security Administration
Office of the Chief Actuary
410-965-3000
Actuary@ssa.gov