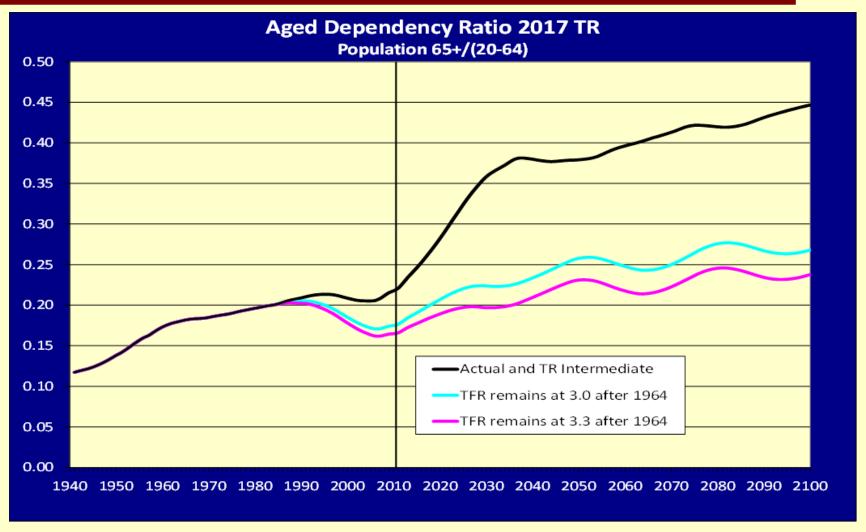# Declining Mortality (Increasing Longevity): At What Rate?

Steve Goss and Karen Glenn
Office of the Chief Actuary
Social Security Administration

Perspective: "Aging" Not Mainly from Mortality

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

Aged Dependency Ratio 2017 TR
Population 65+/(20-64)

Legend:
- Actual and TR Intermediate
- TFR remains at 3.0 after 1964
- TFR remains at 3.3 after 1964
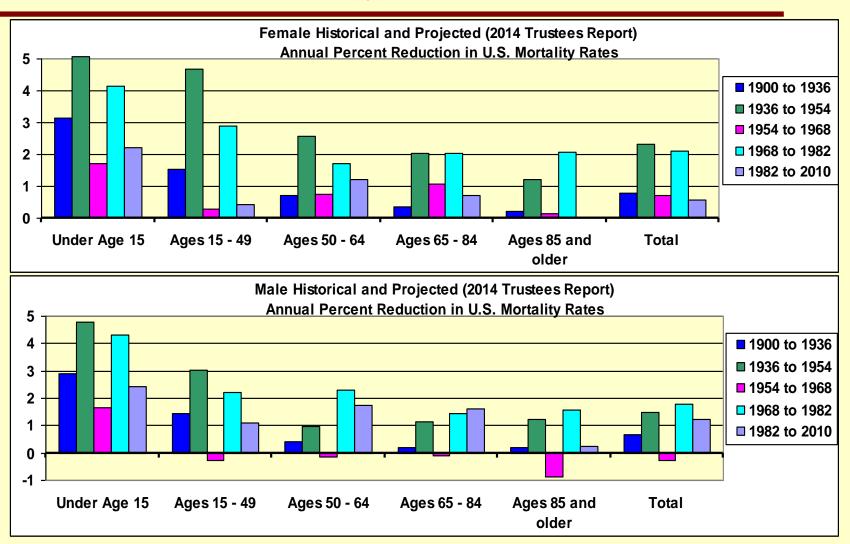
Various Alternative Projection Approaches Using Data

◆ 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

Female Historical and Projected (2014 Trustees Report)
Annual Percent Reduction in U.S. Mortality Rates

Male Historical and Projected (2014 Trustees Report)
Annual Percent Reduction in U.S. Mortality Rates

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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

Life expectancy at birth

Since 1960
y = 0.2269x - 369.42
R² = 0.9877

1886-1960
y = 0.324x - 558.77
R² = 0.9845

1790-1885
y = 0.1172x - 169.52
R² = 0.7751

Before 1790
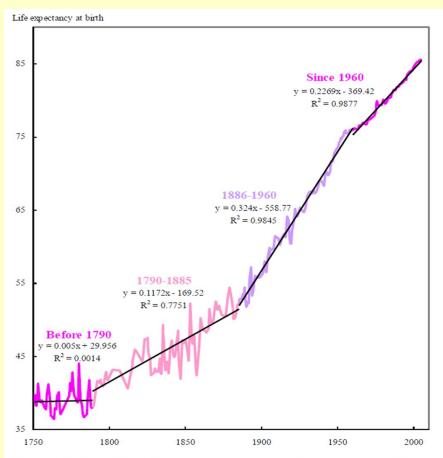y = 0.005x + 29.956
R² = 0.0014

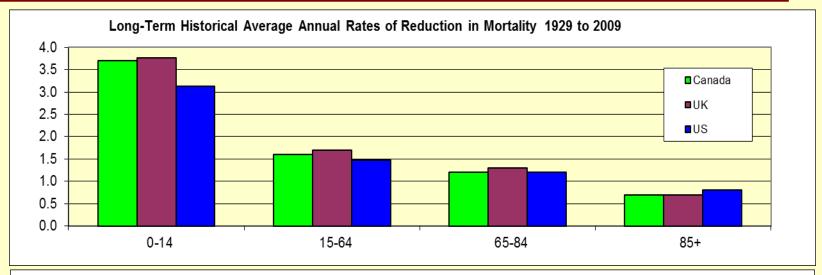**Figure 2. Maximum female life expectancy at birth since 1750 but excluding Norway (until 1866) and New Zealand**
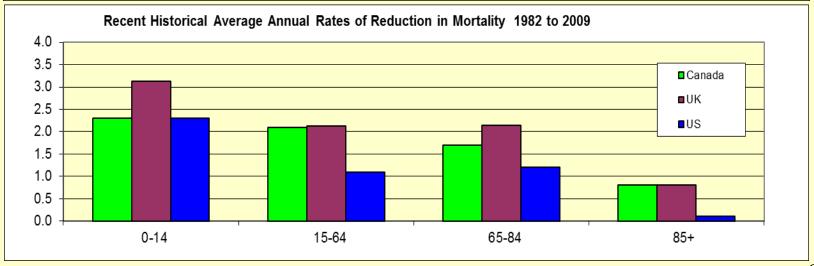Source: Vallin and Meslé 2008

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 higher 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
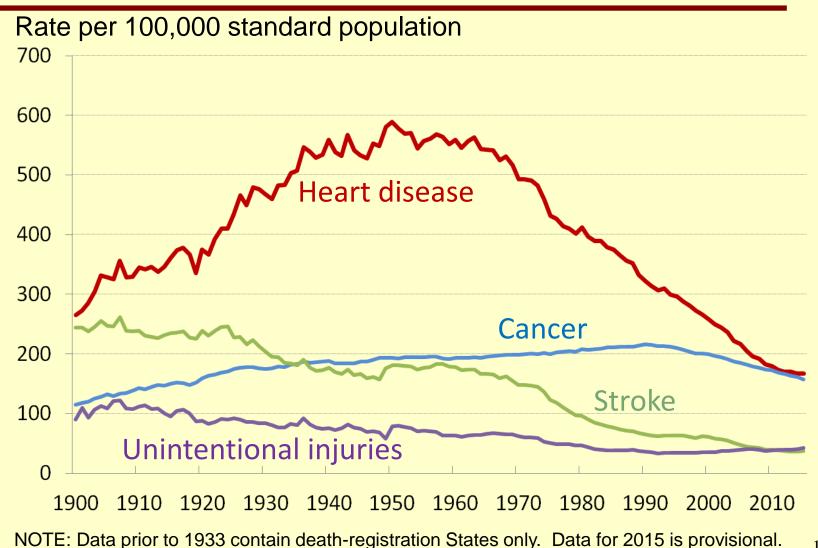
◆ Results in deceleration in mortality decline

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)
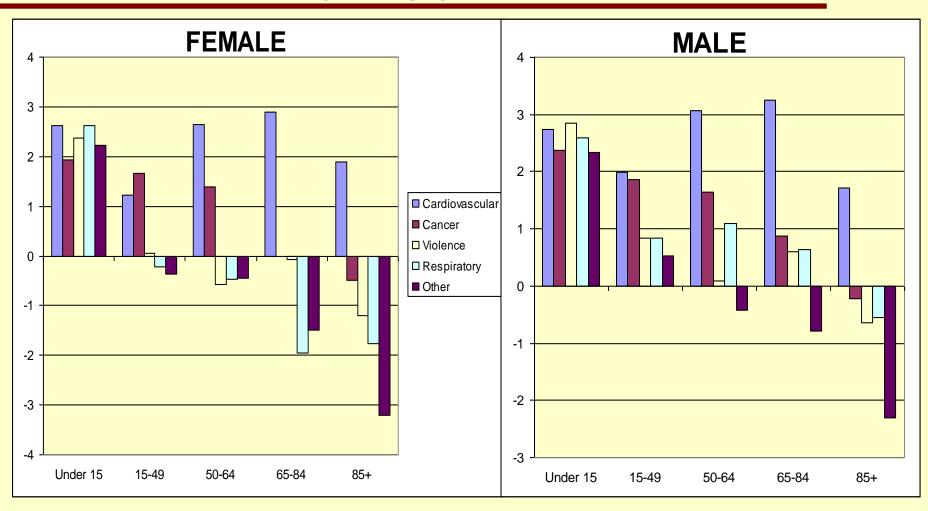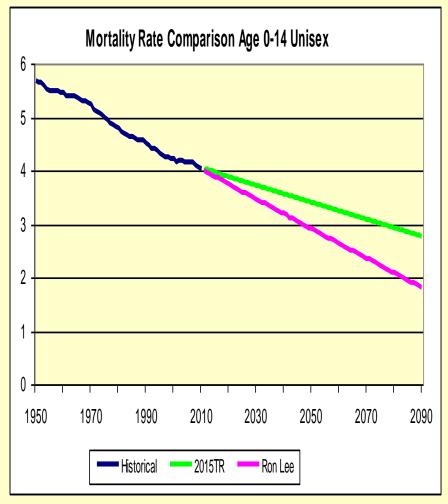

Rate per 100,000 standard population

Heart disease

Cancer

Stroke

Unintentional injuries

NOTE: Data prior to 1933 contain death-registration States only. Data for 2015 is provisional.
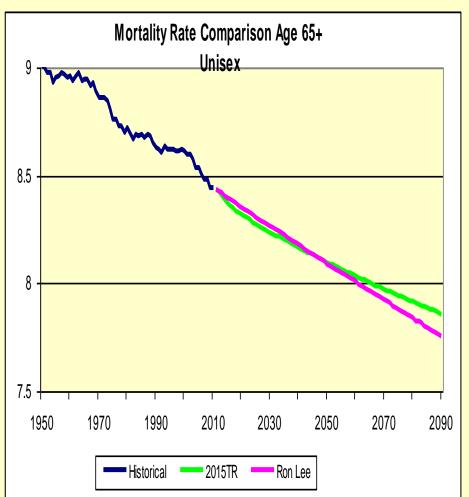
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Mortality Decline by *Cause* of Death:
Rate of change from 1979 to 2013

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

Lee maintaining full age-gradient offsets lack of deceleration
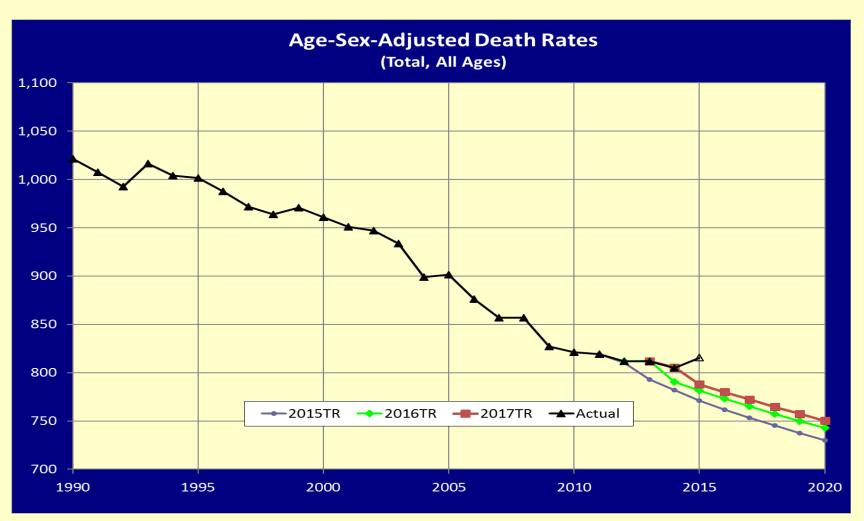*Result: OASDI actuarial deficit unchanged using Lee estimates*

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

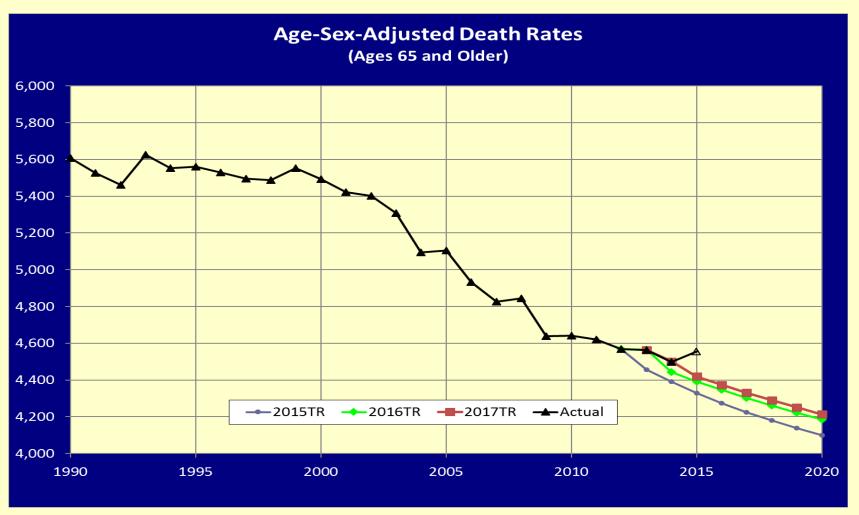◆ Chairperson Alicia Munnell, after TR 2016, said she was glad Trustees did not adopt the 1% rate of decline

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Mortality Experience: All Ages
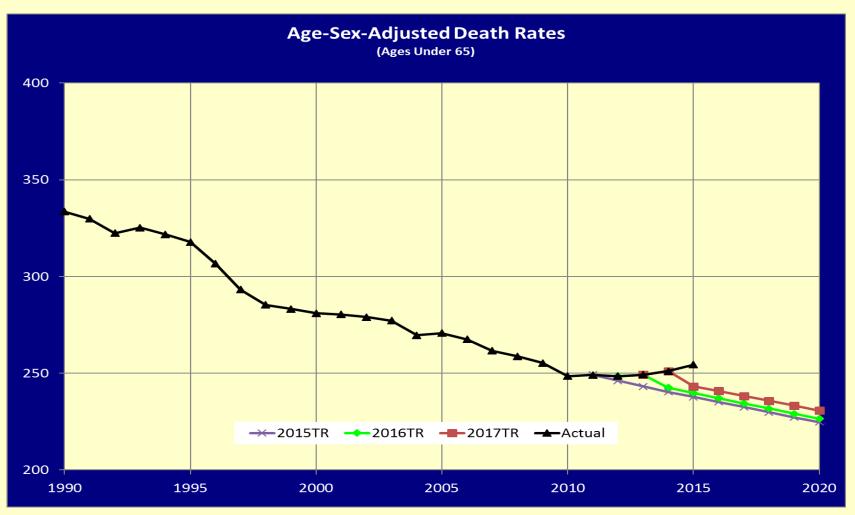*Reductions continue to fall short of expectations*

Mortality Experience: Ages 65 and Older
Reductions since 2009 continue to fall short of expectations

Age-Sex-Adjusted Death Rates
(Ages 65 and Older)

Legend: 2015TR, 2016TR, 2017TR, Actual

Mortality Experience: Ages Under 65
Actual <u>increase</u> since 2010

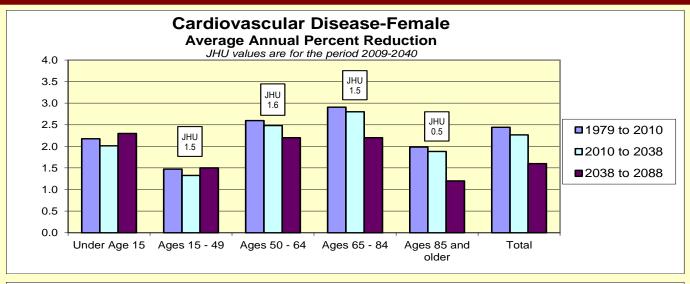**Age-Sex-Adjusted Death Rates**
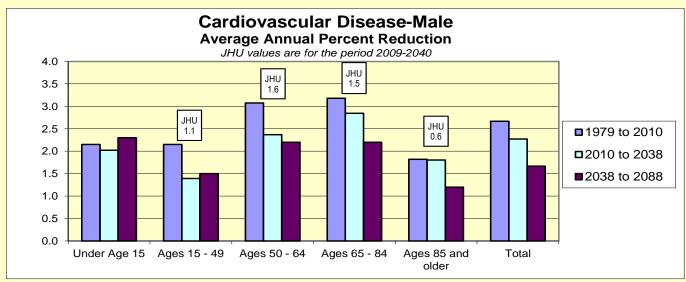(Ages Under 65)

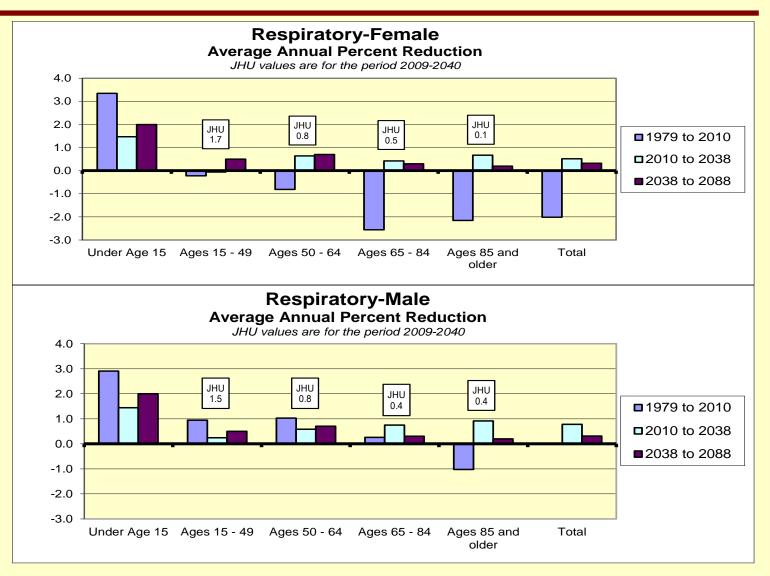Legend: 2015TR, 2016TR, 2017TR, Actual

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

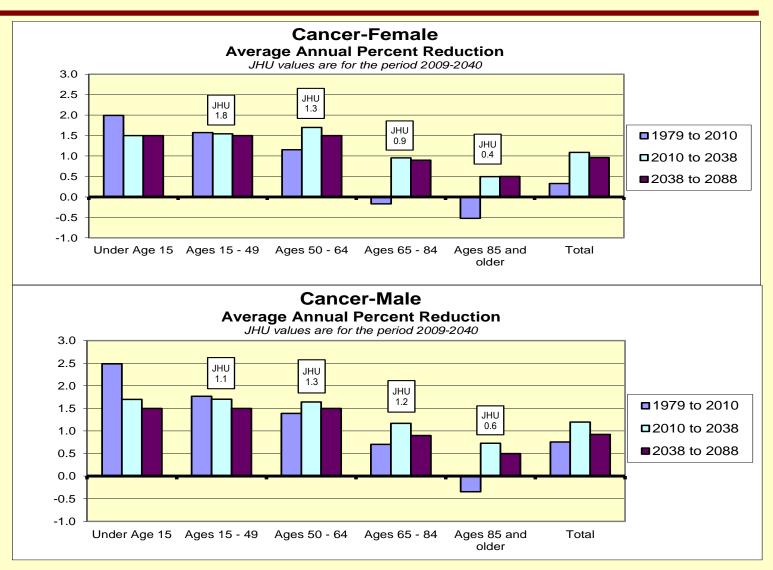# Cardiovascular: JHU Less Optimistic than Trustees over Age 50 for Next 30 Years

Respiratory: JHU More Optimistic under Age 50, Less Optimistic over Age 85
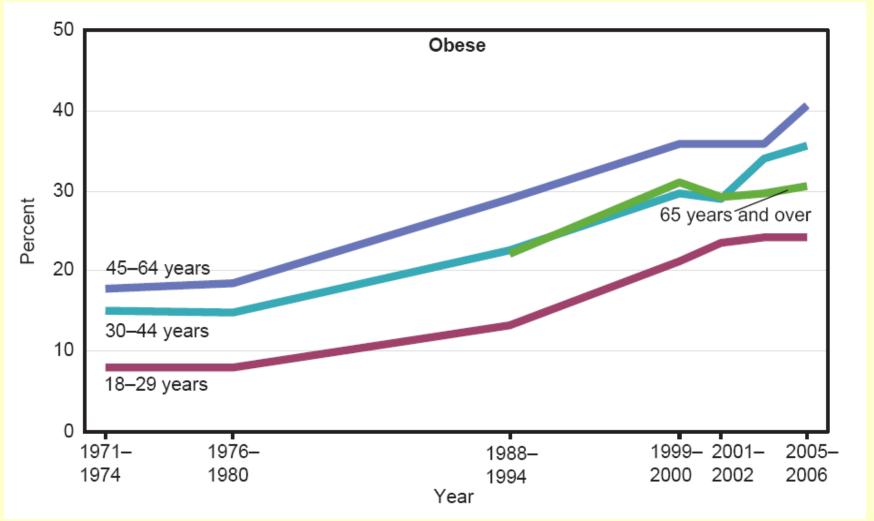
Cancer: JHU Very Similar to Trustees' Expectations

Cancer-Female
Average Annual Percent Reduction
JHU values are for the period 2009-2040

JHU 1.8 (Ages 15 - 49)
JHU 1.3 (Ages 50 - 64)
JHU 0.9 (Ages 65 - 84)
JHU 0.4 (Ages 85 and older)

Legend: 1979 to 2010 | 2010 to 2038 | 2038 to 2088

Categories: Under Age 15, Ages 15 - 49, Ages 50 - 64, Ages 65 - 84, Ages 85 and older, Total

Cancer-Male
Average Annual Percent Reduction
JHU values are for the period 2009-2040

JHU 1.1 (Ages 15 - 49)
JHU 1.3 (Ages 50 - 64)
JHU 1.2 (Ages 65 - 84)
JHU 0.6 (Ages 85 and older)

Legend: 1979 to 2010 | 2010 to 2038 | 2038 to 2088

Categories: Under Age 15, Ages 15 - 49, Ages 50 - 64, Ages 65 - 84, Ages 85 and older, Total

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

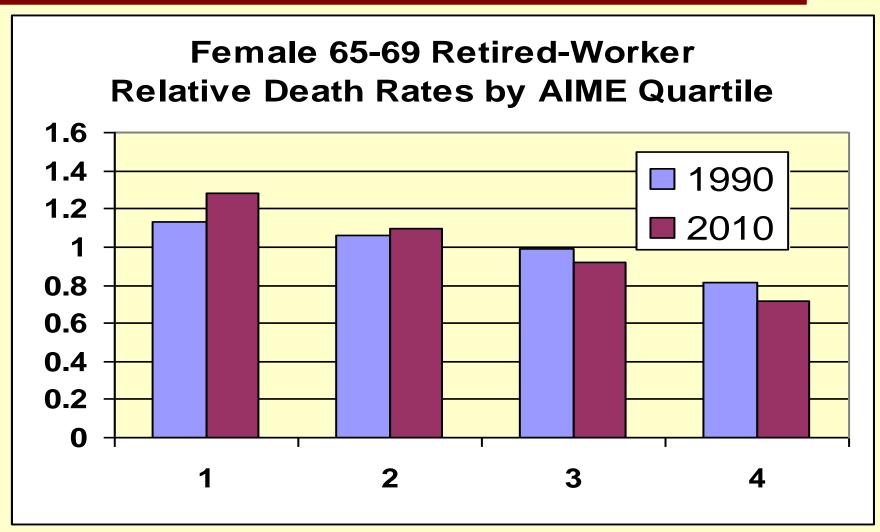◆ Human limits

  – Increasing understanding of deceleration

Trends in Obesity: US 1971-2006
*Sam Preston 2010—must consider **cumulative** effects*
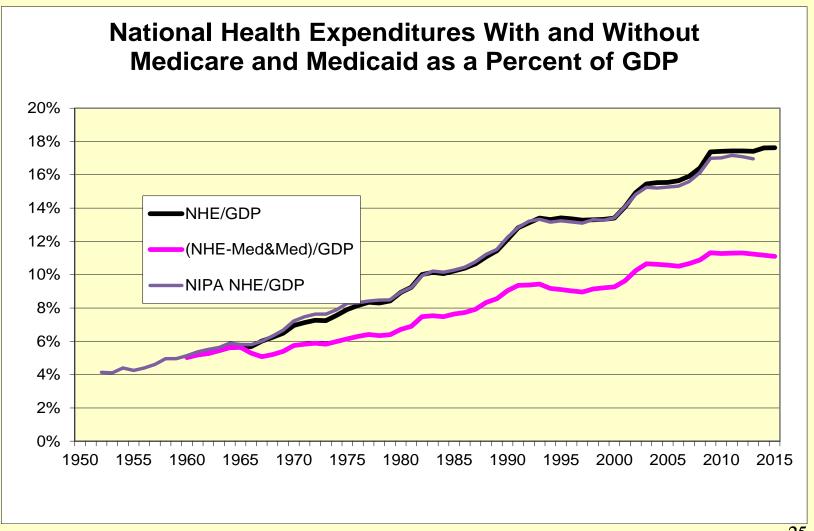*Increasing duration of obesity for aged in future*

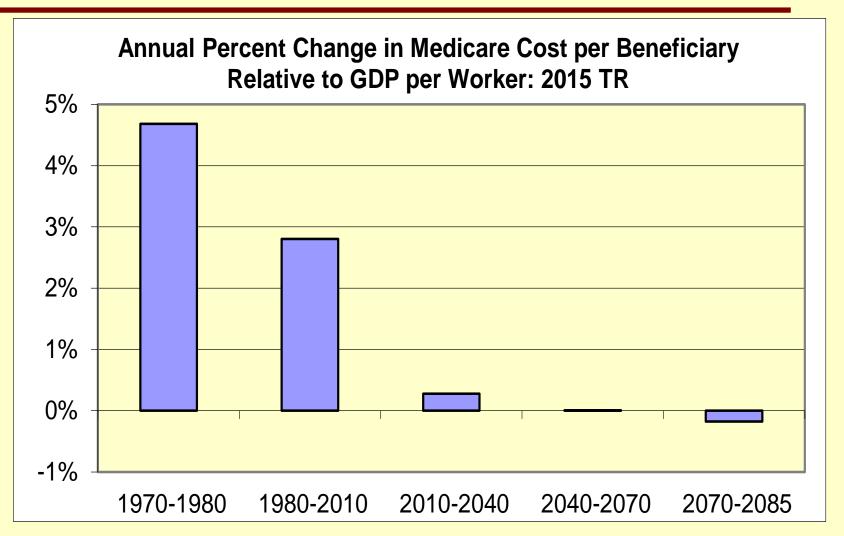# Death Rates Vary by Career Earnings Ranking
Difference has increased

**Female 65-69 Retired-Worker
Relative Death Rates by AIME Quartile**

Legend: 1990, 2010

Does Health Spending Affect Mortality?
Note rise, at least through 2009

National Health Expenditures With and Without Medicare and Medicaid as a Percent of GDP

Health Spending Cannot Continue to Rise at Historical Rates
Note Trustees' deceleration

Annual Percent Change in Medicare Cost per Beneficiary Relative to GDP per Worker: 2015 TR

Is There an Omega?

It appears we are rectangularizing the survival curve?

Survival Curve U.S. Female: Period Data

Survival Curve U.S. Male: Period Data

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/2017/2017_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