Mortality (Longevity): Contributing Factors in the Past and for Projections, and Implications for the Future
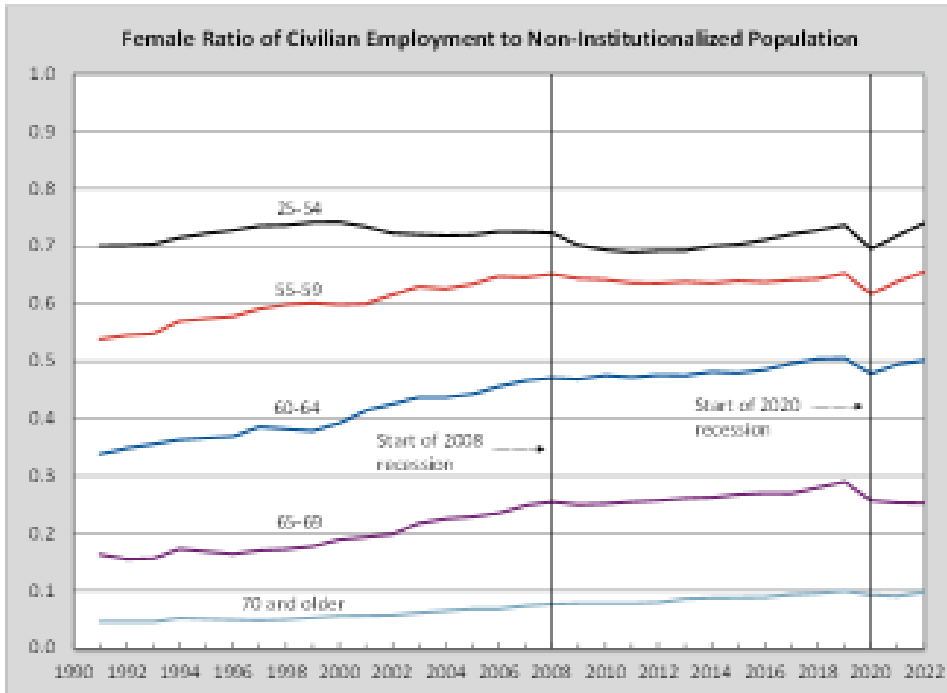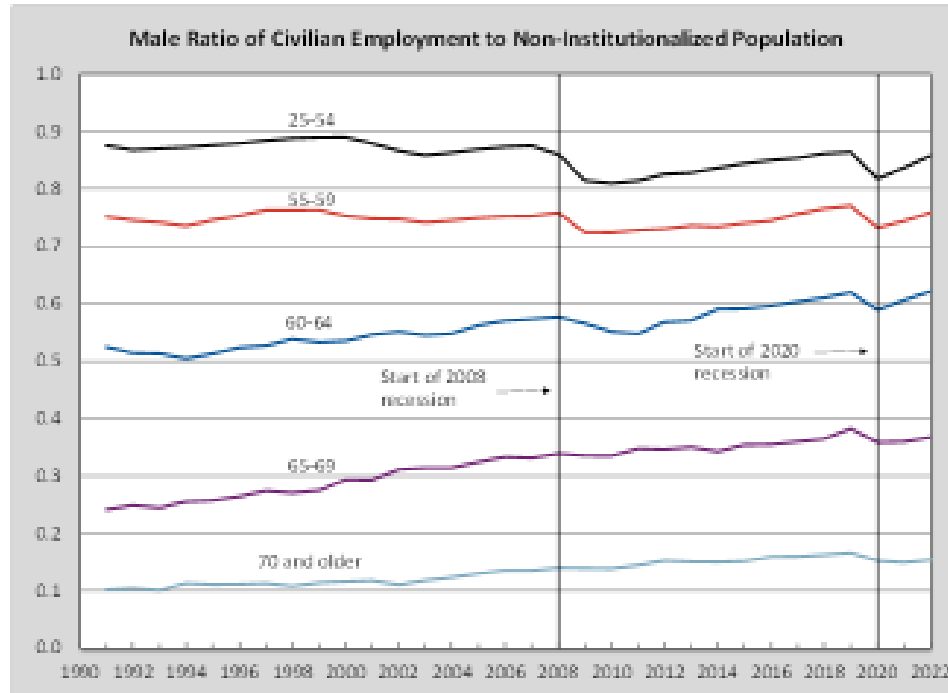
Steve Goss, Chief Actuary

US Social Security Administration

**Expert Forum on Demographic Transitions: Impact on Longevity, Health and Economy
in collaboration with the Global Longevity Council of the World Demographic & Ageing Forum**

January 27, 2023

Employment Over Age 65...

declined briefly with the 2020 recession, but is projected to continue rising. How much of this is from changing the NRA and earnings test? *Is the best retirement approach a job (Paul Samuelson)?*

Male Ratio of Civilian Employment to Non-Institutionalized Population

Female Ratio of Civilian Employment to Non-Institutionalized Population

Outline

- First, current effects from COVID-19: future implications
- Level of mortality depends on exposed population and data source
- Approaches for projecting mortality
  - Extrapolation of past trends?
  - Or developing assumptions by cause of death—consulting experts
- Future conditions
  - Unlikely to replicate remarkable progress of the 20th century
  - Obesity
  - Health spending and climate change
  - Human limits
- Noting recent deceleration—what we expect
- Implications of shifting age distribution
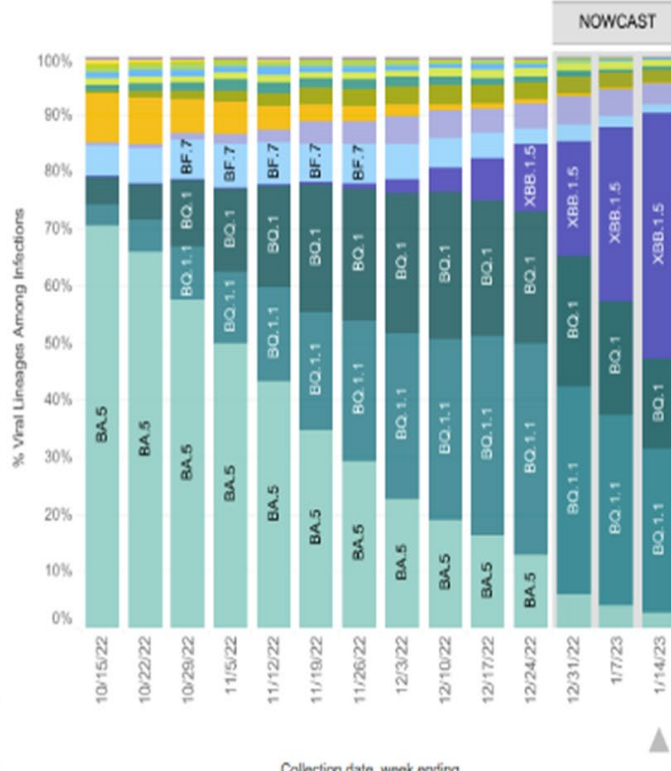
COVID-19; Pandemics

- COVID-19 swept across the globe and continues
  - Enhanced population mobility
  - Highly evolving virus
- Remarkable new MRNA vaccine; recent bivalent booster
  - But only about 16% of eligible in US have taken it
- New variants are arriving regularly; mitigations have waned
- Now endemic?
- Will post-COVID conditions constrain longevity in the future?

In the US, BQ Overtook BA in November; XBB Now Matches BQ, and Dominates in NY/NJ

Across Europe and the Americas—
The Fall/Winter Wave Rising in December

Reported Cases Rising
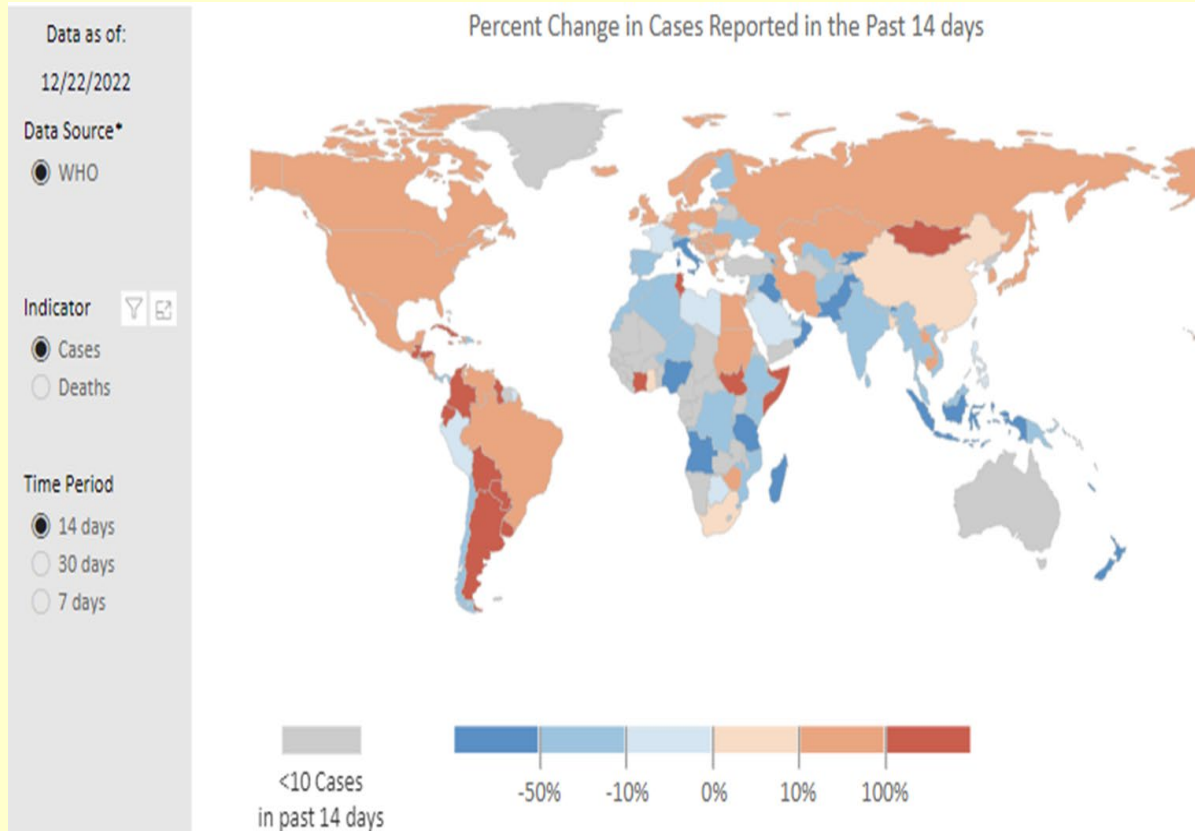
Reported Deaths Increasing in the New Year
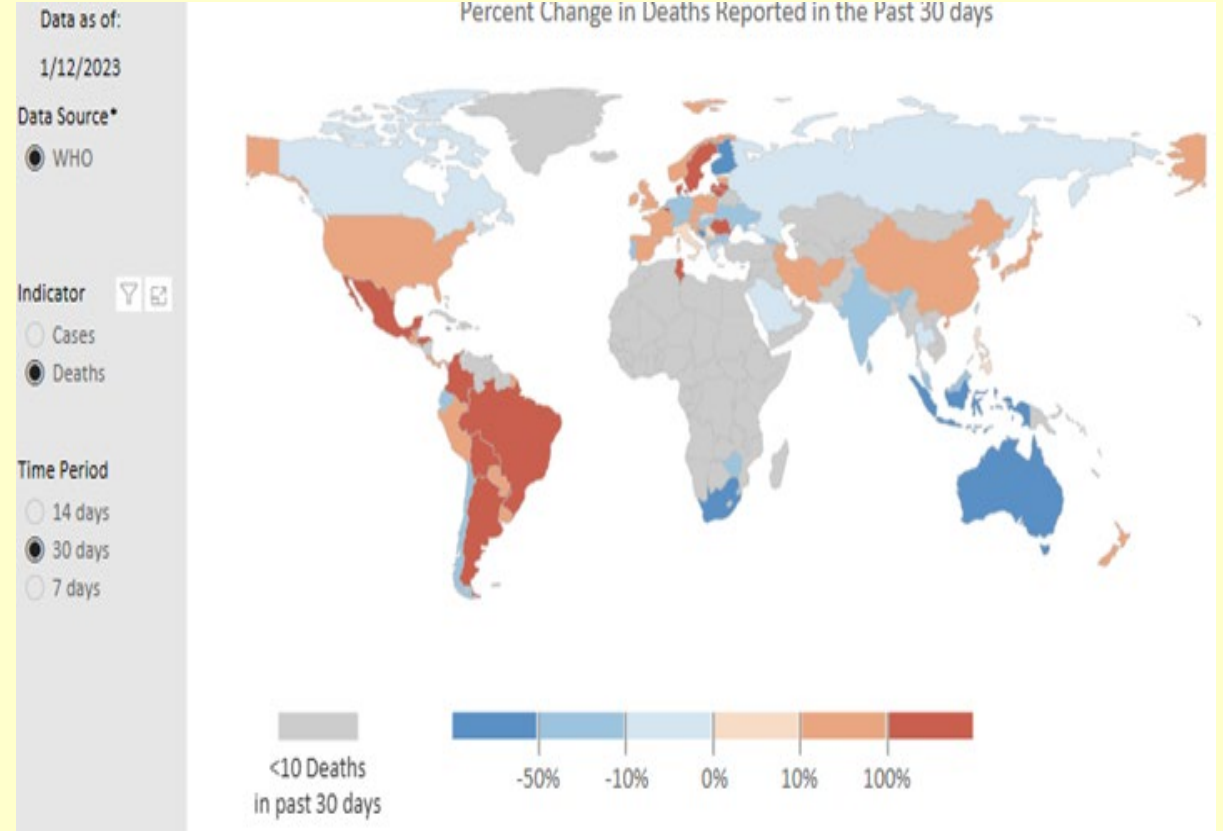
Rise in Hospitalizations in January Makes Clear that New Cases are Increasingly Underreported

Weekly Trends in Number of Cases and Number of New Patients Admitted to Hospital with Confirmed COVID-19 per Week in The United States Reported to CDC
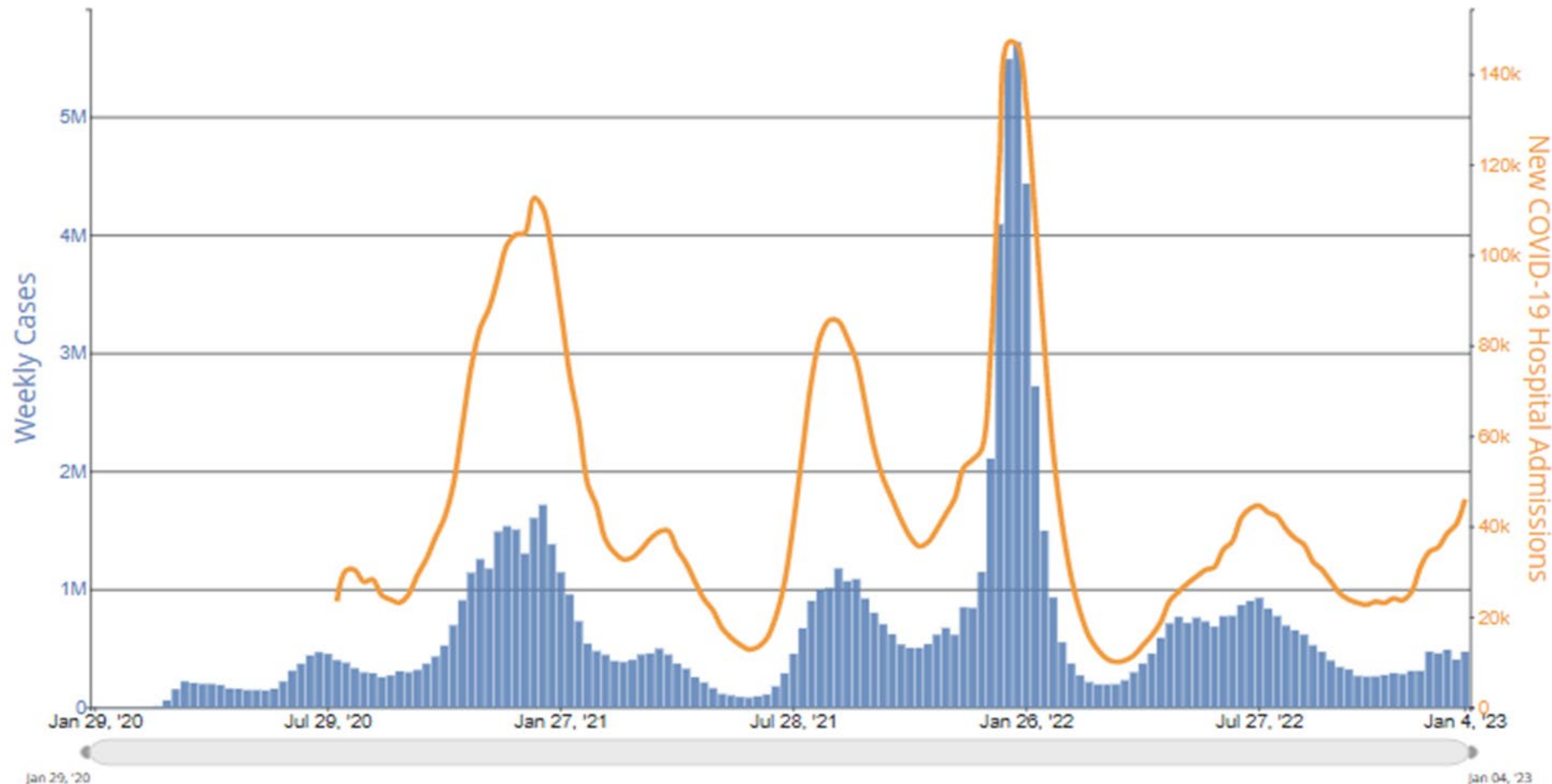
Cases and Deaths are Lower for Those Vaccinated, But How Much Due to Care and Greater Mitigation?
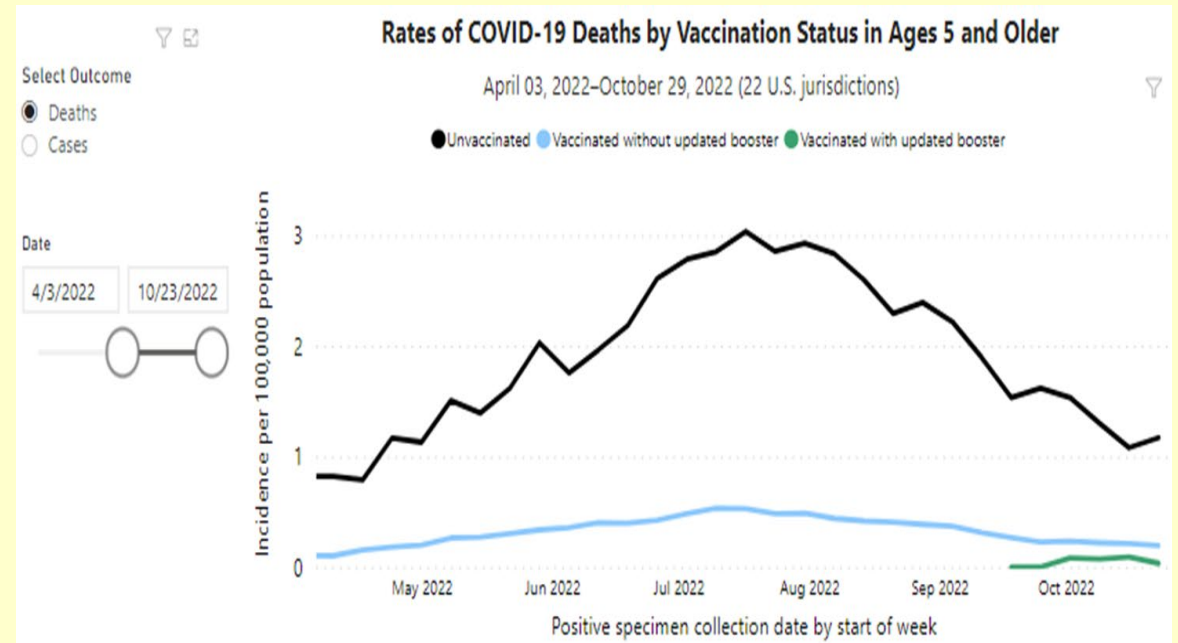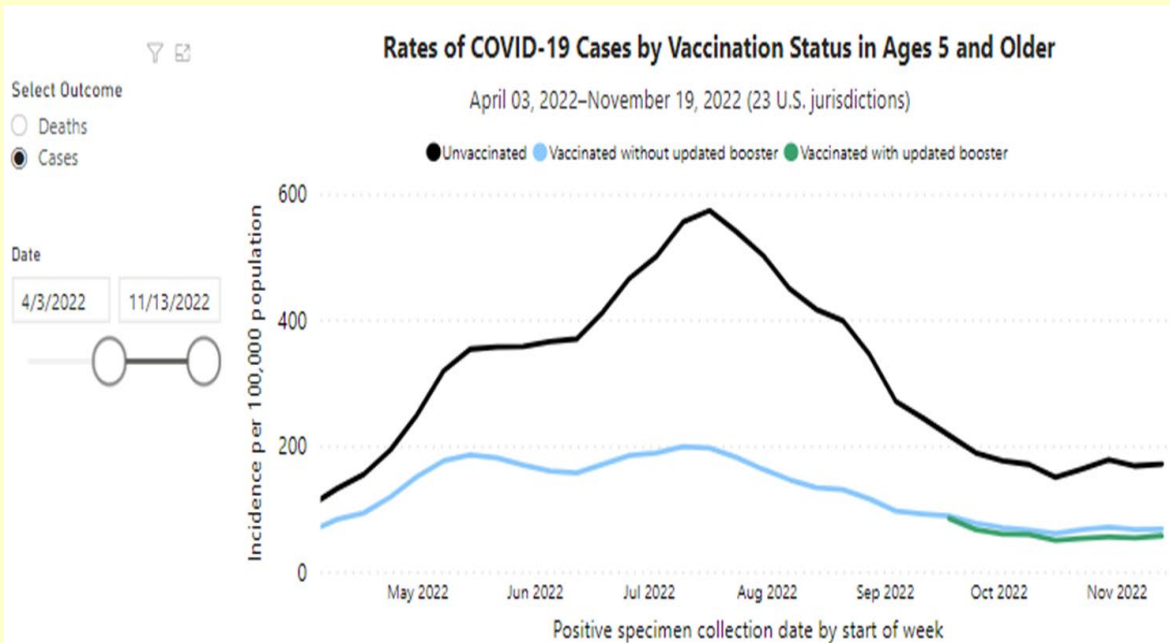
Relative Changes in Death Rates by Age, Total and PIC, Varied by Strain; Did Delta Reflect Earlier Vaccination for 65+?
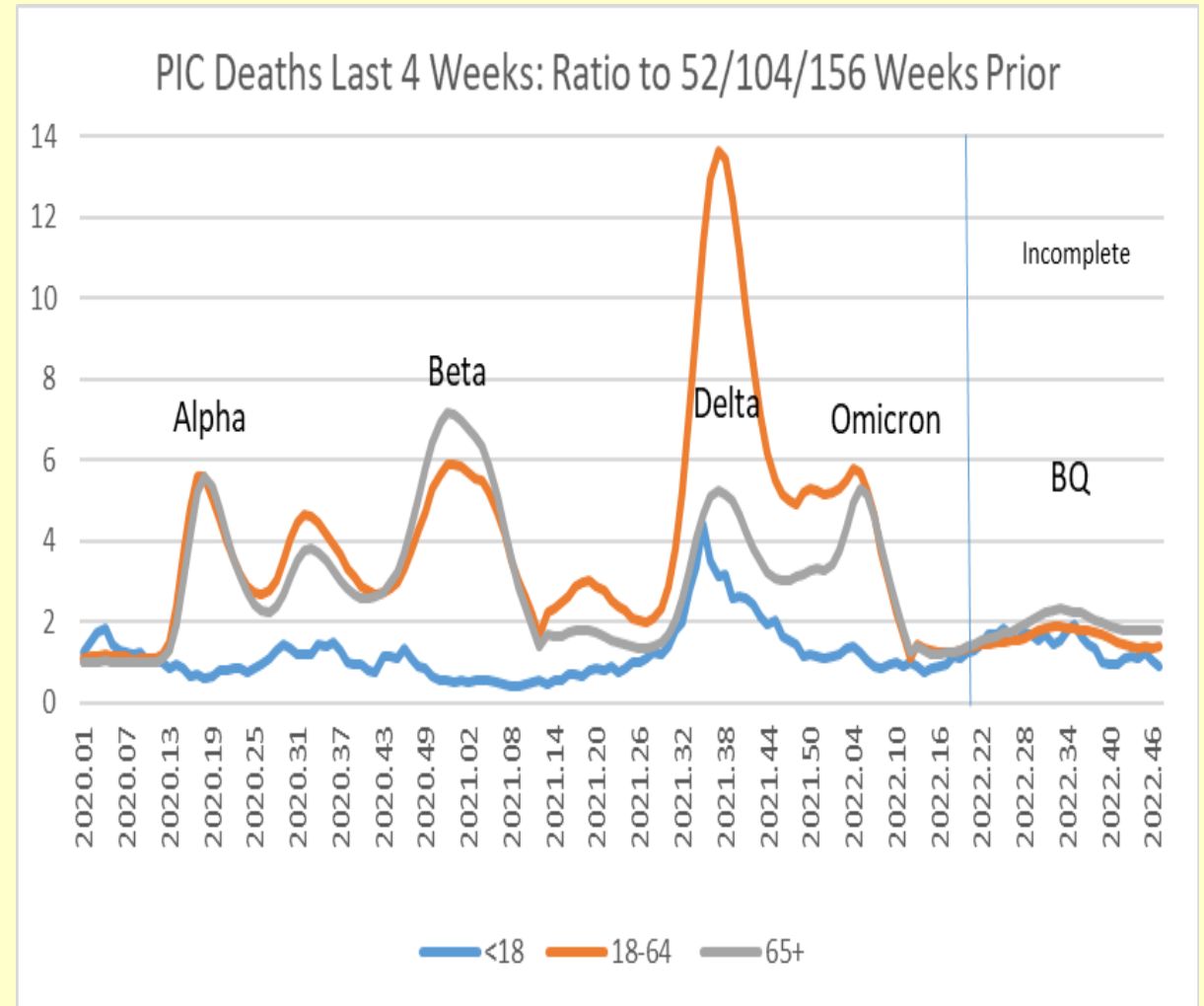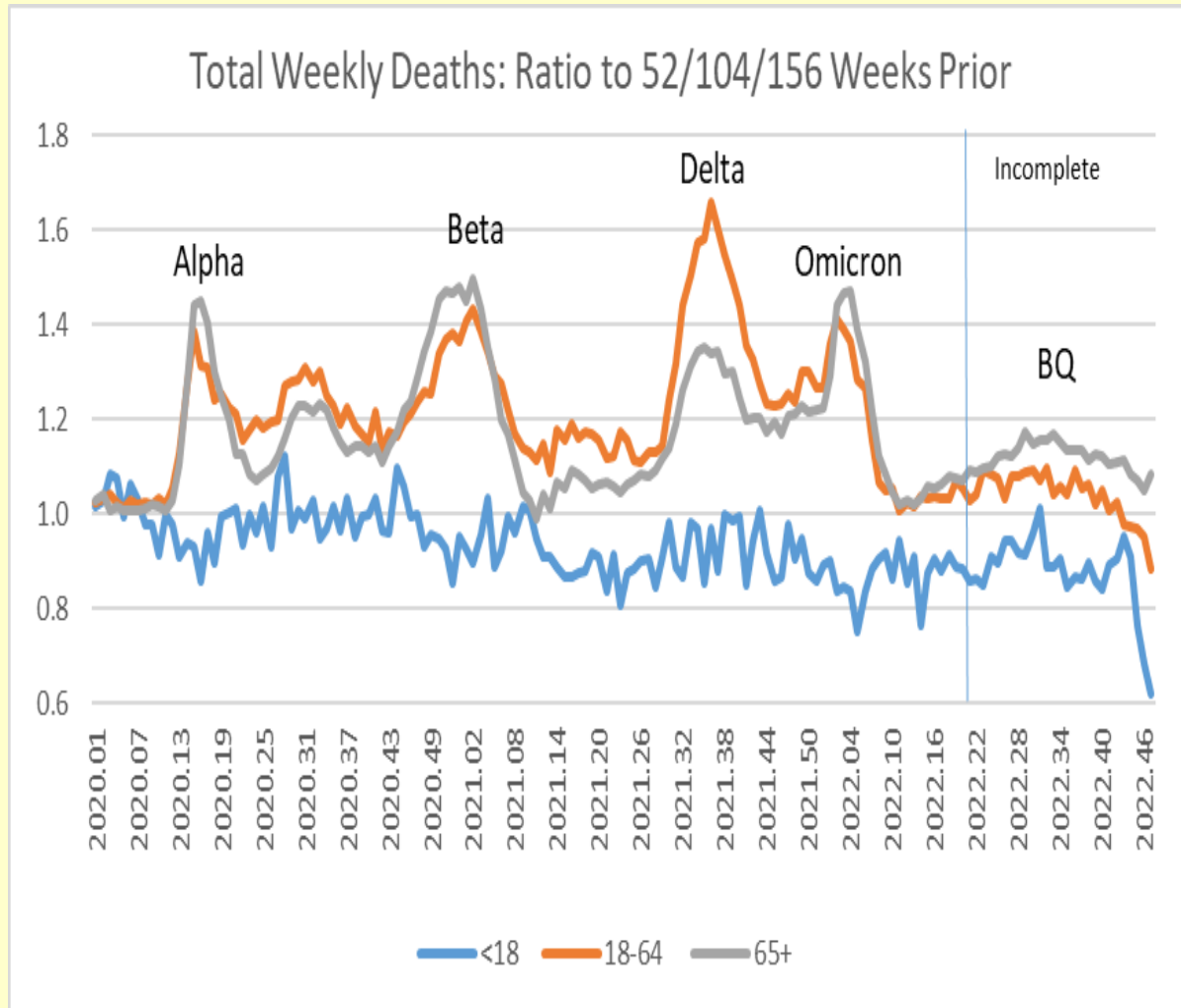
Note the Lag in Reporting of Deaths in the US; Estimated Excess Deaths Rising in Late November

US Total Weekly Deaths: Ratio to 52/104/156 Weeks Prior- At Date of CDC Report
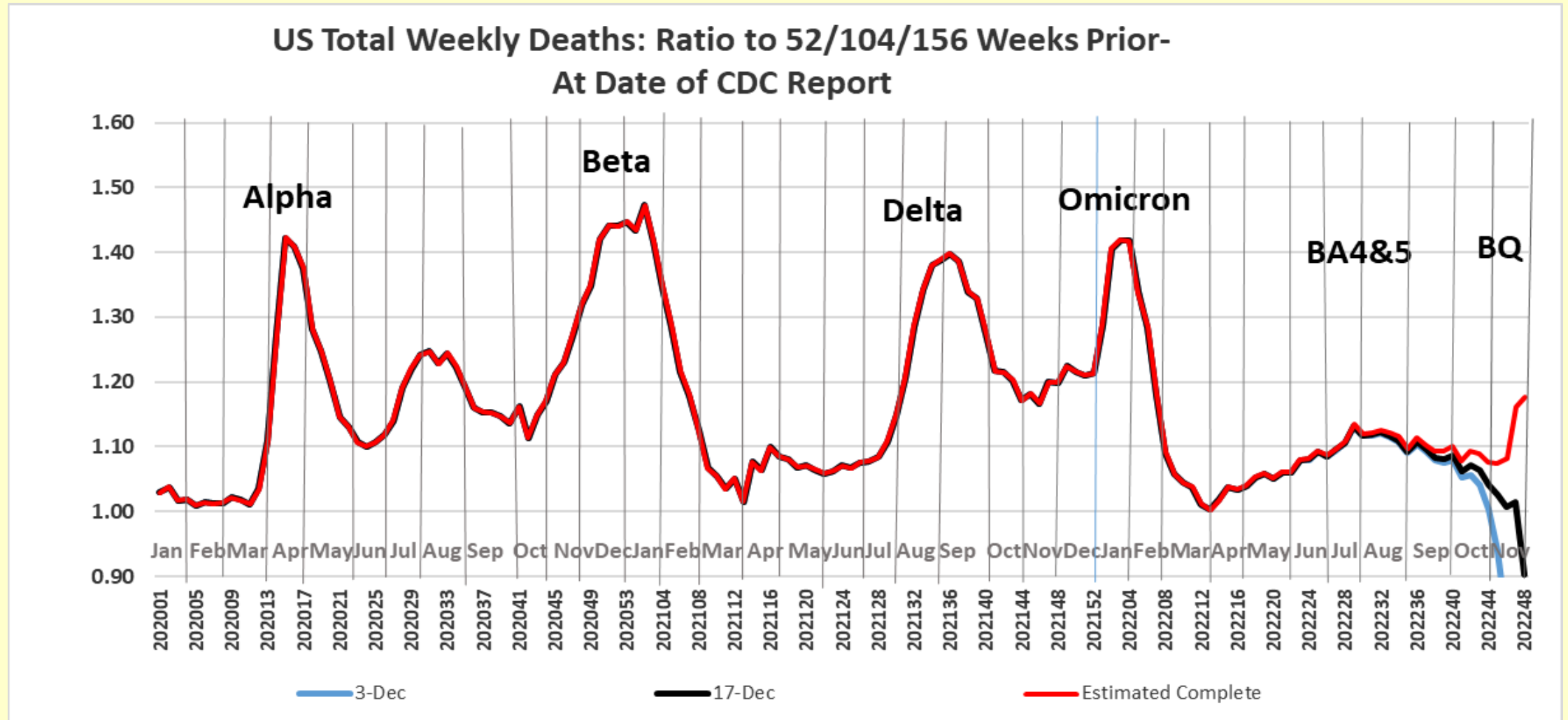
But Excess Deaths Are Not All From COVID; Currently May Be Largely From Other-Than-PIC

US Weekly Deaths Est Complete: Diff from 52/104/156 Weeks Prior

— US Total Weekly Deaths Estimated Complete: Difference from 52/104/156 Weeks Prior

— US Weekly Deaths Excluding Influenza, Pneumonia, or COVID Est Complete: Difference from 52/104/156 Weeks Prior

— US Weekly Deaths from Influenza, Pneumonia, or COVID Est Complete: Difference from 52/104/156 Weeks Prior
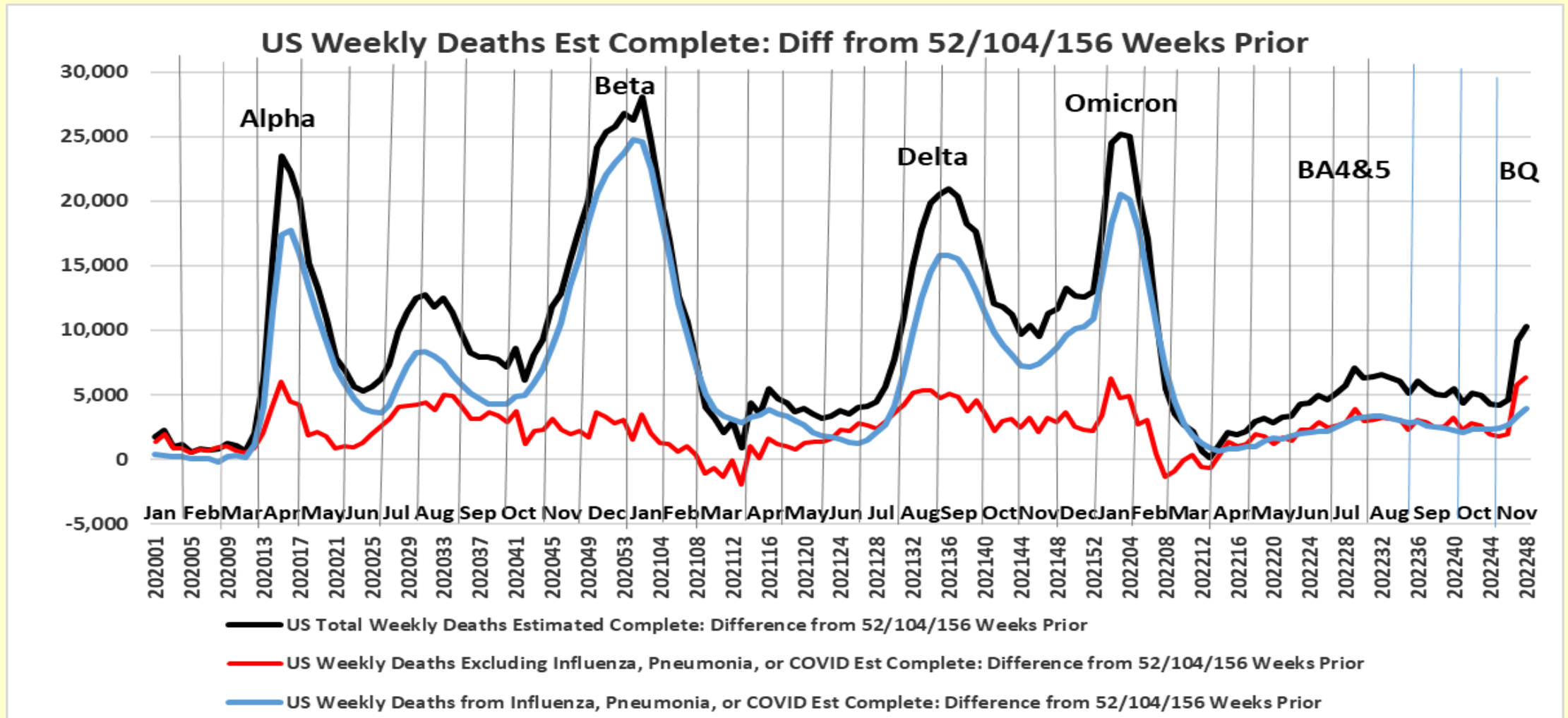
For Latest Complete Provisional Quarter, Age-Sex-Adjusted Death Rates Are All Elevated Over 2019

NCHS Provisional Age-Adjusted Death Rates	2019Q3	2021Q3	Ratio 2021Q3/2019Q3
Alzheimer disease	27.6	29.7	1.08
COVID-19	#N/A	115.6	#N/A
Cancer	145.4	148.5	1.02
Chronic liver disease and cirrhosis	11.1	14.6	1.32
Chronic lower respiratory diseases	33.6	34.6	1.03
Diabetes	19.8	24.8	1.25
Drug overdose	22.4	33.5	1.50
Falls, ages 65 and over	64.2	75.7	1.18
Firearm-related injury	12.4	15.5	1.25
Heart disease	150.5	169.7	1.13
HIV disease	1.3	1.3	1.00
Homicide	6.4	8.7	1.36
Hypertension	8.2	10.3	1.26
Influenza and pneumonia	8.9	10.1	1.13
Kidney disease	11.7	13.1	1.12
Parkinson disease	8.3	9.6	1.16
Pneumonitis due to solids and liquids	4.1	4.9	1.20
Septicemia	8.7	10.2	1.17
Stroke	34.8	39.8	1.14
Suicide	14.7	14.7	1.00
Unintentional injuries	51.3	67.6	1.32
Total	**645.4**	**852.5**	**1.32**
Total w/o COVID	**645.4**	**736.9**	**1.14**

Now, Considerations in Projecting Mortality

- Frequency of future pandemics?
- Variation by age and over time periods
- Variation by earnings level
- Changing causes of death
- Cohort considerations
- Health spending, obesity, smoking, opioids
- Our projections for the United States
- Is there a limit on human longevity?

Pandemics in the Future

- Over the last 100 years, mortality has been about cause reduction
- But if pandemics raise deaths 15% for 2 years in every 20 years
  - Then the level of mortality would be raised by 1.5% per year on average
- But how about residual compromising effects—post-COVID?
  - How much will viability be diminished for the survivors?
- Earlier death later in life might be the larger factor
  - As with other compromising factors like smoking

Variation by Age Has Been Substantial

Reduction in mortality at higher ages is inherently more difficult

Long-Term Historical Average Annual Rates of Reduction in Mortality 1929 to 2009

Recent Historical Average Annual Rates of Reduction in Mortality 1982 to 2009
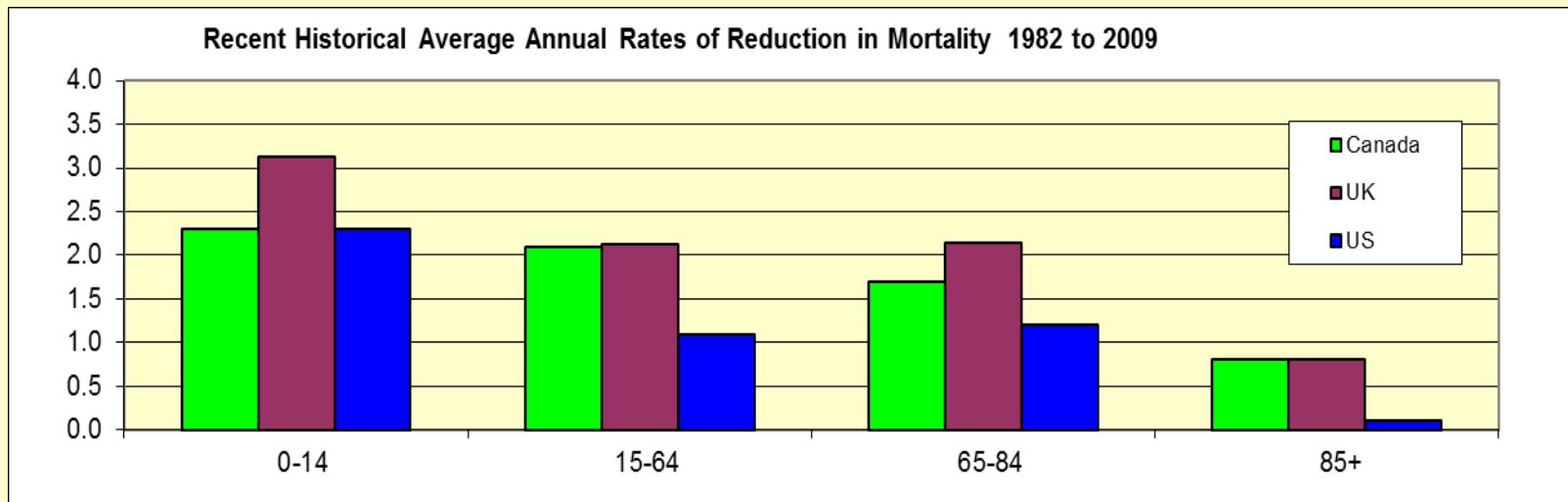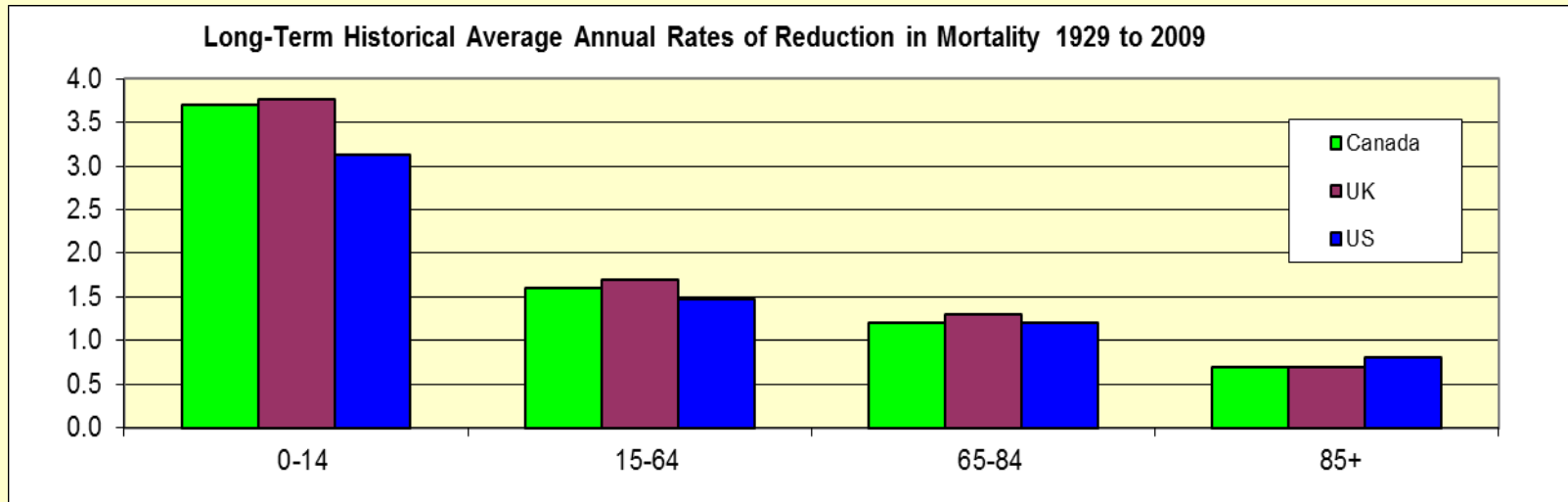
Mortality Decline Has *Varied* Over Time

Conditions: Antibiotics/economy 1936-54; Medicare/Medicaid 1968-82
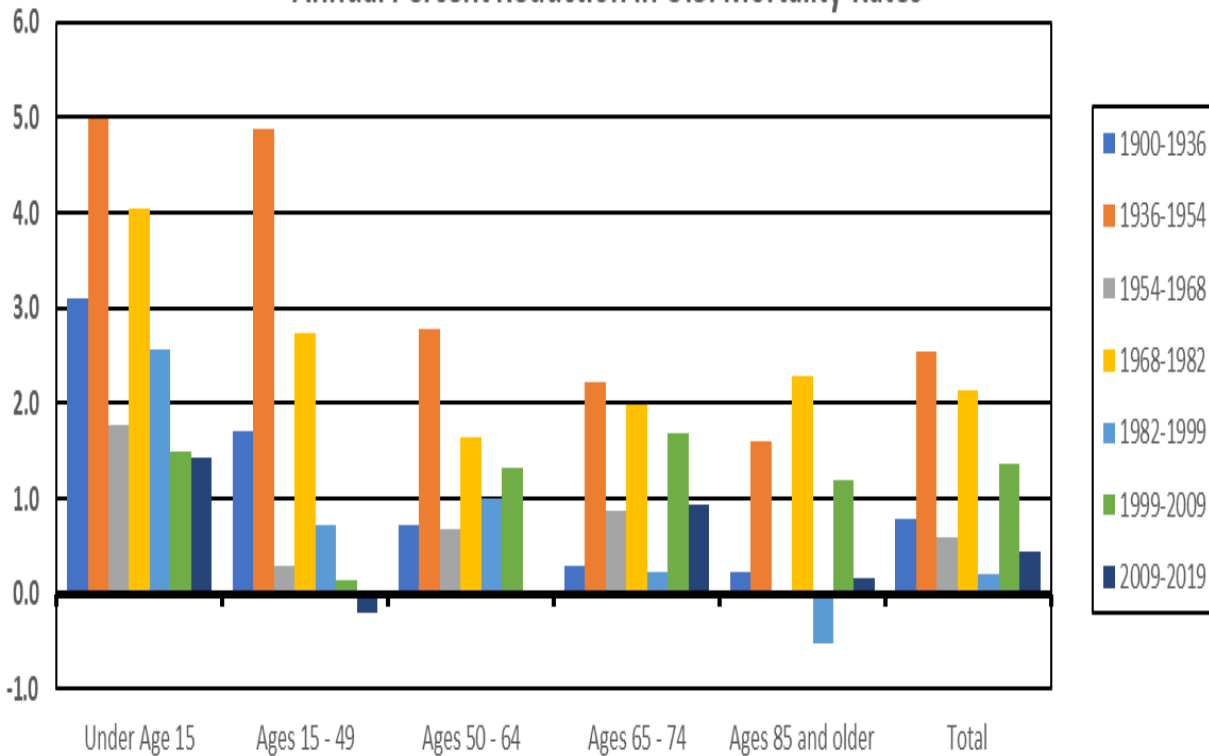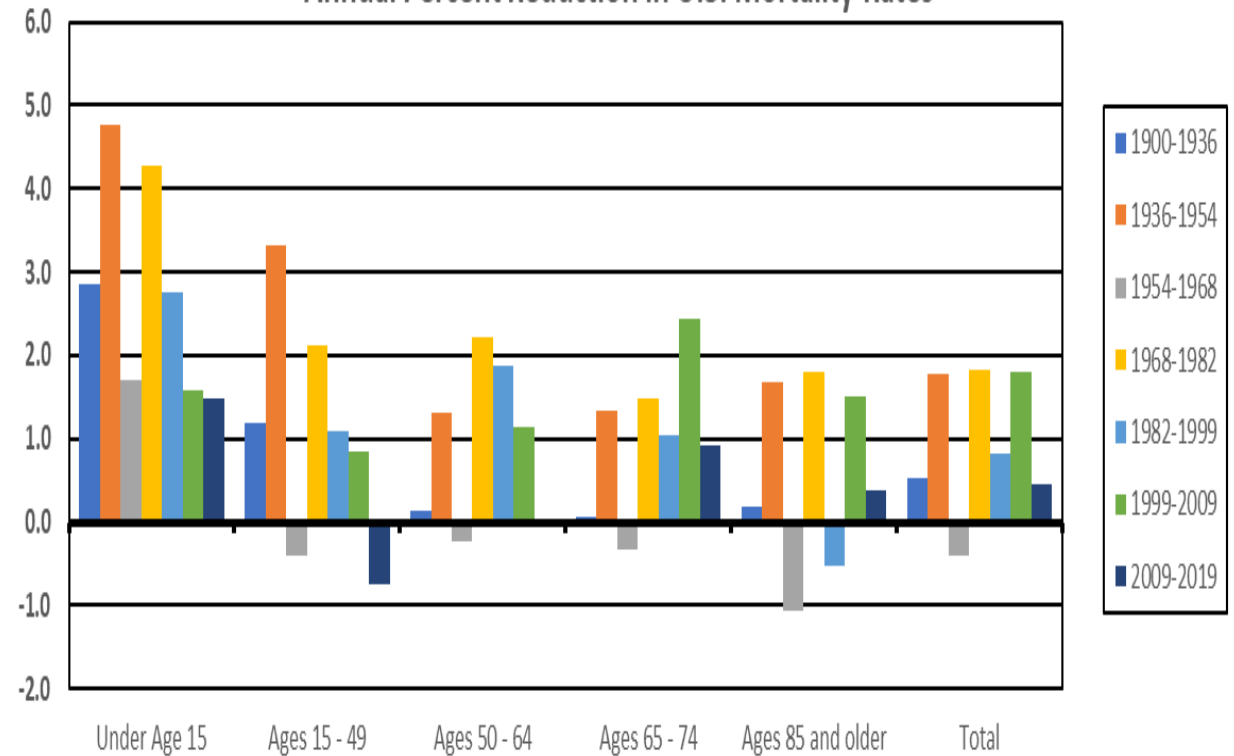
US Mortality Experience: All Ages
Reductions falling short of expectations since 2009

Age-Sex-Adjusted Death Rates (per 100,000)
Total, All Ages
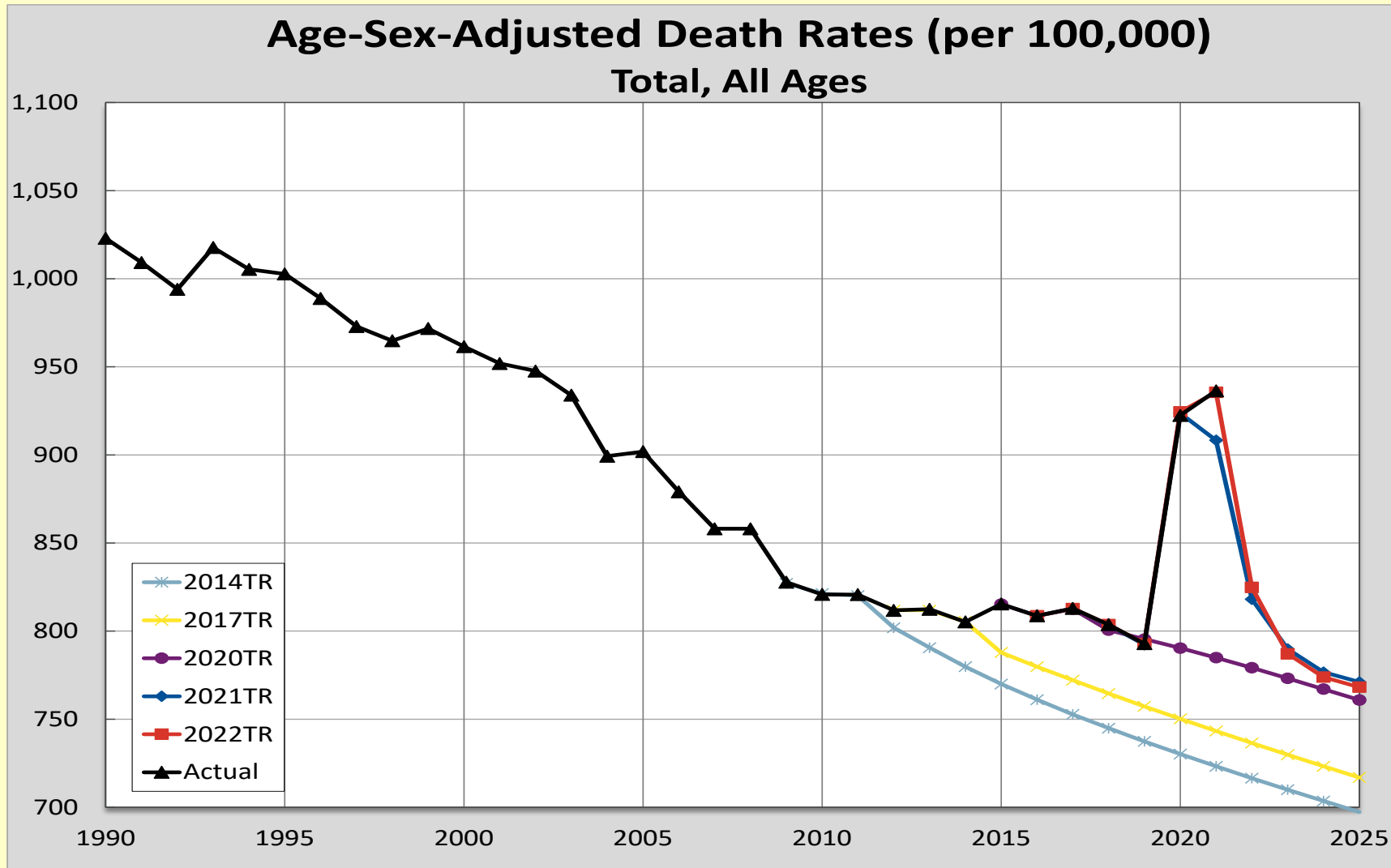
US is Not Alone—United Kingdom Deceleration Since 2011
January 2023 Living to 100 Conference: Adrian Gallop, UK Government Actuary's Office

Age standardised mortality rates, Male & Females, E&W

18
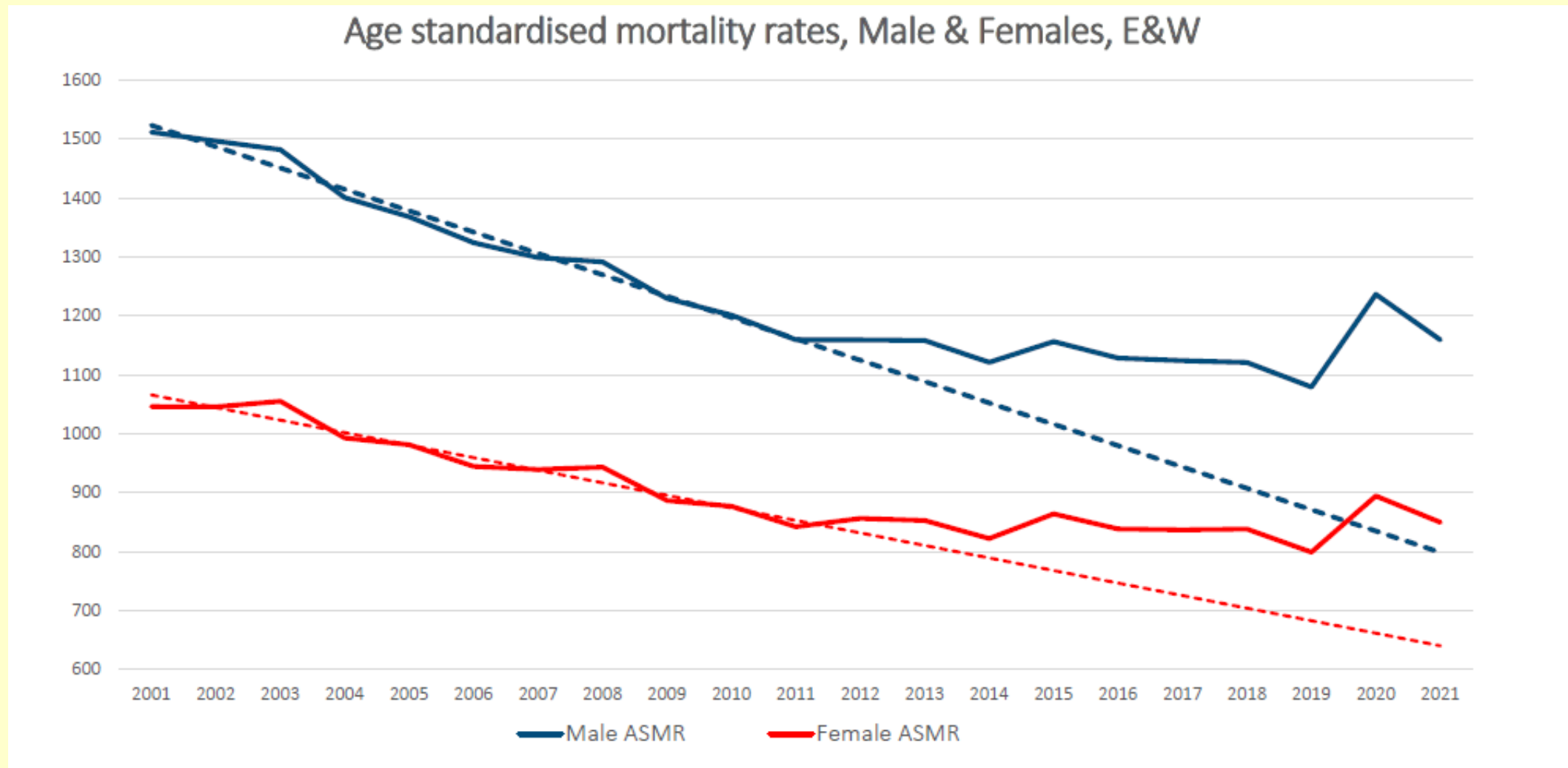
US Mortality Experience: Ages 65 and Over
Reductions falling short of expectations since 2009

Age-Sex-Adjusted Death Rates (per 100,000)
Ages 65 and Older

Legend:
- 2014TR
- 2017TR
- 2020TR
- 2021TR
- 2022TR
- Actual
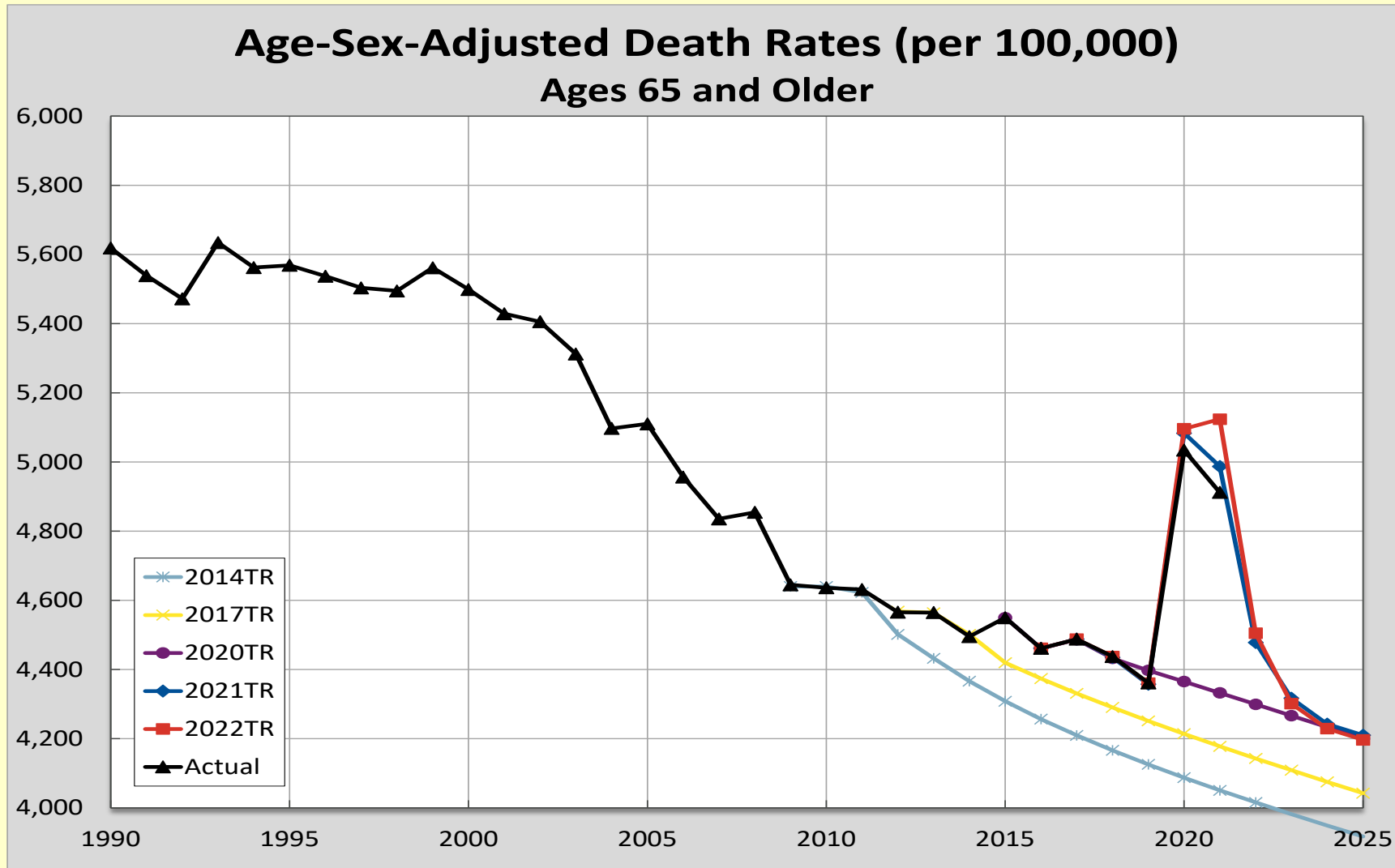
US Mortality Experience: Under Age 65
Experience far worse than expectations since 2009

Age-Sex-Adjusted Death Rates (per 100,000)
Ages Under 65

Legend:
- 2014TR
- 2017TR
- 2020TR
- 2021TR
- 2022TR
- Actual

20
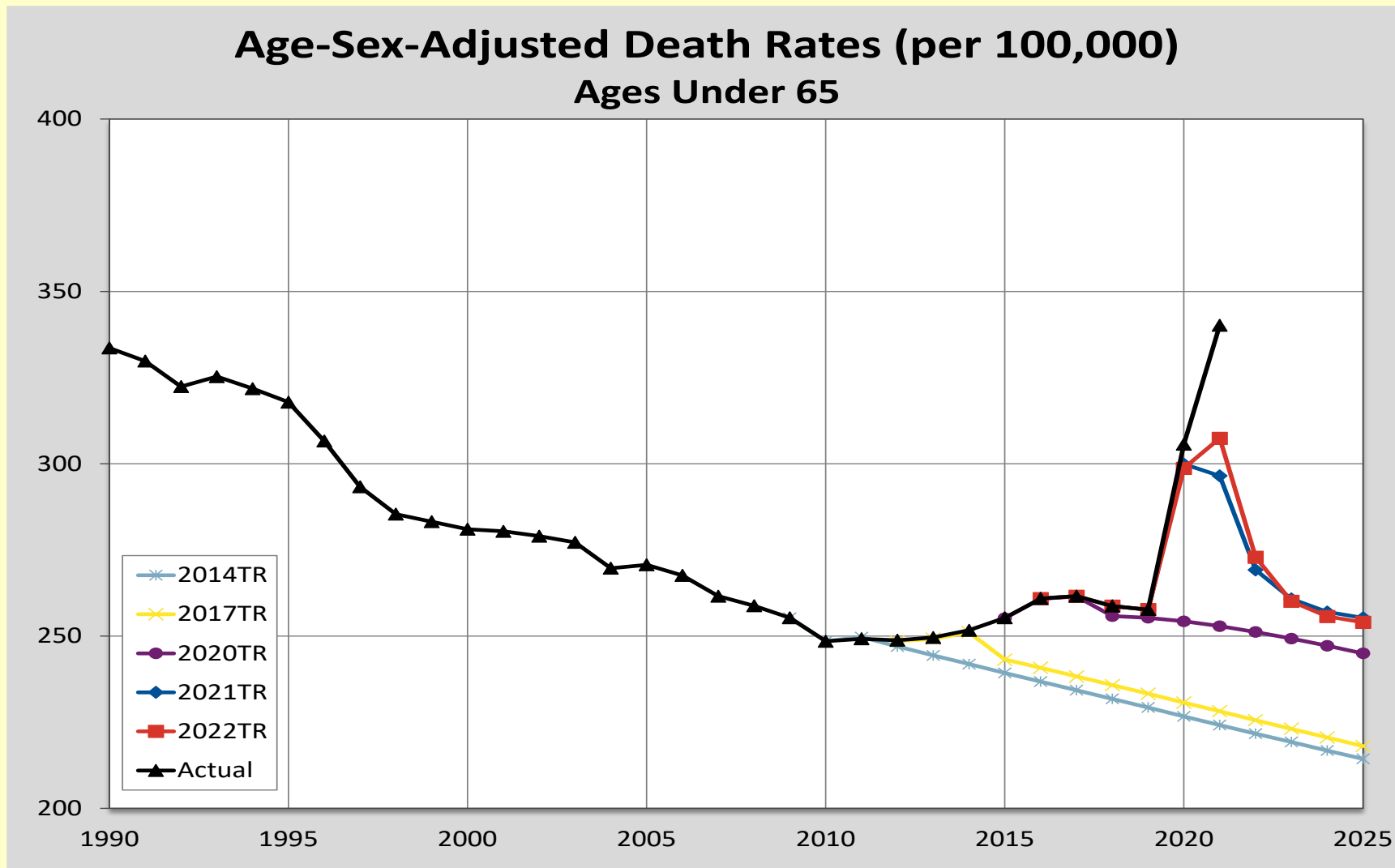
Mortality By Career-Average Earnings Level: Actuarial Study 124
So, crucial to scale to exposed population, but rate of change may be similar

Age group 65-69 relative mortality ratios—not diverging?
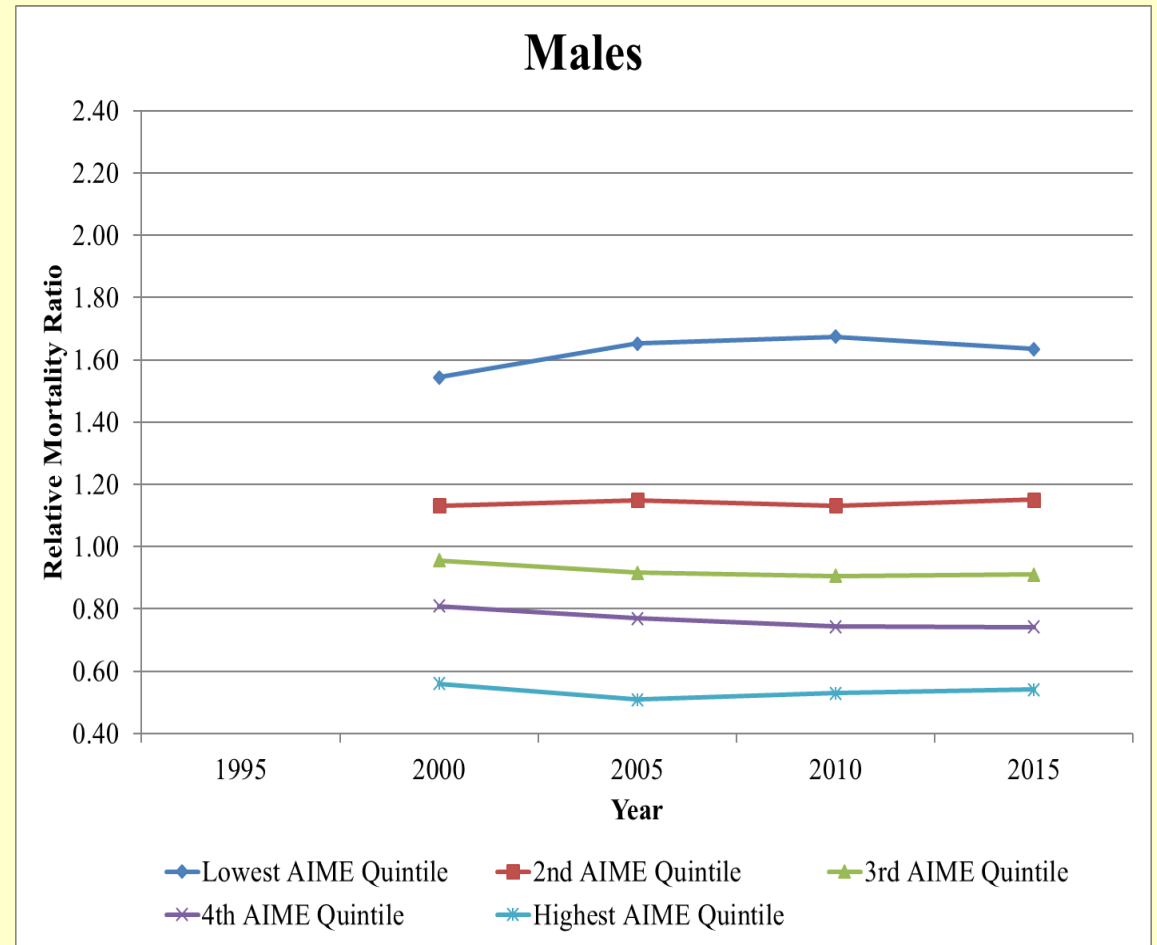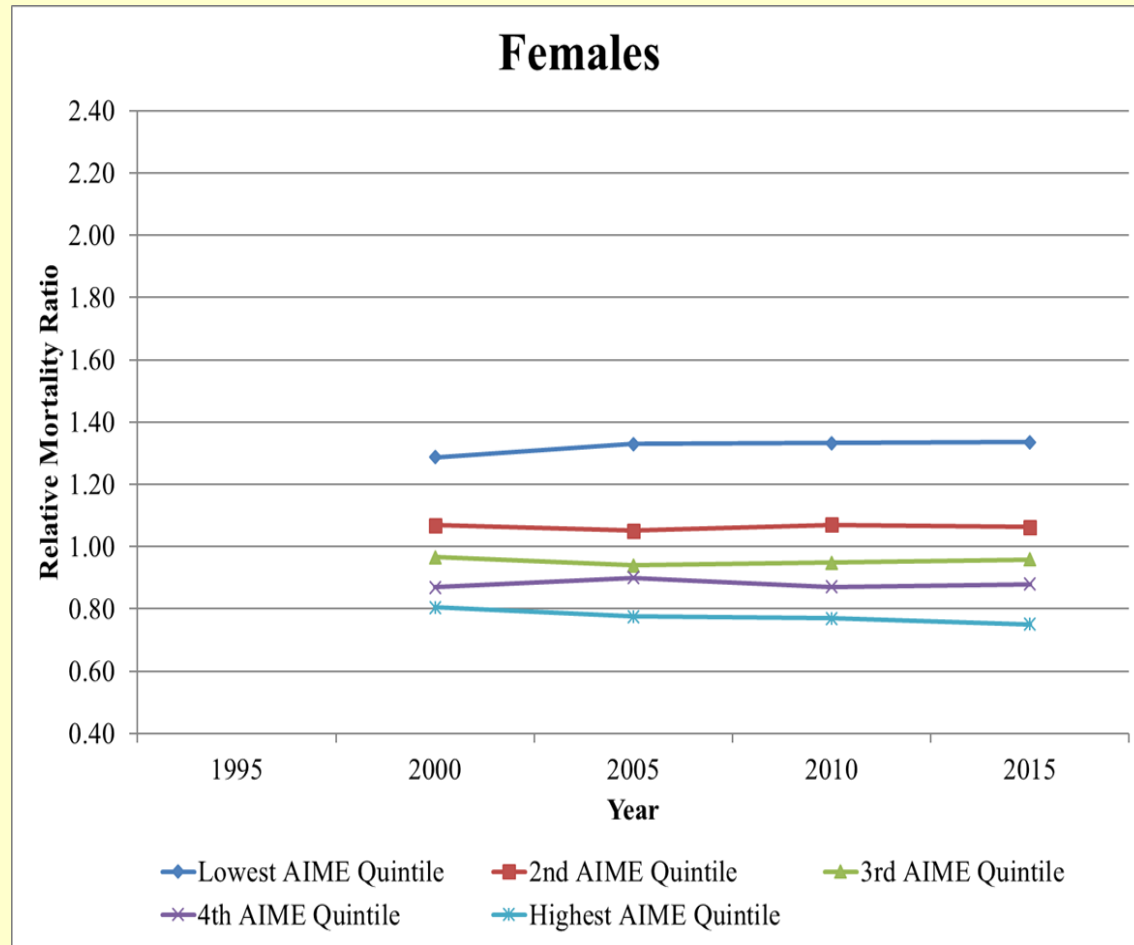
US Mortality Decline by *Cause* of Death:

*Annual rate of **decline** from 1979 to 2019; **note dementia vs. cardio over 50***
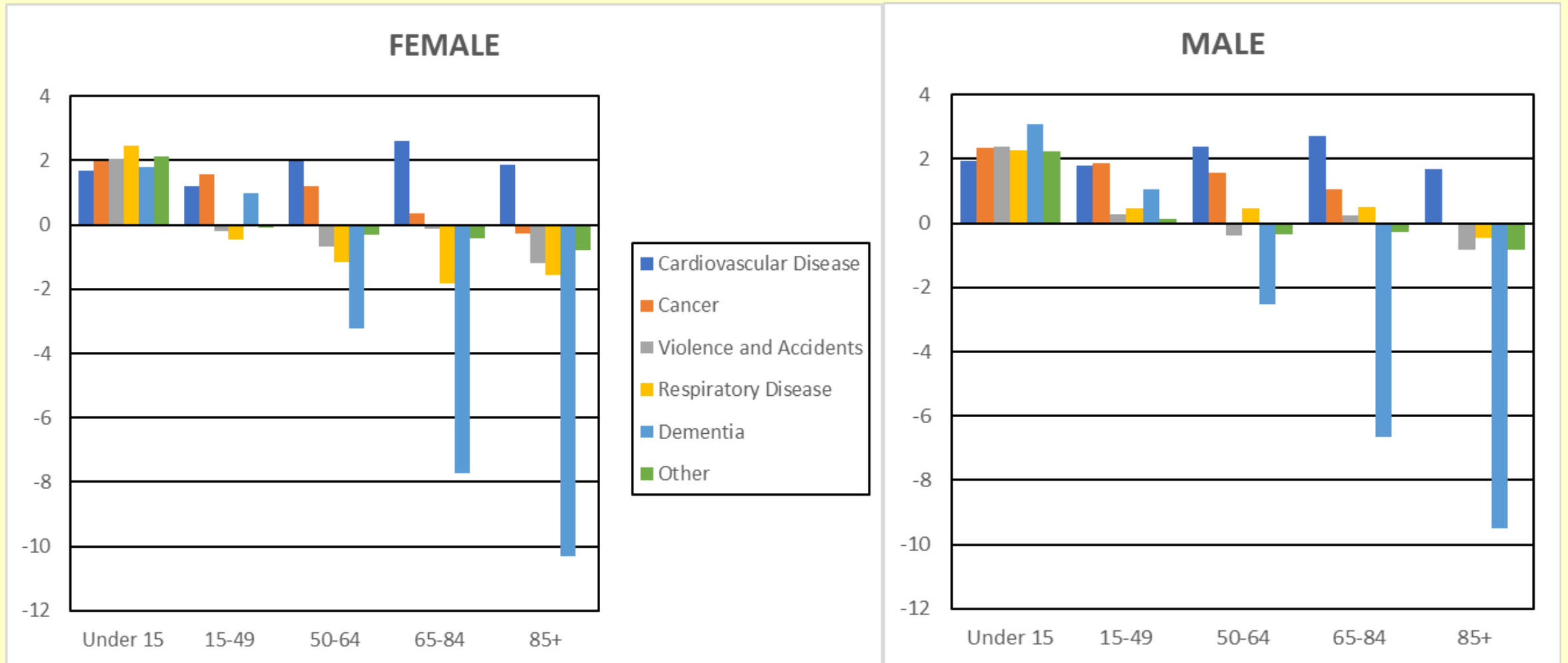
Age-Adjusted Death Rates for Heart Disease, Cancer, Stroke, and Unintentional Injuries: United States, 1900-2021

(courtesy Robert Anderson, NCHS)
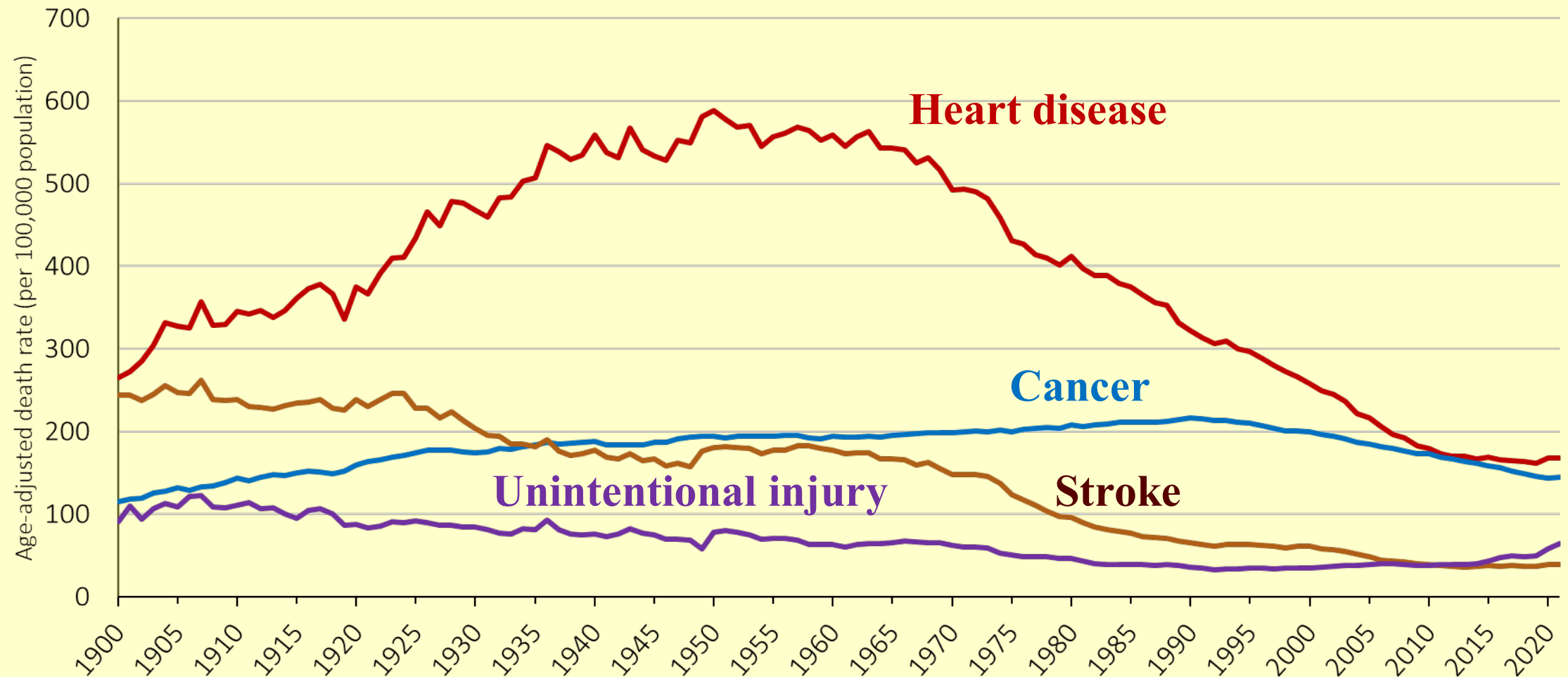
Notes: Data are from the National Vital Statistics System. Prior to 1933, data are for death-registration States only. Data for 2021 are provisional.

Age-Adjusted Death Rates for Heart Disease, Cancer, Stroke, and Unintentional Injuries: United States, 2000-2021

(courtesy Robert Anderson, NCHS)

21
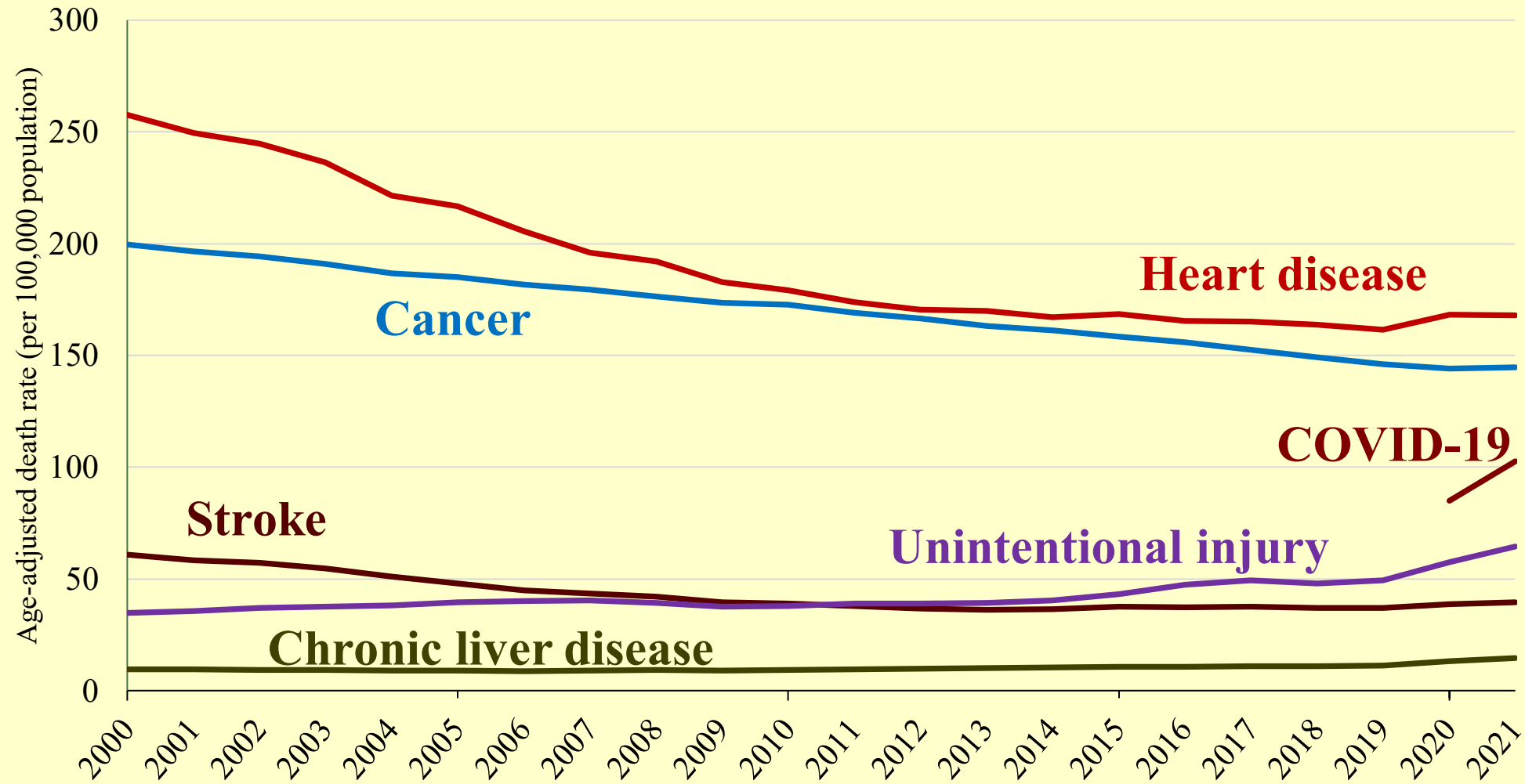
Age-Adjusted Death Rates for Selected Causes: United States, 2000-2021

(courtesy Robert Anderson, NCHS)
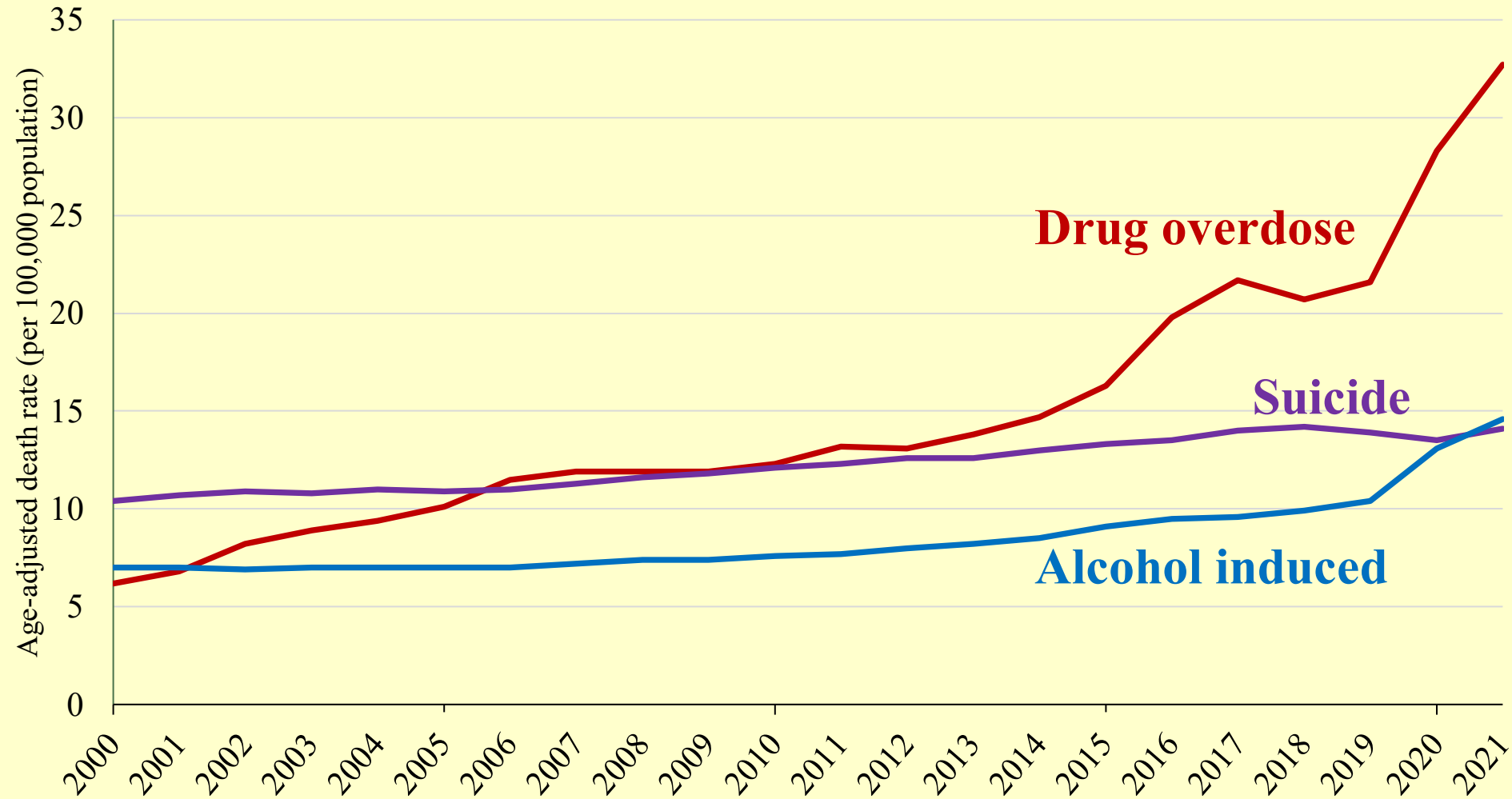
Developing Assumptions by Cause

- Scientific approach reflecting biology and epidemiology
- Trustees and SSA/OCACT develop in consultation with other experts
- Centers for Disease Control/National Institutes of Health
- Johns Hopkins survey of medical researchers and clinicians

Cohort Considerations

- Post-World War 2 births—special conditions:
  - Antibiotics when young; statins, etc. later

- What does change up to age x say above age x?
  - If cohort is fundamentally healthier at x:

    Then expect lower mortality over age x
  - But if medical interventions have just reduced deaths:

    Then cohort mortality over age x could be worse, with increased numbers of impaired survivors
  - What does one cohort imply for the next cohort?

    Further changes depend on conditions, not trend

How Future Conditions Might Change

- Smoking decline for women
  - Started and stopped later than men
- Obesity—sedentary lifestyle
- Health spending—must decelerate
  - An ageing population, and Climate Change will strain resources
  - Advances help only if they 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*
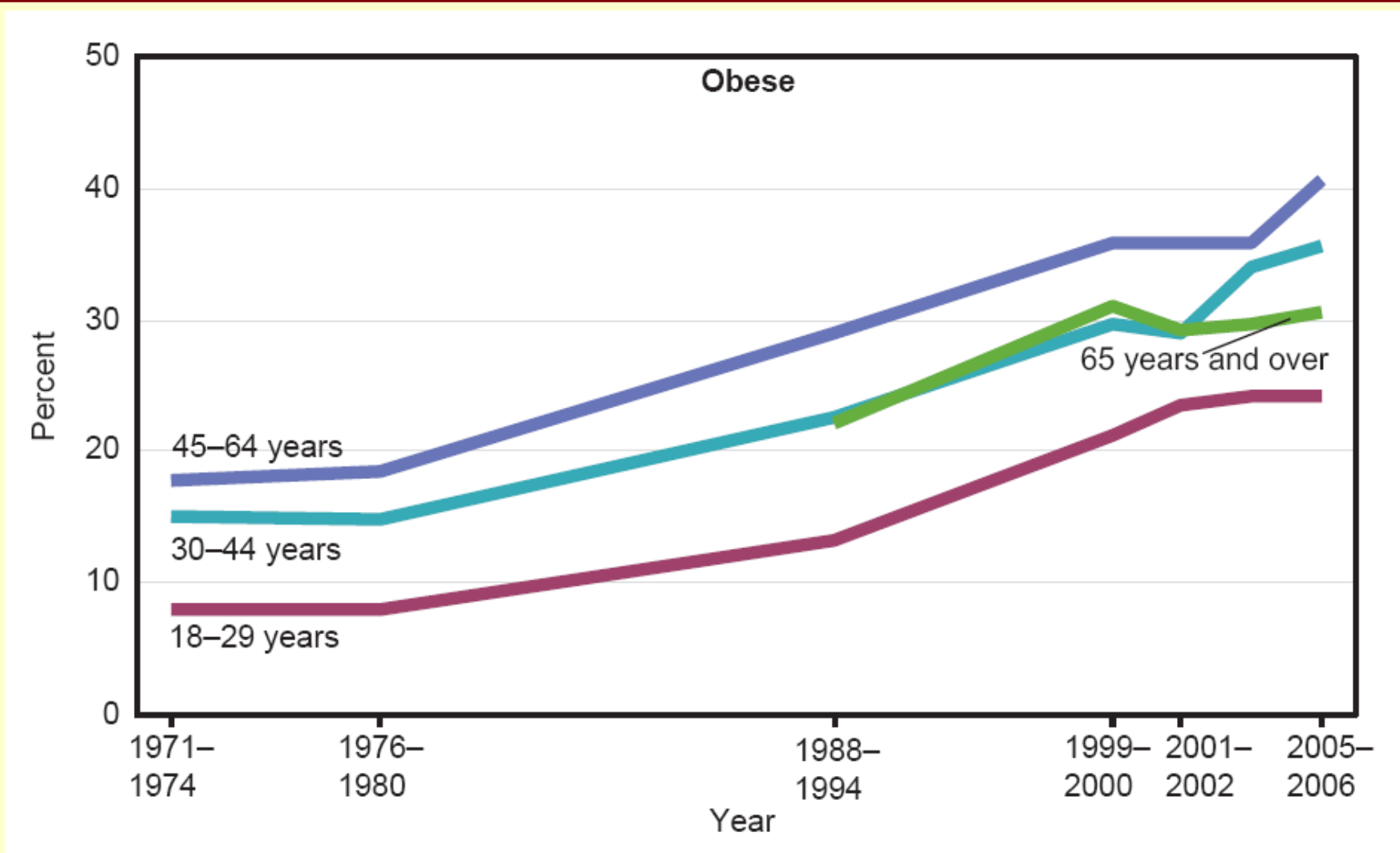
Health Spending Cannot Continue to Rise at Historical Rates
Note Trustees' projected deceleration

Annual Percent Change in Medicare Cost per Beneficiary Relative to GDP per Worker: 2022 TR
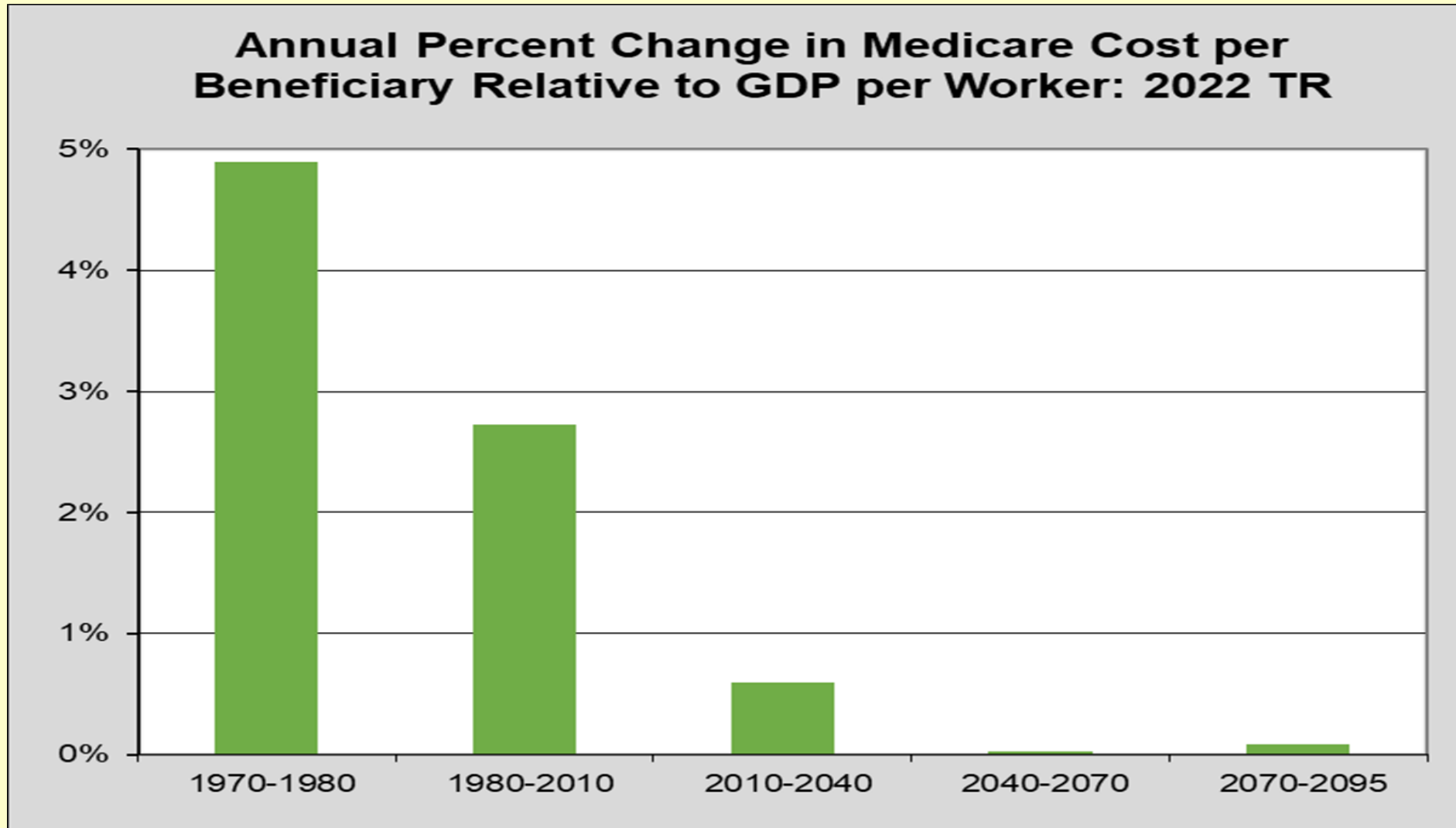
Costs from Climate Change and the Increasing Share of the Adult Population over Age 65 will Strain Resources

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

Aged Dependency Ratio 2022 TR
Population 65+/(20-64)

Historical | Projected

- Actual and TR Intermediate
- TFR remains at 3.0 after 1964
- TFR remains at 3.3 after 1964
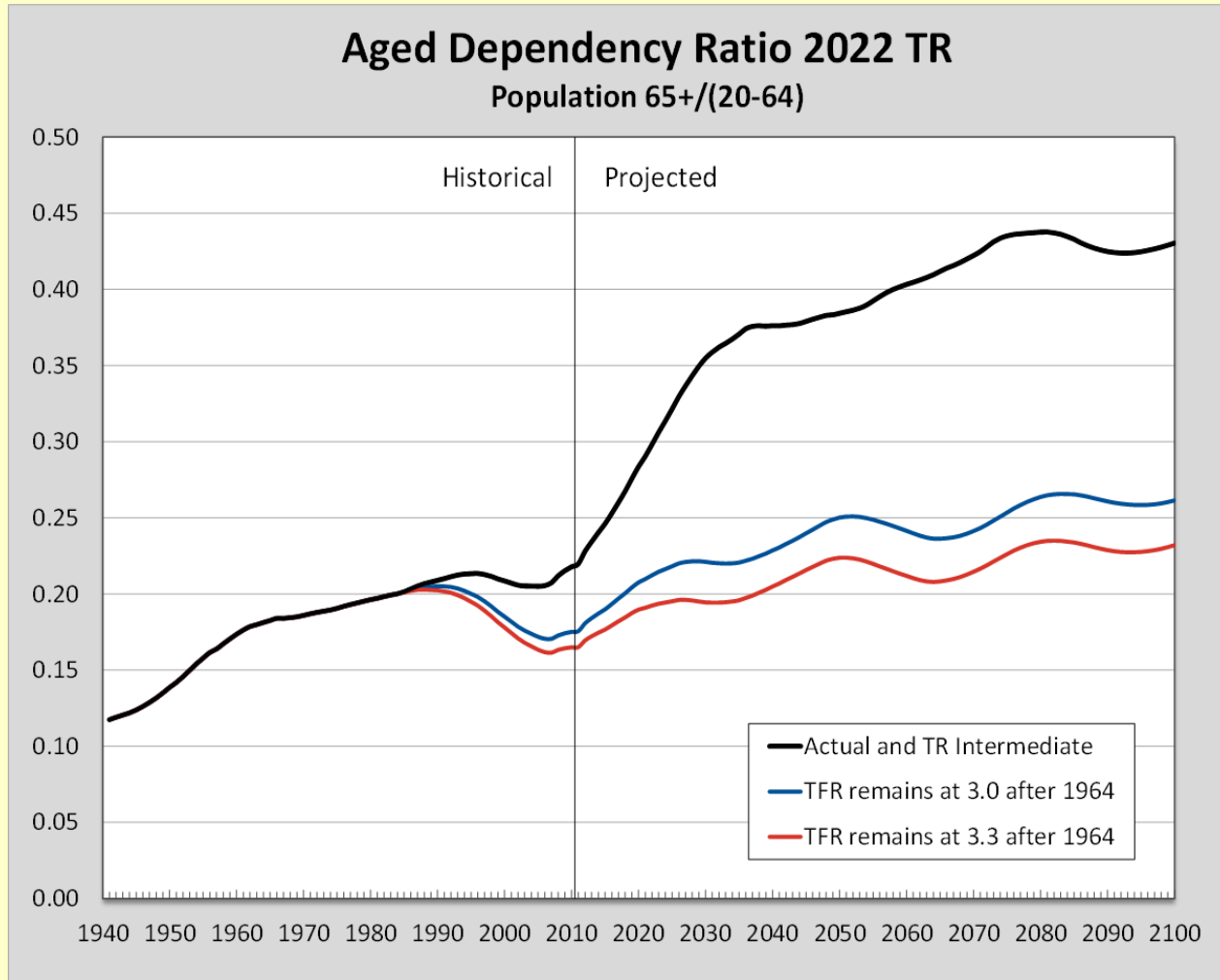
Excluding immigration as well as fertility effects:

Ratio for Ages 65+ to Ages 20-64

■ Expected Years:Period Mortality Alone   ■ Population Ratio Total
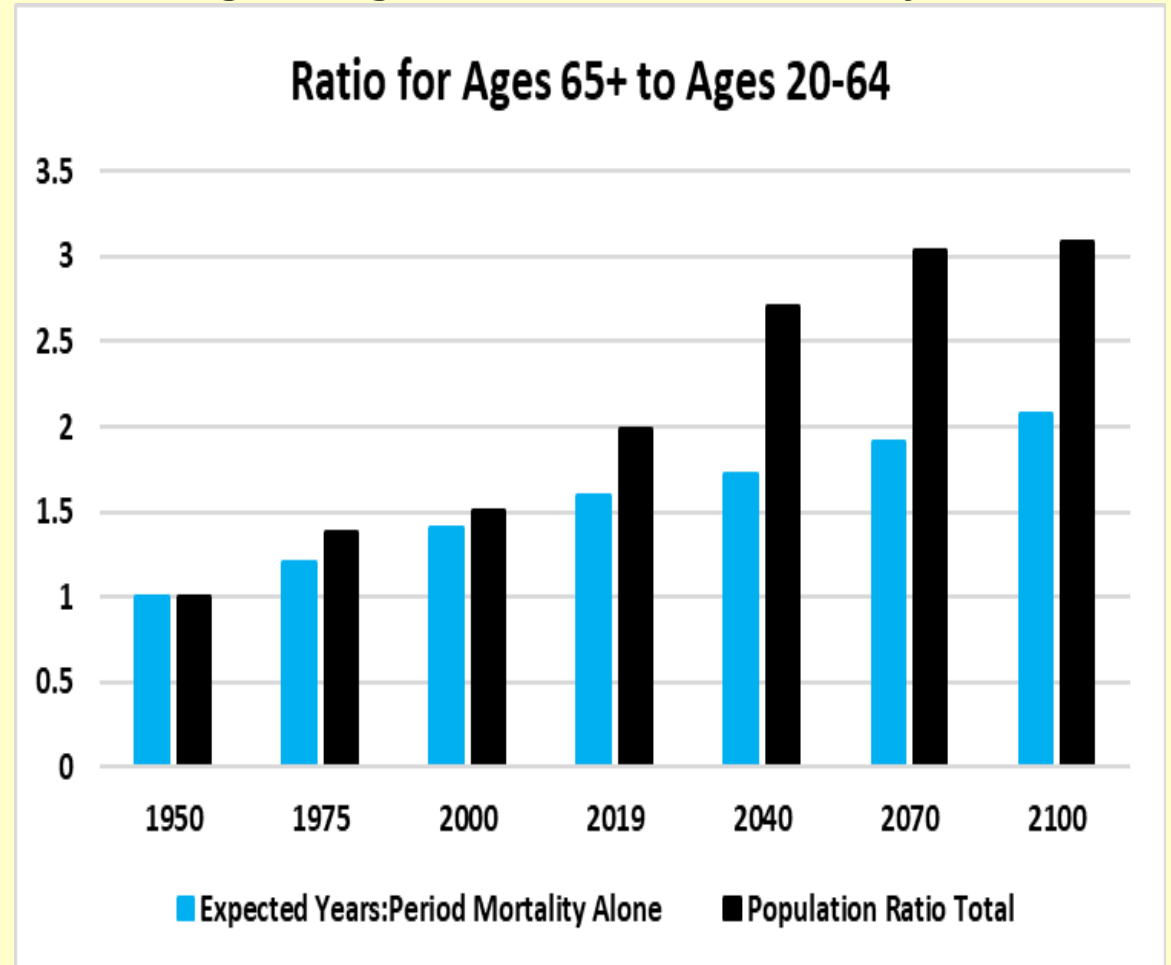
Our Ultimate (2046 to 2096) Projected Rates of Decline: Similar to Period Since 1900 for Ages 50+

Historical and Projected Age-Sex-Adjusted Average Rate of Decline in U.S. Death Rates
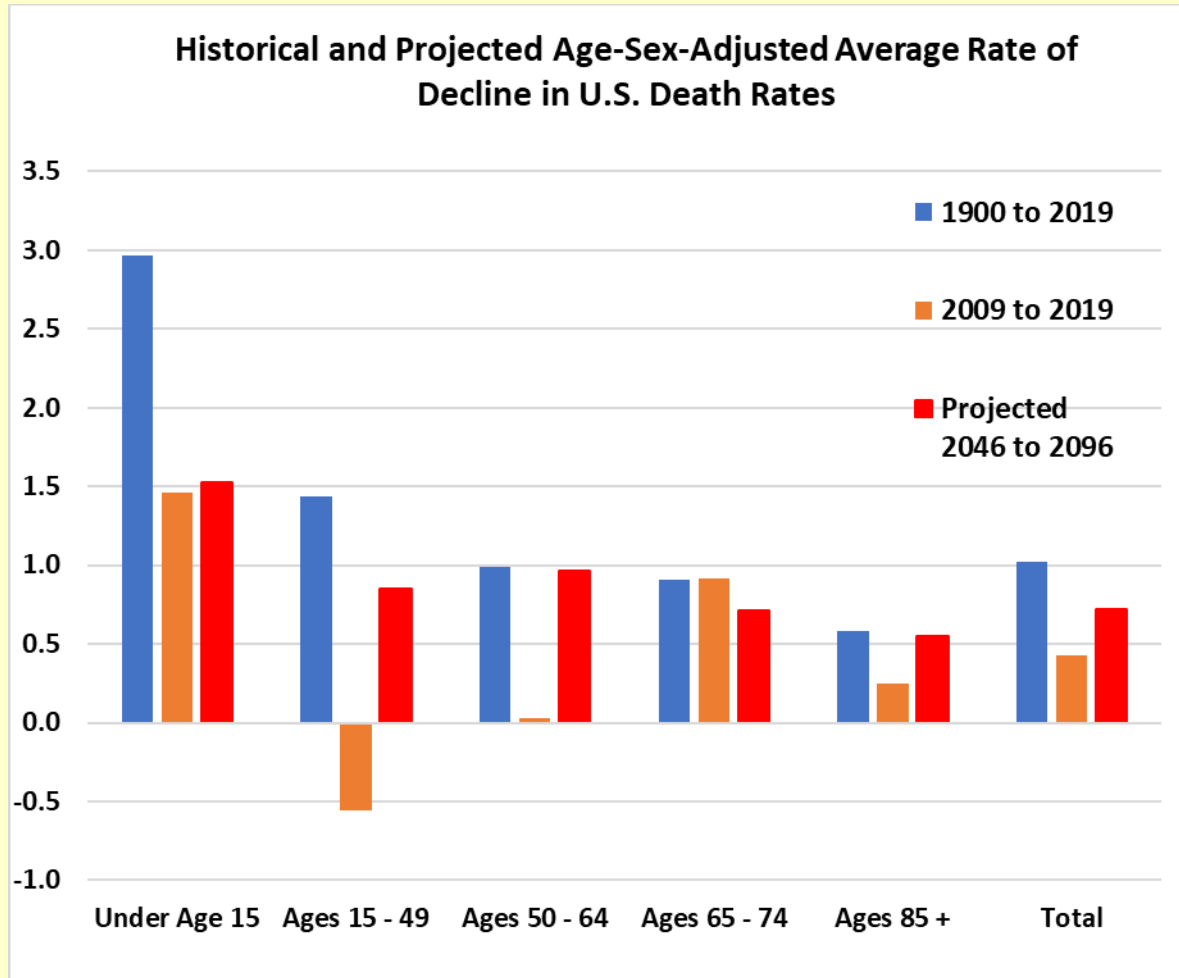
	1900 to 2019	2009 to 2019	Projected 2046 to 2096
Under Age 15	2.97	1.46	1.52
Ages 15 - 49	1.43	-0.55	0.85
Ages 50 - 64	0.99	0.03	0.96
Ages 65 - 74	0.91	0.92	0.71
Ages 85 +	0.58	0.24	0.55
Total	1.02	0.43	0.72

Assumed Ultimate Rates of Change by Age and Cause of Death

	Historical		Alternative II*		Historical		Alternative II*	
			2021 TR	2022 TR			2021 TR	2022 TR
	1979 to 2019	2009 to 2019	2045 to 2095	2046 to 2096	1979 to 2019	2009 to 2019	2045 to 2095	2046 to 2096
Under Age 15	**Male**				**Female**			
Cardiovascular Disease	1.94	2.22	1.9	1.9	1.68	1.62	1.9	1.9
Cancer	2.35	1.69	1.5	1.5	1.98	1.51	1.5	1.5
Violence and Accidents	2.38	0.25	1.0	1.0	2.07	-0.09	1.0	1.0
Respiratory Disease	2.27	2.04	2.0	2.0	2.45	2.63	2.0	2.0
Dementia	3.07	3.93	0.1	0.1	1.80	-1.78	0.1	0.1
Other	2.24	1.75	1.7	1.7	2.13	1.67	1.7	1.7
Resulting Total **	2.27	1.49	1.51	1.51	2.11	1.42	1.54	1.54
Ages 15 - 49	**Male**				**Female**			
Cardiovascular Disease	1.78	0.75	1.3	1.3	1.19	0.42	1.3	1.3
Cancer	1.88	2.26	1.5	1.5	1.58	1.77	1.5	1.5
Violence and Accidents	0.28	-2.44	0.7	0.7	-0.21	-2.35	0.7	0.7
Respiratory Disease	0.45	1.92	0.5	0.5	-0.47	2.08	0.5	0.5
Dementia	1.06	0.50	0.1	0.1	0.96	1.84	0.1	0.1
Other	0.14	0.32	0.8	0.8	-0.09	-0.06	0.8	0.8
Resulting Total **	0.72	-0.74	0.82	0.82	0.49	-0.21	0.89	0.89
Ages 50 - 64	**Male**				**Female**			
Cardiovascular Disease	2.36	0.19	1.5	1.5	1.96	0.06	1.5	1.5
Cancer	1.55	2.04	1.5	1.5	1.22	1.39	1.5	1.5
Violence and Accidents	-0.39	-3.34	0.5	0.5	-0.68	-2.73	0.5	0.5
Respiratory Disease	0.45	-0.33	0.7	0.7	-1.17	-0.75	0.7	0.7
Dementia	-2.51	-2.80	0.1	0.1	-3.23	-3.53	0.1	0.1
Other	-0.34	-0.66	0.6	0.6	-0.31	-0.84	0.6	0.6
Resulting Total **	1.23	0.03	0.95	0.95	0.82	0.02	0.98	0.98
Ages 65 - 84	**Male**				**Female**			
Cardiovascular Disease	2.73	1.31	1.9	1.9	2.61	1.69	1.9	1.9
Cancer	1.07	2.18	0.9	0.9	0.35	1.84	0.9	0.9
Violence and Accidents	0.25	-1.78	0.5	0.5	-0.13	-1.58	0.5	0.5
Respiratory Disease	0.48	1.50	0.3	0.3	-1.83	1.07	0.3	0.3
Dementia	-6.65	-1.89	0.1	0.1	-7.73	-2.39	0.1	0.1
Other	-0.29	-0.63	0.3	0.3	-0.44	0.15	0.3	0.3
Resulting Total **	1.36	0.92	0.74	0.74	0.80	0.93	0.68	0.68
Ages 85 and older	**Male**				**Female**			
Cardiovascular Disease	1.67	1.01	1.5	1.5	1.87	1.24	1.5	1.5
Cancer	0.00	0.83	0.5	0.5	-0.29	0.13	0.5	0.5
Violence and Accidents	-0.83	-1.80	0.3	0.3	-1.18	-2.16	0.3	0.3
Respiratory Disease	-0.45	1.59	0.2	0.2	-1.58	0.51	0.2	0.2
Dementia	-9.48	-2.15	0.1	0.1	-10.32	-2.36	0.1	0.1
Other	-0.83	0.06	0.3	0.3	-0.78	0.75	0.3	0.3
Resulting Total **	0.35	0.38	0.58	0.58	0.23	0.16	0.54	0.54
Total	**Male**				**Female**			
Cardiovascular Disease	2.27	0.99			2.18	1.26		
Cancer	1.04	1.87			0.62	1.44		
Violence and Accidents	0.12	-2.40			-0.27	-2.16		
Respiratory Disease	0.20	1.33			-1.54	0.69		
Dementia	-7.71	-2.06			-8.77	-2.38		
Other	-0.20	-0.26			-0.25	0.19		
Resulting Total **	1.02	0.45	0.74	0.74	0.62	0.45	0.69	0.69

Projected US Age-Sex-Adjusted Death Rates: Only Modest Deceleration *(note importance of log scale)*

Total Age-Sex-Adjusted Death Rates for Alternative II of the 2022 TR

Age-Adjusted Death Rates for 65 and Older Under Alternative II of the 2022 TR
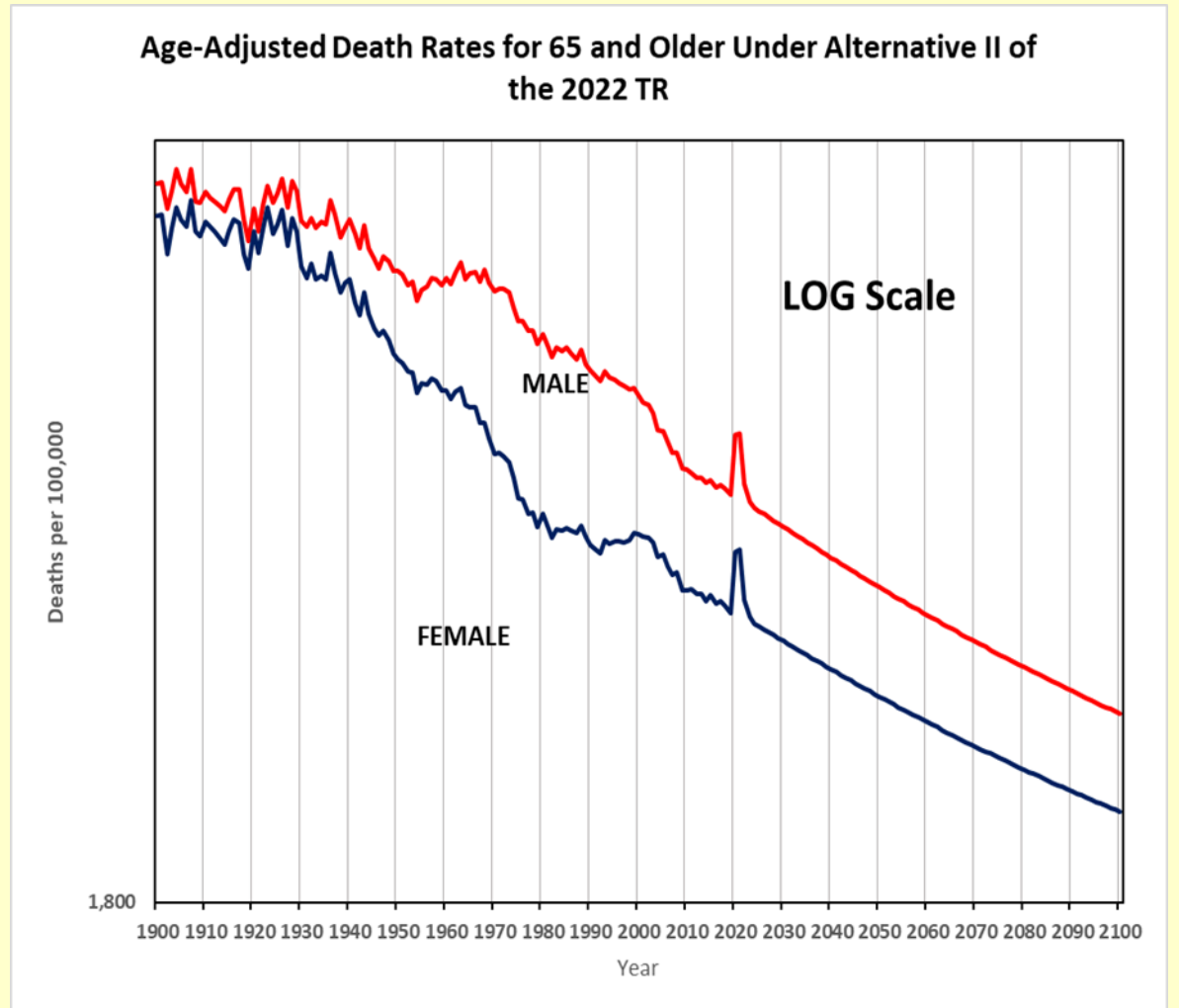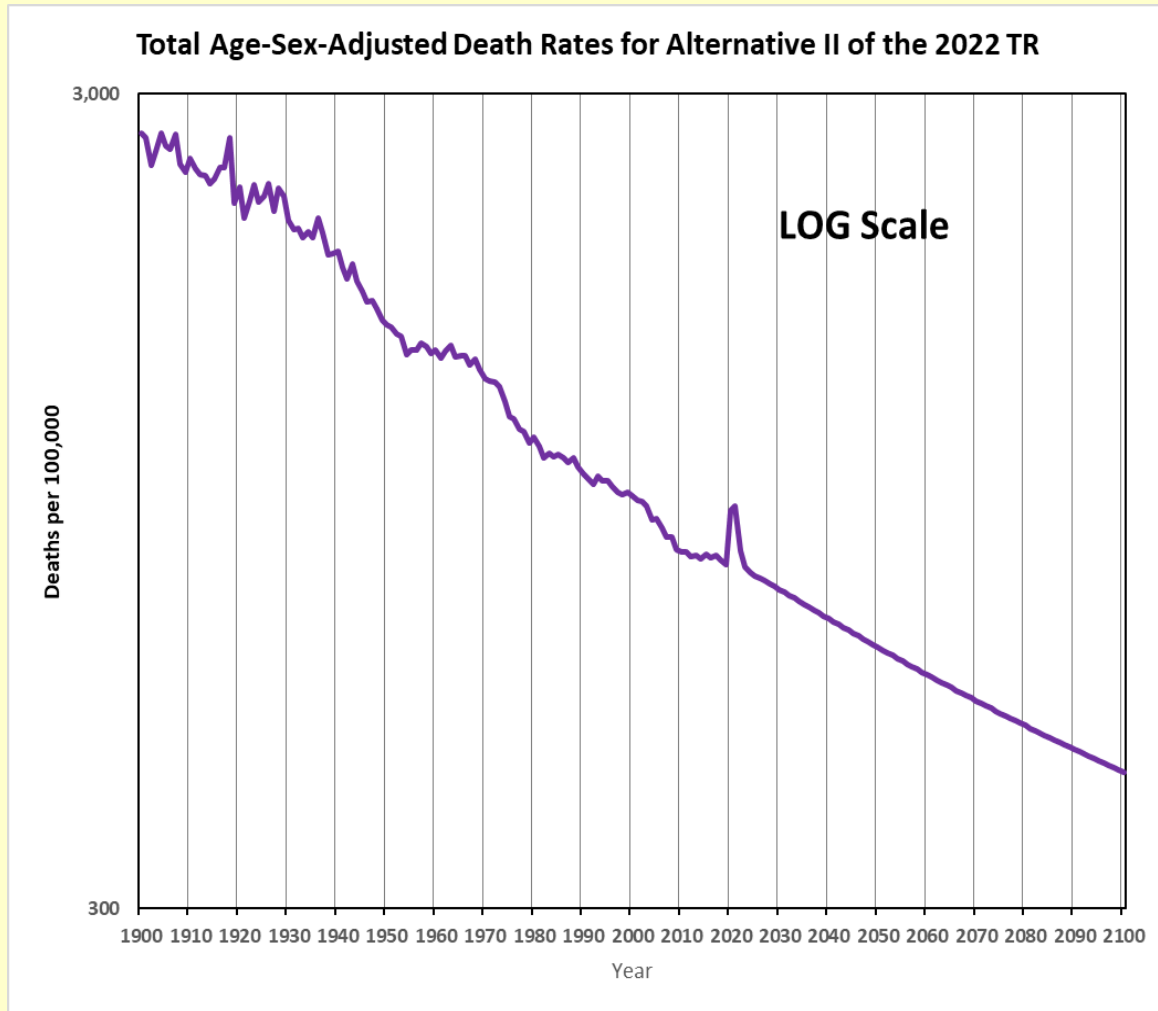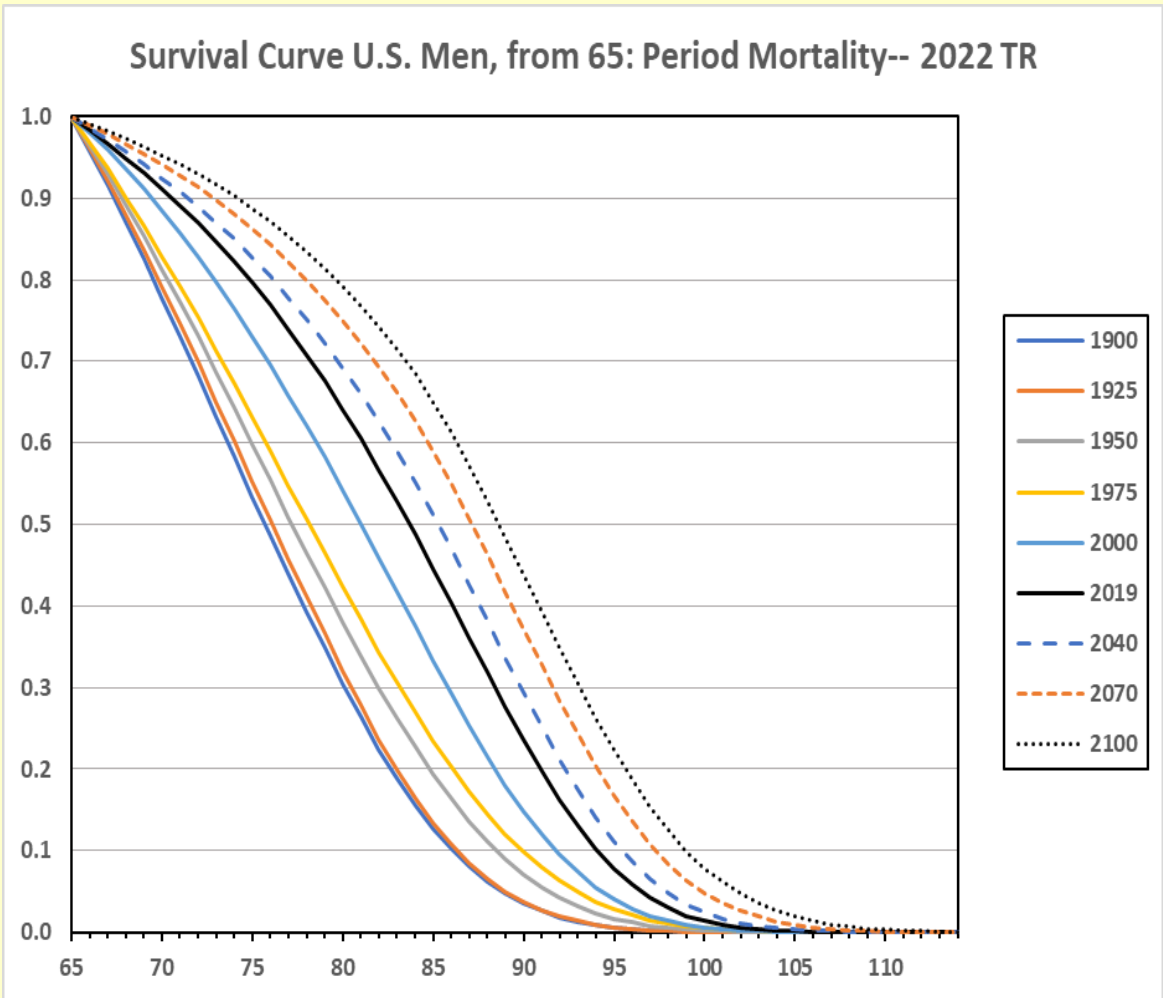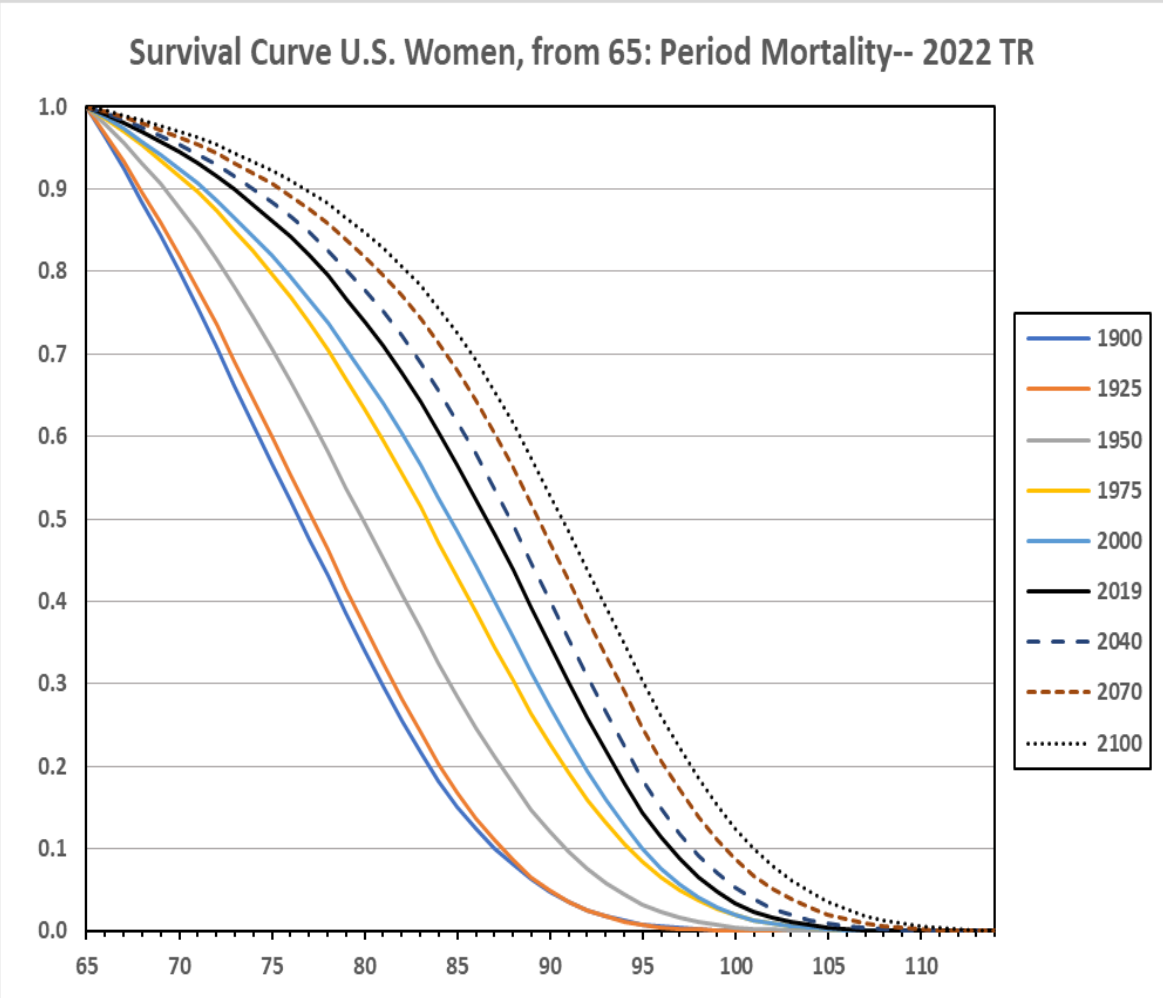
Is There an Omega?

We have been rectangularizing the survival curve; few have actually lived beyond 100
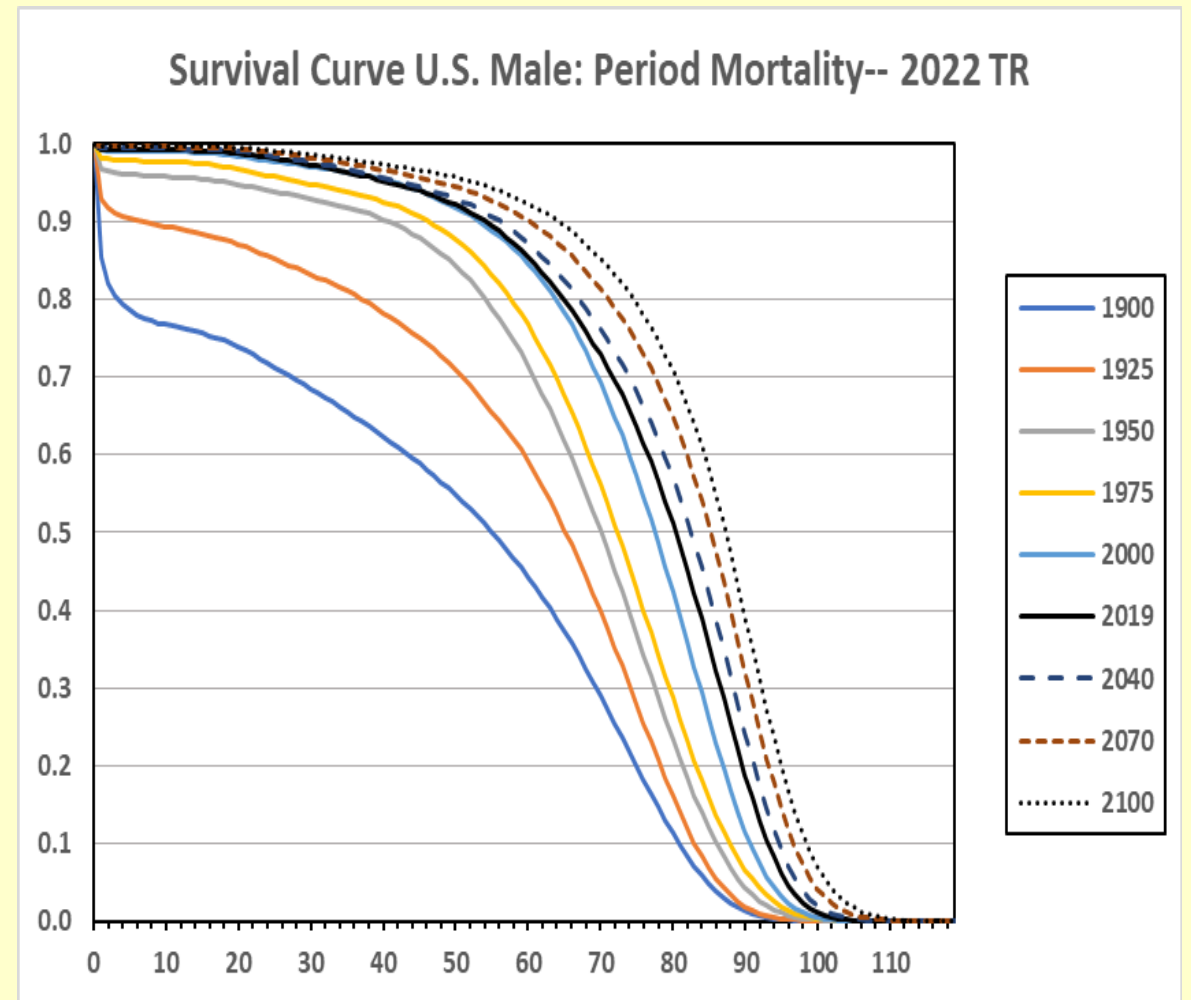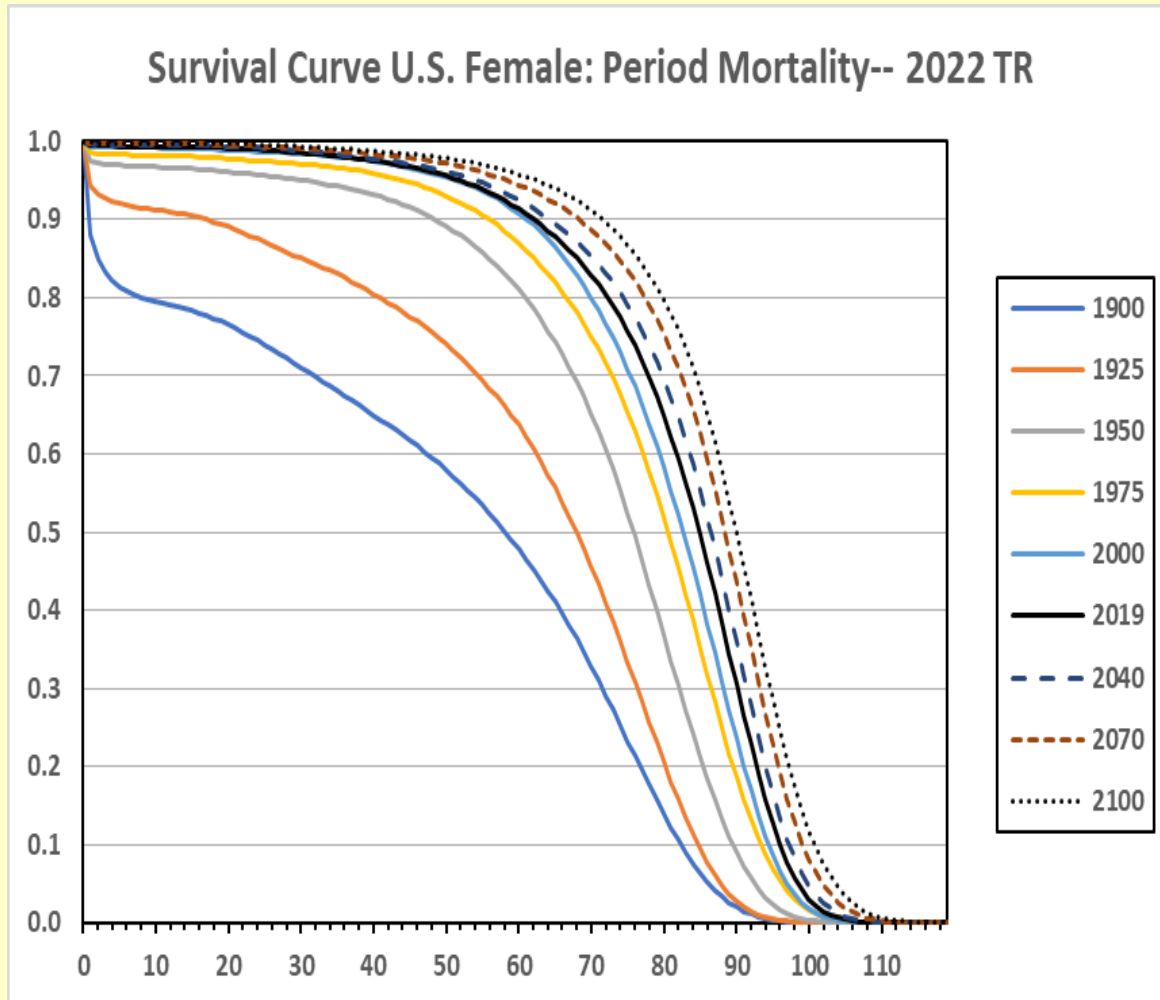
# More Important for Most Annuities is Survival after 65

Are we being overly optimistic in the percent who will survive from 65 to over 100?

Survival Curve U.S. Women, from 65: Period Mortality-- 2022 TR

Survival Curve U.S. Men, from 65: Period Mortality-- 2022 TR

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

- ☐ Must understand past and future conditions
  - – Persistent historical "age gradient", lower improvement at high ages
  - – 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 scientific basis for assumptions
  - – Results: in the 1982 TR, we projected LE65 for 2015 to be 19.1; actual turned out to be 19.1

Ultimately, the Changing Age Distribution of the Population is the Main Factor for Financing Social Security and Retirement in General

Age Distribution of the Population Age 25+, 1940 to 2100 (2022 TR)
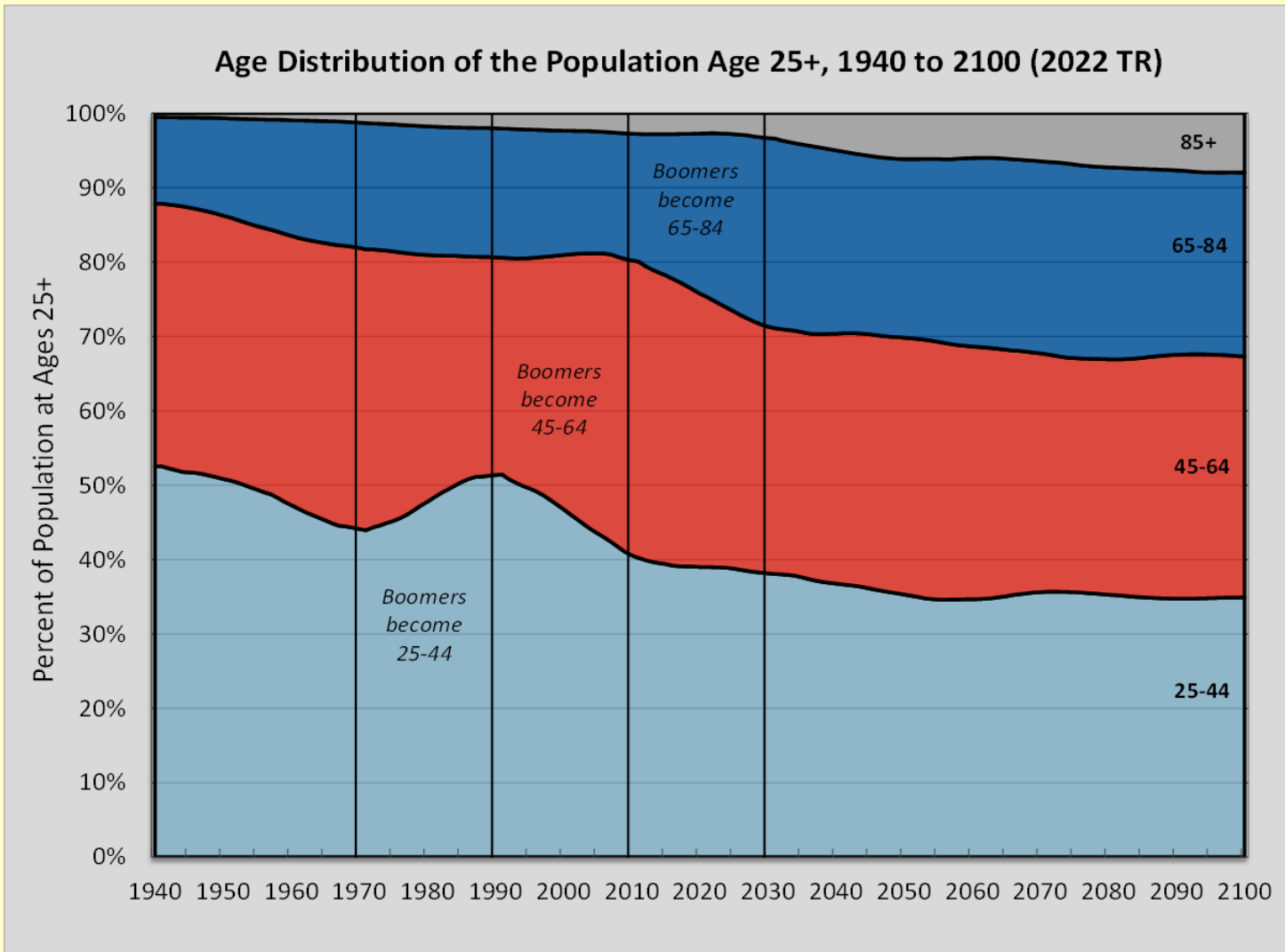
Whether your retirement is financed through "advance funding" or "pay-as-you go financing," it will be the current working population that will both:
(1) produce the goods and services needed for all, and
(2) maintain the value of investments held by all for their own current or future retirement.

38

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

- Documentation of Trustees Report data & assumptions
  https://www.ssa.gov/oact/TR/2022/2022_Long-Range_Demographic_Assumptions.pdf

- 2022 SOA ImpACT Conference, panel 13A with leading demographers
  https://www.ssa.gov/oact/presentations/scgoss_20221027.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