

# The Epidemiological Transition

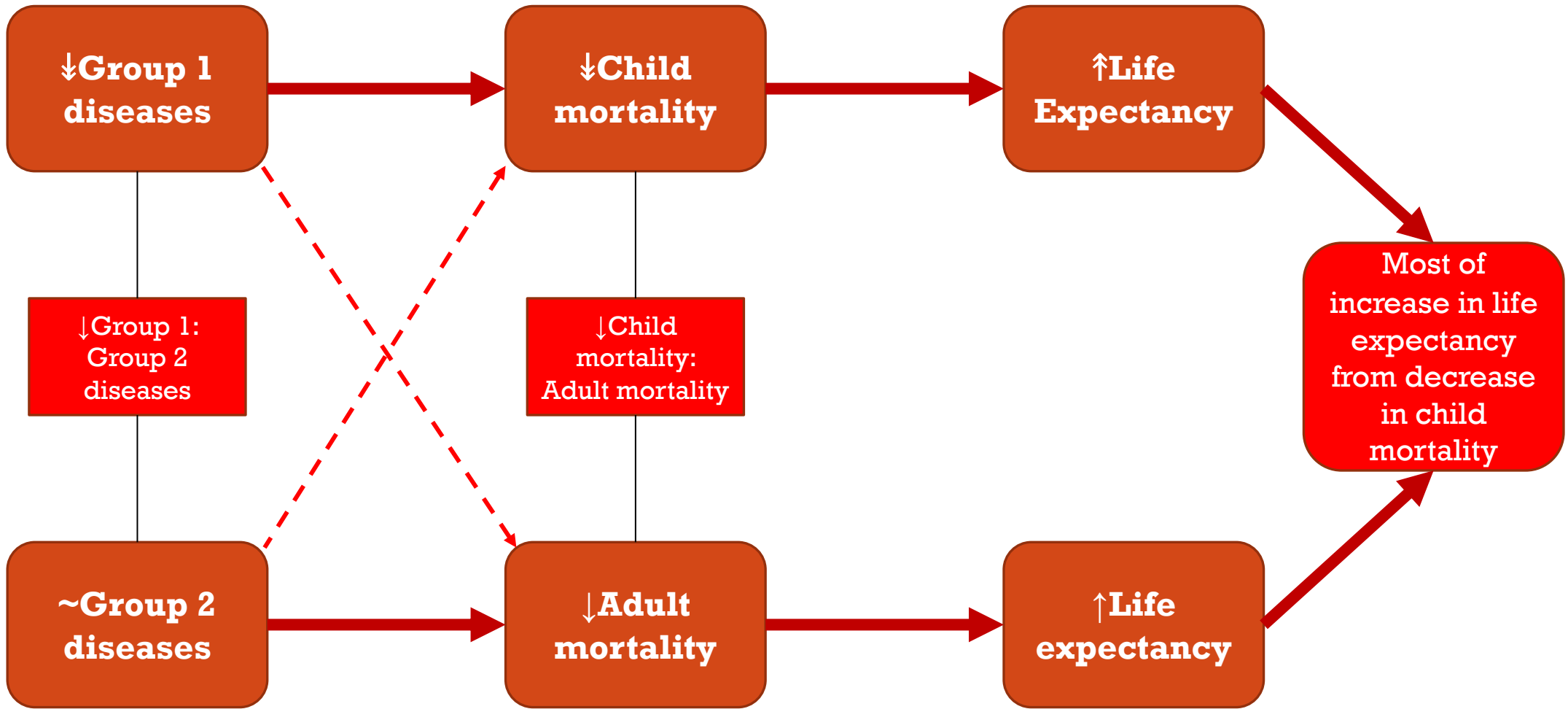
Jordan Klein

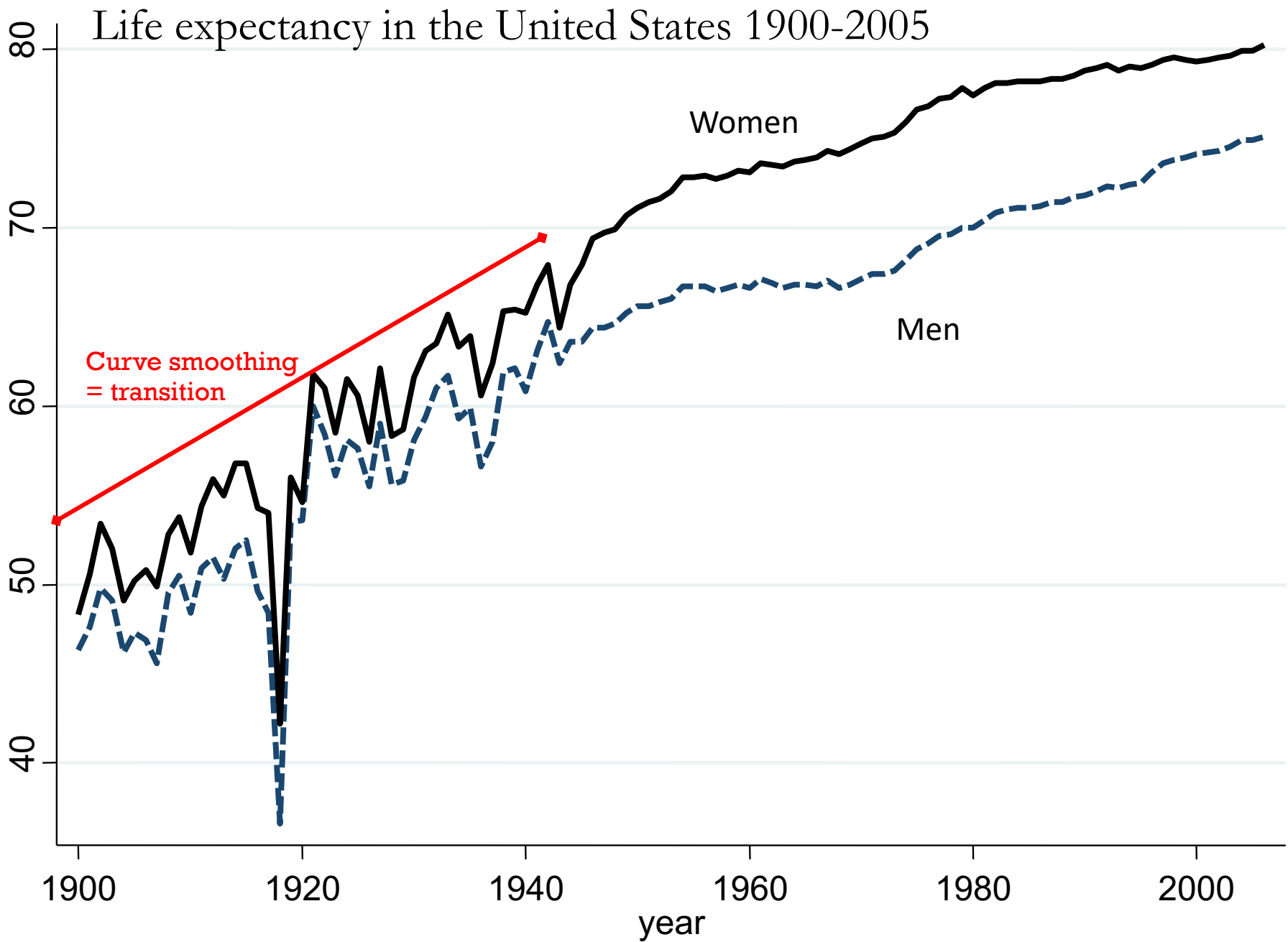
# What is the Epidemiological Transition?

- **Component of the Demographic Transition**
- **Elements**
  1. Reduction in mortality rates/increase in Life Expectancy
  2. Reduction in child mortality
    - Child mortality > old age mortality ->*
    - child mortality < old age mortality*
  3. Shifts in disease burden:
    - Group 1 diseases -> group 2 diseases*
- **Still in progress in the developing world**

\*Group 1 diseases = **Infectious**, maternal, neonatal, & nutritional

\*Group 2 diseases = Non-communicable diseases (NCDs)





Sources: Case 2019, Deaton 2013

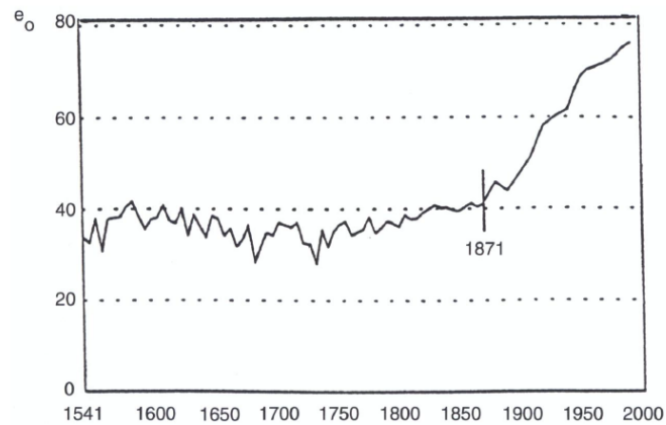


Figure 2. *Life expectancy in England and Wales since the sixteenth century.*

Source: 1541–1871, Wrigley and Schofield (1981, p. 230); 1871 to 1945–47, Keyfitz and Flieger (1968, pp. 36–9); 1950–55 to 1990–95, United Nations (1995).

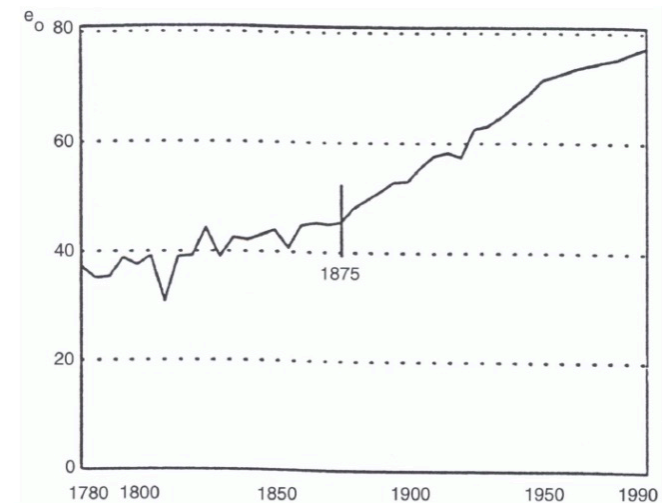


Figure 3. *Life expectancy in Sweden since 1778–82.*

Source: 1778–82 to 1948–52, Keyfitz and Flieger (1968, p. 36); 1950–55 to 1985–90, United Nations (1995).

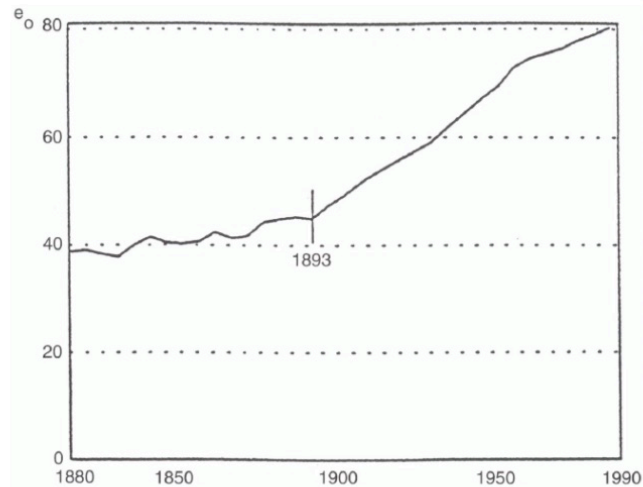


Figure 4. *Female life expectancy in France since 1816–20.*

Source: 1816–20 to 1901–05, Preston and van de Walle (1978, p. 277); 1908–13 to 1946–49, United Nations (1968, p. 726); 1950–55 to 1985–90, United Nations (1995).

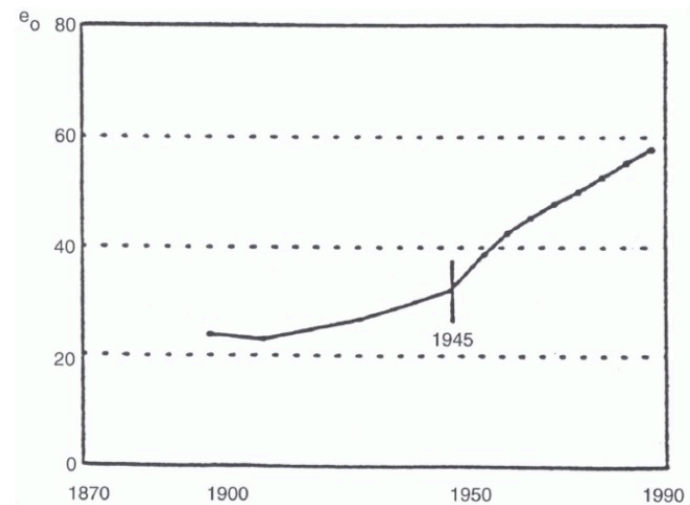
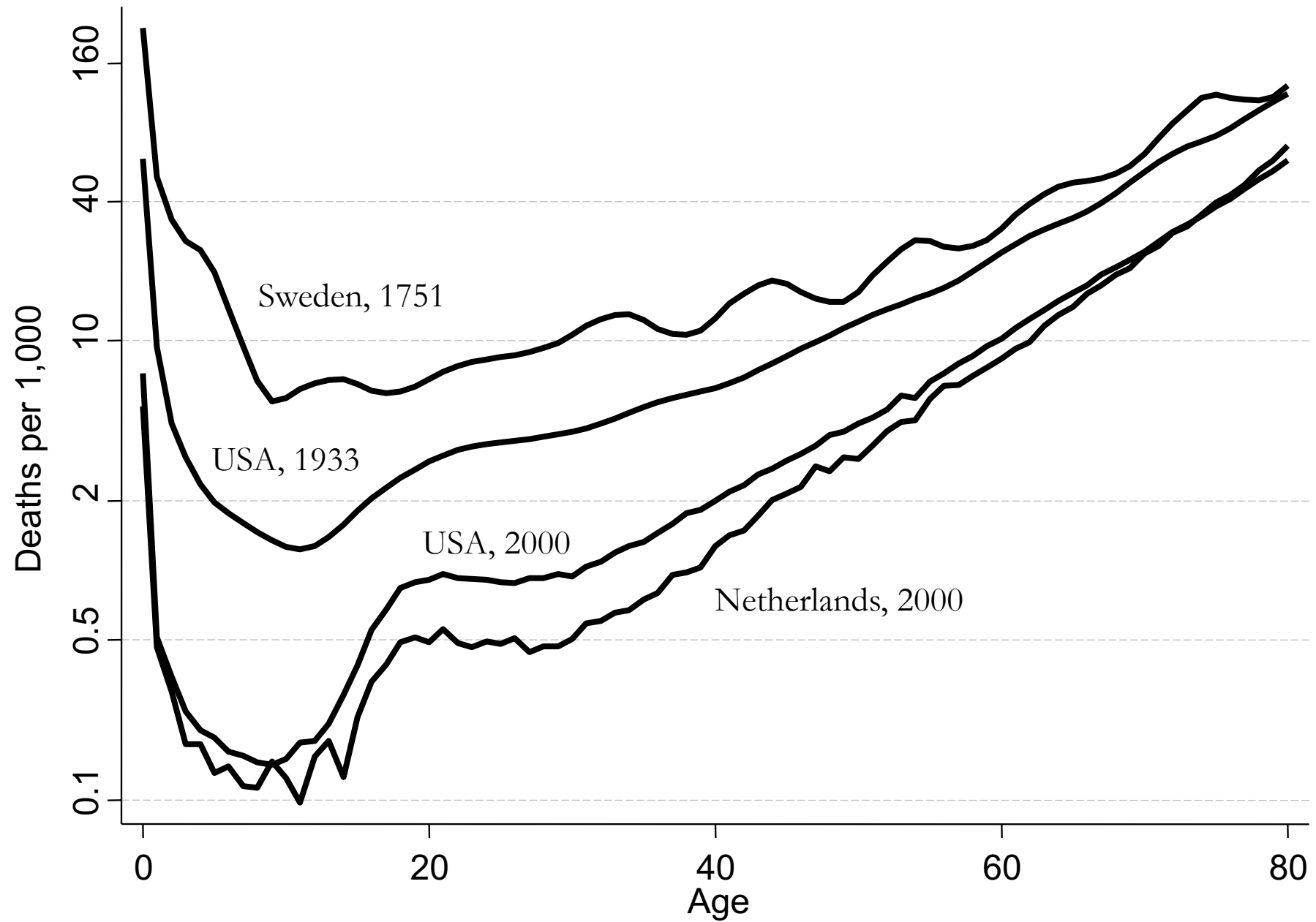
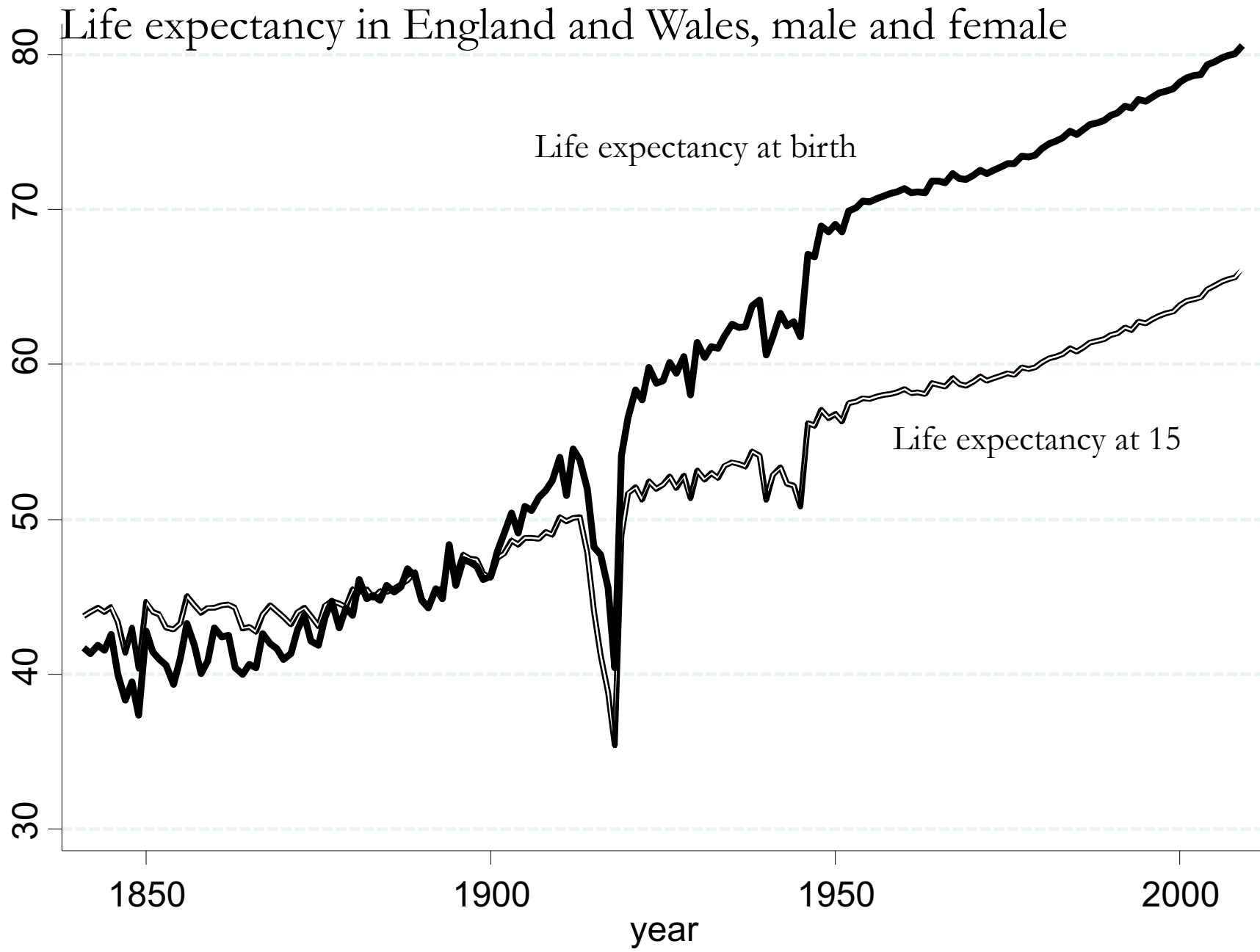


Figure 7. *Life expectancy in India since 1896.*

Source: Easterlin (1996, p. 71).



Sources: Deaton 2013, Case 2019



Sources: Deaton 2013, Case 2019

# Diseases

## INFECTIOUS DISEASES

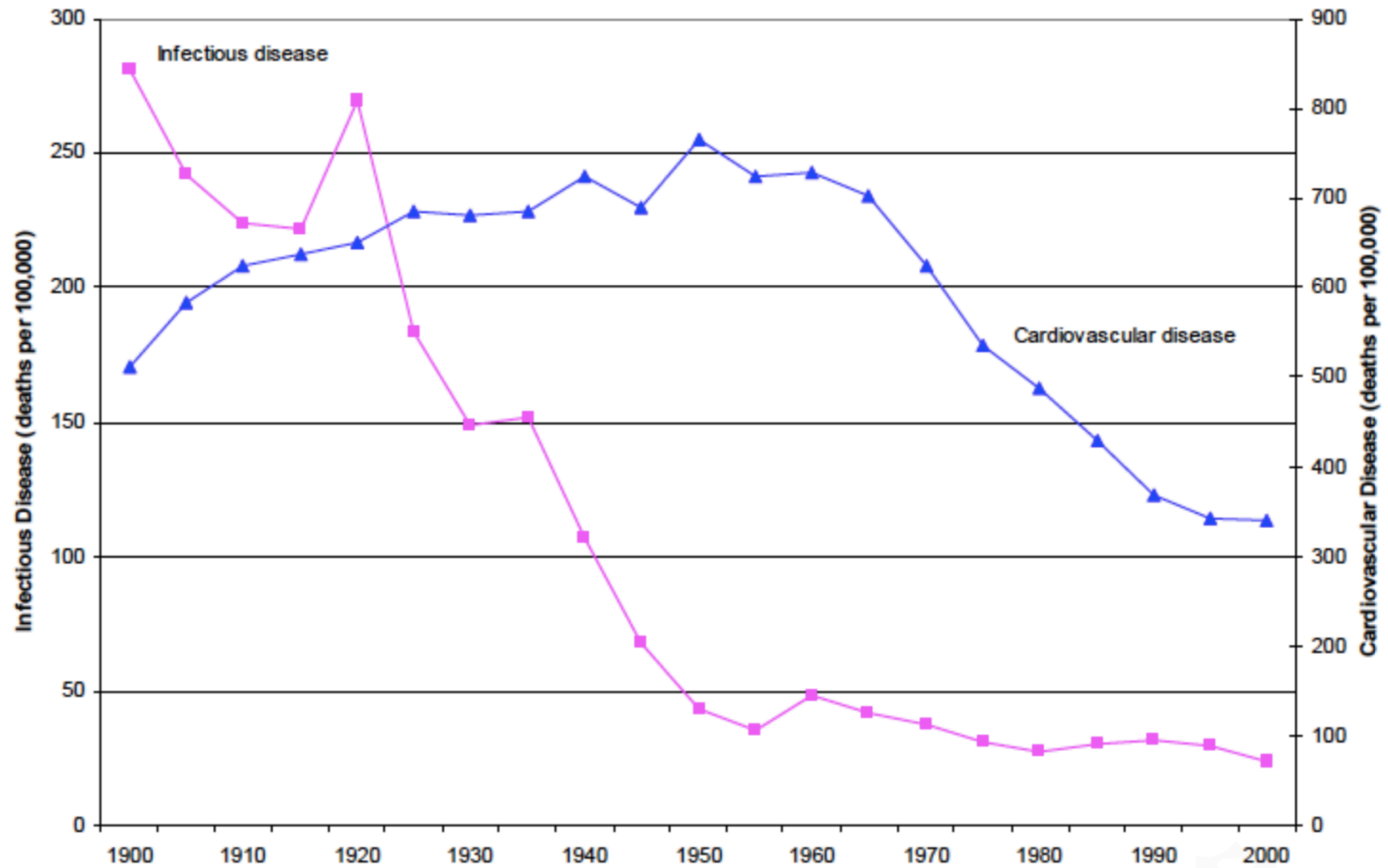
- Transmittable from one person to another
- Highest mortality at younger ages
- Common diseases:
  - Diarrheal diseases
  - Lower respiratory infections (pneumonia)
  - HIV/AIDS, TB, Malaria

## NCDS

- Non-transmittable
- Highest mortality at older ages
- Common diseases:
  - Heart disease
  - Cancers
  - Stroke



Figure 3: Mortality From Infectious Disease and Cardiovascular Disease, US 1900-2000



Source: Laxminarayan 2019



[Healthdata.org](https://healthdata.org)  
(IHME) Global  
Burden of Disease  
(GBD)

## Burden of Disease Visualization

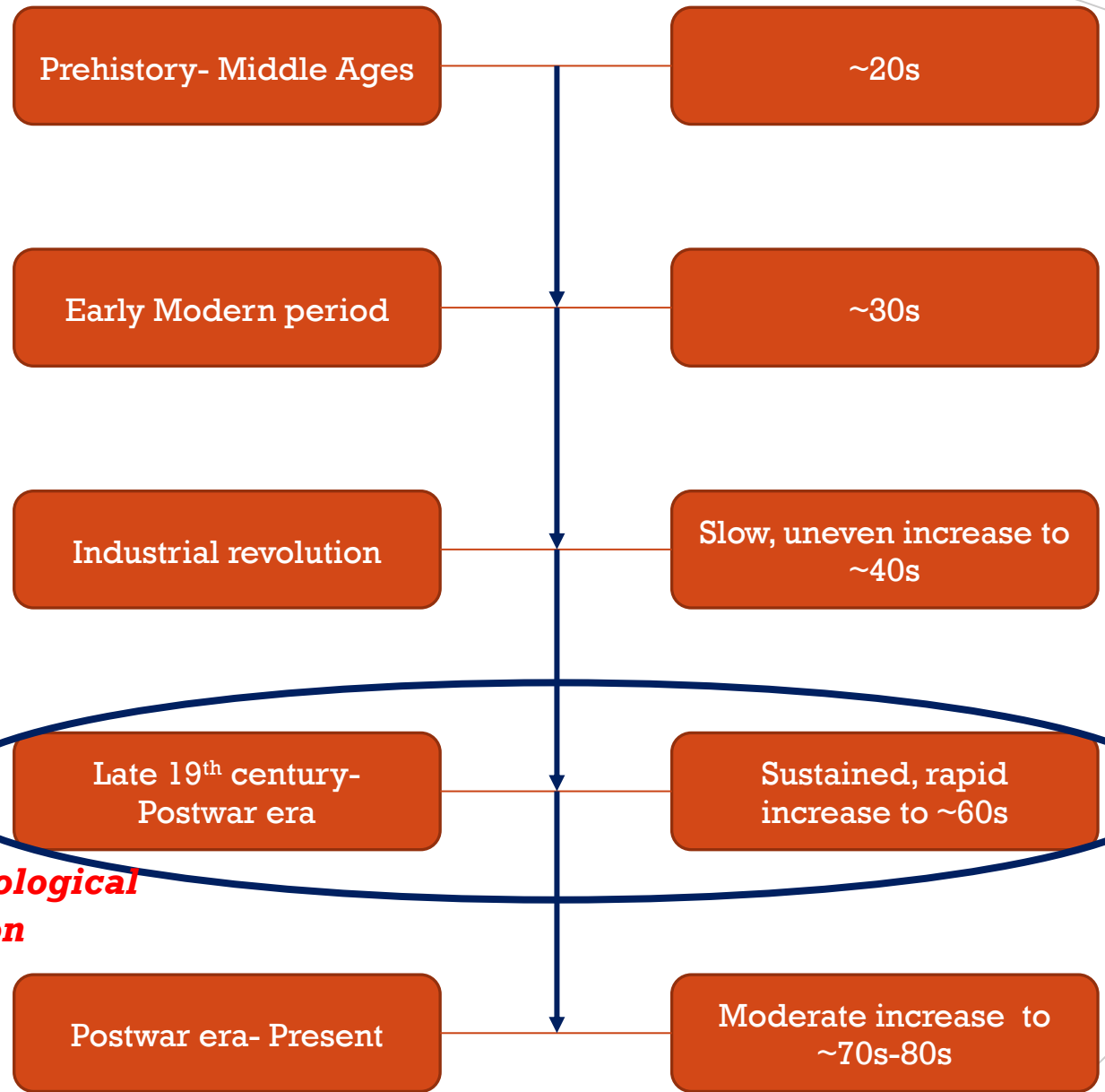
*Map of country classifications*

The background features a series of concentric, overlapping circles in light gray, some solid and some dashed, creating a ripple effect. In the center, there is a large orange callout box with a downward-pointing arrow at its base. The text is centered within this box.

Disease &  
Mortality/Longevity in  
Historical Context

*Timeline of trends in  
life expectancy (Europe  
& offshoots)*

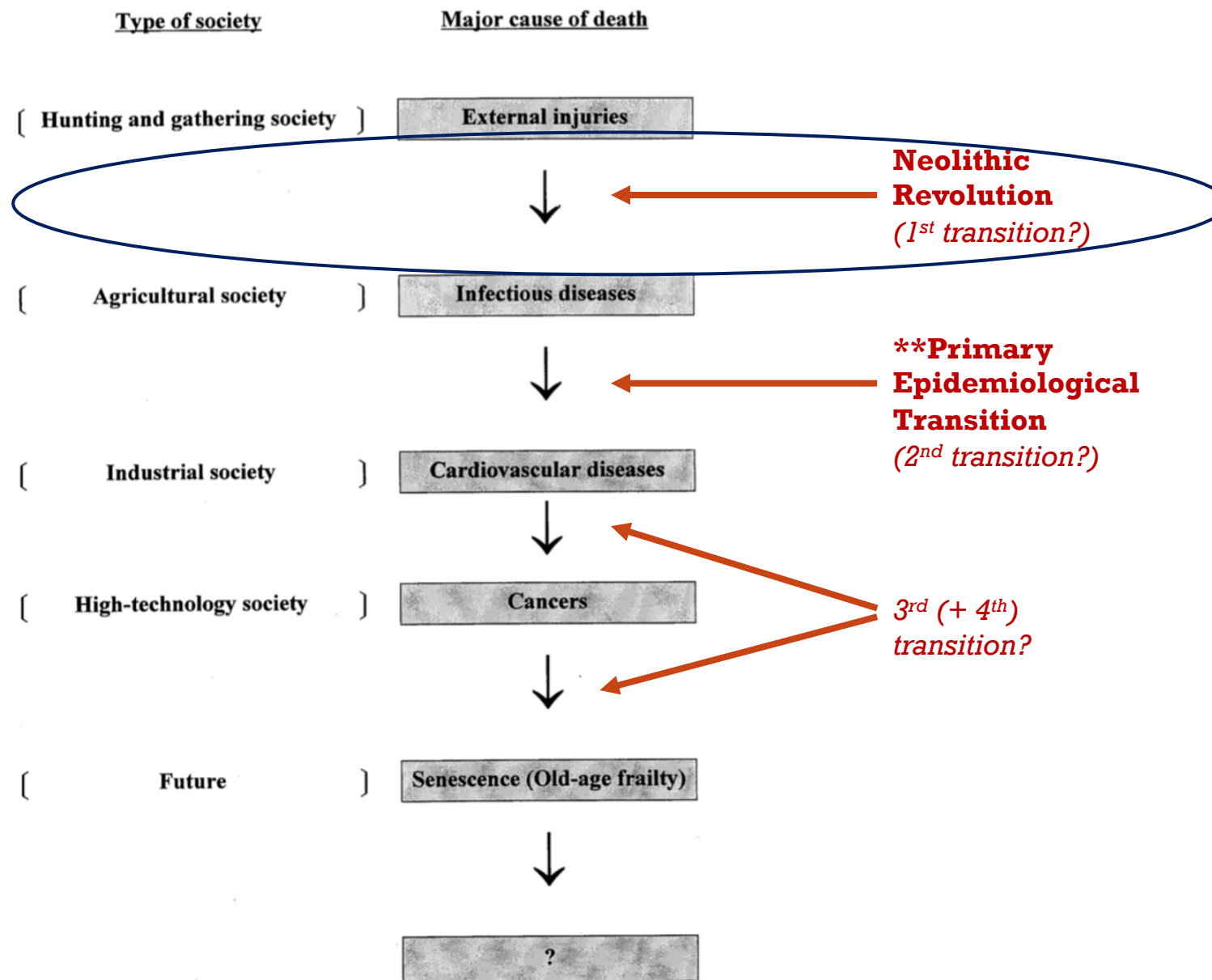
***Epidemiological  
Transition***



**TABLE 1** Estimated Levels of Life Expectancy at Birth and Infant Mortality Throughout Human History

	<b>Life expectancy at birth (in years)</b>	<b>Infant mortality rate (per 1000 live births)</b>
Prehistoric	20–35	200–300
Sweden, 1750s	36	212
India, 1880s	25	230
United States, 1900	48	133
France, 1950	66	51
Japan, 2004	82	3

Figure 1. Epidemiological transitions in the human history



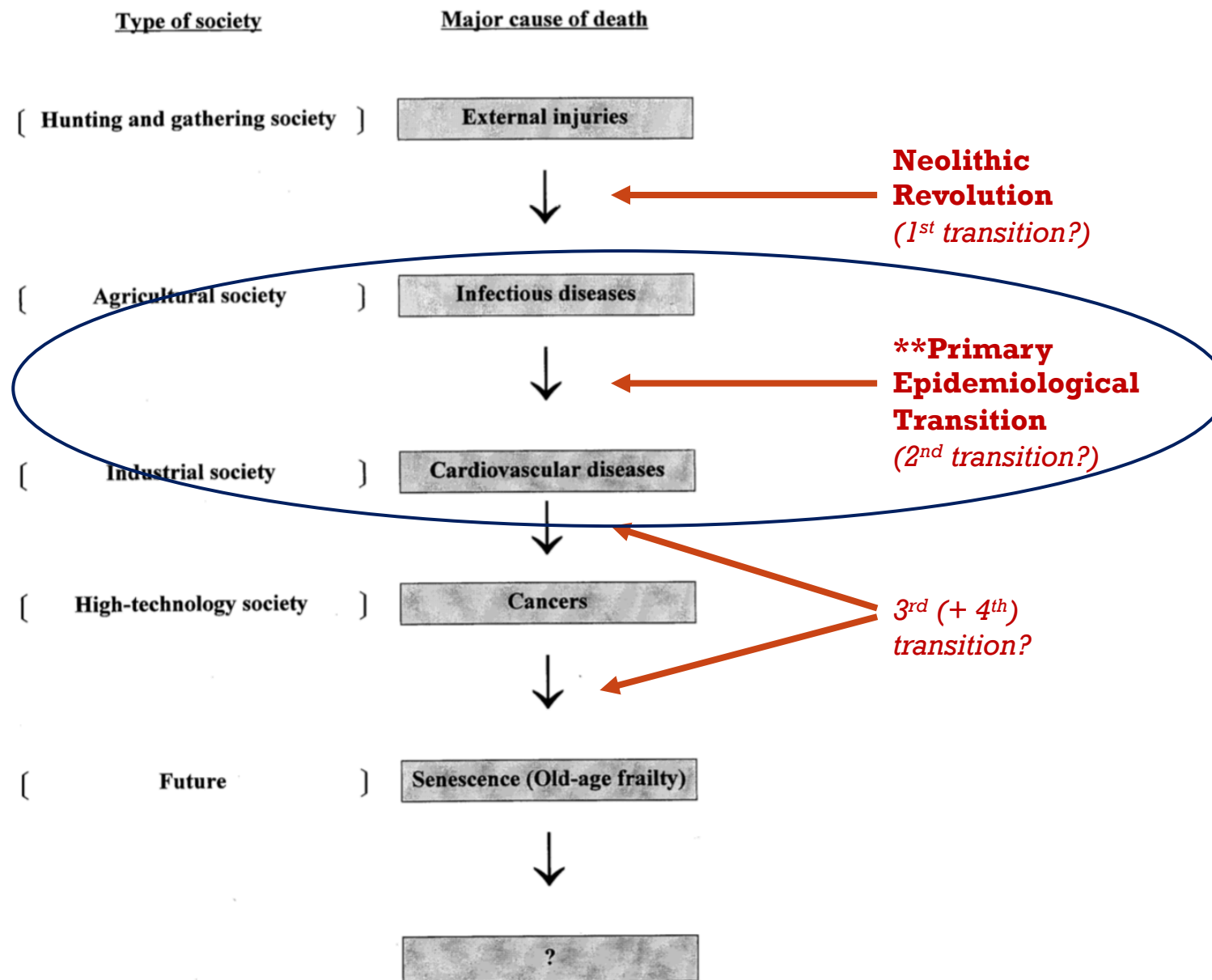
# Neolithic Revolution (1<sup>st</sup> transition?)

**Accidents + Injuries ->**

**Group 1 Diseases**

- *Increase in mortality?*
  - **Emergence of Infectious Disease**
    - Higher population densities
    - Trade networks
    - Animal domestication (zoonosis)
    - Sedentary settlements (fecal-oral transmission)
  - **Nutritional Deficiencies**
    - Monoculture
    - Crop failure/famine

Figure 1. Epidemiological transitions in the human history





# Primary Epidemiological Transition *(2<sup>nd</sup> transition?)*

Group 1 Diseases ->

Group 2 Diseases

## Candidate Catalysts for Epidemiological Transition

*“Revolutions” starting in late  
19<sup>th</sup>/early 20<sup>th</sup> centuries*

- Industrial Revolution (*McKeown Thesis*): improved income, nutrition
  - Modest increase in life expectancy, but “takeoff” occurred afterwards
  - “Reverse transition”: early industrialization + urbanization
- **Sanitary Revolution\*\***
- Medical Revolution: antibiotics
  - Most of increase already happened

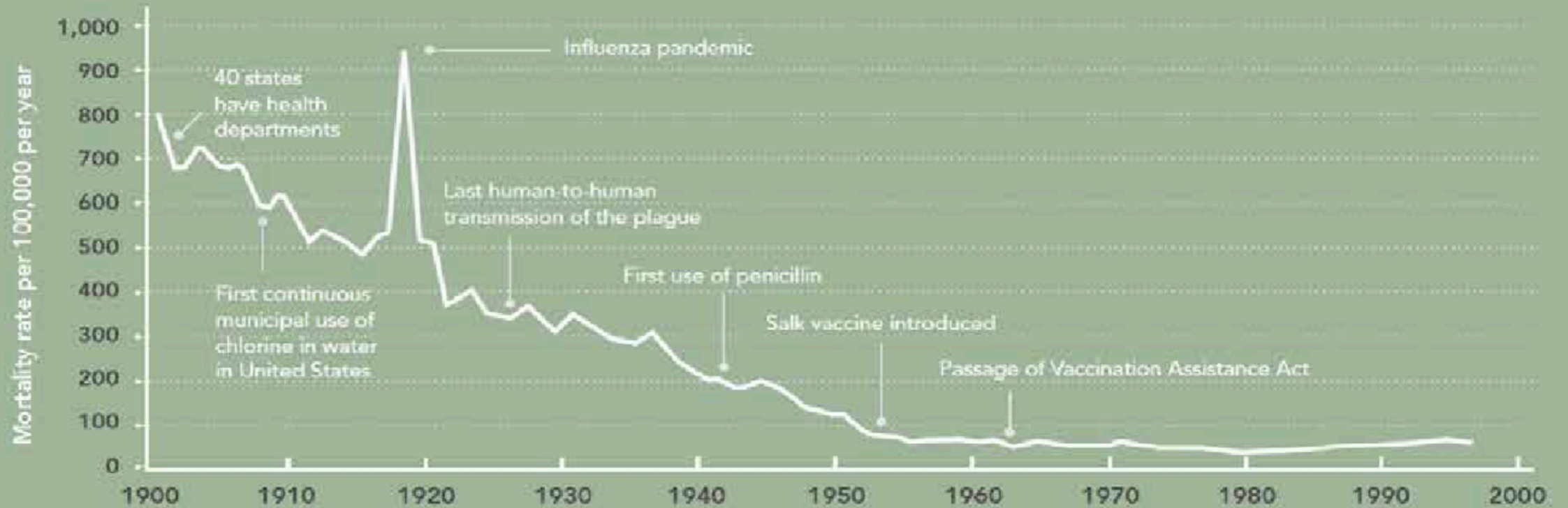
Table 2. *Take-off dates for economic growth and life expectancy in six countries.*

Country	Economic growth	Life expectancy
England and Wales	1783–1830	1871
Sweden	1868–1890	1875
France	1830–1870	1893
Japan	1885–1905	1923
Brazil	1933–1950	1940
India	1952–1963	1945

*Sources:* Figures 2–7 and Rostow (1978).

FIGURE 1.1

### Crude infectious disease mortality rate in the United States, 1900–1996



Source: Adapted from Armstrong, Conn et al. (1999).

Source: Laxminarayan 2019

# McKeown Thesis

- Responsible for Epidemiologic Transition
  - Improvements in broad-based economic & social conditions during **Industrial Revolution**
    - Improved living standards -> improved nutrition
- Not responsible for Epidemiologic Transition
  - Targeted public health (**Sanitary Revolution**) interventions
  - Medical interventions (**Medical Revolution**)

# McKeown Thesis

## Role of Ideology & Refutation

- Ideological belief in shifting the focus of healthcare
  - Curative/“technocratic” oriented medicine -> preventative/”humanistic” medicine
- Selectively interpreted in 70s/80s to support reducing governmental role in health
- Refuted
  - New historical data sources
  - “Improved living standards” during 19<sup>th</sup> century encompassed countervailing forces:
    - Beneficial
      - Social reform & public health movement
    - Detrimental
      - Early industrialization & urbanization
  - Ideological bias against targeted medical intervention & social reform

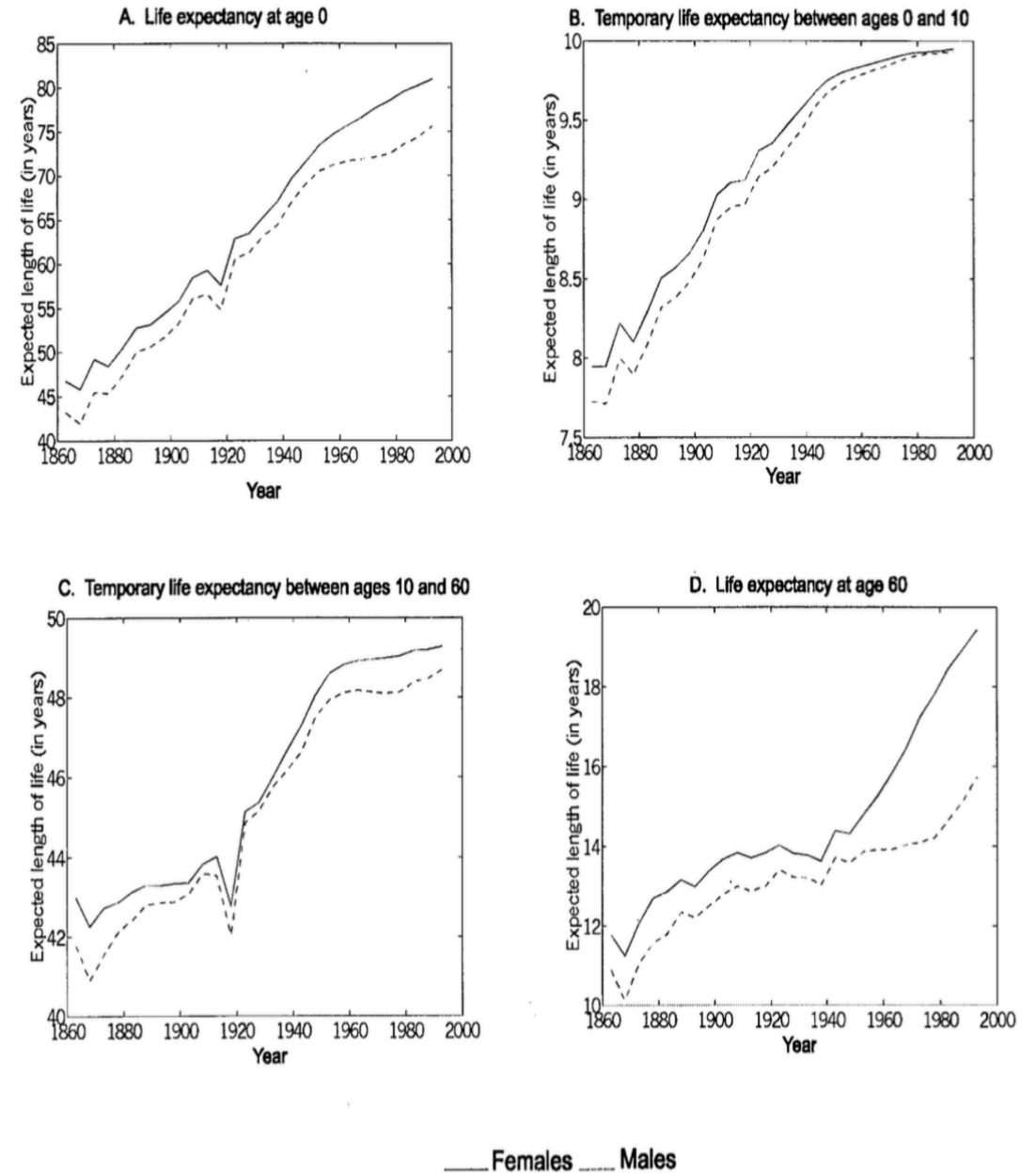
# Sanitary Revolution

- Water treatment
- Sanitation
- Hygiene
- Improved food safety
- Building codes
- Infection control
- Public health departments
  
- **\*\*Instrumental role played by social movement for public health reform & public interventions**

Figure 4. Trends in the expectation of life in Sweden, for five-year periods from 1861-1865 to 1991-1995

## Course of the Transition: concentration of mortality reduction

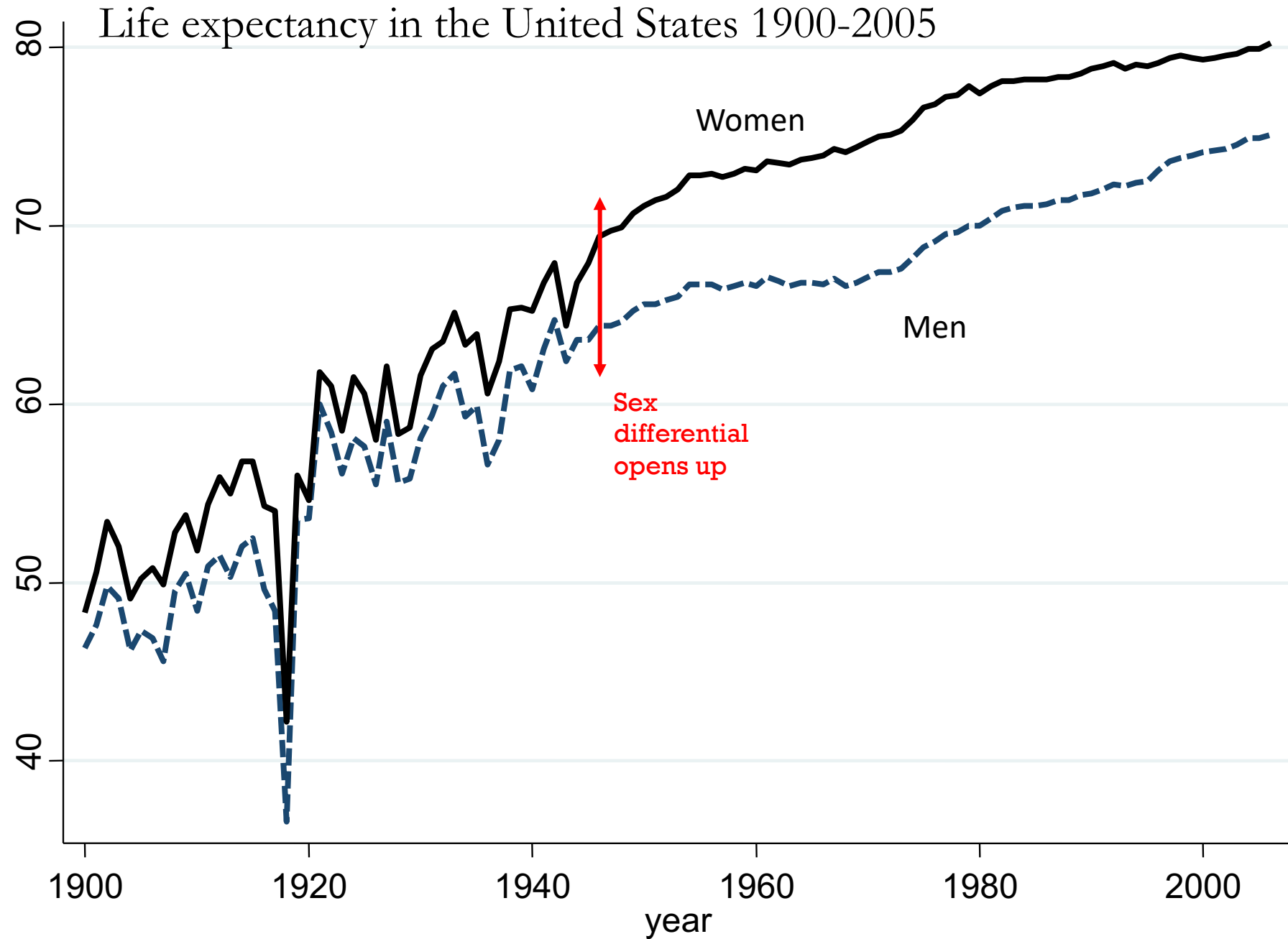
- Beginning: Children
- Later: Young Adults





***Sex differential opens as transition ends***

- *Maternal mortality decreases*
- *Men higher behavioral risk factors for CVD & cancer*



# Preston Curve

- At a *fixed* moment in time, increase in income associated with increase in life expectancy
  - Magnitude of association between income & life expectancy decreases as income rises- *diminishing returns*
- Curve “shifting up” over time
  - Higher- greater life expectancy at given income
  - Steeper- increases in income @ lower levels associated with greater increase in life expectancy
- Increase in world life expectancy over time attributable to “shifts in the curve” more than increases in income
  - “Exogenous factors”
    - Difficult to identify
    - Diffusion of greater stock of health technology in the world?

# Preston curve over time

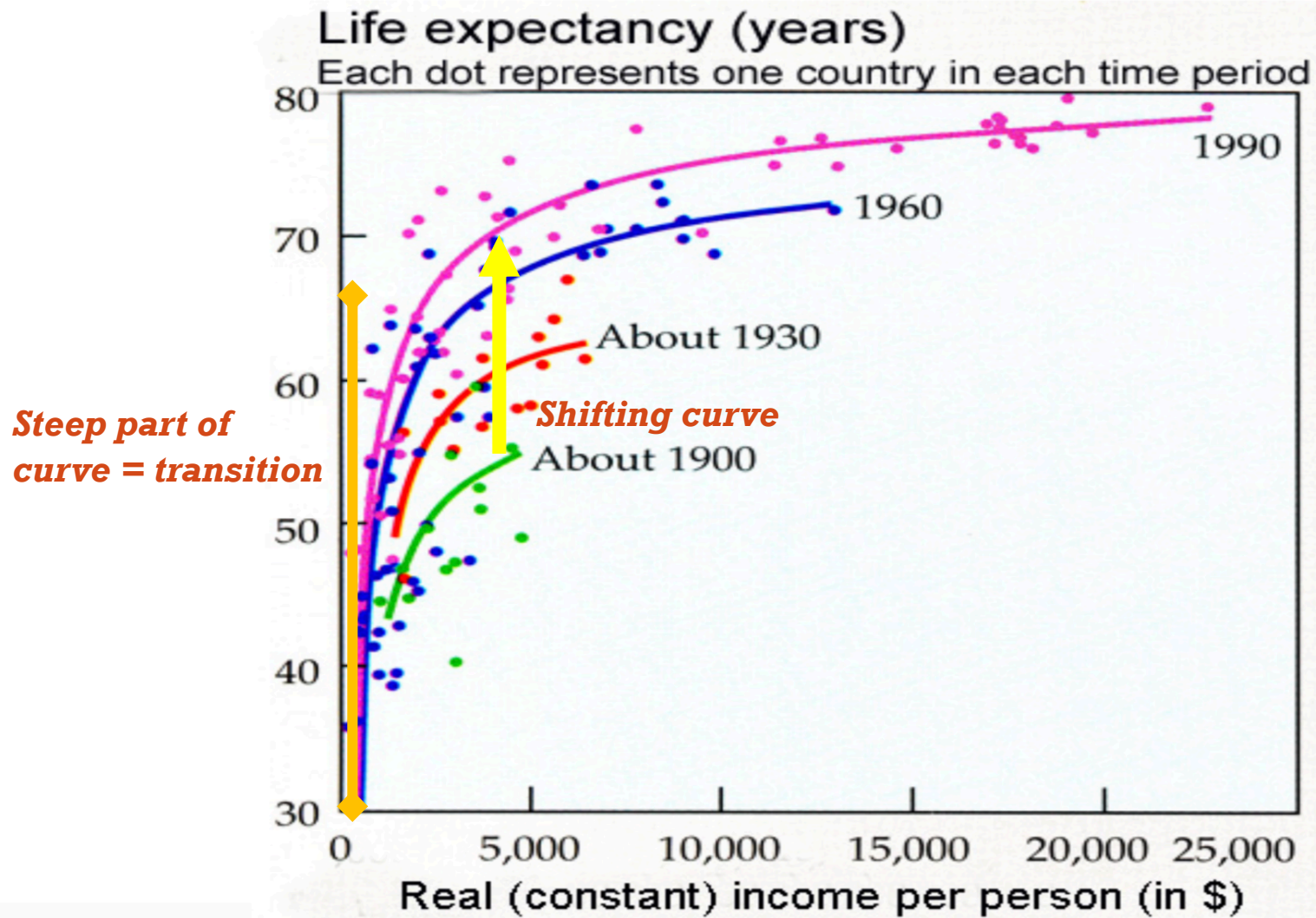
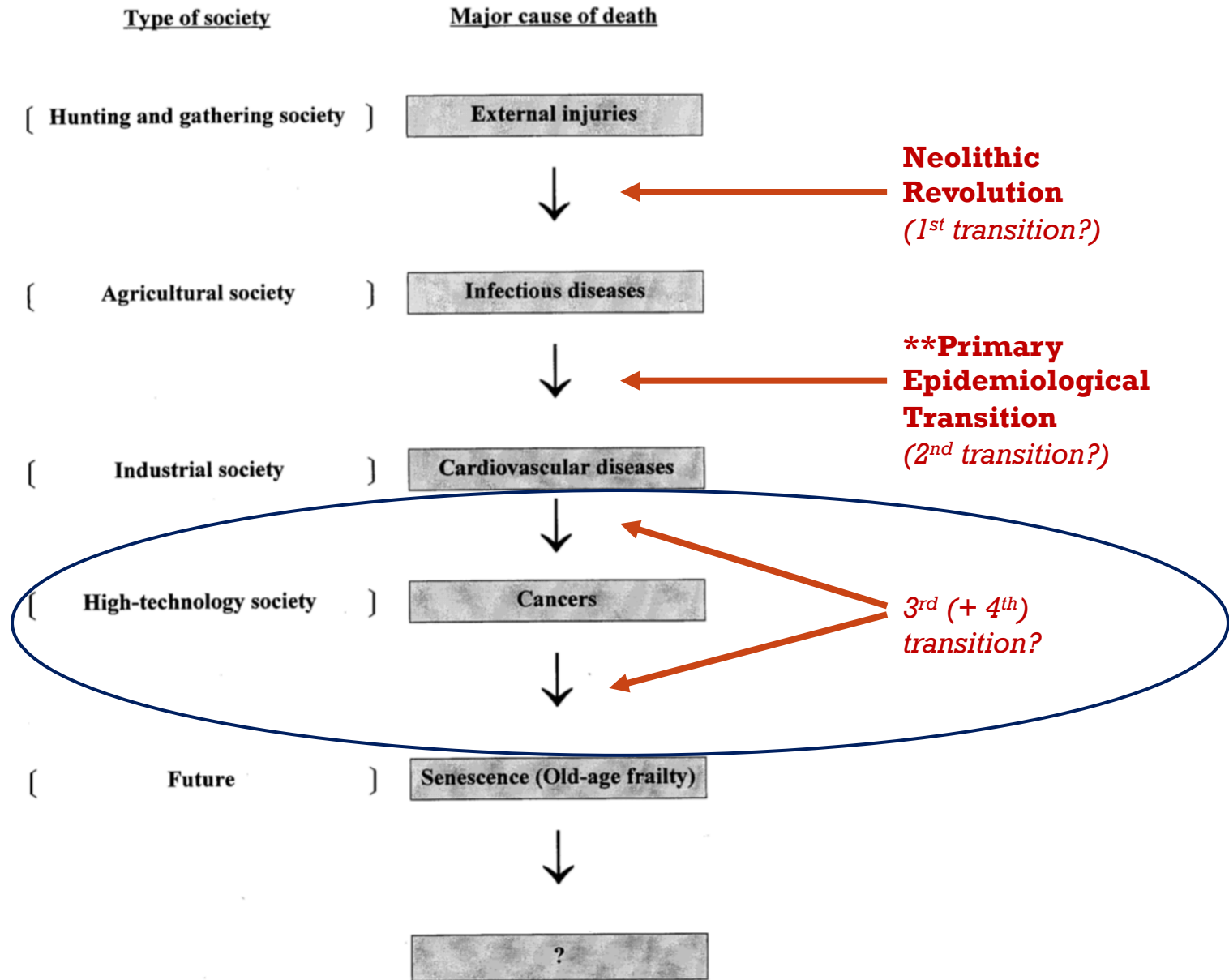


Figure 1. Epidemiological transitions in the human history



## *3<sup>rd</sup> (+ 4<sup>th</sup>) transition?*

Group 2 Disease Mortality  
Reduction

- Reduced mortality in the elderly
- Date(s) of onset in developed world: CVD ~60s, cancer ~90s
- Contributing factors
  - Behavioral
    - Reduction in smoking prevalence
    - Dietary shifts
  - Medical innovations
    - Drugs: Statins, HBP medication, oncology
    - Identification of infectious agents
    - Improved diagnostics/surgery
- “Reverse transition”
  - Obesity

**TABLE 3** Summary of Major Trends in Human Longevity  
in Industrialized Countries

	<b>Before 1960</b>	<b>After 1970</b>
Average life span (life expectancy at birth)	Increasing rapidly because most averted deaths are among younger people. Very rapid reduction in infant/ child mortality linked mostly to effective control of infectious diseases	Increasing moderately because most averted deaths are among older people. Accelerated reduction in old-age mortality linked mostly to better management of cardiovascular disease
Maximum life span (observed and verified maximum age at death)	Increasing slowly mostly due to gradual reductions in death rates at older ages. (Size of birth cohorts and improved survival at younger ages matter much less)	Increasing moderately due almost entirely to accelerated reduction in death rates at older ages
Variability of life span (standard deviation, interquartile range, etc.)	Decreasing rapidly due to reductions in mortality at younger ages	Stable because death rates at older ages are decreasing as rapidly as at younger ages

The background features a series of concentric, overlapping circles in light gray, some solid and some dashed, creating a ripple effect. In the center, there is a large orange callout box with a downward-pointing arrow at its base. The text "Contemporary Trends" is centered within this box in white.

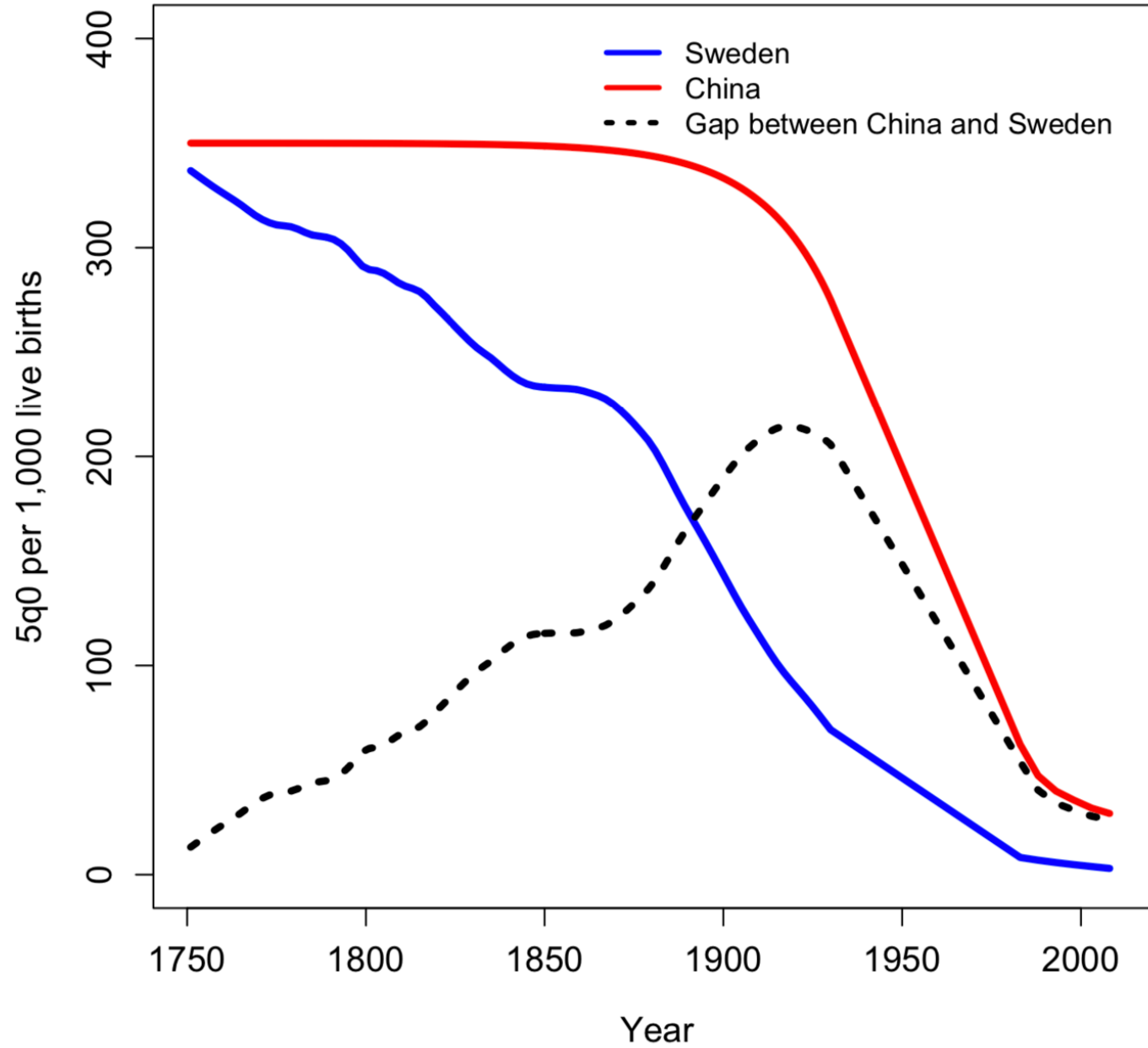
# Contemporary Trends

# “Grand Convergence”

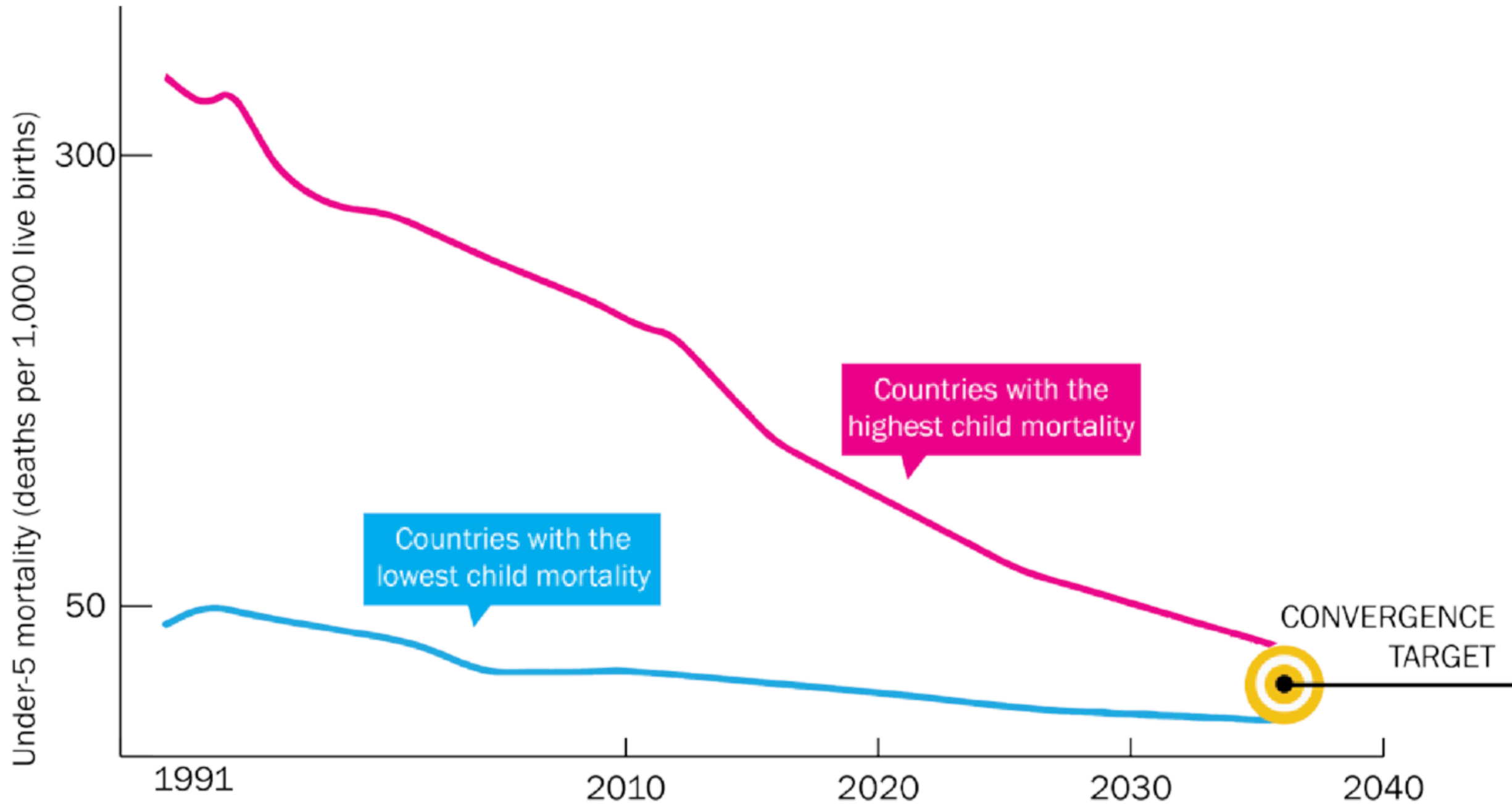
- Developing countries still going through epidemiological transition
- Preston Curve: Poor countries “catch up” more quickly over time
- Countries going through multiple transitions at a time: 2<sup>nd</sup>, 3<sup>rd</sup> (+ 4<sup>th</sup>)
- Will we see convergence in life expectancy, child mortality, & disease burden within a generation?



# Under-five mortality, China and Sweden, 1751-2008



Source: Laxminarayan 2019



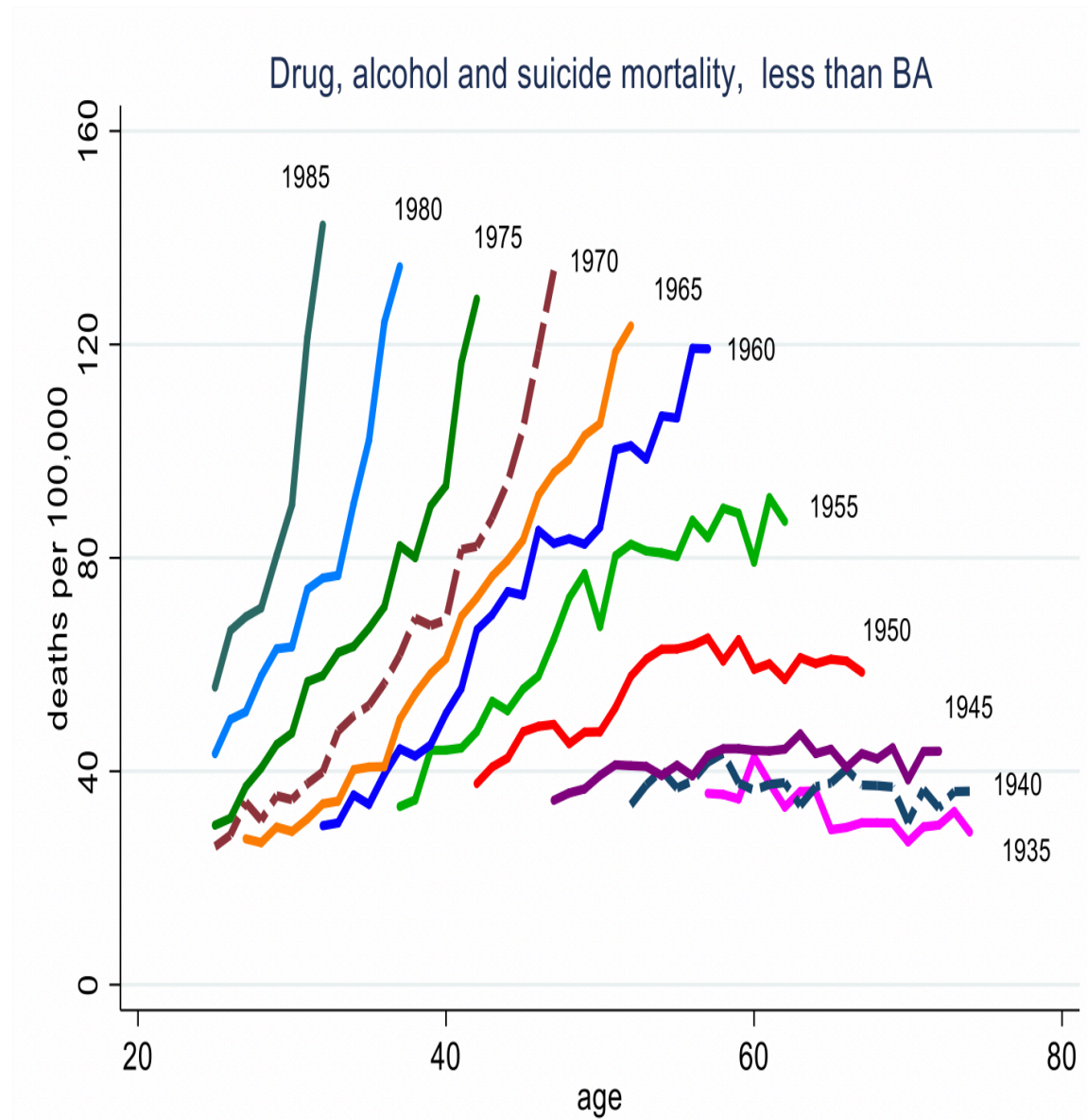
Source: Laxminarayan 2019

# “Reverse Transitions”

- Antimicrobial Resistance (CDDEP)
- Environmental Degradation/Climate Change (Lancet)
- Social Alienation- “Deaths of Despair” (Case and Deaton 2015)

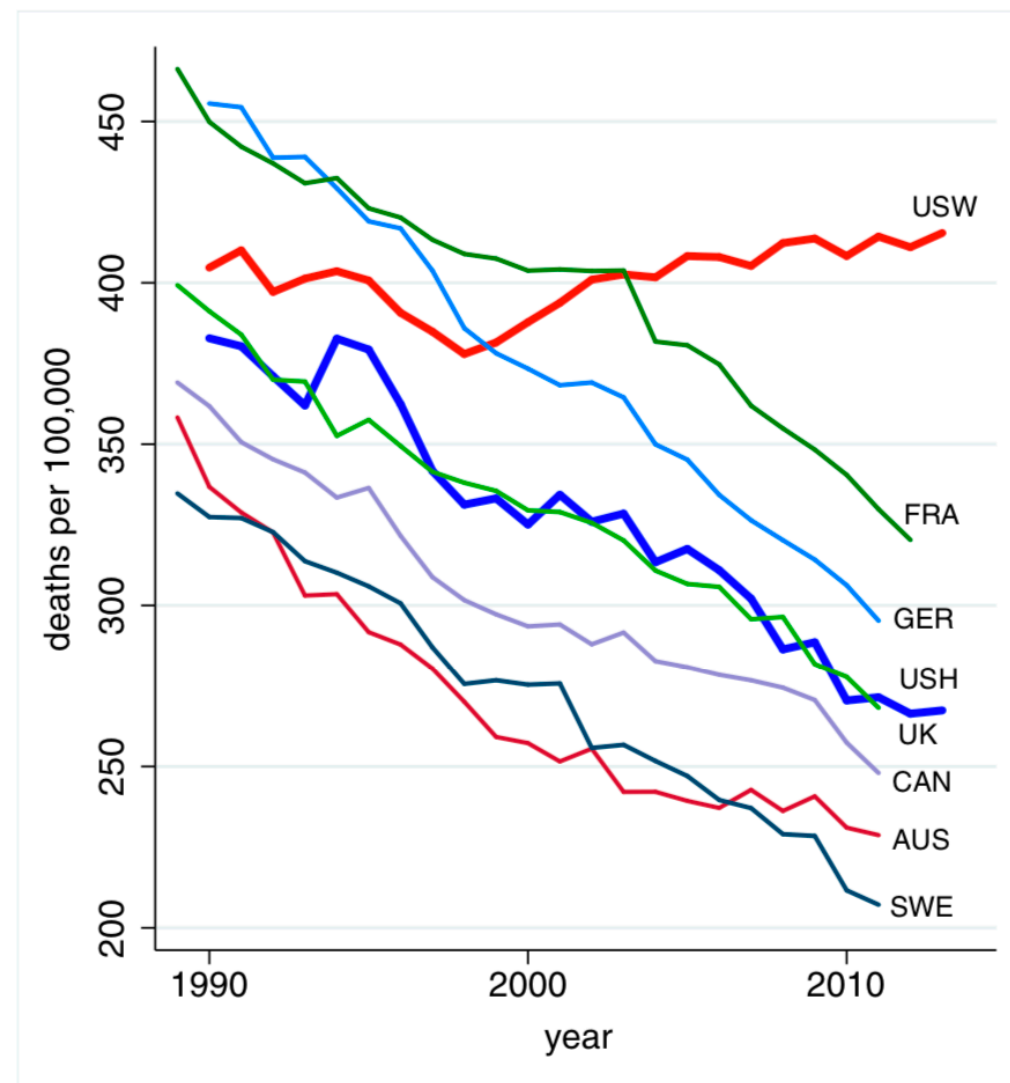
# Drug, alcohol and suicide mortality, white non-Hispanics by birth cohort

## “Deaths of Despair”




Source: Case and Deaton 2015

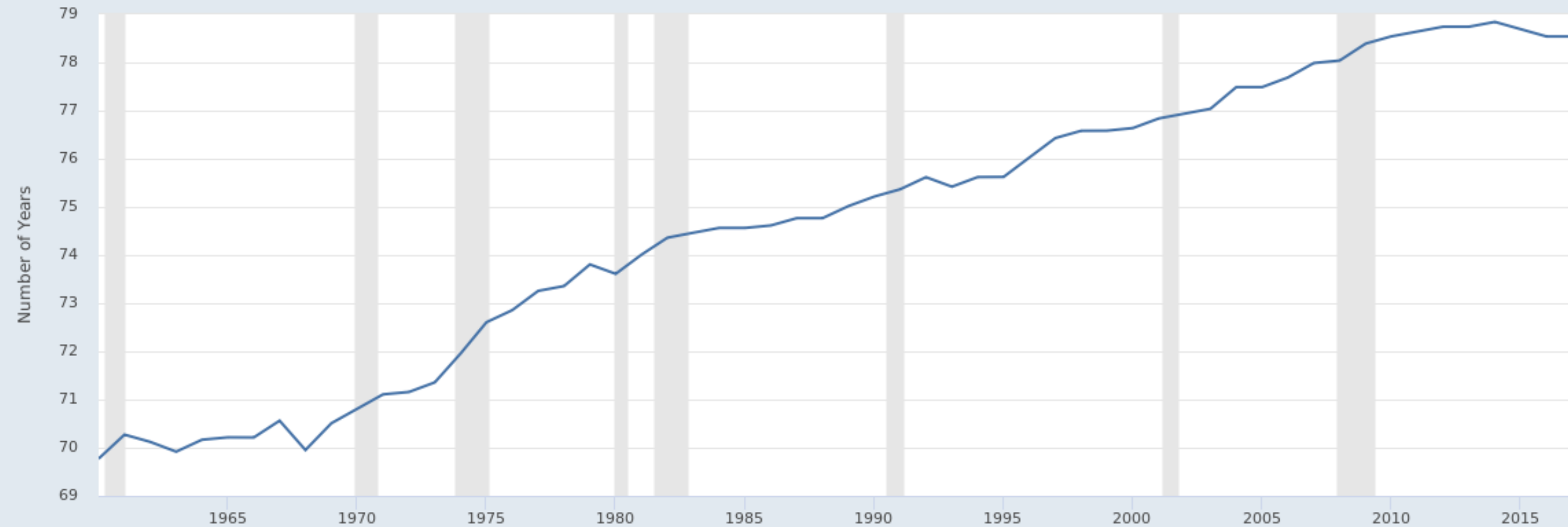
## “Deaths of Despair”



**Fig. 1.** All-cause mortality, ages 45–54 for US White non-Hispanics (USW), US Hispanics (USH), and six comparison countries: France (FRA), Germany (GER), the United Kingdom (UK), Canada (CAN), Australia (AUS), and Sweden (SWE).

# “Deaths of Despair”

**FRED**  — Life Expectancy at Birth, Total for the United States



*Shaded areas indicate U.S. recessions*

Source: World Bank

fred.stlouisfed.org

Source: Federal Reserve 2019

The background features a series of concentric, overlapping circles in light gray, some solid and some dashed, creating a ripple effect. In the center, there is a large orange speech bubble with a pointed bottom. Inside the bubble, the text is centered.

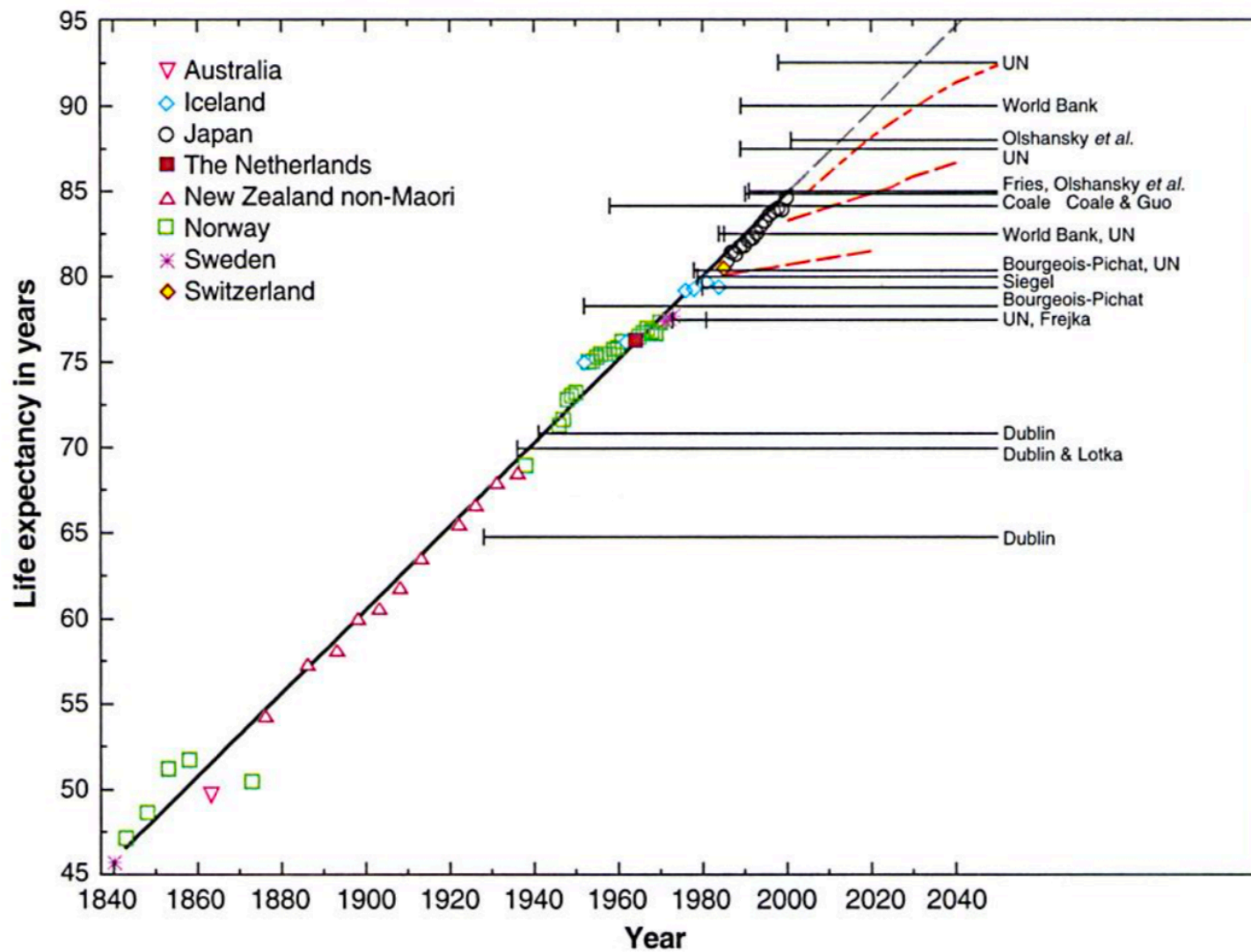
# The Future

Limits to life expectancy?

# Limits to life expectancy?

- **Maximum vs average life expectancy**
- **Maximum life expectancy**
  - Increase in record lifespan has been increasing linearly
  - Past projections of limits of life expectancy have been exceeded
  - Life expectancy increases may slow in individual countries, offset by others catching up & surpassing them
- **Average life expectancy**
  - Rate of increase has slowed as reductions in mortality shift from the young to the old
- **Are extrapolations valid?**
- **Optimism vs pessimism**
  - Technological breakthroughs vs biological determinism





**Fig. 1.** Record female life expectancy from 1840 to the present [suppl. table 2 (1)]. The linear-regression trend is depicted by a bold black line (slope = 0.243) and the extrapolated trend by a dashed gray line. The horizontal black lines show asserted ceilings on life expectancy, with a short vertical line indicating the year of publication (suppl. table 1). The dashed red lines denote projections of female life expectancy in Japan published by the United Nations in 1986, 1999, and 2001 (1): It is encouraging that the U.N. altered its projection so radically between 1999 and 2001.

Source: Oeppen 2002

The background features a series of concentric, overlapping circles in light gray, some solid and some dashed, creating a ripple effect. In the center, there is a large orange callout box with a downward-pointing arrow at its bottom center. Inside this box, the text 'Hans Rosling video' is written in a yellow-green color and is underlined.

Hans Rosling video

The background features several concentric circles in light gray, some solid and some dashed, creating a ripple effect. In the center, there is a large orange speech bubble with a white outline and a downward-pointing tail. Inside the bubble, the text "Thank you!" is written in a large, white, sans-serif font, and "Questions?" is written below it in a smaller, white, sans-serif font.

Thank you!

Questions?