Today’s Objectives

1) Understand conceptually and empirically the historical and regional phases (including causes and timing) of the Epidemiological Transition and its implications for future mortality trends

2) Understand ways in which the epidemiological transition in the developing world is similar and dissimilar to the historical transition
Today’s Objectives continued

3) Understand the role of nutrition in Mortality

4) Consider conditions that foster other factors (political, socio-economic, ecological) to relate to mortality

5) Relate how AIDS is like/unlike other epidemics and its manifold political, social, and economic causes and consequences
1. Introduction to the class, my expectations, syllabus review.

2. The importance of population change and structure.

3. Relate historical and regional evolution of disease and death and morality’s role in population change.

Mortality Histories

"Now this end is called the thagomizer... after the late Thag Simmons."
Pre Agriculture - Very Low Life Expectancy (Eo ~ 25 yrs)

- Low disease transmission
- Low G-I infection
- Low malnutrition and starvation
- Why such low life expectancy?
• Pre Agriculture – Death:
  • Injuries
  • IMR
  • Childbirth-related deaths
Early Agriculture

Settlement permanence

Domesticated animals

From what did people die?
Early Agriculture

Mortality due to:

Human/human, human/animal, and human/pollution disease transmission

Crop failures leading to poor nutrition and starvation
Summary of HG and Agricultural Death & Disease

Hunter-Gatherers “Low Pressure” system w/ low life expectancy and low fertility. Non-communicable diseases, injury etc.

Agriculture “higher pressure” w/ low $E_0$ & higher fertility. Causes of death: nutrition & communicable diseases.
Confluence of Disease Pools

Early civilizations: measles, smallpox, and the plague.

• Rome
• China
• Americas
Smallpox, Measles & Plagues, oh my!
Bubonic Plague 30% loss in Europe 1350-1450
source: ian r.h. rockett. population and health: an introduction to epidemiology. second edition. population reference bureau 54(4); 1999: 9
Epidemiological Transition
Pre-Transition: The Age of Pestilence and Famine
Dawn of Humanity until 1600s

- $E_o = 20-40$ years
- Hunter-Gatherers
- Pre-Agricultural Societies
- Early Civilizations
- Causes of Death Different different.
Epidemiological Transition
Receding Pandemics

- $E_o = 30-50$ years  \(1650s \rightarrow 1800s\)
- Major change = ↓ in frequency and severity of epidemics
- E.g., plague, smallpox, measles, typhus
- Causes: Economic development
  - Quarantines
  - Hygiene
- Big change from Epidemic to Endemic

"Well, there's plague in town, everyone will believe you if you pull a sickie..."
Epidemiological Transition

Receding endemic infectious diseases

(and continued decline in pandemics) 1750s → 1850s

• Improved nutrition. Why?

• Increase in Manufactured goods
  - What was the impact of this?

• Improved understanding of disease transmission.

"That was Pestilence - he's on sick leave."
Epidemiological Transition
late 1800s to 1950

Further decline in all infectious diseases

Impact of Public Health
• clean water
• sanitary sewage
• mosquito suppression (malaria/yellow fever)
• increased food safety – refrigeration and pasteurization
• increased pre & post-natal care

1880s - idea of Germ Theory
Lister & others first disinfectants
• Sulfa drugs & other antibiotics 1930s
• Insecticides 1930s
Epidemiological Transition
The Age of Degenerative and Human-made Diseases
1950s → today

Decline in
• $E_0 = 70+$ How far will it reach?

• Hybristic stage: personal variation.
Figure 3: Causes of Death in New York City (1866-1900) & the United States (1900-1990)

- **Tuberculosis**
- **Communicable Diseases**
- **Cardio-Vascular Diseases**
- **Cancer**
- **Dis. of Early Infancy**
- **Other Causes**
- **Accidents**

**Sources:** Based on data for NYC and national data for USA. See Ref. 30

**Omran**
Figure 1. Life expectancy by race and sex: United States, 1970-96

Models of transition

- **Classical** – western countries
  - Socio-economic and sanitary improvements
  - Not health care improvements

- **Accelerated** – e.g., Japan, S.E. Europe
  - Socio-economic, sanitary and health care improvements

- **Delayed** – developing countries
  - Health care – little socio-economic - improvements
  - Less decline in fertility – population growth

Omran A, 1982
Epidemiologic Transition Models

- **Western/Classical E-T** → radical lowering of mortality 1700s
  - infections lead to degenerative diseases
  - mortality improvements mostly infants & children
  - mortality improvements also more for women than men
  - mortality improvements greater for more privileged portion of pop. – less for disadvantaged

- **Accelerated E-T**: medicine and public health and std of living
  - Japan; Euro-Russia; S.E. Europe
  - ~1900 very rapid improvements
  - overall levels like Classical/Western

- **Delayed E-T**
  - Most of humanity ~75%
  - incomplete = some countries more than others
What’s next?
Quiz #3:

1) Describe the historical and regional phases (including causes and timing) of the Epidemiological Transition and its implications for future mortality trends
Global Life Expectancy

Figure 12. Life Expectancy at Birth Across the Globe: 2002
Sub-Saharan African countries had by far the lowest life expectancy at birth of any region on the globe in 2002.

Source: U.S. Census Bureau, International Programs Center, International Data Base and unpublished tables.
MODELS OF THE EPIDEMIOLOGIC TRANSITION

Western Models

Model 1
Classical

Model 2
Accelerated/
Semi-Western

Model 3
Rapid

Model 4
Intermediate

Model 5
Slow

Birth and Death rates per 1000 Population

1750 1800 1850 1900 1950 2000

Death Rate

Birth Rate

Delayed Models (20th Century)
Causes of Death
Least Developed Countries (LDCs)

- LDCs = 85% of world’s population
- 99% of World’s population Growth
- >90% of world’s births
- >98% of world’s deaths to children < age 5 (95% of these are preventable)
- Wide range of E0 – from 40-70.
- What are people dying from?
Deaths among children under five

Deaths associated with malnutrition

- Acute respiratory infections: 20%
- Diarrhea: 12%
- Measles: 5%
- Malaria: 8%
- HIV/AIDS: 4%
- Perinatal causes: 22%
- Other: 29%

http://www.developmentgoals.org/Child_Mortality.htm#top
Percentage of Children Under 5 Years Who Are Moderately and Severely Underweight Major World Regions 1990-1997

- Developing Countries: 31%
- Least Developed Countries: 40%
- South Asia: 51%
- Sub-Saharan Africa: 31%
- East Asia and the Pacific: 22%
- Middle East and North Africa: 18%
- Latin America and the Caribbean: 10%

Nutrition and Disease

Not just infants and young children:

• 33-57% of world suffers from micronutrient deficiency.
• ~18% of world’s pop. suffer from deficiency of calories and protein.
• 14 % of world’s pop. have food insufficient for min. adult activity & healthy adolescent growth.
Figure 1.2 Age distribution of global mortality: developed and developing countries, 2002

- **Developed**: 10,000 deaths (60+), 5,000 deaths (15-59), 2,000 deaths (5-14), 0 deaths (0-4)
- **Low-mortality developing**: 15,000 deaths (60+), 10,000 deaths (15-59), 2,000 deaths (5-14), 1,000 deaths (0-4)
- **High-mortality developing**: 20,000 deaths (60+), 15,000 deaths (15-59), 3,000 deaths (5-14), 2,000 deaths (0-4)
- **World**: 35,000 deaths (60+), 25,000 deaths (15-59), 4,000 deaths (5-14), 3,000 deaths (0-4)
Figure 1.8 Disease burden (DALYs) among adults (aged 15 years and over) by broad cause, selected epidemiological subregions, 2002

See List of Member States for an explanation of subregions.
Figure 1.9 Adult mortality: probabilities of death between 15 and 60 years of age by cause, selected epidemiological subregions, 2002

See List of Member States for an explanation of subregions.
Other factors in mortality transition & pattern

Evolution

• Natural and human-induced pathogen evolution
• Mosquitos and Aids
other factors in mortality transition & pattern cont.

Transnational Corporations

• Infant formulas
• Junk Food
• Pharmaceuticals
• Tobacco
other factors in mortality transition & pattern cont.

Socio-economic Status

• Education

• Social Class
other factors in mortality transition & pattern cont.

Spatial patterns and Ecology (Geography!)
- Malaria
- Schistosomiasis
Quiz #4

1) What are the main causes of Death in MDCs compared to LDCs?

2) What is the role of nutrition in Mortality?

3) Name 3 other major factors in Mortality. Give an example of each
A Special Case: AIDS

- AIDS (acquired immune deficiency syndrome)

- HIV (human immunodeficiency virus)

- The immune system is said to be "deficient" when it can no longer fulfill its role of fighting off infection and cancers.

- Immune deficient patients are vulnerable to infections from diseases that are very rare among people without immune deficiency.
A global view of HIV infection

38 million people [range: 35-42 million] living with HIV as of end 2003
# Global Summary of the HIV and AIDS Epidemic

## December 2004

### Number of people living with HIV in 2004

<table>
<thead>
<tr>
<th>Category</th>
<th>Total:</th>
<th>(Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>39.4 million</td>
<td>(35.9 – 44.3 million)</td>
</tr>
<tr>
<td>Adults</td>
<td>37.2 million</td>
<td>(33.8 – 41.7 million)</td>
</tr>
<tr>
<td>Women</td>
<td>17.6 million</td>
<td>(16.3 – 19.5 million)</td>
</tr>
<tr>
<td>Children under 15 years</td>
<td>2.2 million</td>
<td>(2.0 – 2.6 million)</td>
</tr>
</tbody>
</table>

### People newly infected with HIV in 2004

<table>
<thead>
<tr>
<th>Category</th>
<th>Total:</th>
<th>(Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>4.9 million</td>
<td>(4.3 – 6.4 million)</td>
</tr>
<tr>
<td>Adults</td>
<td>4.3 million</td>
<td>(3.7 – 5.7 million)</td>
</tr>
<tr>
<td>Children under 15 years</td>
<td>640 000</td>
<td>(570 000 – 750 000)</td>
</tr>
</tbody>
</table>

### AIDS deaths in 2004

<table>
<thead>
<tr>
<th>Category</th>
<th>Total:</th>
<th>(Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>3.1 million</td>
<td>(2.8 – 3.5 million)</td>
</tr>
<tr>
<td>Adults</td>
<td>2.6 million</td>
<td>(2.3 – 2.9 million)</td>
</tr>
<tr>
<td>Children under 15 years</td>
<td>510 000</td>
<td>(460 000 – 600 000)</td>
</tr>
</tbody>
</table>
## Regional HIV and AIDS statistics and features, end of 2004

<table>
<thead>
<tr>
<th>Region</th>
<th>Adults &amp; children living with HIV</th>
<th>Adults &amp; children newly infected with HIV</th>
<th>Adult prevalence [%] *</th>
<th>Adult &amp; child deaths due to AIDS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sub-Saharan Africa</strong></td>
<td>25.4 million [23.4 – 28.4 million]</td>
<td>3.1 million [2.7 – 3.8 million]</td>
<td>7.4 [6.9 – 8.3]</td>
<td>2.3 million [2.1 – 2.6 million]</td>
</tr>
<tr>
<td><strong>North Africa &amp; Middle East</strong></td>
<td>540 000 [230 000 – 1.5 million]</td>
<td>92 000 [34 000 – 350 000]</td>
<td>0.3 [0.1 – 0.7]</td>
<td>28 000 [12 000 – 72 000]</td>
</tr>
<tr>
<td><strong>South and South-East Asia</strong></td>
<td>7.1 million [4.4 – 10.6 million]</td>
<td>890 000 [480 000 – 2.0 million]</td>
<td>0.6 [0.4 – 0.9]</td>
<td>490 000 [300 000 – 750 000]</td>
</tr>
<tr>
<td><strong>East Asia</strong></td>
<td>1.1 million [560 000 – 1.8 million]</td>
<td>290 000 [84 000 – 830 000]</td>
<td>0.1 [0.1 – 0.2]</td>
<td>51 000 [25 000 – 86 000]</td>
</tr>
<tr>
<td><strong>Latin America</strong></td>
<td>1.7 million [1.3 – 2.2 million]</td>
<td>240 000 [170 000 – 430 000]</td>
<td>0.6 [0.5 – 0.8]</td>
<td>95 000 [73 000 – 120 000]</td>
</tr>
<tr>
<td><strong>Caribbean</strong></td>
<td>440 000 [270 000 – 780 000]</td>
<td>53 000 [27 000 – 140 000]</td>
<td>2.3 [1.5 – 4.1]</td>
<td>36 000 [24 000 – 61 000]</td>
</tr>
<tr>
<td><strong>E. Europe &amp; Central Asia</strong></td>
<td>1.4 million [920 000 – 2.1 million]</td>
<td>210 000 [110 000 – 480 000]</td>
<td>0.8 [0.5 – 1.2]</td>
<td>60 000 [39 000 – 87 000]</td>
</tr>
<tr>
<td><strong>Western &amp; Central Europe</strong></td>
<td>610 000 [480 000 – 760 000]</td>
<td>21 000 [14 000 – 38 000]</td>
<td>0.3 [0.2 – 0.3]</td>
<td>6 500 [8 500 – &lt;8 500]</td>
</tr>
<tr>
<td><strong>North America</strong></td>
<td>1.0 million [540 000 – 1.6 million]</td>
<td>44 000 [16 000 – 120 000]</td>
<td>0.6 [0.3 – 1.0]</td>
<td>16 000 [8 400 – 25 000]</td>
</tr>
<tr>
<td><strong>Oceania</strong></td>
<td>35 000 [25 000 – 48 000]</td>
<td>5 000 [2 100 – 13 000]</td>
<td>0.2 [0.1 – 0.3]</td>
<td>700 [&lt;1 700]</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>39.4 million [35.9 – 44.3 million]</td>
<td>4.9 million [4.3 – 6.4 million]</td>
<td>1.1 % [1.0 – 1.3%]</td>
<td>3.1 million [2.8 – 3.5 million]</td>
</tr>
</tbody>
</table>
Adults and Children Estimated to be Living with HIV as of end 2004

Total: 39.4 (35.9 – 44.3) million
Estimated Number of Adults and Children Newly Infected with HIV during 2004

- **Total**: 4.9 (4.3 – 6.4) million
- **Western & Central Europe**: 21,000
  - **Eastern Europe & Central Asia**: 210,000
- **North Africa & Middle East**: 92,000
  - **North Africa & Middle East**: 92,000
  - **Sub-Saharan Africa**: 3.1 million
    - **Sub-Saharan Africa**: 3.1 million
- **Eastern Europe**: 21,000
  - **Eastern Europe**: 21,000
- **Caribbean**: 53,000
  - **Caribbean**: 53,000
- **Latin America**: 240,000
  - **Latin America**: 240,000
- **East Asia**: 290,000
  - **East Asia**: 290,000
- **South & South-East Asia**: 890,000
  - **South & South-East Asia**: 890,000
- **Oceania**: 5,000
  - **Oceania**: 5,000
- **North America**: 44,000
  - **North America**: 44,000
- **Caribbean**: 53,000
  - **Caribbean**: 53,000
- **Latin America**: 240,000
  - **Latin America**: 240,000
- **East Asia**: 290,000
  - **East Asia**: 290,000
- **South & South-East Asia**: 890,000
  - **South & South-East Asia**: 890,000
- **Oceania**: 5,000
  - **Oceania**: 5,000

*PRB 2005*
Estimated Adult and Child Deaths from AIDS during 2004

- Western & Central Europe: 6,500 (2,800 – 3,500) million
- North Africa & Middle East: 28,000 (12,000 – 72,000)
- Sub-Saharan Africa: 2.3 million (2.1 – 2.6 million)
- Eastern Europe & Central Asia: 60,000 (39,000 – 87,000)
- East Asia: 51,000 (25,000 – 86,000)
- South & South-East Asia: 490,000 (300,000 – 750,000)
- Latin America: 95,000 (73,000 – 120,000)
- Caribbean: 36,000 (24,000 – 61,000)
- Northern America: 16,000 (8,400 – 25,000)
- Oceania: 700 (≤1,700)
Children (<15 years) Estimated to be Living with HIV as of end 2004

- **Western & Central Europe**: 6,200 (4,900 – 7,900)
- **North Africa & Middle East**: 24,000 (7,100 – 82,000)
- **Sub-Saharan Africa**: 1.9 million (1.7 – 2.3 million)
- **Eastern Europe & Central Asia**: 8,800 (7,100 – 13,000)
- **Caribbean**: 23,000 (12,000 – 49,000)
- **Latin America**: 26,000 (21,000 – 43,000)
- **North America**: 11,000 (5,600 – 17,300)
- **East Asia**: 9,400 (7,300 – 27,000)
- **South & South-East Asia**: 170,000 (95,000 – 320,000)
- **Oceania**: 700 (< 2,500)

Total: 2.2 (2.0 – 2.6) million

PRB 2005
Estimated Number of Children (<15 years) Newly Infected with HIV during 2004

- Western & Central Europe: <100 (<200)
- North Africa & Middle East: 9,100 (2,800 – 30,000)
- Sub-Saharan Africa: 560,000 (500,000 – 650,000)
- Eastern Europe & Central Asia: 1,800 (1,200 – 3,700)
- East Asia: 41,000 (3,500 – 11,000)
- South & South-East Asia: 51,000 (30,000 – 95,000)
- Oceania: <300 (<1,000)
- Caribbean: 6,100 (3,100 – 13,000)
- Latin America: 6,800 (5,400 – 11,000)
- North America: <100 (<200)
- Caribbean: 6,100 (3,100 – 13,000)

Total: 640,000 (570,000 – 750,000)

PRB 2005
Estimated Deaths in Children (<15 years) from AIDS during 2004

North America & Central Europe
< 100
[< 200]

Caribbean
5 300
[2 700 – 11 000]

Latin America
6 000
[4 800 – 9 800]

Western & Central Europe
< 100
[< 200]

North Africa & Middle East
5 600
[1 700 – 19 000]

Sub-Saharan Africa
450 000
[400 000 – 540 000]

Eastern Europe & Central Asia
1 100
[800 – 2 200]

East Asia
2 400
[900 – 6 900]

South & South-East Asia
37 000
[22 000 – 70 000]

Oceania
< 200
[< 600]

Total: 510 000 (460 000 – 600 000)

PRB 2005
End-2004 Global HIV and AIDS Estimates

Children (<15 years)

- Children living with HIV: 2.2 million [2.0 – 2.6 million]
- New HIV infections in 2004: 640,000 [570,000 – 750,000]
- Deaths due to AIDS in 2004: 510,000 [460,000 – 600,000]

PRB 2005
Review

1) Understand ways in which the epidemiological transition in the developing world is similar and dissimilar to the historical transition

2) Consider conditions that foster other factors (political, socio-economic, ecological) to relate to mortality

3) Relate how AIDS is like/unlike other epidemics and its manifold political, social, and economic causes and consequences
Did we meet Today’s Objectives?

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Did we meet Today’s Objectives?

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Next Time