Outline

- Welcome to the course
- Objectives
- Syllabus
  - Policies and procedures
  - Evaluation
  - Texts and resources
- Why learn methods in infectious disease epidemiology?
Welcome

• Welcome to the course
  – Introductions
    • Professor
      – Professor experience, research emphases
    • Students
      – Background, interest in course material
  – What this course is and what it is not

Course objectives (1)

• At the completion of this course, the student will be able to:
  – Apply epidemiologic methods to the context of infectious disease
  – Critically evaluate infectious disease literature
  – Understand study designs & procedures for evaluating infectious diseases in a variety of settings
  – Confidently work in a public health or research setting focused on infectious disease

Course objectives (2)

– Delineate steps in conducting the following types of studies:
  • Descriptive studies
  • Outbreak investigations
  • Experimental designs
  • Cohort studies
    – Prospective (concurrent)
    – Retrospective (non-concurrent)
    – Ambidirectional
  • Case-control
  • Cross-sectional
Syllabus (1)

• Course logistics (when, where, office hours, etc.)
• Professor-specific policies and procedures
• Textbooks and resources

Syllabus (2)

• Course evaluation

Lecture objectives

• By the end of this lecture, you will be able to
  – Discuss importance of epidemiology methods in the study of infectious disease
  – Define methodology
  – List at least four reasons why epidemiology methods are necessary
Why learn methods? (1)

- “It is time to close the book on infectious diseases, declare the war against pestilence won, and shift national resources to such chronic problems as cancer and heart disease.”
  ~U.S. Surgeon General William H. Stewart, 1967

- “We are standing on the brink of a global crisis in infectious diseases. No country is safe from them. No country can any longer afford to ignore their threat.”
  ~Hiroshi Nakajima, Director-General of the World Health Organization, 1996

Why learn methods? (2)

- Importance of learning methods in addition to clinical infectious disease epidemiology
  - Following decades of decline in infectious diseases, now increasing morbidity and mortality—eroding successes of the past decades
  - Need public health professionals who understand basic principles of studying diseases—including newly emerging or re-emerging ones—in addition to knowledge about existing organisms

Why learn methods? (3)

- [Graph showing trends in infectious diseases]

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Manya Magnus, PhD, MPH
Ten Great Public Health Achievements of the 20th Century, and Remaining Challenges

Source (unless otherwise attributed): adapted from Centers for Disease Control and Prevention
http://www.phppo.cdc.gov/phth/tenachievements/default.asp

The 20th Century in the U.S. has seen:

- A decrease in death rates, especially infant and child mortality
- A corresponding increase in life expectancy
- A shift away from infectious diseases and toward chronic diseases
- This reflects the “Epidemiologic Transition,” which is occurring worldwide in developing countries.

Leading Causes of Death, U.S., 1900 vs. 2000

<table>
<thead>
<tr>
<th>1900</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Influenza &amp; Pneumonia</td>
<td>1- Heart Disease</td>
</tr>
<tr>
<td>2- Tuberculosis</td>
<td>2- Cancer</td>
</tr>
<tr>
<td>3- Heart Disease</td>
<td>3- Stroke</td>
</tr>
<tr>
<td>4- Stroke</td>
<td>4- COPD</td>
</tr>
<tr>
<td>5- Diarrhea/Enteritis</td>
<td>5- Unintentional Injury</td>
</tr>
<tr>
<td>6- Nephritis</td>
<td>6- Diabetes</td>
</tr>
<tr>
<td>7- Cancer</td>
<td>7- Influenza &amp; Pneum.</td>
</tr>
<tr>
<td>8- Unintentional Injury</td>
<td>8- Alzheimer’s Disease</td>
</tr>
<tr>
<td>9- Diphtheria</td>
<td>9- Nephritis</td>
</tr>
<tr>
<td>10- Diseases of Early Infancy</td>
<td>10- Septicemia</td>
</tr>
</tbody>
</table>
What changes have contributed to decreased morbidity and mortality?

Control of Infectious Diseases

For example, control of pneumonia, malaria, polio, smallpox, and mumps
Pneumonia and Influenza mortality rates by age during certain epidemic years. (Centers for Disease Control, 1972)

<table>
<thead>
<tr>
<th>Age</th>
<th>Deaths per 100,000 Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>500</td>
</tr>
<tr>
<td>10</td>
<td>1000</td>
</tr>
<tr>
<td>20</td>
<td>1500</td>
</tr>
<tr>
<td>30</td>
<td>2000</td>
</tr>
</tbody>
</table>

Malaria: Once endemic throughout the southeastern United States, malaria was brought under control by the late 1940s. But this successful effort has not taken place globally.

Mumps—by Year, United States, 1968-1996

Photo by Jim Gathany, Courtesy of CDC
Smallpox Eradicated Worldwide

Smallpox is dead!

1980

Manya Magnus, PhD, MPH

Poliomyelitis (Paralytic)—by Year, United States, 1951-1996

Influenza Vaccine

Poliomyelitis cases reduced by 90% since 1988.

Global eradication is now in sight

Manya Magnus, PhD, MPH
Certain advances have contributed to this public health achievement (and are achievements in their own right):

Improved Sanitation

Vaccinations
Characteristics and sources of foodborne diseases have been identified throughout the 20th century. Control of many diseases has been brought about through technology and safer food-handling procedures, including:

- Hand washing
- Refrigeration
- Pesticide application
- Reduction of foodborne pathogens
- Improved surveillance

- Better sanitation
- Pasteurization
- Safer food processing
- Better animal care and feeding
Safer Workplaces

Motor Vehicle Safety

Improved Occupant Protection:
Approximately 85,000 American lives have been saved because of seat belts.
Changes in Societal Norms and Individual Behavior:
Since 1987, community awareness and driving-while-intoxicated regulations have helped reduce alcohol related traffic fatalities by 32% in the U.S.

Decline in Deaths from Coronary Heart Disease and Stroke

Healthier Mothers and Babies
But the infectious disease book most certainly is not closed. We have increasing challenges, and threats to public health that we cannot yet anticipate.

*Knowledge of how to understand and study infectious disease is needed.*

New modes of disease transmission have been created by progress:

<table>
<thead>
<tr>
<th>Progress</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilation systems</td>
<td>Legionnaires’ Disease</td>
</tr>
<tr>
<td>Blood transfusion</td>
<td>HIV, Hepatitis C</td>
</tr>
<tr>
<td>Centrally processed food</td>
<td>Salmonella, <em>E. coli</em> 0157:H7</td>
</tr>
<tr>
<td>Air travel</td>
<td>Rapid disease spread</td>
</tr>
<tr>
<td>Economic development &amp; tourism</td>
<td>Exposure to new vectors &amp; diseases</td>
</tr>
<tr>
<td>Suburbanization</td>
<td>Lyme disease/rabies</td>
</tr>
<tr>
<td>Antimicrobial agents</td>
<td>Drug-resistant organisms</td>
</tr>
<tr>
<td>Modern medical treatments</td>
<td>Opportunistic infections</td>
</tr>
<tr>
<td>(e.g. bone marrow transplant, chemotherapy, renal dialysis)</td>
<td></td>
</tr>
</tbody>
</table>
What is epidemiology? (1)
The study of how disease is distributed in populations, and of the factors that influence this distribution

Derived from: “epi” (upon)
+ “demo” (people)
+ “logos” (the study of)
What is epidemiology? (2)

The study of the **distribution** and **determinants** of **disease** in human populations and the **application** of this study to control health problems

**Purposes of epidemiology**

- Study the natural history and prognosis of disease
- Determine the extent of disease in a population
- Identify the etiology (causes, risk factors) of disease
- Evaluate effectiveness of preventive measures, therapeutic measures, and modes of health care delivery
- Provide basis for establishing public policy and regulatory decisions

**Ultimate Goal:** identify means to prevent disease

- **Primary Prevention** - actions taken to prevent the development of disease among persons who do not have the disease in question
- **Secondary Prevention** - actions taken among people who have already developed a disease to improve their prognosis; refers to early detection (screening) and early intervention
Differences between basic, clinical, and public health science research:

<table>
<thead>
<tr>
<th>What/Who is Studied</th>
<th>Basic</th>
<th>Clinical</th>
<th>Public Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>cells, tissue, animals</td>
<td>sick patients</td>
<td>populations</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Research Goals</th>
<th>Basic</th>
<th>Clinical</th>
<th>Public Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>disease mechanisms</td>
<td>improve diagnoses and treatments</td>
<td>prevention, health promotion</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
<th>Basic</th>
<th>Clinical</th>
<th>Public Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>toxicology, immunology</td>
<td>internal medicine, pediatrics, etc.</td>
<td>epidemiology, environmental health sciences</td>
<td></td>
</tr>
</tbody>
</table>

Infectious disease epidemiology: how it differs from other applications (1)

- Epidemiology as a “toolkit” of methods
  - Same methodological approach used to understand relationships between exposures and outcomes
- Methods are design approaches that we use to study something and examine relationships—how we do something

Infectious disease epidemiology: how it differs from other applications (1)

- As many conditions and problems there are in public health, there are as many application of epidemiology to them. Some examples:
  - Cancer
  - Social and behavioral concerns (social epidemiology): smoking, obesity, drug use, etc.
  - Chronic diseases
  - Cardiovascular disease
  - Nutrition
  - Environmental and occupational
  - And many, many more
- Same methods used for each of these, with “cultural” changes and modifications to toolkit based on need of specific types of outcomes of interest
Infectious disease epidemiology: how it differs from other applications (2)

• What makes infectious disease different from other arenas of health concerns?
  – Multiple infectious agents
  – Heterogeneous infectious agents
    • Not only different types of organisms—viruses, bacteria, fungi, parasites, etc.—but within each type, still further types and categories. Each one must be studied and treated uniquely
  – There are organisms which cause acute, chronic, or both acute and chronic diseases
  – Symptomatic and asymptomatic diseases
  – Multiple modes of transmission
  – Dynamic, not static
  – Infectious agents constantly emerging, re-emerging, evolving (e.g., resistant strains)

What Lies Ahead

• DNA and the human genome
• Genomics and proteomics
• Genetically-modified foods

A 4-month-old Brazilian infant whose mother was infected with the Zika Virus compared with a normal 4-month-old infant
Assignment for next week:

Thank you for your attention
Questions?