Introduction to Public Health and Epidemiology

King Cholera dispenses contagion: the London Cholera Epidemic of 1866
Learning Objectives

- Define Epidemiology
- Summarize the epidemiologic approach
- List the uses of Epidemiology
- Describe the interactions between host, agent, and environment
Epidemiological Principles

- Diseases (or other health events) don’t occur at random
- Diseases (or other health events) have causal and preventive factors which can be identified
Epidemiology

Epi = upon

Demos = population

Logos = study of
Definition

The study of the distribution and determinants of health related states or events in specified human populations and its application to the control of health problems

Last, 1988
The study of the distribution and determinants of health related states or events in specified human populations and its application to the control of health problems.

Key Words:

Distribution  Time, place, person
The study of the distribution and determinants of health related states or events in specified human populations and its application to the control of health problems.

Determinants ▶ Cause, risk factors
The study of the distribution and determinants of health related states or events in specified human populations and its application to the control of health problems.
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The study of the distribution and determinants of health related states or events in specified human populations and its application to the control of health problems.
Uses of Epidemiology

- Determine the magnitude and trends
- Identify the etiology or cause of disease
- Determine the mode of transmission
- Identify risk factors or susceptibility
- Determine the role of the environment
- Evaluate the impact of the control measures
Epidemiologist Core Functions

- Public health surveillance
- Investigation
- Data analysis
- Evaluation
- Communication
- Management and teamwork
Analytic epidemiology defines risk factors.

Communications to decision makers, media, on problem and risk factors.

Management, advocacy, communications

Descriptive epidemiology, surveys, surveillance, Quality assurance

Evaluate population health and program output, repeat cycle

Public Health Cycle

Target/Evaluate

Intervene

Communicate

Analyze
Basic Epidemiologic Approach

- Observe
- Count cases (events)
- Describe
  - Time, place, person
  - Calculate rates,
- Compare rates
- Develop hypothesis
- Test hypothesis
- Implement actions (control, prevention)
What are the leading causes of death or disability in this population? What can be done to reduce/prevent them?

What is wrong with this patient? What treatment is appropriate?

<table>
<thead>
<tr>
<th>Focus Main Goal Questions</th>
<th>Clinical Medicine</th>
<th>Epidemiology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Individuals</td>
<td>Populations</td>
</tr>
<tr>
<td></td>
<td>Diagnosis and Treatment</td>
<td>Prevention and Control</td>
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Medicine Versus Epidemiology
Epidemiology and Disease
Levels of Disease

*Increasing amount of disease*

- Sporadic
- Endemic
- Epidemic
- Pandemic
Epidemiologic Triad

HOST

AGENT

ENVIRONMENT
# Host, Agent, Environment

<table>
<thead>
<tr>
<th>Host</th>
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</thead>
<tbody>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Sex</td>
</tr>
<tr>
<td>Religion</td>
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<tr>
<td>Exercise</td>
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<td>Behavior</td>
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<tr>
<td>Co-morbidity</td>
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<tr>
<td>Genetics</td>
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<tr>
<td>Food</td>
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</tbody>
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# Host, Agent, Environment

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<tr>
<td>Age</td>
<td>Biologic microorganisms</td>
</tr>
<tr>
<td>Sex</td>
<td>Chemical toxins</td>
</tr>
<tr>
<td>Religion</td>
<td>Physical trauma</td>
</tr>
<tr>
<td>Exercise</td>
<td>Nutrition</td>
</tr>
<tr>
<td>Behavior</td>
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<tbody>
<tr>
<td>Age</td>
<td>Biologic</td>
<td>Disease vectors</td>
</tr>
<tr>
<td>Sex</td>
<td>Microorganisms</td>
<td>Population density</td>
</tr>
<tr>
<td>Religion</td>
<td>Chemical Toxins</td>
<td>Air quality</td>
</tr>
<tr>
<td>SES</td>
<td>Physical Trauma</td>
<td>Weather</td>
</tr>
<tr>
<td>Exercise</td>
<td>Nutrition</td>
<td>Noise</td>
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<tr>
<td>Behavior</td>
<td></td>
<td>Food and water sources</td>
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<tr>
<td>Co-morbidity</td>
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<td>Genetics</td>
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</table>
Chain of Infection

- Reservoir
- Mode of Transmission
- Susceptible Host
- Mode of Transmission

The cycle continues from Host to Reservoir through the Mode of Transmission.
Reservoir

*Habitat in which the disease normally lives and multiplies*

- People
  - Symptomatic - Smallpox
  - Asymptomatic - HIV
- Animals (Zoonoses)
  - Brucellosis
  - Plague
- Environmental
  - Histoplasmosis
  - Legionnaires’ bacillus
Mode of Transmission

- **Direct**
  - Contact - Cutaneous Anthrax, Hookworm
  - Droplet – Smallpox

- **Indirect**
  - Airborne – Histoplasmosis, Inhalation Anthrax
  - Vehicle-borne food or water - Salmonella
  - Vectorborne
    - Mechanical – Shigella by fly limbs
    - Biological – Malaria (maturation)
Chain of Infection

- Reservoir
- Mode of Transmission
- Susceptible Host
- Mode of Transmission
- Host
Smallpox Chain of Infection

Droplet

Droplet

Droplet

Droplet
Smallpox Chain of Infection

Droplet → Droplet → Vaccine

Diagram showing the transmission of smallpox through droplets and the role of vaccination.
Chain of Infection

- Reservoir
- Mode of Transmission
- Susceptible Host
- Mode of Transmission
Do you need to identify the agent to control it?

<table>
<thead>
<tr>
<th>Disease</th>
<th>Control measure</th>
<th>Year</th>
<th>Agent</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scurvy</td>
<td>Diet</td>
<td>1753</td>
<td>Vitamin C</td>
<td>1928</td>
</tr>
<tr>
<td>Pellagra</td>
<td>Diet</td>
<td>1754</td>
<td>Niacin</td>
<td>1924</td>
</tr>
<tr>
<td>Smallpox</td>
<td>Vaccination</td>
<td>1798</td>
<td>Orthopox virus</td>
<td>1958</td>
</tr>
<tr>
<td>Cholera</td>
<td>Water quality</td>
<td>1849</td>
<td>Vibrio cholerae</td>
<td>1893</td>
</tr>
<tr>
<td>Yellow fever</td>
<td>Mosquito control</td>
<td>1901</td>
<td>Flavivirus</td>
<td>1928</td>
</tr>
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</table>
Epidemiologic Transition - Public Health Response

- Shift in primary emphasis of public health priorities....
- **from:** microbiologic investigation of communicable diseases
- **to:** the etiologic role of behavioral and environmental risk factors and methods
Infectious and Chronic Diseases

- Epidemiologists investigate both infectious and chronic (non-communicable) diseases
Why have chronic diseases increased in importance?

- Favorable demographic changes and public health successes during the 1900’s (quality and availability of food, water, housing, sanitation; communicable disease control)

- “Epidemic transition” (i.e. change)
  - Lower overall death rate
  - Greater life expectancy
  - Shift in major causes of death (from infectious to non-communicable)
  - Change in lifestyles (access & economy)
<table>
<thead>
<tr>
<th>Year</th>
<th>Infant Mortality</th>
<th>Life Expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>150.0 deaths /1000 live births</td>
<td>47 years</td>
</tr>
<tr>
<td>1990</td>
<td>9.2 deaths /1000 live births</td>
<td>75 years</td>
</tr>
<tr>
<td>1900</td>
<td>1990</td>
<td></td>
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<tr>
<td>----------------------</td>
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</tr>
<tr>
<td><strong>Pneumonia/Flu</strong></td>
<td><strong>Heart disease</strong></td>
<td></td>
</tr>
<tr>
<td>(202 deaths/100,000)</td>
<td>(281 deaths/100,000)</td>
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<tr>
<td><strong>Tuberculosis</strong></td>
<td><strong>Cancer</strong></td>
<td></td>
</tr>
<tr>
<td>(194 deaths/100,000)</td>
<td>(204 deaths/100,000)</td>
<td></td>
</tr>
<tr>
<td><strong>Gastro/Enteritis</strong></td>
<td><strong>Stroke</strong></td>
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<tr>
<td>(143 deaths/100,000)</td>
<td>(60 deaths/100,000)</td>
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</tbody>
</table>
Chronic Diseases
(Non-communicable or Degenerative Diseases)

- Cardiovascular disease (Coronary heart disease, Stroke, hypertension)
- Cancer
- Chronic lung diseases
- Diabetes Mellitus
- Osteo Arthritis
- Obesity
- Chronic neurological disorders
- Musculoskeletal diseases
Defining characteristics of chronic diseases

- Prolonged course of illness
- Multiple risk factors
- Long latency period
- Non-contagious origin (non-communicable)
- Uncertain etiology (causation)
- Functional impairment or disability
- Incurability
Is Descriptive Epidemiology of chronic and infectious diseases similar?

- Some of the purposes, methods, data sources, and types of variables to be analyzed are similar for the descriptive epidemiology of chronic diseases and infectious diseases
Basic Epidemiologic Approach

- Observe
- Count cases (events)
- Describe
  - Time, place, person
  - Calculate rates,
- Compare rates
- Develop hypothesis
- Test hypothesis
- Implement actions (control, prevention)
Chronic Disease vs. Infectious Disease

- How might data patterns for person, place, and time-specific variables differ for Chronic Disease and Infectious Disease?
The art of epidemiological thinking is to draw conclusions from imperfect data.

George W. Comstock
Acknowledgements

- Presentations
  - M. Valenciano and D. Coulombier, WHO Lyon
  - C. Whalen, Case Western Reserve
  - E. Simoes, CDC

- Reference books
  - M. Gregg, *Field Epidemiology, 2nd ed.*
  - R. Timmreck, *An Introduction to Epidemiology*