Basic Epidemiology: Study Types

John Kobayashi, MD, MPH
August 12, 2009

Learning Objectives

At the end of this presentation, participants will be able to:

- Define some key concepts in epidemiology
- Describe the differences between descriptive and analytical epidemiology
- Describe some types of commonly used epidemiologic studies

The Five Ws of Epidemiology

<table>
<thead>
<tr>
<th>What</th>
<th>Clinical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who</td>
<td>Person</td>
</tr>
<tr>
<td>Where</td>
<td>Place</td>
</tr>
<tr>
<td>When</td>
<td>Time</td>
</tr>
<tr>
<td>Why / How</td>
<td>Cause, risk factors, modes of transmission</td>
</tr>
</tbody>
</table>

Descriptive Epidemiology (Distribution)

Analytic Epidemiology (Determinants)
What Is Descriptive Epidemiology?

- Describes the pattern of disease occurrence in terms of time, place, person
- Defines the relationship of disease to the population at risk

Five Ws: Clinical

- Symptoms
- Signs
- Laboratory findings
- Hospitalizations
- Deaths

Five Ws: Person

- Age
- Sex
- Occupation
- Immunization status
- Underlying disease
- Medications
- Nutritional status
- Socioeconomic status

- Marital status
- Religion
- Travel
- Pets
- Hobbies
- Personal habits
- Genetics
**Five Ws: Place**

<table>
<thead>
<tr>
<th>Geographic Area</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illness begins</td>
<td>Home — patient ill</td>
</tr>
<tr>
<td>Contact occurred between</td>
<td>Restaurant — food eaten</td>
</tr>
<tr>
<td>agent and host</td>
<td></td>
</tr>
<tr>
<td>Source became infected</td>
<td>Farm — eggs infected</td>
</tr>
</tbody>
</table>

**Five Ws: Describing Time**

Secular trends
- Change over time
- Long-term

Measles cases in US

- Vaccine

Reported cases (thousands)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Five Ws: Describing Time (cont.)**

Seasonal patterns and trends
- Cyclical trends
- Seen over several years

Pneumonia & Influenza deaths in 122 cities in US

- Epidemic threshold
- Seasonal baseline

Percentage

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>0</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>
Descriptive Epidemiology

- Why is it important to perform descriptive epidemiology?
  - Describe clinical characteristics of the illness
  - Describe demographic characteristics of those affected
  - Identify or infer population at risk
  - Provide clues to etiology, modes of transmission
  - Guide interventions

Descriptive Studies: Overview

- Display patterns of occurrence
- Focus on person, place, time
- Useful if little is known
- Used for
  - Program planning
  - Generating hypotheses
Descriptive Study Types

Epidemiologic Studies

<table>
<thead>
<tr>
<th>Case Report</th>
<th>Case Series</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptive</td>
<td>Descriptive</td>
<td>Descriptive</td>
</tr>
</tbody>
</table>

- Case report describes person, place, and time information about a specific case.
  - Usually about unexpected symptoms or events
- Case series describes person, place, and time information about a group of cases.
  - Can be retrospective or prospective
  - Data may be used in analytic studies
- Incidence studies describe the number of new cases of a disease during a specific time in a specific population.
  - Allow calculation of true rates of occurrence

Descriptive Studies Compared

Case report
- Individual case data

Case series
- Individual data on a group of cases

Incidence study
- New cases during a specific time

<table>
<thead>
<tr>
<th>State</th>
<th>Encephalitis/Meningitis</th>
<th>Clinical/Unspecified</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Idaho</td>
<td>10</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Oregon</td>
<td>3</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

Cases/100,000/year

Overview of Analytic Studies

- Analytic studies used in research are frequently larger and more complex than descriptive studies
- Assess determinants of diseases
- Focus on risk factors and causes
- Analyze distribution of exposures and diseases
- Key feature: use comparison groups
- Used to:
  - Test hypotheses
  - Look for and measure associations

For additional information, see Measuring Risk in Epidemiology on the NWCPHP Web site.
Descriptive & Analytic Studies Compared

Ways to study severe acute respiratory syndrome (SARS)

- **Descriptive study**
  - Case series: person, place, time, of first 100 patients with SARS

- **Analytic study**
  - Measure risk factors for SARS (contact with animals, infected people)

Types of Analytic Studies

- **Epidemiologic Studies**
  - Clinical trial: study a new drug
  - Community trial: study effectiveness of a drug in preventing flu in a community
  - Cohort: study who received flu vaccine and how many become ill
  - Case-control: study of who has flu and if they were vaccinated
  - Cross-sectional: survey how many cases of flu in different occupations
  - Ecologic: compare rate of flu cases and immunization levels in counties

Experimental Studies

- Assign exposures randomly, follow over time, and monitor for disease
- Types
  - Clinical trial: Data from individuals
  - Community trial: Data from entire community
- Considered most scientific study type
- Expensive and time consuming
- Ethical concerns
Observational Studies

Researcher does not determine who is exposed. Observes participant outcomes.

- **Cohort studies**
  - Determine exposure
  - Observe if illness occurs
- **Case-control studies**
  - Identify ill cases and comparison group
  - Compare exposures
- **Cross-sectional studies**
  - Survey both exposure and disease
- **Ecologic studies**
  - Compare populations rather than individuals

*For additional information, see Study Types in Epidemiology on the NWCPHP Web site.

Cohorts and Cohort Studies

Groups of people who share similar characteristics

<table>
<thead>
<tr>
<th>General population</th>
<th>Exposed</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No disease</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unexposed</th>
<th>Disease</th>
<th>No disease</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No disease</td>
</tr>
</tbody>
</table>

More useful when:
- Population is well defined
- Exposure is uncommon
- Several possible outcomes

Can be prospective or retrospective

Cohort Study Types

<table>
<thead>
<tr>
<th>Past Exposure</th>
<th>Retrospective Outcome</th>
<th>Present Exposure</th>
<th>Prospective Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccine</td>
<td>Influenza</td>
<td>No vaccine</td>
<td>Influenza</td>
</tr>
<tr>
<td>No vaccine</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Influenza
- No influenza

Future Exposure
- Influenza
- No influenza
Case-Control Studies

1. Identify cases of disease or condition of concern
2. Identify similar non-diseased comparison group (controls)
3. Document exposures among cases and controls

<table>
<thead>
<tr>
<th>Exposure</th>
<th># cases</th>
<th># controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restaurant A</td>
<td>12/16</td>
<td>0/16</td>
</tr>
</tbody>
</table>

More useful when:
- Population is not well defined
- Disease is relatively rare
- Many possible exposures

Always retrospective

Comparing Cohort & Case-Control Studies

Cohort Study: Classifies a group according to exposure. Can be prospective or retrospective.

Exposure: Exposed → Diseased
Exposure: Unexposed → ?

Case-Control Study: Identifies group of people with a disease. Selects control group without the disease. Only retrospective.

Exposure: ? → Diseased: Yes (case) → Diseased: No (control)