Using Epidemiology in TB Prevention & Control

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Why learn about epidemiology?

- Assist TB program staff to analyze and make practical use of data
- Assess current and evolving trends in TB morbidity, identify risk groups, and determine where to allocate staff and resources
- Assist all TB program staff in working towards effective TB control

What is epidemiology?

Epidemiology

“The study of the distribution and determinants of health-related states in specified populations, and the application of this study to control health problems.”

Source: http://www.cdc.gov/excite/

What is Epidemiology?

- Descriptive epidemiology concentrates on examining the distribution of diseases in the population in terms of person (who gets the disease), place (where they get the disease) and time (when they get the disease)
- Analytic Epidemiology is concerned with studying the relationship between risk factors and a disease
How do we find descriptive data?

Public Health Surveillance

The systematic, ongoing collection, analysis, interpretation, and dissemination of health data. The purpose of public health surveillance is to gain knowledge of the patterns of disease, injury, and other health problems in a community so that we can work toward controlling and preventing them.

Source: [http://www.cdc.gov/excite/](http://www.cdc.gov/excite/)
TB Surveillance Data Reports

- Descriptive Statistics
  - Person
  - Place
  - Time
  - Combined with Census Data to generate case rates

The number of cases that occur during a specified time period \( \times 100,000 \) population at risk during that time period

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**Descriptive Data: person**

**TB Case Rates by Age Group and Sex, United States, 2009**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Male</th>
<th>Female</th>
<th>Cases per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;15</td>
<td></td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>15-34</td>
<td></td>
<td></td>
<td>2.5</td>
</tr>
<tr>
<td>35-44</td>
<td></td>
<td></td>
<td>4.1</td>
</tr>
<tr>
<td>45-64</td>
<td></td>
<td></td>
<td>5.9</td>
</tr>
<tr>
<td>&gt;65</td>
<td></td>
<td></td>
<td>7.8</td>
</tr>
</tbody>
</table>

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**Descriptive Data: place**

**TB Case Rates,* United States, 2009**

- \( \leq 3.5 \) (year 2000 target)
- 3.6-3.9
- >3.9 (national average)

*Cases per 100,000.
Descriptive Data: time

Using TB Surveillance Data

- Provide the descriptive epidemiology of local and state TB programs.
  - A description of the gender, race, ethnicity, occupation, nationality and place of residence of TB cases can be summarized for state or local areas.
  - Health information such as HIV status, history of substance use, prior diagnosis of TB, site of disease, sputum culture results, initial drug regimen, initial and final drug susceptibility results, type of health care provider and type of therapy received (Directly observed vs. self-administered).

Sources of TB Surveillance Information

- Reported Tuberculosis in the United States, 2009

- Tuberculosis in the United States, 2009 (Slide Set)

- Online Tuberculosis Information System (OTIS)
  OTIS is a query-based system containing information on TB cases reported to CDC. http://wonder.cdc.gov/tb.html

Using TB Surveillance Data

- Information related to treatment outcomes that can be used to evaluate program performance and needs.
  - E.g., date of treatment initiation may be compared with date that therapy was completed to see how long it takes patients to complete therapy.
  - Other program performance goals can be set by the state TB Control Program.

- Use Surveillance data to develop SMART (Specific, Measurable, Achievable, Relevant and Time Bound) program objectives.
Online Tuberculosis Information System (OTIS)

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategory</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease</td>
<td>OTIS Data</td>
<td>Overview of data entry and reporting.</td>
</tr>
<tr>
<td>- Disease Information</td>
<td>- Case Reports</td>
<td>Detailed description of report types and formats.</td>
</tr>
</tbody>
</table>

The Online Tuberculosis Information System (OTIS) is a web-based tool designed to improve the surveillance and reporting of tuberculosis cases in the United States. It allows public health officials to enter, manage, and analyze data related to tuberculosis cases. The system supports various data entry and reporting functionalities, including case reporting, outbreak investigation, and trend analysis. This enhanced system provides real-time access to data and supports improved public health decision-making.
Key epidemiologic measures: Incidence Rate

\[
\text{Incidence Rate} = \frac{\text{# of NEW cases of disease during a specified time period}}{\text{Population at risk of disease during the same time period (also measured as person-time)}} \times 1,000
\]

Key epidemiologic measures: Prevalence Ratio

\[
\text{Prevalence Ratio} = \frac{\text{Total # of (new and old) cases of disease during a time period (or at one point in time)}}{\text{Total population during the same time period}} \times 1,000
\]

Comparing Incidence Rates and Prevalence Ratios

<table>
<thead>
<tr>
<th>INCIDENCE RATE</th>
<th>PREVALENCE RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numerator</td>
<td>Numerator</td>
</tr>
<tr>
<td>New Cases during a time period</td>
<td>NEW and OLD Cases At one point in time or during a time period</td>
</tr>
<tr>
<td>Denominator</td>
<td>Denominator</td>
</tr>
<tr>
<td>Population at risk or Person-Time</td>
<td>Total Population</td>
</tr>
<tr>
<td>Excluding pre-existing cases during a specified time period</td>
<td>At one point in time or during a time period</td>
</tr>
<tr>
<td>Use: Estimate of risk</td>
<td>Use: Burden of disease</td>
</tr>
</tbody>
</table>

Study Design: Cohort Study

Study Design: Cross-Sectional
What is a TB Case Rate? An incidence rate or a prevalence ratio?

The number of cases that occur during a specified time period in a population at risk during that time period x 100,000 population at risk during that time period.

Note: cases are verified cases of TB. If TB recurs or if more than 12 months has elapsed since the person was discharged or lost to follow-up, then the person is counted as a new case.

Sample Problem: Calculating Incidence and Prevalence

A county TB Controller would like to know how many people currently living in a local homeless shelter are TST positive.

A nurse administers and reads the TST test results. Out of 100 homeless shelter residents, 40 had a positive TST result.

All 100 residents remained in this shelter for the next year at which time only those who did not have an initial positive TST result were tested again. Among these 60 residents, 20 had a positive test result.

Calculate:

a. the baseline prevalence of TB infection at this homeless shelter

b. an estimate of the risk of developing TB infection in this population

Sample Problem: Solution Calculating Incidence and Prevalence

A nurse administers and interprets the TST test results. Out of 100 homeless shelter residents, 40 had a positive TST result.

Baseline Prevalence is 40/100 or 40%.

All 100 residents remained in this shelter for the next year at which time only those who did not have an initial positive TST result were tested again. Among these 60 residents, 20 had a positive test result.

b. an estimate of the risk of developing TB infection in this population

Incidence Rate = 20/60 or 33%

TB Control

Assume that these two figures are good representations of the TB occurrence. What does it tell us about TB Control?
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"Since TB has a long period of latent infection, these new infections added to the pool of existing infections, which represents a source for potential TB cases in the years, and even decades, to come. One strategy for global TB control would be to implement an effective screening program in high-risk populations that would identify individuals with latent TB infection and treat them to prevent disease."

Source: Whalen, JAMA, June 8, 2005, p. 2785

Quality of Morbidity Data

- Subjective
- Type of surveillance used (active vs passive)
- Only available if someone seeks care and the information about that care is recorded
- The most severe cases of disease are more likely to be reported than less severe cases of disease
- Validity of a test to identify infection and disease

Mortality

- Is easier to define than morbidity
- Main source of mortality data in the United States is the standard US death certificate
- Collected by states and is kept by the National Center for Health Statistics
- Since TB death rates are so low in US, less likely to see published mortality figures for the US
- TB is a major cause of death in developing countries

Molecular Epidemiology

- TB epidemiology enhanced by molecular strain typing
- Used to differentiate between the different TB mycobacterial isolates
- DNA fingerprinting could be used during contact investigations to confirm (or disprove) known epidemiological links between cases and determine connections among cases where obvious epidemiological links do not exist
Closing

- Epidemiologic methods can help us to identify local, state, and national patterns of disease and their impact on local control of tuberculosis

- Can use epidemiological methods to find ways to improve both patient care outcomes and effectiveness of individual TB Programs