Epidemiologic Investigation of Outbreaks

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What is an outbreak/epidemic?

- An **outbreak** or an **epidemic** exists when there are **more cases of a particular disease than expected in**
  - a given **area**, or among a specific group of **people**, 
  - over a **particular period of time**.

- Many epidemiologists use the terms "**outbreak**" and "**epidemic**" interchangeably;
  - some restrict the use of "epidemic" to situations involving **large numbers** of people over a **wide geographic area**.

- The public is more likely to think that "epidemic" implies a **crisis** situation.
10 Steps of outbreak investigation

1. Prepare for field work
2. Establish the existence of an outbreak
3. Verify the diagnosis
4. Define and identify cases
5. Describe and orient the data in terms of time, place, and person
6. Develop hypotheses
7. Evaluate hypotheses
8. Refine hypotheses and carry out additional studies
9. Implement control and prevention measures
10. Communicate findings
2. Establish the existence of an outbreak

- Does the observed cases exceed the expected number?
  - Notifiable disease, use health dept. data
  - Other local data, hospital discharge records, mortality records etc
  - If local data not available, *guesstimates* from neighboring cities, countries
  - Conduct your own survey of local physicians, telephone etc
3. Verify the diagnosis

- Identify as accurately as possible the specific nature of the disease
  - The disease is what is said to be
- Collaborate closely with the lab
- Visit people who became ill
  - Gain a better understanding of the disease from those who are affected
4. Define and identify cases

- Establish a case-definition
- Be explicit and inclusive
  - Any geographic limits?
  - Fever?
  - How many loose stools?
  - What level of antibodies?
Still step 4: More details and count cases!

- Collect information on standard CRFs
  - Identifying information
  - Demographic
  - Clinical
  - Risk factor
Create line listings

<table>
<thead>
<tr>
<th>Case#</th>
<th>Initials</th>
<th>Date of Report</th>
<th>Date of Onset</th>
<th>Physician Dx</th>
<th>Signs and Symptoms</th>
<th>Lab</th>
<th>Other</th>
<th>Age</th>
<th>Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JG</td>
<td>12-Oct</td>
<td>6-Dec</td>
<td>Hep A</td>
<td>+ + + + + + +</td>
<td>+</td>
<td>SGOT ↓</td>
<td>37</td>
<td>M</td>
</tr>
<tr>
<td>2</td>
<td>BC</td>
<td>12-Oct</td>
<td>5-Oct</td>
<td>Hep A</td>
<td>+ - + + + + +</td>
<td>+</td>
<td>Alt ↓</td>
<td>62</td>
<td>F</td>
</tr>
<tr>
<td>3</td>
<td>HP</td>
<td>13-Oct</td>
<td>4-Oct</td>
<td>Hep A</td>
<td>+ - + + + S* +</td>
<td>+</td>
<td>SGOT ↓</td>
<td>30</td>
<td>F</td>
</tr>
<tr>
<td>4</td>
<td>MC</td>
<td>15-Oct</td>
<td>4-Oct</td>
<td>Hep A</td>
<td>- - + + ? - +</td>
<td>+</td>
<td>Hbs/ Ag-</td>
<td>17</td>
<td>F</td>
</tr>
<tr>
<td>5</td>
<td>NG</td>
<td>15-Oct</td>
<td>9-Oct</td>
<td>NA</td>
<td>- - + - + +</td>
<td>NA</td>
<td>NA</td>
<td>32</td>
<td>F</td>
</tr>
<tr>
<td>6</td>
<td>RD</td>
<td>15-Oct</td>
<td>8-Oct</td>
<td>Hep A</td>
<td>+ + + + + + +</td>
<td>+</td>
<td></td>
<td>38</td>
<td>M</td>
</tr>
</tbody>
</table>
5. Describe and orient the data in terms of time, place, and person

- Characterize the outbreak,
  - Trend over time (epidemic curve),
  - Geographic extent
  - Population affected

- Help you in evaluating the source, mode of transmission, risk factors
The epidemic curve

Helps in:

- Confirming the existence of an epidemic
- Where you are in the course of epidemic
- Project future course
- Determine the probable time period of exposure
- Draw inference about epidemic pattern
  - Common source
  - Person-to-person
  - Both
  - None
How to draw an epi curve

- Date of onset, sometimes hours of onset
- Number of cases on the y-axis
- The unit of time on the x-axis
- **Rule of thumb**: select a unit not longer than 1/3-1/4th of the incubation time
- If you don’t know incubation, draw several
- Include lead-time and end-time periods = Twice the incubation period

Smallpox incubation
Min-max=7-17 days
Average=12-14 days
Shape of the epi curve
Point source outbreak
Common-source outbreaks

- **Single common-source**
- **Intermittent common-source**
- **Continuous common-source**
- **Propagated epidemic-mixed pattern**
Propagated source (Progressive source)

Pure person-to-person transmission
Measles=incubation ~10days (7-14)
6. Develop hypotheses

Why and how the outbreak occurred?

- Talking to affected people is always helpful
- Develop testable hypotheses
Why and how the outbreak occurred?

- Talking to affected people is always helpful
- Develop testable hypotheses
  - If evidence is too strong no need to test

1. Analytical epidemiology
   1. Cohort study
   2. Case-control study
Odds Ratio in a Case-Control Study

Odds of being exposed
Odds of being exposed

Odds of NOT being exposed
Odds of NOT being exposed

Odds of exposure cases =

Odds of exposure non-cases =
**Calculation of odds ratios**

<table>
<thead>
<tr>
<th>Ate strawberries imported from country A?</th>
<th>Cases</th>
<th>Controls</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>a = 30</td>
<td>b = 40</td>
<td>70</td>
</tr>
<tr>
<td>No</td>
<td>c = 10</td>
<td>d = 80</td>
<td>90</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>40</td>
<td>120</td>
<td>160</td>
</tr>
</tbody>
</table>

Odds ratio= \( \frac{ad}{bc} \)

Odds ratio= \( \frac{30 \times 80}{40 \times 10} \) = 6

P-value=95% CI

Odds of strawberries Cases = 30/10

Odds of strawberries Non-cases = 40/80
8. Refine hypotheses and carry out additional studies

- Additional epi studies
- Lab studies
  - Epidemiology can implicate vehicles and guide appropriate public health action, lab evidence can clinch the findings
- Environmental studies
  - Help explain why an outbreak happened
9. Implementing control and prevention measures

- Although it is step 9, do this ASAP!
- You can target the suspects even if you don’t know the real source
  - Destroy possibly contaminated food
  - Sterilize contaminated water
  - Infectious person stay away from food handling
  - Cohorting
  - Immunization
10. Communicate findings

- Clear communication with local authorities
- Always work with the authorities and prepare an action plan of how to inform the public