

## Outbreak Investigations: An Introduction

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## Sources of Information

- “Steps of an Outbreak Investigation,” U.S. Centers for Disease Control and Prevention, [www.cdc.gov/excite/classroom/outbreak\\_steps.htm](http://www.cdc.gov/excite/classroom/outbreak_steps.htm)
- “Investigating an Outbreak,” P. Pontones, Indiana State Department of Health, <http://www.state.in.us/isdh/bioterrorism/epidemiology.htm>
- L. Gordis, *Epidemiology*, Second Edition, Philadelphia: W.B. Saunders, 2000.

## Disease Outbreaks: Recent Examples

- Measles
- Shigella
- *E. coli* O157:H7
- West Nile Virus

## A Combined Effort

- Epidemiologists
- Laboratory workers
- Environmental health specialists
- Healthcare providers
- Local health departments
- State health departments
- Federal agencies
- Public information officers
- The media

## The Ten Steps in an Outbreak Investigation

1. Prepare for fieldwork
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, person

## The Ten Steps in an Outbreak Investigation

6. Develop hypotheses
7. Evaluate hypotheses
8. Refine hypotheses and carry out additional studies
9. Implement control & prevention measures
10. Communicate findings

## Establish the Existence of an Outbreak

- More cases than normally expected in the population at a given time
- Work with area healthcare practitioners, pharmacies, local health department, etc. to determine if observed number is greater than expected

## Review Clinical Data and Establish Case Definition

- Review signs and symptoms, onset dates, common exposures, obtain lab results, if any
- **Case definition** = criteria to decide whether person is part of outbreak
  - time, place, person
  - clinical criteria
- Can change during investigation as more information becomes available

## Case Classification

- **Confirmed:** laboratory verification
- **Probable:** clinical criteria present but w/o lab verification
- **Suspected:** only some clinical criteria present

## Identify/Count Cases and Identify Population At Risk

- Initiate **active surveillance**
- Use questionnaires to survey hospitals, ERs, clinics, laboratories and known cases
  - Administer as soon as possible
  - Both cases and controls
- Review surveillance data

## Describe & Analyze Outbreak

- Describe outbreak by
  - time
  - place
  - person
- Plot number of cases by onset date
- **Index case:** first case of outbreak
- Determine time course and future course, exposure period

## Three Types of Outbreak

- **Point source**
- **Continuous common source**
- **Person-to-person**

## Point Source Outbreaks

- Single location with all exposed at one time
- All cases occur within one incubation period
- Outbreak stops unless secondary spread
- Epidemic curve has steep upslope, followed by gradual down slope

## Continuous Common Source

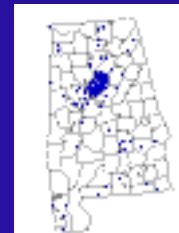
- Rather than single point, source is common (e.g., water)
- May begin suddenly or gradually
- Curve has gradual or steep upslope, plateau, trickling down slope, and may repeat

## Person-to-Person Outbreaks

- Disease is transmitted from person to person
- Secondary cases appear one incubation period after peak of first wave
- Taller successive waves of cases

## Key Epidemiological Tools: Spot Maps

- One spot = case
- Population density not reflected



## Analytic Epidemiology

- Quantify relationships between exposures and disease
- Approaches
  - Cohort study
  - Case-control study

## Cohort Studies

- Defined population
- Can contact all in timely manner
- Calculate attack rate
- Calculate risk ratio to determine risk of contracting illness from exposure

## Attack Rates

Calculate for those ill and exposed  
and those ill and not exposed

$$\frac{\text{number of people at risk who develop illness}}{\text{total number of people at risk}} \times 100$$

## Risk Ratios

$$\frac{\text{attack rate of ill and exposed}}{\text{attack rate of ill, not exposed}}$$

>1.0 = increased risk for exposed  
1.0 = equal risk  
<1.0 = decreased risk for exposed

## Case-Control Studies

- Population not defined
- Looks at diseased and non-diseased
- Calculate odds ratio to determine likelihood of contracting illness from exposure

## Odds Ratios

- Cross multiply and divide

a	b	ad
c	d	bc

>1.0 = increased likelihood  
1.0 = same likelihood  
<1.0 = decreased likelihood

## Selected Control Measures

- Get the word out to the public
- Post-exposure prophylaxis/treatment
- Recalling/destroying contaminated food
- Cleaning or closing an establishment
- Education

## Conclusion

- Ten key steps in an outbreak investigation
  - Prepare for fieldwork
  - Establish existence of outbreak
  - Verify diagnosis
  - Define and identify cases
  - Describe and orient data
  - Develop hypotheses
  - Evaluate hypotheses
  - Refine hypotheses
  - Implement control & prevention measures
  - Communicate findings
- A combined effort involving many professions, fields and disciplines