Outbreak Investigation Basics

Outline

- Definitions
- Epidemic Curve
- Outbreak Investigation Steps
  - Descriptive epi
  - Calculation of RR and OR

Definitions I

- Outbreak- more cases in a time and place (or population) than expected.
- Epidemic- same as outbreak or more widespread/prolonged, more political
- Cluster- a group of cases in a certain place and time suspected to be greater than expected.

Definitions II

- Vehicle- non-living intermediary (food, water, fomite)
- Vector- living intermediary (insect, arthropod): mechanical or biological transmission (part of life cycle)
- Reservoir- habitat where the agent grows and multiplies (humans, animals, environment)

Definitions III

- Modes of transmission
  - Direct:
    - Direct contact (mucous membranes, skin, fecal-oral)
    - Droplet spread
  - Indirect:
    - Airborne
    - Vehicle borne- food, water or fomite
    - Vectorborne- arthropod
- Portals of Entry- ingestion, inhalation, percutaneous

Epidemic Curve

- X axis- time (of onset, of exposure)
- Y axis- number of cases
- No gap between data points (X axis is continuous)
- X axis unit= ¼ as long as the incubation period
- Each box usually= 1 case

Epidemic Curve

- Magnitude over time
- Shape: point source vs propagated
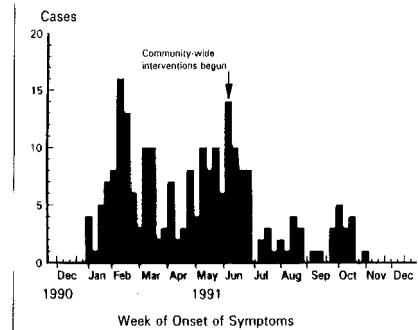- Evaluation of intervention
- Outliers recognized

FIGURE 1—Culture-confirmed cases of shigellosis by week, Lexington–Fayette County, Kentucky, December 1990 to December 1991.

Outbreak Investigation Caveats

- No set list
- No set order
- Many steps are dynamic: case-definition, line listings, descriptive epi, hypotheses
- Keep A LIST to double check in the midst of an outbreak

Steps 1 and 2: Outbreak Exists and Confirmation

- 1) Existence of an outbreak
  - Increase- specific disease or condition in a specific timeframe and/or location:
    - Clinical symptoms- viral meningitis in CCC in 1 month
    - Serotyping can help- *Salmonella* Saphra in CA in 1 month
    - DNA fingerprinting can help
      - *E. coli* O157 in N. Calif. in 1 month (pulsed field gel electrophoresis)
      - TB in a prison in 3 mos (restriction fragment length polymorphism)
- 2) Confirm diagnosis
  - Lab: culture, PCR, serology
    - Examples- shigella, norovirus, viral meningitis/legionellosis
  - Radiology/Expert Opinion- clinical TB in children

Step 3: Define and Count Cases

- 3A) Define cases (case definition): practical, reliable, apply without bias
  - Example: viral meningitis
    - Fever, headache x 2 days, and stiff neck
    - MD dx AND LP with >5 WBCs and no bacterial growth.
  - Example: *E. coli* O157 at Restaurant X on 3/31
    - Confirmed: culture positive with "outbreak" PFGE pattern and ate food purchased from restaurant X on 3/31
    - Probable: bloody diarrhea and ate food purchased at restaurant X during on 3/31
    - Possible: diarrhea (3 loose stools per day) and ate food purchased at restaurant X on 3/31

Step 3: Continued

- Case Definition may need to be updated within an investigation
  - Broad to specific
    - Infection with E. coli O157 vs. infection with the outbreak strain (defined by PFGE pattern)
  - Location of exposure
    - SARS outbreak (travel within 10 d of onset):
      - In February: China/HK/Hanoi/Singapore
      - In April: Toronto, Canada added
      - In May: Taiwan added
  - Dates of exposure can change
    - SARS outbreak: to meet the case definition-dates of exposure dependant on location of exposure
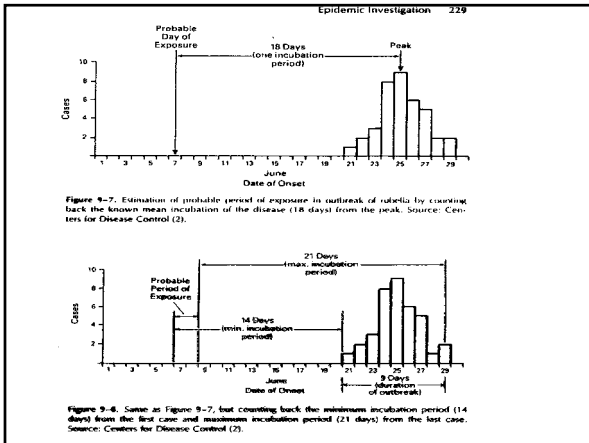
Step 3: Continued

- 3B) Count Cases
  - Case Finding: encourage testing
    - If asymptomatic may need serology to find infected (eg, legionellosis, viral meningitis)
    - Press release, email to attendees, hospital/clinic alert
    - Example: *Cyclospora* in a wedding party
  - Collect:
    - Demographics (age, sex, race, residence, occupation)
    - Symptoms and date of onset
    - Laboratory data
    - Isolates for further testing (eg, DNA fingerprinting)
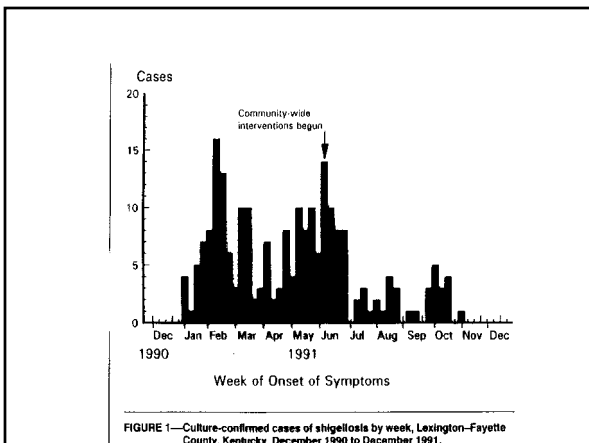   - Line listing (Excel spreadsheet)

Step 4: Orient the Data (Descriptive Epidemiology)

- 4A)Orient data by time (epi curve: # cases [Y axis] vs. onset date/time[X axis])
  - Point source outbreak: mean onset date minus incubation period (if known)= exposure date
    - Example: textbook
  - Ongoing transmission (often person to person)
    - Example: shigellosis in Lexington

Figure 9-7. Estimation of probable period of exposure in outbreak of rubella by counting back the known mean incubation of the disease (18 days) from the peak. Source: Centers for Disease Control (2).

Figure 9-8. Same as Figure 9-7, but counting back the minimum incubation period (14 days) from the first case and maximum incubation period (21 days) from the last case. Source: Centers for Disease Control (2).

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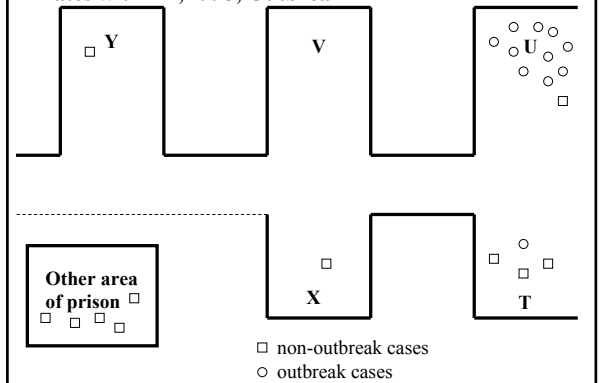   - Example: shigellosis in Lexington

Step 4: Orient the Data

- 4B)Orient data by place: location in city, hospital, prison
  - Example: TB in a prison

Residence in prison at the time of specimen collection for inmates with TB, 1995, Outbreak 1

□ non-outbreak cases
○ outbreak cases

Step 4: Orient the Data

- 4C)Orient data by person:
  - Age group
    - Example: *Salmonella,* young adults, and marijuana
  - Sex
    - Example: *Salmonella*, women, and alfalfa sprouts
  - Ethnicity
    - Example: *Salmonella,* Latinos, and cheese

Step 5: Determine who is at risk

- 5)Determine who is at risk:
  - Common exposure/event: *Salmonella* and Obon Festival

Step 6: Hypothesis Generation

- 6A)Generate Hypotheses
  - Indepth interviews:
    - Example: TB outbreak:day room vs. TV in own cell
    - Example: foodborne outbreak in restaurant: use menu, hypothesis generation with 5-10 patients: garnishes (not on menu)
    - Example: foodborne outbreak multicouny: >70 food item questionnaire and open-ended
  - Usually generates an outbreak specific profile
    - Examples: deli restaurants, Mexican restaurants, spring break in NY/Chicago/Europe

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Step 6: Test Hypothesis

- 6B) Test hypothesis:
  - Cohort study
    - Defined group: wedding party, reside on a unit
    - Compare exposed persons with non exposed persons
    - Calculate attack rates in exposed and compare with attack rate in unexposed (relative risk)
  - Case control study
    - Compare ill persons with well persons
    - Calculate odds of eating item X and compare odds of ill vs well (odds ratio)

Attack Rate Ratio Relative Risk/Risk Ratio

- 1) calculate attack rate for exposed ARexp=(A/A+B)
- 2) calculate attack rate for unexposed AR unexp=(C/C+D)
- 3) Calculate RR RR= ARexp/ARunexp = (A/A+B)/(C/C+D)

	III	Not III
Exposed/ ate	A	B
Unexposed/ did not eat	C	D

Format for Reporting: Cohort Study

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Odds Ratio Calculation

- 1) calculate odds of exposure for ill Odds ill=(A/C)
- 2) calculate odds of exposure for not ill Odds not ill=(B/D)
- 3) Calculate OR
  = Odds ill/Odds not ill
  = (A/C)/(B/D)
  =AD/BC

	III	Not III
Exposed/ ate	A	B
Unexposed/ did not eat	C	D

Format for Reporting: Case-Control Study

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Step 7: Compare the Hypothesis with with Facts

- 7)Compare hypothesis with facts
  - Does the implicated cause fit with the biology of the disease?
    - Example: SE and sandwiches (mayonnaise from eggs)
  - Can the food item be tested?
    - Example: SE and sandwiches (test eggs)
  - Does the implicated item trace to the same source?
    - Example: *Salmonella* -cantaloupe – several distributors but 1 grower in Mexico
    - Example: SE and residence near I80-
      - chicken eaten out (several brands) vs.
      - mung bean sprouts (one sprout grower)

Step 8 – Conduct a More Systematic Study

- 8)More systematic study (if needed)
  - Extent of illness: example Obon SE outbreak
  - Risk factors for infection: serosurvey viral mening.
  - Knowledge/Attitudes/Behavior survey: sprout consumption among women

Step 9: Write a Report

- 9)Written report purposes
  - Action (control and prevention)
  - Record of performance
  - Medical/Legal issues
  - Enhances quality of the investigation

Step 9A: Report the Report

- Report from local health jurisdiction to CDHS
- Forms for reporting
  - Foodborne- use CDC form: 52.13
  - Waterborne- use CDC form: 52.12
  - Norovirus- use DHS "Other Outbreak" form: 8554
  - Forms are on the IDB website: www.dhs.ca.gov/ps/dcdc/html/publicat.htm
  Publications----CD Case Report Forms
- Attach narrative report and tables showing epidemiologic associations

Step 10: Control and Prevention Last but NOT Least

- 10)Control and prevention
  - Specifics depend on the disease
  - Initiate reasonable and generic control measures as soon as possible (eg, time/temperature, handwashing, isolation, exclusion)
  - Do NOT delay control measures in order to investigate the cause of the outbreak
  - Continue control measures while investigating the possible cause