Waterborne outbreak of *Shigella sonnei* associated with a state park - New Jersey 2012

Rebecca Greeley, MPH
Antimicrobial Resistance & Waterborne Disease Coordinator, NJDOH - 2013
Steps of an Outbreak Investigation

- Prepare for field work
- Establish the existence of an outbreak
- Verify the diagnosis
- Define and identify cases
- Describe and orient the data in terms of time, place and person
- Develop hypotheses
- Evaluate hypotheses
- Refine hypotheses
- Implement control and prevention measures
- Communicate findings
"The Call"

- Astute emergency department physician called after-hours on Saturday night to report two families seen in ED with diarrheal illness
- No apparent association between families except for swimming in Lake A (Friday morning) less than 24 hours before symptoms began
- Stool specimens were collected
Verify the Diagnosis

- Initial stool results positive for *Giardia* and *Cryptosporidium*, too long of incubation period
  - Could not have been lake exposure
- **Corrected** laboratory results came back positive for *Shigella sonnei*, negative for *Giardia* and *Cryptosporidium*
  - Lake exposure possible
Shigellosis

- The genus *Shigella* has 4 species, including *Shigella sonnei*
- Bacterial disease that causes diarrhea (often bloody), fever, stomach cramping, vomiting
- Incubation period: usually 1-3 days, range 12-96 hrs
- Fecal-oral route; assoc foodborne outbreaks
- Per CDC, every year 14,000 cases reported in US (prob 20x higher due to under reporting)
- Worldwide, causes 600,000 deaths/year *Shigella dysenteriae*
Establish the Existence of Outbreak

- LHD made aware to look for more cases with possible Lake A exposure
- LHD interviewed cases and ill contacts for details regarding illness onset and potential exposures
- Initial information of cases points to visiting the State Park and/or the lake in the Park as common exposure
Prepare for Field Work

- State Park, not a locally run facility
  - Who has authority?
- Outbreak team assembled for site visit
  - Registered environmental health specialist
  - Epidemiologists
  - Public health nurse
- BRING CAMERA!
- Meet with State Park staff to discuss investigation
- Discuss amenities available at Park; site map
Amenities at State Park A

- State park with 27,000 acres
- Swimming/boating in lake
- Concessions with food and made-to-order flavor-ice
- Campgrounds and cabins
- Septic systems
  - Flush toilets
- Potable water
  - Drinking fountains
  - Showers
Develop Hypothesis

- Knowing the outbreak organism is *Shigella*, what common source at State Park could people have exposed to?
- Transmission is fecal-oral route
  - Eating contaminated food?
  - Drinking contaminated water?
Foodborne outbreak?
Swimming in the lake?
Man-made stagnant lake
Water testing

- Lake A water is sampled weekly (every Monday) as part of the New Jersey Recreational Bathing Facility regulations
  - Samples in 3 areas of lake
  - One sample taken from each of 3 swimming areas
- The lake passed each week of testing for total fecal coliforms (<200 cfus)
Leaking septic system?

Over 100 yards
Septic Field

This is a picture of the large septic field which was over 100 yards away.
Data Collection

- A supplemental questionnaire was developed and provided to the LHD to re-interview any cases who have association with swimming in Lake A
  - Questions on various water exposures
    - Lake, showers, potable water, ice
  - Questions regarding food exposures
    - Snack bar, food from home, grocery stores
- Contacted State Public Health Laboratory to perform PFGE analysis on specific isolates of *Shigella*
Define and Identify Cases

- **Confirmed:** Isolation of *Shigella sonnei* from a clinical specimen from someone who reported at least diarrhea but also may have cramps, fever, nausea, vomiting, and cramps 12-72 hours after swimming in Lake A between June 19-22, with one of three PFGE patterns associated with outbreak.

- **Probable:** A clinically compatible case that is epidemiologically linked to a confirmed case who also reported swimming in Lake A between June 19-22.
Define and Identify Cases (cont)

- **Secondary case**: A confirmed case or a probable case who is epidemiologically linked to a confirmed or probable case with illness onset at least one incubation period (12-72 hrs) after the onset of the first case.
Describe and Orient the Data in Terms of Time, Place, and Person
Descriptive Epidemiology

- Age: Median 8 years (Range 2-33 years)
- Sex: 68% Male
- Illness onset: 10 hrs – 72 hrs
- Confirmed cases: 12
- Probable cases: 13
- Hospitalizations: 2
- Secondary cases: 3
<table>
<thead>
<tr>
<th>Symptoms</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhea and/or bloody diarrhea</td>
<td>100%</td>
</tr>
<tr>
<td>Abdominal cramps</td>
<td>58%</td>
</tr>
<tr>
<td>Fever</td>
<td>52%</td>
</tr>
<tr>
<td>Nausea</td>
<td>42%</td>
</tr>
<tr>
<td>Vomiting</td>
<td>28%</td>
</tr>
<tr>
<td>Headache</td>
<td>13%</td>
</tr>
</tbody>
</table>
Develop Hypothesis
The Swimming Area

- There were 3 sections roped off for swimming
  - Main section
  - Additional section on right/left of main area
- Interviews with head life guard and review of logs revealed:
  - Increase in air and water temperature
  - Dramatic increase in number of swimmers
  - Shortage of lifeguards
  - No additional swimming area opened
  - Not following protocol of recording accidents involving fecal/vomitus
Number of swimmers in lake Jun 18 - Jun 22

- 691 Total
- 305 Total
- 24 Total
- 82 Total
- 21 Total

Water Sampled

Lake closed for thunderstorm
<table>
<thead>
<tr>
<th>Activity</th>
<th>Yes</th>
<th>No</th>
<th>Don’t know</th>
<th>No response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wade or play</td>
<td>11 (100%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Splash in face</td>
<td>7 (%)</td>
<td>1 (9%)</td>
<td>1 (9%)</td>
<td>2 (18%)</td>
</tr>
<tr>
<td>Put face in water</td>
<td>10 (91%)</td>
<td>1 (9%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Water up nose</td>
<td>6 (55%)</td>
<td>1 (9%)</td>
<td>2 (18%)</td>
<td>2 (18%)</td>
</tr>
<tr>
<td>Water in mouth</td>
<td>6 (55%)</td>
<td>1 (9%)</td>
<td>4 (36%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Swallow water</td>
<td>4 (36%)</td>
<td>2 (18%)</td>
<td>4 (36%)</td>
<td>1 (9%)</td>
</tr>
<tr>
<td>Dive or jump in lake</td>
<td>5 (45%)</td>
<td>5 (45%)</td>
<td>1 (9%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>
PFGE Results

- There were 3 PFGE patterns associated with the outbreak
  - There were 10 isolates with the pattern J16X01.1058 (8 associated with the outbreak, 1 secondary case, and 1 case without an epi-link to the lake)
  - There were 2 isolates with the pattern J16X01.0405 (both associated with the lake)
  - There were 4 isolates with the pattern J16X01.0408 (3 confirmed cases with association to the lake and 1 without an epi-link to the lake)
- All 3 patterns considered “fairly common”
PGFE

16X01.0405

J16X01.1058
Identify Cases
Potential Out-of-State Cases

- 176 Campgrounds
- 6 Cabins
- Geographically near Pennsylvania
- Camp record review showed visitors from Germany, TX, MA, PA, DE, GA, MD, NY, VA.
- National EpiX Posted for case finding
- CDC Pulsenet used to look for matches
- No additional cases were reported
Refine Hypothesis
Conclusions by Elimination

- Case onsets were limited to within 3 days
- No cases related to swimming in lake after thunderstorm
- Investigation findings ruled contamination of potable water or concessions
- Ruled out contamination of lake by the septic system
- Small area of lake open for swimming, large number of visitors, therefore fecal accident in stagnant lake most likely cause
Communicate Findings

- Written summary done as the data was finalized
- Copy sent to LHD
- Information added to CDRSS as appropriate
Investigation Summary

- Investigation of State Park Lake A started early because of astute clinician assessing exposures early
- LHD prompt interviewing of cases aided in ruling out other causes of illness
- Specific supplemental questionnaire useful in characterizing lake exposures and activities
- Life guards were not following protocol to report and record fecal and vomitus accidents in lake, changes put in place to address these deficiencies
- PFGE results for *Shigella* isolates may or may not be useful in outbreak case finding/definitions
Acknowledgements

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Local and Regional Health Departments
Centers of Disease Control and Prevention
Question 1

Laboratory diagnosis of shigellosis is determined by:

A. Blood test
B. Urine sample
C. **Feces or rectal swab**
D. Sputum test
Question 2

Which of the following are incorrect about Shigella:

A. Shigella is transmitted via the fecal-oral route
B. Individuals shedding the bacteria may also contaminate food by failing to properly wash hands before food handling
C. Person-to-person spread typically occurs among household contacts, preschool children in daycare and the elderly living in residential facilities
D. Transmission does not occur person-to-person through certain types of sexual contact or contact with a fomite
The public health investigation included a survey to determine common exposures to the disease. Which exposure was most likely to be the cause?

A. Lake
B. Showers
C. Ice
D. Snack bar
E. Food from home
Question 4

In this outbreak of Shigella, PFGE analysis of the organisms was the only key to “cracking the case” and linking all of the cases.

A. True

B. False
Question 5

The epidemic (epi) curve shows the illness onset in June 18, 2012 and another illness onset date of July 9, 2012. If the incubation period is 1-3 days, then how would you explain the late illness onset?

A. **They were secondary cases, linked to an earlier case**
B. Environmental sampling was not done well
C. There were less swimmers in June than in July
D. Sh*t happens
Question 6 (LAST ONE!)

Many factors were considered when determining cause of the outbreak at the lake. What was the single-most important consideration for this outbreak:

A. It was hot and humid
B. Food stand had only potable water
C. Lifeguards followed protocols and reported all vomit/fecal accidents
D. **Swimming in a stagnant lake with unreported fecal accidents**