Shigella Infections in Maryland 1998-2002

Emily Lu, MPH Candidate
PHASE Intern
Johns Hopkins Bloomberg School of Public Health

Janet Holbrook, PhD, MPH
Epidemiology Department, Johns Hopkins University

Pat Ryan, MS
Maryland Department of Health and Mental Hygiene
Emerging Infections Program
Background

- *Shigella* bacteria: gram-negative, nonmotile, non-encapsulated bacilli
- Symptoms: fever, fatigue, watery diarrhea, may progress to cramps and tenesmus
- Complications: severe dehydration, intestinal perforation, septicemia, seizures, and hemolytic uremic syndrome (HUS)
- In the U.S., among pathogens commonly transmitted through food, *Shigella* is the 3rd most common cause of bacterial infections after *Salmonella* and *Campylobacter*.
Research Questions

- Do the characteristics of the population affected by Shigella infections vary over time from 1998 to 2002?
- Why was there a sudden increase in the incidence rate of *Shigella* infection during 2002?
Maryland’s Foodborne Diseases Active Surveillance Network (FoodNet)

- Part of CDC’s Emerging Infections Program
- Population-based active surveillance system for foodborne diseases caused by bacterial and parasitic infections
- Laboratory-confirmed cases
- Pathogens under surveillance: *Campylobacter*, *E. coli* 0157, *Listeria monocytogenes*, *Salmonella*, *Shigella*, *Yersinia enterocolitica*, *Vibrio*, *Cryptosporidium* and *Cyclospora*
Methods

- Descriptive analysis of race distribution, sex ratio, % hospitalization, mean and median age of *Shigella* cases
- Incidence rates of *Shigella* infection calculated using census data from Maryland Department of Planning
- Chi-square test for trend
- Multiple logistic regression analysis
Results
## Shigella Infections in Baltimore Metro Area of Maryland, 1998-2002

### By serogroup

<table>
<thead>
<tr>
<th>Percent (counts)</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shigella boydii</strong></td>
<td>1.7%</td>
<td>3.6%</td>
<td>2.5%</td>
<td>6.5%</td>
<td>0.1%</td>
<td>0.8%</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(2)</td>
<td>(4)</td>
<td>(1)</td>
<td>(10)</td>
</tr>
<tr>
<td><strong>Shigella flexneri</strong></td>
<td>36.2%</td>
<td>36.4%</td>
<td>14.8%</td>
<td>27.4%</td>
<td>0.8%</td>
<td>6.0%</td>
</tr>
<tr>
<td></td>
<td>(21)</td>
<td>(20)</td>
<td>(12)</td>
<td>(17)</td>
<td>(8)</td>
<td>(78)</td>
</tr>
<tr>
<td><strong>Shigella sonnei</strong></td>
<td>55.2%</td>
<td>56.4%</td>
<td>77.8%</td>
<td>64.5%</td>
<td>97.7%</td>
<td>91.2%</td>
</tr>
<tr>
<td></td>
<td>(32)</td>
<td>(31)</td>
<td>(63)</td>
<td>(40)</td>
<td>(1016)</td>
<td>(1182)</td>
</tr>
<tr>
<td><strong>Shigella unspecified</strong></td>
<td>6.9%</td>
<td>3.6%</td>
<td>4.9%</td>
<td>1.6%</td>
<td>1.4%</td>
<td>2.0%</td>
</tr>
<tr>
<td></td>
<td>(4)</td>
<td>(2)</td>
<td>(4)</td>
<td>(1)</td>
<td>(15)</td>
<td>(26)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>(58)</td>
<td>(55)</td>
<td>(81)</td>
<td>(62)</td>
<td>(1040)</td>
<td>(1296)</td>
</tr>
</tbody>
</table>
Shigella Infections in Baltimore Metro Area by Month 2002 vs. 1998-2001
Shigella Incidence Rates in Baltimore Metro Area of Maryland 1998-2002

χ² (df=1) = 2.9 x 10^3, p < 0.0001
Incidence rates of *Shigella* infections in Baltimore Metro Area of Maryland, 1998-2002

### By race

<table>
<thead>
<tr>
<th>Incidence rate/100,000</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>p value**</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>1.6</td>
<td>1.3</td>
<td>3.6</td>
<td>1.0</td>
<td>9.8</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Black</td>
<td>2.7</td>
<td>2.7</td>
<td>1.8</td>
<td>5.8</td>
<td>119.4</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Other*</td>
<td>3.9</td>
<td>2.5</td>
<td>0.9</td>
<td>2.7</td>
<td>6.9</td>
<td>.17</td>
</tr>
</tbody>
</table>

*Other: Asian & other. (Excluded race unknown)

**χ² test for trend, 4 degree of freedom.
Age Distribution

Incidence of *Shigella* Infections in Baltimore Metro Area by Age Category, 1998-2001

![Graph showing incidence per 100,000 population by age group (years) from 1998 to 2001.](image)

- **Incidence per 100,000 population**
  - 0-4
  - 5-9
  - 10-19
  - 20-29
  - 30-39
  - 40-49
  - 50-59
  - >=60

- **Year**
  - 1998
  - 1999
  - 2000
  - 2001
Incidence of *Shigella* Infections in Baltimore Metro Area by Age Category, 1998-2002
Incidence rates of *Shigella* infections in Baltimore Metro Area of Maryland, 1998-2002

By jurisdiction

<table>
<thead>
<tr>
<th>Incidence rate/100,000</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anne Arundel</td>
<td>1.5</td>
<td>2.7</td>
<td>0.6</td>
<td>2.4</td>
<td>9.5</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Baltimore City</td>
<td>3.7</td>
<td>2.9</td>
<td>7.4</td>
<td>4.6</td>
<td>106.3</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Baltimore County</td>
<td>2.5</td>
<td>1.5</td>
<td>3.2</td>
<td>2.0</td>
<td>36.3</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Carroll</td>
<td>1.4</td>
<td>2.0</td>
<td>1.3</td>
<td>0.0</td>
<td>2.5</td>
<td>.423</td>
</tr>
<tr>
<td>Harford</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.9</td>
<td>7.0</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Howard</td>
<td>1.7</td>
<td>3.3</td>
<td>1.2</td>
<td>1.2</td>
<td>5.0</td>
<td>.023</td>
</tr>
</tbody>
</table>

*χ² test for trend, 4 degrees of freedom.
Shigella Incidence Rates by Race and Age Category in Baltimore City, 2002

incidence per 100,000 population

age category (years)

White
Black
Other

0-4 5-9 10-19 20-29 30-39 >=40
Shigella Incidence Rates by Race and Age Category in Baltimore County, 2002

incidence per 100,000 population

age category (years)

0-4 5-9 10-19 20-29 30-39 >=40

White Black Other
## Multiple Logistic Regression Analysis

<table>
<thead>
<tr>
<th></th>
<th>Adj. Odds Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year (2002 vs. 1998-2001)*</td>
<td>16.16 (14.09 to 18.52)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Age category**</td>
<td>0.57 (0.56 to 0.59)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Year (2002 vs. 1998-2001)*</td>
<td>53.48 (40.34 to 70.91)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Age category***</td>
<td>0.77 (0.72 to 0.82)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Year*Age category</td>
<td>0.68 (0.63 to 0.73)</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>


**Age divided into categories: 0-4 years=1, 5-9 years=2, 10-19 years=3, 20-29 years=4, 30-39 years=5, 40-49 years=6, 50-59 years=7, & 60 years or above=8.
Multiple Logistic Regression Analysis (cont’d)

<table>
<thead>
<tr>
<th></th>
<th>Adj. Odds Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year (2002 vs. 1998-2001)*</td>
<td>18.19 (15.73 to 21.03)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Race (0=white, 1=black)</td>
<td>7.64 (6.71 to 8.70)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Year (2002 vs. 1998-2001)*</td>
<td>5.18 (4.12 to 6.50)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Race (0=white, 1=black)</td>
<td>1.72 (1.32 to 2.25)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Year*Race</td>
<td>7.07 (5.16 to 9.67)</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>

Conclusion and Public Health Implication

- *Shigella* infections affecting mostly African American children < 5 years old in 2002
- Age group with highest incidence rate observed is in agreement with day care attendees
- Crowded living conditions, dilapidated housing and poverty may also influence the rates of *Shigella* infection
- To treat or not to treat
  - Vaccine (not currently available)
  - Prevention target: hygiene education (hand washing)
- Detection bias
- An underestimate of true burden
Acknowledgments

- Pat Ryan, MS
- Janet Holbrook, PhD
- David Blythe, MD, MPH
- Melanie Megginson, MPH
- Dipti Shah, MPH
- Michel Ibrahim, MD, PhD, MPH
- Ayanna Fews, MBA
- Frances Burman
- Marie Diener-West, PhD
- Rosa Crum, MD, MHS