Preliminary Results of an Investigation of an Outbreak of \textit{Shigella sonnei} — Genesee and Saginaw Counties, Michigan, 2016

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Goals of the Investigation

1. Characterize the outbreak.

2. Identify risk factors for shigellosis.

3. Determine the need for further study.

4. Engage the community, incorporate input, provide updates.
Methods: Case Series

- Identified case-households
  - Cases reported March 1 to October 29
  - Michigan Disease Surveillance System

- Interviewed case-households
  - Phone interviews
  - Collected demographic and illness information on all household members
  - Identified index cases (earliest onset in HH) and secondary cases
  - Assessed risk factors among index cases
Exposures of Interest among Index Cases

- Childcare
- Occupation
- Diaper contact
- Sick contacts
- Travel
- Mode of transportation
- Attendance of activities/events
- Meals outside the home

- Recreational water
- Drinking water source
- Household water use
  - Handwashing
  - Bathing/showering
  - Drinking
  - Food preparation
  - Cleaning
- Changes in handwashing or bathing habits
Case-household Recruitment

115 Households with working contact information,
83 Households interviewed,
353 HH members,
158 cases
(83 index cases, 75 secondary cases)
Methods: Laboratory and Water Data Analyses

• Molecular typing
  ▪ Pulsed-field gel electrophoresis (PFGE)
  ▪ Whole genome sequencing (WGS)
• Geospatial Research, Analysis, and Services Program (GRASP), ATSDR/CDC
  ▪ Mapping, Spatial-temporal analysis
    • Cases
    • Water quality data from sampling
    • Water main breaks
    • Household size
    • Water supplies
    • Private wells
    • Flint HH water use
REVIEW OF MAIN FINDINGS
Shigelllosis cases reported to MDHHS, by week — Genesee and Saginaw Co., Michigan, Mar 1–Dec 10, 2016 (N=185)
REVIEW OF MAIN FINDINGS

1. *Shigella* bacteria appear to have spread from person to person.
## Mean size and case count of case-households, stratified by county — Michigan, Mar-Oct 2016

<table>
<thead>
<tr>
<th></th>
<th>Saginaw &amp; Genesee Co. (N=83)</th>
<th>Saginaw Co. (n=29)</th>
<th>Genesee Co. (n=54)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean household size</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case-households</td>
<td>4.3*</td>
<td>4.1*</td>
<td>4.3*</td>
</tr>
<tr>
<td>General population† (ref)</td>
<td>2.5</td>
<td>2.5</td>
<td>2.4</td>
</tr>
<tr>
<td><strong>Mean cases per case-household</strong></td>
<td>1.9</td>
<td>2.0</td>
<td>1.8</td>
</tr>
</tbody>
</table>

*Households in the outbreak were larger than the average household*

* $P<0.001$

† 2015 American Community Survey, 1-year estimates
Median age of cases versus that of the general population, by county — Michigan, Mar-Oct 2016

<table>
<thead>
<tr>
<th>Median age (years)</th>
<th>Saginaw Co.</th>
<th>Genesee Co.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases*</td>
<td>12‡</td>
<td>10‡</td>
</tr>
<tr>
<td>General pop. (ref)</td>
<td>40</td>
<td>39.1</td>
</tr>
</tbody>
</table>

* Saginaw County, n=59; Genesee County, n=99; ‡ P<0.0001; † 2015 American Community Survey, 1-year estimates

In each county, people who got sick were significantly younger than the general population.
Median age of cases and non-ill household members — Genesee & Saginaw Co., Michigan, Mar-Oct 2016

<table>
<thead>
<tr>
<th></th>
<th>Median age (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases (n=158)</td>
<td>10*</td>
</tr>
<tr>
<td>Non-ill HH members (n=183) {ref}</td>
<td>23</td>
</tr>
</tbody>
</table>

Cases were significantly younger than household members who didn’t get sick

* P<0.01
Contact with diapers, people wearing diapers, or people with diarrhea outside the home among index cases, by location — Michigan, Mar-Oct 2016

<table>
<thead>
<tr>
<th></th>
<th>Saginaw &amp; Genesee Co. (N=83)</th>
<th>Saginaw Co. (n=29)</th>
<th>Genesee Co. (n=54)</th>
<th>Flint (n=24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact with diapers* or with a person with diarrhea</td>
<td>68%</td>
<td>79%</td>
<td>62%</td>
<td>74%</td>
</tr>
</tbody>
</table>

The majority of sick people either wore diapers, had contact with people who wore diapers, or had contact with a person with diarrhea outside the home.

* Includes diaper contact inside or outside the home
REVIEW OF MAIN FINDINGS

2. *Shigella* bacteria did NOT appear to spread through drinking water.
Tap water consumption among case-households, stratified by location — Michigan, Mar-Oct 2016

<table>
<thead>
<tr>
<th>Tap water consumption*</th>
<th>Saginaw Co.</th>
<th>Genesee Co.</th>
<th>Flint (ref)</th>
<th>Greater Genesee Co.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Either filtered or unfiltered water</td>
<td>100%‡</td>
<td>50%</td>
<td>33%</td>
<td>63%‡</td>
</tr>
<tr>
<td>Unfiltered water</td>
<td>93%‡</td>
<td>20%</td>
<td>8%</td>
<td>30%‡</td>
</tr>
</tbody>
</table>

* Tap water consumption included using tap water for drinking, mixing cold drinks, or using ice made with tap water; ‡ P<0.05

Case-households from greater Genesee County and Saginaw County were significantly more likely to consume tap water than those from Flint
Rate of shigellosis per Census tract as reported to MDSS — Saginaw and Genesee Counties, Michigan, Mar 1–Dec 10, 2016
Rate of shigellosis per City of Flint ward as reported to MDSS — Flint and surrounding Genesee County, Michigan, Mar 1–Dec 10, 2016
REVIEW OF MAIN FINDINGS

3. *Shigella* bacteria from Saginaw and Genesee counties are related to each other, suggesting they are part of the same outbreak.
Four Closely Related PFGE Patterns Among Case-isolates from the Outbreak

Whole genome sequencing of isolates from across MI. Genesee and Saginaw are two most closely related clades (11-34 SNPs). Ingham County isolates in both these clades---suggests longer term evolution vs. point source
Summary of Main Findings

1. *Shigella* bacteria appear to have spread from person to person.

2. *Shigella* bacteria did NOT appear to spread through drinking water.

3. *Shigella* bacteria from Saginaw and Genesee counties are related to each other, suggesting they are part of the same outbreak.
Summary of Additional Findings

- Overall, information was collected on 158 ill people from 83 households

- Characteristics that did not differ by location:
  - Age, gender, the proportion of people who got sick in each household

- Factors that were similar across counties:
  - Travel, dining outside the home, recreational water exposure

- No single event or establishment was identified as the source of the outbreak
What’s Next?

- **Laboratory testing**
  - Processing additional *Shigella* samples from greater Michigan
  - Analyzing the samples to better understand how *Shigella* bacteria in different parts of the state relate to each other

- **Mapping analysis**
  - Collecting and mapping the final pieces of data
  - Determining whether there are any links between shigellosis cases and indicators of poor water quality, such as water main breaks or low chlorine levels.

- Results will be released in a final report
Thank You