Assessment of Non-O157 Shiga Toxin-Producing *Escherichia coli* Infection and Surveillance in Wisconsin

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Presentation Outline

• Introduction
  – STEC infection
  – Serotyping
• Non-O157 vs O157 STEC epidemiology
• The state of STEC screening in Wisconsin
• The public health problem
• Project design
• Conclusions
Introduction

• Shiga Toxin-producing *Escherichia coli* (STEC)
• Normal animal microflora
  – Human illness
• 265,000 STEC infections per year in USA (CDC)

http://rockstargop.files.wordpress.com/2011/04
## Reportable Enteric Conditions

<table>
<thead>
<tr>
<th>Disease</th>
<th>2011 case count</th>
<th>Median age</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEC</td>
<td>315</td>
<td>19</td>
</tr>
<tr>
<td>HUS</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Salmonellosis</td>
<td>750</td>
<td>34</td>
</tr>
<tr>
<td>Typhoid Fever</td>
<td>4</td>
<td>29</td>
</tr>
<tr>
<td>Campylobacteriosis</td>
<td>1385</td>
<td>35</td>
</tr>
<tr>
<td>Cryptosporidiosis</td>
<td>738</td>
<td>23</td>
</tr>
<tr>
<td>Shigellosis</td>
<td>73</td>
<td>23</td>
</tr>
<tr>
<td>Listeriosis</td>
<td>13</td>
<td>76</td>
</tr>
<tr>
<td>Giardiasis</td>
<td>585</td>
<td>34</td>
</tr>
<tr>
<td>Yersiniosi</td>
<td>8</td>
<td>35</td>
</tr>
<tr>
<td>Vibriosis</td>
<td>6</td>
<td>36</td>
</tr>
</tbody>
</table>
STEC Infection

• What is Shiga toxin?
• Incubation: 3-4 days
• Symptoms:
  – Watery diarrhea, frequently bloody
  – Abdominal cramping
  – +/- vomiting
  – +/- low grade fever
• Complications:
  – Hemorrhagic colitis
  – Hemolytic Uremic Syndrome (HUS)
  – Thrombocytopenic purpura (TTP)

http://www.gardenofeaden.blogspot.com
STEC Infection

- Common vehicles: raw or undercooked beef; (especially ground beef); leafy greens and unpasteurized (raw) milk
  - Person-to-person transmission
  - Tests of cure for daycare, healthcare workers, food handlers

http://www.finlaylab.msl.ubc.ca
**E. Coli** serotyping

- O antigen from LPS
- H antigen from flagella
  - O157:H7, O26:H11
- 265,000 STEC infections per year in USA (CDC)
  - O157 causes 36%
  - Non-O157 cause the rest

http://www.foodsafetynews.com
Non-O157 STEC

• Important emerging food-borne pathogens
• Outbreaks as well as sporadic infections
• Illness severity vs. number of cases
  – During 2011, in Wisconsin, 121 out of 318 (38%) reported cases of STEC infection were caused by non-O157 STEC
Reported *STEC* cases
Wisconsin, 2011 (n=318)
Reported *STEC* cases  
Wisconsin, 2011

### Descriptive Epidemiology

<table>
<thead>
<tr>
<th></th>
<th>O157 (n=180)</th>
<th>Non-O157 (n=121)</th>
<th>All STEC (n=318)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No. Confirmed</strong></td>
<td>180</td>
<td>121</td>
<td>318</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td>51.67% Female (n=180)</td>
<td>61.15% Female (n=121)</td>
<td>56.6% Female (n=318)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>18 years old</td>
<td>19 years old</td>
<td>19 years old</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>26</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>0-89</td>
<td>0-88</td>
<td>0-89</td>
</tr>
<tr>
<td><strong>% &lt; 18 years</strong></td>
<td>48%</td>
<td>47%</td>
<td>47%</td>
</tr>
<tr>
<td><strong>No. hospitalized</strong></td>
<td>68 (37.78%)</td>
<td>20 (17.7%)</td>
<td>93 (30.49%)</td>
</tr>
<tr>
<td></td>
<td>n=175</td>
<td>n=113</td>
<td>n=305</td>
</tr>
<tr>
<td><strong>No. died</strong></td>
<td>3 (1.67%)</td>
<td>0 (0%)</td>
<td>3 (.98%)</td>
</tr>
<tr>
<td><strong>No. HUS</strong></td>
<td>4 (2.2%)</td>
<td>0 (0%)</td>
<td>4 (1.26%)</td>
</tr>
</tbody>
</table>
Non-O157 STEC

- Non-O157 are a threat to food safety
- Top non-O157 serotypes implicated in illness (CDC):
  - O26 (22%)
  - O111 (16%)
  - O103 (12%)
  - O121 (9%)
  - O45 (7%)
  - O145 (5%)
- “Big Six” classified as **adulterants** (September 2011)
- USDA begins testing for Big Six (June 2012)
Benefits of Testing

• Early diagnosis can influence patient management
• Early diagnosis can prevent further spread of illness
  – Food handlers
  – Daycare settings
• Testing helps identify clusters and outbreaks
The Public Health Problem:

- Non-O157 STEC now classified as adulterants
- CDC guidelines for clinical laboratories
- Non-uniformity of clinical laboratory screening protocols in the state
  - STX screening- 36/130 labs
  - Cultures
CDC Guidelines for HC Providers and Clinical Laboratories

Guidelines to ensure as complete as possible detection and characterization of STEC infections include the following:

- Specimen received by clinical laboratory
  - All samples should be cultured for STEC O157 AND screened for STX production by EIA or PCR
  - All STX positive samples and STEC O157 isolates should be sent to public health lab for characterization

  **O157 culture only? STX screening only?**

- If HUS patient without positive culture, send sample to public health lab or CDC for add’l tests

  - Public health lab isolates non-O157 STEC

http://www.cdc.gov/ecoli/clinicians.html
http://www.cdc.gov/mmwr/PDF/rr/rr5812.pdf
Project Design

1. Clinical laboratory survey
2. Analysis of STEC surveillance data
3. Mapping and modeling
4. Recommendations
Clinical Laboratory Survey

- Variation in testing protocols exists
- Survey of existing clinical laboratory testing protocols in conjunction with WSLH
- CDC Guidelines alignment

Clinical Laboratory Survey

• Online link
• Sample questions:
  – Does your laboratory currently test for Shiga toxin (STX) production?
  – If you perform in-house testing, which kit do you use?
  – Which samples are screened?
    – All samples?
    – Requested samples only?
    – *E. coli* O157:H7 isolates only?..  
  – Do you culture STX positive samples? (details)
  – Do you routinely culture non-O157 cases? (details)
• Survey results will be reported back to participants
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Analysis of STEC Surveillance Data

- WI DHS surveillance data (2006-present)
- FoodCORE grant surveillance data (2011-2012)
  - Labs A, B, and C
  - Different geographical areas
- Descriptive epidemiology, O157 and non-O157 STEC
  - Demographic data
  - Onset dates
  - Symptoms and severity
  - Exposure characteristics
  - Geographical data
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4. Recommendations
Mapping and Modeling

- Map geographic distribution of cases over time
- Map clinical laboratory territory and dates of testing onset
- Model expected case burden by county, and compare with observed case burdens over time
- Identify and describe areas of potential surveillance enhancement
Mapping and Modeling
2011 Confirmed STEC Cases by County (n=319)

Non-O157 (n=138)  O157 (n=181)
Mapping and Modeling

- Map geographic distribution of cases over time
- **Map clinical laboratory territory and dates of testing onset**
- Model expected case burden by county, and compare with observed case burdens over time
- Identify and describe areas of potential surveillance enhancement
Reported Shiga toxin-producing *Escherichia coli* (STEC) cases
Wisconsin 2005-2011
Mapping and Modeling

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Conclusions

• Non-O157 STEC are emerging foodborne pathogens
  – Number of reported cases
  – Sources
  – Adulterants
• Epidemiology of non-O157 STEC cases in Wisconsin has not been extensively studied
• Availability of testing has increased in recent years, leading to enhanced STEC surveillance
• Testing protocols vary by laboratory, leading to possible variation in number of diagnosed non-O157 cases
• Review of existing laboratory testing protocols in relation to geographical case distribution over time could help illustrate areas of potential STEC surveillance enhancement
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http://www.tumblr.com/tagged/ecoli