Public Health Laboratory Services for Foodborne Illness in Ontario

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Public Health Laboratory Services for Foodborne Outbreaks in Ontario

- Clinical Specimens
- Typing
- Food and Water Testing

- Early Detection of Potential Clinical Clusters
- Laboratory Evidence of Potential Food or Water Source
Laboratory Testing Infrastructure in Foodborne Illness in Ontario: Clinical Specimens

Community and hospital labs
- Routine stool testing from primary specimens

OAHPP public health laboratories (PHL)
- Confirmation, subtyping, detection of rare organisms,
  Primary specimens in outbreak

National Microbiology Laboratory/Health Canada
- Specialized testing such as botulism

NB All *Salmonella*, *E. coli* O157, *Shigella*, *Listeria* requested by PHL for confirmation and typing

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Test Menu for Enteric Specimens at OAHPP Laboratories

Bacteriology
• Culture
• Speciation
• Serotyping
• 16S available (for isolates)
• Organisms investigated on primary specimens
  – VTEC (including *E coli O157*, *Salmonella*, *Shigella*, *Campylobacter* and *Yersinia*)

Virology
• PCR and electron microscopy for norovirus

Parasitology
• Microscopy
### Enteric Specimens at OAHPP Laboratories

<table>
<thead>
<tr>
<th>Species</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Salmonella Enteritidis</em></td>
<td>690</td>
<td>771</td>
<td>707</td>
</tr>
<tr>
<td><em>Salmonella Typhimurium</em></td>
<td>791</td>
<td>455</td>
<td>368</td>
</tr>
<tr>
<td><em>Campylobacter spp.</em></td>
<td>442</td>
<td>318</td>
<td>243</td>
</tr>
<tr>
<td><em>E. coli O157</em></td>
<td>303</td>
<td>267</td>
<td>154</td>
</tr>
<tr>
<td><em>Yersinia spp.</em></td>
<td>276</td>
<td>250</td>
<td>241</td>
</tr>
<tr>
<td><em>Shigella spp.</em></td>
<td>220</td>
<td>256</td>
<td>245</td>
</tr>
<tr>
<td><em>L. monocytogenes</em>*</td>
<td>-</td>
<td>117</td>
<td>51</td>
</tr>
<tr>
<td>Enteric parasites***</td>
<td>639</td>
<td>619</td>
<td>431</td>
</tr>
<tr>
<td>Norovirus</td>
<td>-</td>
<td>580</td>
<td>947</td>
</tr>
</tbody>
</table>

*Campylobacter isolates not routinely submitted to OAHPP PHL

**Listeria isolates are from sterile sites only

*** Enteric parasites include *Cyclospora, Cryptosporidium, Giardia, and Entamoeba spp.*
Laboratory Testing Infrastructure in Foodborne Illness in Ontario: Food Specimens

OAHPP Public Health Laboratories
Service Public Health Inspectors
1) Outbreak investigation
2) Routine surveillance
3) Analysis of critical control points in HACCP evaluation

Canadian Food Inspection Agency Laboratories
Wide scope, including testing of commercial and federally regulated food products

National Microbiology Laboratory/Health Canada
Offer specialized testing i.e. botulism, Listeria, Hepatitis A

OMAFRA & University of Guelph Laboratories
Offer extensive menu for food testing & supports OMAFRA’s focus on provincially regulated food programs

Private food laboratories
Results and isolates may be forwarded to one of the laboratories above
Testing of Food Specimens: Analyses Available at OAHPP Laboratories

1) Indicator bacteria
   - Aerobic plate count (heterotrophic plate count)
   - Total coliform count
   - Escherichia coli
   - Total gram negative count

2) Bacterial pathogens (culture)
   - Bacillus cereus
   - Campylobacter jejuni
   - Clostridium perfringens
   - Escherichia coli O157:H7
   - Listeria monocytogenes
   - Salmonella species
   - Shigella species (not routinely performed)
   - Staphylococcus aureus
   - Vibrio species
   - Yersinia enterocolitica

3) Physiochemical Tests
   - pH
   - Phosphatase
   - Water activity

Referred to HC and CFIA laboratories
   - Clostridium botulinum
   - Hepatitis A
   - Norovirus
   - Cryptosporidium
   - Cyclospora
   - Giardia
   - Trichinella
   - Toxoplasma
   - Prions
   - Shellfish poisoning
## Testing of Food Specimens at OAHPP Laboratories

<table>
<thead>
<tr>
<th>Scenario #1</th>
<th>Scenario #2</th>
<th>Scenario #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rise in clinical cases of foodborne illness with <strong>no</strong> pathogen identified</td>
<td>Suspected foodborne outbreak with identified pathogen</td>
<td>Routine surveillance or critical point in HACCP analysis</td>
</tr>
<tr>
<td><strong>Food testing to be guided by epidemiological investigation</strong></td>
<td><strong>Foods should be submitted that are identified common among ill and associated as vector of suspected pathogen</strong></td>
<td><strong>Submitted by Public Health Inspectors</strong></td>
</tr>
<tr>
<td>Depending of suspected etiology, foods should be submitted that are identified as common among ill and associated as vector of suspected pathogen</td>
<td></td>
<td><strong>Indictors and appropriate pathogen specific analyses based on food matrix</strong></td>
</tr>
</tbody>
</table>

NB Please contact the CFIA if more appropriate for testing to be arranged through their laboratories
Pulsed Field Gel Electrophoresis (PFGE)

Electric field alternate 120° every 80 seconds for 16 to 24 hours at 14°C.
PulseNet

Local Laboratory
Basic Diagnosis

Provincial Laboratory
Molecular Subtyping (Pulsed-Field Gel Electrophoresis)
PFGE Pattern/DNA Fingerprint
Search for recent “matches”

National Microbiology Laboratory

Compare to national library
Apply standardized nomenclature
Search for recent “matches”

Clusters of cases posted and discussed on web board, continuously monitored/accessed by:
- Federal epidemiologists
- Provincial laboratories
- Provincial epidemiologists

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Courtesy of Celine Nadon and Matthew Gilmour PulseNet Canada, NML
Laboratory Testing Infrastructure in Foodborne Illness in Ontario: Molecular Typing

**OAHPP Public Health Laboratories**

- Pulsed Field Gel Electrophoresis (PFGE)
  - Clinical isolates: all *Listeria*, and *E coli* 0157, and others if 🔻 cases.
  - Food isolates: all isolates

**Canadian Food Inspection Agency**

- PFGE of all food isolates of *Listeria*, *E coli* 0157, *Salmonella* and *Shigella*

**Other Provincial Public Health Laboratories**

- PFGE of clinical and food isolates or sends isolates to NML to perform this testing

**CDC and Other International Partners**

- PulseNet USA establishes PFGE protocols
- Establishing secondary methods of molecular typing (MLVA)
- Will compare PFGE and MLVA results across borders

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Submissions to PulseNet Canada

Total number of PFGE patterns performed or uploaded

<table>
<thead>
<tr>
<th>Year</th>
<th>E. coli O157</th>
<th>Salmonella</th>
<th>Shigella</th>
<th>Listeria</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>60.7%</td>
<td>11.4%</td>
<td>7.5%</td>
<td>?</td>
</tr>
<tr>
<td>2006</td>
<td>74.3%</td>
<td>20.3%</td>
<td>3.2%</td>
<td>4.5%</td>
</tr>
<tr>
<td>2007</td>
<td>95.3%</td>
<td>34.8%</td>
<td>29.6%</td>
<td>30.5%</td>
</tr>
<tr>
<td>2008</td>
<td>86.4%</td>
<td>33.7%</td>
<td>34.1%</td>
<td>44.3%</td>
</tr>
</tbody>
</table>

Courtesy of Celine Nadon and Matthew Gilmour PulseNet Canada, NML
Combined Salmonella, E. coli O157:H7, L. monocytogenes, Shigella

Increased Laboratory Driven Cluster and Source Identification

serrano peppers, pet snake, restaurant, chicken, mussels, pet turtle, peanut butter, travel (Cuba, Mexico, Hawaii), Baby carrots, Ready-to-eat meat products, ready-to-eat pad thai, blue cheese
International linkages

PULSENET INTERNATIONAL

PulseNet Canada
PulseNet USA
PulseNet Latin America
PulseNet Europe
PulseNet Middle East
PulseNet Asia Pacific

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Courtesy of Celine Nadon and Matthew Gilmour PulseNet Canada, NML
Communication of Public Health Laboratory Results

Routine reporting of results to:
- Submitter
- Local public health unit
  (if positive for reportable disease)

Reporting to Ontario MOHLTC:
- All positive food isolates
- Line list of clinical isolates
  - Routine for *E coli* O157 and *Listeria*
  - Other organisms upon request

Communication with other agencies:
- Communication of urgent results coordinated through MOHLTC
- Weekly Ontario teleconference with other agencies including CFIA and OMAFRA
- via Pulsenet national discussion board, CIOSC alerts, and weekly national teleconferences

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Future Directions

• Molecular testing for enteric and food diagnostics
  – Such as real time PCR
    • Faster turn around time
    • Multiplex capacity
    • Currently unable to perform typing
    • Culture is gold standard

• Alternative molecular typing
  – Multilocus variable number tandem repeat analysis (MLVA)
    • High throughput and short turn around time
    • Alternative typing methodology when PFGE and phage typing unable to provide sufficient discrimination
    • Standardized methods being developed by PulseNet USA for Salmonella Typhimurium and E coli O157
  – Whole genome sequencing
Thank you.
Any questions?