An ongoing investigation of *Salmonella Enteritidis* in BC: Integrated surveillance, investigation and actions from farm to fork in BC

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*Promoting a Culture of Food Safety Symposium*

Nov 8 2011
Outline

- Introduction to integrated *Salmonella* surveillance in BC
- Outbreak investigation in BC (2008-2011)
  - Epidemiological
  - Environmental
  - Collaboration with animal health colleagues
  - Actions taken
- Lessons learned
Integrated *Salmonella* Surveillance in BC
Rationale and partners

- Desire to better identify and prevent source of human illness in farm to fork continuum
- First meeting with partners in 2005
  - Public health (BCCDC, PHAC)
  - Animal health (BC MAg, CFIA)
  - Food (CIPARS)
  - Labs (human, animal, food)
- Launched *Salmonella* pilot using existing data and resources in 2006
  - Based on Danish microbial tracking model
Goals and objectives

1. Identify sources and patterns of endemic and emerging disease caused by foodborne pathogens
   - Monitor the occurrence of pathogens along the food chain
   - Investigate the association between pathogens isolated from food and animal sources and human disease

2. Support an efficient and coordinated multi-agency response to health risks along the food chain
   - Formalize inter and intra-agency partnerships required to respond to health risks along the food chain
   - Identify, investigate and respond to health risks along the food chain by sharing information from human, food and animal sources
**Salmonella data sources and flow**

Diagram showing data sources and flow in the context of Salmonella surveillance. The diagram includes nodes representing different data sources such as BCCDC PHMRL, Food Testing Data, CFIA, Animal Health Centre, PHAC, and integrated surveillance database. Arrows indicate the direction of data transfer between these sources.
## Data collected
### Oct 2006-May 2010

<table>
<thead>
<tr>
<th></th>
<th>Human</th>
<th>Animal</th>
<th>Food</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number isolates</td>
<td>3700</td>
<td>1135</td>
<td>168</td>
<td>5003</td>
</tr>
<tr>
<td>Proportion chicken</td>
<td></td>
<td>81%</td>
<td>96%</td>
<td></td>
</tr>
<tr>
<td>Proportion positive</td>
<td></td>
<td></td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Number different serotypes</td>
<td>185</td>
<td>51</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Proportion SE</td>
<td>40%</td>
<td>33%</td>
<td>37%</td>
<td></td>
</tr>
</tbody>
</table>

Galantis *Food Res Int* 2011
Top 10 *Salmonella* serotypes by sector
Oct 2006-May 2010

Human (N=3700)

Animal - Chicken (N=701)

Food – Chicken (N=149)

<table>
<thead>
<tr>
<th>Enteritidis</th>
<th>Kentucky</th>
<th>Typhimurium</th>
<th>Heidelberg</th>
<th>4,5,12:i:-</th>
<th>Paratyphi A</th>
<th>Hadar</th>
<th>Newport</th>
<th>Stanley</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>26%</td>
<td>4%</td>
<td>2%</td>
<td>5%</td>
<td>2%</td>
<td>5%</td>
<td>4%</td>
<td>2%</td>
<td>2%</td>
<td>4%</td>
</tr>
</tbody>
</table>

Galanis *Food Res Int* 2011
S. Enteritidis by month and sector
Oct 2006-May 2010

Galanis *Food Res Int* 2011
Successes

- Implemented integrated surveillance of *Salmonella* along the foodchain using existing resources and data
  - Support and participation of original agencies and individuals
  - Ongoing collaboration
- Sharing and integrating data
  - Knowledge gained on surveillance programs
- Multi-disciplinary analysis
  - Joint analysis confirmed and clarified independent findings
- Collaborative response
  - Integrated surveillance process facilitated efficient and coordinated multi-sectoral response
The ongoing investigation of *Salmonella Enteritidis* in BC
Salmonella Enteritidis (SE) illness

- **Incubation**
  - 12-36h

- **Clinical illness**
  - Diarrhea, fever, nausea
  - Duration: few days
  - 22% hospitalized
  - Death rare
SE reservoir and transmission

- **Reservoir**: poultry
- Horizontally transmitted to other poultry
- Vertically transmitted to eggs
- **Source**: contaminated food
  - Occasionally via contact with poultry
  - Rarely person-to-person
SE global pandemic

- SE caused global pandemic in 1970-90s
  - Mostly due to PT4
  - Avoided Canada
- Initially, eggs were virtually sole source
- More recently, chicken has also been implicated
- Some countries have successfully controlled SE, others not
  - Requires intensive on farm control measures and top-down approach
SE from a BC perspective

- *Salmonella* is the second most common enteric pathogen in BC
  - 1078 cases reported in 2010
- SE has been the most common serotype since 2004
  - 2004: 20% of all *Salmonella* isolates
  - 2010: 49% of all *Salmonella* isolates
SE Incidence in BC, 2000-2010

Source: BCCDC PHRML
Emergence of SE 3 in BC

- Restaurant cluster associated with raw egg mayo in June 2008
- Previous outbreaks
  - 2000: egg wash*
  - 2007: egg noodle factory
  - 2007: chicken omelette
- Animal data
  - BC Ministry of Agriculture
  - CIPARS

Investigation methods

- Epidemiology
  - Case follow-up
  - Case control study
- Environmental
  - Cluster investigations
  - Egg confiscations
- Laboratory
  - Food testing
- Animal health (Animal Health Centre)
  - Diagnostic
  - Monitoring data
    - Registered broiler hatcheries (CFIA monitoring)
    - Regulated table egg industry (Industry monitoring)
Case follow-up

- Case interviews conducted with all cases of salmonellosis in BC
- Routine and enhanced questionnaires used
- Questionnaires forwarded to BCCDC for central analysis
- Matched to PFGE information
SE 3 infections, BC, by reported month, January 2007- June 2011

Source: BCCDC PHRML
Cluster investigations

- Cluster = multiple cases associated with a common food place or event
- Investigation conducted by an EHO
  - Information on food sources collected
  - Investigate hygiene, food preparation, appropriate food storage.
- Information on incidents of egg confiscations due to dirty, cracked or inappropriately stored eggs collected
Investigation results - Environmental

- **Traceback**
  - Attempted for all clusters and sporadic cases where possible
  - No single common source was identified
  - Significant challenges identified during ungraded egg traceback
    - Lack of receipts, supplier information
  - Redistribution of eggs from farms
Case Control Study

- Retrospective case control conducted from November, 2008-February, 2009
- 92 cases matched to one control
  - Geography and age range (0-4, 5+)
- Controls recruited through sequential digit dialing
Laboratory Investigation

- 53 food samples tested during the investigation
  - 48 samples were ungraded broiler hatching eggs
- Mayonnaise made with raw egg on-site from the first restaurant cluster was positive.
  - Matched the outbreak PFGE pattern (SE 3)
Investigation results-Animal data

- Chicken diagnostics
- Registered broiler hatchery monitoring
- Registered table egg monitoring
Select SE phage types by sector*
Oct 2006-May 2010

* Phagetypeing of animal isolates started in 2008

Galanis Food Res Int 2011
Actions taken in BC-Successes

- Public
  - Annual media releases to raise awareness
- Restaurants/retail
  - Confiscation of eggs
  - Progressive enforcement
  - Brochure for FSE
- Farm level
  - MAg: awareness raising among industry
  - Broiler hatching egg industry
    - SE vaccination
    - Pilot of increased SE testing
    - Recommended ceasing sale of hatching eggs at farmgate
Impact

- Decrease in number of restaurant egg confiscations and clusters identified (peak in 2008)
- No decrease in overall incidence rate in humans
  - Too early?
  - Insufficient actions?
  - Inappropriate actions?
Lessons learned

- Current SE subtyping methods insufficient to discriminate between sources of SE
  - Collaboration with NML
- Commonly consumed food item is difficult to identify as source of outbreak
  - Collaborate multi-sectorally
  - Use variety of methods and data sources
- Traceback is challenging
  - How do we improve our traceback and traceability?
- Ongoing integration of human and animal data
Ongoing work

Investigation
- Enhanced surveillance to identify more clusters, characterise and focus on “at risk” restaurants and traceback to source farms

Actions
- Continued interaction and sharing of information with industry to encourage action
  - Nationally
    - SE Symposium-December 2010
  - Locally
    - Meetings with public health, agriculture and industry
Final thoughts

- Integrating from farm to fork
  - Surveillance
  - Investigation
  - Actions
  - Research/projects

- Development of a platform
  - Relationships
  - Data sharing
  - Ongoing challenges (representative, diversity, timeliness)

- Evolution to collaborative investigations and further work
Acknowledgements

- Vancouver Coastal Health Authority
- Fraser Health Authority
- Vancouver Island Health Authority
- Interior Health Authority
- Northern Health Authority
- BC Ministry of Agriculture
- BCCDC Public Health Microbiology and Reference Lab
- Canadian Food Inspection Agency
- Public Health Agency of Canada
- BC Centre for Disease Control