Changing Trends in Foodborne and Enteric Zoonotic Outbreaks

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Centers for Disease Control and Prevention
**Salmonella**

- Most common bacterial cause of enteric illness in United States
  - 1.2 million illnesses
  - 24,000 hospitalizations
  - 450 deaths

- Multiple sources
  - Food (e.g.: meat, poultry, eggs, produce)
  - Water
  - Animal contact (direct and indirect)
Timeline for Reporting *Salmonella* Cases

- **Person Exposed to Food/Animal**: 1 to 3 days
  - Time to contact with health care system = 1 to 5 days

- **Stool Sample Collected**

- **Public Health Laboratory Receives Sample**

- **Person Becomes Ill**: Time to Diagnosis = 1 to 3 days
  - Shipping Time = 0 to 7 days

- **Salmonella Identified**
  - Serotyping and “DNA fingerprinting” = 2 to 10 days

- **Case Confirmed as Part of Outbreak**

**Typically 2-3 weeks for *Salmonella* infections**
How do we find outbreaks and illnesses?

- National molecular subtyping network for enteric disease surveillance
  - >85 public health and regulatory laboratories

- Molecular subtyping of disease-causing bacteria
  - Pulsed-field gel electrophoresis (PFGE)
  - PFGE pattern = molecular fingerprint for each isolate
PulseNet USA

- Molecular “fingerprints” shared electronically
- Kept in national database at CDC
- Monitored for clusters
Outbreak Detection

- On May 6, 2014, PulseNet USA identified cluster of *Salmonella* Newport
  - 9 infections in 5 states
  - Novel PFGE pattern in United States

- On May 14, 2014, PulseNet Canada queried in collaboration with CDC
  - Identified matching cluster of outbreak strain
  - 4 infections in 2 provinces
<table>
<thead>
<tr>
<th>Demographics</th>
<th>n = 31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years), median (range)</td>
<td>48 (1–81)</td>
</tr>
<tr>
<td>Female</td>
<td>19 (61%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>n = 22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalizations</td>
<td>5 (22%)</td>
</tr>
<tr>
<td>Deaths</td>
<td>0</td>
</tr>
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</table>
Persons Infected with the Outbreak Strains of *Salmonella* Newport, Hartford, or Oranienburg, by State, 2014, n=31
Identifying Common Exposures

- **State questionnaires**
  - Healthy-eater signal (e.g.: vegan, vegetarian, nondairy)
  - ‘Chia seed flour’ noted by local health department in Wisconsin during investigation of ill person

- **Open-ended interviews with ill persons or proxies**
  - Seven (100%) of seven reported eating chia seed powder
  - Six (86%) of seven reported the same brand (Brand X)
Brand X investigated utilizing lot code information from leftover product of ill persons.

Firm Y sprouted chia seed powder during timeframe of interest.

Country Z supplied Firm Y with three lots of suspect chia seeds grown and harvested by two farms in June and July 2013.
Facility Inspections

- Conducted by Canadian Food Inspection Agency (CFIA)
- Manufactured chia seed powder
- Outbreak strains identified in retention samples
- Likely source of outbreak

- Conducted by U.S. Food and Drug Administration (FDA) and state partners
- Firm Y sole source of chia seed powder
- No evidence contamination occurred at Brand X facility
Eight Canadian companies

Brand X

Three other U.S. companies

14 other countries

Firm Y
Recalls

Eight Canadian companies

9 brand names

Brand X

Three other U.S. companies

5 brand names

Canada

United States
Public Health Actions

Public Health Emergency of International Concern (PHEIC), June 26
Import Alert issued June 11

Brand X

Firm Y

Canada

United States
Chia Seed Powder

- Novel vehicle for foodborne illness outbreak
- Chia seeds were sprouted, dried, and ground to make powder
- Sprouting without chlorination likely allowed for amplification
- Consumed without additional processing
Epidemiology of *Listeria monocytogenes* Infections

- **Annual disease burden**
  - >1500 infections
  - >250 deaths

- **Groups at higher risk of infection**
  - Immunocompromised
  - Elderly
  - Pregnant women
  - Newborns
Case Definition

- An illness with an outbreak PFGE pattern reported to PulseNet
- Genetically related by WGS
- Onset on or after October 1, 2014
# Final Epidemiologic Data

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of ill persons</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Median Age* (range)</td>
<td>64</td>
<td>7-92</td>
</tr>
<tr>
<td>Female* (%)</td>
<td>8/24</td>
<td>33</td>
</tr>
<tr>
<td>Pregnancy-associated</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Hospitalizations</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Deaths</td>
<td>7</td>
<td>20</td>
</tr>
</tbody>
</table>

*among non-pregnancy cases
Persons Infected with the Outbreak Strains of *Listeria monocytogenes*, by State (n=35)

- **1 case**
  - CA 3
  - WA 1
  - AZ 5
  - UT 1
  - CO 1
  - NV 1
  - NC 1
  - NV 1
  - TX 4
  - WI 3
- **2-3 cases**
  - AZ 5
  - NM 6
  - MO 5
- **≥4 cases**
  - MO 4
  - CA 3
Ill Persons Infected with the Outbreak Strains of *Listeria monocytogenes*, by Isolation Date as of February 12, 2014 (n=35)
Epidemiologic Investigation

- Administered a *Listeria* questionnaire and a general questionnaire
- Open-ended questioning identified caramel apples as a potential vehicle
Caramel Apple Brands and Retail Chains

- Limited number of caramel apple brands
- Multiple different retail chains

Do not eat “commercially produced, prepackaged caramel apples”
Traceback Investigation

Retail 1 → Manufacturer 1
Retail 2
Retail 3
Retail 4
Retail 5
Retail 6
Retail 7
Retail 8
Retail 9

Distributor 1

Manufacturer 2

Manufacturer 3

Manufacturer 4

Manufacturer 5

Single common apple supplier
Recalls

- Product recalls issued to 3 caramel apple manufacturers
- Public recall issued for all apples produced from the apple supplier in 2014
Ill Persons Infected with the Outbreak Strains of *Listeria monocytogenes*, by Isolation Date as of February 12, 2014 (n=35)
Challenges

- Novel vehicle not captured by standard questionnaires
- Long shelf life of caramel apples and apples
- Daily practices of the apple producer are unknown
Summary

- **Epidemiology**
  - Largest *Listeria* outbreak since 2011

- **Traceback**
  - Converged to one single apple facility

- **Laboratory (WGS)**
  - Link between environmental, apple, and human isolates
Zoonotic Salmonellosis

- *Salmonella* bacterial infection that is transmitted to humans from animals

- 11% of all *Salmonella* infections

- Among enteric zoonoses, non-typhoidal *Salmonella* infections result in the highest morbidity and mortality
  - 48% of hospitalizations
  - 62% of deaths
Live Poultry-Associated Salmonellosis Outbreaks

- Past (1955–1990)
  - Few outbreaks
  - Spring
  - Young children
  - Dyed birds, pets
Live Poultry-Associated Salmonellosis Outbreaks

- Past (1955–1990)
  - Few outbreaks
  - Spring
  - Young children
  - Dyed birds, pets

- Present (1990–2013)
  - Multiple multistate outbreaks
  - Year-round
  - Adults and children
  - Backyard flocks, pets
Backyard Poultry

- Small flocks of <50 birds
- Increase in urban and suburban settings
- Popular with organic and locally sourced food movements
Poultry Popularity

Photo attribution: [http://www.peoplepets.com/people/pets/article/0,,20495496,00.html](http://www.peoplepets.com/people/pets/article/0,,20495496,00.html)
[http://www.neimanmarcus.com/christmasbook/media.jsp?itemId=cat45440759&icid=product_beaucoup](http://www.neimanmarcus.com/christmasbook/media.jsp?itemId=cat45440759&icid=product_beaucoup)
Mail-order Hatchery Industry — United States

- ~20 core mail-order hatcheries
- >50,000,000 chicks sold annually
- Hatcheries may distribute nationwide
- Typically distributed through U.S. Postal Service to
  - Agricultural feed stores
  - Sold directly to customers
Shipment of Live Baby Poultry

- Cardboard boxes
  - 100-120 chicks
  - 80 turkey poultts
  - 60 ducklings
  - 32 goslings

- One box may contain multiple species

- Opportunities for cross-contamination during shipment
Live Baby Poultry Sales at Agricultural Feed Stores

- Mail-order hatchery minimum purchase requirements

- Requirements lower at feed stores
  - Sell chicks, ducklings, etc.
  - Spring, sometimes fall “chick days”
  - Sales peak in spring, decline in winter

- Opportunities for cross-contamination in store displays
Live Poultry-Associated Outbreaks — United States, 1990–2013
Live Poultry-Associated Outbreaks and Outbreak Associated Cases — United States, 1990–2013
## Live Poultry-Associated Salmonellosis Outbreaks

<table>
<thead>
<tr>
<th>Outbreaks</th>
<th>n=51</th>
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<tbody>
<tr>
<td>Illnesses</td>
<td>2,228</td>
</tr>
<tr>
<td>Hospitalizations</td>
<td>306</td>
</tr>
<tr>
<td>Deaths</td>
<td>5</td>
</tr>
<tr>
<td>Median number of illnesses (range)</td>
<td>25 (4–356)</td>
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<tr>
<td>Median outbreak duration (range)</td>
<td>4.7 months (1–12)</td>
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## Live Poultry Exposure Type

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<tr>
<th>Exposures</th>
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<tr>
<td>Adult poultry</td>
<td>117 (20%)</td>
</tr>
<tr>
<td>Baby poultry</td>
<td></td>
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<tr>
<td>Chicks only</td>
<td>214 (57%)</td>
</tr>
<tr>
<td>Ducklings only</td>
<td>64 (17%)</td>
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<td>Chicks and ducklings</td>
<td>83 (22%)</td>
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# Baby Poultry Exposure at Home

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<th>Location of Chickens</th>
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<td>Indoors</td>
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Conclusions

- Increases in frequency, size, and duration
- Children are disproportionately affected
- Contact with baby poultry was common, but adult poultry contact can also cause illness
- High risk practices
  - Keeping poultry indoors
  - Close contact such as holding and kissing poultry
One Health Approach

- One Health integrates human, animal, and environmental health

- Involves multiple disciplines
  - Health care professionals
  - Veterinarians
  - Epidemiologists
  - Environmental scientists

- Prevention Recommendations
  - Mail-order hatcheries
  - Consumers
  - Feed stores
  - Health professionals
After you touch ducklings or chicks, wash your hands so you don’t get sick!

- Contact with live poultry (chicks, chickens, ducklings, ducks, geese, and turkeys) can be a source of human Salmonella infections.
- *Salmonella* germs can cause a diarrheal illness in people that can be mild, severe, or even life threatening.
- Chicks, ducklings, and other live poultry can carry *Salmonella* germs and still appear healthy and clean.
- *Salmonella* germs are shed in their droppings and can easily contaminate their bodies and anything in areas where birds live and roam.

Protect Yourself and Your Family from Germs

**DO:**
- Wash your hands thoroughly with soap and water right after touching live poultry or anything in the area where they live and roam.
- Adults should supervise hand washing for young children.
- If soap and water are not readily available, use hand sanitizer until you are able to wash your hands thoroughly with soap and water.
- Clean any equipment or materials associated with raising or caring for live poultry outside the house, such as cages or feed or water containers.

**DON’T:**
- Don’t let children younger than 5 years of age, elderly persons, or people with weak immune systems handle or touch chicks, ducklings, or other live poultry.
- Don’t let live poultry inside the house, in bathrooms, or especially in areas where food or drink is prepared, served, or stored, such as kitchens, or outdoor patios.
- Don’t snuggle or kiss the birds, touch your mouth, or eat or drink around live poultry.

For more information, call 1-800-CDC-INFO or visit [www.cdc.gov](http://www.cdc.gov).
Shipping *Salmonella* Education
Have a backyard flock? Don’t wing it.

LEARN HOW TO

Safely clean coops.
Handle birds safely.

FIND OUT WHY

Poultry belong outside.
Handwashing protects you from germs.

cdc.gov/Features/SalmonellaPoultry/
Salmonella and Bearded Dragons

- April 2014 Wisconsin contacted CDC
  - 10 patients with a very rare serotype of *Salmonella*
  - Majority of cases reported contact with bearded dragons

- National Investigation
  - 166 ill persons from 36 states, additional cases in Canada
  - 57% of ill persons were 5 years of age or younger
  - Spanned 2012-2014
Persons infected with the outbreak strains of *Salmonella* Cotham or Kisaware, by state of residence, as of July 21, 2014 (n=166)
Salmonella Cotham and Kisarawe Case Age Distribution (n=166): Jan 2012 - Jul 2014

*As of July 21, 2014*
Traceback Investigation: Where were Bearded Dragons coming from?

- Collected member cards
  - Used with permission
- Communicated with retailers during investigation
- Provided details to store
  - Store name, location or phone number, date of purchase, type of animal, shopper card, other details
- Identified 3 reptile breeding facilities in 3 countries
- Next steps...investigation of breeding facilities
Investigation of Breeding Facilities
Outbreak of *Salmonella* Infections Linked to Bearded Dragons

- Epidemiologic, laboratory, and traceback findings linked outbreak to bearded dragons purchased from multiple stores in different states
- First outbreak of human salmonellosis linked to bearded dragon lizards in USA
- Infected lizards originated from multiple breeding facilities
- One Health approach including public health, pet industry and breeders ongoing for prevention
Salmonella and Pet Foods

- **2012 - Dry Dog Food**
  - 49 ill persons
  - High percentage of patients reported dog ownership
  - Owners reported feeding different types of dry dog food
  - Outbreak linked to multiple brands of dry dog food produced in a single facility

- **2014 – Frozen Feeder Rodents**
  - 41 persons with outbreak strain
  - High percentage reported reptile exposure
  - Matching strain found in:
    - Reptiles
    - Frozen feeder rodents
E. coli O157

• Bacteria, can be found in gut of health cattle
• Fecal-oral transmission
  – Contaminated food, water, environment
  – Contact with animal or persons
• Very low infectious dose
• Can survive >42 weeks in environment

• Symptoms
  – abdominal cramps, diarrhea (often bloody), and vomiting
  – 5-10% develop potentially life-threatening hemolytic uremic syndrome (HUS)
Washington Outbreak Summary

- **60 cases**
  - 25 confirmed
  - 35 probable
- **Median age: 7 (<1-47 years)**
- **11 (45%) hospitalized**
  - 6 (18%) developed HUS
  - No deaths
Epidemiologic curve of *E.coli* 0157 infections

[Graph showing the number of ill persons from 22-Apr to 25-May 2015, with bars indicating primary and secondary cases.]
Youth Fair, Dairy and Beef Cattle Shows, April 10-11, 2015
Milk Makers Fest
Investigation Results

- **40 case-patients attended the festival**
  - 35 first-graders
  - 3 high school students
  - 1 parent
  - 1 teacher
- **20 were secondary case-patients**
- **Outbreak strain identified in environmental samples**
Conclusions

- **Foodborne Outbreaks**
  - Rise of novel health food items
  - Utilization of Whole Genome Sequencing (WGS)
  - Multi-agency and multi-national coordination needed for traceback and interventions

- **Enteric Zoonotic Outbreaks**
  - Increasing in frequency
  - Changing landscape of pets and pet foods
  - Indirect contact
Thank you