Investigating an Outbreak of *E. coli* O157:H7 Infections Associated with Ground Bison

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Overview

• How *E. coli* O157 cases and outbreaks are detected and investigated at the state level

• How local, state, and federal public health agencies collaborate during an outbreak

• Example of real outbreak investigation
**E. coli O157:H7**

- **Annual public health impact — United States**
  - >63,000 illnesses
  - 2,100 hospitalizations
  - 20 deaths

- **Colorado**
  - ~75 cases reported per year
  - ~2000 illnesses per year in Colorado

- **Diarrheal illness**

- **Hemolytic-uremic syndrome (HUS)**
  - 5–10%
**E. coli O157:H7**

- **Epidemiology**
  - Fecal-oral transmission
  - Incubation 2–10 days
  - Foodborne
  - Animal contact, person-to-person, waterborne

- **Implicated foods include**
  - Beef and other meats
  - Fresh produce
  - Dairy products
  - Processed foods (cookie dough, frozen foods)
Tracking *E. coli* O157:H7 Infections

- *E. coli* O157:H7 infections are ‘reportable’ in each state
  - Clinicians and/or laboratories **must** report infections to state or local health departments within a specific time frame (e.g. 7 days)

- Case investigation by local public health agency
  - Prevent further transmission
  - Determine if an outbreak is occurring
  - Determine source of infection

- Patient’s specimen sent to state public health laboratory for further testing
  - DNA ‘fingerprinting’ using pulsed-field gel electrophoresis (PFGE)
  - Used to identify potential clusters of cases
Colorado’s *E. coli* O157 Case Investigation Form

### Travel Information

- Did patient travel outside the US in the 7 days prior to the onset of illness?  
  - Yes  
  - No  
  - Unk  
  - If yes,  
    - Country 
    - Date left US 
    - Date returned to US 
    - Check box if case was adopted or immigrated to US (no "date"

### Water

- During the 7 days before illness, what was patient’s primary source of drinking water?  
  - Municipal  
  - Well water  
  - Bottled water  
  - Other  
- Did patient drink any untreated water from a pond, stream, spring, or lake?  
  - Yes  
  - No  
  - Unk  
- Did the patient swim or wade in any of the following types of recreational water?  
  - Hot tub/spa, whirlpool, Jacuzzi  
  - Lake, pond, river, or stream  
  - Recreational water park or any type of fountain  
  - Swimming or wading pool  
  - Drainage ditch/irrigation canal  
  - Other, specify:  

### Pet or Animal Exposure in 7 Days Prior to Illness

- Did the patient live on a farm with animals?  
  - Yes  
  - No  
  - Unk  
- Visit any animal exhibits (petting zoo, county fair, farm, etc)  
  - Yes  
  - No  
  - Unk  
  - If yes to either, did the case have exposure to manure?  
    - Yes  
    - No  
    - Unk  
- Work in a slaughterhouse or meat packing plant?  
  - Yes  
  - No  
  - Unk  
- Have a pet or contact with other people’s pets?  
  - Yes  
  - No  
  - Unk  

### If yes to any of these, indicate the animals with which patient had contact:

- Dog/puppy  
  - Yes  
  - No  
  - Unk  
- Cat/kitten  
  - Yes  
  - No  
  - Unk  
- Cow/calf  
  - Yes  
  - No  
  - Unk  
- Chicken  
  - Yes  
  - No  
  - Unk  
- Chick/duckling  
  - Yes  
  - No  
  - Unk  
- Sheep  
  - Yes  
  - No  
  - Unk  
- Pig  
  - Yes  
  - No  
  - Unk  
- Horse  
  - Yes  
  - No  
  - Unk  
- Elk  
  - Yes  
  - No  
  - Unk  
- Reptile (e.g. snake, iguana, turtle)  
- Rodent (e.g. mouse, hamster, guinea pig)  
- Exotic bird (e.g. parakeet, parrot)  
- Other? specify: 

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Typical reporting path: *E. coli* O157:H7

Exposure: 3 - 4 days (2 - 8 days)

Illness Onset: 3 - 5 days (1 - 14 days)

Seeks Health Care: 2 - 3 days (1 - 4 days)

Specimen Tested: 3 - 7 days (0 - 14 days)

Result Reported to the Health Dept. Isolate Sent to PH lab

Usually: 11 - 20 days
The Outbreak

• June 18, 2010
  – CO state public health lab notified epidemiology of 4 *E. coli* O157:H7 isolates with same PFGE pattern

• Earlier that week...
  – Epidemiology had already started to investigate
  – 4 *E. coli* O157:H7 cases
  – Reported June 8 – June 14
  – All males; between 6-24 years
  – 2 reported consuming ground bison
  – A 5\(^{th}\) case just reported also ate ground bison
Questions to address

• Do we have an outbreak?

• Is it unusual to have 3/5 people eating bison? In Colorado?

• Did the cases eat the same bison product?

• Is there any bison we can test?

• Who regulates bison?
Investigation Methods

• Case finding – look for additional ill people
• Generate hypotheses about potential cause of outbreak
• Test hypotheses
  – Compare ill people to well people
  – Test foods or environment
  – Traceback
• Take action to prevent more illness
  – Recall a product
  – Public messaging
• Monitor to make sure outbreak is over
Finding Additional Ill People

• Case definition
  – A person with laboratory-confirmed *E. coli* O157:H7 infection with the outbreak PFGE pattern since June 1, 2010 in the US

• Monitored Colorado database for new cases

• Notified local public health agencies, other state health departments, and CDC about the outbreak

• Used CDC’s PulseNet database to search for *E. coli* O157 cases with the same ‘DNA fingerprint’ in other states
Generating Hypotheses

• Each case re-interviewed with more specific questionnaire
  – Any foods > 2 cases reported eating on initial questionnaire
  – Detailed purchase and handling information
  – Asked about leftover bison
  – Obtained shopper card numbers

• 4/5 Colorado cases ate ground bison or had it in their home
  – All bison was Brand A in same size and style of package

• No other common exposures identified
Testing the Hypothesis: Case-Control Study

• Compare exposures of cases to exposures of well people

• All 5 cases

• 3 ‘controls’ per case, matched by age group and neighborhood
  – Located using on-line tools for finding residential phone numbers in a case’s neighborhood
  – Enrolled 14 controls
Case-Control Study Results

Consuming ground bison or having it in one’s home was statistically associated with illness

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Cases Exposed N (%)</th>
<th>Controls Exposed N (%)</th>
<th>Odds Ratio</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consume bison meat</td>
<td>3 (60)</td>
<td>2 (14)</td>
<td>9.0</td>
<td>0.08</td>
</tr>
<tr>
<td>Bison meat in home</td>
<td>3 (60)</td>
<td>2 (14)</td>
<td>9.0</td>
<td>0.08</td>
</tr>
<tr>
<td><strong>Consume bison meat or have in home</strong></td>
<td><strong>4 (80)</strong></td>
<td><strong>2 (14)</strong></td>
<td><strong>24.0</strong></td>
<td><strong>0.02</strong></td>
</tr>
<tr>
<td>Consume ground beef</td>
<td>3 (60)</td>
<td>10 (71)</td>
<td>0.6</td>
<td>1.0</td>
</tr>
<tr>
<td>Consume lettuce</td>
<td>4 (80)</td>
<td>11 (85)</td>
<td>0.7</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Consume organic milk</strong></td>
<td><strong>3 (75)</strong></td>
<td><strong>2 (15)</strong></td>
<td><strong>16.5</strong></td>
<td><strong>0.05</strong></td>
</tr>
</tbody>
</table>

*each case consumed milk from a different source
Testing the Hypothesis: Product Testing

- One case had a leftover cooked ground bison patty in freezer
- We purchased one package from local grocery store
- Both tested at state public health laboratory
- Both negative for *E. coli* O157
Testing the Hypothesis: Traceback

• Generally a collaboration between state health departments, CDC, and appropriate regulatory agency

• Review detailed purchase information
  – Lot numbers or best by dates
  – Purchase dates and locations

• Shopper card data can be valuable

• Who regulates ground bison?
Bison Regulation

- Bison considered a ‘game meat’
- Not included in Federal Meat Inspection Act
- Falls under US Food and Drug Administration (FDA) authority
- Inspection authority typically delegated to state agriculture departments
- CO Department of Agriculture has no resources to regulate bison producers and requires they enter into USDA’s voluntary inspection program
Traceback: Using Shopper Cards

• Potentially a powerful tool
  – Stores collect data on shopper purchases including purchase date and product details

• Can be challenging to use
  – Cases do not always have shopper card numbers handy
  – Elderly people receive groceries from many sources (less of an issue in this outbreak)
  – Some retailers require signed consents
  – Authority to compel retailers to provide information varies by state
Traceback Results

- Shopper card data collected for 4 Colorado cases
  - All purchased implicated Brand A ground bison product

- USDA FSIS determined product came from Plant A in Denver, Colorado

- USDA FSIS environmental investigation at Plant A
  - Plant A agreed to recall implicated product
Take Action to Prevent More Illness

Recall Date: July 2, 2010

Product: 66,000 pounds of ground and tenderized steak bison products

Distribution: Nationwide

Public messaging via press release to inform consumers
Results of Case Finding

• 5 additional cases of *E. coli* O157:H7 with indistinguishable PFGE patterns detected in other states after Brand A ground bison product was implicated
  – Connecticut (2), Illinois (1), Maryland (1), New York (1)

• All 5 reported consuming Brand A ground bison
Multistate *E. coli* O157:H7 Outbreak Associated with Ground Bison, June 2010 (N=10)
Outbreak Summary

• 10 PFGE-matched cases in 5 states
• Onset dates: June 4 – June 24, 2010
• Median age = 26 years (range: 6 – 86 years)
• 70% male
• All cases survived
• 29% (2/7) were hospitalized
• No HUS
Conclusions

- *E. coli* O157:H7 outbreak caused by ground bison
- Regulatory authority for bison not as straightforward as for some other foods
  - Coordination and collaboration is key
- Traceback concurrently with epidemiologic investigation can result in earlier public health action
- Standardized protocols for using shopper card helpful
Acknowledgements

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Thank you

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