Foodborne Outbreaks

Rand Carpenter, DVM
Tennessee Department of Health
Cocktail Party Conversations for Public Health Officials and Healthcare Providers

Bringing the real you out of your shell

Rand Carpenter, DVM
Tennessee Department of Health
Notifiable Disease Reporting

• Communicable disease rules
  – >80 conditions
  – Clusters or outbreaks of any condition

• Basis of public health surveillance
  – State statistics
  – CDC--MMWR

• It’s the law!
Communicable and Environmental Disease Services

Notifiable Diseases

The diseases and conditions listed below are declared to be communicable and/or dangerous to the public and are to be reported to the local health department by all hospitals, physicians, laboratories, and other persons knowing of or suspecting a case in accordance with the provision of the statutes and regulations governing the control of communicable diseases in Tennessee.

Category 1: Immediate telephonic reporting required followed with a written report using PH-1600

<table>
<thead>
<tr>
<th>Category 1: Communicable Diseases</th>
<th>Possible Biohazardous Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthrax (2)</td>
<td>Anthrax (2)</td>
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<tr>
<td>Botulism</td>
<td>Plague (33)</td>
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<tr>
<td>Diphtheria (11)</td>
<td>Venezuelan Equine Encephalitis (100)</td>
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<tr>
<td>Disease Outbreaks</td>
<td>Smallpox (107)</td>
</tr>
<tr>
<td>1. Headache</td>
<td>Influenza (15)</td>
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<tr>
<td>2. Meningitis</td>
<td>Scarlet Fever (15)</td>
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<tr>
<td>3. All Other</td>
<td>Q Fever (106)</td>
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<tr>
<td>Encephalitis Arsenic</td>
<td>Rocky Mountain Spotted Fever (106)</td>
</tr>
<tr>
<td>1. California Arsenic encephalitis</td>
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<tr>
<td>2. Eastern Equine (122)</td>
<td>Staphylococcal Bacterial pneumonia (106)</td>
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<td>3. Rift Valley (122)</td>
<td>Viral Hemorrhagic Fever (106)</td>
</tr>
<tr>
<td>4. Western Equine (124)</td>
<td>Brucellosis (9)</td>
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<tr>
<td>Bacterial Septicemia Disease (33)</td>
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<tr>
<td>Group A Septicemia Disease (33)</td>
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<tr>
<td>Group B Septicemia Disease (47)</td>
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<tr>
<td>Appendicitis &amp; Inflammatory Disease (54)</td>
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<tr>
<td>Meningococcal Disease (85)</td>
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<tr>
<td>Meningitis - Other Bacterial (102)</td>
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<tr>
<td>Mumps (11)</td>
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<tr>
<td>Pertussis (32)</td>
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<td>Plague (33)</td>
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<td>Pneumococcal Pneumonia (26)</td>
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<td>Rocky Mountain Spotted Fever (106)</td>
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<tr>
<td>Salmonella Typhoid Fever (30)</td>
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<tr>
<td>Typhoid Fever (41)</td>
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<tr>
<td>West Nile Fever (125)</td>
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<tr>
<td>West Nile Encephalitis (125)</td>
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</tbody>
</table>

http://health.state.tn.us/CEDS/notifiable.htm
Salmonella I 4, [5], 12:i:-

• Emerging serotype similar to S. Typhimurium

• Little known about environmental reservoirs

• Single case in Sequatchie County
  – Infant with few exposures
  – Water from a spring-fed system

• Investigation by TDEC and TDH
Investigation Results

• Other illness in household and community
• Spring system serves 5 homes and church
• Matching Salmonella found in water in multiple locations
• System consists of 2 springs, a tank, and a pump station for 2 homes
Outcome

• Community alerted to water risks
  – Church and residents using alternative drinking water sources
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• Interagency, multi-level outbreak response
  – EHS-Net and WBDO coordinator
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• Salmonella I 4, [5], 12:i:- epidemiology better described
Outbreak Investigations

WHY?

• Stop the outbreak!
  – No more new cases
  – Minimize economic impact

• Learn something new
  – New disease
  – New characteristics of a known disease

• Reassure the public

• Prevent future outbreaks and disease
Public health prevention and the cycle of continuous improvement

Surveillance

Prevention measures Interventions

Epidemiologic investigation

Public health research
Infectious Disease Surveillance

• Burden of infections
• Trends
  – Evaluation of control strategies
• Detect anomalies, outbreaks
• Enhanced in Tennessee by FoodNet involvement
Disease Detection Pyramid

Surveillance for confirmed infections
Reported to health department
Culture-confirmed case
Lab tests for organism
Specimen obtained
Person seeks care
Person becomes ill
Population exposures
E. coli O157:H7
Important Human Pathogen

- Public health threat in 1980/90’s
  - Outbreaks from fast food chain hamburgers
- Outbreaks of bloody diarrhea and hemolytic uremic syndrome (HUS)
- >73,000 illnesses per year in US
- Virulent
Matching *E. coli* O157:H7 Cases

- June 2006: 1 isolate
- December 2007: 5 isolates

Date range: June 2006 - December 2007
Epidemiologic Investigation

Notification from laboratory; case report forms
Epidemiologic Investigation

Notification from laboratory; case report forms

Hypothesis generation
E. Coli Cases, Tennessee, by County
“Shotgun” Questionnaire

- Pre-made, ready-to-use, 4 pages long
- Requires 30–45 minutes
- Covers variety of foods, sources, activities
  ~450 specific food items
- Optimized for data entry—requires <1 minute
- [http://www.healthoregon.org/acd/keene.cfm](http://www.healthoregon.org/acd/keene.cfm)
Epidemiologic Investigation

Notification from laboratory; case report forms

Hypothesis generation

Fast Food Restaurants
Lettuce
Cheese
Frozen Pizza
Epidemiologic Investigation

Notification from laboratory; case report forms

Hypothesis generation

Fast Food Restaurants
Lettuce
Cheese
Frozen Pizza

Case-Control Study
## Totino’s Risk

<table>
<thead>
<tr>
<th></th>
<th>Case (N=8)</th>
<th>Control (N=25)</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ate Pizza</td>
<td>6</td>
<td>1</td>
<td>144.0</td>
</tr>
<tr>
<td>Did Not</td>
<td>1</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

**OR=144.0 (95% CI: 6–21000)**
Epidemiologic Investigation

Notification from laboratory; case report forms

Hypothesis generation

Fast Food Restaurants
Lettuce
Cheese
Frozen Pizza

Case-Control Study

Frozen Pizza
Epidemiologic Investigation

Notification from laboratory; case report forms

Hypothesis generation
- Fast Food Restaurants
- Lettuce
- Cheese
- Frozen Pizza

Case-Control Study
- Frozen Pizza
- Cheese

Expanded Multi-state Investigation
Matching *E. coli* O157:H7 Cases

- June 2006: 1 isolate
- December 2007: 5 isolates
Typing & Subtyping

- **Phenotypic**: observable characteristic
  - Colony size, color or other characteristic
  - CPE of virus on cell culture
  - Biochemical property

- **Genotypic**: specific genetic makeup (DNA)
  - Sequencing
  - DNA macrorestriction--PFGE
PFGE
Pulsed Field Gel Electrophoresis

• DNA “cut” by endonuclease enzymes at certain points (macrorestriction analysis)

• Place in gel

• Fragments moved by electrical currents

• Large DNA fragments move at varying speeds
Pulse Field Gel Electrophoresis (Adapted From Cacapon Institute Web Site)

Many *E. coli* isolates from environment → Purify DNA from each → Cut each DNA into pieces with specific restriction enzyme that only cuts rarely

Separate DNA pieces by pulse field agarose gel electrophoresis → Detect species specific DNA piece using DNA specific stain.
Buffer solution

Put DNA Samples here

Larger fragments

Gel

Horizontal gel electrophoresis

Smaller fragments
DNA fragments fractionated by size (visible under UV light if gel is soaked in ethidium bromide)
A typical *E. coli* O157:H7 PFGE Gel

Fragment Size

- 1135 Kb
- 452.7 Kb
- 216.9 Kb
- 76.8 Kb
- 33.3 Kb
• National network of public health laboratories
• Routine standardized molecular subtyping of bacteria
• Isolates from food, humans, animals, environment
• Share DNA “fingerprints” in real-time via internet
• Dynamic database of DNA “fingerprints”
Can This Meat Kill You?

The E. coli Threat—It's Worse Than You Think
Western USA, 1993

726 cases identified
4 deaths

E. coli O157:H7
1993 Western States *E. coli* O157 Outbreak

- Outbreak detected
- Meat recall

726 cases
4 deaths
16 *E. coli* O157:H7 infections linked by PFGE in two states, 25 million pounds of ground beef recalled
Rapid identification of problem
Rapid & appropriate response

![Diagram showing the relationship between time, intervention point, number of cases, and cost.](image)
Outbreak Identification

• Two children hospitalized with HUS
  – One culture confirmed *E. coli* O157

• 1 enzyme immunoassay (EIA) positive stool

• Epi-linked to a youth fund-raising event
‘Kids Hunting for a Cure’

- Lincoln County fairgrounds
- Guided deer hunting, archery, pistol shooting, tree stand safety
- Food
  - Some donated
  - Saturday noon meal prepared by volunteers on-site
  - Snack vendors
News from a KHFAC Event

Hunter Meeks of Fayetteville gets help from some of his friends to show off the monster 10-pointer he bagged during the KHFAC event.

His buck weighed 185 pounds and had an inside spread of 18.5 inches.

Our Mission

TO REGISTER FOR THE HUNT CLICK THE TAB AT THE TOP OF THE PAGE!

Lincoln County
Fairgrounds
1003 Hedgemont Ave.
Fayetteville, TN 37334

Kids Hunting For a Cure is a non-profit organization which
Kids Hunting For a Cure is a non-profit organization which provides financial support to research hospitals/foundations dedicated to developing cures for cancer and childhood diseases. Monies are raised by children and adults through community-sponsored outdoor events designed for youth.

More About Us

News

OCT 24TH AND 25TH
2008 KIDS DEER HUNT!

TO REGISTER FOR THE HUNT CLICK THE TAB AT THE TOP OF THE PAGE!
Location

- County fair held 6 weeks prior
  - Barns: sheep & goat, pig, cattle, exotic animals
- One available restroom
- Hand sanitizer dispensers empty
The Big Deal Saturday Meal

• Prepared on-site at the ‘Cowboy Café’
• Adequate food temperatures not kept
• Novel food items
  – Elk stew
  – Pulled buffalo
  – Wild pig
• No tables or seating provided
  – Many ate in the barns & bleachers
Epi Investigation

• Retrospective cohort study
  – All attendees
  – Food, activity, hand hygiene history

• Specimens
  – Stool from 11
  – Serum from 20

• Other sampling
  – 18 food samples
  – 26 environmental

• Laboratory
  – Stools tested for *E. Coli* O157
  – Sera tested for *E. Coli* O157 antibodies
  – Serotype 3 isolates from raw buffalo meat
  – PFGE
Cohort Study

374 attendees

186 (50%) interviewed

18 (10%) with symptoms

12 (6.5%) met case definition
Illness Associated with the Fund-raising Event

Onset Date

Cases

- Confirmed
- Probable
Cohort Multivariate Analysis

- Multivariate and logistic regression analysis
- Consumption of pulled buffalo
  - Risk ratio 12.5
  - 95% confidence interval 1.6–100
Food And Environmental Testing

• Buffalo meat samples
  – STEC isolated
  – 3 isolates serotyped as E. coli O15:H27, 2 PFGE sub-types

• Environmental samples
  – 22 / 26 specimens shiga toxin positive by PCR
  – Could not be cultured
Conclusions

- First outbreak associated with buffalo meat
  - Cohort study data implicated buffalo meat
  - Buffalo meat contaminated with *E. coli* O15:H27

- Multiple STEC involved

- Multiple possible transmission factors
  - Intrinsic buffalo meat contamination
  - Contact with contaminated environment
  - Limited handwashing access
Questions?

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