Investigating a Foodborne Illness Outbreak

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Overview

- Key Concepts
- Epidemiological Investigation
  - Detecting the Outbreak
  - Clinical Assessment
  - Environmental Assessment
- Sampling
- Analyze Data
- Control Measures

Top 10 causes of reported foodborne disease outbreaks in U.S.

<table>
<thead>
<tr>
<th>Etiology</th>
<th># of outbreaks</th>
<th>% of all outbreaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown etiology</td>
<td>4,490</td>
<td>57.4%</td>
</tr>
<tr>
<td>Norovirus</td>
<td>657</td>
<td>8.9%</td>
</tr>
<tr>
<td>Salmonella</td>
<td>585</td>
<td>8.8%</td>
</tr>
<tr>
<td>Shigella</td>
<td>152</td>
<td>1.9%</td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>130</td>
<td>1.6%</td>
</tr>
<tr>
<td>Campylobacter</td>
<td>118</td>
<td>1.4%</td>
</tr>
<tr>
<td>Bacterial cause</td>
<td>101</td>
<td>1.3%</td>
</tr>
<tr>
<td>Listeria innocua</td>
<td>84</td>
<td>1.1%</td>
</tr>
<tr>
<td>Shiga toxin-producing E. coli</td>
<td>67</td>
<td>0.9%</td>
</tr>
<tr>
<td>Salmonella paratyphosa</td>
<td>60</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

Key Concepts:

- Epidemiology is the study of factors affecting the **health** and **illness** of populations, and serves as the foundation and **logic** of interventions made in the interest of **public health** and **preventive medicine**.
- Systematic approach to get the right answer as quickly as possible
- Purpose...prevent additional cases, recurrences of illness, or both

Pathogen characteristics:

- **Agents**
  - Bacteria, viruses, parasites, chemical toxins
- **Reservoirs**
  - Humans, animals, environment
- **Transmission modes**
  - Food, water, person-to-person, animal-to-person
- **Clinical syndromes**
  - Nausea & vomiting without fever, abdominal cramps & bloody diarrhea with fever, neurologic manifestations, etc.

Surveillance

**Definition**...Ongoing, systematic collection, analysis, interpretation and dissemination of data

- **Types**
  - **Active** – Go out and look for reports
    - Advantages: Accuracy and completeness
    - Disadvantages: Time consuming, expensive, slow
  - **Passive** – Wait for reports to come to you
    - Advantages: Easier, cheaper, faster
    - Disadvantages: Potential to miss cases
The Surveillance Pyramid

Population exposures
Person becomes ill
Person seeks care
Specimen obtained
Lab tests for organism
Culture-confirmed case
Reported to health department

Source: Centers for Disease Control and Prevention

Detecting an Outbreak

- Two or more unrelated persons sharing a common food or meal?
- Clinical picture consistent with a foodborne disease agent?
- Number of ill higher than normally expected?
- Have other organizations received reports of potentially associated illness?
- Likelihood of ongoing exposure?

Source: Investigating a Foodborne Illness Outbreak

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Complaint types:

- Complaint without illness
- Single ill person
- Household cluster
- Obvious outbreak

**All could lead to detection of an outbreak**

Using surveillance data to detect an outbreak

Using surveillance data to detect an outbreak

When to investigate further?

- Increase in number of reports over expected
- Possible epidemiologic associations
  - Person, place, time
  - Possible laboratory linkage
  - Same organism isolated from multiple patients
- High risk setting
  - Daycare, Head Start, nursing home, etc.
Make Epidemiologic Associations:
- Person, place, and time
- Systematically organize key information
- Develop initial hypothesis (case definition)
  - Based on signs, symptoms, dates of illness onset, duration of illness, incubation period, hypothesize the most likely foodborne pathogen(s)

Develop and Administer Questionnaires:
- Patients
  - Develop a standardized questionnaire
  - Interview as many exposed persons as possible, both ill and well
  - Begin interviews as soon as possible
- Food handlers
  - Develop a standardized questionnaire (work history, job tasks and responsibilities, illness history to include family members, other employment)

Collect Patient and Food Specimens
- Coordinate proper specimen collection and handling
- Collect stool specimens from cases and food handlers as appropriate to the investigation
- Collect specimens as soon as possible
- If cases have food specimens available, request that they be saved
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Analyze Data
- Demographic profile
- Person association/place association/time association
- Symptom profile
- Epidemic curve
  - Point Source, ongoing, or secondary exposure
- Duration of illness
- Incubation period

Establish Surveillance for Additional Cases
- Identify potential subsequent cases
- Assess ongoing transmission
- Nature of system
  - Active
  - Passive
  - Enhanced passive

“When you have a foodborne outbreak, more than one thing went wrong.”

Dr. Frank Bryan
Centers for Disease Control and Prevention
Types of Environmental Activities

- Plan Review / HACCP
  - Focuses on **FUTURE** operations

- Routine Regulatory Inspection
  - Focuses on **PRESENT** operations

- Environmental Assessment / Food Prep Review
  - Focuses on **PAST** operation/event

Environmental Assessment (Food Preparation Review)

- **Definition:** A systematic evaluation of food establishment suspected of causing a foodborne illness outbreak
  - A cluster of consumer complaints of illness
  - Lab and/or epidemiological information associated and causative agent identified
  - Initial agent and vehicle information may be limited

Environmental Assessment / Food Prep Review Objectives

- Identify foods and beverages offered
- Reconstruct past events – when foods were produced?
- Contributing factors – what happened?
  - Contamination
  - Survival
  - Proliferation
- Identify environmental antecedents – why did it happen?
- Implement effective control actions
Observe Operations- General

- What process do the foods fit into?
  - Process 1 – No Cook Step
  - Process 2 – Same Day Service
  - Process 3 – Complex Foods

- What controls are essential for the foods in this process?

Danger Zone Diagram

C. S. P.

- Identify Contributing Factors
  - Contamination
  - Survival
  - Proliferation
**Contamination:**

- Receiving, storage, preparation, transport, service
- Worker hands, ill workers
- Equipment, utensils
- Cross-contamination
- Use of leftovers, returned food

**Survival:**

- Ingredients that inhibit growth: acids, salts, preservative
- Time/temperature abuse
- Survival on contaminated surfaces, ingredients
  - Bacteria: spores, toxins
  - Viruses and parasites
- Will the agent survive the process?

**Proliferation:**

- Nutrients
- Availability of oxygen
- Temperature
- pH
- Water activity ($a_w$)
- Presence of inhibitory substances
- Microbial interactions
- Previous stress
- Time
**Knowing the Agent Helps Target Investigation and Control Measures**

<table>
<thead>
<tr>
<th>HAZARD</th>
<th>Related Contributing Factors to Investigate During Field Visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spore-Formers Preformed Toxins</td>
<td>Cooling, Re-Heating, Hot Holding, Bare Hand Contact, Room Temp Storage, Cold Holding</td>
</tr>
<tr>
<td>Viral Infections</td>
<td>Ill Food Worker, Bare Hand Contact, Handwashing, Contaminated Raw Product</td>
</tr>
<tr>
<td>Bacterial Infections</td>
<td>Ill Food Worker, Bare Hand Contact, Handwashing, Contaminated Raw Product, Cross Contamination, Cooking</td>
</tr>
<tr>
<td>Parasitic Infections</td>
<td>Contaminated Raw Product, Contaminated Source</td>
</tr>
</tbody>
</table>

*See IAFP manual for details on specific diseases*

**Differences in Investigation Approaches**

- **NO IMPLICATED FOOD:**
  - Cannot focus on a single item in food prep review in the early stages of investigation if no food association established.
  - Conduct general risk-based assessment using most up to date information available.
  - Determine which samples epi and lab investigators are most interested in (food, clinical, environmental, water/ice)

- **IMPLICATED FOOD:**
  - Food Preparation Review is Key!!

**Observe Operations - Specific**

- How the same items are prepared today
- Attempt to reconstruct how they were prepared during the time period of interest
- Take measurements (Time, Temperature Product Dimensions, Locations)
Analyze findings - CSP

- Identify CSP at each step
- Determine what happened and what did not
- Interpret:
  - Laboratory findings
  - Time/temperature curves
  - Food flow diagrams
  - Food preparation reviews/diagrams

Conducting Interviews

- Review health, hygiene and education practices
- Identify who worked with the implicated food(s)...reconstruct timeline
- Worker ill during time period of interest?
- Reconcile with supervisor and coworker recollections
- Document findings

Example of Systems-Based Investigation Results

- What happened?
  - Cutting board and knife used to cut raw chicken were then used to slice carrots for the salad.
- Why did it happen?
  - Employee was unaware of the dangers of cross-contamination.
- What can be done now?
  - Improve food safety education for employees

SOURCE: EHS-Net
Food Collection Procedures

What To Collect?
- Suspect food items
- Preferably in original containers (if possible)
- Original product from suspect facility
- Collect leftovers of foods under suspicion
- Take representative sample portions if dealing with a large amount of sample
- May have to target individual ingredients if complete product is not available

What’s Representative?
Solid / Semi-Solid Food Items
- Homogeneous — of uniform composition
  - If solid item take center, top, bottom, sides
- If dealing with a large food vessel take well mixed sub-portions

What’s Representative
Large Lot Consignments
- Make note of Lot #’s & Code Dates
- Take from the beginning, middle, and end of the Production Lot / Code Date.
- If the food is composed of several parts / components
  - Sample individual components separately
  - Avoid cross-contamination
What’s Representative?
Liquid Food / Beverages

- Original containers are ideal.
- If not practical—shake very well and take aliquot.
- Use leak proof containers
- Stay away from glass containers.

Aseptic/Clean Transfer of Food

- Transfer using aseptic / clean technique
  - Wash hands
  - Gloves recommended, but not mandatory
  - Whirl-pak bags 10 and 18 Oz
  - Sterile disposable plastic spoons
  - Metal utensils (alcohol wipe and/or flame)
  - If in a jam washing metal utensils will do.

Aseptic Transfer

- Do not mix different food types/food sources
- Fill each container / bag to ½ capacity (150 to 500g)
- Properly seal container / bag
- Clean bag / container outer surface
- Properly label sample bags / containers
Aseptic Transfer Images

Sample Collection / Packing
- Note initial temp & include a temperature control (same matrix or water bottle)
- Packing criminal containers (carefully) seal and label with marking tape
- Fill out “Food Analysis Test Request Form”
  One sample—one test form

Sample Handling
- TEMPERATURE
  - Hold most samples at refrigerated temps (0-10°C)
  - Dry and canned foods can be at room temp
  - If originally frozen—maintain frozen
  - Transport in insulated container
    “Ice Chest”/”Isotemp Box Container”
    Use ice packs, not loose ice.
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**Packing of Samples**

- Use rigid insulated container
- Avoid direct sample contact with ice packs
- Contain samples (Zip-Lock Bags)
- Properly close insulated container
- Don’t forget the “Test Request Forms”

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**Food Sample Collection**

- The adequacy and condition of the sample is of primary importance.
- Improper sampling, collection/transfer, and handling technique could lead to meaningless lab results.
- Chain of Custody
- Garbage in = Garbage out

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**Completing the Epidemiologic Investigation**

- Recommend control measures based on
  - Characteristics of the outbreak
  - Etiologic agent
  - Implicated food item(s)
  - Environmental investigation
- Complete final report and evaluation
Control Actions

- Immediately stop the outbreak:
  - Embargo/Voluntary Destruction/Condemnation
  - Exclusions/Restrictions
  - Closure/Desist
  - Recall
  - Menu Limitation
- Long term strategies to prevent recurrence:
  - HACCP
  - Risk Control Plans [“Mini-HACCP”]
  - Training
  - Menu/Supplier/Recipe Modifications

References

- New Mexico Department of Health, New Mexico Environment Department, New Mexico Foodborne Illness Investigation Manual, November 29, 2007
- http://en.wikipedia.org/wiki/Main_Page

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