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Epi-Ready Team Training
Foodborne Illness Response Strategies

Purpose
The goal of this training is to help members of the foodborne outbreak investigation team and others prepare for and rapidly detect foodborne disease outbreaks; quickly launch a coordinated investigation involving epidemiology, environmental health, and the laboratory; and implement control measures in a timely fashion to reduce the incidence of foodborne illness.

Overall Objectives
The workshop will help participants to:

1. Improve performance as members of the foodborne disease outbreak investigation team.
2. Develop insights into the work of other team members.
3. Improve communications with other team members.
4. Increase familiarity with other local, state, and federal partners.
Module 1: Foodborne Diseases & Outbreaks

At the end of this module, the participant will be able to:

1. Describe what is meant by “foodborne disease.

2. List examples of common foodborne disease causative agents.

3. Define the terms “outbreak” and “cluster.”

4. List the goals of a foodborne disease outbreak investigation.

5. Describe the desirable knowledge and skills available in a foodborne outbreak investigation team.
Module 1: CIFOR Toolkit Keys to Success

- Agency has access to staff with knowledge and experience in epidemiology, environmental health, laboratory, health education, and communications.

- Agency has a designated investigation team with expertise in epidemiology, environmental health, and the laboratory.

- Investigation team members have been trained in agency’s outbreak response protocols and their individual and combined roles.

- Agency anticipates gaps in resources and identifies sources to fill those gaps.
MODULE 1 – FOODBORNE DISEASES AND OUTBREAKS

FOODBORNE DISEASE OUTBREAK INVESTIGATION TEAM TRAINING

AT THE END OF THIS MODULE, YOU WILL BE ABLE TO
1. Describe what is meant by “foodborne disease.”
2. List examples of common foodborne disease causative agents.
3. Define the terms “outbreak” and “cluster.”
4. List the goals of a foodborne disease outbreak investigation.
5. Describe desirable knowledge and skills among members of a foodborne outbreak investigation team.

BREAKING NEWS
• Students and teachers rushed to hospital
• Nausea, vomiting, stomach pain, and dizziness after lunch at school cafeteria
• Health department team dispatched to school and hospital to investigate

GROUP EXERCISE
1. Briefly introduce yourself to others at your table.
2. Re-read the news report at end of module and answer these questions.
   − Do you think the illnesses are foodborne?
   − Do you think the illnesses represent an outbreak?
   − If this is a foodborne outbreak, who would you involve in the response?

Be prepared to share with class.
Time: 5 minutes

FOODBORNE DISEASE
Illness caused by ingestion of contaminated food
Symptoms often affect stomach or intestinal tract including nausea and vomiting, diarrhea, and abdominal pain
Sometimes nonspecific symptoms and symptoms outside GI tract, depending on agent
Greatest risk for severe illness
• Young children
• Pregnant women
• Elderly and immunocompromised persons

FOODBORNE DISEASE
An estimated 1 in 6 people suffers from foodborne illness each year in the United States leading to an estimated
• 48 million illnesses
• 128,000 hospitalizations
• 3,000 deaths
• More than 1,000 outbreaks detected annually
• $35 billion in medical costs, lost productivity, illness related mortality each year

Source: Centers for Disease Control and Prevention
http://www.cdc.gov/foodborneburden/index.html
COMMON CAUSATIVE AGENTS

- Bacteria:
  - Bacillus cereus
  - Campylobacter
  - Clostridium botulinum
  - Clostridium perfringens
  - Escherichia coli
  - Shiga toxin-producing E. coli
  - Enterotoxin producing E. coli
  - Enteroinvasive E. coli
  - Enteropathogenic E. coli
  - Listeria monocytogenes
  - Salmonella, Typhi and non-typhoid
  - Shigella
  - Staphylococcus aureus
  - Vibrio
  - Yersinia enterocolitica

- Viruses:
  - Norovirus
  - Astrovirus
  - Hepatitis A virus

- Parasites:
  - Cyclospora
  - Cryptosporidium
  - Entamoeba histolytica
  - Giardia intestinalis
  - Trichinella

- Chemicals/other:
  - Heavy metals
  - Pesticides
  - Fungal toxins
  - Fish toxins

FREQUENCY OF CAUSATIVE AGENTS IN FOODBORNE OUTBREAKS IN THE UNITED STATES

Source: Centers for Disease Control and Prevention based on data from 2008

FOOD VEHICLES

Variety of foods associated with foodborne illnesses
Almost any food can be a vehicle for disease but food and production/processing must:
- Allow opportunity for contamination by causative agent
- Allow agent (or toxin) to survive (not be inactivated)
- (For some agents) support proliferation of agent and/or elaboration of preformed toxins

Common food-causative agent pairings

... ALSO OTHER MODES OF TRANSMISSION

Pathogens associated with food also spread through other modes
- Waterborne
- Person-to-person
- Animal-to-person

Multiple modes possible in a single outbreak

DEFINITION OF OUTBREAK

Two or more cases of a similar illness among individuals who have had a common exposure

Critical components of definition
- Same diagnosis or symptoms and signs suggestive of same illness
- Clear association between cases, with or without a recognized common source

DEFINITION OF CLUSTER

More cases than expected for given geographic location and time
No immediately obvious association between cases
Suggestive of an outbreak but needs further exploration to make determination
IS THIS AN OUTBREAK?
Development of nausea and vomiting in three friends within 30 minutes of eating at a restaurant.

IS THIS AN OUTBREAK?
Diarrhea and abdominal pain due to *Salmonella Agona* (an unusual serotype only seen once before) in 24 persons in one state.

IS THIS AN OUTBREAK?
A single case of botulism.

PRIMARY GOALS OF OUTBREAK INVESTIGATIONS
Stop current outbreak as soon as possible by implementing effective control measures and prevent similar outbreaks in future.
Rapidly identify cause of outbreak including:
- People at risk (and characteristics)
- Causative agent
- Mode of transmission and vehicle
- Source of contamination
- Contributing factors

OUTBREAK INVESTIGATION TEAM
Composition varies but almost always needs knowledge and skills in
- Environmental health
- Epidemiology
- Laboratory
- Public health education
- Communications
- Leadership

To do all these things .... you need an Outbreak Investigation Team.
THE TEAM: ENV’T HEALTH INVESTIGATOR
Focuses on contaminated food:

THE TEAM: EPIDEMIOLOGIC INVESTIGATOR
Focuses on cases:

THE TEAM: COMMUNICABLE DISEASE INVESTIGATOR
Focuses on patients:

THE TEAM: LABORATORY INVESTIGATOR
Focuses on specimens:

THE TEAM: OTHER SKILL SETS
Other persons often included on outbreak investigation team:
- Public health officer
- Public health educator
- Support staff
- Public information officer
- Regulatory investigators
- Interpreters
- Veterinarians
- Health care providers
- Industry members

THE TEAM: TOGETHER
- Work together and support each other
- Team responsibilities
  - Develop hypotheses about outbreak source
  - Prioritize and assign activities
  - Interpret investigation findings
  - Determine how far to take an investigation
  - Develop public messages
  - Decide on control measures
GROUP EXERCISE

For your jurisdiction: Complete the outbreak investigation team matrix at the end of the module.

1. Examine the roles and responsibilities listed under each outbreak investigation team member.
2. Insert your name and the names of your team members in the appropriate cells.
3. Which responsibilities are not covered? How might these gaps be filled?
4. Are others included on your team? What do they do?

Be prepared to share.
Time: 10 minutes
Module 1 – Group Exercise: Breaking News

Divide into groups by table.
1. Briefly introduce yourself to others at your table, sharing your name and where you work (if they don’t already know).
2. Re-read the news report and answer the questions below

This just in from Eye Witness News Channel 13:

An unreported number of students and teachers from D. Sharp Middle School have been rushed to the hospital by emergency medical services. Eye witness accounts report students became violently ill with nausea, vomiting, stomach pain, and dizziness after eating at the school cafeteria today. The illness appears to have been first reported in one classroom, quickly spreading throughout the school.

The number of ill students has not been confirmed but at least six ambulances were called to the scene, some being summoned by students using their cell phones. Reports suggest at least two teachers were also rushed to the hospital.

A spokeswoman from the County Department of Health and Human Services, when contacted about the likely cause of the illness, declined to speculate. A health department team has been dispatched to the hospital and school to investigate.

Anxious parents have gathered at the hospital, awaiting news on their children. We will bring you more on this story as it develops …..

Question 1: Do you think the illnesses are foodborne?

Question 2: Do you think the illnesses represent an outbreak?

Question 3: If this is a foodborne outbreak, who would you involve in the investigation?
Module 1 – Group Exercise: Identifying Your Foodborne Outbreak Investigation Team

Working alone or with others who are from the same jurisdiction, complete the outbreak investigation team matrix below.

1. Examine the roles and responsibilities listed under each outbreak investigation team member.
2. Insert your name and affiliation in the appropriate cell and the names of other investigation team members and their affiliations.
3. Which responsibilities are not covered? How might these gaps be filled?
4. Are there other people routinely included on your outbreak investigation team? What do they do?

<table>
<thead>
<tr>
<th>Role</th>
<th>Environmental Health Investigator</th>
<th>Epidemiology Investigator</th>
<th>Public Health Nurse</th>
<th>Laboratory Investigator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roles and responsibilities</td>
<td>• Receives and interprets foodborne illness complaints from consumers</td>
<td>• Analyzes pathogen-specific surveillance data and identifies clusters</td>
<td>• Interviews patients</td>
<td>• Analyzes clinical, food, and environmental specimens</td>
</tr>
<tr>
<td></td>
<td>• Investigates suspected food or establishment</td>
<td>• Characterizes outbreak cases by time, place, and person</td>
<td>• Collects clinical specimens from patients</td>
<td>• Interprets test results</td>
</tr>
<tr>
<td></td>
<td>− Interviews food workers and managers</td>
<td>• Plans epidemiologic studies</td>
<td>• Administers questionnaires for epidemiologic studies</td>
<td>• Advises team about tests and collection, handling, storage, and transport of specimens</td>
</tr>
<tr>
<td></td>
<td>− Examines food handling and preparation</td>
<td>• Interviews cases and healthy controls</td>
<td>• Advises patients on how to prevent spread of illness</td>
<td>• Coordinates additional testing by partner labs</td>
</tr>
<tr>
<td></td>
<td>− Identifies factors that resulted in contamination of food or survival and proliferation of contaminants</td>
<td>• Analyzes and interprets results of epidemiologic studies</td>
<td>• Provides public health education</td>
<td></td>
</tr>
<tr>
<td></td>
<td>− Collects environmental and food samples</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Who does this?</td>
<td>(Name/affiliation)</td>
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<tr>
<td>How might gaps be addressed?</td>
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</tbody>
</table>
1. Insert your name and affiliation in the appropriate cell.
2. Insert the names of other investigation team members and their affiliations. Do you know how to contact all team members?
3. Which roles are not covered? How might these gaps be filled?
4. Are there other people routinely included on your outbreak investigation team? What do they do?

<table>
<thead>
<tr>
<th>Name/affiliation</th>
<th>Environmental Health Investigator</th>
<th>Epidemiology Investigator</th>
<th>Public Health Nurse</th>
<th>Laboratory Investigator</th>
<th>Public Information Officer</th>
<th>Others</th>
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<td>Name/affiliation</td>
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<tr>
<td>How might gaps be filled?</td>
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</tbody>
</table>
Module 2: Surveillance & Outbreak Detection

At the end of this module, the participant will be able to:

1. Describe the surveillance of foodborne illness through notification/complaint systems.

2. List ways to improve the accuracy of the food history obtained in a foodborne illness complaint.

3. Describe the surveillance of foodborne illness through pathogen-specific surveillance.

4. Recognize a possible foodborne outbreak/cluster through notification/complaint systems and pathogen-specific surveillance.

5. Describe the role of local health in national pathogen-specific surveillance.
Module 2: CIFOR Toolkit Keys to Success

Notification/Complaint Systems

➤ Agency has established process for receiving reports from public.

➤ Public knows how to report foodborne illnesses.

➤ Agency trains staff at food establishments to report illness complaints to health department.

➤ Agency solicits reports from other agencies.

➤ Staff collect specific information for each report.

➤ Staff regularly review reports to identify clusters.

➤ Staff triage reports for response.

Pathogen-specific Surveillance

➤ State has mandatory reporting of cases of food-borne diseases and submission of patient isolates.

➤ Case reports are actively solicited.

➤ Isolates are rapidly transported to the laboratory.

➤ The laboratory quickly processes and tests specimens and shares results.

➤ Sufficient information is collected on cases to rapidly recognize clusters.

➤ Staff have access to information to determine whether case counts exceed expected numbers.

➤ Data are examined frequently for clusters.
MODULE 2 – FOODBORNE DISEASE SURVEILLANCE AND OUTBREAK DETECTION

FOODBORNE DISEASE OUTBREAK INVESTIGATION TEAM TRAINING

AT THE END OF THIS MODULE, YOU WILL BE ABLE TO
1. Describe the surveillance of foodborne illness through complaint systems.
2. List ways to improve the accuracy of a food history obtained in a foodborne illness complaint.
3. Describe the surveillance of foodborne illness through pathogen-specific surveillance.
4. Recognize a possible outbreak using a complaint system or pathogen-specific surveillance.
5. Describe the role of local public health in national pathogen-specific surveillance.

FOODBORNE DISEASE SURVEILLANCE
Many ways to find out about cases of foodborne illnesses and outbreaks
Two primary means
- Foodborne illness complaint systems
- Pathogen-specific surveillance (notifiable disease reporting)

FOODBORNE ILLNESS COMPLAINT SYSTEMS

COMPLAINT SYSTEMS
- Complaints of illness among individuals and groups reported by affected members of the community (and others)
- Includes any illness thought to be related to food
- Common exposures used to link cases together

STEPS IN RECEIVING COMPLAINTS

1. Illness in individual or group
2. Complaint to local health department
3. Interview of complainant
4. Documentation of information
5. Key information entered into log
6. Routine review of log
7. Evaluation of individual reports for immediate action
8. Evaluation of reports over time for outbreaks

Starts with complaint by consumer
Common exposures link cases over time
INTERVIEW OF COMPLAINANT

- Who is affected?
- What is the problem?
- When did problem occur?
- Where?
- Why/how?

COLLECTING FOOD HISTORIES

Complete food history including:
- Foods eaten in 5 days before onset of illness
  - If norovirus likely, focus on 24-48 hours before illness.
  - If >1 ill person, focus on shared foods/meals.
- ALL foods eaten during time period of interest (unless focusing on shared foods/meals)
- Details of named events, food establishments, or suspect food products
- Information on non-food exposures

SMALL GROUP EXERCISE

Divide into groups of three. One person will be the interviewer; one, the complainant; and one, an evaluator.

1. The interviewer should solicit a 5-day food history from the complainant.
2. The complainant should respond to questions as if they just developed symptoms that day and based on what they really ate in the last 5 days.
3. Was it easy or difficult? Did you get a complete history? What approaches were helpful?

Improve Food Histories

- Extract key information from the complaint to facilitate examination of reports over time
  - Date of illness onset
  - Predominant signs and symptoms
  - Name of food thought to have caused illness
  - Names of eating places or gatherings
  - Source of water and type
  - Other exposures
- Transfer information carefully
- Use consistent abbreviations and codes

ENTERING INFORMATION INTO LOG

- Foodborne Disease Surveillance System
  - Name of foodborne disease
  - Date of illness onset
  - Predominant signs and symptoms
  - Name of food thought to have caused illness
  - Names of eating places or gatherings
  - Source of water and type
  - Other exposures

EVALUATION OF COMPLAINTS

- Symptoms suggestive of serious illnesses
- Laboratory-confirmed diagnoses
- Reports of obvious food safety problems
- Group illnesses thought to be due to an identified, shared exposure
GROUP ILLNESSES DUE TO IDENTIFIED, SHARED EXPOSURE
Illnesses are likely to be related to an identified, shared exposure, if group members have:
- Similar signs and symptoms
- Shared a food or meal prior to onset of illness and had no other common exposures
- Onset and nature of illness is consistent with identified shared exposure

EVALUATION OF COMPLAINTS (CONT’D)
Looking at reports over time
- Multiple individual complaints with same exposure (e.g., same food establishment or food)
- Multiple individual complaints with clustering by time, place, or person
- Overall increase in complaints

RESPONSE TO COMPLAINTS
- Notify epidemiology unit/communicable disease staff of laboratory-confirmed diagnoses.
- Refer food safety problem to agency with regulatory authority.
- Alert appropriate persons if possible outbreak detected.
- Prioritize follow-up of commercial establishments.

FOLLOW-UP OF COMMERCIAL ESTABLISHMENTS
Rational approach to follow-up
- As required by local law/statute or
- If complainant observed food safety problem or
- If two or more persons (not from same household)
  - Have similar illness
  - Shared history of eating at establishment
  - Onset and nature of illness with shared foods

SMALL GROUP EXERCISE
Study the foodborne illness log at the end of this module spanning a 2-week period and determine:
1. Is the number of complaints what you would expect for the period covered?
2. Are there individual complaints of concern?
3. Are there common exposures (e.g., foods, establishments) across complaints signaling an outbreak?

Be prepared to share with class.
Time: 10 minutes

QUESTION
Which of the following group illnesses are likely to be due to the identified restaurant exposure?
Due to Exposure
Person developed diarrhea after eating at a restaurant. Neighbors who ate at the restaurant also are sick but complainant does not know their symptoms.
Four friends develop nausea and vomiting, facial flushing, headache, and itching skin within an hour of eating fish at a restaurant.
Family members develop bloody diarrhea within hours of eating at a restaurant.
STRENGTHS OF COMPLAINT SYSTEMS
Primary means to detect outbreaks that are
- Localized (involving only one jurisdiction)
- Due to diseases with a short incubation period

COMPLAINT SYSTEM ISSUES
Inaccurate and incomplete food histories
Large numbers of complaints
Anonymous complaints
Complaints with unknown causative agent
- Inability to exclude unrelated cases
- Inability to link cases based on illness unless symptoms very unique or cases report similar exposure

PATHOGEN-SPECIFIC SURVEILLANCE
- Also called “reportable diseases,” “notifiable diseases,” or “laboratory-based reporting”
- Reports of individual lab-confirmed cases of foodborne disease by medical and laboratory staff with submission of clinical isolates, where requested
- Only covers diseases selected by public health agency
- Cases linked to each other by common pathogen

INITIAL REPORT
- From health-care provider or laboratory
- Standardized form (often pathogen-specific)
- Information of interest
  - Patient identifiers
  - Basic demographic information
  - Clinical information
  - Laboratory results
FOLLOW-UP INTERVIEW OF CASE

- To identify potential exposures leading to illness
- Similar to interview for complaint system but tailored to specific pathogen
  - High-risk food exposures for agent
  - Other exposures related to agent (e.g., contact with ill people, animals, water)
- Often occurs weeks after exposure leading to illness resulting in poor recall

LABORATORY CHARACTERIZATION OF PATHOGEN

- Submission of patient isolate to public health laboratory for confirmation and subtyping
- Increased detail about the pathogen (e.g., serotyping, PFGE) improves
  - Recognition of clusters
  - Linking an outbreak with an exposure
- Most critical with common pathogens

ANALYSIS FOR CLUSTERS

Examine cases by pathogen over time using
- Different levels of specificity of pathogen (e.g., species, selected subtypes)
- Subgroups of population (certain time, place, or person characteristics)

Look for increase in number of cases over expected or baseline, indicating a cluster

ANALYSIS BY CAUSATIVE AGENT

Lab-confirmed salmonellosis cases by month of diagnosis, 2010

ANALYSIS BY CAUSATIVE AGENT SUBTYPE

Lab-confirmed salmonellosis cases by month of diagnosis, 2010

ANALYSIS BY CAUSATIVE AGENT AND AGE GROUP

Lab-confirmed salmonellosis cases by month of diagnosis, 2010
STRENGTHS OF PATHOGEN-SPECIFIC SURVEILLANCE

Primary means to detect outbreaks that are
- Wide-spread (i.e., multijurisdictional),
- Due to prolonged low-level food contamination, or
- Due to diseases with a long incubation (e.g., hepatitis A)

PATHOGEN-SPECIFIC SURVEILLANCE ISSUES

- Incomplete detection and reporting
- Elapsed time
- Availability of isolate for further characterization

COMPARISON OF SURVEILLANCE SYSTEMS

<table>
<thead>
<tr>
<th></th>
<th>Complaint system</th>
<th>Pathogen-specific surveillance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of foodborne illnesses detected</td>
<td>All</td>
<td>Only selected diseases</td>
</tr>
<tr>
<td>Initiating event</td>
<td>Consumer complaint</td>
<td>Positive lab result</td>
</tr>
<tr>
<td>Means to link cases</td>
<td>Common exposures</td>
<td>Same pathogen</td>
</tr>
<tr>
<td>Linkage of cases across jurisdictions</td>
<td>Not usually</td>
<td>Yes</td>
</tr>
<tr>
<td>Exclusion of unrelated cases</td>
<td>Difficult</td>
<td>Good</td>
</tr>
<tr>
<td>Speed</td>
<td>Fast</td>
<td>Relatively slow</td>
</tr>
<tr>
<td>Types of outbreaks best detected</td>
<td>Localized outbreaks, short incubation illnesses</td>
<td>Widespread; low-level contamination events; long incubation illnesses</td>
</tr>
</tbody>
</table>

NATIONAL PATHOGEN-SPECIFIC SURVEILLANCE SYSTEMS
NATIONAL PATHOGEN-SPECIFIC SURVEILLANCE

NNDSS (National Notifiable Disease Surveillance System)
- Data from pathogen-specific surveillance forwarded to CDC (minimal case information)
- Statistical algorithm used to identify increases

PulseNet (National Molecular Subtyping Network for Foodborne Disease Surveillance)
- Lab network that uses standardized PFGE methods
- PFGE patterns uploaded by labs for STEC, Salmonella, Shigella, Listeria, Campylobacter
- Comparisons of patterns to identify clusters

CaliciNet (National Electronic Norovirus Outbreak Network)
- Laboratory network that subtypes/sequences norovirus isolates related to outbreaks
- Data uploaded to CDC allows linkage of outbreaks and identification of new variants

NARMS (National Antimicrobial Resistance Monitoring System—enteric bacteria)
- Submission of Salmonella, Shigella, E. coli O157, Campylobacter, and non-cholerae Vibrio to CDC
- Determines trends in antimicrobial resistance

ROLE OF LOCAL HEALTH DEPARTMENTS

Local pathogen-specific case reports and lab results feed into national surveillance
Important for local health departments to

WHAT DIFFERENCE DOES ONE LOCAL CASE MAKE?

- Two E. coli O157:H7 infections in MN with same PFGE pattern; both ate tenderized steaks
- Through PulseNet, single cases identified in KS and MI; both ate tenderized steaks
- Steaks eaten by cases from same plant
- Recall of 739,000 lbs. of beef
- Outbreak generated concern about needle/blade tenderized steaks
Foodborne Illness Complaint Form

Incident/Outbreak ID#: ___________  Complainant ID #: ___________

Date Received: ___________  Receiving Agency: ___________  Call Received By: ___________

Complainant Data

Name: ___________  DOB: ___________  Gender: M F  Race: W B H A  Other: ___________

Phone: (Work) ___________  (Home) ___________  (Cell) ___________  (Email) ___________

Occupation(s): ___________  Previous Illness or Chronic Condition: Y N  Existing Medications: Y N

Comments: __________________________________________________________________________________________

Illness Data

Illness Onset: Date: ___________  Time: ___________ AM / PM  Illness Stopped: Date: ___________  Time: ___________ AM / PM

Illness Ongoing: Y N

Signs and Symptoms:

- Diarrhea _ Watery _ Bloody
- Headache
- Itching (location) ___________
- Vomiting
- Myalgia (muscle ache)
- Numbness (location) ___________
- Nausea
- Dizziness
- Tingling (location) ___________
- Abdominal Pain
- Double Vision
- Edema (location) ___________
- Fever _ °F
- Jaundice
- Rash
- Chills
- Weakness
- Other: ___________

Diarrhea Onset: Date: ___________  Time: ___________ AM / PM  Diarrhea Stopped: Date: ___________  Time: ___________ AM / PM

Vomiting Onset: Date: ___________  Time: ___________ AM / PM  Vomiting Stopped: Date: ___________  Time: ___________ AM / PM

Vomiting Ongoing: Y N

Clinical Data

Was a doctor or other healthcare provider visited? Y N

Date Visited: ___________  Time: ___________ AM / PM  Admitted: Y N  Length of Stay: ___________ (hrs)

Healthcare Facility: ___________  Physician Name: ___________  Phone: ___________

Were clinical specimens taken? Y N  Blood  Stool  Diagnosis: ___________

Would you be willing to provide a stool sample? Y N  N/A – Samples no longer available

Suspect Meal Data

Date: ___________  Location: ___________  Suspect Meal: ___________

Time: ___________ AM / PM

Number of people in party: ___________  Number of people reportedly ill: ___________  Group Contact: ___________

(Use following page for additional contacts)

List anything unusual about the meal (temperature, taste, color, etc.)? ___________
# Foodborne Illness Complaint Form

## Other Contacts

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone</th>
<th>Associated Meal and/or Location</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

## Other Exposures

### Other Possible Non-food Exposures within Past 2 Weeks: (swimming pool, river, lake, etc.)

- Travel outside the US: [ ] Y [ ] N  
  Location(s): __________________________
- Water consumed outside residence: [ ] Y [ ] N  
  Location(s): __________________________
- Well water consumed: [ ] Y [ ] N  
  Location(s): __________________________
- Exposure to recreational water: [ ] Y [ ] N  
  Location(s): __________________________

### Exposure to the following:

- Petting zoo
- Mass gatherings
- Daycare facility
- Ill person at home or outside of home
- Ill animal
- Diapered kids or adults
- Domestic animals or livestock
- Birds or reptiles
- Visit nursing home
- Other __________________________

### Notes:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
### Foodborne Illness Complaint Form

**Day of Illness Onset:**

<table>
<thead>
<tr>
<th>Meal</th>
<th>Location</th>
<th>Time</th>
<th>Suspect Meal?</th>
<th>Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast</td>
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<td>Lunch</td>
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<td>Dinner</td>
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<tr>
<td>Other Foods/Water</td>
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</tr>
</tbody>
</table>

**Date:**

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**One Day Prior to Illness Onset:**

<table>
<thead>
<tr>
<th>Meal</th>
<th>Location</th>
<th>Time</th>
<th>Suspect Meal?</th>
<th>Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast</td>
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<td>Other Foods/Water</td>
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</tbody>
</table>

**Date:**

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**Two Days Prior to Illness Onset:**

<table>
<thead>
<tr>
<th>Meal</th>
<th>Location</th>
<th>Time</th>
<th>Suspect Meal?</th>
<th>Contacts</th>
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</thead>
<tbody>
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<td>Breakfast</td>
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<tr>
<td>Other Foods/Water</td>
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</tbody>
</table>

**Date:**
Module 2 – Group Exercise: Collecting a Food History

Divide into groups of two. One person will be the interviewer; one will be the complainant.
1. The person playing the interviewer should try to solicit a 5-day food history from the complainant.
2. The person playing the complainant should respond to questions from the interviewer as if they just developed symptoms of a foodborne illness that day and based on what they really ate in the last 5 days.
3. Was it easy or difficult? Did you get a complete food history? What approaches were helpful?

### Day of Illness Onset (enter date):

<table>
<thead>
<tr>
<th>Meal</th>
<th>Location</th>
<th>Time</th>
<th>Suspect Meal?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast</td>
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<td>Lunch</td>
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<td>Dinner</td>
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<td>Other Foods/Water</td>
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</tr>
</tbody>
</table>

### One Day Prior to Illness Onset (enter date):

<table>
<thead>
<tr>
<th>Meal</th>
<th>Location</th>
<th>Time</th>
<th>Suspect Meal?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast</td>
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<td>Lunch</td>
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<td>Dinner</td>
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<tr>
<td>Other Foods/Water</td>
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</table>

### Two Days Prior to Illness Onset (enter date):

<table>
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<tr>
<th>Meal</th>
<th>Location</th>
<th>Time</th>
<th>Suspect Meal?</th>
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</thead>
<tbody>
<tr>
<td>Breakfast</td>
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<td>Lunch</td>
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<tr>
<td>Dinner</td>
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<td></td>
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<tr>
<td>Other Foods/Water</td>
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<tr>
<td>Three Days Prior to Illness Onset (enter date):</td>
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<td>------------------------------------------------</td>
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<tr>
<td><strong>Breakfast:</strong> __________________ Location: _____________ Time: _____ AM / PM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contacts: ______________________________________</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspect Meal?  □ Yes  □ No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lunch:</strong> __________________ Location: _____________ Time: _____ AM / PM</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Contacts: ______________________________________</td>
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<tr>
<td>Suspect Meal?  □ Yes  □ No</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Dinner:</strong> __________________ Location: _____________ Time: _____ AM / PM</td>
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<tr>
<td>Contacts: ______________________________________</td>
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<tr>
<td>Suspect Meal?  □ Yes  □ No</td>
<td></td>
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<tr>
<td><strong>Other Foods/Water:</strong> __________ Location: __________ Time: _____ AM / PM</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Contacts: ______________________________________</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspect Meal?  □ Yes  □ No</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Four Days Prior to Illness Onset (enter date):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breakfast:</strong> __________________ Location: _____________ Time: _____ AM / PM</td>
</tr>
<tr>
<td>Contacts: ______________________________________</td>
</tr>
<tr>
<td>Suspect Meal?  □ Yes  □ No</td>
</tr>
<tr>
<td><strong>Lunch:</strong> __________________ Location: _____________ Time: _____ AM / PM</td>
</tr>
<tr>
<td>Contacts: ______________________________________</td>
</tr>
<tr>
<td>Suspect Meal?  □ Yes  □ No</td>
</tr>
<tr>
<td><strong>Dinner:</strong> __________________ Location: _____________ Time: _____ AM / PM</td>
</tr>
<tr>
<td>Contacts: ______________________________________</td>
</tr>
<tr>
<td>Suspect Meal?  □ Yes  □ No</td>
</tr>
<tr>
<td><strong>Other Foods/Water:</strong> __________ Location: __________ Time: _____ AM / PM</td>
</tr>
<tr>
<td>Contacts: ______________________________________</td>
</tr>
<tr>
<td>Suspect Meal?  □ Yes  □ No</td>
</tr>
</tbody>
</table>
Divide into groups by table. Study the foodborne illness log below spanning a 2-week period and answer the following questions:
1. Is the number of complaints what you would expect for the period covered?
2. Are there individual complaints of concern?
3. Are there common exposures (e.g. foods, establishments) across complaints signaling an outbreak?

<table>
<thead>
<tr>
<th>Complaint</th>
<th>Illness</th>
<th>Food</th>
<th>Where eaten within 72 h</th>
<th>Where ingested within 72 h</th>
<th>Where contacted within 2 wks</th>
<th>Source</th>
<th>Other exposures</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>8/16</td>
<td>8/15</td>
<td>1</td>
<td>Diarrhea</td>
<td>Redguard</td>
<td>Community</td>
<td>Intern'l travel</td>
<td><em>Giardia lamblia</em> isolated from stool specimen</td>
</tr>
<tr>
<td>102</td>
<td>8/20</td>
<td>8/18</td>
<td>1</td>
<td>Diarrhea</td>
<td>Hamburger, Roast beef</td>
<td>Speedy Foods Nitestar Club</td>
<td>Dixon</td>
<td>Community</td>
</tr>
<tr>
<td>103</td>
<td>8/21</td>
<td>8/21</td>
<td>12</td>
<td>Diarrhea</td>
<td>Dixon Day Care Center</td>
<td>Dixon</td>
<td>Community</td>
<td>Day care</td>
</tr>
<tr>
<td>104</td>
<td>8/23</td>
<td>8/23</td>
<td>0</td>
<td>Corn</td>
<td></td>
<td>Daulton</td>
<td></td>
<td><em>Swollen can, Brand W code LM 308</em></td>
</tr>
<tr>
<td>105</td>
<td>8/24</td>
<td>8/23</td>
<td>1</td>
<td>Vomiting</td>
<td>Ham</td>
<td>Joe's Diner</td>
<td>Dixon</td>
<td>Community</td>
</tr>
<tr>
<td>106</td>
<td>8/23</td>
<td>8/23</td>
<td>1</td>
<td>Nausea, vomiting</td>
<td>Cold cuts from deli</td>
<td>Jo's Market</td>
<td>Dixon</td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>8/26</td>
<td>8/24</td>
<td>1</td>
<td>Diarrhea, fever, vomiting</td>
<td></td>
<td>Plainville</td>
<td>Well</td>
<td><em>Salmonella Chester</em> isolated from stool</td>
</tr>
<tr>
<td>108</td>
<td>8/26</td>
<td>8/25</td>
<td>1</td>
<td>Diarrhea, fever</td>
<td>Church supper</td>
<td>Dixon</td>
<td>Community</td>
<td></td>
</tr>
<tr>
<td>109</td>
<td>8/27</td>
<td>8/25</td>
<td>1</td>
<td>Diarrhea, chills</td>
<td></td>
<td>Midvale</td>
<td></td>
<td><em>Salmonella Anatum</em> isolated from stool</td>
</tr>
<tr>
<td></td>
<td>Date 1</td>
<td>Date 2</td>
<td>Date of Incident</td>
<td>Illness Reported</td>
<td>Establishment</td>
<td>Community</td>
<td>Additional Information</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>110</td>
<td>8/27</td>
<td>8/26</td>
<td>1</td>
<td>Vomiting, diarrhea</td>
<td>Oysters</td>
<td>Dixon</td>
<td>Community</td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>8/29</td>
<td>8/28</td>
<td>1</td>
<td>Vomiting</td>
<td>Joe’s Café</td>
<td>Clear Falls</td>
<td>Well</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>8/29</td>
<td>0</td>
<td>1</td>
<td>Vomiting</td>
<td>Baby cereal</td>
<td>Dixon</td>
<td>Community</td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>8/30</td>
<td>8/28</td>
<td>1</td>
<td>Nausea, vomiting, headache</td>
<td>Oysters</td>
<td>Ralph’s Seafood</td>
<td>Dixon</td>
<td>Community</td>
</tr>
<tr>
<td>114</td>
<td>9/1</td>
<td>8/29</td>
<td>1</td>
<td>Diarrhea, fever, vomiting</td>
<td>Dixon Arts Festival</td>
<td>Dixon</td>
<td>Community</td>
<td>Salmonella Chester isolated from stool</td>
</tr>
<tr>
<td>115</td>
<td>9/2</td>
<td>8/29</td>
<td>1</td>
<td>Blurred and double vision, paralysis</td>
<td>Dixon Arts Festival</td>
<td>Dixon</td>
<td>Community</td>
<td>Hospital reported assisted breathing</td>
</tr>
</tbody>
</table>
Module 3: Preliminary Investigation

At the end of this module, the participant will be able to

1. Describe the initial steps used to confirm an outbreak.
   • Verify the diagnosis
   • Search for additional cases
   • Create a case definition
   • Generate hypotheses

2. Develop a case definition for an outbreak.

3. Generate hypothesis about an outbreak using information on the causative agent, the implicated facility, the descriptive epidemiology, and case interviews.

4. Prioritize an outbreak for further investigation.
Module 3: CIFOR Toolkit Keys to Success

- Agency has processes for the response to a possible outbreak.
- Agency has criteria for determining scale of response.
- Staff develop hypothesis about an outbreak early in the investigation to guide subsequent steps.
- Staff can prioritize the response to a possible outbreak and know what circumstances require an immediate response, a more moderate response, or no response at all.
AT THE END OF THIS MODULE, YOU WILL BE ABLE TO
1. Describe the initial steps of an outbreak investigation including
   - Verify the diagnosis
   - Search for additional cases
   - Create a case definition
   - Generate a hypothesis about the source
2. Develop a case definition for an outbreak.
3. Generate a hypothesis about the source of an outbreak.
4. Prioritize an outbreak for further investigation.

STEP 1: VERIFY DIAGNOSIS

Purpose
- Make sure illness properly diagnosed
- Rule out laboratory and reporting errors
- Determine that all cases suffer from same illness

WAYS TO VERIFY DIAGNOSIS
- Obtain clinical samples for lab testing
- Review medical records and lab results
- Talk with health-care providers of cases
- Interview (and even examine) cases
- Consult microbiologist

LABORATORY ERROR – EXAMPLE

Increase in intestinal amebiasis (Entamoeba histolytica infection) in Los Angeles
- 38 cases in 4 months (usual: one per month)
- Investigation showed no common exposures
- Diagnostic slides reexamined

STEP 2: SEARCH FOR ADDITIONAL CASES

Identified cases often “tip of the iceberg”
Might not represent all cases associated with outbreak
Need to actively search for additional cases to
- Determine true magnitude of outbreak
- Characterize outbreak accurately
- Increase ability of epi studies to link illness with true cause of outbreak
WHY SEARCH FOR ADDITIONAL CASES?

- = Female  ● = Male

First cases detected (N=10)

WAYS TO SEARCH FOR ADDITIONAL CASES

STEP 3: DEVELOP A CASE DEFINITION

Standard set of criteria used to classify ill people as being cases associated with particular outbreak

Criteria include
- Clinical findings suggestive of the disease or common among those with outbreak-related illness
- Restrictions by time, place, and person

All cases have to meet these criteria

Different from a clinical diagnosis, used for epidemiologic purposes only

CASE DEFINITION - EXAMPLE

For outbreak of salmonellosis at child care center

Clinical criteria
- ≥ 3 loose stools in a 24-hour period OR
- stool culture that yielded *Salmonella* Javiana

Restrictions
- Time: onset from October 24-30
- Place: attended/worked at Child Care Center X
- Person: excludes siblings of initial case in a family (if onset of illness after initial case)

CASE DEFINITION CRITERIA

- Objective – Not open to interpretation
  - Example: fever vs. oral temperature of 100.4°F or higher

- Discriminating – Distinguishes between individuals with illness associated with outbreak and illness not associated with the outbreak
  - Example: ≥ 3 loose stools in 24-hours vs. stool culture that yielded *Salmonella*

CASE DEFINITION

- Does not include suspected source of outbreak (i.e., hypothesis you are trying to test)
- Can reflect different levels of certainty that person has disease associated with outbreak
  - Typical signs and symptoms only (“probable case”)
  - Inclusion of laboratory testing or subtyping (“confirmed case”)
- Can change over time as more information about the illness or outbreak is revealed
SMALL GROUP EXERCISE
Divide into groups of two or three.
1. Develop a case definition for an outbreak following a birthday party at a private home. A line list of ill guests is provided at the end of this module.
2. Consider the questions posed as you develop your case definition.

Be prepared to share with class.
Time: 10 minutes

STEP 4: GENERATE HYPOTHESIS
Using available information to make an educated guess about the cause and source of an outbreak

Purpose
- To direct immediate control measures
- To narrow focus of subsequent studies
- To determine the need to involve others in investigation

Undertaken by entire team

HYPOTHESIS
Includes likely causative agent, people at risk, mode of transmission, vehicle, and period of interest

Example:
“The outbreak is due to a bacterium that was spread during the first week of November by a food commonly consumed by children.”

KEY SOURCES OF INFORMATION
1. Basic information about causative agent
2. Information on implicated facility or food
3. Descriptive epidemiology (i.e., describe cases by time, place, and person)
4. Case interviews (“hypothesis-generating interviews”)

BASIC INFORMATION ABOUT CAUSATIVE AGENT
- Common reservoirs of causative agent
- Vehicles in past outbreaks
- Growth requirements for causative agent
- Incubation period (time from exposure to onset of illness)

REFERENCES ON CAUSATIVE AGENTS
- APHA Control of Communicable Diseases Manual
- IAFP Procedures to Investigate Foodborne Illness (Table B)
- AMA “Diagnosis and Management of Foodborne Illnesses: A Primer for Physicians”
- FDA Bad Bug Book (online)
- CDC A-Z Index (online)
QUESTION
Using Control of Communicable Diseases Manual (CCDM), what is the average incubation period for salmonellosis?

Using Table B from IAFP’s Procedures to Investigate, what other agents cause lower intestinal tract symptoms and have an incubation period similar to salmonellosis?

Using either reference, what foods are commonly associated with salmonellosis?

DIAGNOSIS AND MANAGEMENT OF FOODBORNE ILLNESSES
A Primer for Physicians
- Introduction and clinical considerations
- Patient scenarios
- Tables on bacterial, viral, parasitic, and non-infectious agents
- Clinical vignettes—what’s your call?
- Resources

INFORMATION ON IMPLICATED FACILITY
Foods produced or served; production, processing, distribution methods; past food safety problems
Help identify high risk foods, likely causative agent, and contributing factors
Sources of information
- Paperwork from past inspections, HACCP risk assessment, facility plan review
- Online menus
- Regulatory inspector

DESCRIPTIVE EPIDEMIOLOGY
Simple characterization of outbreak by
- Time
- Place
- Person
Can provide clues about the mode of transmission and vehicle
Comparison group usually needed to put findings in perspective

TIME – ONSET OF ILLNESS
- Time or date of onset of symptoms
- Relates back to likely period of exposure
- Typically presented as epidemic curve (epi curve)

USES OF EPI CURVE
- Grasp magnitude of outbreak
- Clarify outbreak’s time course
- Identify cases that are outliers
- Draw inferences about pattern of spread
  - Point source outbreak
  - Continuous common source outbreak
  - Propagated outbreak
POINT SOURCE OUTBREAK
Exposure to same source over brief time
Cases rise rapidly to a peak and fall off gradually
Majority of cases within one incubation period

CONTINUOUS COMMON SOURCE OUTBREAK
Exposure to same source over prolonged time
Epidemic curve rises gradually
May plateau

PROPAGATED OUTBREAK
Spread from person to person
Series of progressively taller peaks
Peaks one incubation period apart

QUESTION
Thirty seven cases of campylobacteriosis were identified among children attending a summer camp. Based on the epi curve, what is the most likely means of spread: point source, continuous common source, or propagated? (average incubation period 3-5 days)

PLACE
Residence of cases (typically)
Distribution reveals clues about source of outbreak
- Over broad area → commercial product with wide distribution
- Clustering → locally sold product, point source, or person-to-person spread
- Concentrated areas with outliers → travel to affected area or importation of product
Typically presented as spot map

PLACE – EXAMPLE
Outbreak of Salmonella Typhimurium with unique PFGE pattern in San Diego
50 cases among Mexicans and Mexican Americans
Spot map of households of cases
PLACE – EXAMPLE (CONT’D)

PLACE – EXAMPLE

Outbreak associated with Mexican-style soft cheese sold by street vendors; four vendors cited

PERSON

Age group, sex, and other characteristics
Influence individual’s susceptibility to illness or opportunities for disease exposure → can provide clues to source of outbreak
Typically presented as percentage of all cases or rate among affected population

PERSON – EXAMPLE

E. coli O104 outbreak in Germany with many cases of hemolytic uremic syndrome (HUS)
88% of HUS cases ≥20 years (usually 1-10%)
71% of HUS cases female (usually around 50%)

DESCRIPTIVE EPIDEMIOLOGY CLUES

Person-to-person transmission
- Clustering in social units
- Localized to one part of community
- Occurrence of cases in waves

Transmission by public drinking water
- Widespread illness, affecting both sexes and all ages
- Distribution consistent with public water system

Transmission by food
- Increased risk among certain groups
- Distribution similar to distribution of foods

QUESTION

Based on the following case characteristics, what mode of transmission seems likely in each outbreak?

Cases live in one community; most <3 years of age; attend same child care center; onset of cases in waves
Majority of cases live in city limits, age range 1-75 years; 52% female
Cases live in two states; high proportion 20-29 years; 65% male
HYPOTHESIS-GENERATING INTERVIEWS

Extensive exploration of illness and exposures with cases

Purpose
- To identify a common location or activity
- To shorten list of foods and exposures for study

Much more detailed than interviews for foodborne illness complaints or pathogen-specific surveillance

Use of standard questionnaire

INTERPRETATION OF COMMONALITIES

If you find commonalities among cases:

Are commonalities unique to cases or a reflection of common exposures in the community?

Comparison group needed
- "Controlled" epidemiologic study
- Other cases of unrelated foodborne illness interviewed for other reasons (case-case comparisons)
- FoodNet Atlas of Exposures

FOODNET ATLAS OF EXPOSURES

Population-based survey at FoodNet sites

Exposures among respondents in previous 7 days

Estimates of background rate of exposure

Available at http://www.cdc.gov/foodnet/studies/population-surveys.html

PRIORITIZATION FOR FURTHER INVESTIGATION

Ideally, all outbreaks investigated further to
- Prevent others from becoming ill from the outbreak source
- Identify problematic food preparation practices or risky foods to prevent future outbreaks
- Add to our knowledge of foodborne diseases

Given limited resources, not all outbreaks can be investigated

HIGH PRIORITY INVESTIGATIONS

-
ABILITY OF LOCAL TEAM TO RESPOND?

When to ask for help
- Scale of outbreak likely to overwhelm local resources
- Nature of outbreak or response beyond the experience of local staff
- Outbreak suspected to affect multiple counties, states, or countries

How to ask for help
- Call State Epidemiologist
- Be prepared to share outbreak information

GROUP EXERCISE

Divide into groups by table.
1. Read the brief description of an E. coli O157:H7 outbreak that occurred in Wisconsin.
2. Answer the questions.
3. Develop a hypothesis about the source of the outbreak.

Be prepared to share with class.
Time: 15 minutes
Module 3 – Small Group Exercise: Creating a Case Definition

Divide into groups of two or three.

1. Develop a case definition for illness associated with an outbreak following a birthday party at a private home. The party occurred on June 10. At the party, a meal was served including potato salad, hamburgers, and ice cream.

2. Consider the following questions as you create your case definition:
   - What symptoms are reported among ill persons (and what is their frequency)?
   - How many ill persons have a positive stool culture? (Are symptoms among ill persons without a positive stool culture consistent with salmonellosis?)
   - What restrictions by time, place, and person might help discriminate between outbreak-related illness and background illness?

YOUR CASE DEFINITION:
### Line List of Ill Guests following Birthday Party in Private Home (Module 3)

<table>
<thead>
<tr>
<th>#</th>
<th>Sex</th>
<th>Age</th>
<th>Onset</th>
<th>Vomiting</th>
<th>Diarrhea*</th>
<th>Fever</th>
<th>Headache</th>
<th><strong>Salmonella Positive Stool Culture</strong></th>
<th>Salad</th>
<th>Burger</th>
<th>Ice Cream</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>14</td>
<td>6/12</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>5</td>
<td>6/13</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>NA</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>16</td>
<td>6/12</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>NA</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>18</td>
<td>6/10</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>16</td>
<td>6/14</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>NA</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>15</td>
<td>6/11</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>NA</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>15</td>
<td>6/13</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>NA</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>17</td>
<td>6/12</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>NA</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>16</td>
<td>6/20</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>14</td>
<td>6/12</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>NA</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
</tbody>
</table>

*Three or more stools in a 24-hour period
NA=culture not performed
Module 3 – Group Exercise: Generating Hypotheses about an Outbreak

Divide into groups by table.
1. Read the brief description of an *E. coli* O157:H7 outbreak that occurred in Wisconsin in.
2. Answer the questions.
3. Develop a hypothesis about the source of the outbreak.

On September 5, the Wisconsin Division of Public Health received separate reports of clusters of laboratory-confirmed *E. coli* O157:H7 infections in three non-contiguous counties: Manitowoc, Ozaukee, and Dane. The Manitowoc County cluster involved five ill persons, four of whom visited an animal exhibition at a county fair.

On September 7, the Wisconsin state epidemiologist was called by the director of the Blood Center of Southeastern Wisconsin regarding five adults who received plasma exchanges in the prior 3 days to treat illnesses consistent with hemolytic uremic syndrome. Three had a laboratory-confirmed *E. coli* O157:H7 infection.

A total of 30 *E. coli* O157:H7 infections were reported among Wisconsin residents in one week. (On average, 15 *E. coli* O157:H7 infections are reported in each month.)

**Question 1:** Do these cases represent an outbreak? What explanations might explain the increase in cases (other than an outbreak)? What information might help you determine if the cases represent an outbreak?

Molecular subtyping of 12 of the *E. coli* O157:H7 isolates showed seven had PFGE patterns that were indistinguishable. Infections with this strain had only been reported sporadically in the past. The PFGE patterns from the four Manitowoc County fairgoers did not match this pattern.

Officials from the Wisconsin Division of Public Health decided that the cases of *E. coli* O157:H7 infection with the indistinguishable PFGE pattern represented a possible outbreak and assembled the outbreak investigation team to consider the situation.

**Question 2:** What are the modes of transmission for *E. coli* O157:H7? What vehicles have been associated with *E. coli* O157:H7 in past outbreaks? What is the average incubation period of *E. coli* O157:H7?

To search for additional cases of *E. coli* O157:H7 infection, the Wisconsin Division of Public Health staff used the Wisconsin Health Alert Network and e-mail to notify local, regional, and tribal health departments; laboratories; infection control professionals; hospitals; emergency departments; and clinics of the suspected outbreak.
For the investigation, a case was defined as a patient who was infected with the outbreak strain of *E. coli* O157: H7, who resided in Wisconsin and had onset of symptoms since August 1.

A total of 49 Wisconsin residents from 10 counties had illness meeting the case definition. The most frequently reported signs and symptoms among the cases included diarrhea (96%), abdominal cramps (96%), bloody diarrhea (88%), fatigue (80%), watery diarrhea (63%), and chills (57%).

Among cases, illness onset dates occurred from August 20 through September 14. (Figure 1) Case ages ranged from 1 to 84 years; 38 (78%) cases were ≥ 20 years of age. Of the 49 cases, 35 (71%) were female, 24 (49%) were hospitalized, and 9 (18%) had hemolytic uremic syndrome.

Figure 1. Onset of illness among persons infected with outbreak strain of *E. coli* O157:H7, Wisconsin.

**Question 3:** Interpret the descriptive epidemiology of the outbreak including the epidemic curve (Figure 1). Were symptoms among patients consistent with infection with *E. coli* O157:H7? Does the epi curve suggest a mode of transmission? Was clustering of cases by selected demographic characteristics apparent?

Staff at local health departments and the Wisconsin Division of Public Health conducted telephone interviews of cases using a standard comprehensive enteric disease questionnaire. Of the initial 9 cases interviewed, 7 (78%) ate potatoes, 5 (56%) ate romaine lettuce, and 8 (89%) ate bagged spinach.
**Question 4:** Using the excerpt from the FoodNet Atlas of Exposures, are these exposures unusual?

**Question 5:** State your hypothesis about the source of this outbreak including causative agent, people at risk, mode of transmission, vehicle, and period of interest.

**Question 6:** How would you prioritize this outbreak for investigation? Why?

Foodborne Diseases Active Surveillance Network (FoodNet)

Population Survey


U.S. Department of Health & Human Services
Centers for Disease Control and Prevention
### Fresh Vegetables Consumed in the Past 7 Days, by FoodNet Site (Food Exposures B)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabbage</td>
<td>160 30.5</td>
<td>229 24.4</td>
<td>202 22.8</td>
<td>311 35.3</td>
<td>225 24.8</td>
<td>206 23.3</td>
<td>259 29.9</td>
<td>222 24.5</td>
<td>310 34.6</td>
<td>299 35.1</td>
<td>2,423 28.4</td>
</tr>
<tr>
<td>Potatoes</td>
<td>365 69.5</td>
<td>700 74.7</td>
<td>664 74.9</td>
<td>662 75.2</td>
<td>662 72.9</td>
<td>701 79.1</td>
<td>699 80.7</td>
<td>729 80.6</td>
<td>679 75.8</td>
<td>682 80.0</td>
<td>6,543 76.6</td>
</tr>
<tr>
<td>Yams or sweet potatoes</td>
<td>106 20.2</td>
<td>191 20.4</td>
<td>232 26.2</td>
<td>270 30.7</td>
<td>235 25.9</td>
<td>135 15.2</td>
<td>179 20.7</td>
<td>213 23.5</td>
<td>140 15.6</td>
<td>204 23.9</td>
<td>1,905 22.3</td>
</tr>
<tr>
<td>Any salad mix that came in a sealed bag</td>
<td>233 44.4</td>
<td>407 43.4</td>
<td>304 34.3</td>
<td>320 36.4</td>
<td>334 36.8</td>
<td>328 37.0</td>
<td>342 39.5</td>
<td>339 37.5</td>
<td>418 46.7</td>
<td>315 36.9</td>
<td>3,340 39.1</td>
</tr>
<tr>
<td>Mesclun lettuce (spring mix)</td>
<td>202 38.5</td>
<td>303 32.3</td>
<td>267 30.1</td>
<td>214 24.3</td>
<td>246 27.1</td>
<td>180 20.3</td>
<td>262 30.3</td>
<td>267 29.5</td>
<td>247 27.6</td>
<td>203 23.8</td>
<td>2,391 28.0</td>
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<tr>
<td>Any other iceberg lettuce</td>
<td>187 35.6</td>
<td>449 47.9</td>
<td>407 45.9</td>
<td>403 45.8</td>
<td>407 44.8</td>
<td>392 44.2</td>
<td>394 45.5</td>
<td>450 49.7</td>
<td>420 46.9</td>
<td>397 46.5</td>
<td>3,906 45.7</td>
</tr>
<tr>
<td>Any romaine lettuce</td>
<td>312 59.4</td>
<td>482 51.4</td>
<td>454 51.2</td>
<td>339 38.5</td>
<td>430 47.4</td>
<td>348 39.3</td>
<td>413 47.7</td>
<td>437 48.3</td>
<td>465 51.9</td>
<td>296 34.7</td>
<td>3,976 46.5</td>
</tr>
<tr>
<td>Any other leaf lettuce</td>
<td>205 39.0</td>
<td>286 30.5</td>
<td>251 28.3</td>
<td>198 22.5</td>
<td>243 26.8</td>
<td>209 23.6</td>
<td>286 33.0</td>
<td>239 26.4</td>
<td>327 36.5</td>
<td>167 19.6</td>
<td>2,411 28.2</td>
</tr>
<tr>
<td>Any lettuce on sandwiches/burgers</td>
<td>271 51.6</td>
<td>467 49.8</td>
<td>416 46.9</td>
<td>425 48.3</td>
<td>432 47.6</td>
<td>432 48.8</td>
<td>502 58.0</td>
<td>424 46.9</td>
<td>509 56.8</td>
<td>443 51.9</td>
<td>4,321 50.6</td>
</tr>
<tr>
<td>Any tomatoes on a sandwich or burger</td>
<td>307 58.5</td>
<td>574 61.3</td>
<td>522 58.9</td>
<td>508 57.7</td>
<td>528 58.1</td>
<td>496 56.0</td>
<td>585 67.6</td>
<td>487 53.8</td>
<td>549 61.3</td>
<td>558 65.4</td>
<td>5,114 59.9</td>
</tr>
<tr>
<td>Fresh spinach (not frozen)</td>
<td>165 31.4</td>
<td>278 29.7</td>
<td>200 22.5</td>
<td>157 17.8</td>
<td>193 21.3</td>
<td>174 19.6</td>
<td>236 27.3</td>
<td>203 22.4</td>
<td>253 28.2</td>
<td>157 18.4</td>
<td>2,016 23.6</td>
</tr>
<tr>
<td>Other greens (collard, mustard, etc)</td>
<td>93 17.7</td>
<td>91 9.7</td>
<td>98 11.0</td>
<td>204 23.2</td>
<td>133 14.6</td>
<td>47 5.3</td>
<td>97 11.2</td>
<td>74 8.2</td>
<td>86 9.6</td>
<td>149 17.5</td>
<td>1,072 12.5</td>
</tr>
<tr>
<td>Fresh garlic</td>
<td>313 59.6</td>
<td>398 42.5</td>
<td>430 48.5</td>
<td>256 29.1</td>
<td>317 34.9</td>
<td>260 29.3</td>
<td>387 44.7</td>
<td>367 40.6</td>
<td>385 43.0</td>
<td>201 23.6</td>
<td>3,314 38.8</td>
</tr>
<tr>
<td>Fresh mushrooms</td>
<td>246 46.9</td>
<td>355 37.9</td>
<td>308 34.7</td>
<td>264 30.0</td>
<td>273 30.1</td>
<td>267 30.1</td>
<td>284 32.8</td>
<td>315 34.8</td>
<td>352 39.3</td>
<td>197 23.1</td>
<td>2,861 33.5</td>
</tr>
<tr>
<td>Beets, turnips, or radishes</td>
<td>139 26.5</td>
<td>180 19.2</td>
<td>207 23.3</td>
<td>144 16.4</td>
<td>170 18.7</td>
<td>162 18.3</td>
<td>179 20.7</td>
<td>172 19.0</td>
<td>227 25.3</td>
<td>157 18.4</td>
<td>1,737 20.3</td>
</tr>
<tr>
<td>Any organic produce</td>
<td>274 52.2</td>
<td>337 36.0</td>
<td>260 29.3</td>
<td>151 17.2</td>
<td>220 24.2</td>
<td>199 22.5</td>
<td>254 29.3</td>
<td>188 20.8</td>
<td>318 35.5</td>
<td>138 16.2</td>
<td>2,339 27.4</td>
</tr>
</tbody>
</table>

Page | 10
### Fresh Herbs Consumed in the Past 7 Days, by FoodNet Site

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
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<tr>
<td>Fresh basil</td>
<td>130</td>
<td>24.8</td>
<td>144</td>
<td>15.4</td>
<td>224</td>
<td>25.3</td>
<td>121</td>
<td>13.8</td>
<td>159</td>
<td>17.5</td>
<td>110</td>
</tr>
<tr>
<td>Fresh parsley</td>
<td>140</td>
<td>26.7</td>
<td>158</td>
<td>16.9</td>
<td>224</td>
<td>25.3</td>
<td>128</td>
<td>14.5</td>
<td>178</td>
<td>19.6</td>
<td>124</td>
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<tr>
<td>Fresh cilantro</td>
<td>179</td>
<td>34.1</td>
<td>230</td>
<td>24.5</td>
<td>105</td>
<td>11.8</td>
<td>115</td>
<td>13.1</td>
<td>131</td>
<td>14.4</td>
<td>117</td>
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### Sprouts Consumed in the Past 7 Days, by FoodNet Site

<table>
<thead>
<tr>
<th>Exposure</th>
<th>California N=1,089</th>
<th>Colorado N=1,841</th>
<th>Connecticut N=1,802</th>
<th>Georgia N=1,811</th>
<th>Maryland N=1,837</th>
<th>Minnesota N=1,814</th>
<th>New Mexico N=1,770</th>
<th>New York N=1,838</th>
<th>Oregon N=1,794</th>
<th>Tennessee N=1,776</th>
<th>Total N=17,372</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Alfalfa sprouts</td>
<td>75</td>
<td>6.9</td>
<td>110</td>
<td>6.0</td>
<td>71</td>
<td>3.9</td>
<td>52</td>
<td>2.9</td>
<td>64</td>
<td>3.5</td>
<td>80</td>
</tr>
<tr>
<td>Bean sprouts</td>
<td>125</td>
<td>11.5</td>
<td>141</td>
<td>7.7</td>
<td>108</td>
<td>6.0</td>
<td>85</td>
<td>4.7</td>
<td>104</td>
<td>5.7</td>
<td>89</td>
</tr>
<tr>
<td>Other sprouts (clover, mixed, broccoli)</td>
<td>102</td>
<td>9.4</td>
<td>157</td>
<td>8.5</td>
<td>156</td>
<td>8.7</td>
<td>185</td>
<td>10.2</td>
<td>181</td>
<td>9.9</td>
<td>101</td>
</tr>
</tbody>
</table>
Module 4: Laboratory Investigation

At the end of this module, the participant will be able to:

1. Determine the likely causative agent for a foodborne outbreak based on clinical findings and/or suspect food.

2. List important considerations in the collection and submission of clinical and food specimens to the laboratory.

3. Interpret results from testing of clinical and food specimens.

4. Describe three ways subtyping of the causative agent can be used in an outbreak investigation.
Module 4: CIFOR Toolkit Keys to Success

- Laboratory staff have expertise in testing methodologies and access to equipment and reagents to perform testing.
- Investigators collect appropriate specimens and store and transport them properly.
- Laboratory staff characterize isolates in a timely fashion and post the results to national databases.
- Investigators link patient and laboratory test results.
- Staff communicate in a timely fashion and coordinate activities with other team members.
AT THE END OF THIS MODULE, YOU WILL BE ABLE TO
1. Determine the likely causative agent for a foodborne outbreak based on clinical findings and/or suspect food.
2. List important considerations in the collection and submission of clinical and food specimens to the laboratory.
3. Interpret results from testing of clinical and food specimens.
4. Describe three ways subtyping of the causative agent can be used in an outbreak investigation.

MODULE 4 – LABORATORY INVESTIGATION

FOODBORNE DISEASE OUTBREAK INVESTIGATION TEAM TRAINING

DETERMINING CAUSATIVE AGENT

Laboratory testing

Clues about causative agent can be gained from:
- Clinical findings among ill persons
- Suspected food, if known

NON-LABORATORY METHODS FOR DETERMINING CAUSATIVE AGENT

USEFUL CLINICAL FINDINGS AMONG ILL PERSONS

Predominant signs and symptoms
Incubation period (i.e., time from exposure to causative agent to onset of illness)
Duration and severity of illness

GENERAL CATEGORIES OF FOODBORNE ILLNESS

Illnesses caused by preformed toxins
Illnesses caused by infections with growth in the gastrointestinal tract with
- Direct damage to tissues and/or
- Release of toxins in the gut (enterotoxins)
ILLNESSES DUE TO PREFORMED TOXINS

Ingestion of food already contaminated by toxins

Common clinical findings
- Short incubation period (minutes or hours)
- Abrupt onset
- Symptoms depend on toxin
  - Vomiting common
  - Fever and elevated white blood cells in peripheral blood rare

SOURCES OF PREFORMED TOXINS

Bacteria - *Staphylococcus aureus*, *Bacillus cereus*, *Clostridium perfringens*

Fish – Scombrotxin (histamine fish poisoning), tetrodotoxin (puffer fish)

Marine algae – Ciguatoxin, saxitoxin (paralytic shellfish poisoning)

Fungus – Aflatoxin, mushroom toxins

Chemicals – Heavy metals, pesticides

ILLNESSES DUE TO INFECTIONS

Growth of microorganism in body with direct damage to tissues and/or release of toxins in the gut (enterotoxins)

Common clinical findings
- Relatively long incubation period
- Diarrhea, nausea, vomiting, abdominal pain
- Fever, elevated white blood cells in peripheral blood, white blood cells and red blood cells in stool

GENERAL TYPES OF INFECTIONS

Viruses – Norovirus, hepatitis A virus, rotavirus

Bacteria – *Salmonella*, *Shigella*, Shiga toxin-producing *E. coli*

Parasites – *Cryptosporidium*, *Cyclospora cayetanensis*, *Giardia intestinalis*, *Trichinella*

Other – prions

GENERALIZATIONS BY INFECTION TYPE

<table>
<thead>
<tr>
<th>Incubation period</th>
<th>Viruses</th>
<th>Bacteria</th>
<th>Parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than a day to 4 days</td>
<td>Less than a day to a week</td>
<td>1-4 weeks</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Possible symptoms</th>
<th>Viruses</th>
<th>Bacteria</th>
<th>Parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vomiting, diarrhea, (rarely bloody) abdominal pain, fever</td>
<td>Vomiting, diarrhea, (sometimes bloody), abdominal pain, fever</td>
<td>Abdominal pain and diarrhea</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signs</th>
<th>Viruses</th>
<th>Bacteria</th>
<th>Parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑WBC; fecal WBC</td>
<td>↑↑WBC; ↑↑feecal WBC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Viruses</th>
<th>Bacteria</th>
<th>Parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-5 days</td>
<td>Several days to a week</td>
<td>Several weeks</td>
<td></td>
</tr>
</tbody>
</table>

QUESTION

Twenty people became ill after attending a banquet. Onset of illness occurred (on average) about 4 hours after eating at the banquet (range 1-8 hours). All cases reported nausea and vomiting. Two reported diarrhea and none reported fever. No ill persons sought health care. All were well in 48 hrs.

Based on the clinical findings reported by cases, is the causative agent likely to be a preformed toxin or infection due to a virus, bacteria, or parasite?
51 children and staff from a childcare center developed gastroenteritis following a field trip to a dairy farm. Symptoms included diarrhea (100%), bloody diarrhea (27%), fever (45%), and vomiting (45%). White blood cell counts were elevated for the 10 patients tested. The average incubation period among cases was 3.5 days (range: 2-10 d).

Based on the clinical findings reported by cases, is the causative agent likely to be a preformed toxin or infection due to a virus, bacteria, or parasite?

**CLINICAL FINDINGS**
Always exceptions to the rules
Unique clinical findings can help agent
Consult references

**SUSPECT FOODS**
Certain causative agents are associated with certain foods because the foods
- Derive from animal reservoirs of agent
- Derive from plants/animals that produce or accumulate toxin
- Provide adequate conditions for contamination, survival, and proliferation of agent

Common food-illness pairings

**FOODS AND COMMONLY ASSOCIATED CAUSATIVE AGENTS**

<table>
<thead>
<tr>
<th>Food</th>
<th>Commonly associated causative agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw seafood</td>
<td>Vibrio spp., hepatitis A virus, noroviruses</td>
</tr>
<tr>
<td>Raw eggs</td>
<td>Salmonella (particularly serotype Enteritidis)</td>
</tr>
<tr>
<td>Undercooked meat or poultry</td>
<td>Salmonella, Campylobacter, STEC, Clostridium perfringens</td>
</tr>
<tr>
<td>Unpasteurized milk or juice</td>
<td>Salmonella, Campylobacter, Yersinia, STEC</td>
</tr>
<tr>
<td>Unpasteurized soft cheeses</td>
<td>Salmonella, Campylobacter, Yersinia, Listeria, STEC</td>
</tr>
<tr>
<td>Home-made canned goods</td>
<td>Clostridium botulinum</td>
</tr>
<tr>
<td>Raw hot dogs, deli meats</td>
<td>Listeria spp.</td>
</tr>
<tr>
<td>Mussels, clams, scallops</td>
<td>Saxitoxin (paralytic shellfish poisoning)</td>
</tr>
<tr>
<td>Tropical fish</td>
<td>Ciguatera poisoning</td>
</tr>
<tr>
<td>Shellfish</td>
<td>Brevetoxin (neurotoxic shellfish poisoning)</td>
</tr>
<tr>
<td>Mackerel, tuna, bluefish</td>
<td>Scombrotoxin (histamine fish poisoning)</td>
</tr>
<tr>
<td>Puffer fish</td>
<td>Tetrodotoxin</td>
</tr>
<tr>
<td>Wild mushrooms</td>
<td>Mushroom poisoning</td>
</tr>
</tbody>
</table>

**QUESTION**
Which causative agents are commonly associated with each of these foods?

- Undercooked chicken
- Unpasteurized milk
- Raw seafood
- Raw eggs
- Deli meats

Commonly associated causative agent
- Shiga toxin-producing E.coli (STEC)
- Salmonella
- Hepatitis A virus
- Listeria
- Norovirus

**NEW FOOD VEHICLES**

- Bagged spinach
- Carrot juice
- Peanut butter
- Dog food
- Pot pies
- Broccoli powder on snack food
- Canned chili sauce
- Hot peppers
- White pepper
- Raw cookie dough
- Whole, raw papaya
- Hazelnuts
- Pine nuts
LABORATORY METHODS FOR DETERMINING CAUSATIVE AGENT

"Laboratory responsibility"
Important role of other team members
- Collect specimens
- Package and store them
- Transport them to the laboratory
- Request proper test(s)
- Provide information about illness and specimen

DIAGNOSTIC SPECIMENS
Need to have suspicion of likely causative agent because appropriate specimen differs by agent
- Stool – Most infectious foodborne agents
- Blood – Bacteria that cause invasive disease (bacteremia)
- Serum – Hepatitis A virus and Trichinella
- Urine/hair – Heavy metals
- Vomitus, stool, suspected food – Preformed toxins

GUIDANCE ON DIAGNOSTIC SPECIMENS
Testing laboratory
"Diagnosis and Management of Foodborne Illness: A Primer for Physicians"
CDC. “Guidelines for Confirmation of Foodborne-Disease Outbreaks.” MMWR 2000; 49 (1): 54-62. (Table B)

COLLECTION OF STOOL SPECIMENS
Collect and submit as soon as possible
Typically from 5-10 cases not treated with antibiotics with illness characteristic of outbreak
Considerations that depend on suspected agent
- Acceptability of rectal swabs
- If more than one specimen is needed per patient
- Use of preservative
- Acceptability of freezing

<table>
<thead>
<tr>
<th>Suspected Agent</th>
<th>Viruses</th>
<th>Bacteria</th>
<th>Parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount</td>
<td>10 cc bulk stool</td>
<td>Bulk stool (rectal swab)</td>
<td>10 cc bulk stool</td>
</tr>
<tr>
<td>Specimens per patient</td>
<td>One</td>
<td>One</td>
<td>Up to three</td>
</tr>
<tr>
<td>Preservative</td>
<td>No**</td>
<td>Cary Blair</td>
<td>10% formalin, PVA</td>
</tr>
<tr>
<td>Freezing</td>
<td>No (only if RNA or antigen testing)</td>
<td>Acceptable*</td>
<td>No (only if RNA or antigen testing)</td>
</tr>
</tbody>
</table>

*Freezing causes die off of Campylobacter jejuni.
**Cary Blair acceptable in some laboratories but dilutes stool sample.
QUESTION
Using the references provided, what specimen would you collect if you suspect the following diseases? Are there any special considerations?

- Campylobacteriosis
- Staphylococcal food poisoning
- Giardiasis
- Listeriosis

STOOL SPECIMENS
Label specimen clearly and maintain log.
Complete necessary laboratory forms.
Provide patient information:
- Date of collection,
- Date of onset, and
- Signs and symptoms.

TESTING STOOL SPECIMENS
Routine stool culture
- Salmonella, Shigella, STEC, Campylobacter jejuni/coli
Special requests
- Vibrio, Yersinia, E. coli O157:H7*, other Campylobacter species
- Viruses – detection of viral RNA by RT-PCR or visualization of virus under electron microscope
- Most parasites – visualization by ova and parasite exam; Cryptosporidium or Cyclospora require special techniques

INTERPRETING STOOL SPECIMEN TESTING
Positive for certain agent

FOOD SPECIMENS
Collect as soon as possible and store.
Follow local policies on food collection private homes.
Test when food implicated by other studies.
Check with laboratory on collection and storage.
- Keep frozen foods frozen.
- Refrigerate perishable foods.
- If testing >48 hours after collecting, consult lab about freezing.

SUBMITTING FOOD SPECIMENS
Label container and maintain log.
Complete necessary laboratory forms.
Provide sample information:
- Date of collection,
- When originally served, and
- Handling since time of ingestion that caused illness.
**CHAIN OF CUSTODY**
Chronological written record that identifies who had control over specimen during what time
Includes all persons handling sample
Persons signing form
- Are responsible for sample while in their possession
- May be called to testify in criminal proceeding
Each agency has own form

**TESTING FOOD SPECIMENS**
Challenging because
- Food components can interfere with culture.
- Food is not sterile.
- Different methods are needed for different foods and causative agents.
- Generally accepted procedures are not available.
Not all public health laboratories do food testing → May need to submit to reference laboratory
Consult with testing laboratory.

**INTERPRETATION OF FOOD SPECIMEN TESTING**
Positive for certain agent

Negative for certain agent

**QUESTION**
An outbreak of gastroenteritis occurs following a wedding dinner reception. Ill persons reported diarrhea (100%), bloody diarrhea (25%), vomiting (80%), and fever (50%). The average incubation period for development of illness was 2 days. Stool specimens were collected from 10 ill persons.

The dinner was catered by a local business. No foods from the dinner were available except raw chicken from a package used in the chicken Cordon Bleu. A sample was collected and submitted to the laboratory.

**QUESTION (CONT’D)**
Eight of the 10 stool cultures were positive for Salmonella. How do you interpret the stool culture results?

**QUESTION (CONT’D)**
The raw chicken was also positive for Salmonella. How do you interpret the food test results, given the results of the stool cultures?

What information might help you interpret this information properly?
**SUBTYPING OF CAUSATIVE AGENTS**

Characterization of microorganisms below the species level using characteristics that
- Differ between strains
- Are same among isolates with common origin

Variety of subtyping methods (e.g., serotyping, phage typing, antibiotic susceptibility, pulsed field gel electrophoresis [PFGE], multiple-locus variable number tandem repeat analysis [MLVA]), not all of which are available for all organisms

Not all methods equally discriminatory

---

**USES OF SUBTYPING IN OUTBREAK INVESTIGATION**

Usefulness in outbreaks based on presumption
- Isolates in an outbreak have a common origin
- Single strain will be the culprit in most outbreaks

Uses
- Link cases together
- Link foods with outbreaks
- Refine case definition decreasing misclassification in epidemiologic studies
- Link outbreaks in different locations

---

**PULSED FIELD GEL ELECTROPHORESIS (PFGE)**

Separation of DNA fragments in a gel using a pulsing electric field

Creates visual banding pattern unique for isolate

Different DNA composition → different PFGE

Indistinguishable patterns suggest similar origin of isolates

---

**PULSENET LABORATORY NETWORK**

Participating Laboratories
- Standardized testing of:
  - *E. coli* O157:H7,
  - Salmonella,
  - *Shigella*,
  - *Listeria*, and
  - *Campylobacter*

PFGE Patterns
- Patterns uploaded by testing laboratory

PulseNet National Database (CDC)
- Monitors for similar patterns
- Notifies foodborne epidemiologists of clusters
- State labs can query

---

**PULSENET PARTICIPANTS**

- PulseNet headquarters
- Regional laboratories
- Local and secondary state laboratories
- Federal laboratories
**E. coli O157:H7 AND HAZELNUTS**

December 2010, cluster of 8 cases of E. coli O157:H7 identified through PulseNet

Follow-up interviews revealed in-shell hazelnuts consumed by all cases

Outbreak strain isolated from hazelnuts

Traceback led to common distributor

Product recalled

---

**SUBTypING ISSUES**

- Matching of subtypes not proof of common exposure
- Association of multiple subtypes with one outbreak
- Need for routine subtyping (in real time)
- Limited ability of available methods to distinguish between strains
- Patient isolate not available if rapid diagnostic testing used

---

**NO SMOKING GUN?**

Most convincing evidence about the source of an outbreak is isolation of causative agent from suspected vehicle (i.e., food)

Causative agent isolated from food vehicle in only 14% of outbreaks with a confirmed etiology

Importance of epi and EH studies
Module 5: Environmental Health Investigation

At the end of this module, the participant will be able to:

1. Discuss how contributing factors are related to the causative agent, suspect food, and setting in which a food was prepared.

2. Compare an environmental health assessment with a HAACP plan review, facility plan review, and a regulatory inspection.

3. List types of activities included in an environmental health assessment.

4. Describe the likely role of local jurisdictions in a traceback investigation.
Module 5: CIFOR Toolkit Keys to Success

- Staff have expertise in food production, HACCP, environmental health, and tracebacks.

- Agency has a written protocol outlining the steps in the environmental health investigation.

- Staff undertake environmental health assessments at implicated facilities.

- Staff have good interviewing skills to solicit information from facility managers and workers.

- Staff undertake traceback and traceforward investigations.

- Staff communicate in a timely fashion and coordinate activities with other team members.
FOODBORNE DISEASE OUTBREAK INVESTIGATION TEAM TRAINING

MODULE 5 – ENVIRONMENTAL HEALTH INVESTIGATION

AT THE END OF THIS MODULE, YOU WILL BE ABLE TO
1. Discuss how contributing factors are related to causative agent, suspect food, and food processing method.
2. Compare environmental health assessment with HAACP plan review, facility plan review, and regulatory inspection.
3. List types of activities included in an environmental health assessment.
4. Describe the likely role of local jurisdictions in a traceback investigation.

FOOD SYSTEM

Primary producers
Manufacturers
Distributors
Retailers
Point of service establishments

FOOD ESTABLISHMENTS AS DYNAMIC SYSTEMS

INPUTS:
- Raw foods
- Ingredients
- Chemicals
- Packing materials
- Water

OUTPUT:
Final product

CONTRIBUTING FACTORS

Factors that increase the risk of foodborne illnesses and repeatedly contribute to outbreaks

Identification (and correction) of these factors facilitates prevention and control of foodborne diseases

Three major categories
- Contamination
- Survival
- Proliferation
CATEGORIES OF CONTRIBUTING FACTORS

<table>
<thead>
<tr>
<th>Contributions</th>
<th>Survival</th>
<th>Proliferation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contamination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survival</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proliferation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CONTRIBUTING FACTORS

Presence alone may not be sufficient to cause illness

Relationship between

- Contributing factors
- Food vehicle
- Causative agent
- Processing methods

COMMON CONTRIBUTING FACTORS BY CAUSATIVE AGENT AND FOOD

Situational Keys A-F (starting on page 80)

GENERALIZATIONS

<table>
<thead>
<tr>
<th>Causative agent</th>
<th>Common contributing factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spore formers and preformed toxins</td>
<td>Cooling, reheating, hot holding, bare-hand contact, room temperature storage, cold holding</td>
</tr>
<tr>
<td>Viral infections</td>
<td>Ill food worker, bare-hand contact, inadequate handwashing, contaminated raw products, contaminated surfaces</td>
</tr>
<tr>
<td>Bacterial infections</td>
<td>Ill food worker, bare-hand contact, inadequate handwashing, contaminated raw product, cross-contamination, inadequate cooking</td>
</tr>
<tr>
<td>Parasitic infections</td>
<td>Contaminated raw products, source, water, cross-contamination, inadequate cooking</td>
</tr>
</tbody>
</table>

QUESTION

Are the following likely to be contributing factors for the outbreaks described?

- Bare-hand contact of lettuce in an outbreak of shigellosis linked to a salad bar
- Refrigerator at 47°F in an outbreak of hepatitis A virus linked to a restaurant
- Refrigerator at 47°F in an outbreak of Staphylococcal intoxication linked to potato salad
- Cat in the kitchen of a restaurant prior to an outbreak of norovirus

ENVIRONMENTAL ANTECEDENTS

The root cause or circumstances that set the stage for contributing factors to occur

Include economic constraints, inadequate worker education, management decisions, social and cultural beliefs

Must be addressed to eliminate contributing factors
EXAMPLE
Salmonellosis outbreak linked to potato salad
Contributing factor: Potato salad contaminated because under thawing chicken in refrigerator
Environmental antecedents:
- Economic issues led to hiring more part-time, less experienced workers
- Inadequate food worker education
- Inadequate oversight and supervision

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

ENVIRONMENTAL HEALTH ASSESSMENT
A systematic, detailed, science-based evaluation
Focuses on factors that contributed to an outbreak
Different from a
- Hazard Analysis and Critical Control Point (HACCP) risk assessment review
- Facility plan review
- Food establishment regulatory inspection

HACCP RISK ASSESSMENT REVIEW
Preemptive solutions to potential food safety problems in the future
Undertaken before a problem occurs
Focus
- Foods produced by establishment and related procedures
- Identification of potential food safety problems
- Control measures to mitigate potential problems
Initiated by establishment

FACILITY PLAN REVIEW
Preemptive solutions to potential food safety problems in the future
Undertaken before a problem occurs
Focus
- Proposed structural plans and equipment at establishment
- Relation to intended procedures
- Functionality, durability, ease of cleaning
Initiated by establishment
FOOD ESTABLISHMENT REGULATORY INSPECTION
Addresses food safety problems occurring today
Routinely scheduled inspections
Focus
- Ongoing processes and procedures
- Leading causes of foodborne illness (risk-based approach)
Initiated by regulatory authority

ENVIRONMENTAL HEALTH ASSESSMENT
Addresses food safety issues that occurred in the past
Occurs in response to a food safety problem
Focuses on (reconstructs) past events related to
- Implicated food(s)
- Prepared/served during outbreak period
Initiated by outbreak investigation team, guided by epidemiologic and laboratory information

SUMMARY

<table>
<thead>
<tr>
<th></th>
<th>HACCP/Facility Plan Review</th>
<th>Regulatory Inspection</th>
<th>Env’t Health Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>When undertaken</td>
<td>Before a food safety problem occurs</td>
<td>Regularly scheduled inspections</td>
<td>In response to specific problem</td>
</tr>
<tr>
<td>Time focus</td>
<td>Future</td>
<td>Today</td>
<td>Past</td>
</tr>
<tr>
<td>Focus of effort</td>
<td>Areas where food safety problems could occur</td>
<td>Ongoing processes focus on common problems</td>
<td>Problems related to implicated food during outbreak period</td>
</tr>
<tr>
<td>Who initiates</td>
<td>Food establishment</td>
<td>Regulatory agency</td>
<td>Outbreak investigation team</td>
</tr>
</tbody>
</table>

ENVIRONMENTAL HEALTH ASSESSMENT
Objectives:
1. Reconstruct past events, focusing on implicated food(s)
2. Identify contributing factors
3. Identify environmental antecedents
4. Develop effective interventions

PREPARATION FOR ASSESSMENT
Examine available outbreak information
- Causative agent
- Onset of illness
- Likely exposure dates/meals/foods
Review information on causative agent
- Reservoirs and previously identified vehicles
- Modes of transmission
- Likely contributing factors
Collect food establishment information
- Existing regulatory records
- Menus, recipes, product formulations
- Connection to chain of food establishments

SITE VISIT
Focuses on implicated food and time period of outbreak
1. MANAGER INTERVIEW
Work to gain cooperation in investigation
Assess management knowledge and attitude toward food safety
Collect information about food workers who prepared the implicated food
Review standard operating procedures

2. FACILITY WALK THROUGH
Get sense of general layout of facility and floor design
Walk through movement of implicated food through facility
Identify opportunities for occurrence of relevant contributing factors

EXAMPLE FOOD FLOW THROUGH FACILITY

3. OBSERVATION OF OPERATIONS
Focus on implicated food and associated processes
Attempt to reconstruct how food was prepared during period of interest
Take measurements
Record observations on food preparation worksheet

EXAMPLE FOOD PREPARATION WORKSHEET

EXAMPLE FLOW DIAGRAM

4. COLLECTION OF SAMPLES
Collect food, water, and environmental samples based on suspicions about outbreak source
Consult with laboratory on collection, storage, and transportation procedures
Collect as soon as possible and note condition (may store for testing at later time)

5. WORKER INTERVIEWS
Interview in private
Reconstruct preparation of implicated food during period of interest
Note unusual circumstances during period of interest and inconsistencies in the story
Collect information about food worker hygiene and recent illnesses

6. COLLECTION OF RECORDS
Collect and review
Records that identify source of food or ingredients (e.g., receipts and invoices)
Worker logs or time cards
Monitoring logs (e.g., temperatures in walk-in refrigerators)

SMALL GROUP EXERCISE
Divide into groups by table.
1. Study the information provided on an outbreak of salmonellosis linked to a restaurant.
2. Walk through the environmental health assessment of the restaurant, answering the questions.
3. Do you see contributing factors likely to be related to the outbreak?
Be prepared to share with class.
Time: 15 minutes

DEVELOP EFFECTIVE INTERVENTIONS
Immediate control measures
- Hold
- Seize
- Cease/desist
- License sanctions
- Menu limitation
- Embargo
- Closure
- Worker exclusion or restrictions
- Recalls
Long term strategies to prevent recurrence
- HACCP plan
- Risk control plans
- Training
- Menu/supplier/recipe modifications

TRACEBACK INVESTIGATIONS
TRACEBACK INVESTIGATIONS

Process used to determine the production and distribution chain of an implicated food

Purpose:
- Identify product so that it can be removed from further consumption
- Determine likely origin of food safety problem
- Strengthen epidemiologic associations between food and illness

Formal regulatory traceback vs. informational traceback

RESULTS OF TRACEBACK INVESTIGATIONS

CASES

POINT OF SERVICE ESTABLISHMENTS

DISTRIBUTORS/ IMPORTERS

PRODUCERS/ PROCESSORS

CASES

POINT OF SERVICE

ESTABLISHMENTS

DISTRIBUTORS/ IMPORTERS

PRODUCERS/ PROCESSORS

ROLE OF LOCAL HEALTH DEPARTMENTS

Undertake scientifically sound investigations to
- Implicate specific food item
- Rule out end user contamination

Interview cases for product details and where they purchased the food (e.g., receipts)

Collect paperwork (e.g., receipts, invoices, shipping documents) from retail food establishments

TRACEFORWARD INVESTIGATIONS

Once source of outbreak identified:

Process used to trace distribution of all implicated lots of food from the original source (not just foods eaten by known cases)

Purpose
- Support recall efforts
- Support further case-finding
- Test hypothesis about source

EXAMPLE - TRACEFORWARD

EXAMPLE - TRACEFORWARD
SALMONELLA TYPHIMURIUM AND PEANUT BUTTER

- Cluster of S. Typhimurium detected by PulseNet
- Studies implicate peanut butter sold to institutions and peanut butter crackers.
- Outbreak traced to one plant.
- Initial recall of specific lots of peanut butter expanded to include all peanuts and peanut products from implicated plant.
- FDA performs traceforward.
- Ultimately 3,900 products recalled from several hundred companies.
Module 5– Group Exercise: Undertaking an Environmental Health Assessment of a Restaurant associated with an Outbreak of Salmonellosis

Divide into groups by table.
1. Study the information provided on an outbreak of salmonellosis linked to a restaurant.
2. Walk through the environmental health assessment of the restaurant, answering the questions below.
3. Do you see any contributing factors likely to be related to the outbreak?

An outbreak of gastrointestinal illness is linked to a local restaurant. Seven unrelated restaurant patrons are sick with abdominal pain, nausea, vomiting, and diarrhea. Onset of illness among cases was January 22-24. Two ill patrons had stool specimens positive for *Salmonella*.

**Question 1:** You are responsible for undertaking the environmental health assessment associated with this outbreak. How would you prepare yourself for the investigation?

The restaurant is known for its burgers but serves a variety of sandwiches and salads. Based on patient interviews by the public health nurse, ill persons ate at the restaurant on January 20. All but one ate chicken salad. Three ill persons had only chicken salad.

**Question 2:** What type of activities will you undertake at the facility as part of the environmental health assessment?

**Question 3:** Given the causative agent (*Salmonella*), implicated food (chicken salad), and setting (food service establishment), what contributory factors will you be looking for?
The manager tells you two employees (Willard and Anita) usually make the salad. Making the chicken salad is a 2-day process. You interview the employees to reconstruct how the salad was made.

Day 1 (Preparation of chicken): Refrigerated, whole chickens are washed, trimmed, and placed in a clean and sanitized tub for transport to the cooking area. The chickens are placed on rotisserie spindles, 5 chickens to a spindle. The chickens are cooked until the chicken’s internal temperature reaches at least 165° F for 15 seconds which usually takes about 1.5 hours. The chickens are removed from spindles to cool in shallow cooling pans. After about an hour, the chicken is warm to the touch and is deboned and diced. The diced chicken is placed into a shallow pan (4-inches deep) and is covered with plastic wrap, leaving a vent for warm air to dissipate. The pan is placed in the walk-in refrigerator.

**Question 4:** Draw a flow diagram for preparing the chicken.

Day 2 (Salad assembly): Pre-chilled salad ingredients, including nuts, celery, and grapes, are washed, chopped, and placed in a bowl. Chopped ingredients are mixed with pre-chilled mayonnaise. The salad is placed onto a serving platter, covered with plastic wrap, and placed in the walk-in refrigerator.
Question 5: You then watch Willard and Anita make the salad. These photos were taken as you observed the salad being made. Do any concern you? Do you see any factors likely contributing to the outbreak of salmonellosis?
Module 6: Epidemiologic Investigation

At the end of this module, the participant will be able to:

1. Compare a case series, a case-control study, and a cohort study.

2. Interpret the measure of association for a case-control and cohort study.

3. Explain what is meant by the term “statistically significant.”

4. Identify potential problem areas in the conduct of epidemiologic which might impact the findings.
Module 6: CIFOR Toolkit Keys to Success

- Staff have expertise in epidemiologic study design or have access to staff with this expertise.
- Agency has a written protocol outlining the steps in the epidemiologic investigation.
- Staff interview cases about exposures as soon as possible after the case is reported.
- Staff have good interviewing skills and can collect complete and accurate exposure information.
- Staff have access to standard epidemiologic questionnaires used by other investigators.
- Staff communicate in a timely fashion and coordinate activities with other team members.
MODULE 6 – EPIDEMIOLOGIC INVESTIGATION

FOODBORNE DISEASE OUTBREAK INVESTIGATION TEAM TRAINING

AT THE END OF THIS MODULE, YOU WILL BE ABLE TO
1. Compare a case series, a cohort study, and a case-control study.
2. Interpret the measure of association for a cohort and a case-control study.
3. Explain what is meant by the term “statistically significant.”
4. Identify potential problem areas in the conduct of an epidemiologic study which might impact the findings.

EPIDEMIOLOGIC ACTIVITIES
Perform descriptive epidemiology
Conduct hypothesis-generating interviews
Undertake analytic studies
Case series
Cohort studies
Case-control studies

CASE SERIES
- Examination of a series of cases associated with an outbreak
- Collection of detailed information on foods eaten by cases (and other exposures)
- Common foods (or other exposures) among cases suggestive of source of outbreak

MULTISTATE OUTBREAK OF SALMONELLA ENTERIDITIS
Using shopper card information, determined that 7 of 9 cases bought Turkish pine nuts from chain store in week before illness
Background rate: <1% of all shoppers bought Turkish pine nuts at store in previous six months
Lab testing identified outbreak strain of S. Enteritidis in pine nuts/pesto from store
Store and producer voluntarily recalled pine nuts

THE NEED FOR A COMPARISON GROUP
Commonalities among cases:
- Reflective of population at large?
- A chance happening?
- Related to some unknown factor that is the true source of the outbreak? (confounders)
Comparison (control) group needed to put findings into perspective
COHORT STUDY
- Well-defined group in which outbreak occurs
- Compare attack rates among people who ate and did not eat certain food(s)
- Higher attack rates among people eating a food (compared to those not eating it) suggest the food might be associated with illness

<table>
<thead>
<tr>
<th>Ate food</th>
<th>Illness</th>
<th>No illness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did not eat food</td>
<td>Illness</td>
<td>No illness</td>
</tr>
</tbody>
</table>

Well defined group

OUTBREAK OF SALMONELLOSIS AT HOSPITAL X
Over 200 cases of salmonellosis occurred among nurses (a well-defined group) at Hospital X after Nurse's Appreciation Day Luncheon.

Cohort study of nurses at hospital:
- 736 nurses and nursing students responded
- 195 (34%) of 571 persons who attended luncheon became ill
- 8 (5%) of 165 persons who did not attend luncheon became ill

RELATIVE RISK (RR)
- Measure of association for a cohort study
- Compares proportion of people who ate the food who became ill with the proportion of people who did not eat the food who became ill

\[
\text{relative risk} = \frac{\text{attack rate among exposed}}{\text{attack rate among unexposed}}
\]

Answers: "How much more likely is it for people who ate the food to become ill than people not eating the food?"

OUTBREAK OF SALMONELLOSIS AT HOSPITAL X
Returning to the outbreak of salmonellosis:
- 195 (34%) of 571 attending luncheon became ill
- 8 (5%) of 165 not attending luncheon became ill

\[
\text{relative risk} = \frac{\text{attack rate (attended)}}{\text{attack rate (did not attend)}} = \frac{34\%}{5\%} = 6.8
\]

A relative risk of 6.8 means that people who attended the luncheon were almost 7 times more likely to become ill than those who did not attend. Attending the luncheon might be a risk factor for salmonellosis in this outbreak.

QUESTION
Looking only at the nurses who attended the Nurse's Appreciation Day Luncheon:
- 14 (18%) of 78 eating tuna salad became ill
- 172 (40%) of 431 not eating tuna salad became ill

Relative risk = 0.45

What does this relative risk mean?
CASE-CONTROL STUDY
- Cases (people with illness) and controls (people with no illness)
- Compare foods eaten by cases and controls
- Foods more commonly eaten by cases than controls might be associated with illness

OUTBREAK OF BOTULISM IN VANCOUVER, B.C.
36 cases of botulism among patrons of Restaurant X
Case-control study undertaken
- 20 (91%) of 22 cases ate beef dip sandwich
- 3 (14%) of 22 controls ate beef dip sandwich

OUTBREAK OF BOTULISM IN VANCOUVER, B.C.
Returning to the outbreak of botulism:
- 20 of 22 cases ate beef dip sandwich (2 didn’t)
- 3 of 22 controls ate beef dip sandwich (19 didn’t)
odds ratio = \( \frac{odds\ of\ eating\ food\ (cases)}{odds\ of\ eating\ food\ (controls)} = \frac{20/2}{3/19} = 63 \)
An odds ratio of 63 means the odds that cases ate the beef dip sandwich was 63 times higher than the odds among controls. Eating the beef dip sandwich might be a risk factor for botulism in this outbreak.

OUTBREAK OF BOTULISM IN VANCOUVER, B.C.
Outbreak of cyclosporiasis in New Jersey not associated with particular event/establishment
Case-control study undertaken
- 21 (70%) of 30 cases ate raspberries
- 4 (7%) of 60 controls ate raspberries
Odds ratio = 32.7
What does this odds ratio mean?

ODDS RATIO (OR)
- Measure of association for a case-control study
- Compares odds of cases having eaten a certain food to odds of controls having eaten the food
odds ratio = \( \frac{odds\ of\ eating\ food\ among\ cases}{odds\ of\ eating\ food\ among\ controls} \)
- Answers: “How much higher is the odds of eating the food among cases than controls?”

ODDS RATIO INTERPRETATION
Close to 1.0 = odds of eating food is similar among cases and controls → no association between food and illness
Greater than 1.0 = odds of eating food among cases is higher than among controls → food could be risk factor
Less than 1.0 = odds of eating food among cases is lower than among controls → food could be “protective factor”
Magnitude reflects strength of association between illness and eating the food.
WHEN TO DO WHICH TYPE OF STUDY?

Case series – when the number of cases is small (less than five) and no controls are available

Cohort study – when investigators can easily identify the population at risk (i.e., outbreak has occurred in a well-defined group) and the population at risk can be enumerated

Case-control study – when the population at risk (i.e., people potentially exposed to source of outbreak) is unknown or cannot be enumerated or the illness is rare

SUMMARY

<table>
<thead>
<tr>
<th></th>
<th>Case Series</th>
<th>Cohort Study</th>
<th>Case-control Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enroll</td>
<td>People with disease</td>
<td>People in a well-defined group who ate and did not eat certain foods</td>
<td>People with and without disease</td>
</tr>
<tr>
<td>Analysis</td>
<td>Ate food or not</td>
<td>Developed disease or not</td>
<td>Ate food or not</td>
</tr>
<tr>
<td>Measure of association</td>
<td>None</td>
<td>Relative risk</td>
<td>Odds ratio</td>
</tr>
<tr>
<td>When to use</td>
<td>Small number of cases</td>
<td>Population at risk • Easily identified • Can be enumerated</td>
<td>Population at risk unknown • Rare disease</td>
</tr>
</tbody>
</table>

ROLE OF CHANCE

Things do just happen by coincidence!

Odds ratios and relative risks are estimates

Observed results could be due to chance alone

Role of chance explored through
- p-value
- Confidence interval (CI)

P-VALUE

Probability that findings due to chance alone

Ranges from 0 to 1 (0% to 100%)

- Closer to 1.0 (100%) → high probability findings due to chance
- Closer to 0.0 (0%) → low probability findings due to chance

Example:

p-value = 0.02

Interpretation: finding occurred by chance 2 in 100 times

P-VALUE AND STATISTICAL SIGNIFICANCE

- If p-value smaller than predetermined value → considered “statistically significant”
- Cut-off for statistical significance set by investigator (usually 0.05 meaning the finding could have occurred by chance alone 5 in 100 times)

Example:

If cut-off for statistical significance is 0.05
p-value = 0.02 → statistically significant
CONFIDENCE INTERVALS (CI)
Measure of association single best estimate
Confidence interval (CI)
- Range of values for the measure of association that are consistent with study findings
- Has specified probability (e.g., 95%) of including “true value” for the measure of association
Example:
  - odds ratio = 5.2
  - 95% CI = 4.0 – 6.1
CONFIDENCE INTERVALS (CI) (CONT’D)
Measure of association of 1 means no association.
Therefore, if CI includes 1.0 → not statistically significant
Example: 95% CI = 0.8 – 4.2
If CI does not include 1.0 → statistically significant
Example: 95% CI = 1.8 – 4.2

QUESTION
An outbreak of *Salmonella* Typhi in Tajikistan
Case-control study undertaken
Exposures in 30 days before illness for cases (or before interview for controls)
Results analyzed using a p-value of 0.05 as the cut-off for statistical significance

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Odds ratio</th>
<th>p-value</th>
<th>95% CI</th>
<th>Statistically significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eating street vendor food</td>
<td>1.5</td>
<td>0.3</td>
<td>0.9–5.6</td>
<td></td>
</tr>
<tr>
<td>Eating apples</td>
<td>0.2</td>
<td>0.03</td>
<td>0.04–0.9</td>
<td></td>
</tr>
<tr>
<td>Drinking untreated water</td>
<td>9.6</td>
<td>0.0005</td>
<td>2.7–34</td>
<td></td>
</tr>
</tbody>
</table>

STATISTICAL SIGNIFICANCE
Means chance is an unlikely (though not impossible) explanation for observed association
Does not mean cause and effect or indicate “public health significance”
Is affected by size of study (the more subjects included in a study, the smaller the p-value will be regardless of the measure of association)

NO STATISTICALLY SIGNIFICANT FINDINGS?
Too few study subjects
Did not ask about food or other exposure that led to outbreak
Multiple contaminated food items
Everyone ate the contaminated food
Problems with study
POTENTIAL STUDY PROBLEM AREAS

- Investigator “beliefs” about the cause of the outbreak (investigator bias)
- Study participation (selection bias)
- Accuracy of information on development of illness or foods eaten (information bias)
- Quality of study (investigator error)

SMALL GROUP EXERCISE

Work in groups of two or three.
1. Read the brief description of a study that was undertaken following an outbreak associated with an office potluck.
2. Circle any red flags that make you concerned about the study conduct or its findings.
3. Do you agree with the investigator about the cause of the outbreak?

Be prepared to share with class.
Time: 10 minutes

ALWAYS SCRUTINIZE STUDY RESULTS!

RELATIVE RISK (OPTIONAL)

\[
\begin{array}{c|c|c|c}
 & \text{Ill} & \text{Well} & \text{TOTAL} \\
\hline
\text{Ate food} & a & b & a+b \\
\text{Did not eat food} & c & d & c+d \\
\hline
\text{TOTAL} & a+c & b+d & \\
\end{array}
\]

\[
\text{attack rate}_{\text{(ate food)}} = \frac{a}{a+b} \\
\text{attack rate}_{\text{(did not eat food)}} = \frac{c}{c+d}
\]

\[
\text{relative risk} = \frac{\text{attack rate among those eating food}}{\text{attack rate among those not eating food}} = \frac{a/(a+b)}{c/(c+d)}
\]

For more information, see Appendix on Calculating Measures of Association.

ODDS RATIO (OPTIONAL)

\[
\begin{array}{c|c|c|c}
 & \text{Case} & \text{Control} & \text{(two-by-two table)} \\
\hline
\text{Ate food} & a & b & \\
\text{Did not eat food} & c & d & a+c+b+d \\
\hline
\text{TOTAL} & a+c & b+d & \\
\end{array}
\]

\[
\text{odds ratio} = \frac{\text{odds of eating food (cases)}}{\text{odds of eating food (controls)}} = \frac{a/c}{b/d} = \frac{a \times d}{b \times c}
\]

For more information, see Appendix on Calculating Measures of Association.
Module 6– Group Exercise: Identifying Problem Areas in an Epidemiologic Study

Work in groups by table.
1. Read the brief description of a study that was undertaken following at outbreak associated with an office potluck.
2. Circle any red flags that make you concerned about the study conduct or its findings?
3. Do you agree with the investigator about the cause of the outbreak?

A holiday potluck luncheon was held on December 22 at the headquarters of a private business. Submarine sandwiches were purchased from a local deli. Staff members and their spouses were invited and asked to bring a side dish.

Over 120 persons attended the luncheon. About 40 side dishes were brought by attendees. Staff and spouses socialized, ate, and drank most of the afternoon. The office was then closed for the holidays.

The office reopened on January 5.

At a managers’ meeting a week later (January 12), several managers reported that they or their spouses had become ill following the potluck. Symptoms included predominantly nausea with some vomiting. None had fever. None sought medical care. The illnesses lasted less than a day.

Several managers thought that the illness was due to potato salad brought by the boss’ wife.

An intern working with the company, who had taken a course in epidemiology in college, volunteered to do a cohort study. The intern sent an email to all persons invited to the party asking:

Did you get sick after the office holiday potluck held on December 22?
Did you eat the potato salad?

By January 20, responses had been received from 30 people. The intern analyzed the results using Epi-Info and reported his findings to the boss:

- Fourteen people who attended the potluck said they had been ill.
- 15 said they had not been ill.
- Ten of the 14 ill were managers or their spouses.
- The 10 ill managers or spouses said they all had eaten potato salad made by the boss’ wife.

The intern shared these calculations:

- 10 (64%) of 14 ill people ate potato salad.
- 4 (25%) of 16 well people ate potato salad.
- odds ratio=10
- p-value = 0.04 95% CI = 2.2-8.0

The intern reported to the boss that the outbreak was caused by his wife’s potato salad and that he was not surprised because it tasted terrible.

The intern was re-assigned to the file storage room in the basement.
FOODBORNE DISEASE OUTBREAK INVESTIGATION TEAM TRAINING

MISTAKES DO OCCUR
Nationwide outbreak of cyclosporiasis
One site announced outbreak due to California strawberries
Strawberry market devastated
True source Guatemalan raspberries

HOW TO AVOID MISTAKES
Use body of evidence to make decisions
Follow the tenets of causation
- Exposure precedes illness
- Strength of association
- Dose-response relationship
- Consistency of data with other investigations
- Biologic plausibility

Balance public health consequences of not taking action with quality of data and potential damage to business/industry

Implement control measures whenever sufficient information is available!
Module 7: Multijurisdictional Outbreaks

At the end of this module, the participant will be able to:

1. Discuss recent increases in multijurisdictional outbreaks.
2. List indicators that suggest an outbreak is likely to involve cases from multiple jurisdictions.
3. Describe federal agency contributions to multi-jurisdictional foodborne outbreak investigations.
4. List clues that an outbreak might be due to intentional contamination.
5. State whether the local incident command system is activated during an outbreak response.
Module 7: CIFOR Toolkit Keys to Success

- Staff recognize signs suggestive of a multi-jurisdictional outbreak and rapidly notify agencies that need to know about the outbreak.
- Staff know how to contact local, state, and federal agencies likely to be involved in the investigation.
- Agency has procedures for working with other agencies during an outbreak response.
- Staff understand resources and contributions key agencies can provide and cross-trains with them.
- Agency determines in advance the role of ICS in the response to an outbreak.
MODULE 7 – MULTIJURISDICTIONAL OUTBREAKS

FOODBORNE DISEASE OUTBREAK INVESTIGATION TEAM TRAINING

AT THE END OF THIS MODULE, YOU WILL BE ABLE TO
1. Discuss recent shifts in nature of foodborne disease outbreaks.
2. List indicators that suggest an outbreak is likely to involve cases from multiple jurisdictions.
3. Describe federal public health agencies likely to participate in multijurisdictional investigations.
4. List clues that an outbreak might be due to intentional contamination.
5. State whether the local incident command system is activated during an outbreak response in your jurisdiction.

TRADITIONAL OUTBREAK SCENARIO

Focal outbreak
- Caused by local food handling error (endpoint contamination event)
- Large number of cases in one jurisdiction
- Detected by affected group
- Local investigation
- Local solution

TRADITIONAL OUTBREAK SCENARIO (CONT’D)

Production
Processing
Distribution
Final preparation and cooking

Farm

Problematic food safety practices

Localized cases

NEW OUTBREAK SCENARIO

Dispersed outbreak
- Caused by industrial contamination event (during production, processing, or distribution) with a widely distributed food
- Small numbers of cases in many jurisdictions
- Detected by pathogen-specific surveillance with subtyping
- Multijurisdictional investigation
- Solution has broad implications

DIFFUSE OUTBREAK SCENARIO (CONT’D)

Production
Processing
Distribution
Final preparation and cooking

Dispersed cases

Problematic food safety practices

Farm
**E. coli O157:H7 and Cookie Dough**

- Cluster of E. coli O157:H7 detected by PulseNet with cases from 13 states
- No commonalities through initial case interviews; open-ended interviews in WA revealed 5 of 5 cases ate raw cookie dough
- Multistate case-control study linked illness to Brand X cookie dough
- Non-outbreak STEC from cookie dough and flour supplier
- 77 cases in 30 states

**Significance of Multijurisdictional Outbreaks**

- Small proportion (2%) of reported foodborne outbreaks are multistate
- Disproportionate public health impact
  - 7% of outbreak-related illnesses
  - 31% of outbreak-related hospitalizations
  - 34% of outbreak-related deaths
  - 40% of E. coli O157:H7 and 25% of *Salmonella* and hepatitis A outbreaks


**Significance of Multijurisdictional Outbreaks**

Centrally produced and widely distributed food products

Globalization of food supply

Increased detection of outbreaks through
- Improved surveillance efforts
- Subtyping of causative agents
- Information sharing

Source: CDC, National Foodborne Disease Outbreak Surveillance System

**Local Significance of Multijurisdictional Outbreaks**

- "Local" outbreak may herald a national or international event.

**Listeriosis and Cantaloupe**

- Seven cases of listeriosis reported from CO
- All had eaten cantaloupe in month before illness
- Cases in other states detected through PulseNet; comparisons of outbreak- and non-outbreak listeriosis cases confirm cantaloupe link
- Traceback converges on CO producer that shipped to 24 states
- 146 cases from 28 states
MULTIJURISDICTIONAL OUTBREAK INDICATORS

- Implicated food contaminated before point of service and
  - Commercially distributed, processed, or ready-to-eat item
  - Fresh produce item
  - Ground beef in E. coli O157:H7 outbreak
- Illnesses linked to multiple food-service establishments
- Molecular subtype of causative agent matches agent associated with outbreaks in other locations
- Exposed persons have subsequently dispersed

QUESTION

Which of the following outbreaks are likely to involve cases residing in multiple jurisdictions?

- Illness linked to food safety problem at elementary school cafeteria
- Outbreak associated with national brand food; no local contributing factors
- Cases linked to food purchased from several different restaurants in one city
- Outbreak linked to food on airline flight

LOCAL SIGNIFICANCE OF MULTIJURISDICTIONAL OUTBREAKS

- "Local" outbreak may herald a national or international event.
- Local jurisdictions will need to coordinate investigation efforts with other local, state, and federal partners.

FEDERAL PUBLIC HEALTH AGENCIES

- Centers for Disease Control and Prevention (CDC) - Non-regulatory agency that focuses on disease surveillance, outbreak detection, and investigation
- U.S. Department of Agriculture/Food Safety and Inspection Service (USDA/FSIS) - Regulatory agency that oversees safety of meat, poultry, and pasteurized egg products
- U.S. Food and Drug Administration (FDA) - Regulatory agency that oversees safety of most foods except meat, poultry, and pasteurized egg products

FEDERAL AGENCY CONTRIBUTIONS TO OUTBREAK INVESTIGATION

- Leadership and coordination
- Expertise and experience
- Laboratory testing
- Other resources (e.g., manpower, educational materials)
- Public health regulatory authority over certain control measures (e.g., recalls)

WHEN TO INVOLVE FEDERAL AGENCIES

Outbreaks associated with
- Cases from multiple states (or countries)
- Commercially distributed food contaminated before point of service
- Highly pathogenic or unusual causative agent
- Large numbers of cases that require additional resources to investigate
- Intentional contamination suspected

Request for assistance through state epidemiologist
LOCAL SIGNIFICANCE OF MULTIJURISDICTIONAL OUTBREAKS

- "Local" outbreak may herald a national or international event.
- Local jurisdictions will need to coordinate investigation efforts with other local, state, and federal partners.
- Local jurisdictions may be asked to urgently investigate one or a few cases that are part of a larger outbreak despite their apparently small local impact.

ROLE OF STATE AND LOCAL JURISDICTIONS IN MULTIJURISDICTIONAL OUTBREAKS

RESOURCE FOR MULTIJURISDICTIONAL TEAMS

Guidelines for Foodborne Disease Outbreak Response

- Fundamentals and concepts
- Agency roles and responsibilities
- Surveillance
- Outbreak detection and investigation
- Indicators and notification steps for multijurisdictional outbreaks
- And much more

Download CIFOR Guidelines for free from www.cifor.us

INTENTIONAL CONTAMINATION

NICOTINE POISONING AND GROUND BEEF

- Supermarket customers in MI complain of burning of the mouth, nausea, vomiting, and dizziness following consumption of ground beef purchased on certain dates
- Supermarket recalls 1,700 lbs. beef from out-of-state processor that was ground at the store
- Samples of ground beef found positive for nicotine
- Local health department identifies over 90 cases
- Employee indicted by grand jury

INTENTIONAL CONTAMINATION OF FOOD

- Few documented incidents
- Food vulnerable target
- Vigilance and heightened awareness regarding tampering with food supply are essential
PUBLIC HEALTH CLUES
- Likely to mimic unintentional foodborne outbreak
- Clues that might be intentional

<table>
<thead>
<tr>
<th>Env't Health</th>
<th>Epidemiologic</th>
<th>Laboratory</th>
</tr>
</thead>
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<td></td>
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</tbody>
</table>

NICOTINE POISONING AND GROUND BEEF (CONT’D)
Hints of intentional contamination
- Nicotine as a contaminant of ground beef
- 300 mg/kg of nicotine in implicated ground beef
- Contamination limited to single store
- Nicotine-containing pesticides not used at store
- Source of nicotine thought to be Black Leaf 40, an insecticide formulation discontinued in 1992

INVESTIGATION OF INTENTIONAL CONTAMINATION
Follows same approach as for all outbreaks until intentional contamination suspected
Then everything changes!!!
- Different partners with different objectives
- Added steps (e.g., parallel investigation by law enforcement)
- Special issues (e.g., safety of team, proper handling of specimens, capacity to test for unusual agents)

Importance of developing working relationship with possible partners BEFORE incident occurs

INCIDENT COMMAND SYSTEM

INCIDENT COMMAND SYSTEM (ICS)
- Management system that helps multiple agencies work together
- Supports and coordinates necessary activities and communications
- Has operating rules and processes

SALMONELLA AND PUBLIC WATER SYSTEM
- Salmonella outbreak in Alamosa, Colorado, with 442 illnesses and one death
- Source determined to be public water system
- Colorado Safe Drinking Water program focused on correcting problems with public water system
- ICS helped to manage others aspects of response
  - Bulk water delivery
  - Public notification of advisories and updates
  - Interagency coordination
**ACTIVATION OF ICS IN OUTBREAK RESPONSE?**

- Determined by agency/jurisdiction
  - Some jurisdictions use ICS extensively
  - Others do not
- Triggers for involvement should be decided in advance
- Necessary integration of ICS into response planning and team training, if decision is made to activate system under certain circumstances

**QUESTION**

1. Is the Incident Command System (ICS) activated in your jurisdiction when a foodborne outbreak is detected?
2. If so, under what circumstances is it activated?
Module 8: Team Communications

At the end of this module, the participant will be able to:

1. Discuss ways to improve communications among outbreak investigation team members before, during, and after an outbreak.

2. Identify key stakeholders to be notified in the event of a foodborne outbreak.

3. List considerations in dealing with the media about a foodborne disease outbreak.

4. Outline the components of a final report from an outbreak investigation.
Module 8: CIFOR Toolkit Keys to Success

Before an outbreak:
- Agency identifies key individuals/agencies to be notified if outbreak occurs.
- Staff know how to contact key individuals/agencies and communicate with them routinely.
- Staff are trained in media and risk communications.

During/After:
- Team members share information in timely fashion.
- Staff rapidly notify other agencies about outbreak.
- Agency identifies spokesperson.
- Agency conducts debriefing after each outbreak.
MODULE 8 – COMMUNICATIONS AMONG TEAM MEMBERS

FOODBORNE DISEASE OUTBREAK INVESTIGATION TEAM TRAINING

AT THE END OF THIS MODULE, YOU WILL BE ABLE TO
1. Discuss ways to improve communications among outbreak investigation team members before, during, and after an outbreak.
2. Identify key stakeholders to be notified in the event of a foodborne outbreak.
3. List considerations in dealing with the media about a foodborne disease outbreak.
4. Outline the components of a final report from an outbreak investigation.

COMMUNICATIONS BETWEEN TEAM MEMBERS AND AGENCIES

Good communication is key to outbreak investigation success!
Goal: Sharing information in a way that supports a timely, coordinated, and effective outbreak response
Opportunities
- Pre-outbreak
- During investigation
- After investigation

PRE-OUTBREAK

Designate team members (and their likely roles) before an outbreak occurs
Make sure team members know each other and establish routine communications
Train and exercise teams together

PRE-OUTBREAK (CONT’D)

Define formal communication processes for team member agencies
Address information sharing issues
- Legal authority to share certain information
- Need for information sharing agreements
Identify key stakeholders to be notified in the event of a foodborne outbreak

STAKEHOLDERS

Key individuals/agencies who are likely to be
- Involved in the investigation
- Able to provide valuable input during an investigation
- Affected by outbreak

Establish contact list of stakeholders, when they should be notified (i.e., triggers), and who is responsible for notifying each stakeholder
QUESTION
What stakeholders would you notify in the event of a foodborne outbreak in your jurisdiction? Why?

DURING INVESTIGATION
Notify team when outbreak suspected
Assemble and brief team as soon as outbreak confirmed
Hold regular meetings to
- Share information collected by each investigator
- Interpret findings
- Decide on next activities
Document actions, findings, and decisions

GROUP EXERCISE
Divide into groups that have a mix of disciplines.
1. Read the initial report of an outbreak following a school awards banquet at the end of the module.
2. A decision is made to investigate the outbreak. What initial activities is each team member likely to undertake?
3. What resulting information will be useful to other members of the team and how?

Be prepared to share with class.
Time: 10 minutes

SHOULD YOU TALK WITH IMPLICATED BUSINESS?
Level of confidence that implicated food service establishment is source of outbreak
Undertaken in concert with local legal precedence and support of legal office
As agreed upon by outbreak investigation team
- What to share?
- When to share it?

SHOULD YOU NOTIFY THE PUBLIC?
Does the public need to be notified?

DO’S IN TALKING WITH MEDIA
Identify spokesperson for team.
Identify goal of each contact with the media and work with team to craft message.
Stress key points (i.e., the who, what, when, where, why, and how).
Provide factual, objective information.
Develop standard explanations for difficult to understand concepts.
DON'TS IN TALKING WITH MEDIA

Don’t talk to media unless you are the spokesperson for the team or asked by PIO. Don’t use jargon. Don’t wow them with your command of statistics! Don’t say “no comment.” Don’t go off the record. Don’t lose your temper.

AFTER INVESTIGATION

Debriefing
Final report
Submission of summary data by state for national reporting

DEBRIEFING

Meeting of all team members and other investigation participants
Structured review of investigation with specific topics to be covered
Purpose
- Identify things that went well or need improvement
- Solicit input for changes
- Make recommendations for future investigations

FINAL REPORT

Written document that summarizes investigation activities and findings
Purpose
- Documents what happened
- Clarifies control and prevention measures
- Documents performance to justify program resources
- Acts as public record
- Allows investigators and others to learn from experience

FINAL REPORT – OUTLINE

Introduction and background
Environmental health investigations
  ▪ Methods
  ▪ Results
Epidemiology investigations
  ▪ Methods
  ▪ Results
Laboratory investigations
  ▪ Methods
  ▪ Results

FINAL REPORT – OUTLINE (CONT’D)

Conclusions
- Brief summary of major findings
- Study limitations
- Rationale to accept or reject hypothesis of outbreak source (i.e., evidence to support causation)
Recommendations
- Control measures for current outbreak
- Measures to prevent future outbreaks
- Improvement of future investigations
**FINAL REPORT – TIPS**

Be concise  
Include key positive and negative findings but not supporting paperwork/details  
Organize in logical and meaningful way  
Be objective, honest, and accurate  
Include names and affiliations of investigation participants  
Write with public disclosure in mind

**FREEDOM OF INFORMATION ACT (FOIA)**

Requires disclosure of agency documents and other public records with selected exemptions  
In documenting outbreak investigation and in final report  
- Do not identify individuals or legally nonpublic information  
- Do not use inappropriate language  
- Do not express personal feelings

**FINAL REPORT – DISTRIBUTION**

Distribute to

**SUBMISSION OF SUMMARY DATA FOR NATIONAL REPORTING**

Summary of investigation findings submitted to CDC’s National Foodborne Disease Outbreak Surveillance System (FDOSS)  
Standard form (NORS report form [CDC 52.13])  
Completed by state based on information provided by local investigators  
Purpose  
- Assess national trends in foodborne outbreaks  
- Evaluate control and prevention measures  
- Link related outbreaks at different sites

**NORS REPORT FORM (CDC FORM 52.13)**

General section  
- Investigation methods  
- Dates of illness  
- Location of cases  
- Case characteristics  
- Clinical manifestations  
Laboratory section  
Food-specific information  
- Implicated food  
- Where prepared and served  
- Contributing factors
Module 8 – Group Exercise: Sharing Investigation Information among Team Members

Divide into groups that have a mix of disciplines, if possible.
1. Read the initial report of an outbreak following a school awards banquet below.
2. A decision is made to investigate the outbreak. What initial activities is each team member likely to undertake?
3. What resulting information will be useful to other members of the team and how?

An outbreak of gastrointestinal illness was reported among guests who attended a school awards banquet on May 6. From the initial report by the school nurse, at least 20 of the 206 banquet attendees (5 students and 15 parents) developed vomiting and diarrhea after the event. The banquet meal was a buffet catered by a local restaurant and was held at the school cafeteria. The event was organized by the president of the parent-teacher organization.

The outbreak investigation team, including an environmental health and epidemiologic investigator from the local health department and a laboratorian from the state public health laboratory, were notified of the outbreak. The team assembled at the local health department and reviewed what was known about the outbreak. A decision is made to investigate the outbreak.

**Question 1:** What initial activities is the **environmental health investigator** likely to undertake? What resulting information will be useful to other members of the team and how?

**Question 2:** What initial activities is the **epidemiologic investigator** likely to undertake? What resulting information will be useful to other members of the team and how?

**Question 3:** What initial activities is the **laboratory investigator** likely to undertake? What resulting information will be useful to other members of the team and how?
General

National Outbreak Reporting System

Foodborne Disease Transmission, Person-to-Person Disease Transmission, Animal Contact

This form is used to report enteric foodborne, person-to-person, and animal contact-related disease outbreak investigations. This form has 5 sections: General, Etiology, Settings, Animal Contact, and Food, as indicated by tabs at the top of each page. Complete the General and Etiology tabs for all modes of transmission and complete additional sections as indicated by the mode of transmission. Please complete as much of all sections as possible.

CDC USE ONLY

CDC Report ID
State Report ID

Primary Mode of Transmission (check one)

- Food (complete General, Etiology, and Food tabs)
- Person-to-person (complete General, Etiology, and Settings tabs)
- Water (complete CDC 52.12)
- Environmental contamination other than food/water (complete General, Etiology, and Settings tabs)
- Animal contact (complete General, Etiology, and Animal Contact tabs)
- Other/Unknown (complete General, Etiology, and Settings tabs)

Investigation Methods (check all that apply)

- Interviews only of ill persons
- Case-control study
- Cohort study
- Food preparation review
- Water system assessment: Drinking water
- Water system assessment: Nonpotable water

Comments

Dates (mm/dd/yyyy)

Date first case became ill (required) / / 
Date last case became ill / / 
Date of initial exposure / / 
Date of last exposure / / 
Date of report to CDC (other than this form) / / 
Date of notification to State/Territory or Local/Tribal Health Authorities / / 

Geographic Location

Reporting state: 
- Exposure occurred in multiple states
- Exposure occurred in a single state, but cases resided in multiple states
- Other states:

Reporting county:
- Exposure occurred in multiple counties in reporting state
- Exposure occurred in a single county, but cases resided in multiple counties in reporting state
- Other counties:

City/Town/Place of exposure: 
(Do not include proprietary or private facility names)

Primary Cases

<table>
<thead>
<tr>
<th>Number of primary cases</th>
<th>Sex (number or percent of the primary cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab-confirmed primary cases</td>
<td># Male # %</td>
</tr>
<tr>
<td>Probable primary cases</td>
<td># Female # %</td>
</tr>
<tr>
<td>Estimated total primary cases</td>
<td># Unknown # %</td>
</tr>
</tbody>
</table>

Primary Case Outcomes

<table>
<thead>
<tr>
<th># Cases Total # of cases for whom info is available</th>
<th>Age (number or percent of the primary cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died</td>
<td># &lt;1 year # % 20–49 years # %</td>
</tr>
<tr>
<td>Hospitalized</td>
<td># 1–4 years # % 50–74 years # %</td>
</tr>
<tr>
<td>Visited Emergency Room</td>
<td># 5–9 years # % ≥ 75 years # %</td>
</tr>
<tr>
<td>Visited health care provider (excluding ER visits)</td>
<td># 10–19 years # % Unknown # %</td>
</tr>
</tbody>
</table>
### General

#### Incubation Period, Duration of Illness, Signs or Symptoms for Primary Cases Only

<table>
<thead>
<tr>
<th>Feature</th>
<th># Cases with signs or symptoms</th>
<th>Total # of cases for whom info is available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vomiting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diarrhea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bloody stools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fever</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdominal cramps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HUS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymptomatic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other/Unknown</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Secondary Cases

**Mode of secondary transmission (check all that apply)**

- Food
- Water
- Animal contact
- Person-to-person
- Environmental contamination other than food/water
- Other/Unknown

**Number of secondary cases**

- Lab-confirmed secondary cases: #
- Probable secondary cases: #
- Estimated secondary cases: #
- Estimated total cases (Primary + Secondary): #

#### Environmental Health Specialists Network (if applicable)

- EHS-Net Evaluation ID: 1) ______ 2) ______ 3) ______ 4) ______

#### Traceback (for food and bottled water only, not public water)

- □ Please check if traceback conducted

#### Recall

- □ Please check if any food or bottled water product was recalled

#### Reporting Agency

- Agency name: __________ E-mail: __________
- Contact name: __________ Phone no.: __________
- Contact title: __________ Fax no.: __________

#### General Remarks

*Briefly describe important aspects of the outbreak not covered above. Please indicate if any adverse outcomes occurred in special populations (e.g., pregnant women, immunocompromised persons.)*
**Etiology Section** – complete for all modes of transmission except Water

<table>
<thead>
<tr>
<th>Etiology known?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>If etiology is unknown, were patient specimens collected?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>If yes, how many specimens collected? (provide numeric value)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What were they tested for? (check all that apply)</td>
<td>Bacteria</td>
<td>Chemicals/Toxins</td>
</tr>
</tbody>
</table>

**Genus** | **Species** | **Serotype/Genotype** | **Confirmed outbreak etiology** | **Other characteristics** | **Detected in** | **# Of Lab-Confirmed cases** |
<table>
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<td>yes</td>
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<td>yes</td>
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</tr>
</tbody>
</table>

*Detected in (choose all that apply): 1 - patient specimen 2 - food specimen 3 - environment specimen 4 - food worker specimen

**Isolates/Strains** (For bacterial pathogens, provide a representative for each distinct pattern. For viral pathogens, provide CaliciNet key, outbreak number, sequenced region, and genotype for each distinct strain.)

<table>
<thead>
<tr>
<th>State Lab ID/CDC PulseNet or CaliciNet Key</th>
<th>CDC PulseNet or CaliciNet Outbreak Number</th>
<th>CDC PulseNet Pattern Designation for Enzyme 1</th>
<th>CDC PulseNet Pattern Designation for Enzyme 2</th>
<th>CaliciNet Sequenced Region/Other Molecular Designation 1</th>
<th>CaliciNet Genotype/Other Molecular Designation 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

**Settings Section** – complete for person-to-person, environmental contamination, and other/unknown primary mode of transmission

- **Major setting of exposure** (choose one)
  - Camp
  - Hotel
  - Private setting (residential home)
  - School
  - Child day care
  - Nursing home
  - Religious facility
  - Ship
  - Community-wide
  - Prison or detention facility
  - Restaurant
  - Workplace
  - Hospital
  - Other, please specify: 

**Attack rates for major setting of exposure**

<table>
<thead>
<tr>
<th>Group (based on setting)</th>
<th>Estimated exposed in major setting*</th>
<th>Estimated ill in major setting</th>
<th>Crude attack rate [(estimated ill / estimated exposed) x 100]</th>
</tr>
</thead>
<tbody>
<tr>
<td>residents, guests, passengers, patients, etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>staff, crew, etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*e.g., number of persons on ship, number of residents in nursing home or affected ward

**Other settings of exposure** (choose all that apply)

<table>
<thead>
<tr>
<th>Setting of exposure</th>
<th>Type of animal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camp</td>
<td>Private setting (residential home)</td>
</tr>
<tr>
<td>Child day care</td>
<td>Religious facility</td>
</tr>
<tr>
<td>Community-wide</td>
<td>Restaurant</td>
</tr>
<tr>
<td>Hospital</td>
<td>Other, please specify:</td>
</tr>
</tbody>
</table>

**Animal Contact Section** – complete for animal contact primary mode of transmission

<table>
<thead>
<tr>
<th>Setting of exposure</th>
<th>Type of animal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Food Section – complete for foodborne primary mode of transmission

- Food vehicle undetermined

<table>
<thead>
<tr>
<th>Food</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of food (excluding any preparation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ingredient(s) (enter all that apply)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contaminated ingredients(s) (enter all that apply)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total # of cases exposed to implicated food</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reason(s) suspected (enter all that apply from list in appendix)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method of processing (enter all that apply from list in appendix)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method of preparation (select one from list in appendix)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of preparation (select one from list in appendix)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contaminated food imported to US?</td>
<td>☐ Yes, Country</td>
<td>☐ Yes, Country</td>
<td>☐ Yes, Country</td>
</tr>
<tr>
<td></td>
<td>☐ Yes, Unknown</td>
<td>☐ Yes, Unknown</td>
<td>☐ Yes, Unknown</td>
</tr>
<tr>
<td></td>
<td>☐ No</td>
<td>☐ No</td>
<td>☐ No</td>
</tr>
<tr>
<td>Was product both produced under domestic regulatory oversight and sold?</td>
<td>☐ Yes</td>
<td>☐ Yes</td>
<td>☐ Yes</td>
</tr>
<tr>
<td></td>
<td>☐ No</td>
<td>☐ No</td>
<td>☐ No</td>
</tr>
<tr>
<td></td>
<td>☐ Unknown</td>
<td>☐ Unknown</td>
<td>☐ Unknown</td>
</tr>
</tbody>
</table>

### Location where food was prepared (check all that apply)

- Restaurant – ‘Fast-food’ (drive up service or pay at counter)
- Restaurant – Sit-down dining
- Restaurant – Other or unknown type
- Private home
- Banquet Facility (food prepared and served on-site)
- Caterer (food prepared off-site from where served)
- Fair, festival, other temporary or mobile services
- Grocery store
- Workplace, not cafeteria
- Workplace cafeteria

### Location of exposure (where food was eaten) (check all that apply)

- Nursing home, assisted living facility, home care
- Hospital
- Child day care center
- School
- Prison, jail
- Church, temple, religious location
- Camp
- Picnic
- Workplace, not cafeteria
- Workplace cafeteria

Where Prepared Remarks:  
Where Eaten Remarks:
### Contributing Factors (check all that contributed to this outbreak)

- Contributing factors unknown

### Contamination Factor

- C1
- C2
- C3
- C4
- C5
- C6
- C7
- C8
- C9
- C10
- C11
- C12
- C13
- C14
- C15
- C-N/A

### Proliferation/Amplification Factor (bacterial outbreaks only)

- P1
- P2
- P3
- P4
- P5
- P6
- P7
- P8
- P9
- P10
- P11
- P12
- P-N/A

### Survival Factor

- S1
- S2
- S3
- S4
- S5
- S-N/A

### The confirmed or suspected point of contamination (check one)

- Before preparation
- Preparation

If ‘Before Preparation’:
- Pre-Harvest
- Processing
- Unknown

### Reason suspected (check all that apply)

- Environmental evidence
- Laboratory evidence
- Epidemiologic evidence
- Prior experience makes this a likely source

### Was food-worker implicated as the source of contamination?  
- Yes
- No

If yes, please check only one of the following:
- Laboratory and epidemiologic evidence
- Epidemiologic evidence
- Laboratory evidence
- Prior experience makes this a likely source

### School Questions

(Complete this section only if “school” is checked in either sections “Location where food was prepared” or “Location of exposure (where food was eaten)”)

1. Did the outbreak involve a single or multiple schools?
   - Single
   - Multiple (number of schools ___)

2. School characteristics (for all involved students in all involved schools)

   a. Total approximate enrollment
      (number of students)
      - Unknown or undetermined
   b. Grade level(s)
      - Preschool
      - Grade school (grades K-12)
        Please check all grades affected:
        - K
        - 1st
        - 2nd
        - 3rd
        - 4th
        - 5th
        - 6th
        - 7th
        - 8th
        - 9th
        - 10th
        - 11th
        - 12th
        - College/university/technical school
        - Unknown or Undetermined
   c. Primary funding of involved schools
      - Public
      - Private
      - Unknown

3. Describe the preparation of the implicated item: (check all that apply)

   - Heat and serve (item mostly prepared or cooked off-site, reheated on-site)
   - Served a-la-carte
   - Serve only (preheated or served cold)
   - Cooked on-site using primary ingredients
   - Provided by a food service management company
   - Provided by a fast-food vendor
   - Provided by a pre-plate company
   - Part of a club or fundraising event
   - Made in the classroom
   - Brought by a student/teacher/parent
   - Other (describe in General Remarks)
   - Unknown or Undetermined

4. How many times has the state, county or local health department inspected this school cafeteria or kitchen in the 12 months before the outbreak?*
   - Once
   - Twice
   - More than two times
   - Not inspected
   - Unknown or Undetermined

*If multiple schools are involved, please answer according to the most affected school.

5. Does the school have a HACCP plan in place for the school feeding program?*
   - Yes
   - No
   - Unknown or Undetermined

*If multiple schools are involved, please answer according to the most affected school.
6. Was implicated food item provided to the school through the National School Lunch/Breakfast Program?  
☐ Yes  ☐ No  ☐ Unknown or Undetermined
If yes, was the implicated food item donated/purchased by:
☐ USDA through the Commodity Distribution Program  
☐ The state/school authority  
☐ Other (describe in General Remarks)  
☐ Unknown or Undetermined

Ground Beef

1. What percentage of ill persons (for whom information is available) ate ground beef raw or undercooked?  ____________ %
2. Was ground beef case-ready?  ☐ Yes  ☐ No  ☐ Unknown
   (Case-ready ground beef is meat that comes from a manufacturer packaged for sale that is not altered or repackaged by the retailer.)
3. Was the beef ground or reground by the retailer?  ☐ Yes  ☐ No  ☐ Unknown
   If yes, was anything added to the beef during grinding (such as shop trim or any product to alter the fat content)?:  ____________

Additional Salmonella Questions
(Complete this section for Salmonella outbreaks)

1. Phage type(s) of patient isolates:
   ____________ if RDNC* then include # ____________
   ____________ if RDNC* then include # ____________
   ____________ if RDNC* then include # ____________
   ____________ if RDNC* then include # ____________
* Reacts, Does Not Conform

Eggs

1. Were eggs (check all that apply)
   ☐ in shell, unpasteurized?
   ☐ in shell, pasteurized?
   ☐ packaged liquid or dry?
   ☐ stored with inadequate refrigeration during or after sale?
   ☐ consumed raw?
   ☐ consumed undercooked?
   ☐ pooled?
2. Was Salmonella enteritidis found on the farm?  ☐ Yes  ☐ No  ☐ Unknown

Egg Comment (e.g., eggs and patients isolates matched by phage type):  ________________
__________________________
Form 52.13
National Outbreak Reporting System (NORS) Appendix

Signs and Symptoms: **Choose all that apply.** NORS users may enter new signs and symptoms if it is not listed below.

- Abdominal Cramps
- Alopecia (absence of hair)
- Anaphylaxis
- Anorexia
- Appendicitis
- Arthralgia
- Asymptomatic
- Ataxia
- Backache
- Bedridden
- Bloating
- Blood pressure flux
- Bloody Stools
- Bloody vomitus
- Blurred vision
- Body ache
- Bradycardia
- Bullous skin lesions
- Burning
- Burns in mouth
- Chest pain
- Chills
- Coma
- Congestion
- Cough
- Dark Urine
- Dehydration
- Descending paralysis
- Diarrhea
- Difficulty breathing
- Difficulty swallowing
- Dilated pupils
- Diplopia (double vision)
- Disoriented
- Dizziness
- Dry mouth
- Dysconjugate gaze
- Dysesthesia (impairment of a sense, esp. touch)
- Ear ache
- Ears ringing
- Edema
- Eosinophil
- Erythemia
- Excess saliva
- Eye problems
- Facial weakness
- Faintness
- Fasciculations (bundling nerve/muscle fibers)
- Fatigue
- Fever
- Flushing
- Gas
- Hallucinations
- Headache
- Heartburn
- Hemorrhage
- Histamine reaction
- Hives
- Hoarse
- Hot flash/flush
- HUS (Hemolytic Uremic Syndrome)
- Hypotension
- Insomnia
- Itching
- Jaundice
- Joint pain
- Lethargy
- Light-headed
- Liver necrosis
- Loss of appetite
- Loss of consciousness
- Lymphadenopathy
- Malaise
- Memory loss
- Meningitis
- Mucus
- Mucus in stool
- Muscle breakdown
- Muscle fatigue
- Muscle spasm
- Myalgia
- Nausea
- Neurological symptoms
- Nightmares
- Numbness
- Oral Swelling
- Pain
- Palpitations
- Paralysis
- Paresthesia
- Periorbital edema
- Pharyngitis
- Photophobia
- Prostration
- Ptosis
- Quadriplegia
- Rapid pulse
- Rash
- Redness
- Respiratory arrest
- Rhinitis
- Seizures
- Septicemia
- Shakes
- Shock
- Shortness of breath
- Sore throat
- Speech difficulty
- Stiff neck
- Stiffness
- Stomach ache
- Sweating
- Swelling
- Swollen glands
- Swollen lymph nodes
- Tachycardia
- Taste Disturbance
- Temperature reversal
- Temperature variant
- Thick tongue
- Thirst
- Thrombocytopenia
- Tingling
- Trembling
- TTP (Thrombotic thrombocytopenic purpura)
- Urinary problems
- Urticaria
- Vomiting
- Weak pulse
- Weakness
- Weight loss
- Wheezing

Last updated: 6/24/2009
**Reason(s) suspected:** Choose all that apply.
1 – Statistical evidence from epidemiological investigation
2 – Laboratory evidence (e.g., identification of agent in food)
3 – Compelling supportive information
4 – Other data (e.g., same phage type found on farm that supplied eggs)
5 – Specific evidence lacking but prior experience makes it likely source

**Method of processing** (Prior to point-of-service: Processor): Choose all that apply.
1 – Pasteurized (e.g., liquid milk, cheese, and juice etc)
2 – Unpasteurized (e.g., liquid milk, cheese, and juice etc)
3 – Shredded or diced
4 – Pre-packaged (e.g., bagged lettuce or other produce)
5 – Irradiation
6 – Pre-washed
7 – Frozen
8 – Canned
9 – Acid treatment (e.g., commercial potato salad with vinegar, etc)
10 – Pressure treated (e.g., oysters, etc)
11 – None or Unknown

**Method of Preparation** (At point-of-service: Retail: restaurant, grocery store): Select only one
1 – Prepared in the home
2 – Ready to eat food: No manual preparation, No cook step. (e.g., sliced cheese, pre-packaged deli meats; whole raw fruits; pre-shucked raw oysters, etc)
3 – Ready to eat food: Manual preparation, No cook step. (e.g., cut fresh fruits and vegetables, chicken salad made from canned chicken, etc)
4 – Cook and Serve Foods: Immediate service. (e.g., soft-cooked eggs, hamburgers, etc)
5 – Cook and hot hold prior to service. (e.g., soups, hot vegetables, mashed potatoes, etc)
6 – Advance preparation: Cook, cool, serve (e.g., sliced roast beef from a whole cooked roast, etc)
7 – Advance preparation: Cook, cool, reheat, serve (e.g., casseroles, soups, sauces, chili, etc)
8 – Advance preparation: Cook, cool, reheat, hot hold, serve (e.g., chili, refried beans, etc)
9 – Advance preparation: Cook-chill and Reduced Oxygen Packaging (ROP) (e.g., sauces, gravies, cheeses, etc packaged under ROP)
10 – None or Unknown

**Level of preparation:** Select only one
1 – Foods eaten raw with minimal or no processing. (e.g., washing, cooling)
2 – Foods eaten raw with some processing. (e.g., no cooking, fresh cut and/or packaged raw)
3 – Foods eaten heat processed. (e.g., cooked: a microbiological kill step was involved in processing)

Last updated: 6/24/2009
Contributing Factors: Choose all that apply.

Contamination Factors:
C1 – Toxic substance part of the tissue  
C2 – Poisonous substance intentionally/deliberately added  
C3 – Poisonous substance accidentally/inadvertently added  
C4 – Addition of excessive quantities of ingredients that are toxic in large amounts  
C5 – Toxic container  
C6 – Contaminated raw product – food was intended to be consumed after a kill step  
C7 – Contaminated raw product – food was intended to be consumed raw or undercooked/under-processed  
C8 – Foods originating from sources shown to be contaminated or polluted (such as a growing field or harvest area)  
C9 – Cross-contamination of ingredients (cross-contamination does not include ill food workers)  
C10 – Bare-hand contact by a food handler/worker/preparer who is suspected to be infectious  
C11 – Glove-hand contact by a food handler/worker/preparer who is suspected to be infectious  
C12 – Other mode of contamination (excluding cross-contamination) by a food handler/worker/preparer who is suspected to be infectious  
C13 – Foods contaminated by non-food handler/worker/preparer who is suspected to be infectious  
C14 – Storage in contaminated environment  
C15 – Other source of contamination  
C-N/A – Contamination Factors - Not Applicable  

Proliferation/Amplification Factors:  
P1 – Food preparation practices that support proliferation of pathogens (during food preparation)  
P2 – No attempt was made to control the temperature of implicated food or the length of time food was out of temperature control (during food service or display of food)  
P3 – Improper adherence of approved plan to use Time as a Public Health Control  
P4 – Improper cold holding due to malfunctioning refrigeration equipment  
P5 – Improper cold holding due to an improper procedure or protocol  
P6 – Improper hot holding due to malfunctioning equipment  
P7 – Improper hot holding due to improper procedure or protocol  
P8 – Improper/slow cooling  
P9 – Prolonged cold storage  
P10 – Inadequate modified atmosphere packaging  
P11 – Inadequate processing (acidification, water activity, fermentation)  
P12 – Other situations that promoted or allowed microbial growth or toxic production  
P-N/A – Proliferation/Amplification Factors - Not Applicable  

Survival Factors:  
S1 – Insufficient time and/or temperature control during initial cooking/heat processing  
S2 – Insufficient time and/or temperature during reheating  
S3 – Insufficient time and/or temperature control during freezing  
S4 – Insufficient or improper use of chemical processes designed for pathogen destruction  
S5 – Other process failures that permit pathogen survival  
S-N/A – Survival Factors - Not Applicable  

Last updated: 6/24/2009
Gastroenteritis at a University in Texas
Epi-Ready Course
STUDENT'S VERSION

Original investigators: Nicholas A. Daniels,¹ David A. Bergmire-Sweat,² Kellogg J. Schwab,³ Kate A. Hendricks,² Sudha Reddy,¹ Steven M.. Rowe,¹ Rebecca L. Fankhauser,¹,⁴ Stephan S. Monroe,¹ Robert L. Atmar,³ Roger I. Glass,¹ Paul S. Mead,¹ Ree A. Calmes-Slovin,⁵ Dana Cotton,⁶ Charlie Horton,⁶ Sandra G. Ford,⁶ Pam Patterson⁶

¹Centers for Disease Control and Prevention, ²Texas Department of Health, ³Baylor College of Medicine, ⁴Atlanta Veterans Administration Medical Center, ⁵City of Huntsville, Health Inspections, ⁶Texas Department of Health, Region 6/5S

Case study and instructor’s guide created by: Jeanette K. Stehr-Green, MD

NOTE: This case study is based on a real-life outbreak investigation undertaken in Texas in 1998. Some aspects of the original outbreak and investigation have been altered, however, to assist in meeting the desired teaching objectives and allow completion of the case study in less than 1.5 hours.

Students should be aware that this case study describes and promotes one particular approach to foodborne disease outbreak investigation. Procedures and policies in outbreak investigations, however, can vary from country to country, state to state, and outbreak to outbreak.

It is anticipated that the epidemiologist investigating a foodborne disease outbreak will work within the framework of an “investigation team” which includes persons with expertise in epidemiology, microbiology, sanitation, food science, and environmental health. It is through the collaborative efforts of this team, with each member playing a critical role, that outbreak investigations are successfully completed.

Please send us your comments on this case study by visiting our website at http://www.cdc.gov/epicasestudies. Please include the name of the case study with your comments.

April 2012

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
Atlanta, Georgia 30333
STUDENT'S VERSION
Gastroenteritis at a University in Texas

**Learning objectives:**
After completing this case study, the student should be able to:
1. List categories and examples of questions that should be asked of complainants who report a possible foodborne illness to the health department.
2. Prioritize the investigation of a suspected foodborne illness or foodborne disease outbreak.
3. List clues that might help determine the causative agent in an outbreak of acute gastrointestinal illness.
4. Use the descriptive epidemiology among cases, information about the setting in which the outbreak has occurred, and the results of hypothesis-generating interviews to develop hypotheses about the source of an outbreak.
5. Discuss some of the issues associated with the collection of clinical specimens for the investigation of a suspected foodborne disease outbreak.
6. List key areas of focus in investigating a facility implicated in a foodborne disease outbreak including interviews with food workers, observation of kitchen practices, and collection of samples.
7. Interpret the measure of association for a case-control study.

**PART I - OUTBREAK DETECTION**
On the morning of March 11, the Texas Department of Health (TDH) in Austin received a telephone call from a student at a university in south-central Texas. The student reported that he and his roommate, a fraternity brother, were suffering from nausea, vomiting, and diarrhea. Both had become ill during the night. The roommate had taken an over-the-counter medication with some relief of his symptoms. Neither the student nor his roommate had seen a physician or gone to the emergency room.

The students believed their illness was due to food they had eaten at a local pizzeria the previous night. They asked if they should attend classes and take a biology midterm exam that was scheduled that afternoon.

**Question 1:** What questions (or types of questions) would you ask the student?
The “Foodborne Illness Complaint Worksheet” (Appendix 1) was completed based on the call. The student refused to give his name or provide a telephone number or address at which he or his roommate could be reached.

**Question 2:** Do you think the student’s complaint should be investigated further? (VOTE)
A) Definitely
B) Probably
C) Probably not
D) Definitely not

TDH staff were skeptical of the student’s report but felt that a minimal amount of exploration was necessary. They contacted the City Health Department to determine if staff were aware of a problem. City Health Department staff reviewed the foodborne illness complaint log to see if others had reported similar illnesses or exposures. Although a few reports of vomiting and diarrhea had been received, no other recent complaints mentioned the pizzeria or involved students from the university.

TDH staff then made a few telephone calls. The pizzeria, where the student and his roommate had eaten, was closed until 11:00 A.M. There was no answer at the University Student Health Center, so a message was left on its answering machine.

A call to the emergency room of a hospital close to the university (Hospital A) revealed that 23 university students had been seen for acute gastroenteritis in the last 24 hours. Based on the emergency room triage log, only three patients had been seen for similar symptoms from March 5-9, none of who were associated with the university. Stool specimens from 17 students had been submitted for routine bacterial pathogens to the Hospital Laboratory on March 10, but no results were available.

Around 10:30 A.M., the physician from the University Student Health Center returned the call from TDH and reported that 20 students with vomiting and diarrhea had been seen at the clinic the previous day and more were waiting to be seen that morning. He believed only 1-2 students typically would have been seen for these symptoms in a week.

**Question 3:** Do you think these cases of gastrointestinal illness represent an outbreak at the university? Why or why not?
PART II - HYPOTHESIS GENERATION

TDH asked health care providers from the University Student Health Center, the Hospital A emergency room, and the emergency departments at six other hospitals located in the general vicinity of the university to report all patients with vomiting or diarrhea seen since March 5.

TDH investigators then visited the emergency room at Hospital A and reviewed medical records of the 26 patients seen at the facility for vomiting and/or diarrhea since March 5. All but three were students at the university. Based on these records, symptoms among the students included vomiting (91%), diarrhea (85%), abdominal cramping (68%), headache (66%), muscle aches (49%), and bloody diarrhea (5%). Oral temperatures ranged from 98.8°F (37.1°C) to 102.4°F (39.1°C) (median: 100°F [37.8°C]). Complete blood counts, performed on 10 students, showed an increase in white blood cells (median count: 13.7 per cubic mm [normal: 4.8-10.8 per cubic mm]).

Preliminary stool culture results from the 17 students from whom specimens had been collected did not identify Salmonella, Shigella, Campylobacter, Vibrio, Listeria, Yersinia, Escherichia coli O157:H7, Bacillus cereus, or Staphylococcus aureus. Examinations for ova and parasites were negative. Some specimens were positive for fecal leukocytes and fecal occult blood.

Question 4: How might you interpret the bacterial culture results?

Question 5: Based on the findings so far, what type of agent do you think might be causing this outbreak? (VOTE)
A) Bacteria
B) Virus
C) Parasite
D) Preformed toxin or chemical
By the next morning, March 12, seventy-five persons with vomiting or diarrhea had been reported to TDH. All were students who lived on the university campus. No cases were identified among university faculty or staff, students living off-campus, or from the local community. Except for one case, the dates of illness onset were March 9-12. (Figure 1) The median age of patients was 19 years (range: 18-22 years), 69% were freshman, and 62% were female.

Figure 1. Onset of gastroenteritis among students, University X, Texas. (N=72) (Date of onset was not known for three ill students.)

Question 6: Based on the epidemic curve and likely causative agent, what is the likely mode of transmission and the period of interest for possible exposures related to this outbreak?

TDH and City Health Department staff met with the Student Health Center physician and nurse and several administrators to learn more about the university and student body. The following information was gathered:

The university had an enrollment of approximately 12,000 students; 2,386 students lived on campus at one of the 36 residential halls scattered across the 200+ acres of the main campus.
The university used municipal water and sewage services. Due to the large size of the campus, residential halls received water from several dozen water mains. There had been no work on water or sewage lines in the past year nor recent roadwork or digging around campus.

The campus dining service included two cafeterias; about 2,000 students belonged to the university meal plan which was limited to persons living on campus. Most on-campus students dined at the main cafeteria which served hot entrees, as well as items from a grill, deli bar, and salad bar. A second smaller cafeteria on campus offered menu selections with a per item cost and was also accessible to meal plan members. In contrast to the main cafeteria, the smaller cafeteria tended to be used by students who lived off campus and university staff.

To better understand the likely source of the outbreak, investigators undertook hypothesis-generating interviews with seven of the earliest cases reported by the emergency room and the Student Health Center; all of the cases had onset of illness on March 10. Four were male and three were female.

Among the seven students interviewed, all but one was a freshman. Two students were psychology majors; one each was majoring in English and animal husbandry. Three students were undecided about their major. The students were from seven different residential halls and all reported eating most of their meals at the university’s main cafeteria. During the past week, all but one student had eaten food from the deli bar; two had eaten food from the salad bar, and three from the grill. Seven-day food histories revealed no particular food item that was common to all or most of the students.

None of the students shared any classes; only one student knew someone with a similar illness (i.e., his roommate). In the last week, none of the students had had contact with children in diapers and only the student majoring in animal husbandry had had contact with animals.

Five students belonged to a sorority or a fraternity. Three students had attended an all school mixer on March 6, the Friday before the outbreak began; two students went to an all night science fiction film festival at one of the dorms on March 7. Students reported attendance at no other special events; most had been studying for midterm exams for most of the weekend.

**Question 7:** At this point, what is your leading hypothesis on the mode of transmission in this outbreak? (VOTE)
A) Foodborne  
B) Waterborne  
C) Person-to-person transmission  
D) Animal-to-person transmission
Based on clinical findings, the descriptive epidemiology of early cases, information about the university, and hypothesis-generating interviews, investigators hypothesized that the source of the outbreak was a viral pathogen spread by a food or beverage served at the main cafeteria at the university between March 5 and 10.

**Question 8:** What studies or other investigations would you undertake to explore this hypothesis?
PART III - STUDIES TO TEST THE HYPOTHESIS: THE THREE-LEGGED STOOL

LABORATORY STUDIES
To explore the source of the outbreak at the university, TDH investigators initiated three lines of investigation: laboratory studies to determine the causative agent, an environmental health assessment of the university main cafeteria, and an epidemiologic study of students living on campus.

Health care providers were asked to collect stool specimens from new cases of vomiting and diarrhea. Bacterial cultures from patients seen in the emergency rooms were to be performed at the hospital at which they were collected and confirmed at the TDH Laboratory. Specimens collected at the Student Health Center were to be cultured at the TDH Laboratory. Stool specimens from a sample of ill patients were sent to the Centers for Disease Control and Prevention (CDC) for viral studies including reverse transcription-polymerase chain reaction (RT-PCR).

Question 9: What instructions would you give to health care providers for the collection of stool specimens from patients? Include instructions on how specimens should be collected, stored, and transported.

ENVIRONMENTAL HEALTH STUDIES
On the afternoon of March 12, TDH and City Health Department food safety inspectors conducted an environmental health assessment of the main cafeteria at University X and interviewed staff. Thirty-one staff members were employed at the cafeteria of whom 24 (77%) were food workers. Except for one employee, all dining service personnel were interviewed.
Question 10: Given that investigators suspect a virus as the causative agent, what contributing factors are likely to have played a role in this outbreak?

Question 11: What activities would you undertake during the environmental health assessment? What key areas should be explored during interviews with the cafeteria food workers?
Investigators toured the facility and obtained a list of the foods served at the main cafeteria during the implicated period. Cafeteria staff were questioned about their responsibilities such as the foods they handled, which meals they served, and where they usually worked (e.g., deli bar, grill). They also were asked about use of gloves, handwashing practices, work schedule during the week before the outbreak, and if they had been ill. None of the food workers reported being ill in the last two weeks. The cafeteria did not have a sick food workers policy.

An inspection of the main cafeteria food preparation area, equipment, and serving line was unremarkable. Walk-in refrigerators and freezers were organized to prevent cross contamination and maintained at appropriate temperatures. Food preparation surfaces were clean and appropriately situated with respect to flow of kitchen traffic. Steam tables on the serving line heated to proper temperatures. Other equipment (e.g., meat slicer) was clean and in good working order.

The deli bar had its own refrigerator and preparation area. During mealtimes, sandwiches were made to order by a food worker. Each day, newly prepared deli meats, cheeses, and condiments were added to partially depleted deli bar items from the day before (i.e., without discarding leftover food items). While the deli bar was open for service, sandwich ingredients were not kept refrigerated or on ice. The deli bar containers were not routinely cleaned. The refrigerator cooled only to 47°F.

Water and ice from the cafeteria were collected to test for fecal coliforms. Samples of leftover food were collected from the deli bar for bacterial cultures and special viral studies at CDC. Stool specimens were requested from all cafeteria staff.

Before dinner on March 12, the City Health Department closed the deli bar.

**Question 12:** Do you agree with the decision to close the deli bar? (VOTE)
A) Definitely
B) Probably
C) Probably not
D) Definitely not

**EPIDEMIOLOGIC STUDIES**
By the morning of March 13, one hundred and twenty-five persons with vomiting or diarrhea had been reported to TDH. All cases were among students who lived on campus.

TDH staff undertook a case-control study to test the hypothesis that the source of the outbreak was a food or beverage served at the main cafeteria at the university between March 5 and 10. For the study, a case was defined as vomiting or diarrhea (3 or more loose bowel movements during a 24-hour period) with onset on or after March 5 in a student who lived on campus. Cases were selected from those reported to TDH by one of the local emergency rooms or the Student
Health Center. Controls were students who lived on campus who did not have nausea, vomiting, or diarrhea since March 5.

Investigators administered the study questionnaire by telephone from March 15-23. Investigators asked cases and controls about a variety of exposures including foods eaten during March 5-10 and where the foods were prepared. Thirty-six cases and 144 controls were contacted. Cases included in the study were similar to all cases with respect to gender, age, year in college, and onset of illness.

TDH investigators tabulated the results from the case-control study. Eating lunch or dinner at the deli bar on March 9 or 10 was statistically significantly associated with illness. To identify the specific item(s) at the deli bar causing the outbreak, investigators reanalyzed study data only from cases and controls who ate at the deli bar during March 9-10. (Table 1) For these analyses, information from 28 cases and 20 controls were examined.

Table 1. Food items eaten by students who ate at deli bar during implicated meals,* case-control study, University X, Texas

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Ill exposed/ Total ill (%)</th>
<th>Well exposed/ Total well (%)</th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>American cheese</td>
<td>13/28 (46)</td>
<td>4/20 (20)</td>
<td>3.4</td>
<td>0.80-17.5</td>
<td>0.06</td>
</tr>
<tr>
<td>Swiss cheese</td>
<td>8/28 (29)</td>
<td>8/20 (40)</td>
<td>0.61</td>
<td>0.15-2.4</td>
<td>0.30</td>
</tr>
<tr>
<td>Ham</td>
<td>11/28 (39)</td>
<td>6/20 (30)</td>
<td>1.5</td>
<td>0.38-6.3</td>
<td>0.36</td>
</tr>
<tr>
<td>Turkey</td>
<td>15/28 (54)</td>
<td>11/20 (55)</td>
<td>0.95</td>
<td>0.26-3.5</td>
<td>0.57</td>
</tr>
<tr>
<td>Shredded lettuce</td>
<td>13/28 (46)</td>
<td>10/20 (50)</td>
<td>0.87</td>
<td>0.24-3.2</td>
<td>0.52</td>
</tr>
<tr>
<td>Tomato</td>
<td>7/28 (25)</td>
<td>6/20 (30)</td>
<td>0.78</td>
<td>0.18-3.5</td>
<td>0.50</td>
</tr>
<tr>
<td>Pickles</td>
<td>7/28 (25)</td>
<td>7/20 (35)</td>
<td>0.63</td>
<td>0.15-2.6</td>
<td>0.63</td>
</tr>
<tr>
<td>Mayonnaise</td>
<td>20/28 (71)</td>
<td>9/20 (45)</td>
<td>3.1</td>
<td>0.78-12.4</td>
<td>0.06</td>
</tr>
<tr>
<td>Mustard</td>
<td>10/28 (36)</td>
<td>9/20 (45)</td>
<td>0.68</td>
<td>0.18-2.6</td>
<td>0.52</td>
</tr>
</tbody>
</table>

*includes lunch and dinner on March 9 and lunch on March 10

Question 13: Interpret the results in Table 1.
PART IV - CONTROL AND PREVENTION MEASURES

Water and ice samples obtained from the cafeteria on March 12 were negative for fecal coliforms. Stool cultures from the 23 food workers were negative for bacteria.

Of the 18 fresh stool specimens sent on ill students to CDC, 9 (50%) had evidence of norovirus by reverse transcription-polymerase chain reaction (RT-PCR). Of the deli foods available from the implicated meals, only the ham sample was positive by RT-PCR for the presence of norovirus RNA.

On March 25, the university cafeteria staff member who initially refused to be interviewed agreed to talk to the investigators. The staff member worked primarily at the deli bar. She reported slicing ham on March 9 for use at the deli bar during lunch and dinner that day, and lunch the following day. She also prepared and served sandwiches for these same meals. She reported that she had worn gloves while slicing the ham and while serving sandwiches at the deli bar. Because she wore gloves during food preparation and serving, however, she did not feel that handwashing was an important activity.

The staff member denied any gastrointestinal illness during the outbreak period but reported that her infant had been sick with watery diarrhea since March 7, two days before she prepared items for the implicated meals. A stool sample collected from the ill infant on March 25 was positive for norovirus by RT-PCR. The sequence of the amplified product was identical to those products from the ill students and the deli ham.

On March 26, the chief of the campus food service called TDH to find out what must be done to reopen the deli bar.

**Question 14:** What actions would you recommend/require?
The deli bar was thoroughly cleaned. All equipment and surfaces were disinfected. All leftover foods and ingredients were thrown away. The deli bar refrigerator was fixed so that it cooled to 40°F (or less).

TDH staff worked with university officials to develop and implement policies to assure safe food preparation. Special training sessions were held with cafeteria employees to make sure they understood the policies and safe food preparation practices. The local health department intensified its monitoring of food service activities at the university, placing a special emphasis on the oversight provided by food services management. After implementing control measures recommended by TDH staff, the deli bar was reopened on April 1.

TDH investigators summarized the outbreak investigation in a written report and completed the CDC Form 52.13 (i.e., the National Outbreak Reporting System [NORS] report form).
**State Department of Health**

**FOODBORNE ILLNESS COMPLAINT WORKSHEET**

**PERSON COMPLETING INFORMATION**

<table>
<thead>
<tr>
<th>Date: 03/11/97</th>
<th>#: 97-076</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: Xavier Onassis</td>
<td>☏: (512) 555-1234</td>
</tr>
<tr>
<td>Affiliation: ☐ Local BOH (town): ______________</td>
<td>☒ State DPH (division): Epi</td>
</tr>
</tbody>
</table>

**REPORTER/COMPLAINANT**

<table>
<thead>
<tr>
<th>Name: Refused to provide</th>
<th>☏: ( ) ______ - __________</th>
</tr>
</thead>
</table>
| Affiliation: ☒ Consumer | ☐ Laboratory | ☐ Local BOH | ☐ Medical Provider | ☐ State DPH | ☐ Other (specify: ___________________________)

**ILLNESS INFORMATION**

**# Persons ill:** __2__

**Symptoms:** (mark if reported for anyone):

<table>
<thead>
<tr>
<th>Diarrhea: ☒ Yes ☐ No</th>
<th>Vomiting: ☒ Yes ☐ No</th>
<th>Nausea: ☒ Yes ☐ No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal cramps: ☐ Yes ☒ No</td>
<td>Fever: ☒ Yes ☐ No</td>
<td>Bloody stool: ☐ Yes ☒ No</td>
</tr>
<tr>
<td>Headache: ☒ Yes ☐ No</td>
<td>Muscle aches: ☐ Yes ☒ No</td>
<td>Chills: ☐ Yes ☒ No</td>
</tr>
<tr>
<td>Loss of appetite: ☐ Yes ☒ No</td>
<td>Fatigue: ☒ Yes ☐ No</td>
<td>Dizziness: ☐ Yes ☒ No</td>
</tr>
<tr>
<td>Burning in mouth: ☐ Yes ☒ No</td>
<td>Other symptoms: None</td>
<td></td>
</tr>
</tbody>
</table>

**Onset:**

<table>
<thead>
<tr>
<th>Earliest Date: 03/10/97</th>
<th>Time: 11:30 AM PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latest Date: 03/11/97</td>
<td>Time: 2:30 AM PM</td>
</tr>
</tbody>
</table>

**Duration:** ☐ Less than 24 Hours ☐ 24-48 Hours ☐ More than 48 Hours ☒ Ongoing ☐ Unknown

<table>
<thead>
<tr>
<th>Ill Person’s Name</th>
<th>☏</th>
<th>Age</th>
<th>Onset</th>
<th>Physician’s Name (if seen for this illness)</th>
<th>Other Relevant Information*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 reporter (above)</td>
<td>☏</td>
<td>18 y</td>
<td>3/11 (2:30 AM)</td>
<td></td>
<td>drinks water from campus, no contact with children in diapers or animals</td>
</tr>
<tr>
<td>2 Refused</td>
<td>☏</td>
<td>19 y</td>
<td>3/10 (11:30 PM)</td>
<td></td>
<td>drinks bottled water; no contact with children in diapers or animals</td>
</tr>
<tr>
<td>3</td>
<td>☏</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>☏</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note if individual is foodhandler.

**Medical attention received (by anyone)?** ☐ Yes ☒ No ☐ Unknown → **If Yes, specify above:** ↑

**Stool specimens submitted (by anyone)?** ☐ Yes ☒ No ☐ Unknown LABORATORY: __________________________

**Medical diagnosis?** __________________________
### FOOD HISTORY

- **72 hours** prior to symptoms, or, if organism identified, **between min and max incubation** periods
- If 2 or more ill, follow above time frame for **common meals (foods) only**

<table>
<thead>
<tr>
<th>Date &amp; Time¹</th>
<th>#</th>
<th>Food(s) consumed</th>
<th>Restaurant / store where purchased (name, town)</th>
<th>Place consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 8</td>
<td>☐ B</td>
<td>Ate separately</td>
<td>University cafeteria</td>
<td>☑ Same (as left)</td>
</tr>
<tr>
<td></td>
<td>☐ L</td>
<td></td>
<td></td>
<td>☐ Home</td>
</tr>
<tr>
<td></td>
<td>☐ D</td>
<td></td>
<td></td>
<td>☑ Other (specify):</td>
</tr>
<tr>
<td>March 9</td>
<td>☐ B</td>
<td>Ate separately</td>
<td>University cafeteria</td>
<td>☑ Same (as left)</td>
</tr>
<tr>
<td></td>
<td>☐ L</td>
<td></td>
<td></td>
<td>☐ Home</td>
</tr>
<tr>
<td></td>
<td>☐ D</td>
<td></td>
<td></td>
<td>☑ Other (specify):</td>
</tr>
<tr>
<td>March 10</td>
<td>☐ B</td>
<td>Anchovy pizza (cheese, onions, and anchovies) and beer</td>
<td>University cafeteria</td>
<td>☑ Same (as left)</td>
</tr>
<tr>
<td></td>
<td>☐ L</td>
<td></td>
<td>Local pizzeria</td>
<td>☐ Home</td>
</tr>
<tr>
<td></td>
<td>☐ D</td>
<td></td>
<td></td>
<td>☑ Other (specify):</td>
</tr>
</tbody>
</table>

#### NOTES

Student reported that he and his roommate usually ate separately at the University X main cafeteria. Could not provide list of foods eaten. The only shared meal was at pizzeria.

### FOOD TESTING

Food(s) available for testing? ☐ Yes ☐ No ☑ Unknown → **Sent to State Lab?** ☐ Yes ☐ No ☑ Unknown → **If Yes, specify food(s) & sources:**

### PRODUCT AND MANUFACTURER INFORMATION FOR COMMERCIALY-PROCESSED FOOD(S)

- Product name: ________________________________________________
- Code/lot #: __________________
- Expiration date: _____ / _____ / _____
- Package size/type: __________________________________________
- Manufacturer: ________________________________________________
- ☑: ( ) _______ - __________
- Address: ____________________________________________________________________________

¹State Laboratory Institute
²Always record Time if possible; otherwise, choose B=breakfast, L=lunch, D=dinner
³Total # persons (both ill and well) who consumed indicated food(s)
ACRONYMS

AEC  Annual Educational Conference (NEHA)
APHL  Association of Public Health Laboratories
CaliciNet  National Electronic Norovirus Outbreak Network (CDC)
CDC  Centers for Disease Control and Prevention
CI  Confidence interval
CIFOR  Council to Improve Foodborne Outbreak Response
CFSAN  Center for Food Safety and Applied Nutrition (FDA)
CORE  Coordinated Outbreak Response and Evaluation Network (FDA)
CSTE  Council of State and Territorial Epidemiologists
DHHS  Department of Health and Human Services
DPDx  Laboratory Identification of Parasites of Public Health Concern (CDC)
EHS-Net  Environmental Health Specialists Network (CDC)
ELC  Epidemiology and Laboratory Capacity for Infectious Diseases (CDC)
Epi-X  Epidemic Information Exchange (CDC)
FBI  Federal Bureau of Investigation
FDA  U.S. Food and Drug Administration
FDOSS  Foodborne Disease Outbreak Surveillance System (CDC)
FEMA  Federal Emergency Management Agency
FERN  Food Emergency Response Network (FDA)
FoodCore  Foodborne Diseases Centers for Outbreak Response Enhancement (CDC)
FoodNet  Foodborne Diseases Active Surveillance Network (CDC)
FOOD  Foodborne Outbreak Online Database (CDC)
FSMA  Food Safety Modernization Act
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>HACCP</td>
<td>Hazard Analysis and Critical Control Points</td>
</tr>
<tr>
<td>HUS</td>
<td>Hemolytic uremic syndrome</td>
</tr>
<tr>
<td>IAFP</td>
<td>International Association for Food Protection</td>
</tr>
<tr>
<td>ICS</td>
<td>Incident command system</td>
</tr>
<tr>
<td>MMWR</td>
<td>Morbidity, Mortality Weekly Report (CDC)</td>
</tr>
<tr>
<td>NARMS</td>
<td>National Antimicrobial Resistance Monitoring System (CDC, FDA, USDA)</td>
</tr>
<tr>
<td>NEHA</td>
<td>National Environmental Health Association</td>
</tr>
<tr>
<td>NNDS</td>
<td>National Notifiable Diseases Surveillance System (CDC)</td>
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<tr>
<td>NORS</td>
<td>National Outbreak Reporting System (CDC)</td>
</tr>
<tr>
<td>OR</td>
<td>Odds ratio</td>
</tr>
<tr>
<td>PCR</td>
<td>Polymerase chain reaction</td>
</tr>
<tr>
<td>PFGE</td>
<td>Pulsed-field gel electrophoresis</td>
</tr>
<tr>
<td>PIO</td>
<td>Public information officer</td>
</tr>
<tr>
<td>PulseNet</td>
<td>National Molecular Subtyping Network for Foodborne Disease Surveillance (CDC)</td>
</tr>
<tr>
<td>RR</td>
<td>Relative Risk</td>
</tr>
<tr>
<td>RRT</td>
<td>Rapid Response Team (FDA)</td>
</tr>
<tr>
<td>RT-PCR</td>
<td>Reverse transcription polymerase chain reaction</td>
</tr>
<tr>
<td>STEC</td>
<td>Shiga toxin-producing <em>Escherichia coli</em></td>
</tr>
<tr>
<td>USDA/FSIS</td>
<td>U.S. Department of Agriculture/Food Safety and Inspection Service</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization of the United Nations</td>
</tr>
</tbody>
</table>
**FOODBORNE ILLNESS GLOSSARY**

**2 x 2 table** - A tabular cross-classification of data such that subcategories of one characteristic are indicated horizontally (in rows) and subcategories of another characteristic are indicated vertically (in columns). Tests of association between characteristics in the columns and rows can be readily applied. Also known as contingency tables. The simplest contingency table is the fourfold or 2 x 2 table. Contingency tables may be extended to include several dimensions of classification.

<table>
<thead>
<tr>
<th></th>
<th>Ill</th>
<th>Not Ill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>Not Exposed</td>
<td>c</td>
<td>d</td>
</tr>
</tbody>
</table>

**Asymptomatic** - without symptoms.

**Attack rate** - The proportion of a well-defined population that develops illness over a limited period of time, as during an epidemic or outbreak. It is often expressed as a percentage. The difference between attack rates for those exposed and non-exposed to a particular food provides important clues in the investigation of the etiology of an acute outbreak.

**Carrier** - A person or animal that harbors a specific infectious agent, is asymptomatic, and is a potential source of infection for man or animals.

**Case** - In epidemiology, a person in the population or study group identified as having the particular disease, health disorder, or condition under investigation. A variety of criteria may be used to identify cases (e.g., individual physicians’ diagnoses, registries and notifications, abstracts of clinical records, surveys of the general population, population screening, reporting of defects such as in a dental record).

**Case-control study** – A type of observational analytic study. Enrollment into the study is based on the presence (“case”) or absence (“control”) of disease. Characteristics such as previous exposures are then compared between cases and controls.

**Case definition** – A set of criteria used for investigative purposes to decide whether a person has a particular disease or whether a person is to be included in a “case” category by specifying clinical and laboratory criteria and by specifying limitations on time, place and person. This definition may be used differently in various phases of an investigation. For example, a broad definition might be used early in an investigation to capture all possible cases, while later in the investigation, the definition might be narrowed to capture only definite cases. Often, a “possible” and “confirmed” case definition are generated, with the latter being cases with, for example, a positive laboratory test in addition to symptoms.

**Chain of custody** - A record that establishes the complete chronological disposition of an entity of concern (e.g., laboratory specimen, document).
Cluster - aggregation of cases of a disease or other health-related condition, which are closely grouped in space and time. The number of cases may or may not exceed the expected number.

Cohort study – type of observational analytic study. Enrollment in the study is based on exposure characteristics or membership in a group. Disease, death, or other health-related outcomes are then ascertained and compared.

Commercial confidential – trade secrets protected by law from public disclosure (e.g., monitoring records, customer lists, traceback information). Unlawful release of this information can result in legal punishment, including imprisonment.

Common source outbreak - outbreak that results from a group of persons being exposed to an infectious agent or toxin from a single source.

Confidence intervals (CI) - the computed interval with a given probability (e.g., 95%, that the true value of a variable such as a mean, proportion, or rate is contained within the interval). This is a measure of statistical significance; if a confidence interval includes the value 1.0, it means that there is no association between the exposure in question and the outcome.

Confirmed cases – a case that has met the case definition and with a laboratory-identified etiology.

Contact – exposure to a source of an infection, or a person so exposed.

Confirmed outbreak - clusters (see above) which are confirmed by laboratory or epidemiologic study to be caused by a common agent or among persons who have shared a common exposure.

Contact – exposure to a source of an infection, or a person so exposed.

Contaminant - an infectious agent or a chemical or physical hazard.

Contamination - the presence of an infectious, chemical, or physical agent or substances in or on water, milk, and food that has the potential to cause harm, including illness or injury.

Controls – in a case-control study, comparison group of persons without disease/illness.

Epidemic - the occurrence of more cases of disease than expected in a given area or among a specific group of people during a particular period of time.
**Epidemic curve (Epi curve)** - a histogram that shows the course of a disease outbreak or epidemic by plotting the number of cases by time of onset. Epidemic curves help characterize an outbreak and give clues about the source of the outbreak (e.g., common or point source, secondary spread, etc.)

**Epidemiology** – the study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems.

**Firm** - any individual, partnership, corporation, or association that deals in articles subject to the FD&C Act.

**Food-specific attack rate** - the food-specific attack rate table compares the illness rate among those who ingested specific foods at an event or meal to the illness rate of those who were at the event or meal but did not ingest these food items.

**Food worker** - person directly involved in producing, harvesting, processing, packaging, preparing, or storing the food under investigation.

**HACCP** (Hazard Analysis and Critical Control Point) - a prevention-based food safety system. HACCP is a system that identifies and monitors specific foodborne hazards - biological, chemical, or physical properties - that can adversely affect the safety of the food product. This hazard analysis serves as the basis for establishing critical control points (CCPs). CCPs identify those points in the process that must be controlled to assure the safety of the food. Further, critical limits are established that document the appropriate parameters that must be met at each CCP. Monitoring and verification steps are included in the system, again, to assure that potential risks are controlled. The hazard analysis, critical control points, critical limits, and monitoring and verification steps are documented in a HACCP plan.

**Host** - a person or other living organism that can be infected by an infectious agent under natural conditions.

**Hypothesis** - A supposition arrived at from observation or reflection that leads to refutable predictions. Any conjecture cast in a form that will allow it to be tested and refuted.

**Implicated food** - Food thought to be the outbreak vehicle (i.e. food thought to have made people ill, based on laboratory results and/or epidemiological evidence).

**Incubation period** - The time period between exposure to an infectious agent and the onset of signs and symptoms of disease.

**Index case** - the first case among a number of similar cases that are epidemiologically related.
**Infection** - the entry and development of multiplication of an infectious agent in the body of man or animals. Infection is not synonymous with infectious disease: the result may not be apparent or manifest. The presence of living infectious agents on exterior surfaces of the body is called "infestation" (e.g., pediculosis, scabies). The presence of living infectious agents upon articles of apparel or soiled articles is not infection, but represents contamination of such articles.

**Line List** - a table listing case names, age, sex, onset time, residence, symptoms, employment, etc., which facilitates comparisons of many characteristics for possible similarities or associations.

**Matching** - the process of making a study and comparison group comparable with respect to extraneous factors. Individual matching relies on identifying individual subjects for comparison, each resembling a study subject on the matched variables (e.g., age, gender). Studies using matching in the interview phase use matching in the statistical analysis.

**Measure of association** - a quantified relationship between exposure and disease. Commonly used measures of association are differences between means, proportions or rates, rate ratio, odds ratio, relative risk, and correlation and regression coefficients.

**Odds Ratio (OR)** – a measure of association which quantifies the relationship between an exposure and health outcome from a comparative study. The term odds is defined differently according to the situation under discussion. Using a standard 2 x 2 table, the odds ratio (cross-product ratio) is \( \frac{ad}{bc} \).

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</table>

**Onset** – the time the first clinical signs or symptoms begin to occur.

**Outbreak** – same as epidemic. Limited to localized increases in the incidence of a disease (e.g., in a village, town, or closed institution).

**Pathogen** - organism capable of causing disease (literally, causing a pathological process).
**Pesticide** - any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Pests can be insects, mice and other animals, unwanted plants (weeds), fungi, or microorganisms like bacteria and viruses. Though often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides and various other substances used to control pests. Under United States law, a pesticide is also any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant. Common pesticides include: algaecides, antifouling agents, anti-microbials, attractants, biocides, disinfectants and sanitizers, fungicides, fumigants, herbicides, insecticides, miticides, microbial pesticides, molluscicides, nematicides, oxicides, pheromones, repellents, rodenticides, defoliants, desiccants, insect growth regulators and plant growth regulators ([http://www.epa.gov/opp00001/whatis.htm](http://www.epa.gov/opp00001/whatis.htm)).

**Point source outbreak** – see common source outbreak.

**Proliferation/amplification factors** – factors that allow proliferation of the etiologic agents:
1. Allowing foods to remain at room or warm-outdoor temperature for several hours
2. Slow cooling
3. Inadequate cold-holding temperature
4. Preparing foods a half-day or more before serving
5. Prolonged cold storage for several weeks
6. Prolonged time and/or insufficient temperature during hot holding
7. Insufficient acidification
8. Insufficiently low water activity
9. Inadequate thawing of frozen products
10. Anaerobic packaging or modified atmosphere
11. Inadequate fermentation

**Probable Cause** – a case without laboratory confirmation that has typical clinical features of the particular disease under investigation without laboratory confirmation.

**p-value** – a measure of the chance the observed results would occur if the null hypothesis were true. The probability associated with a statistical hypothesis will help decide if there is a significant association between exposure and illness or if the results are due to chance (coincidence).

**Questionnaire** – a predetermined set of questions used to collect data (e.g., demographics, clinical data, social status, occupational group).

**Rate** – an expression of the frequency with which an event occurs in a defined population.
Recall – A firm’s voluntary removal or correction of a marketed product(s), including its labeling and/or promotional materials, that FDA or FSIS considers to be in violation of the laws it administers, and which the agency would initiate legal action (e.g., seizure or the full range of administrative and civil actions available to the agency). “Recall” does not include a market withdrawal or stock recovery.

Regulatory authority – Agency that regulates (permits/licenses and inspects) the substance or establishment under consideration.

Relative Risk (RR) –
1. The ratio of the risk of disease or death among the exposed to the risk among the unexposed; this usage is synonymous with risk ratio.
2. Alternatively, the ratio of the cumulative incidence rate in the exposed to the cumulative incidence rate in the unexposed (i.e., the cumulative incidence ratio).
3. The term relative risk has also been used synonymously with odds ratio. The use of the term relative risk for several different quantities arises from the fact that for “rare” disease (e.g., most cancers) all the quantities approximate one another. For common occurrences (e.g., neonatal mortality in infants under 1500g birth weight), the approximations do not hold.

Reservoir – the habitat, in which an infectious agent normally lives, grows and multiplies; reservoirs include human reservoirs, animal reservoirs, and environmental reservoirs.

Sample size determination – the mathematical process of deciding, before a study begins, how many subjects should be studied. The factors to be taken into account include the incidence or prevalence of the condition being studied, the estimated or putative relationship among the variable in the study, the power that is desired, and the allowable magnitude of type I error.

Serotype (or serovar) – a subdivision of a species or subspecies distinguishable from other strains therein on the basis of antigenic character.

Source (point of contamination) – the person, animal, object, or substance from which an infectious agent passes to a host. Source of infection should be clearly distinguished from source of contamination, such as overflow of a septic tank contaminating a water supply or an infected cook contaminating a salad.

Sporadic case – occurring irregularly and infrequently (e.g., cases of certain infectious diseases) also, a case NOT associated with a known outbreak.

Statistically significant association – statistical methods allow an estimate to be made of the probability of the observed or greater degree of association between independent and dependent variables under the null hypothesis. From this estimate, in a sample of given size, the statistical “significance” of a result can be state. Usually the level of statistical significance is stated by the p-value.
**Strength of association** – the magnitude of the measure of association (see above); for example, the size or value of the odds ratio is a measure of the strength of association between an exposure and an illness or other outcome. The larger the odds ratio, the stronger the association.

**Study design** – the procedures and methods, predetermined by an investigator, to be adhered to in conducting a research project.

**Subtype** – see serotype

**Surveillance** – the detection of health problems through the appropriate collection of data, followed by its collation, analysis, interpretation, and dissemination.

- **Active surveillance** – agencies regularly contact reporting sources to elicit reports of illnesses. An active surveillance system is likely to provide more complete illness reporting but is more labor intensive and costly to operate.

- **Passive surveillance** – agencies receive disease reports from physicians, laboratories, the public, and institutions as mandated by state law.

**Susceptible** – a person lacking sufficient resistance to a particular disease agent to prevent disease if or when exposed.

**Survival factors** - factors that allow survival or fail to inactivate the contaminant:
1. Insufficient time and/or temperature during cooking or heat processing
2. Insufficient time and/or temperature during reheating
3. Inadequate acidification
4. Insufficient thawing followed by insufficient cooking

**Suspect Cases** - persons meeting part of the case definition (see above); for example, persons with specific symptoms (and, perhaps, exposure to a food item of interest) who do not have a laboratory test confirming the cause of their illness; can also refer to persons with laboratory-confirmed illness who are not known to have the exposure of interest.

**Suspect Outbreak** – a cluster of cases linked by time or space which has not been confirmed to be caused by the same agent or item (exposure) but which have characteristics (e.g., an unusual organism or exposure) which makes it likely that the cases are linked not by chance alone.

**Suspect food** - food from the implicated meal that is a likely vehicle for the causative agent. These foods are often identified by the Food Specific Attack Rate Table.

**Symptomatic** - demonstrating clinical signs or symptoms (e.g., diarrhea, abdominal pain, fever).
**Time/temperature abuse** - Insufficient time and/or temperature during cooking or heat processing, insufficient time and/or temperature during reheating.

**Traceback** – the method used to determine the source and scope of the product/processes associated with the outbreak and document the distribution and production chain of the product that has been implicated in a foodborne illness or outbreak.

**Traceforward** - once the source of an implicated food item is established, investigators may do a "traceforward" to document the distribution of all implicated lots of food from the source. This can help epidemiologists with case finding and can be used to test hypotheses about the outbreak. Traceforwards should only be used when there is a reasonable degree of confidence that the traceback correctly identified the source of the implicated product.

**Vector** – an animate intermediary in the indirect transmission of an agent that carries the agent from a reservoir to a susceptible host.

**Vehicle (of infection transmission)** - an inanimate intermediary in the indirect transmission of an agent that carries the agent from a reservoir to a susceptible host.

**Sources for Glossary**
Procedures to Investigate Foodborne Illness, 5th edition, IAMFES.
FDA Satellite Training: Traceback of Fresh Produce and Other Commodities, June 16-17, 1999.

EPA website: [http://www.epa.gov/opp00001/whatis.htm](http://www.epa.gov/opp00001/whatis.htm)
Foodborne Illness Complaint Form

Incident/Outbreak ID#: ___________ Complainant ID #: ___________

Date Received: ___________ Receiving Agency: ___________________ Call Received By: ______________________

Name: ___________________ DOB: ___________ Gender: M F Race: W B H A Other: ___________

Phone: (Work) ___________ (Home) ___________ (Cell) ___________ (Email) ___________

Occupation(s): ___________ Previous Illness or Chronic Condition: Y N Existing Medications: Y N

Comments: __________________________________________________________________________________________

Illness Onset: Date: ___________ Time: ________ AM / PM  Illness Stopped: Date: ___________ Time: ________ AM / PM

☐ Illness Ongoing

Signs and Symptoms:

☐ Diarrhea __ Watery ___ Bloody       ☐ Headache

☐ Vomiting   ☐ Myalgia (muscle ache)       ☐ Itching (location) ___________

☐ Nausea     ☐ Dizziness                   ☐ Numbness (location) ___________

☐ Abdominal Pain ☐ Double Vision         ☐ Tingling (location) ___________

☐ Fever _____ °F   ☐ Jaundice            ☐ Rash

☐ Chills     ☐ Weakness                  ☐ Other: ___________

Diarrhea Onset: Date: ___________ Time: ________ AM / PM  Diarrhea Stopped: Date: ___________ Time: ________ AM / PM

☐ Illness Ongoing

Vomiting Onset: Date: ___________ Time: ________ AM / PM  Vomiting Stopped: Date: ___________ Time: ________ AM / PM

☐ Illness Ongoing

Clinical Data

Was a doctor or other healthcare provider visited?  Y N

Date Visited: ___________ Time: ________ AM / PM  Admitted: Y N  Length of Stay: ________ (hrs)

Healthcare Facility: ___________________ Physician Name: ___________________ Phone: ___________

Were clinical specimens taken?  Y N  ☐ Blood ☐ Stool  Diagnosis: ___________

Would you be willing to provide a stool sample?  Y N  N/A – Samples no longer available

Suspect Meal Data

Date: ___________ Location: ___________________ Suspect Meal: ___________________

Time: ________ AM / PM __________________________________________________________

Number of people in party: _____ Number of people reportedly ill: _____ Group Contact: ___________________

(Use following page for additional contacts)  (Phone): ___________________

List anything unusual about the meal (temperature, taste, color, etc.)? ________________
# Foodborne Illness Complaint Form

**Other Contacts**

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone</th>
<th>Associated Meal and/or Location</th>
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</tbody>
</table>

**Other Exposures**

Other Possible Non-food Exposures within Past 2 Weeks: (swimming pool, river, lake, etc.)

- Travel outside the US:  
  - Y  
  - N  
  Location(s): ____________

- Water consumed outside residence:  
  - Y  
  - N  
  Location(s): ____________

- Well water consumed:  
  - Y  
  - N  
  Location(s): ____________

- Exposure to recreational water:  
  - Y  
  - N  
  Location(s): ____________

Exposure to the following:

- Petting zoo
- Ill person at home or outside of home
- Ill animal
- Diapered kids or adults
- Mass gatherings
- Domestic animals or livestock
- Birds or reptiles
- Visit nursing home
- Daycare facility
- Other ____________________________

**Notes:**

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
| Day of Illness Onset: |  |  |
|-----------------------|-----------------|
| Breakfast:            | Location:       | Time: ______ AM / PM |
|                       |                 | Suspect Meal? [ ] Yes [ ] No |
| Contacts:             |                 |                          |
| Lunch:                | Location:       | Time: ______ AM / PM |
|                       |                 | Suspect Meal? [ ] Yes [ ] No |
| Contacts:             |                 |                          |
| Dinner:               | Location:       | Time: ______ AM / PM |
|                       |                 | Suspect Meal? [ ] Yes [ ] No |
| Contacts:             |                 |                          |
| Other Foods/Water:    | Location:       | Time: ______ AM / PM |
|                       |                 | Suspect Meal? [ ] Yes [ ] No |

| One Day Prior to Illness Onset: |  |  |
|---------------------------------|-----------------|
| Breakfast:                      | Location:       | Time: ______ AM / PM |
|                                  |                 | Suspect Meal? [ ] Yes [ ] No |
| Contacts:                       |                 |                          |
| Lunch:                          | Location:       | Time: ______ AM / PM |
|                                  |                 | Suspect Meal? [ ] Yes [ ] No |
| Contacts:                       |                 |                          |
| Dinner:                         | Location:       | Time: ______ AM / PM |
|                                  |                 | Suspect Meal? [ ] Yes [ ] No |
| Contacts:                       |                 |                          |
| Other Foods/Water:              | Location:       | Time: ______ AM / PM |
|                                  |                 | Suspect Meal? [ ] Yes [ ] No |

| Two Days Prior to Illness Onset: |  |  |
|----------------------------------|-----------------|
| Breakfast:                       | Location:       | Time: ______ AM / PM |
|                                  |                 | Suspect Meal? [ ] Yes [ ] No |
| Contacts:                        |                 |                          |
| Lunch:                           | Location:       | Time: ______ AM / PM |
|                                  |                 | Suspect Meal? [ ] Yes [ ] No |
| Contacts:                        |                 |                          |
| Dinner:                          | Location:       | Time: ______ AM / PM |
|                                  |                 | Suspect Meal? [ ] Yes [ ] No |
| Contacts:                        |                 |                          |
| Other Foods/Water:               | Location:       | Time: ______ AM / PM |
|                                  |                 | Suspect Meal? [ ] Yes [ ] No |