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Food-borne Outbreak Investigation

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Introduction

Food-borne illness in the United States is a major cause of personal distress, social disruption, preventable death and avoidable economic burden. The economic impact of illness is staggering since the unpleasant symptoms of even a mild case of food-borne illness may require absence from school or work. The microbiologic hazards associated with food and food preparation are receiving increasing public attention. They are causing increasing concern not only among consumers, but also among those involved in all facets of food production and distribution. While benefits of the availability of such a variety of foods are many, the potential for transmission of food-borne pathogens to large populations spread over large geographic areas also increases with modern food production and distribution.

Changing food industry practices, dietary choices of the American people and increasing global distribution of food supplies bring new challenges to providing a diet safe from pathogens. Commonly consumed food items contaminated with infectious agents place large numbers of persons at risk. In addition to the dangers inherent in the modern food distribution system, newly emerging or reemerging infectious diseases influence and complicate the occurrence of food-borne illness. Transmission of a new pathogen may be poorly understood and laboratory methods for diagnosis may be difficult or unavailable.

Definitions

Complaints by citizens of symptoms that they feel are caused by food are common. These complaints often involve only one or two related people and cannot be shown to be food-related.

- **A suspected food-borne disease outbreak** is a clustering of people (two or more unrelated persons) with onset of similar objective symptoms (for example, vomiting or diarrhea) within a 48-hour period after eating a common food or eating at a common restaurant/gathering. Most single source food borne outbreaks will meet this definition however, continuous source outbreaks or outbreaks involving diseases with long incubation periods (hepatitis A for example), do not meet this definition.
- **A probable food-borne disease outbreak** includes, in addition, a strong association (OR >1.5) between some of the food and the illness.
- **A confirmed food-borne disease outbreak** includes isolation of identical microorganisms both in the food and in clinical specimens.
- A **food-related complaint** is defined as a report by persons of symptoms which they believe are related to a food source, but which does not fit the definition of a food-borne disease outbreak. Food-related complaints either occur over more than 48 hours, involve only one person, involve only people from one household, or are characterized only by subjective symptoms (such as nausea, headache, or dizziness).
- **A Food establishment complaint** is a complaint related to food such as the sale of spoiled or adulterated food or unsanitary conditions at a restaurant. It is important to track consumer complaints and review the data periodically for clusters of illness or changes in trends of illness.

Determining the cause of the food-borne outbreak

Food poisoning results from consumption of raw, cooked or processed food and of beverage contaminated with either:

1-Toxic substance (toxin) produced by a microorganism
2-Toxin naturally occurring in the food /beverage
3-Artificial chemical compound added accidentally or intentionally
4-Pathogenic microorganisms

In evaluating an outbreak that could be the result of food poisoning:

- List the suspected foods
- List the individuals that attended and the foods that they ate or did not eat
- List the delays between food consumption and onset of symptoms (incubation period)
- List the main symptoms experienced by each individual

Inquire about food preparation (details are known by the patient if food were prepared at home). Food more likely to be contaminated are foods stored at room temperature for several hours, food cooked in large quantities and stored in large container in the refrigerator (improper cooling), inadequate cooking of meat (oozing blood in the center), and inadequate reheating of left-over food.

Confirm the etiologic diagnosis

If food poisoning is suspected, it is essential to obtain an etiologic diagnosis that will guide the preventive actions to be taken.

If possible, request that all suspect food and its original container or packages be kept. If the original container is not available, use an unused plastic bag or a clean (preferably boiled) jar. They should be placed in a paper or plastic bag and sent to the laboratory. If immediate transfer to the laboratory is impossible, the specimens should be kept in a refrigerator (not in the freezer). Some pathogens (e.g. the vegetative form of *C.perfringens*) are killed by freezing. Samples of food do not need to exceed 450 g (1 lb) or 500 ml, if liquid.

Collect also samples of vomitus and stools. If unavailable, consider obtaining samples by gastric lavage or rectal swab. These may not be well accepted by the patients.

To collect vomitus: if the patient is vomiting, get the patient to vomit in large sterile specimen container or transfer vomitus from a clean receptacle or lavatory into a sterile container. Use a clean spoon to transfer the vomitus.

To collect stools several methods can be used: Provide the patient with a stool specimen container and a disposable plastic or wooden spoon or tongue depressor. If a patient is not producing stools, a rectal swab is necessary. This can be collected by an experienced technician. If unacceptable, the patient may collect the swab him/herself. Excrement-smeared toilet paper or tissue are also acceptable. If examination is not carried out immediately, a transport medium is necessary.

In patients with acute fever, a blood sample may be useful.

Response to a suspected food-borne outbreak

<u>Public Health Response Teams</u>
When a potential outbreak situation occurs, the first person involved should ensure that all the stake-holders are informed. This would include Regional Medical Director /Administrator, other regional staff

(Epidemiologist, Disease Surveillance Specialist, Sanitarian), and the Infectious Disease Epidemiology Section.

All relevant information pertaining to the outbreak/condition will be discussed in order to determine the course of action. A decision will be made whether to activate the RRT.

Rapid Response Teams (RRT) are multidisciplinary groups of specially trained Office of Public Health (OPH) staff who can respond promptly to emergency epidemiological outbreaks/conditions. The OPH Regional Office in partnership with the Infectious Disease Epidemiology Section (IDES), supervises and directs the RRT's specific activities during an investigation or intervention.

The IDES will assign a lead epidemiologist for each investigation who will collaborate with the RRT and can outline correct protocols to follow.

The regional RRT Coordinator will coordinate the investigative tasks with the other team members and will be responsible for keeping the Regional Administrator/Medical Director informed of local activities on a daily basis.

It may not always be possible to have all three team members pulled from their regular job responsibilities and work together continually on an outbreak. Team members may not be at their home base when the investigation begins. However, there are quite a few activities that can be done away from the home base, such as designing questionnaires, making calls, faxing information and conferencing with other team members.

At the end of the investigation a member of the RRT, regional staff or IDES (to be discussed by the team), will prepare a summary report on the activities and analysis of data and interpretation of results, recommendations.

A post-exit conference with IDES staff and RRT members may be conducted (most likely via telephone conferencing) to review the investigative process and evaluate effectiveness and appropriateness of the outbreak activities.

Upon initiation of activities, the RRT members will be provided with the appropriate project code number for charging their time.

Health Unit Staff

Whereas handling a food-related complaint is the responsibility of the sanitarian, investigation of a food-borne disease outbreak is a joint effort by the sanitarian, parish health unit nurse, Regional Office, Regional RRT Coordinator and staff from the IDES. Initially, a nurse or sanitarian may be the first to hear of a food-borne outbreak. In this case, the nurse or sanitarian's first responsibility is to notify the Regional staff, RRT Coordinator and the IDES of the outbreak so that the investigation can be organized. In carrying out the investigation, the RRT team - in conjunction with the local sanitarian, will investigate the food-service establishment and ensure that continued food contamination does not occur. The local parish health unit nurse may need to assist and collaborate with the RRT team in obtaining stool and/or blood specimens from ill persons. Both the nurse and sanitarian may need to assist the RRT team and the IDES in completing questionnaires on ill and non-ill persons and assist in obtaining stool culture from foodhandlers.

Role of the State Laboratory

The Central and Regional Laboratories are state reference laboratories where hospitals and other laboratories send specimens or isolates for confirmation and serotyping. In addition to reference laboratory activities, these laboratories examine implicated food and clinical specimens (in outbreak and non-outbreak situations) to identify the organism or extraneous materials responsible for human illness.

Feces and food specimens are considered appropriate for food-borne related-illness testing. Blood is an acceptable specimen when typhoid, botulism or other relevant microorganisms are suspected. Routine cultures performed on fecal specimens include: Campylobacter; Vibrio; Salmonella; Shigella. On request: *E. Coli 0157:H7; Staph. aureus; Clostridium perfringens; Bacillus cereus.* The Central Laboratory can identify Norovirus on stool specimens. In special circumstances, the Centers for Disease Control and Prevention (CDC) in Atlanta may be utilized for laboratory assistance in conducting viral testing on fresh stool specimens.

In 1998, a Molecular Epidemiology Laboratory had been established that was capable of performing molecular subtyping of bacterial pathogens by pulsed field gel electrophoresis (PFGE). Traditionally, epidemiologic investigations of infectious disease outbreaks had relied primarily on detailed evaluation of cases and comparison of those cases with carefully selected controls. Both differences and similarities between cases and controls were used to identify factors that may have been associated with a specific illness under investigation. Laboratory isolation and identification of an etiologic agent from the suspected source provided independent confirmation of the probable source of the outbreak. When laboratory methods such as serotyping were developed to characterize bacteria below the species level, these methods were also applied to more definitively match between case isolates and isolates from suspected sources of infection.

Pulse field gel electrophoresis (PFGE) is a technique used to produce the DNA fingerprints. PFGE testing can determine how closely related bacteria are to one another by comparing their fingerprints. Identical or very similar DNA fingerprint patterns strongly suggest a close relationship, while bacteria with distinctly different patterns are not closely related.

Procedures for Stool Sample Collection and Submission

Each Regional Rapid Response Team has been provided with a laboratory RRT kit containing all necessary supplies. The Regional RRT Coordinator is responsible for maintaining inventory of supplies and requesting replacements as needed.

1. Transport Media
All State Public Health Labs provide Carey-Blair transport media for stool collection for Salmonella sp., Shigella sp. and Campylobacter sp.

2. Collection time of samples
Diagnosis of most food-borne diseases can be made more easily when etiologic agents are isolated from clinical specimens of ill persons. Encourage ill persons to submit stool specimens while they are still experiencing symptoms. Collect stool specimens prior to antibiotic treatment.

3. Methods of stool collection
Stools for bacteriology testing should be evitable on the collection kit swab to be considered adequate for testing. Stools submitted for viral testing should be at least a cupful of fresh stool (even if liquid) in a clean seal-proof container. Rectal swabs are not usually recommended; however, if it is the only available method, the swab should be inserted past the anal sphincter muscle to obtain a representative fecal sample. It is preferable to obtain a whole stool sample to make sure there is enough material for viral and bacterial isolation. The stools may be collected in a screw cap container or any container with a tight lid. Refrigerate the specimen immediately.

4. Transporting and Labeling
Each stool sample should be labeled with the patient's name, date of collection and be accompanied by the appropriate laboratory requisition slip with completed information as required. Place samples in a zip lock bag to prevent spillage or leakage during transport and place lab slips in a separate plastic bag or waterproof envelope. Place these samples in a styrofoam box, insert frozen icepacks to avoid deterioration of the specimens.

5. Shipping

It is preferable that all outbreak-related specimens be shipped as quickly as possible to the receiving lab. If specimens cannot be hand-carried to the laboratory, shipping by Greyhound bus is the next best method. Please be sure to indicate and label on the outside of the package, "NEXT BUS OUT" to ensure the specimens are sent on the most immediate scheduled trip.

Procedures for Food Sample Collection and Submission

Follow the same procedures as for stool samples except:

Collect a cup of food per organism to be tested. Refrigerate immediately.

Keep the food in a sturdy leakproof container such clean and dry plastic container. If there is more than one item in the meal, keep food samples separate. Each food sample should be accompanied by a separate food request form. Pre-numbered adhesive tags are provided at the bottom of these forms; attach tags to the appropriate sample to avoid mismatching. Place these samples in a styrofoam box with frozen icepacks. Place this box in an addressed cardboard box.

REMINDER: Key Components of Lab Collection Process

- Timeliness of specimen collection - usually during the acute phase of illness
- Specimen type - based on suspected disease
- Proper handling - temperature control and follow biohazardous procedures
- Proper labeling/packaging - be sure to include patient identifiers, submitter's identification, and abide by established protocols for packaging
- Proper modes of transportation - consider the length of time the specimen will remain viable, level/timeliness of follow-up needed and location of specimen/laboratory
- Common types of specimens used to identify agents: **viruses** - serology, stool, throat cultures; **bacteria** - stool, food, tissue cultures (CSF, wound); **parasites** - stool.

Procedures for Collection of Serum Specimens

The identification of specific antigens and/or antibodies in serum is the method of choice when the acute stage of disease is past or when the agent is difficult or dangerous to isolate. Diagnosis of viral infection using serological testing must be done using both the laboratory data and clinical observations. The laboratory can provide two types of serological analysis helpful in diagnosing acute viral infection – total antibody titers on paired serum specimens or detection of virus specific IgM class antibodies. It is important that the acute or single specimen be collected as soon as possible after onset of the illness. Timely collection, careful transport and accurate analysis of a specimen are all essential to insure clinically useful test results.

Collect one tube of blood in a red/gray serum separator blood collection tube (may need to check with the laboratory if other blood tubes are to be used), for analysis as early as possible after the onset of illness. Specimens may be submitted as **separated serum** or as **whole** blood.

Specimens submitted as whole blood must comply with the following requirements:
-- For each serological analysis requested, optimally draw 7 - 10 ml of blood into one gray/red-topped tube with serum separator. Allow the tube to completely fill during venipuncture; partially filled tubes limit the number of tests that the laboratory can perform and increases the number of redraws.
-- Allow the whole blood to clot. It is not necessary to remove the clot or separate the serum from the clot for transport to the laboratory unless there will be a delay of several days to arrive at the lab. If a delay is expected, the serum must be separated from the clot and frozen.
-- Blood should be stored at refrigerator temperature and should remain cool during transport. Blood tubes should be packed in insulated cryotube mailing containers with sufficient refrigeration packs to maintain

the integrity of the specimens. The refrigerant cold packs must not come in direct contact with the blood tubes as this may cause hemolysis.
-- Specimens submitted as serum must be spun down and separated from the cells. Serum or plasma must be received in the laboratory within 48 hours of collection. If more than 48 hours will elapse between spinning the blood and arrival at the laboratory, the plasma or serum must be decanted into fresh cryotubes for freezing. The specimen must remain frozen for both storage and shipment.
-- When submitting acute and convalescent specimens, it is better to hold the acute sera until the convalescent sera has been collected and forward both specimens to the laboratory at the same time. The acute specimen should be collected as early as possible and not later than 5 days after onset. The convalescent specimen should be collected 14 - 21 days after onset. Occasionally upon request, the acute serum may need to be sent as soon as collected if there are available methods for rapid testing on single specimens.
-- Please be sure the tube is labeled with appropriate identification, such as bar-coded labels from the bar coded-lab forms, and submit the laboratory slip with complete information requested on the form. All forms accompanying specimens should be placed in a separate water-proof bag or envelope and placed outside of the specimen container.

Submission of Clinical Specimens to the State Laboratory:

Laboratory identification of a pathogen can validate the hypothesis and allow easier implementation of control and preventive measures. Increased certainty results if the statistical association of illness is combined with the isolation of a pathogen from the ill person and the implicated food item(s). Therefore, time is of the essence when requesting and collecting clinical and food specimens. Stool specimens should be collected within 48 to 72 hours after onset of symptoms during the period of active diarrhea.

Reporting and Confidentiality

Louisiana law stipulates that all epidemiologic investigations are confidential.

TITLE 40: PUBLIC HEALTH AND SAFETY, CHAPTER 1. DIVISION OF HEALTH AND HEALTH OFFICERS, PART I. STATE DIVISION OF HEALTH, §3.1. Confidentiality of public health investigations; prohibited disclosure and discovery; civil penalties
A. All records of interviews, questionnaires, reports, statements, notes, and memoranda procured by and prepared by employees or agents of the office of public health or by any other person, agency, or organization acting jointly with that office, including public or private colleges and universities, in connection with special morbidity and mortality studies and research investigations to determine any cause or condition of health, and any documents, records, or other information produced or given to the state health officer in response to a court order issued pursuant to R.S. 40:8, hereinafter referred to as "confidential data", are confidential and shall be used solely for statistical, scientific, and medical research purposes relating to the cause or condition of health, or for the purposes of furthering an investigation pursuant to R.S. 40:8, except as otherwise provided in this Section.

The following are guidelines to be considered when discussing the investigation with media, patients, food handlers and business owners:
1. Individual patient information: Details about individual illness history, results of individual laboratory tests shall only be discussed with the patient him/herself. For example do not give specific individual information on lab results to the business owner (food handler that was ill) or the party organizer (who was ill).
2. Lab test results: Individual lab test results should only be given to the individual patient from whom the samples were collected. Collective results can be divulged: for example one may say “this was a norovirus outbreak” as long as the names of the ill persons are not mentioned.
3. Food Service establishment /food preparation: When collecting the information on food preparation, the epidemiologist assures the food preparer that the specific information will be kept confidential. The purpose is to make the food preparer comfortable enough to discuss possible mistakes made during preparation without fear of reprisals. Therefore that information is to be kept confidential and will only be discussed with the business owner/food preparer to prevent future mishandling of food. While the epidemiologic investigation is confidential by law, the inspections made by the sanitarians are public documents. It is acceptable to discuss the results of the sanitary inspection.

4. Statistical results: Basic statistical numbers can be given out. For example "in this outbreak there were 20 cases", or "we carried out a case control study with 25 cases and 25 controls, the odds ratio was…"

5. Media questions: The media often obtain information from the public and expect to gain more information from the epidemiologists. Information already in the media is not confidential and can be discussed as long as the above guidelines are followed.

6. Public summary: When an outbreak has gained large media attention, it is useful to prepare an outbreak investigation summary limited to statistical results, sanitarians' inspection and common knowledge already in the media's hands.

Table 1: Incubation and symptoms of food poisoning

Agent	Incubation		Symptoms			
	common	limits	Vomit	Diarrhea	Abdo pain	Fever
Staphylococcus aureus	2-4 hrs	up 8 hrs	+++	+	±	±
Bacillus cereus	2-4 hrs	8-16 hrs	+++ +	+ +++	- ++	- -
Salmonella	18-24 hrs	6-72 hrs	±	++	+++	+
E.coli ETEC EIEC EHEC	12-48 hrs 12-48 hrs 2-3 days		± + -	++ ++ ++	++ ++ ++	- + -
Shigella	1-3 days		±	++ bld	++	++
Campylobacter jejuni	3-5 days		±	++ bld	+++	+
Vibrio parahemolyticus	12 hrs	2-48 hrs	+	++	++	+
Yersinia enterolytica	3-5 days		++	++	++	++
Clostridium botulinum	12-36 hrs	2-72 hrs	-	rare mostly neurological	+	-
Clostridium perfringens	10-12 hrs	6-24 hrs	±	+++	++	-
Norovirus	16-48 hrs		+++	++	+	±
Viral gastroenteritis	16-48 hrs		+	++	+	±

Table2 : Food type and source of contamination

Agent	Food commonly involved	Source of contamination			
		IH	Cool	Hyg	Eqp
Staph. aureus	Beef, poultry, ham, pastries	+	-	++	-
Bacillus cereus	Cooked Rice	++	+	+	-
Salmonella	Beef, raw milk, poultry, pork, ice cream,	++	+	+	+
E.coli ETEC	Salad, raw veg, cheese, water	++	+	+	+
EIEC	Salad, raw veg, cheese, water	++	+	+	+
EHEC	Beef, raw milk, water	++	+	+	+
Shigella	Salad, raw	+	-	+++	-
Campylobacter jejuni	Raw milk, poultry, water	+	+	-	-
Vibrio parahaemolyticus	Shellfish	+	++	-	-
Y enterolytica	Pork	++	+	+	+
Clos. botulinum	Vegetables, fish	+	++	-	-
Clos. perfringens	Beef, poultry				-
Norwalk					-
Viral agent					-

IH=Improper holding, Cool=Inadequate cooling, Hyg=Poor hygiene, Eqp=Contaminated equipment

List of Illnesses Attributed to Food

1. Upper gastro intestinal tract signs & symptoms, nausea & vomiting, Incubation less than 1 hour
-Mushroom: eating unknown varieties of mushrooms.
-Antimony, Cadmium, Copper, Lead: eating from newly purchased utensils, enamel-ware poorly fired, highly acidic food and beverages.
-Tin, Zinc: eating from food stored in zinc or tin containers, high acidic foods.

2. Upper gastro intestinal tract signs & symptoms, nausea & vomiting, incubation 1 to 6 hours
-*Bacillus cereus*: poorly handled food (1).
-*Staphylococcus aureus*: poorly handled food (1).
-Nitrite: cured meats, vegetables from field with excessive nitrate administration.
-Shellfish poisoning: mussels, shell, scallops

3. Upper respiratory symptoms, Incubation less than 1 hour
-Sodium hydroxide poisoning: inadequate rinsing of dishes with caustic soda
-ß hemolytic streptococcal infections: contaminated raw milk or eggs

4. Lower gastrointestinal signs & symptoms, abdominal cramps & diarrhea, incubation 6-12 hours (up to 72hrs)
-*Clostridium perfringens*: poorly handled food (1).
-*Campylobacter jejuni*: raw milk or raw meat, poorly cooked milk or meat.
-Cholera:fish, shellfish, poorly handled food (1).

-*Vibrio cholera*-like gastro-enteritis: raw fish, shellfish.
-Pathogenic *E.coli*: poorly handled food (1).
-*Salmonella*: poultry, meat, egg products, milk and dairy poorly cooked.
-*Shigella*:poorly handled food (1).
-*Vibrio parahemolyticus*: fish, shellfish poorly cooked or contamination by sea water.
-*Yersinia enterolytica*: milk poorly pasteurized or cooked.

5. Lower gastrointestinal signs & symptoms, abdominal cramps & diarrhea, incubation >72 hours
-Norwalk agent: Raw shellfish, green vegetables, pastry, poorly handled food (1).
-Viral gastro enteritis (ECHO, Coxsackie, Reo, Adeno, Rota and Polio viruses): food contaminated by carrier and poorly reheated.
-Amoebic dysentery: raw vegetables and fruits.
-Giardiasis: raw vegetables and fruits.
-Anisakiasis: Raw fish.
-Beef tape worm (teniasis): Poorly cooked beef meat.
-Pork tape worm (teniasis): Poorly cooked pork meat.
-Fish tapeworm (diphyllobothriasis): Raw fish.

6. Neurological symptoms: visual disturbances, confusion, tingling, twitching or paralysis, incubation less than 1 hour
-Mushroom poisoning by ibotenic acid group or muscarinic group.
-Organophosphorous: food accidentally contaminated by pesticide.
-Carbamate: food accidentally contaminated by pesticide.
-Neurologic shellfish poisoning: shellfish from areas with red tides.
-Puffer fish

7. Neurological symptoms: visual disturbances, confusion, tingling, twitching or paralysis, incubation 1 to 6 hours
-Chlorinated hydrocarbons: food accidentally contaminated by pesticide.
-Ciguatera: tropical fish in specific areas

8. Neurological symptoms: visual disturbances, confusion, tingling, twitching or paralysis, incubation 12 to 72 hours
-Botulism: poorly canned low acid food, improperly cured ham and fish, food held at room temperature for long time.

9. Neurological symptoms: visual disturbances, confusion, tingling, twitching or paralysis, incubation > 72 hours
-Mercury: grain treated with mercury, fish from heavily polluted area.

10. Generalized infection: fever, chills, malaise, incubation > 72 hours
-Brucellosis: raw milk and dairy products.
-Listeriosis: raw milk and dairy products.
-Typhoid: poorly handled food (1).
-*Vibrio vulnificus* septicemia: raw shellfish.
-Hepatitis A: poorly handled food (1), shellfish from contaminated areas.
-Toxoplasmosis: poorly cooked meat.
-Angiostrongyliasis: raw crab, shrimp, salad with slugs.
-Trichinosis: poorly cooked pork meat.

Clinical Classification

1. Nausea and Vomiting within 1 to 6 Hours: *Staphylococcus aureus* and *Bacillus cereus*

The short incubation period results from the action of a preformed enterotoxin. Both staphylococcal and short-incubation *B. cereus* outbreaks are illnesses of short duration, usually lasting less than 12 hours.

Staphylococcal food poisoning is characterized by vomiting (82% of cases) and diarrhea (68%); fever is relatively uncommon (16%). Staphylococcal enterotoxins are multiple serologically distinct enterotoxins (currently, A through Q, excluding F) but not all are emetic. More than 99% of enterotoxigenic staphylococci associated with food poisoning are coagulase positive

B. cereus strains can cause two types of food poisoning syndromes:
1- characterized primarily by nausea and vomiting with an incubation period of 1 to 6 hours (short-incubation "emetic" syndrome). The short-incubation syndrome, characterized by vomiting (100% of cases), abdominal cramps (100%), and, less frequently, diarrhea (33%), is caused by a toxin resistant to heat, pH and proteolysis
2- characterized primarily by abdominal cramps and diarrhea with an incubation period of 8 to 16 hours (long-incubation "diarrhea" syndrome)..

Other major etiologic considerations for nausea, vomiting and abdominal cramps within 1 Hour: This syndrome may be caused by **heavy metals** - copper, zinc, tin and cadmium. Incubation periods most often range from 5 to 15 minutes. Nausea, vomiting and abdominal cramps result from irritation of the gastric mucosa and usually resolve within 2 to 3 hours after removal of the offending agent during emesis.

Nausea, vomiting, abdominal cramps and diarrhea may occur after ingestion of **mushrooms** containing gastrointestinal irritants that are not well characterized.

2. Paresthesias within 1 Hour.

When patients have this symptom - fish poisoning, shellfish poisoning, Chinese restaurant syndrome and niacin poisoning are the major possibilities.

Histamine fish poisoning (scombroid) is characterized by symptoms resembling those of a histamine reaction. Burning of the mouth and throat, flushing, headache and dizziness are common; abdominal cramps, nausea, vomiting and diarrhea also occur in most cases (see Manual section on Food poisoning due to Fish consumption).

The Chinese restaurant syndrome is characterized by a burning sensation in the neck, chest, abdomen, or arms and by a sensation of tightness over the face and chest. Headache, flushing, diaphoresis, lacrimation, weakness, nausea, abdominal cramps and thirst frequently occur. Symptoms appear to be caused by excessive amounts of monosodium L-glutamate in foods, although other undefined substances may also play a role. The illness usually resolves within several hours.

Niacin poisoning produces a burning facial erythema within 20 minutes of ingestion, which rapidly resolves.

3. Paresthesias or other neurological symptoms within 1 to 6 Hours.

The major diagnostic considerations for this syndrome are **Paralytic Shellfish Poisoning**, **ciguatera fish poisoning** and **mushroom poisoning**..

Ciguatera is characterized by an onset of abdominal cramps, nausea, vomiting and diarrhea, preceded or followed by numbness and paresthesias of the lips, tongue and throat.

Miscellaneous Mushroom Poisoning Syndromes with Onset within 2 Hours.

At least 4 clinical syndromes may occur within 2 hours of ingestion of toxic mushrooms.
1-Species containing ibotenic acid and muscimol cause an illness that mimics acute alcoholic intoxication and is characterized by confusion, restlessness and visual disturbances followed by lethargy; symptoms resolve within 24 hours.
2-Species containing muscarine cause an illness characterized by evidence of parasympathetic hyperactivity (e.g., salivation, lacrimation, diaphoresis, blurred vision, abdominal cramps, diarrhea). Some patients experience miosis, bradycardia and bronchospasm. Symptoms usually resolve within 24 hours.
3-Species containing the toxic substances psilocybin and psilocin cause an acute psychotic reaction manifested by hallucinations and inappropriate behavior, which usually resolves within 12 hours.
4-The mushroom *Coprinus atramentarius* contains a disulfiram-like substance that can result in headache, flushing, paresthesias, nausea, vomiting and tachycardia if alcohol is consumed during the 48-hour period after ingestion.

4. Abdominal Cramps and Diarrhea within 8 to 16 Hours: *Clostridium perfringens* and *B. cereus.*

In contrast to staphylococcal food poisoning and the short-incubation *B.cereus* disease, caused by ingestion of preformed enterotoxins in food, *C. perfringens* and long-incubation *B. cereus* food poisoning are caused by toxins produced in vivo, accounting for the longer incubation period. Although nausea occurs in many patients with *C. perfringens* and long-incubation *B. cereus* food poisoning, vomiting occurs infrequently. In fact, occurrence of vomiting in more than one third of affected persons suggests that these organisms are not involved. Although these illnesses last longer than staphylococcal and short-incubation *B. cereus* food poisoning, symptoms usually resolve within 24 hours. However, in some long-incubation *B. cereus* outbreaks, the mean duration of illness can be more than 2 days and occasionally illness may last several weeks.

In ***C. perfringens*** food poisoning, the most common symptoms are diarrhea and abdominal cramps. Although nausea may occur, vomiting and fever are uncommon, occurring in less than 10% of the patients. Although five types of *C. perfringens* toxin have been described, type A is almost always the toxin causing this food poisoning syndrome. *C. perfringens* enterotoxin is heat-labile.

B. cereus strains, cause a similar long-incubation syndrome that produces diarrhea (96%) and abdominal cramps (75%), sometimes vomiting (33%), and rarely fever.

5. Abdominal Cramps and Diarrhea within 6 to 24 Hours, Followed by Hepatorenal Failure.

Species of poisonous mushrooms containing amatoxins and phallotoxins are responsible for this syndrome. The most common implicated species are *Amanita phalloides, Amanita virosa* and *Amanita verna*. The illness is typically biphasic; the abdominal cramps and diarrhea, which may be severe, usually resolve within 24 hours. The patient then remains well for 1 to 2 days before evidence of hepatic and renal failure supervenes. A mortality rate of 20% to 50% has been reported.

A similar clinical syndrome occurs after ingestion of mushrooms of the Gyromitra genus, which contain the toxic substance gyromitrin. Hemolysis, seizures, and coma can occur, but this toxin does not cause acute renal failure.

6. Fever, Abdominal Cramps, and Diarrhea within 16 to 48 Hours.

The major etiologies for this syndrome are **Salmonella, Shigella, *Campylobacter jejuni, Vibrio parahaemolyticus* and *E. coli***. Bloody diarrhea and vomiting occur in a varying proportion of patients infected with these pathogens. These illnesses usually resolve within 2 to 7 days.

C. jejuni is the most common foodborne bacterial pathogen. Salmonella is the second most common foodborne bacterial pathogen and the most common bacterial pathogen associated with foodborne outbreaks.

7. Abdominal Cramps and Watery Diarrhea within 16 to 72 Hours.

The major etiologies for this syndrome are enterotoxigenic strains of ***E. coli, V. parahaemolyticus, V. cholerae*** **non-O1** and, in Louisiana, ***V. cholerae*** **O1 and O139**; ***C. jejuni*****, Salmonella and Shigella** may also cause this syndrome. Enterotoxins synthesized in vivo are usually responsible for this syndrome.

Severe cholera manifests as a profuse, watery diarrhea accompanied by muscular cramps. With the other infections, fever and vomiting occur in a minority of cases. With the exception of cholera, which may last for 5 days and disease caused by *V. cholerae* non-O1, which may last for 2 to 12 days, these illnesses usually resolve within 72 to 96 hours.

8. Vomiting and Nonbloody Diarrhea within 24 to 48 Hours

Noroviruses are the most common etiology. The syndrome progresses to include watery, nonbloody diarrhea, abdominal pain and nausea. Vomiting is more common among children, whereas diarrhea is more likely to predominate among adults. Fever occurs in one third to one half of patients, is usually low grade and lasts for less than 24 hours. Symptoms usually resolve in 1 to 3 days. It is impossible to distinguish between norovirus and some bacterial causes of gastroenteritis, such as enterotoxigenic strains of *E. coli* (ETEC), for a single patient based on clinical course, but a few simple criteria have been used epidemiologically to assess whether norovirus was the likely cause of outbreaks. Criteria that suggest norovirus infection include:

(1) failure to detect a bacterial or parasitic pathogen in stool specimens
(2) the occurrence of vomiting in greater than 50% of patients
(3) a mean duration of illness of 12 to 60 hours and
(4) a mean incubation period of 24 to 48 hours.

9. Fever and Abdominal Cramps within 16 to 48 Hours, without Diarrhea

Yersinia enterocolitica is the usual etiology. In older children and adults, the clinical illness may be prolonged and one syndrome may closely resemble acute appendicitis; nausea and vomiting are relatively uncommon, occurring in less than 25% to 40% of the cases. Duration of the illness ranges from 24 hours to 4 weeks.

10. Bloody Diarrhea without Fever within 72 to 120 Hours

The distinctive syndrome of hemorrhagic colitis has been linked to **Shiga toxin–producing strains of *E. coli***, most often serotype O157-H7. The illness is characterized by severe abdominal cramping and diarrhea, which is initially watery but may later be grossly bloody. Patients with uncomplicated infection usually remain afebrile. The duration of uncomplicated illness ranges from 1 to 12 days. Other *E. coli* serogroups that produce Shiga toxins can also cause hemorrhagic colitis and hemolytic uremic syndrome.

11.Persistent Diarrhea within 1 to 3 Weeks

Two distinctive persistent diarrheal syndromes can be foodborne: **cyclosporiasis** and **Brainerd diarrhea**.

Cyclosporiasis emerged as a major foodborne infection in the United States in 1996, when it caused many outbreaks related to imported raspberries. In 1997 and 1999, outbreaks of cyclosporiasis were associated with fresh mesclun and fresh basil. The diarrhea is often intermittent and relapsing; is associated with anorexia, weight loss, nausea and profound fatigue; it begins after a median incubation period of 7 days.

A distinctive chronic watery diarrhea, known as **Brainerd diarrhea**, was first described in persons who had consumed raw milk. After a mean incubation period of 15 days, affected persons developed acute, watery diarrhea with marked urgency and abdominal cramping. Diarrhea persisted for a mean of 2 years. No etiologic agent was identified.

12. Nausea, Vomiting, Diarrhea and Paralysis within 18 to 36 Hours

The occurrence of acute gastrointestinal symptoms simultaneously with or just before the onset of descending weakness or paralysis strongly suggests the diagnosis of foodborne botulism. Constipation is common once the neurologic syndrome is well established, but nausea and vomiting occur at onset in 50% of the patients and diarrhea occurs in approximately 20% to 25% of the patients. The disease in older children and adults results from ingestion of preformed toxin. The syndrome of infant botulism results from ingestion of spores, with subsequent toxin production in vivo. Both illnesses last from several weeks to several months. Clinical suspicion is critical if the disease is to be correctly diagnosed.

Guillain-Barré syndrome has been associated with serologic evidence of recent infection with *C. jejuni.* In a multicenter study of 118 patients in the United States with Guillain-Barré syndrome, 36% had serologic evidence of a preceding *C. jejuni* infection. When preceding diarrheal illness is reported, it typically occurs 1 to 3 weeks before the onset of neurologic symptoms. In contrast to botulism, this syndrome is usually manifested by an ascending paralysis accompanied by sensory findings and abnormal nerve conduction velocity.

13. Systemic Illness

Some foodborne diseases manifest mainly as invasive infections in immunocompromised patients.

Listeriosis typically affects pregnant women, fetuses and persons with compromised cellular immunity, who present with fever, myalgias and primary bacteremia or meningitis. Sources are most often foods, including cold processed meats and dairy products. The incubation period is prolonged, ranging from 2 to 6 weeks and the case-fatality rate is 23%.

***Vibrio vulnificus* infections** cause fulminant myonecrosis or primary bacteremia after ingestion of raw oysters. This severe syndrome is seen almost exclusively in patients with underlying liver disease, especially if associated with iron-overload states.

Other infectious diseases causing systemic illnesses include **group A β-hemolytic streptococci** (most commonly in potato and egg salads), **typhoid fever** (shellfish), **brucellosis** (goat's milk cheese), **anthrax** (meat), **tuberculosis** (milk), **Q fever** (milk), **hepatitis A** (shellfish, fresh produce), **trichinosis** (pork), **toxoplasmosis** (beef), **anisakiasis** (fish), and **tapeworms** (beef, pork, and fish).

14. Postinfection Syndromes.

Reactive arthritis (Reiter's syndrome) may develop after infection with Salmonella, Yersinia, Campylobacter, or Shigella, as well as after nonfoodborne infections such nongonococcal urethritis and Cyclospora infection.

Reiter's syndrome consists of the classic triad of aseptic inflammatory polyarthritis, urethritis and conjunctivitis, although not all components occur in all patients.

Completion of Food-borne Case History Forms:

A food-borne case history form (see below) is a tool that is essential to any food-borne disease outbreak investigation. It is not possible to have a standard form that would apply to all food-borne disease outbreaks. However the IDES has prepared a generic case history form that can easily be adapted to a particular outbreak (call for information). Prior to officially investigating all individuals involved in the outbreak, the IDES and the RRT team coordinator will collaborate to prepare a special questionnaire or make modifications to existing questionnaires. Nonetheless, all food-borne disease outbreak questionnaires follow the same general principles. Below are guidelines for how these questionnaires are written and used:

-- Demographic information is addressed in the first section, followed by exposure information and finally the disease history. This format will help with collecting exposure data in the same manner on cases and non-cases, independent as much as possible of disease status. It will also be easier to enter data information on non-cases in the computer program, since the disease information will not be applicable.

-- A section containing food items from the meal(s) in question with blank spaces is listed next. It is important for the investigator to remember to enter the complete menu in the blanks before making bulk number of copies that are necessary. Line listing food items will avoid open-ended questions such as what did you eat? (Open-ended questions may well result in incomplete information being obtained, especially if the individual being questioned forgets some of the food items served or if the individual is a child.)

-- There are three columns in the food history section for answers YES, NO, NOT SURE. When only YES and NO are allowed, it frequently results in blank entries that are difficult to handle in the analysis (it is always unclear whether the blank entries mean no, not sure, or data not collected).

-- The section containing a list of possible symptoms should follow the food history section. Once the investigator is able to develop a case definition, he/she will need specific symptoms, well defined, with YES –NO - NOT SURE answers for the same reasons as in the above.

-- Since diarrhea is the symptom used most often in establishing a case definition, there is a need to specify a standard definition for diarrhea. For the purpose of disease outbreak investigations, diarrhea shall be defined as three or more loose stools per day. Standardizing the definition for diarrhea should eliminate individual interpretations which result in conflicting information.

If the number of cases and non-cases are relatively small, it is essential to collect information contained on the food history questionnaire on all cases and all non-cases, if at all possible. If not, a way to draw a random sample of the non-cases to serve as controls will have to be designed by the IDES and should be discussed with that section early in the investigative process, before data are collected.

Depending on the suspected illness, the characteristics of the patients and the circumstances of the outbreak, other optional information might be necessary:

- date of birth
- place of employment, work phone numbers
- names/ages/disease status of household contacts (secondary cases/daycare/school)
- underlying conditions, medications
-travel history
- treatment: drug/dosage/duration
- places and times of exposure, if multiple

The epidemiologic investigation should also include information on both environmental and laboratory investigations. While each part of a food-borne investigation compliments the other, team work and ongoing communication is of utmost importance.

Investigation of an outbreak is a team effort where each member has an essential role to perform. The team may include a number of individuals at the local level (public health nurse, sanitarian, laboratory and disease investigator) as well as the Regional RRT team. It is important to remember that the RRT team and the Infectious Disease Epidemiology Section are available for guidance and assistance throughout each step of the investigation.

Analysis of Food-borne Case History Forms:
In general, the IDES will be assisting the RRT Teams in analyzing the Food-borne Case History Forms to identify the specific food item that caused the outbreak.

OPH-EPI-27 FOOD-BORNE CASE HISTORY FORM							Record No.
Name (Last First)				Age Yr Mo			Sex M F
Address				City			ZIP
Phone			Occupation				Grade
Did you attend the event/meal? Yes No Not Sure							
Date of the suspected meal / / 200				Time: : am pm			
Did you bring left over? Yes No Not sure				Date eaten / /200			Time: : am pm
Did you eat the following food?				Yes	No	Not sure	Remark
Which of the following symptoms did you have?							
Diarrhea	Yes	No	Not sure	# stools/day:	Duration days		
Fever	Yes	No	Not sure	Temperature			
Blood/stools	Yes	No	Not sure	Abdominal cramps	Yes	No	Not sure
Nausea	Yes	No	Not sure	Vomiting	Yes	No	Not sure
Headache	Yes	No	Not sure		Yes	No	Not sure
	Yes	No	Not sure		Yes	No	Not sure
	Yes	No	Not sure		Yes	No	Not sure
When did symptoms started / / 200				Time: : am pm			
How long did symptoms last? hours days							
Did you consult a physician? Yes No				Physician's Name			
Were you hospitalized? Yes No				Hospital name			
Did you suffer any complications? Yes No							
Was a stool specimen submitted? Yes No							
Comments							
Person completing form				Date			

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