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Diagnosis and Management of Foodborne Illnesses

A Primer for Physicians and Other Health Care Professionals

DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION

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Disclosure of Relationship

Elaine F. Brainerd, R.N., M.A., has indicated that she has a financial relationship with CDC because she is the Director of a Food Safe Schools project that is funded under a cooperative agreement by CDC. The remaining preparers have signed a conflict of interest disclosure form that verifies no conflict of interest.

Diagnosis and Management of Foodborne Illnesses

A Primer for Physicians and Other Health Care Professionals

Produced collaboratively by the
American Medical Association
American Nurses Association–American Nurses Foundation
Centers for Disease Control and Prevention
Center for Food Safety and Applied Nutrition, Food and Drug Administration
Food Safety and Inspection Service, US Department of Agriculture

Preface

Foodborne illness is a serious public health problem. CDC estimates that each year 76 million people get sick, more than 300,000 are hospitalized, and 5,000 die as a result of foodborne illnesses. Primarily the very young, the elderly, and the immunocompromised are affected. Recent changes in human demographics and food preferences, changes in food production and distribution systems, microbial adaptation, and lack of support for public health resources and infrastructure have led to the emergence of novel as well as traditional foodborne diseases. With increasing travel and trade opportunities, it is not surprising that now there is a greater risk of contracting and spreading a foodborne illness locally, regionally, and even globally.

Physicians and other health care professionals have a critical role in the prevention and control of food-related disease outbreaks. This primer is intended to provide practical and concise information on the diagnosis, treatment, and reporting of foodborne illnesses. It was developed collaboratively by the American Medical Association, the American Nurses Association-American Nurse Foundation, CDC, the Food and Drug Administration's Center for Food Safety and Nutrition, and the United States Department of Agriculture's Food Safety and Inspection Service.

Clinicians are encouraged to review the primer and participate in the attached continuing medical education (CME) program.

Background

This primer is directed to primary care and emergency physicians, who are likely to see the index case of a potential food-related disease outbreak. It is also a teaching tool to update physicians and other health care professionals about foodborne illness and remind them of their important role in recognizing suspicious symptoms, disease clusters, and etiologic agents, and reporting cases of foodborne illness to public health authorities.

Specifically, this guide urges physicians and other health care professionals to

- Recognize the potential for a foodborne etiology in a patient's illness;
- Realize that many but not all cases of foodborne illness have gastrointestinal tract symptoms;
- Obtain stool cultures in appropriate settings, and recognize that testing for some specific pathogens, eg, *E. coli* O157:H7, *Vibrio* spp., must be requested;
- Report suspect cases to appropriate public health officials;
- Talk with patients about ways to prevent food-related diseases; and
- Appreciate that any patient with foodborne illness may represent the sentinel case of a more widespread outbreak.

Foodborne illness is considered to be any illness that is related to food ingestion; gastrointestinal tract symptoms are the most common clinical manifestations of foodborne illnesses. This document provides detailed summary tables and charts, references, and resources for health care professionals. Patient scenarios and clinical vignettes are included for self-evaluation and to reinforce information presented in this primer. Also included is a CME component.

This primer is not a clinical guideline or definitive resource for the diagnosis and treatment of foodborne illness. Safe food handling practices and technologies (eg, irradiation, food processing and storage) also are not addressed. More detailed information on these topics is available in the references and resources listed in this document, as well as from medical specialists and medical specialty societies, state and local public health authorities, and federal government agencies.

An earlier edition of this Primer, covering different foodborne illnesses, was published in *MMWR* in 2001 (MMWR 2001;50[No. RR-2]) and also as a separate publication by the American Medical Association, CDC, the Food and Drug Administration, and the U.S. Department of Agriculture. This report updates and supplements the previous edition. It is being reprinted here as a courtesy to the collaborating agencies and the MMWR readers.

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Centers for Disease Control and Prevention
http://www.cdc.gov/foodsafety/cme.htm
Center for Food Safety and Applied Nutrition, Food and Drug Administration
http://www.cfsan.fda.gov
Food Safety and Inspection Service, US Department of Agriculture
http://www.fsis.usda.gov

Clinical Considerations

Food-related disease threats are numerous and varied, involving biological and nonbiological agents. Foodborne illnesses can be caused by microorganisms and their toxins, marine organisms and their toxins, fungi and their related toxins, and chemical contaminants. During the last 20 years, some foods that have been linked to outbreaks include milk (*Campylobacter*); shellfish (noroviruses); unpasteurized apple cider (*Escherichia coli* O157:H7), raw and undercooked eggs (*Salmonella*); fish (ciguatera poisoning); raspberries (*Cyclospora*); strawberries (hepatitis A virus); and ready-to-eat meats (*Listeria*).

While physicians and other health care professionals have a critical role in surveillance for and prevention of potential disease outbreaks, only a fraction of the people who experience gastrointestinal tract symptoms from foodborne illness seek medical care. In those who do seek care and submit specimens, bacteria are more likely than other pathogens to be identified as causative agents. Bacterial agents most often identified in patients with foodborne illness in the United States are *Campylobacter*, *Salmonella*, and *Shigella* species, with substantial variation occurring by geographic area and season. Testing for viral etiologies of diarrheal disease is rarely done in clinical practice, but viruses are considered the most common cause of foodborne illness.

This section and the accompanying Foodborne Illnesses Tables summarize diagnostic features and laboratory testing for bacterial, viral, parasitic, and noninfectious causes of foodborne illness. For more specific guidance, consult an appropriate medical specialist or medical specialty society, as well as the various resources listed in this primer. Also refer to this section and the accompanying Foodborne Illnesses Tables when working through the various Patient Scenarios and the Clinical Vignettes portion of this primer.

Recognizing Foodborne Illness

Patients with foodborne illnesses typically present with gastrointestional tract symptoms (eg, vomiting, diarrhea, abdominal pain); however, nonspecific symptoms and neurologic symptoms may also occur. Every outbreak begins with an index patient who may not be severely ill. A physician or health care professional who encounters this person may be the only one with the opportunity to make an early and expeditious diagnosis. Thus, the physician or health care professional must have a high degree of suspicion and ask appropriate questions to recognize that an illness may have a foodborne etiology.

Important clues to determining the etiology of a foodborne disease are the

- Incubation period;
- Duration of the resultant illness;
- Predominant clinical symptoms; and
- Population involved in the outbreak.

Additional clues may be derived by asking whether the patient has consumed raw or poorly cooked foods (eg, raw or undercooked eggs, meats, shellfish, fish), unpasteurized milk or juices, home-canned goods, fresh produce, or soft cheeses made from unpasteurized milk. Inquire as to whether any of the patient's family members or close friends have similar symptoms. Inquiries about living on or visiting a farm, pet contact, day care attendance, occupation, foreign travel, travel to coastal areas, camping excursions to mountains or other areas where untreated water is consumed, and attendance at group picnics or similar outings also may provide clues for determining the etiology of the illness.

If a foodborne illness is suspected, submit appropriate specimens for laboratory testing and contact the state or local health department for advice about epidemiologic investigation. For the physician or other health care professional, implication of a specific source in disease transmission is difficult from a single patient encounter. Attempts to identify the source of the outbreak are best left to public health authorities.

Because infectious diarrhea can be contagious and is easily spread, rapid and definitive identification of an etiologic agent may help control a disease outbreak. Early identification of a case of foodborne illness can prevent further exposures. An individual physician who obtains testing can contribute the clue that ultimately leads to identification of the source of an outbreak.

Finally, health care professionals should recognize that while deliberate contamination of food is a rare event, it has been documented in the past. The following events may suggest that intentional contamination has occurred: an unusual agent or pathogen in a common food, a common agent or pathogen affecting an unusually large number of people, or a common agent or pathogen that is uncommonly seen in clinical practice, as might occur with pesticide poisoning.

Diagnosing Foodborne Illnesses

Differential Diagnosis

As shown in Table 1 and the Foodborne Illnesses Tables, a variety of infectious and noninfectious agents should be considered in patients suspected of having a foodborne illness. Establishing a diagnosis can be difficult, however, particularly in patients with persistent or chronic diarrhea, those with severe abdominal pain, and when there is an underlying dis-

TABLE 1. Etiologic agents to consider for various manifestations of foodborne illness

Clinical presentation	Potential food-related agents to consider
Gastroenteritis (vomiting as primary symptom; fever and/or diarrhea also may be present)	Viral gastroenteritis, most commonly rotavirus in an infant or norovirus and other caliciviruses in an older child or adult; or food poisoning due to preformed toxins (eg, vomitoxin, *Staphylococcus aureus* toxin, *Bacillus cereus* toxin) and heavy metals.
Noninflammatory diarrhea (acute watery diarrhea without fever/dysentery; some patients may present with fever)*	Can be caused by virtually all enteric pathogens (bacterial, viral, parasitic) but is a classic symptom of Enterotoxigenic *Escherichia coli* *Giardia* *Vibrio cholerae* Enteric viruses (astroviruses, noroviruses and other caliciviruses, enteric adenovirus, rotavirus) *Cryptosporidium* *Cyclospora cayetanensis*
Inflammatory diarrhea (invasive gastroenteritis; grossly bloody stool and fever may be present)†	*Shigella* species *Campylobacter* species *Salmonella* species Enteroinvasive *E. coli* Enterohemorrhagic *E. coli* *E. coli* O157:H7 *Vibrio parahaemolyticus* *Yersinia enterocolitica* *Entamoeba histolytica*
Persistent diarrhea (lasting ≥14 days)	Prolonged illness should prompt examination for parasites, particularly in travelers to mountainous or other areas where untreated water is consumed. Consider *Cyclospora cayetanensis, Cryptosporidium, Entamoeba histolytica,* and *Giardia lamblia*.
Neurologic manifestations (eg, paresthesias, respiratory depression, bronchospasm, cranial nerve palsies)	Botulism (*Clostridium botulinum* toxin) Organophosphate pesticides Thallium poisoning Scombroid fish poisoning (histamine, saurine) Ciguatera fish poisoning (ciguatoxin) Tetradon fish poisoning (tetradotoxin) Neurotoxic shellfish poisoning (brevitoxin) Paralytic shellfish poisoning (saxitoxin) Amnesic shellfish poisoning (domoic acid) Mushroom poisoning Guillain-Barré syndrome (associated with infectious diarrhea due to *Campylobacter jejuni*)
Systemic illness (eg, fever, weakness, arthritis, jaundice)	*Listeria monocytogenes* *Brucella* species *Trichinella spiralis* *Toxoplasma gondii* *Vibrio vulnificus* Hepatitis A and E viruses *Salmonella* Typhi and *Salmonella* Paratyphi Amebic liver abscess

* Noninflammatory diarrhea is characterized by mucosal hypersecretion or decreased absorption without mucosal destruction and generally involves the small intestine. Some affected patients may be dehydrated because of severe watery diarrhea and may appear seriously ill. This is more common in the young and the elderly. Most patients experience minimal dehydration and appear mildly ill with scant physical findings. Illness typically occurs with abrupt onset and brief duration. Fever and systemic symptoms usually are absent (except for symptoms related directly to intestinal fluid loss).

† Inflammatory diarrhea is characterized by mucosal invasion with resulting inflammation and is caused by invasive or cytotoxigenic microbial pathogens. The diarrheal illness usually involves the large intestine and may be associated with fever, abdominal pain and tenderness, headache, nausea, vomiting, malaise, and myalgia. Stools may be bloody and may contain many fecal leukocytes.

ease process. The extent of diagnostic evaluation depends on the clinical picture, the differential diagnosis considered, and clinical judgment.

The presentation of a patient with a foodborne illness is often only slightly different from that of a patient who presents with a viral syndrome. In addition, viral syndromes are so common that it is reasonable to assume that a percentage of those diagnosed with a viral syndrome have actually contracted a foodborne illness. Therefore, the viral syndrome must be excluded in order to suspect the foodborne illness and take appropriate public health action. Fever, diarrhea, and abdominal cramps can be present or absent in both cases so they are not very helpful. The absence of myalgias or arthralgias would make a viral syndrome less likely and a foodborne illness (that does not target the neurologic system) more likely. Foodborne illnesses that do target the neurologic system tend to cause paraesthesias, weakness and paralysis that are distinguishable from myalgias or arthralgias (see below). The presence of dysentery (bloody diarrhea) is also more indicative of a foodborne illness, particularly if it is early in the course.

If any of the following signs and symptoms occur in patients, either alone or in combination, laboratory testing may provide important diagnostic clues (particular attention should be given to very young and elderly patients and to immunocompromised patients, all of whom are more vulnerable):

- Bloody diarrhea
- Weight loss
- Diarrhea leading to dehydration
- Fever
- Prolonged diarrhea (3 or more unformed stools per day, persisting several days)
- Neurologic involvement, such as paresthesias, motor weakness, cranial nerve palsies
- Sudden onset of nausea, vomiting, diarrhea
- Severe abdominal pain

In addition to foodborne causes, a differential diagnosis of gastrointestinal tract disease should include underlying medical conditions such as irritable bowel syndrome; inflammatory bowel diseases such as Crohn's disease or ulcerative colitis; malignancy; medication use (including antibiotic-related *Clostridium difficile* toxin colitis); gastrointestinal tract surgery or radiation; malabsorption syndromes; immune deficiencies; and numerous other structural, functional, and metabolic etiologies. Consideration also should be given to exogenous factors such as the association of the illness with travel, occupation, emotional stress, sexual habits, exposure to other ill persons, recent hospitalization, child care center attendance, and nursing home residence.

The differential diagnosis of patients presenting with neurologic symptoms due to a foodborne illness is also complex. Possible food-related causes to consider include recent ingestion of contaminated seafood, mushroom poisoning, and chemical poisoning. Because the ingestion of certain toxins (eg, botulinum toxin, tetrodotoxin) and chemicals (eg, organophosphates) can be life-threatening, a differential diagnosis must be made quickly with concern for aggressive therapy and life support measures (eg, respiratory support, administration of antitoxin or atropine), and possible hospital admission.

Clinical Microbiology Testing

When submitting specimens for microbiologic testing, it is important to realize that clinical microbiology laboratories differ in protocols used for the detection of pathogens. To optimize recovery of an etiologic agent, physicians and other health care professionals should understand routine specimen-collection and testing procedures as well as circumstances and procedures for making special test requests. Some complex tests (eg, toxin testing, serotyping, molecular techniques) may only be available from large commercial or public health laboratories. Contact your microbiology laboratory for more information.

Stool cultures are indicated if the patient is immunocompromised, febrile, has bloody diarrhea, has severe abdominal pain, or if the illness is clinically severe or persistent. Stool cultures are also recommended if many fecal leukocytes are present. This indicates diffuse colonic inflammation and is suggestive of invasive bacterial pathogens such as *Shigella*, *Salmonella*, and *Campylobacter* species and invasive *E. coli*. In most laboratories, routine stool cultures are limited to screening for *Salmonella* and *Shigella* species and *Campylobacter jejuni/coli*. Cultures for *Vibrio* and *Yersinia* species, *E. coli* O157:H7, and *Campylobacter* species other than *jejuni/coli* require additional media or incubation conditions and therefore require advance notification or communication with laboratory and infectious disease personnel.

Stool examination for parasites generally is indicated for patients with suggestive travel histories, who are immunocompromised, who suffer chronic or persistent diarrhea, or when the diarrheal illness is unresponsive to appropriate antimicrobial therapy. Stool examination for parasites is also indicated for gastrointestinal tract illnesses that appear to have a long incubation period. Requests for ova and parasite examination of a stool specimen will often enable identification of *Giardia lamblia* and *Entamoeba histolytica*, but a special request may be needed for detection of *Cryptosporidium* and *Cyclospora cayetanensis*. Each laboratory may vary in its rou-

tine procedures for detecting parasites, so it is important to contact your laboratory.

Blood cultures should be obtained when bacteremia or systemic infection is suspected.

Direct antigen detection tests and molecular biology techniques are available for rapid identification of certain bacterial, viral, and parasitic agents in clinical specimens. In some circumstances, microbiologic and chemical laboratory testing of vomitus or implicated food items also is warranted. For more information on laboratory procedures for the detection of foodborne pathogens, consult an appropriate medical specialist, clinical microbiologist, or state public health laboratory.

Treating Foodborne Illness

Selection of appropriate treatment depends on identification of the responsible pathogen (if possible) and determining if specific therapy is available. Many episodes of acute gastroenteritis are self-limiting and require fluid replacement and supportive care. Oral rehydration is indicated for patients who are mildly to moderately dehydrated; intravenous therapy may be required for more severe dehydration. Routine use of antidiarrheal agents is not recommended because many of these agents have potentially serious adverse effects in infants and young children.

Choice of antimicrobial therapy should be based on

- Clinical signs and symptoms;
- Organism detected in clinical specimens;
- Antimicrobial susceptibility tests; and
- Appropriateness of treating with an antibiotic (some enteric bacterial infections are best not treated).

Knowledge of the infectious agent and its antimicrobial susceptibility pattern allows the physician to initiate, change, or discontinue antimicrobial therapy. Such information also can support public health surveillance of infectious disease and antimicrobial resistance trends in the community. Antimicrobial resistance has increased for some enteric pathogens, which dictates judicious use of this therapy.

Suspected cases of botulism are treated with botulinum antitoxin. Equine botulinum antitoxin for types A, B, and E can prevent the progression of neurologic dysfunction if administered early in the course of illness. Physicians and other health care professionals should notify their local and state health departments regarding suspected cases of botulism. CDC maintains a 24-hour consultation service to assist health care professionals with the diagnosis and management of this rare disease.

Surveillance and Reporting of Foodborne Illness

Reporting of foodborne illnesses in the United States began more than 50 years ago when state health officers, concerned about the high morbidity and mortality caused by typhoid fever and infantile diarrhea, recommended that cases of "enteric fever" be investigated and reported. The intent of investigating and reporting these cases was to obtain information about the role of food, milk, and water in outbreaks of gastrointestinal tract illness as the basis for public health actions. These early reporting efforts led to the enactment of important public health measures (eg, the Pasteurized Milk Ordinance) that profoundly decreased the incidence of foodborne illnesses.

Often health care professionals may suspect foodborne illness either because of the organism involved or because of other available information, such as several ill patients who have eaten the same food. Health care professionals can serve as the eyes and ears for the health department by providing such information to local or state public health authorities. Foodborne disease reporting is not only important for disease prevention and control, but more accurate assessments of the burden of foodborne illness in the community occur when physicians and other health care professionals report foodborne illnesses to the local and state health department. In addition, reporting of cases of foodborne illness by practicing physicians to the local health department may help the health officer identify a foodborne disease outbreak in the community. This may lead to early identification and removal of contaminated products from the commercial market. If a restaurant or other food service establishment is identified as the source of the outbreak, health officers will work to correct inadequate food preparation practices, if necessary. If the home is the likely source of the contamination, health officers can institute public education about proper food handling practices. Occasionally, reporting may lead to the identification of a previously unrecognized agent of foodborne illness. Reporting also may lead to identification and appropriate management of human carriers of known foodborne pathogens, especially those with high-risk occupations for disease transmission such as foodworkers.

Table 2 lists current reporting requirements for foodborne diseases and conditions in the United States. National reporting requirements are determined collaboratively by the Council of State and Territorial Epidemiologists and CDC. Additional reporting requirements may also be mandated by state and territorial laws and regulations. Details on specific state reporting requirements are available from state health depart-

TABLE 2. Foodborne diseases and conditions designated as notifiable at the national level* — United States 2003

Notifiable BACTERIAL foodborne diseases and conditions
- Anthrax
- Botulism
- Brucellosis
- Cholera
- Enterohemorrhagic *Escherichia coli*
- Hemolytic uremic syndrome, post-diarrheal
- Listeriosis
- Salmonellosis (other than *S.* Typhi)
- Shigellosis
- Typhoid fever (*S.* Typhi and *S.* Paratyphi infections)

Notifiable VIRAL foodborne diseases and conditions
- Hepatitis A

Notifiable PARASITIC foodborne diseases and conditions
- Cryptosporidiosis
- Cyclosporiasis
- Giardiasis
- Trichinellosis

In the United States, additional reporting requirements may be mandated by state and territorial laws and regulations. Details on specific state reporting requirements are available from state health departments and from the

Council of State and Territorial Epidemiologists (phone number: 770-458-3811). Information available electronically at: www.cste.org/nndss/reportingrequirements.htm.

Centers for Disease Control and Prevention. Information available electronically at www.cdc.gov/epo/dphsi/phs/infdis2003.htm.

ments and from the Council of State and Territorial Epidemiologists and CDC.

Typically, the appropriate procedure for health care professionals to follow in reporting foodborne illnesses is to contact the local or state health department whenever they identify a specific notifiable foodborne disease. However, it is often unclear if a patient has a foodborne illness prior to diagnostic tests, so health care professionals should also report potential foodborne illnesses, such as when 2 or more patients present with a similar illness that may have resulted from the ingestion of a common food. Local health departments then report the illnesses to the state health departments and determine if further investigation is warranted.

Each state health department reports foodborne illnesses to CDC. CDC compiles these data nationally and disseminates information via the weekly *Morbidity and Mortality Weekly Report* and annual summary reports. CDC assists state and local public health authorities with epidemiologic investigations and the design of interventions to prevent and control food-related outbreaks. CDC also coordinates a national network of public health laboratories, called PulseNet, which performs "molecular fingerprinting" of bacteria (by pulsed-field gel electrophoresis) to support epidemiologic investigations.

Thus, in addition to reporting cases of potential foodborne illnesses, it is important for physicians to report noticeable increases in unusual illnesses, symptom complexes, or disease patterns (even without definitive diagnosis) to public health authorities. Prompt reporting of unusual patterns of diarrheal/gastrointestinal tract illness, for example, can allow public health officials to initiate an epidemiologic investigation earlier than would be possible if the report awaited definitive etiologic diagnosis.

Finally, new information on food safety is constantly emerging. Recommendations and precautions for people at high risk are updated whenever new data about preventing foodborne illness become available. Physicians and other health care professionals need to be aware of and follow the most current information on food safety.

Foodborne Illnesses (Bacterial)

Etiology	Incubation Period	Signs and Symptoms	Duration of Illness	Associated Foods	Laboratory Testing	Treatment
Bacillus anthracis	2 days to weeks	Nausea, vomiting, malaise, bloody diarrhea, acute abdominal pain.	Weeks	Insufficiently cooked contaminated meat.	Blood.	Penicillin is first choice for naturally acquired gastrointestinal anthrax. Ciprofloxacin is second option.
Bacillus cereus (preformed enterotoxin)	1–6 hrs	Sudden onset of severe nausea and vomiting. Diarrhea may be present.	24 hrs	Improperly refrigerated cooked or fried rice, meats.	Normally a clinical diagnosis. Clinical laboratories do not routinely identify this organism. If indicated, send stool and food specimens to reference laboratory for culture and toxin identification.	Supportive care.
Bacillus cereus (diarrheal toxin)	10–16 hours	Abdominal cramps, watery diarrhea, nausea.	24–48 hours	Meats, stews, gravies, vanilla sauce.	Testing not necessary, self-limiting (consider testing food and stool for toxin in outbreaks).	Supportive care.
Brucella abortus, B. melitensis, and *B. suis*	7–21 days	Fever, chills, sweating, weakness, headache, muscle and joint pain, diarrhea, bloody stools during acute phase.	Weeks	Raw milk, goat cheese made from unpasteurized milk, contaminated meats.	Blood culture and positive serology.	*Acute:* Rifampin and doxycycline daily for ≥6 weeks. Infections with complications require combination therapy with rifampin, tetracycline, and an aminoglycoside.
Campylobacter jejuni	2–5 days	Diarrhea, cramps, fever, and vomiting; diarrhea may be bloody.	2–10 days	Raw and undercooked poultry, unpasturized milk, contaminated water.	Routine stool culture; *Campylobacter* requires special media and incubation at 42°C to grow.	Supportive care. For severe cases, antibiotics such as erythromycin and quinolones may be indicated early in the diarrheal disease. Guillain-Barré syndrome can be a sequela.
Clostridium botulinum—children and adults (preformed toxin)	12–72 hrs	Vomiting, diarrhea, blurred vision, diplopia, dysphagia, and descending muscle weakness.	Variable (from days to months). Can be complicated by respiratory failure and death.	Home-canned foods with a low acid content, improperly canned commercial foods, home-canned or fermented fish, herb-infused oils, baked potatoes in aluminium foil, cheese sauce, bottled garlic, foods held warm for extended periods of time (eg, in a warm oven).	Stool, serum, and food can be tested for toxin. Stool and food can also be cultured for the organism. These tests can be performed at some state health department laboratories and CDC.	Supportive care. Botulinum antitoxin is helpful if given early in the course of the illness. Contact the state health department. The 24-hour number for state health departments to call is (770) 488-7100.
Clostridium botulinum—infants	3–30 days	In infants <12 months, lethargy, weakness, poor feeding, constipation, hypotonia, poor head control, poor gag and sucking reflex.	Variable	Honey, home-canned vegetables and fruits, corn syrup.	Stool, serum, and food can be tested for toxin. Stool and food can also be cultured for the organism. These tests can be performed at some state health department laboratories and CDC.	Supportive care. Botulism immune globulin can be obtained from the Infant Botulism Prevention Program, Health and Human Services, California (510-540-2646). Botulinum antitoxin is generally not recommended for infants.
Clostridium perfringens toxin	8–16 hrs	Watery diarrhea, nausea, abdominal cramps; fever is rare.	24–48 hrs	Meats, poultry, gravy, dried or precooked foods, time- and/or temperature-abused food.	Stools can be tested for enterotoxin and cultured for organism. Because *Clostridium perfringens* can normally be found in stool, quantitative cultures must be done.	Supportive care. Antibiotics not indicated.
Enterohemorrhagic *E. coli* (EHEC) including *E. coli* O157:H7 and other Shiga toxin-producing *E. coli* (STEC)	1–8 days	Severe diarrhea that is often bloody, abdominal pain and vomiting. Usually, little or no fever is present. More common in children <4 years.	5–10 days	Undercooked beef especially hamburger, unpasteurized milk and juice, raw fruits and vegetables (eg. sprouts), salami (rarely), and contaminated water.	Stool culture; *E. coli* O157:H7 requires special media to grow. If *E. coli* O157:H7 is suspected, specific testing must be requested. Shiga toxin testing may be done using commercial kits; positive isolates should be forwarded to public health laboratories for confirmation and serotyping.	Supportive care, monitor renal function, hemoglobin, and platelets closely. *E. coli* O157:H7 infection is also associated with hemolytic uremic syndrome (HUS), which can cause lifelong complications. Studies indicate that antibiotics may promote the development of HUS.

Foodborne Illnesses (Bacterial) (*Continued*)

Etiology	Incubation Period	Signs and Symptoms	Duration of Illness	Associated Foods	Laboratory Testing	Treatment
Enterotoxigenic *E. coli* (ETEC)	1–3 days	Watery diarrhea, abdominal cramps, some vomiting.	3 to >7 days	Water or food contaminated with human feces.	Stool culture. ETEC requires special laboratory techniques for identification. If suspected, must request specific testing.	Supportive care. Antibiotics are rarely needed except in severe cases. Recommended antibiotics include TMP-SMX and quinolones.
Listeria monocytogenes	9–48 hrs for gastrointestinal symptoms, 2–6 weeks for invasive disease	Fever, muscle aches, and nausea or diarrhea. Pregnant women may have mild flu-like illness, and infection can lead to premature delivery or stillbirth. Elderly or immunocompromised patients may have bacteremia or meningitis.	Variable	Fresh soft cheeses, unpasteurized milk, inadequately pasteurized milk, ready-to-eat deli meats, hot dogs.	Blood or cerebrospinal fluid cultures. Asymptomatic fecal carriage occurs; therefore, stool culture usually not helpful. Antibody to listerolysin O may be helpful to identify outbreak retrospectively.	Supportive care and antibiotics; Intravenous ampicillin, penicillin, or TMP-SMX are recommended for invasive disease.
	At birth and infancy	Infants infected from mother at risk for sepsis or meningitis.				
Salmonella spp.	1–3 days	Diarrhea, fever, abdominal cramps, vomiting. *S.* Typhi and *S.* Paratyphi produce typhoid with insidious onset characterized by fever, headache, constipation, malaise, chills, and myalgia; diarrhea is uncommon, and vomiting is not usually severe.	4–7 days	Contaminated eggs, poultry, unpasteurized milk or juice, cheese, contaminated raw fruits and vegetables (alfalfa sprouts, melons). *S.* Typhi epidemics are often related to fecal contamination of water supplies or street-vended foods.	Routine stool cultures.	Supportive care. Other than for *S.* Typhi and *S.* Paratyphi, antibiotics are not indicated unless there is extra-intestinal spread, or the risk of extra-intestinal spread, of the infection. Consider ampicillin, gentamicin, TMP-SMX, or quinolones if indicated. A vaccine exists for *S.* Typhi.
Shigella spp.	24–48 hrs	Abdominal cramps, fever, and diarrhea. Stools may contain blood and mucus.	4–7 days	Food or water contaminated with human fecal material. Usually person-to-person spread, fecal–oral transmission. Ready-to-eat foods touched by infected food workers, eg, raw vegetables, salads, sandwiches.	Routine stool cultures.	Supportive care. TMP-SMX recommended in the US if organism is susceptible; nalidixic acid or other quinolones may be indicated if organism is resistant, especially in developing countries.
Staphylococcus aureus (preformed enterotoxin)	1–6 hrs	Sudden onset of severe nausea and vomiting. Abdominal cramps. Diarrhea and fever may be present.	24–48 hrs	Unrefrigerated or improperly refrigerated meats, potato and egg salads, cream pastries.	Normally a clinical diagnosis. Stool, vomitus, and food can be tested for toxin and cultured if indicated.	Supportive care.
Vibrio cholerae (toxin)	24–72 hrs	Profuse watery diarrhea and vomiting, which can lead to severe dehydration and death within hours.	3–7 days. Causes life-threatening dehydration.	Contaminated water, fish, shellfish, street-vended food typically from Latin America or Asia.	Stool culture; *Vibrio cholerae* requires special media to grow. If *V. cholerae* is suspected, must request specific testing.	Supportive care with aggressive oral and intravenous rehydration. In cases of confirmed cholera, tetracycline or doxycycline is recommended for adults, and TMP-SMX for children (<8 years).
Vibrio parahaemolyticus	2–48 hrs	Watery diarrhea, abdominal cramps, nausea, vomiting.	2–5 days	Undercooked or raw seafood, such as fish, shellfish.	Stool cultures. *Vibrio parahaemolyticus* requires special media to grow. If *V. parahaemolyticus* is suspected, must request specific testing.	Supportive care. Antibiotics are recommended in severe cases: tetracycline, doxycycline, gentamicin, and cefotaxime.
Vibrio vulnificus	1–7 days	Vomiting, diarrhea, abdominal pain, bacteremia, and wound infections. More common in the immunocompromised, or in patients with chronic liver disease (presenting with bullous skin lesions). Can be fatal in patients with liver disease and the immunocompromised.	2–8 days	Undercooked or raw shellfish, especially oysters, other contaminated seafood, and open wounds exposed to sea water.	Stool, wound, or blood cultures. *Vibrio vulnificus* requires special media to grow. If *V. vulnificus* is suspected, must request specific testing.	Supportive care and antibiotics; tetracycline, doxycycline, and ceftazidime are recommended.

Foodborne Illnesses (Bacterial) (*Continued*)

Etiology	Incubation Period	Signs and Symptoms	Duration of Illness	Associated Foods	Laboratory Testing	Treatment
Yersinia enterocolytica and *Y. pseudotuberculosis*	24–48 hrs	Appendicitis-like symptoms (diarrhea and vomiting, fever, and abdominal pain) occur primarily in older children and young adults. May have a scarlitiniform rash with *Y. pseudotuberculosis.*	1–3 weeks, usually self-limiting	Undercooked pork, unpasteurized milk, tofu, contaminated water. Infection has occurred in infants whose caregivers handled chitterlings.	Stool, vomitus, or blood culture. *Yersinia* requires special media to grow. If suspected, must request specific testing. Serology is available in research and reference laboratories.	Supportive care. If septicemia or other invasive disease occurs, antibiotic therapy with gentamicin or cefotaxime (doxycycline and ciprofloxacin also effective).

Foodborne Illnesses (Viral)

Etiology	Incubation Period	Signs and Symptoms	Duration of Illness	Associated Foods	Laboratory Testing	Treatment
Hepatitis A	28 days average (15–50 days)	Diarrhea, dark urine, jaundice, and flu-like symptoms, i.e., fever, headache, nausea, and abdominal pain.	Variable, 2 weeks – 3 months	Shellfish harvested from contaminated waters, raw produce, contaminated drinking water, uncooked foods and cooked foods that are not reheated after contact with infected food handler.	Increase in ALT, bilirubin. Positive IgM and anti-hepatitis A antibodies.	Supportive care. Prevention with immunization.
Noroviruses (and other caliciviruses)	12–48 hrs	Nausea, vomiting, abdominal cramping, diarrhea, fever, myalgia, and some headache. Diarrhea is more prevalent in adults and vomiting is more prevalent in children.	12–60 hrs	Shellfish, fecally contaminated foods, ready-to-eat foods touched by infected food workers (salads, sandwiches, ice, cookies, fruit).	Routine RT-PCR and EM on fresh unpreserved stool samples. Clinical diagnosis, negative bacterial cultures. Stool is negative for WBCs.	Supportive care such as rehydration. Good hygiene.
Rotavirus	1–3 days	Vomiting, watery diarrhea, low-grade fever. Temporary lactose intolerance may occur. Infants and children, elderly, and immunocompromised are especially vulnerable.	4–8 days	Fecally contaminated foods. Ready-to-eat foods touched by infected food workers (salads, fruits).	Identification of virus in stool via immunoassay.	Supportive care. Severe diarrhea may require fluid and electrolyte replacement.
Other viral agents (astroviruses, adenoviruses, parvoviruses)	10–70 hrs	Nausea, vomiting, diarrhea, malaise, abdominal pain, headache, fever.	2–9 days	Fecally contaminated foods. Ready-to-eat foods touched by infected food workers. Some shellfish.	Identification of the virus in early acute stool samples. Serology. Commercial ELISA kits are now available for adenoviruses and astroviruses.	Supportive care, usually mild, self-limiting. Good hygiene.

Foodborne Illnesses (Parasitic)

Etiology	Incubation Period	Signs and Symptoms	Duration of Illness	Associated Foods	Laboratory Testing	Treatment
Angiostrongylus cantonensis	1 week to ≥1 month	Severe headaches, nausea, vomiting, neck stiffness, paresthesias, hyperesthesias, seizures, and other neurologic abnormalities.	Several weeks to several months	Raw or undercooked intermediate hosts (eg, snails or slugs), infected paratenic (transport) hosts (eg, crabs, fresh water shrimp), fresh produce contaminated with intermediate or transport hosts.	Examination of CSF for elevated pressure, protein, leukocytes, and eosinophils; serologic testing using ELISA to detect antibodies to *Angiostrongylus cantonensis.*	Supportive care. Repeat lumbar punctures and use of corticosteroid therapy may be used for more severely ill patients.
Cryptosporidium	2–10 days	Diarrhea (usually watery), stomach cramps, upset stomach, slight fever.	May be remitting and relapsing over weeks to months	Any uncooked food or food contaminated by an ill food handler after cooking, drinking water.	Request specific examination of the stool for *Cryptosporidium.* May need to examine water or food.	Supportive care, self-limited. If severe consider paromomycin for 7 days. For children aged 1–11 years, consider nitazoxanide for 3 days.
Cyclospora cayetanensis	1–14 days, usually at least 1 week	Diarrhea (usually watery), loss of appetite, substantial loss of weight, stomach cramps, nausea, vomiting, fatigue.	May be remitting and relapsing over weeks to months	Various types of fresh produce (imported berries, lettuce).	Request specific examination of the stool for *Cyclospora.* May need to examine water or food.	TMP-SMX for 7 days.

Foodborne Illnesses (Parasitic) (*Continued*)

Etiology	Incubation Period	Signs and Symptoms	Duration of Illness	Associated Foods	Laboratory Testing	Treatment
Entamoeba histolytica	2–3 days to 1–4 weeks	Diarrhea (often bloody), frequent bowel movements, lower abdominal pain.	May be protracted (several weeks to several months)	Any uncooked food or food contaminated by an ill food handler after cooking, drinking water.	Examination of stool for cysts and parasites—may need at least 3 samples. Serology for long-term infections.	Metronidazole and a luminal agent (iodoquinol or paromomycin).
Giardia lamblia	1–2 weeks	Diarrhea, stomach cramps, gas.	Days to weeks	Any uncooked food or food contaminated by an ill food handler after cooking, drinking water.	Examination of stool for ova and parasites — may need at least 3 samples.	Metronidazole.
Toxoplasma gondii	5–23 days	Generally asymptomatic, 20% may develop cervical lymphadenopathy and/or a flu-like illness. In immunocompromised patients: central nervous system (CNS) disease, myocarditis, or pneumonitis is often seen.	Months	Accidental ingestion of contaminated substances (eg, soil contaminated with cat feces on fruits and vegetables), raw or partly cooked meat (especially pork, lamb, or venison).	Isolation of parasites from blood or other body fluids; observation of parasites in patient specimens via microscopy or histology. Detection of organisms is rare; serology (reference laboratory needed) can be a useful adjunct in diagnosing toxoplasmosis. However, IgM antibodies may persist for 6–18 months and thus may not necessarily indicate recent infection. PCR of bodily fluids. For congenital infection: isolation of *T. gondii* from placenta, umbilical cord, or infant blood. PCR of white blood cells, CSF, or amniotic fluid, or IgM and IgA serology, performed by a reference laboratory.	Asymptomatic healthy, but infected, persons do not require treatment. Spiramycin or pyrimethamine plus sulfadiazine may be used for pregnant women. Pyrimethamine plus sulfadiazine may be used for immunocompromised persons, in specific cases. Pyrimethamine plus sulfadiazine (with or without steroids) may be given for ocular disease when indicated. Folinic acid is given with pyrimethamine plus sulfadiazine to counteract bone marrow suppression.
Toxoplasma gondii (congenital infection)	In infants at birth	Treatment of the mother may reduce severity and/or incidence of congenital infection. Most infected infants have few symptoms at birth. Later, they will generally develop signs of congenital toxoplasmosis (mental retardation, severely impaired eyesight, cerebral palsy, seizures), unless the infection is treated.	Months	Passed from mother (who acquired acute infection during pregnancy) to child.		
Trichinella spiralis	1–2 days for initial symptoms; others begin 2–8 weeks after infection	Acute: nausea, diarrhea, vomiting, fatigue, fever, abdominal discomfort followed by muscle soreness, weakness, and occasional cardiac and neurologic complications.	Months	Raw or undercooked contaminated meat, usually pork or wild game meat (eg, bear or moose).	Positive serology or demonstration of larvae via muscle biopsy. Increase in eosinophils.	Supportive care plus mebendazole or albendazole.

Foodborne Illnesses (Noninfectious)

Etiology	Incubation Period	Signs and Symptoms	Duration of Illness	Associated Foods	Laboratory Testing	Treatment
Antimony	5 min – 8 hrs. usually <1 hr	Vomiting, metallic taste.	Usually self-limited	Metallic container.	Identification of metal in beverage or food.	Supportive care.
Arsenic	Few hrs	Vomiting, colic, diarrhea.	Several days	Contaminated food.	Urine. May cause eosinophilia.	Gastric lavage, BAL (dimercaprol).
Cadmium	5 min – 8 hrs. usually <1 hr	Nausea, vomiting, myalgia, increase in salivation, stomach pain.	Usually self-limited	Seafood, oysters, clams, lobster, grains, peanuts.	Identification of metal in food.	Supportive care.
Ciguatera fish poisoning (ciguatera toxin)	2–6 hrs 3 hrs 2–5 days	GI: abdominal pain, nausea, vomiting, diarrhea. Neurologic: paresthesias, reversal of hot or cold, pain, weakness. Cardiovascular: bradycardia, hypotension, increase in T wave abnormalities.	Days to weeks to months	A variety of large reef fish. Grouper, red snapper, amberjack, and barracuda (most common).	Radioassay for toxin in fish or a consistent history.	Supportive care, IV mannitol. Children more vulnerable.
Copper	5 min – 8 hrs. usually <1 hr	Nausea, vomiting, blue or green vomitus.	Usually self-limited	Metallic container.	Identification of metal in beverage or food.	Supportive care.
Mercury	1 week or longer	Numbness, weakness of legs, spastic paralysis, impaired vision, blindness, coma. Pregnant women and the developing fetus are especially vulnerable.	May be protracted	Fish exposed to organic mercury, grains treated with mercury fungicides.	Analysis of blood, hair.	Supportive care.
Mushroom toxins, short-acting (muscinol, muscarine, psilocybin, coprius artemetaris, ibotenic acid)	<2 hrs	Vomiting, diarrhea, confusion, visual disturbance, salivation, diaphoresis, hallucinations, disulfiram-like reaction, confusion, visual disturbance.	Self-limited	Wild mushrooms (cooking may not destroy these toxins).	Typical syndrome and mushroom identified or demonstration of the toxin.	Supportive care.
Mushroom toxin, long-acting (amanitin)	4–8 hrs diarrhea; 24–48 hrs liver failure	Diarrhea, abdominal cramps, leading to hepatic and renal failure.	Often fatal	Mushrooms.	Typical syndrome and mushroom identified and/or demonstration of the toxin.	Supportive care, life-threatening, may need life support.
Nitrite poisoning	1–2 hrs	Nausea, vomiting, cyanosis, headache, dizziness, weakness, loss of consciousness, chocolate-brown colored blood.	Usually self-limited	Cured meats, any contaminated foods, spinach exposed to excessive nitrification.	Analysis of the food, blood.	Supportive care, methylene blue.
Pesticides (organophosphates or carbamates)	Few min to few hrs	Nausea, vomiting, abdominal cramps, diarrhea, headache, nervousness, blurred vision, twitching, convulsions, salivation and meiosis.	Usually self-limited	Any contaminated food.	Analysis of the food, blood.	Atropine; 2-PAM (Pralidoxime) is used when atropine is not able to control symptoms and is rarely necessary in carbamate poisoning.
Puffer fish (tetrodotoxin)	<30 min	Parasthesias, vomiting, diarrhea, abdominal pain, ascending paralysis, respiratory failure.	Death usually in 4–6 hours	Puffer fish.	Detection of tetrodotoxin in fish.	Life-threatening, may need respiratory support.
Scombroid (histamine)	1 min – 3 hrs	Flushing, rash, burning sensation of skin, mouth and throat, dizziness, uriticaria, parasthesias.	3–6 hrs	Fish: bluefin, tuna, skipjack, mackerel, marlin, escolar, and mahi mahi.	Demonstration of histamine in food or clinical diagnosis.	Supportive care, antihistamines.

Foodborne Illnesses (Noninfectious) (*Continued*)

Etiology	Incubation Period	Signs and Symptoms	Duration of Illness	Associated Foods	Laboratory Testing	Treatment
Shellfish toxins (diarrheic, neurotoxic, amnesic)	Diarrheic shellfish poisoning (DSP) — 30 min to 2 hrs	Nausea, vomiting, diarrhea, and abdominal pain accompanied by chills, headache, and fever.	Hrs to 2–3 days	A variety of shellfish, primarily mussels, oysters, scallops, and shellfish from the Florida coast and the Gulf of Mexico.	Detection of the toxin in shellfish; high-pressure liquid chromatography.	Supportive care, generally self-limiting. Elderly are especially sensitive to ASP.
	Neurotoxic shellfish poisoning (NSP) — few min to hours	Tingling and numbness of lips, tongue, and throat, muscular aches, dizziness, reversal of the sensations of hot and cold, diarrhea, and vomiting.				
	Amnesic shellfish poisoning (ASP) — 24–48 hrs	Vomiting, diarrhea, abdominal pain and neurologic problems such as confusion, memory loss, disorientation, seizure, coma.				
Shellfish toxins (paralytic shellfish poisoning)	30 min – 3 hrs	Diarrhea, nausea, vomiting leading to parasthesias of mouth, lips, weakness, dysphasia, dysphonia, respiratory paralysis.	Days	Scallops, mussels, clams, cockles.	Detection of toxin in food or water where fish are located; high-pressure liquid chromatography.	Life-threatening, may need respiratory support.
Sodium fluoride	Few min to 2 hrs	Salty or soapy taste, numbness of mouth, vomiting, diarrhea, dilated pupils, spasms, pallor, shock, collapse.	Usually self-limited	Dry foods (eg, dry milk, flour, baking powder, cake mixes) contaminated with sodium fluoride–containing insecticides and rodenticides.	Testing of vomitus or gastric washings. Analysis of the food.	Supportive care.
Thallium	Few hrs	Nausea, vomiting, diarrhea, painful parathesias, motor polyneuropathy, hair loss.	Several days	Contaminated food.	Urine, hair.	Supportive care.
Tin	5 min – 8 hrs. usually <1 hr	Nausea, vomiting, diarrhea.	Usually self-limited	Metallic container.	Analysis of the food.	Supportive care.
Vomitoxin	Few min to 3 hrs	Nausea, headache, abdominal pain, vomiting.	Usually self-limited	Grains such as wheat, corn, barley.	Analysis of the food.	Supportive care.
Zinc	Few hrs	Stomach cramps, nausea, vomiting, diarrhea, myalgias.	Usually self-limited	Metallic container.	Analysis of the food, blood and feces, saliva or urine.	Supportive care.

Patient Scenarios

The learning scenarios in this section can be used to reinforce medical management information pertaining to foodborne illnesses, such as that provided from the previous sections of this primer. The case studies provide questions that need to be considered when dealing with a potential case of foodborne illness. Answers are provided immediately following the questions to enhance the learning process.

Similar learning scenarios are also available for other foodborne pathogens.

Congenital Toxoplasmosis, A Patient Scenario

Susan, a 6-month-old infant, is brought to your office for evaluation of apparent blindness. Her mother reports that she had been well during the pregnancy and the delivery was uncomplicated. The baby appeared healthy until age 4 months, when the parents became concerned about her vision.

Physical examination was normal except for bilateral macular scars, microphthalmos, and unresponsiveness to visual stimuli. There were no other neurologic abnormalities, and her growth and development were appropriate for her age. A computed tomography (CT) scan of the head was obtained.

Congenital infection with which of the following should be included in the differential diagnosis?

- Viruses:
  - — Cytomegalovirus
  - — Rubella
  - — Herpes simplex
  - —Human immunodeficiency virus
- Bacteria:
  - — *Treponema pallidum*
  - — *Listeria monocytogenes*
- Parasites:
  - — *Toxoplasma gondii*

What additional information would assist with the diagnosis?

- More history from the mother, including travel to foreign country
- Vaccination record, including during pregnancy
- History of exposure to cats and raw meat
- History of multiple sex partners and sexually transmitted disease (STD)
- History of herpes
- Evaluation of CT scan

The CT scan of the child's head showed periventricular calcifications and asymmetric dilation of the lateral ventricles. The mother is 35 years old and reiterated that she does not recall being ill during the pregnancy; however, she also indicated that she would not necessarily remember every little symptom. She also denied having a history of STDs. She had received the mumps-measles-rubella (MMR) vaccine as a child but no vaccines during pregnancy. The mother recalled eating insufficiently cooked meat while traveling in France during the first trimester of pregnancy. The family does not own a cat, and she does not recall having been exposed to cats during her pregnancy.

What diagnostic tests are needed?

Serologic evaluation of both mother and child focusing on potential congenital infection (ie, a ToRCH profile) based on the history of the mother ingesting raw meat while traveling in a foreign country during first trimester of pregnancy and the clinical findings (blindness, cerebral calcifications, and hydrocephalus).

Results of serologic testing detected both IgG and IgM antibodies to *Toxoplasma gondii* in both the baby's and mother's serum. The mother's IgM titer was 1:6400 and IgG titer was 1:6400, while those of the baby were IgM titer of 1:160 and IgG titer of 1:6400.

How does this information assist with the diagnosis?

Diagnosis of toxoplasmosis is usually confirmed by serologic tests. Occasionally, organisms are identified in tissue or body fluids or isolated by culture or animal inoculation. Polymerase chain reaction (PCR)-based assays are available from some laboratories for diagnosis of fetal infection and infection in compromised hosts. For immunocompetent persons, seroconversion or a 4-fold rise of specific IgG antibodies or demonstration of specific IgM antibodies indicate recent infection. High titers of IgG antibodies in the absence of IgM antibodies are consistent with chronic latent infection acquired in the past. The IgM-capture enzyme-linked immunosorbent assay (ELISA) is more sensitive than the IgM-indirect fluorescent-antibody assay (IFA) test. However, IgM tests may be false-positive, and true-positive IgM tests may persist for a year or more. Therefore, to determine if infection occurred during pregnancy, additional tests, such as an anti-*Toxoplasma* avidity test, may be required at a reference laboratory.

Immunodeficient persons usually do not have measurable IgM antibodies, even in the presence of active disease. The diagnosis of central nervous system (CNS) toxoplasmosis in such persons is therefore based on clinical picture, typical CT scan or magnetic resonance imaging (MRI) showing multiple ring-enhancing hypodense nodules, and a positive IgG test. Brain biopsy is reserved for cases that fail to respond to an empiric trial of anti-*Toxoplasma* drugs.

The baby was diagnosed with congenital toxoplasmosis.

How is toxoplasmosis best treated?

Toxoplasmosis in immunocompetent persons rarely requires treatment, whereas infection in immunodeficient persons or in infants with congenital infections usually requires treatment. The combination of pyrimethamine and sulfadiazine is the treatment of choice. Folinic acid (leucovorin) is given to prevent bone marrow suppression. Treatment must be continued for the duration of immunosuppression and for life in AIDS patients whose immunity is not reconstituted by highly aggressive antiretroviral therapy (HAART).

For persons unable to tolerate the pyrimethamine and sulfadiazine combination, high doses of pyrimethamine (and leucovorin) and clindamycin are effective.

The management of toxoplasmosis acquired during pregnancy is controversial. Testing of newly pregnant women for *T. gondii* infection is not routinely done, and routine testing is not recommended by CDC or by the American College of Obstetricians and Gynecologists. To prevent fetal infection, one approach is to administer spiramycin (a macrolide antibiotic, which is concentrated in the placenta and is not harmful to the fetus). At the same time, amniotic fluid is submitted for PCR-based testing to determine whether fetal infection has occurred. If so, options may include pyrimethamine and sulfadiazine given after the 16th week of pregnancy (since pyrimethamine is potentially teratogenic) or consideration of terminating the pregnancy. If the fetus is shown to be uninfected, spiramycin is continued throughout pregnancy.

Different protocols exist for treatment of infants born with congenital infection. The most commonly recommended treatment is pyrimethamine and sulfadiazine plus leucovorin during the first year of life. In the present case, the child was treated for 6 months with pyrimethamine and sulfadiazine plus leucovorin.

Human infection with the intracellular protozoan parasite *Toxoplasma gondii* occurs globally. Infection is usually subclinical or produces a mild illness, except in immunodeficient persons and fetuses infected in utero. Most infants with congenital toxoplasmosis appear healthy at birth but have a high incidence of developing serious ophthalmologic and neurologic sequelae during the next 20 years of life. Severe congenital toxoplasmosis may be apparent at birth or become apparent during the first 6 months of life. Chorioretinitis, intracerebral calcifications, and hydrocephalus, as in the present case, are typical features

The child was treated with pyrimethamine, sulfadiazine, and folinic acid for 6 months. She remains blind, and has developed moderate psychomotor retardation.

How could *Toxoplasma* infection have been prevented in this child?

Toxoplasma gondii may be transmitted transplacentally to the fetus if the mother acquired toxoplasmosis during pregnancy. There is almost no risk of transplacental transmission if the mother was infected prior to conception; accordingly, women with positive IgG antibody tests for toxoplasmosis at the onset of pregnancy are not at risk for developing acute toxoplasmosis. Women with negative IgG antibody tests during pregnancy should avoid eating insufficiently cooked or uncooked meat and should avoid ingestion of soil and water or food that may be contaminated with cat feces.

Transmission occurs by a) ingestion of tissue cysts in raw or insufficiently cooked meat, especially lamb, pork, and wild game; b) accidental ingestion of food, water, or soil contaminated with cat feces that contain infective oocysts; c) transplacental passage of infective tachyzoites; d) transfusion of infected white blood cells or transplantation of an infected organ; and e) laboratory accidents.

Prevention of toxoplasmosis is particularly important for uninfected (ie, seronegative) pregnant mothers, HIV-infected persons, and other immunocompromised patients:

- Avoid ingestion of raw or insufficiently cooked meat and poultry; cook meat to 160°F (71°C) or freeze to -4°F (-20°C). For more details on preventing toxoplasmosis, please see the Suggested Resources and Suggested Reading List.
- Avoid ingestion of environmental oocysts by avoiding contact with cat litter, soil, water, and vegetables potentially contaminated with cat feces.

Infection acquired by healthy persons is usually asymptomatic or may lead to painless lymphadenopathy or a mononucleosis syndrome. Maternal infection is usually unrecognized.

Disease in persons with depressed cellular immunity (eg, persons with AIDS, transplant recipients, persons receiving immunosuppressants) usually is due to reactivation of latent infection but can result from acute infection. Toxoplasmosis in these persons leads to lethal meningoencephalitis, focal lesions of the CNS, and less commonly, myocarditis or pneumonitis. The clinical picture may include headache, seizures, mental status changes, focal neurologic signs, and aseptic meningitis. Thirty to forty percent of AIDS patients with IgG antibodies to *T. gondii* (indicating chronic latent infection) develop active toxoplasmosis unless they take preventive medication.

Congenital infection occurs when a previously uninfected mother develops infection during pregnancy. Infection prior to conception, demonstrated by specific IgG antibodies, in nearly all cases guarantees against infection of the fetus. However, transplacental transmission occurs from mothers whose prior infections reactivate when they receive immunosuppressant medications or develop AIDS. Congenital toxoplasmosis may result in abortion, stillbirth, mental retardation, and retinal damage. Recurrent toxoplasmic chorioretinitis in children and young adults is frequently the result of congenital infection that was asymptomatic at birth.

Acute Hepatitis A: A Patient Scenario

While working in an emergency room, you are asked to see a 31-year-old Asian-American woman who has had fever, nausea, and fatigue for the past 24 hours. She also reports dark urine and has had 3 light colored stools since yesterday. She has previously been healthy and has no previous history of jaundice. Her physical examination shows a low-grade fever of 100.6°F/38.1°C, faint scleral icterus, and hepatomegaly. Her blood pressure and neurologic exam are normal and there is no rash. Initial laboratory studies show an alanine aminotransferase (ALT) result of 877 IU/L, aspartate amino transferase (AST) enzyme levels of 650 IU/L, an alkaline phosphatase of 58 IU/L and a total bilirubin of 3.4 mg/dL. White blood cell count is 4.6, with a normal differential; electrolytes are normal; the blood urea nitrogen level is 18 mg/dL; and serum creatinine level is 0.6 mg/dL. Pregnancy test is negative.

What should be included in the differential diagnosis of acute hepatitis?

- Viral infections:
  - — hepatitis A, B, C, D, and E
  - — varicella
  - — cytomegalovirus
  - — herpes virus
  - — Epstein-Barr virus
- Bacterial infections:
  - — typhoid fever
  - — Q fever
  - — Rocky Mountain spotted fever
  - — leptospirosis
  - — secondary syphilis
  - — sepsis
- Parasitic infections:
  - — toxocariasis
  - — liver flukes
- Drugs:
  - — acetaminophen
  - — isoniazid
  - — rifampin
  - — oral contraceptives
  - — anti-seizure medications
  - — sulfonamides
- Toxins:
  - — alcohol, carbon tetrachloride
- Autoimmune disease:
  - — autoimmune hepatitis
  - — systemic lupus erythematosus

What additional information would assist with the diagnosis?

- Has she traveled outside the United States recently?
- Does she use illicit drugs?
- Is anyone else in the household ill?
- How many sex partners has she had in the past 6 months?
- Does she have regular contact with animals?
- What medications is she taking?
- Has she ever had a transfusion?
- Does she drink alcohol?
- Does she take care of children?
- Has she ever received hepatitis B vaccination?
- Has she ever received hepatitis A vaccination?
- Did she receive immune globulin within the past 3 months?
- What is her occupation?

She has no children, and her boyfriend is not ill. She has been in a monogamous relationship with her boyfriend for 2 years. She was born in the United States; her parents immigrated to the United States from Taiwan in the 1950s. She works as a food preparer for a catering business. She returned 4 weeks ago from a 1-week vacation in Mexico (Mexico City and nearby areas), where she stayed with her boyfriend in several hotels. She drank only bottled water but ate both cooked and uncooked food at numerous restaurants while in Mexico, and she visited a family friend and her 3 young children in a Mexico City suburb.

She did not receive hepatitis A vaccine or immune globulin before going on vacation. She is not sure if she has received hepatitis B vaccine. She has not gone camping or hiking and had no recent tick exposures. She has never used illicit drugs, drinks alcohol rarely, and has never received a transfusion. She is taking oral contraceptives but no other prescription medication, and took 500 milligrams of Tylenol® once after onset of her current symptoms. She has a pet cat but no other animal exposures. She had chickenpox and mononucleosis during childhood.

How does this information assist with the diagnosis?

Lack of animal or tick exposures makes leptospirosis and Rocky Mountain spotted fever unlikely, and Q fever less likely. Yellow fever and typhoid fever are very unlikely with no history of travel to rural endemic areas, and assuming exposure occurred in Mexico, inconsistent with the long incubation period. Hepatitis A virus (HAV), hepatitis B virus (HBV), hepatitis C virus (HCV), and hepatitis E virus (HEV) infection are all possible diagnoses. A drug reaction to the oral contraceptive is a possible cause of hepatitis. The history of travel to an endemic area makes hepatitis A the most likely diagnosis.

What diagnostic tests are needed?

Specific diagnostic serologic studies are necessary to distinguish one form of viral hepatitis from another. Testing for total (IgG+ IgM) anti-HAV does not distinguish between a past history of hepatitis A virus infection and current infection and is not useful in diagnosing acute hepatitis A. Hepatitis A can be easily confirmed with an anti-IgM anti-HAV test. This test is widely available and results are usually available within 24 hours. A hepatitis panel is ordered, and results from such a panel are shown here.

You obtain the following results from the serologic testing:

- Total anti-HAV: positive
- IgM anti-HAV: positive
- Total anti-HBc: positive
- IgM anti-hepatitis B core antigen: negative
- HBsAg: negative
- anti-HBs: positive
- anti-HCV: negative

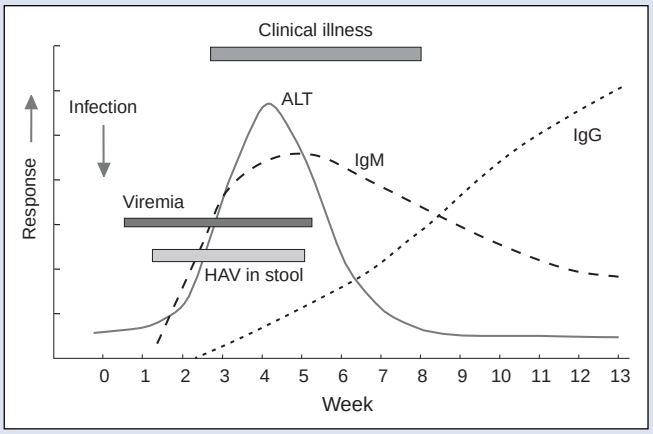
What is the diagnosis?

The diagnosis is hepatitis A. The hepatitis B serologic tests indicate past, resolved infection with no chronic infection. Acute hepatitis C is also possible; the appearance of anti-HCV may be delayed for as long as 9 months after exposure. However, with a confirmed diagnosis of hepatitis A, further testing for HCV RNA is not indicated at this point. Finally, note that hepatitis E is rarely reported in travelers, and results of serologic tests for hepatitis E virus (HEV) are difficult to interpret. Tests for HEV should only be performed if other more common causes of hepatitis have been excluded.

The incubation period for hepatitis A is 15–50 days, with an average of 28 days. The most common signs and symptoms associated with acute hepatitis A include jaundice, fever, malaise, anorexia, and abdominal discomfort. The illness can be severe and approximately 10% to 20% of reported cases require hospitalization. The likelihood of having symptoms with HAV infection is related to the person's age. In children <6 years of age, most (70%) infection is asymptomatic; if illness does occur it is not usually accompanied by jaundice. Older children and adults are more likely to have symptomatic disease, although jaundice may be absent in as many as one third of adults with HAV infection. In many developing countries in Asia, Africa, and Central and South America, infection is nearly universal during early childhood and is often asymptomatic.

What treatment is indicated?

There is no specific treatment for hepatitis A. Bed rest does not hasten recovery. Hepatitis A is never a chronic infection, although 10% to 15% of symptomatic persons have prolonged or relapsing disease lasting up to 6 months. While rarely fatal in younger persons, the case-fatality rate is nearly 2% among reported patients who are more than 50 years old. Following is a depiction of a typical course, including times of peak fecal excretion of HAV, liver function test abnormalities, and clinical symptoms.



How is hepatitis A virus transmitted, and who is at risk for this disease?

HAV is an RNA virus that only infects primates. HAV has a fecal-oral route of transmission and is easily transmitted person to person. HAV is also transmitted through contaminated food or water. Because HAV is present in the blood during acute infection, bloodborne transmission is also possible, but rare. The highest levels of HAV are found in the stool, and peak levels occur in the 2 weeks before onset of illness.

Groups at increased risk for hepatitis A include travelers to developing countries, men who have sex with men, and injecting and noninjecting drug users. In the United States, 4% to 6% of reported cases occur among international travelers, many of whom presumably acquired HAV infection from contaminated food or water. Approximately 50% of persons with hepatitis A do not report any known risk factors, and some of these infections may be from unrecognized transmission via HAV-contaminated food.

How might this illness have been prevented?

Persons planning to travel to an endemic region should receive hepatitis A vaccine or immune globulin before departure. Hepatitis A vaccination can be given to anyone 2 years of age and older, and has the advantage of providing long-term protection (at least 20 years). Hepatitis A vaccine is an inactivated HAV preparation; the first dose of vaccine provides protective anti-HAV levels within 30 days for >90% of vaccine recipients. Licensed hepatitis A vaccines available in the United States are considered to be equivalent in effectiveness, and include Havrix® (manufactured by Glaxo SmithKline), VAQTA® (Merck & Co.), and Twinrix® (combined hepatitis A and hepatitis B vaccine, Glaxo SmithKline). Vaccination is administered in a 2-dose schedule (0, 6 months) for Havrix® and VAQTA®, and a 3-dose schedule (0, 1, 6 months) for Twinrix®. The second (or third) dose is provided to ensure protection in those who did not respond to the first dose of vaccine. Ninety-nine percent of vaccinees will be protected after 2 doses of vaccine.

For persons who present for hepatitis A immunoprophylaxis <30 days before departure to an endemic region and for children <2 years old, immune globulin (IG) is an effective means of preventing hepatitis A. IG is the appropriate immunoprophylaxis for children <2 years old. IG is a sterile preparation of concentrated antibodies (immunoglobulins) made from pooled human plasma. IG provides protection against hepatitis A for 3–5 months, depending on dosage, through passive transfer of antibody. Vaccine and IG may be given simultaneously.

Hepatitis A is the most common vaccine-preventable disease among travelers. The risk varies according to region visited and the length of stay, and is increased even among travelers who report observing measures to protect themselves against enteric infection or stay only in urban areas. In the United States, children account for approximately one third of reported travel-related cases.

What else needs to be done?

Cases of hepatitis A should be reported to the local health department immediately. The patient's boyfriend and any other household or sexual contacts whose last exposure to the patient was <14 days ago should be given IG. Screening for immunity before administering IG is not recommended in this situation because it is more costly than IG and would delay its administration. IG is not indicated for family members or friends not living in the household.

Prompt reporting of hepatitis A cases allows time to decide on a course of action and provide timely immunoprophylaxis when appropriate. Because this patient works as a food preparer, the health department will need to visit the establishment to assess the likelihood that her duties and hygiene practices pose a significant risk of food contamination. IG is often recommended for co-workers of commercial food handlers with hepatitis A. In addition, if she worked at any time during the 2 weeks before onset of jaundice to 1 week after onset, persons who ate food prepared or handled by this patient may be candidates for IG prophylaxis. Determina-

tions of the need for IG prophylaxis are made on a case-by-case basis by experienced health department personnel. Again, immediate reporting of hepatitis A cases allows time to decide on a course of action and provide timely treatment and intervention when appropriate.

Norovirus Infection: A Patient Scenario

Nancy is a 25-year-old previously well graduate student who presents to the emergency department with a 12-hour history of nausea, diarrhea, abdominal cramping, and vomiting (about 6 episodes), malaise, and a low-grade fever. She describes her onset of symptoms as sudden.

Physical examination shows that Nancy is afebrile with a supine blood pressure of 123/74 mm Hg. She has a diffusely tender abdomen and is dehydrated. Stool examination is negative for occult blood.

What is the possible differential diagnosis for her chief complaint?

- Infectious gastroenteritis
- Food intoxication (noninfectious gastroenteritis)
- Inflammatory bowel disease
- Appendicitis
- Pelvic inflammatory disease

What additional information would assist with the diagnosis?

- Did anyone in her household experience similar illness within the week prior to onset of symptoms?
- Has she been in contact with anyone outside her household with similar symptoms within the previous week?
- Has she had such symptoms before?
- Does she know if anyone else became ill?
- Has she traveled outside the United States within the last month?
- Has she previously had a sexually transmitted diseases or does she have multiple sex partners?

Nancy reports that she rarely has diarrhea or vomiting. She also reports no contact with anyone who was ill in the past week, nor has she been out of the country in the past month. Her boyfriend, who does not live with her, has similar symptoms with an almost identical onset time. Both attended a wedding 2 days ago. The meal at the wedding reception, which was held at a local reception hall, was the only meal they shared in the past several days. Nancy does not know if anyone else who attended the wedding became ill. Nancy reports that she has no history of a sexually transmitted disease and that she and her boyfriend have a monogamous sexual relationship.

How does this information assist with the diagnosis?

Based on the rapid onset of symptoms, Nancy's reported past history of good health, and the fact that her boyfriend has an almost identical history, inflammatory bowel disease, appendicitis, and pelvic inflammatory disease are the least likely diagnoses.

Food intoxication is also not very likely. Assuming that the wedding reception was the source of the toxin, and this was their most recent common meal, the time from exposure to onset of symptoms is too long. Toxins usually cause illness within minutes to hours after ingestion.

The most likely diagnosis is infectious gastroenteritis. There is a possibility that Nancy's and her boyfriend's illness may be associated with an outbreak of gastroenteritis.

What additional information would assist with the identification of the etiologic agent?

- What sorts of foods were served at the wedding reception?
- When did the couple last share a meal prior to the wedding reception?
- Has an outbreak of gastroenteritis associated with this reception has been reported to the local health department?. The health department may be able to aid in determining what the etiologic agent was if it is currently investigating the outbreak.

At the wedding, the couple had a choice of meal. Nancy had lobster tail and filet mignon. Her boyfriend had chicken. They both consumed stuffed mushrooms, salad, and hors d'oeuvres preceding the main meal. For dessert they both had wedding cake and fresh fruit. Both drank wine or beer during the reception.

The couple attended a barbecue the previous week. This outing was a function sponsored by Nancy's employer. Nancy tells you that none of her co-workers have been ill with vomiting and diarrhea.

You place an inquiry with the local health department about the possible outbreak. The health department notifies you that an investigation is currently under way. Illness has also been reported among 75% of attendees at a wedding the day before the one Nancy attended, at the same reception hall. The only common food between the 2 weddings is the salad,

and the health department currently suspects a food handler who worked during both weddings who was experiencing diarrhea. Most patients have reported nausea, vomiting (about 90%), and diarrhea (70%), with some fever, malaise, headache, chills, and abdominal pain. The mean incubation period for those who have reported illness is 28.6 hours, with a mean duration of 31.8 hours.

The health department suspects viral gastroenteritis caused by a norovirus. A norovirus is suspected because of the rapid onset of symptoms, the short 36-hour incubation period and relatively short duration of illness, the absence of bloody diarrhea, and the high percentage of vomiting. Bacterial cultures are negative for enteric pathogens on stool samples collected thus far.

What are the complications of norovirus infection?

Noroviruses are common causes of self-limiting acute gastroenteritis, with illness frequently lasting no longer than 60 hours. They commonly cause outbreaks in such settings as restaurants, catered events, cruise ships, schools, and nursing homes. The viruses can be spread person to person through the fecal-oral route, through contaminated food or water, or by raw or undercooked shellfish.

How should norovirus infections be managed?

There is no antiviral agent that can be used to treat norovirus infections. Supportive care such as oral or intravenous fluids for rehydration should be provided.

To reduce the spread of illness, patients should be educated to use good hand washing practices, particularly after using the bathroom and before preparing and handling food.

The health department requests that a stool sample be collected. The sample should be collected in a sterile container without transport media, and kept at 4°C (40°F) until shipped. The sample should be shipped on ice packs to the local health department laboratory for testing. The health department also asks you to encourage Nancy's boyfriend to submit a stool sample.

How could this norovirus infection have been prevented?

The food handler with diarrhea should not have returned to work for at least 24–48 hours after symptoms subsided.

Proper hand washing procedures can prevent the spread of the virus between persons. Hands should be washed under warm water with soap for approximately 15 seconds to prevent fecal-oral transmission.

Antibiotic-Resistant Salmonellosis: A Patient Scenario

Andrea brings her 3-year-old son, Marcus, to your office with a 2-day history of low-grade fever, nausea, and 6–8 watery stools per day. Marcus has also been complaining of abdominal pain and feeling tired. He has been eating and drinking less than usual. His medical history is remarkable for recurrent otitis media, for which he was prescribed oral antibiotics 10 days prior to this visit.

Physical examination reveals a well-developed boy who appears fatigued. Vital signs are remarkable for low-grade fever (99.5°F/37.5°C). He does not have signs of dehydration. His otitis appears resolved and he has a normal cardiopulmonary exam. The abdominal exam reveals hyperactive bowel sounds, mild diffuse tenderness, and stool negative for occult blood.

What is the differential diagnosis for Marcus' chief complaint?

- Infectious gastroenteritis
- Appendicitis
- Celiac disease
- Inflammatory bowel disease
- Antibiotic-associated colitis

What additional information would assist with the diagnosis?

- Has he had similar symptoms before?
- Does he attend child care? If yes, have other children attending the same care facility been ill with similar symptoms?
- Has the child recently consumed a meal outside his home; eg, at a birthday party or restaurant?
- Do other members of the household or close acquaintances have diarrhea or bloody diarrhea?

- Has he traveled in the month prior to the onset of illness? If yes, where?
- Has he had contact with pet reptiles or farm animals or visited petting zoos in the week prior to his symptom onset?

Marcus has not had similar episodes of diarrhea in the past. He attends preschool and is cared for by his grandmother after school in her home. He last visited a petting farm 3 months prior to this illness. Their family returned the previous day from a 5-day Caribbean cruise. Marcus was diagnosed with otitis media 4 days prior to their departure and was prescribed a 1-week course of oral antibiotics. Andrea has had nausea and 3–4 loose stools per day for the previous 2 days. She has not had any fever, abdominal pain, or vomiting. Marcus' father and two sisters also traveled on the cruise and are asymptomatic. None of the family members took prophylactic antibiotics for travelers' diarrhea during the cruise.

How does this information assist with the diagnosis?

The additional history suggests that Marcus' and Andrea's illness may be an infectious gastroenteritis related to their recent travel. Antibiotic-associated colitis caused by *Clostridium difficile* infection must be considered since the child was prescribed antibiotics for otitis 8 days prior to this illness. Given the recent onset, travel history, and his mother's symptoms, it is unlikely that appendicitis, celiac disease, or inflammatory bowel disease are the etiologies of Marcus' illness.

The most likely diagnosis is infectious gastroenteritis.

What additional historical information will assist in the identification of the etiologic organism?

- What foods did Marcus and Andrea consume in the previous week? In particular, which foods/ beverages did they consume that the other family members did not?
- Did either Marcus or Andrea consume undercooked meats, runny eggs, unpasteurized milk, raw shellfish, or untreated water?
- Is there a reptile in the home?
- Marcus was prescribed antibiotics for otitis media 1 week prior to the onset of his gastrointestinal symptoms. Has Andrea been prescribed antibiotics during the month prior to the onset of her diarrheal illness?
- Have there been other cases of diarrhea recognized in the cruise ship travelers, in their community, or at Marcus' school?

An open-ended food history reveals multiple common meals eaten by Andrea and Marcus. Andrea denies the consumption of unpasteurized milk, raw shellfish, and undercooked meats. She does report that, unlike the rest of the family, she and Marcus used to wake up early enough to enjoy the breakfasts served on board the cruise. Breakfast served on the cruise consisted of a choice of French toast or pancakes with fruit compote, scrambled eggs or omelets made to order, potatoes, and fresh fruit along with a choice of beverages, including milk, coffee, and tea. Andrea complained that the eggs were occasionally runny. Several fellow passengers told Andrea at breakfast that they were experiencing vomiting and diarrhea. Andrea and Marcus ate the remainder of their meals with the entire family. They did not drink any untreated water or eat items purchased from street vendors at ports of call. In response to your other questions, Marcus does not have a reptile at home. Andrea has not been prescribed antibiotics for more than 1 year. The family lives in a city and has access to municipal water.

Based on the additional historical details, it appears that many people on board the cruise were experiencing symptoms of vomiting and diarrhea. This suggests an outbreak of infectious gastroenteritis that may be related to a common food or water source on the ship. The etiologic agent may be bacterial, viral, or parasitic. The most likely bacterial organisms causing this diarrheal illness are *Campylobacter jejuni, Escherichia coli, Shigella* species, and *Salmonella*. *C. jejuni* is the most common bacterial cause of diarrheal illness in the United States. Outbreaks of *C. jejuni* have been linked to raw milk, poultry, eggs, and water. Enterotoxigenic *E. coli* (ETEC) is recognized as the most common cause of "travelers' diarrhea" and can be transmitted via food or water. *Salmonella* is an important bacterial cause of foodborne illness, ranking just behind *C. jejuni* in its frequency. Vehicles most commonly implicated in foodborne outbreaks of salmonellosis include beef, poultry, produce, eggs, pork, and dairy products. Large waterborne outbreaks of salmonellosis have occurred rarely.

Why is identification of the cause of the diarrhea important?

Identification of the cause of diarrhea in these two cases is important because of the impact on treatment, identification of related cases, and detection of an outbreak and identification of the responsible vehicle. Stool cultures

should be performed to detect common bacterial pathogens such as *Campylobacter*, *Salmonella*, *Shigella*, or *E. coli* O157:H7. Antimicrobial susceptibility results can guide antibiotic therapy if a resistant organism is detected. Additional testing may be conducted to detect nonbacterial organisms. Stool examination for ova and parasites (O&P) will reveal parasitic causes of foodborne and waterborne illness such as *Cyclospora cayetanensis.* Rotavirus infection, one of the most common etiologies of pediatric diarrhea, may be diagnosed with enzyme immunoassay (EIA). The presence of fecal leukocytes suggests bacterial infection but may be found in other infectious or inflammatory states. Testing for the presence of Shiga toxin to detect infection with enterohemorrhagic *E. coli* (EHEC) would be appropriate if Marcus or Andrea had bloody diarrhea.

What approaches would you take to treating Marcus' and Andrea's illness? Are antibiotics indicated for both Marcus and Andrea? What other therapeutic measures are useful for the management of diarrheal illness?

Because Andrea's symptoms are mild, she does not wish to receive antibiotics. For Marcus, you prescribe trimethoprim-sulfamethoxazole at appropriate doses. You encourage Andrea to monitor for worsening fever, diarrhea, vomiting, and dehydration. You obtain stool specimens for culture and O&P from both Marcus and Andrea to confirm the etiologic agent.

The primary goal of therapy for Marcus and Andrea is the maintenance of adequate hydration and electrolyte balance. A commercial oral rehydration solution (ORS) may be used, particularly for Marcus, to provide glucose and salts. You encourage Andrea to give Marcus ORS to prevent dehydration. Bismuth subsalicylate or loperamide may be used to decrease the number of unformed stools and shorten the duration of diarrhea, although neither is available over the counter for children of Marcus' age. Loperamide should not be used in those patients who develop fever or dysentery.

Finally, empiric antibiotic therapy can be used to treat "travelers' diarrhea," which is most commonly caused by ETEC, after obtaining the stool samples but prior to obtaining results of stool cultures.

Three days after the initial visit, Andrea feels better with fewer stools per day, but Marcus has had worsening vomiting and diarrhea. He has had several episodes of high fever and has not been drinking ORS adequately. In the office, Marcus is febrile (102°F/38.8°C) and appears dehydrated with dry mucous membranes and decreased skin turgor. No significant change is noted in the abdominal examination. You admit Marcus for intravenous hydration and encouragement of oral rehydration and consider a change in antibiotic therapy. Because of the progressive systemic nature of his illness, you also obtain blood cultures at this time.

What information will guide your therapy at this time?

The use of intravenous fluids to improve volume status is reasonable given Marcus' inability to maintain hydration with ORS. However, during hospitalization, he should be encouraged to resume drinking ORS as early as possible. The decision to change from oral to intravenous antibiotics may be based on Marcus' increased vomiting and on his clinical decline. The choice of antibiotics should reflect the results of stool culture and antimicrobial sensitivities.

The laboratory reports the growth of *Salmonella* Typhimurium from Marcus' stool cultures. Susceptibility testing reveals an organism resistant to multiple antibiotics, including ampicillin and sulfamethoxazole. Multidrug-resistant *S.* Typhimurium has been on the rise in the United States since the early 1990s and now accounts for at least 25% of these isolates. Definitive type 104 (DT 104), the most common phage type of multidrug-resistant *S.* Typhimurium, may be responsible for more invasive disease than other phage types. In an outbreak, resistant organisms appear to cause more cases than do sensitive strains. Marcus' recent exposure to antibiotics for otitis media likely increased his susceptibility to *Salmonella* infection, perhaps by decreasing the usual protection offered by normal bowel flora, and thus decreasing the infectious dose necessary to cause illness. In addition, he was placed at increased risk for infection with a resistant strain of *S.* Typhimurium if he was exposed while still taking the antibiotic.

Treatment of *Salmonella* gastroenteritis with antibiotic therapy is controversial because of the resulting increase in asymptomatic carriage, particularly among children less than 5 years of age. However, given the systemic nature of his illness, you choose to treat Marcus with several days of an intravenous third-generation cephalosporin. This is a reasonable choice in light of the antimicrobial resistance and the reluctance to use fluoroquinolones in the pediatric population.

Should these cases be reported to the local health department? What are the public health implications of these two cases of salmonellosis?

Salmonellosis is a nationally notifiable disease, and most states require clinicians to report cases to local or state public health agencies. The health department and its public health partners can conduct studies to determine whether these cases indicated an outbreak of salmonellosis aboard the cruise ship. If an outbreak is confirmed, additional investigation is necessary to identify the contaminated food or the ill food worker infected with *Salmonella*, and whether there were correctable food-handling errors. If a food vehicle is identified, traceback and recall may be necessary to remove it from the market and prevent the occurrence of other cases. Given the increasing prevalence of drug-resistant strains of *S.* Typhimurium, public health laboratories may perform bacteriophage typing or pulsed-field gel electrophoresis (PFGE) to further characterize the drug-resistance patterns of these organisms. Reporting of these cases will contribute to essential nationwide surveillance of salmonellosis, foodborne outbreaks, and antimicrobial resistance.

What prevention measures will you recommend to Marcus and Andrea? Are repeat stool cultures necessary?

To prevent *Salmonella* infections, all meat and egg dishes should be fully cooked. Andrea can purchase eggs that are pasteurized in the shell, and irradiated ground beef and poultry to reduce the risk of contamination. Basic food safety practices in the kitchen can also help prevent such infections, such as refrigerating leftovers promptly, washing hands and utensils after contact with raw meat and poultry, and keeping raw meat and poultry separate from ready-to-eat foods. Marcus and Andrea should be reminded to wash their hands with warm running water and soap after using the bathroom and before and after meals to avoid transmitting the infection to others. Marcus is likely to have prolonged carriage of *Salmonella* in the intestines. While he may return to preschool as soon as he is feeling well enough to do so because direct spread from one child to another is rare, clinicians should defer to their local health departments regarding their clearance policies for convalescing children attending preschool.

With adequate hydration and your chosen antimicrobial therapy, Marcus will likely recover fully from this diarrheal illness without residual complications.

Unexplained Illness: A Patient Scenario

You have been a primary care practitioner in Manhattan, New York, for several years. Jack, a 29-year-old otherwise healthy male, has been your patient for the past year. At 8:00 a.m. he calls your triage nurse complaining of a very sudden onset of nausea, cramps, coughing, and sweating. The nurse is concerned about the suddenness of onset and wants to know what you would like to do.

Should you have him call again later if he does not improve? Should you have him make an acute-visit appointment, or should you send him to the emergency room?

You are concerned about the suddenness of the onset of symptoms but not the severity, so you decide to have him come to the office immediately.

Jack presents in your office 30 minutes later. In addition to nausea, cramps, coughing, and sweating, his eyes have begun to tear uncontrollably and he complains of having had difficulty breathing while en route to the office. Upon arrival, he immediately asks to use the bathroom.

Jack reports that he started his morning routine as usual with a run. Upon returning home, he finished drinking the bottle of water he had purchased earlier from the local deli and began to get ready for work. By the time he had finished showering and dressing, he began to feel sick to his stomach. He then developed cramping but no diarrhea. Shortly thereafter, he began to have bouts of coughing uncontrollably. He does not know when the sweating started. He states that he had difficulty breathing while en route to the office, and that the tearing just started. He denies vomiting, hemoptysis, hematuria, bright red blood per rectum (BRBPR), chills, fever, headache, myalgia, arthralgia, or diarrhea. Jack also denies the use of any medication, other drugs or alcohol. "That stuff rots your gut."

Jack reports that he finished his run at about 7:00 a.m. It is now 9:00 a.m..

Despite having just urinated, he states that he must go again and immediately. However, Jack experiences incontinence on his way to the bathroom. Upon his return to the exam room, you notice a slight tremor in his left arm. He states that this has only just begun.

What preliminary diagnosis can you make at this point?

- An anxiety attack
- A viral syndrome
- A potential foodborne illness
- Anticholinergic poisoning

You are not ready to reach a conclusion at this point, so you move to a physical exam and observe the following:

Objective:

Respiration rate: 20
BP: 92/60 mm Hg.
Heart rate: 50
Temperature: 98.6°F (37°C)

You note that Jack is anxious but oriented to time, place, and person. His head, ears, eyes, nose, throat (HEENT) examination shows bilateral miosis and decreased reactivity. There are no signs of trauma or bleeding. His heart has regular rate and rhythm, no murmur, and good perfusion. Radial and dorsal pulses are 2+. His lung examination reveals scattered wheezing. His abdomen is soft, nontender, not distended, with increased bowel sounds, and no mass. Extremities appear within normal limits. The neurologic exam reveals the slight tremor in his left arm, slightly slurred speech, excessive salivation, and transient fasciculations in both upper extremities. You note negative Babinski and his cranial nerves (CN) 2-11 appear intact, while CN 12 appears slightly abnormal.

What other information would assist with the diagnosis?

More history from Jack, including most recent activity and diet.

You now seek additional history. Jack lives alone and does not believe that he has been in contact with anyone who is ill. He works in an office as a lawyer. His run takes him up 5th Avenue and then over to 3rd Avenue, then back home. He does not run through Central Park. He does not have plants and does not garden as a hobby. His most recent meal was the night before, about 10 hours prior to the onset of his symptoms. It consisted of boiled pasta, steamed broccoli, and olive oil. He prepared the meal himself. He states that he carefully washed the broccoli, the oil was from a bottle he opened last week, and the pasta was from a box he had already used 2 days before. All he had to drink was tap water with dinner last evening and the bottled water from this morning.

Jack's presentation appears to involve which of the following systems?

- Autonomic nervous system
- Lymphatic system
- Central nervous system

The signs and symptoms in Jack's presentation predominantly involve increased autonomic responses, and are perhaps progressing to include the central nervous system as well. You decide that immediate treatment is called for and order oxygen, atropine, and pralidoxime (2-PAM). Given that Jack does not appear to have been exposed dermally, the most likely route appears to have been oral. Therefore, you also appropriately begin an IV with normal saline

What is the initial diagnosis?

This presentation is not consistent with bacterial, viral, or parasitic food poisoning. While the signs and symptoms indicate acute organophosphate poisoning, the history provides no indication, and indeed seemingly contradicts this theory because of the lack of exposure. There has been no exposure to places where organophosphates are typically used, such as on lawns, house plants, and parks. Nevertheless, Jack has presented with a fairly classic case of organophosphate poisoning. Therefore, ingestion must be considered. Since you have no suggestion of deliberate ingestion on Jack's part, it must be assumed that he has consumed it unintentionally.

Organophosphate poisoning has an onset of 30 minutes to 2 hours. Jack has actually made it easy to identify the most likely source: the only thing he has consumed in 10 hours is water. The broccoli could have had pesticides on it that may not have been removed when Jack washed it, but then he would have developed his symptoms during the night. Taking into account the temporal relationship between his ingestion of the bottled water and the onset of his symptoms, the bottled water seems the most likely candidate.

Given this information, what are key questions you should consider?

- Is the water truly contaminated?
- If it is, how did it become contaminated?
- Who else may have ingested it?
- Who else is at risk?
- What action should be taken?

You realize that if your diagnosis and conclusions are correct then a public health hazard may exist. Two things need to be done. First, the health department must be contacted, and second, tests need to be done that will confirm your diagnosis. While the usual work-up for organophosphate poisoning is clinical diagnosis, there are assays available to measure cholinesterase activity in plasma and red blood cells. It is also possible to detect some pesticides in urine. You decide to order both tests as this will provide the greatest insight into what the possible exposure is for other people in Jack's building, neighborhood, or even his city.

When communicating with the local public health department, whom should you ask to speak to concerning this situation?

- The medical epidemiologist?
- The medical director?
- The infectious disease officer?

You ask to speak with the medical director. You present Jack's case, making careful note of the time course, and also inform the medical director of your suspicions of the source. The medical director takes this information and agrees with your concerns. She then asks you to speak with the chief epidemiologist so that an investigation can begin.

In many large cities, there is a city health department; in smaller cities or towns, it will usually be necessary to contact the local or state health department. Try to match the level with the greatest number of people who may become affected. Other persons who may be of immediate help if you cannot reach the medical officer are the epidemiologist or even an environmental health officer. These people will most likely know what to do with the information you have.

Most health departments across the country have been working to increase their knowledge or at least their awareness of the possibility of intentional contamination. Many have also created positions solely devoted to this task. Therefore, it is possible that you will be directed to such an individual.

The health department initiates an investigation that includes testing the water; looking for other cases of organophosphate poisoning; interviewing the patient; notifying other parts of the public health system, including law enforcement, CDC, and the state health department. They may even issue a public notice.

There is another possible cause for the case you have just seen: sarin gas can cause a similar presentation. If sarin gas had been sprayed into the air, it is possible that Jack could have respiratory exposure to the nerve gas.

If this were true, how would it change what you did?

Persons exposed to sarin, and possibly other nerve agents, will have a clinical presenation similar to those with organophosphate poisoning. Hence, medical management will likely be similar.

Finally, you are gratified to have helped detect a possible act of contamination that could potentially harm or even kill a great many people. Afterward, while making rounds in the hospital that day you are told by a colleague that a number of runners from a 5K race in Central Park this morning and tourists visiting the Empire State Building were brought to the emergency room complaining of sudden onset of nausea, cramps, and coughing. It was reported that all had been drinking bottled water.

Clinical Vignettes: What's Your Call?

The following clinical vignettes are provided for your self-evaluation. All are possible situations that may present at your practice. The "Diagnostic Considerations" section and the tables of etiologic agents that are also part of this primer will provide the information necessary for you to adequately address these clinical situations. Note that these vignettes include both infectious and noninfectious forms of foodborne illness.

For the following clinical vignettes, choose the best answer from the choices listed at the end of the vignettes:

A — likely diagnosis; choose the best possible answer listed on "answer selections" page under **A** selections.

B — most appropriate choice to confirm the diagnosis (there may be more than one correct answer — list all of them). Choose from the possible answers listed on "answer selections" page under the **B** section.

Finally, decide whether the situation warrants reporting to the local or state health department.

Clinical Vignettes

I. You receive a long-distance call from a patient who is an outdoorsman. He is with a group that collected and ate some wild mushrooms less than 2 hours ago. Several members of the group have since developed vomiting, diarrhea, and some mental confusion.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

II. A newborn child has symptoms of sepsis. Cerebrospinal fluid studies are consistent with meningitis. The mother had a flu-like syndrome prior to delivery.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

III. This patient has just returned today from Latin America following a 2-day business trip. He reports having eaten several meals of fish that he bought from street vendors around his hotel. He feels very ill with profuse, watery diarrhea, and vomiting.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

IV. An 18-month-old child is brought to your office with fever, bloody diarrhea, and some vomiting. She has been drinking unpasteurized milk in the last 48 hours. No other family members are ill.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

V. A patient calls and states that he and several family members are ill with severe vomiting. They ate at a church picnic 4 hours earlier.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

VI. A patient calls and states that most family members have developed severe vomiting, about 1 hour after eating at a picnic. They ate barbecued beef, chips, potato salad, and homemade root beer. Some are complaining of a metallic taste.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

VII. A patient has had chronic intermittent diarrhea for about 3 weeks. There is no fever or vomiting and no blood in the stool. The patient travels to Latin America and Eastern Europe frequently, most recently 2 weeks ago.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

VIII. The parents of a 6-month-old infant are concerned because she is listless and weak. The infant is feeding poorly, has poor head control, and is constipated. There is no fever or vomiting.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

IX. A businessman who travels frequently is ill with fatigue, jaundice, abdominal pain, and diarrhea. About 1 month ago, he returned from an international trip during which he consumed raw oysters.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

X. Several members of a single family are ill with abdominal cramps and watery diarrhea. They just returned from visiting friends on the East Coast of the United States, where they consumed raw oysters 48 hours ago.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

XI. A minister at a local church calls to report that many members began experiencing watery diarrhea on the morning after the annual turkey dinner fundraiser. Some people also reported nausea and abdominal cramps, but no one has fever or bloody stools.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

XII. You receive a long-distance call from a patient on a fishing vacation off the coast of Belize. Her family has been eating a variety of local fish and shellfish that they caught. She reports that several family members developed abdominal pain, severe diarrhea, and weakness the morning after they consumed the seafood for dinner. One family member began having difficulty speaking later on that same night.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

XIII. A family in a rural community is worried that their father may be having a stroke. He is complaining of double vision and is having trouble swallowing. They have a large garden and eat home-canned vegetables.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

XIV. A 2-year-old child who attends day care presents with abdominal cramps and severe bloody diarrhea, which has been present for 2 days. He has no fever.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

XV. Susan tells you that she has had diarrhea, nausea, and abdominal cramping for almost 12 hours now. She also presents with malaise and a low-grade fever and informs you that as far as she can tell, the symptoms developed very suddenly. Stool examination is negative for occult blood. Susan informs you that her good friend is also sick and they both attended a company picnic less than 2 days ago.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

XVI. Sally arrives at your office with acute gastrointestinal illness characterized by diarrhea, abdominal cramps, chills, fever, and body aches. She also informs you that about 3 days before she started getting sick, she had consumed raw ground beef that was seasoned with onions and an herb mix.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

XVII. James presents to the emergency room with a low-grade fever and complaining of fatigue and nausea for the past 24 hours. He also describes his urine as being dark and states that he has had 4 bowel movements in the past 24 hours, all of which were light colored. Upon further questioning, James says that he has no history of jaundice and that he returned from a business trip to the Philippines a month ago.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

XVIII. You are halfway through your shift in the ER. There are four patients, two adults and two children, with a history of nausea, vomiting, abdominal pain, and profuse (especially in the children) watery diarrhea in the absence of fever. They each report that these symptoms began 5 days ago and resolved after 1 day. They had all been symptom free for 3 days, but now the symptoms have returned. There is also a new onset of jaundice and bloody diarrhea. Lab results indicate elevated LFTs. The patients do not know each other, but all report eating hamburgers several hours before the initial onset of symptoms.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

XIX. A mother has brought in a 5-month-old child with apparent blindness. She reports that the child had been healthy until the past month when the vision problems appeared. The mother states that she had been well during the pregnancy, but further questioning reveals that the mother had two young cats at home for which she was the sole care provider. The cats were given away just before the birth of the child because of concerns about the child being smothered by the cats.

A — likely diagnosis: _____
B — most appropriate test to confirm etiology/follow-up action: _____
Report to the health department? ___Yes ___No

Answer Choices

A: Choose from any of these possible etiologies:

1. Intoxication from preformed toxins of *Staphylococcus aureus* or *Bacillus cereus*
2. Intoxication from toxins produced *in vivo* by *Clostridium perfringens*
3. *Salmonella* or *Campylobacter* are possible.
4. *E. coli* O157:H7
5. Noroviruses, *Vibrio parahaemolyticus*, and other *Vibrio* infections
6. *Vibrio cholerae* infection
7. Botulism must be ruled out
8. *Listeria monocytogenes* sepsis
9. *Cryptosporidium parvum*
10. *Cyclospora cayetanensis*
11. A form of metal poisoning
12. A form of mushroom poisoning
13. Likely fish/shellfish toxin
14. *Giardia lamblia*
15. *Trichinella spiralis*
16. Hepatitis A virus
17. Congenital toxoplasmosis
18. Intentional amanitin poisoning

B: Choose from any of these following tests/actions

1. Clinical diagnosis; laboratory tests may not always be indicated.
2. Generally detected on routine stool cultures.
3. Generally, a reference laboratory is needed to identify the toxin from food, stool, or vomitus.
4. Important to identify causative organism for public health reasons.
5. Send stool samples to health department (*Vibrio cholerae*, other vibrios, *E. coli* O157:H7, special toxin tests, *Clostridium perfringens*, *Clostridium botulinum*).
6. Not detected by routine stool cultures (*E. coli* O157:H7, *Vibrio cholerae*, other vibrios).
7. Should test for viral agents.
8. For cysts, ova, and parasite detection, at least 3 stool samples must be collected. Sometimes the organism may still be missed.
9. Test for appropriate metal.
10. Special test needed to identify a fish toxin.
11. Consult a mycologist to identify the mushroom.
12. Blood culture is the best source for diagnosis.
13. Blood test helpful to identify the agent.
14. May need acute and convalescent serum or viral cultures.
15. Isolation of *T. gondii* from infant blood. PCR of white blood cells or CSF, or IgM and IgA serology, performed by a reference laboratory.
16. Rapid and aggressive antitoxin therapy. There is no single effective antidote at this time, but silibinin (with penicillin G) and N acetyl cysteine are showing promise. Plan for hepatic and renal failure.

Answers

Question number	Choice(s) for A	Choice(s) for B	Report to Health Dept.?
I	12	11	Yes
II	8	12	Yes
III	6	5,6	Yes
IV	3,4	2	Yes
V	1	1,3	Yes
VI	11	9	Yes
VII	14	8	Yes
VIII	7	5	Yes
IX	16	13,7,14	Yes
X	5	5,6,7	Yes
XI	2	1,5	Yes
XII	13	10	Yes
XIII	7	3,5	Yes
XIV	4	5,6	Yes
XV	3,5	5,6,7	Yes
XVI	3,4	2	Yes
XVII	16	13,7,4	Yes
XVIII	18	16,	Yes (intentional contamination?)
XIX	17	15,13	Yes

Suggested Resources

General Information

CDC Food Safety Information
http://www.cdc.gov/foodsafety
Continuing Medical Education (CDC)
http://www2.cdc.gov/mmwr/cme/conted.html
US Government Food Safety Information Gateway
http://www.foodsafety.gov
Fight BAC!™ Education Campaign
http://www.fightbac.org
Foodborne Illness Education Information Center
http://www.nal.usda.gov/fnic/foodborne/foodborn.htm
Public Health Partners — Networks and Resources
http://www.cdc.gov/other.htm
Bad Bug Book (FDA)
http://www.cfsan.fda.gov/~mow/intro.html
Travelers' Health Information (CDC)
http://www.cdc.gov/travel

Listing of foodborne diseases, pathogens and toxins (CDC)
http://www.cdc.gov/foodsafety/disease.htm
Searchable database: U.S. Foodborne Disease Outbreaks, 1990–1995
www2.cdc.gov/ncidod/foodborne/fbsearch.asp
Terrorism and Public Health (CDC)
http://www.bt.cdc.gov/

Professional Organizations

American Academy of Family Physicians
http://www.aafp.org
American Medical Association (AMA)
http://www.ama assn.org
Infectious Diseases Society of America
http://www.idsociety.org
American Academy of Pediatrics
http://www.aap.org
American Nurses Association (ANA)
http://www.nursingworld.org
American Association for Health Education
http://www.aahperd.org
American Dietetic Association
http://www.eatright.org

State and Local Organizations

Association of Food and Drug Officials
http://www.afdo.org
Association of State and Territorial Directors of Health Promotion and Public Health Education
http://www.astdhpphe.org
Association of Public Health Laboratories (APHL)
http://www.aphl.org
Association of State and Territorial Health Officials (ASTHO)
http://www.astho.org
Council of State and Territorial Epidemiologists (CSTE)
http://www.cste.org
National Public Health Information Coalition (NPHIC)
http://www.nphic.org
National Association of County and City Health Officials (NACCHO)
http://www.naccho.org

Government

US Department of Agriculture (USDA) Food Safety and Inspection Service
http://www.fsis.usda.gov
US Department of Health and Human Services (DHHS):
Centers for Disease Control and Prevention
http://www.cdc.gov
US Food and Drug Administration
http://www.fda.gov
Center for Food Safety and Applied Nutrition (CFSAN)
Information for Health Professionals
http://www.cfsan.fda.gov/~dms/hpro-toc.html
State and local government agencies
http://www.foodsafety.gov/~fsg/fsggov.html
Role of Government Agencies in Food Safety
http://vm.cfsan.fda.gov/~lrd/foodteam.html
Gateway to government food safety information
http://www.foodsafety.gov

Reports and Journals

CDC, *Morbidity and Mortality Weekly Report*
http://www.cdc.gov/mmwr
CDC, *Emerging Infectious Diseases Journal*
http://www.cdc.gov/eid

Food Safety Education Resources

An Ounce of Prevention Keeps the Germs Away
http://www.cdc.gov/ncidod/op
Attention Pregnant Women: What you can do to keep germs from harming you and your baby
http://www.cdc.gov/foodsafety/edu.htm
Consumer Advice from CFSAN
http://www.cfsan.fda.gov/~lrd/advice.html
Cooking for Groups: A Volunteer's Guide to Food Safety
www.fsis.usda.gov/OA/pubs/cfg/cfg.htm
Fight BAC: Keep Food Safe From Bacteria
http://www.fightbac.org
Food Safety Resources for Kids, Teens and Educators
http://www.foodsafety.gov/~fsg/fsgkids.html
For Kids, Teens, and Educators
http://www.cfsan.fda.gov/~dms/educate.html
Hand Hygiene in Healthcare Settings
http://www.cdc.gov/handhygiene
Healthy Pets, Healthy People
http://www.cdc.gov/healthypets
Healthy Schools, Healthy People — It's a SNAP
http://www.ItsASnap.org
Listeriosis and Pregnancy: What is Your Risk?
http://www.fsis.usda.gov/OA/pubs/lm_tearsheet.htm
National Food Safety Education Month
http://www.nraef.org/nfsem
Thermy™ Campaign
http://www.fsis.usda.gov/thermy

Thinking Globally, Working Locally: A Conference on Food Safety Education
http://www.fsis.usda.gov/Orlando2002
To Your Health: Food Safety for Seniors
http://www.foodsafety.gov/%7Efsg/sr2.html
Toxoplasmosis: An important message for pregnant women
http://www.cdc.gov/ncidod/dpd/parasites/toxoplasmosis/ToxoWomen.pdf

Food Safety Education Partnerships

Clean Hands Coalition
Email to: cleanhands@cdc.gov
Food Safety Training and Education Alliance
http://www.FSTEA.org
National Coalition for Food Safe Schools
http://www.FoodSafeSchools.org
Partnership for Food Safety Education
http://www.fightbac.org
Canadian Partnership for Consumer Food Safety Education
http://www.canfightbac.org

Toll-free Information Phone Numbers

USDA Meat and Poultry Hotline:
1-800-535-4555
FDA Safe Food Hotline:
1-888-SAFE FOOD (723-3366)
CDC Voice Information System:
1-888-CDC-FAXX (232-3299)

Bioterrorism/Food Bioterrorism Informational Web Sites

AMA Resources on Disaster Preparedness and Emergency Response
http://www.ama-assn.org/go/disasterpreparedness
ANA Bioterrorism and Disaster Response
http://www.ana.org/news/disaster
DHHS/CDC Bioterrorism Resources
http://www.bt.cdc.gov
DHHS/FDA Counterterrorism Resources
http://www.fda.gov/oc/opacom/hottopics/bioterrorism.html
DHHS/FDA/CFSAN Food Safety and Terrorism Resources
http://www.cfsan.fda.gov/~dms/fsterr.html
USDA-FSIS Biosecurity Resources
http://www.fsis.usda.gov/oa/topics/biosecurity.htm

Suggested Reading List

General Reading

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Recommendations and Reports April 16, 2004 / Vol. 53 / No. RR-4

Continuing Education Activity Sponsored by CDC
Diagnosis and Management of Foodborne Illnesses
EXPIRATION — April 16, 2007

You must complete and return the response form electronically or by mail by **April 16, 2007**, to receive continuing education credit. If you answer all of the questions, you will receive an award letter for 2.75 hours Continuing Medical Education (CME) credit; 0.25 Continuing Education Units (CEUs); 3.0 hours Certified Health Education Specialist (CHES) credit; or 3.3 contact hours Continuing Nursing Education (CNE) credit. If you return the form electronically, you will receive educational credit immediately. If you mail the form, you will receive educational credit in approximately 30 days. No fees are charged for participating in this continuing education activity.

INSTRUCTIONS

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1. Read this *MMWR* (Vol. 53, RR-4), which contains the correct answers to the questions beginning on the next page.
2. Go to the *MMWR* Continuing Education Internet site at <http://www.cdc.gov/mmwr/cme/conted.html>.
3. Select which exam you want to take and select whether you want to register for CME, CEU, CNE, or CHES credit.
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6. Submit your answers no later than **April 16, 2007**.
7. Immediately print your Certificate of Completion for your records.

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1. Read this *MMWR* (Vol. 53, RR-4), which contains the correct answers to the questions beginning on the next page.
2. Complete all registration information on the response form, including your name, mailing address, phone number, and e-mail address, if available.
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   Atlanta, GA 30333
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ACCREDITATION

Continuing Medical Education (CME). This activity has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education through joint sponsorship of CDC; the Food Safety and Inspection Service, U.S. Department of Agriculture; and the Center for Food Safety and Applied Nutrition, Food and Drug Administration. CDC is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians. CDC designates this educational activity for a maximum of 2.75 hours in category 1 credit toward the AMA Physician's Recognition Award. Each physician should claim only those hours of credit that he/she actually spent in the educational activity.

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Goal and Objectives

This *MMWR* provides recommendations for physicians and other health-care professionals who have a critical role in diagnosing, treating, and reporting food-related disease outbreaks. These recommendations were developed by the American Medical Association, the American Nurses Association-American Nurse Foundation, the Centers for Disease Control and Prevention, the Food and Drug Administration's Center for Food Safety and Nutrition, and the United States Department of Agriculture's Food Safety and Inspection Service. The goal of this report is to provide health-care providers with guidance and patient-education materials regarding foodborne illness. After completing this continuing education activity, the reader should be able to 1) differentiate between the six etiologic agents that should be considered regarding manifestations of foodborne illness; 2) describe four criteria to consider when treating a diagnosed foodborne illness; 3) summarize the reporting requirements for foodborne illness; and 4) identify three groups of persons who are at higher risk for foodborne illnesses.

To receive continuing education credit, please answer all of the following questions:

1. Which of the following provide important clues to the possible etiology of a food-associated illness?
- A. Incubation period.
- B. Duration of illness.
- C. Predominant clinical signs and symptoms (e.g., vomiting, diarrhea, and abdominal pain).
- D. Travel history.
- E. All of the above.

2. Which group is at higher risk for complications from foodborne illness?
- A. Persons with weakened immune systems.
- B. Persons with liver disease.
- C. Pregnant women.
- D. Older adults.
- E. All of the above.

3. Which of the following is not a safe food-handling behavior?
- A. Using the same cutting board for raw foods and cooked foods.
- B. Using a food thermometer to check the internal temperature of food before eating it.
- C. Rinsing raw produce with water.
- D. Washing hands before and after handling food.

4. What is the appropriate method to use in determining if a hamburger is cooked to a proper temperature?
- A. Cooking it until it is brown inside.
- B. Using a food thermometer to ensure that the internal temperature reaches 160°F.
- C. Determining if a hamburger is cooked to a proper temperature is not necessary because it is too small.
- D. Taking a bite of the hamburger to ensure that it tastes cooked.

5. When a foodborne outbreak is suspected, who would be a helpful contact at the health department?
- A. Medical officer.
- B. Epidemiology officer.
- C. Environmental health officer.
- D. Any of the above would be helpful.

6. Which of the following is not consistent with inflammatory diarrhea?
- A. Presence of fecal leukocytes.
- B. Grossly bloody stool.
- C. Infection with invasive or cytotoxigenic bacterial and protozoan species.
- D. Involvement of the small intestine.

7. If a foodborne illness is suspected, which of the following should be considered?
- A. Submission of appropriate specimens for laboratory testing.
- B. Contacting the state or local health department.
- C. Initiating oral rehydration therapy.
- D. All of the above.

8. Intentional contamination of food is uncommon, but which of the following would make you suspect that such an act had occurred (i.e., the unusual nature of the situation would induce suspicion of intentional contamination)?
- A. An unusual agent or pathogen in a common food.
- B. A common agent or pathogen affecting an unusually large number of persons.
- C. A common agent or pathogen that is uncommonly seen in clinical practice.
- D. All of the above.

9. Multidrug-resistant *Salmonella* typhimurium cases . . .
- A. have been on the rise in the United States since the 1990s.
- B. might be responsible for more invasive disease than other types.
- C. often are resistant to ampicillin and sulfamethoxazole.
- D. cause more cases in an outbreak than do sensitive strains.
- E. all of the above.

10. Norovirus infection, which often results in nausea, vomiting, and watery/large-volume diarrhea within 24–48 hours, can be caused by . . .
- A. inadequately cooked shellfish.
- B. inadequately cooked hamburger.
- C. ready-to-eat foods (e.g. salads).
- D. iced drinks.
- E. A, C, and D are correct.

11. Indicate your work setting.
- A. State/local health department.
- B. Other public health setting.
- C. Hospital clinic/private practice.
- D. Managed care organization.
- E. Academic institution.
- F. Other.

12. Which best describes your professional activities?
- A. Physician.
- B. Nurse.
- C. Health educator.
- D. Office staff.
- E. Other.

13. I plan to use these recommendations as the basis for . . . (*Indicate all that apply.*)
- A. health education materials.
- B. insurance reimbursement policies.
- C. local practice guidelines.
- D. public policy.
- E. other.

14. Each month, approximately how many patients with a foodborne illness do you treat?

A. None.
B. 1–5.
C. 6–20.
D. 21–50.
E. 51–100.
F. >100.

15. How much time did you spend reading this report and completing the exam?

A. <2.0 hours.
B. >2.0 hours but <3.0 hours.
C. >3.0 hours but <4.0.
D. >4.0 hours.

16. After reading this report, I am confident I can differentiate between the six etiologic agents that should be considered regarding manifestations of foodborne illness.

A. Strongly agree.
B. Agree.
C. Neither agree nor disagree.
D. Disagree.
E. Strongly disagree.

17. After reading this report, I am confident I can describe four criteria to consider when treating a diagnosed foodborne illness.

A. Strongly agree.
B. Agree.
C. Neither agree nor disagree.
D. Disagree.
E. Strongly disagree.

18. After reading this report, I am confident I can summarize the reporting requirements for foodborne illness.

A. Strongly agree.
B. Agree.
C. Neither agree nor disagree.
D. Disagree.
E. Strongly disagree.

19. After reading this report, I am confident I can identify three groups of persons who are at higher risk for foodborne illnesses.

A. Strongly agree.
B. Agree.
C. Neither agree nor disagree.
D. Disagree.
E. Strongly disagree.

20. The objectives are relevant to the goal of this report.

A. Strongly agree.
B. Agree.
C. Neither agree nor disagree.
D. Disagree.
E. Strongly disagree.

21. The teaching strategies used in this report (text, figures, and tables) were useful.

A. Strongly agree.
B. Agree.
C. Neither agree nor disagree.
D. Disagree.
E. Strongly disagree.

(Continued on pg CE-4)

Detach or photocopy.

MMWR Response Form for Continuing Education Credit
April 16, 2004/Vol. 53/No. RR-4
Diagnosis and Management of Foodborne Illnesses

To receive continuing education credit, you must
1. provide your contact information;
2. indicate your choice of CME, CEU, CNE, or CHES credit;
3. answer all of the test questions;
4. sign and date this form or a photocopy;
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Failure to complete these items can result in a delay or rejection of your application for continuing education credit.

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Check One
☐ *CME Credit*
☐ *CEU Credit*
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☐ *CHES Credit*

Fill in the appropriate blocks to indicate your answers. Remember, you must answer all of the questions to receive continuing education credit!

1. [ ]A [ ]B [ ]C [ ]D [ ]E	14. [ ]A [ ]B [ ]C [ ]D [ ]E [ ]F		
2. [ ]A [ ]B [ ]C [ ]D [ ]E	15. [ ]A [ ]B [ ]C [ ]D		
3. [ ]A [ ]B [ ]C [ ]D	16. [ ]A [ ]B [ ]C [ ]D [ ]E		
4. [ ]A [ ]B [ ]C [ ]D	17. [ ]A [ ]B [ ]C [ ]D [ ]E		
5. [ ]A [ ]B [ ]C [ ]D	18. [ ]A [ ]B [ ]C [ ]D [ ]E		
6. [ ]A [ ]B [ ]C [ ]D	19. [ ]A [ ]B [ ]C [ ]D [ ]E		
7. [ ]A [ ]B [ ]C [ ]D	20. [ ]A [ ]B [ ]C [ ]D [ ]E		
8. [ ]A [ ]B [ ]C [ ]D	21. [ ]A [ ]B [ ]C [ ]D [ ]E		
9. [ ]A [ ]B [ ]C [ ]D [ ]E	22. [ ]A [ ]B [ ]C [ ]D [ ]E		
10. [ ]A [ ]B [ ]C [ ]D [ ]E	23. [ ]A [ ]B [ ]C [ ]D [ ]E		
11. [ ]A [ ]B [ ]C [ ]D [ ]E [ ]F	24. [ ]A [ ]B [ ]C [ ]D [ ]E		
12. [ ]A [ ]B [ ]C [ ]D [ ]E	25. [ ]A [ ]B [ ]C [ ]D [ ]E		
13. [ ]A [ ]B [ ]C [ ]D [ ]E	26. [ ]A [ ]B [ ]C [ ]D [ ]E [ ]F		

Signature *Date I Completed Exam*

22. Overall, the presentation of the report enhanced my ability to understand the material.

A. Strongly agree.
B. Agree.
C. Neither agree nor disagree.
D. Disagree.
E. Strongly disagree.

23. These recommendations will affect my practice.

A. Strongly agree.
B. Agree.
C. Neither agree nor disagree.
D. Disagree.
E. Strongly disagree.

24. The content of this activity was appropriate for my educational needs.

A. Strongly agree.
B. Agree.
C. Neither agree nor disagree.
D. Disagree.
E. Strongly disagree.

25. The availability of continuing education credit influenced my decision to read this report.

A. Strongly agree.
B. Agree.
C. Neither agree nor disagree.
D. Disagree.
E. Strongly disagree.

26. How did you learn about this continuing education activity?

A. Internet.
B. Advertisement (e.g., fact sheet, *MMWR* cover, newsletter, or journal).
C. Coworker/supervisor.
D. Conference presentation.
E. *MMWR* subscription.
F. Other.

Correct answers for questions 1–10.
1. E; 2. E; 3. A; 4. B; 5. D; 6. D; 7. D; 8. D; 9. E; 10. E.

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