

FOOD BORNE DISEASES

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1. Introduction

Foodborne diseases is caused by consuming contaminated foods or beverages. Many different disease-causing microbes or pathogens can contaminate foods, so there are many different types of foodborne diseases. More than 200 pathogens are associated with food borne disease. An estimated 76 million cases occur annually, resulting in 3lakhs hospitalizations and 5,000 deaths. The onset of food borne disease is generally acute, with resolution of an uncomplicated illness in 72 hours for most episodes. Proper food handling and preparation, personal hygiene, and improved methods of decontamination of consumer products could significantly reduce the extent of morbidity and mortality of this common problem.

Food borne disease can be caused by bacteria, parasites, toxins, and viruses. Despite efforts to investigate food borne disease, less than 50% of all outbreak causes are identified, usually because of limited diagnostic capabilities. Viruses are likely the most common cause of food borne disease but are seldom investigated and confirmed because of the short duration and self-limited nature of the illness. In addition, the inherent difficulty of laboratory investigation and subsequent cost of viral studies lead to a lack of clinician investigation and therefore overall underreporting. Bacteria are the most common documented cause.

Foodborne disease is more likely to affect the extremes of age as well as immune-compromised patients and pregnant women. These groups suffer higher incidence, morbidity, and mortality. The effect of foodborne disease may extend beyond the immediate illness. The most commonly identified pathogens are *Campylobacter* spp., *Salmonella* spp. and *Shigella* spp. These organisms have evolved and now have greater cold, heat, and acid tolerance, as well as resistance to multiple antibiotics. Increased drug resistance has been associated with prolonged illness and a greater risk of hospitalization.

2. Foods Associated with Foodborne diseases

- Raw foods of animal origin, that is, raw meat and poultry, raw eggs, unpasteurized milk, and raw shellfish are the most likely to be contaminated.
- Fruits and vegetables can also be contaminated with animal waste when manure is used to fertilize produce in the field, or unclean water is used for washing the produce.

- Raw sprouts are particularly concerning because the conditions under which they are sprouted are ideal for growing microbes.
- Unpasteurized fruit juices or cider can also be contaminated if there are pathogens on the fruit that is used to make it.
- Any food item that is touched by a person who is ill with vomiting or diarrhea, or who has recently had such an illness, can become contaminated. When these food items are not subsequently cooked (e.g., salads, cut fruit) they can pass the illness to other people.

3. Epidemiology of food borne diseases

Previous outbreaks of foodborne disease were smaller and limited in scope, more often originated in the home, and were associated with *Staphylococcus* or *Clostridium* spp. Family picnics or dinners and home-canned foods were the typical sources for the outbreaks. Today, many people dine outside the home and travel more extensively. As a result, more than 80% of foodborne disease cases occur.

Technology has provided the means for mass production and distribution of food. Therefore, foodborne disease often occurs on a massive scale, whereby hundreds or thousands are exposed and may become ill. Mobility and travel have resulted in exposure to foods abroad, where regulation of food safety and food products for sale may vary. When traveling, the axiom “boil it, peel it, cook it, or forget it” remains true in many areas of the world.

Unique ethnic food preferences and preparation have been associated with several food-related illnesses. One example is the African American tradition of eating chitterlings (cooked swine intestines) during the holiday season. This food has been associated with an outbreak of *Yersinia enterocolitica* infection in infants. Fresh cheese made from unpasteurized milk has been associated with episodes of listeriosis.

Almost any food can be a source of foodborne disease. Some foods are more commonly associated with particular organisms. *Salmonella* has traditionally been associated with poultry and eggs, *Campylobacter* with chicken and unpasteurized milk.

Water may be the vector of illness when contaminated with viruses, bacteria, parasites, or chemicals. Crowding, poor sanitation, disruption of water supplies, and natural disasters are closely linked to waterborne illness. Viruses are the most common cause of waterborne illness and include *rotaviruses*, *enteric adenovirus*, *astrovirus*, *caliciviruses* and *hepatitis A virus*. Outbreaks of gastroenteritis aboard cruise ships in recent years were a result of noroviruses. *Salmonella* spp., *Shigella* spp., *E. coli*, and *Vibrio* spp. are the predominant bacterial pathogens involved. *Cryptosporidium* spp. and *Giardia lamblia* are the parasitic pathogens most commonly encountered in water-borne illness. Immuno-compromised hosts, particularly organ transplant recipients and HIV-infected patients, should exercise extra precaution in situations of potential waterborne illness.

Incubation periods of foodborne disease may offer clues to the cause. Four time frames may be envisioned: very brief, short, intermediate, and long durations of incubation. The very brief category (less than 8 hours) is generally caused by preformed toxins, which may be found in *staphylococcal* or *bacillus*-contaminated food. Short incubation periods (24-48 hours) are more typical of viral causes. Intermediate incubation periods (1-5 days) correlate with many bacterial pathogens. The long-duration incubation group (>5 days) approximates the time course of parasitic infections. These time frames are crude groupings and areas of overlap exist between them. In addition, the inoculum of organisms ingested may influence the incubation period and the rapidity of onset of illness—for example, a large inoculum may cause a shortened time to onset of illness.

4. Important food borne diseases

Salmonellosis

Salmonella is the most commonly identified bacterial cause of foodborne disease. It is estimated that 1.4 million cases occur annually. Fever, abdominal cramps, and diarrhea (occasionally bloody in a minority of cases) are the usual manifesting symptoms after 8 to 48 hours of incubation. Although generally self limited, *Salmonella* infection may cause sepsis and localized infections, such as septic arthritis and infection of endovascular prosthetic devices, such as grafts. The most common serotypes are *Salmonella typhimurium* and *S. enteritidis*.

Eggs remain a common source because of vertical transovarial transmission within an infected poultry flock. Poultry itself has become a significant source of *Salmonella* infection. Fruits, vegetables, meats, and ice cream are other reported food associations.

Populations at greatest risk are infants, older adults, and the immunocompromised, but also those with inflammatory bowel disease, and endovascular prosthetic devices. Patients older than 60 years have the highest rate of hospitalization and highest case-fatality rate. Antibiotic treatment should be considered for these high-risk groups because bacteremia may occur in 2% to 14% of cases. Unfortunately, increasing resistance to the usual antibiotics (cephalosporins, aminoglycosides, and fluoroquinolones) has made therapy more challenging.

***Campylobacter* infections**

Campylobacter is the second most common identified organism in foodborne disease. Over one million cases are estimated to occur annually. After a 2- to 5-day incubation period, acute dysentery ensues. Nearly two thirds of patients will have fever, and one half will have bloody diarrhea. Illness may last 1 week and then resolve spontaneously. Immunocompromised patients may experience life-threatening sepsis and therefore should receive aggressive therapy.

Age-related biphasic peaks of *Campylobacter* infection occur in infancy and early adulthood. Young men are more often affected because of poor food handling knowledge. Almost all human

illness is caused by one species, *Campylobacter jejuni*. Poultry is the overwhelming source. Additional food sources include raw milk, water, and ice cream.

Shigellosis

Although less common than *Salmonella* or *Campylobacter*, *Shigella* is a significant cause of foodborne disease. Shigellosis is responsible for 10% to 20% of cases of bacterial foodborne illness each year in the world. After 2 to 4 days of incubation, it produces an invasive dysentery syndrome that often includes fever and bloody diarrhea. Shiga toxins are frequently elaborated. Duration is typically 5 to 7 days. Fruits, vegetables, and shellfish are common food associations. Third-generation cephalosporins and fluoroquinolones are the antibiotics of choice; however, drug resistance may be encountered.

Shiga toxin-producing *E. coli* (STEC O157:H7) infections

Shiga toxin-producing *E. coli* infection was initially associated with ground beef. Multiple other food associations have been recognized, such as unpasteurized milk and dairy products, juices, and lettuce. In addition, this has been associated with non-foodborne illness after contact with cattle and swimming in contaminated lakes.

An estimated 60,000 to 70,000 cases occur annually, resulting in approximately 2000 hospitalizations and 60 to 70 deaths. The average incubation period is 4 to 8 days. Symptoms include abdominal cramps with bloody diarrhea but little or no fever. The diarrhea usually resolves within 1 week. Antibiotics appear to play no role in treatment, because the illness is the result of a Shiga toxin produced by the organism. It is more common in the young and older adults.

Listeriosis

Listeriosis is caused by *Listeria monocytogenes*. It is a much less common cause of foodborne disease, with approximately 2500 cases annually. However, it has the highest hospitalization and mortality rates of all foodborne diseases, with approximately 500 deaths each year. It strikes more often at the extremes of age, attacking the young and older adults, as well as those who are immunocompromised, causing a more severe illness in this population. Pregnant women are also at increased risk of infection. Manifestations appear to vary by host-related factors. Older adults and immunocompromised patients often present with sepsis and meningitis, whereas immunocompetent patients develop gastroenteritis. Pregnant women may experience a flulike illness, resulting in bacteremia, meningitis, or both in the newborn infant.

Listeriosis has been associated with meats, breads, soft cheeses, unpasteurized milk and dairy products. Illness follows a 1- to 2-day incubation period. Clinical symptoms include fever, gastrointestinal upset, and subsequent diarrhea. When treatment is needed, ampicillin appears to be the most effective antibiotic with the consultation of doctor.

***Vibrio* infection**

Vibrio foodborne disease tends to be seasonal, with a peak incidence in late summer and early autumn. Consumption of raw seafood from coast is the most common food association. *V. parahaemolyticus* and *V. vulnificus* are the most frequent species isolated. They are halophilic and cold-tolerant organisms, which allow *Vibrio* to survive in conditions that may normally retard or prevent food contamination.

A clinical syndrome of watery diarrhea, abdominal cramping, nausea, vomiting, and fever occurs 1 to 4 days after ingestion. The illness is usually self limited, with resolution in about 3 days. Persons with liver disease may develop a severe sepsis syndrome, with 50% mortality. *Vibrio cellulitis* and wound infections are occupational risks for fishermen and oyster shuckers.

Yersiniosis

Yersiniosis is an uncommon cause of foodborne disease. It has been associated with the consumption of raw pork, unpasteurized milk and dairy products, and contaminated water. The preparation, handling, or consumption of chitterlings (small intestines of a pig, cattle and other animals) has been associated with *Yersinia* infections.

The incubation period is 4 to 7 days and is followed by fever, abdominal pain, and bloody diarrhea. The abdominal pain may mimic that of appendicitis. Additional manifestations include carditis, joint pain, and sepsis. Although most cases resolve spontaneously, severe cases may require medical therapy.

Protozoan food borne diseases

Parasites are an uncommon form of foodborne illness. The most frequent causes include *Cryptosporidium* spp. and *Giardia lamblia*, which have been associated with contaminated water. Additional foodborne diseases include cyclosporiasis, trichinosis, toxoplasmosis, and amebiasis. Cyclosporiasis has been previously linked to imported raspberries. Trichinosis was traditionally linked to pork but can be contracted through other sources, such as inadequately cooked food. Toxoplasmosis has been most often associated with undercooked meat and amebiasis is associated with contaminated water. Cryptosporidiosis may be difficult to treat.

Food borne diseases through Toxins

Foodborne disease caused by toxins may have a variety of presentations that include gastrointestinal symptoms, neurologic manifestations, or both. Preformed heat-stable enterotoxins associated with *Staphylococcus aureus* and *Bacillus cereus* have an acute onset of nausea, vomiting, and diarrhea within 1 to 6 hours of ingestion. Fever is not a common component of this self-limited syndrome. Symptoms resolve rapidly, often within 12 hours.

Clostridium perfringens has a slower onset of illness, occurring approximately 12 hours after ingestion, because the heat-labile enterotoxin is produced in vivo after consumption of contaminated food. Cramping and diarrhea are the major manifestations, with resolution of symptoms in about 24 hours.

Botulinus toxin is considered the most potent lethal substance known. It is produced by *Clostridium botulinum*. Illness occurs 18 to 36 hours after ingestion of the source food. Home-canned foods have been the traditional sources. The onset of illness is heralded by nausea, vomiting, and diarrhea, followed by constipation. A descending paralysis then occurs. Antitoxins are available but only prevent further progression of paralysis because they neutralize circulating toxin and have no effect on bound toxin. Foodborne botulism carries a 5% to 10% mortality rate. If the individual survives, many months may be required before recovery.

Marine bacteria present on the surface of some fish produce inhibitors of histamine degradation, resulting in high levels of histamine. When they are consumed, scombroid poisoning (histamine fish poisoning) may occur. The syndrome resembles a histamine reaction, with flushing, headache, nausea, vomiting, cramping, and burning in the mouth and throat. Poisoning by ciguatera fish such as grouper and snapper produces nausea, vomiting, and diarrhea. Shellfish poisoning causes a similar syndrome except that muscle weakness, paralysis, or amnesia may occur in severe cases. The neurologic manifestations resolve in hours to a few days.

Mushroom poisoning can produce various clinical syndromes. Onset is rapid, within 2 hours of ingestion, and resolution of symptoms occurs in approximately 24 hours. Organ failure may follow after an additional 1 to 2 days. Without emergent liver transplantation, acute hepatic failure rapidly leads to death.

Viral food borne diseases

Hepatitis A and *Norwalk* virus are the two most commonly identified viral sources of foodborne disease. Many additional cases of foodborne disease occur as a result of unidentified viruses. *Hepatitis A* is often associated with shellfish and infected food handlers. Proper knowledge of food handling, storage, and preservation could have a significant impact on the occurrence of this common problem. Improved conditions in mass production and processing of foods have produced tangible results. New methods of sterilization, such as irradiation, represent avenues of future progress.

5. Diagnosis of food borne pathogens

Diagnosis is accomplished through a careful history, physical examination, and laboratory evaluation. The history should include questioning about the suspected time of exposure, recent travel, the food and drink consumed, other people who may have been present and eaten similar foods, and the specific symptoms involved (e.g., nausea, vomiting, diarrhea with or without visible blood, cramping, gas, fever, neurologic symptoms, alteration of mental status). Dietary

history may include intake during the last 2 to 3 weeks. The physical examination should focus on vital signs, including orthostatic measurements, skin turgor, mental status, abdominal findings, and stool testing for blood. Fresh stool samples for culture and analysis (less than 6 hours old) provide the highest yield. The clinician must be knowledgeable of the laboratory's assay procedures to facilitate proper sample testing. Specific culture requests for suspected organisms may be necessary, as well as microscopic examination of stool samples for parasites. Three samples on different days will generally provide adequate diagnostic results. Special circumstances may dictate the need to perform special assays for toxins (e.g., botulinum toxin) on gastric aspirates or stool samples. Blood cultures are often useful, particularly if Salmonellosis or Listeriosis is suspected or when evaluation involves high-risk groups and immunocompromised hosts.

6. Description and Treatment

Most foodborne disease is self limited and requires only supportive care. The very young, older adults, immunocompromised patients, and pregnant women may benefit from antibiotic treatment for certain bacterial or parasitic infections. Drug-resistant pathogens require knowledge of regional, national, and international patterns of resistance to allow appropriate empirical selection of therapy.

Conclusion

- Viruses and bacteria are responsible for the vast majority of food borne diseases.
- The time course of onset from ingestion to illness can be useful in establishing the cause.
- Certain food groups are associated with particular pathogens.
- Supportive care is sufficient for most cases but antibiotics may be lifesaving in others.
- Proper food handling, preparation, and hand hygiene can prevent most food borne illnesses.