

# ***Common Foodborne Diseases: Causes, Diagnosis & Treatment***

***2.0 Contact Hours***

***Presented by:***

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# **Common Foodborne Diseases: Causes, Diagnosis & Treatment**

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*The contents of this course are taken from the U.S. Department of Health & Human Services, National Institute of Allergy and Infectious Diseases. Learning objectives and post test have been prepared by Dr. Ratnakar P. Kini*

## **Campylobacteriosis**

### **OVERVIEW**

Campylobacteriosis is an infectious disease caused by eating or handling contaminated food or drinking contaminated beverages. Health care providers report more than 10,000 cases to the Centers for Disease Control and Prevention (CDC) yearly, of which about 100 people die. It occurs more frequently in summer than winter.

Infectious diseases spread through food or beverages are a common, distressing, and sometimes life-threatening problem for millions of people in the United States and around the world. CDC estimates 76 million people suffer foodborne illnesses each year in the United States, accounting for 325,000 hospitalizations and more than 5,000 deaths.

Foodborne disease is extremely costly. Health experts estimate that the yearly cost of all foodborne diseases in this country is 5 to 6 billion dollars in direct medical expenses and lost productivity.

There are more than 250 known foodborne diseases. They can be caused by bacteria, viruses, or parasites. Natural and manufactured chemicals in food products also can make people sick. Some diseases are caused by toxins (poisons) from the disease-causing microbe (germ), others by the human body's reactions to the microbe itself.

To better understand the epidemiology (study of disease origin and spread) of foodborne diseases in the United States, 10 states across the country are collecting annual data on the occurrence of new cases of the most common causes of bacterial and parasitic infections through the Foodborne Diseases Active Surveillance Network, a CDC-sponsored program known as FoodNet ([www.cdc.gov/foodnet](http://www.cdc.gov/foodnet)).

Recently, public health, agriculture, and environmental officials have expressed growing concern about keeping the nation's food and water supply safe from terrorist acts. A number of U.S. agencies, including the National Institutes of Health, CDC, Food and Drug Administration, U.S. Department of Agriculture, and U.S. Environmental Protection Agency, are studying this bioterrorism threat.

## **CAUSE**

Campylobacteriosis is caused by bacteria called *Campylobacter*. *Campylobacter jejuni*, *C. fetus*, and *C. coli* are the types that usually cause the disease in people.

*C. jejuni* causes most cases of this foodborne disease. According to CDC, *C. jejuni* is the leading cause of bacterial diarrheal illness in the United States, affecting about 2.4 million people every year. The bacteria cause between 5 and 14 percent of all diarrheal illness worldwide. *C. jejuni* primarily affects children less than 5 years old and young adults (15 to 29 years old).

## **TRANSMISSION**

You can get infected with *Campylobacter* from handling raw poultry, eating undercooked poultry, drinking nonchlorinated water or raw milk, or handling infected human or animal feces. Most frequently, poultry and cattle waste are the sources of the bacteria, but feces from puppies, kittens, and birds also may be contaminated with the bacteria.

## **SYMPTOMS**

If you are infected with *Campylobacter*, you may have no symptoms. If you do, they can include

- Diarrhea (often bloody)
- Abdominal cramping and pain
- Nausea and vomiting
- Fever
- Tiredness

Campylobacteriosis usually lasts for 2 to 5 days, but in some cases as long as 10 days. Rarely, some people have convulsions with fever or meningitis (inflammation of the lining of the spinal cord).

## **DIAGNOSIS**

Your health care provider can use laboratory tests to identify *Campylobacter* in your stool if you are infected.

## **TREATMENT**

If you are like most people infected with *Campylobacter*, you will get better with no special treatment. If you need treatment, your health care provider can prescribe an antibiotic such as ciprofloxacin or azithromycin. Erythromycin helps treat diarrhea caused by *Campylobacter*. If you have diarrhea, be sure to drink plenty of water.

## PREVENTION

- Wash hands before preparing food.
- Wash hands immediately after handling raw poultry or other meat.
- Wash thoroughly with soap and hot water all food preparation surfaces and utensils that have come in contact with raw meat.
- Cook poultry products to an internal temperature of 170 degrees Fahrenheit for breast meat and 180 degrees Fahrenheit for thigh meat.
- Don't drink unpasteurized milk and water that isn't chlorinated or boiled.
- Wash hands after handling pet feces or visiting petting zoos.

## COMPLICATIONS

Some people infected with *Campylobacter* develop arthritis. A small number of people may develop Guillain-Barré Syndrome (GBS), the leading cause of acute paralysis in this country. This rare condition develops from 2 to 4 weeks after *Campylobacter* infection and usually after diarrheal symptoms have disappeared. People with GBS suffer from increasing paralysis of the limbs which lasts for several weeks. In more severe cases, they develop breathing problems requiring very long hospital stays.

## RESEARCH

Basic research is helping scientists to better understand how pathogens spread by contaminated food or water cause disease in humans. National Institute of Allergy and Infectious Diseases (NIAID)-supported researchers are studying the bacterial genes that help pathogens establish themselves in the human body and cause disease. For example, scientists have identified genes that appear to be involved in signaling certain immune system cells to cause inflammation and may contribute to the development of diarrhea.

Other NIAID-sponsored research focuses on methods by which the organism grows and interacts in host cells. Scientists have discovered that some intestinal bacteria recognize when they are in a human host and respond by activating a particular set of powerful genes that enable the organism to live in the host and cause disease. Future studies will define new ways to intervene, whether by prevention or treatment, in the disease process.

In addition to the genomic studies mentioned above, scientists have determined the complete genome (group of genes) sequences for *Salmonella typhi*, *S. typhimurium*, and *C. jejuni*. Sequencing studies are underway for *Shigella*, *Yersinia*, as well as other harmful strains of *E. coli*. Scientists hope this new information will speed the discovery of new targets for treatments and vaccines against foodborne pathogens.

# Foodborne Botulism

## OVERVIEW

Botulism is a rare but serious illness. Each year, U.S. health care providers report an average of 110 cases of food, infant, and wound botulism to Centers for Disease Control and Prevention (CDC). About 10 to 30 outbreaks of foodborne botulism are reported annually. Although this illness does not occur frequently, it can be fatal if not treated quickly and properly. This fact sheet will focus on botulism caused by eating contaminated food.

Infectious diseases spread through food or beverages are a common, distressing, and sometimes life-threatening problem for millions of people in the United States and around the world. CDC estimates 76 million people suffer foodborne illnesses each year in the United States, accounting for 325,000 hospitalizations and more than 5,000 deaths.

Foodborne disease is extremely costly. Health experts estimate that the yearly cost of all foodborne diseases in this country is 5 to 6 billion dollars in direct medical expenses and lost productivity.

There are more than 250 known foodborne diseases. They can be caused by bacteria, viruses, or parasites. Natural and manufactured chemicals in food products also can make people sick. Some diseases are caused by toxins (poisons) from the disease-causing microbe (germ), others by the human body's reactions to the microbe itself.

To better understand the epidemiology (study of disease origin and spread) of foodborne diseases in the United States, 10 states across the country are collecting annual data on the occurrence of new cases of the most common causes of bacterial and parasitic infections through the Foodborne Diseases Active Surveillance Network, a CDC-sponsored program known as FoodNet ([www.cdc.gov/foodnet](http://www.cdc.gov/foodnet)).

Recently, public health, agriculture, and environmental officials have expressed growing concern about keeping the nation's food and water supply safe from terrorist acts. A number of U.S. agencies, including the National Institutes of Health, CDC, Food and Drug Administration (FDA), U.S. Department of Agriculture, and U.S. Environmental Protection Agency, are studying this bioterrorism threat.

## CAUSE

Botulism is caused by toxin produced by *Clostridium botulinum* bacteria. This toxin affects your nerves and, if untreated, can cause paralysis and respiratory failure. *C. botulinum* toxin is one of the most powerful toxins known in nature. Exposure to the toxin, particularly in an aerosolized (spray) form, can be fatal. *C. botulinum* has been made into weapons by rogue states and is a focus of current efforts to counter bioterrorism.

## **TRANSMISSION**

Often, cases of foodborne botulism come from home-canned foods with low acid content, such as asparagus, green beans, beets, and corn. *C. botulinum* is anaerobic, which means it can survive and grow with little or no oxygen. Therefore, it can live very well in sealed containers. Outbreaks of the infection, however, are often from more unusual sources such as chili peppers, tomatoes, and improperly handled baked potatoes wrapped in aluminum foil.

## **SYMPTOMS**

- Double vision and drooping eyelids
- Slurred speech
- Dry mouth and difficulty swallowing
- Weak muscles

Symptoms of foodborne botulism usually begin within 18 to 36 hours after you eat contaminated food, but can occur in as few as 6 hours or as much as 10 days afterward.

## **DIAGNOSIS**

A health care provider can use laboratory tests to identify *C. botulinum* toxin in your blood or stool if you are infected.

## **TREATMENT**

If you are diagnosed early, your health care provider can treat foodborne botulism successfully with an antitoxin that blocks the action of the bacterial toxin circulating in your blood. Although antitoxin keeps the disease from becoming worse, it will still take many weeks before you recover. Your health care provider may try to remove any contaminated food still in your gut by making you vomit or by giving you an enema.

## **PREVENTION**

- Follow strict hygienic steps when home canning.
- Refrigerate oils containing garlic or herbs.
- Keep baked potatoes wrapped in aluminum foil either hot until served or refrigerated.
- Consider boiling home-canned food before eating it to kill any bacteria lurking in the food.

## **COMPLICATIONS**

If left untreated, this illness can cause paralysis of the arms, legs, trunk, and the muscles that help you breathe. The paralysis usually improves slowly over several weeks. People

who develop severe botulism experience breathing failure and paralysis and need to be put on ventilators (breathing machines).

## **RESEARCH**

Basic research is helping scientists to better understand how pathogens spread by contaminated food or water cause disease in humans. National Institute of Allergy and Infectious Diseases (NIAID)-supported researchers are studying the bacterial genes that help pathogens establish themselves in the human body and cause disease. For example, scientists have identified genes that appear to be involved in signaling certain immune system cells to cause inflammation and may contribute to the development of diarrhea.

Other NIAID-sponsored research focuses on methods by which the organism grows and interacts in host cells. Scientists have discovered that some intestinal bacteria recognize when they are in a human host and respond by activating a particular set of powerful genes that enable the organism to live in the host and cause disease. Future studies will define new ways to intervene, whether by prevention or treatment, in the disease process.

## **Foodborne *E. coli***

### **OVERVIEW**

#### ***E. coli***

Outbreaks of foodborne disease caused by *E. coli* (*Escherichia coli*) bacteria have become a serious problem in this country. *E. coli* O157:H7 (one type of the bacteria) has caused illness and major disease outbreaks in the United States. The Centers for Disease Control and Prevention (CDC) estimates 73,000 cases of infection with *E. coli* O157:H7 and 61 deaths occur in this country each year.

#### ***Foodborne Diseases***

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microbe (germ), others by the human body's reactions to the microbe itself. To better understand the epidemiology (study of disease origin and spread) of foodborne diseases in the United States, 10 states across the country are collecting annual data on the occurrence of new cases of the most common causes of bacterial and parasitic infections through the Foodborne Diseases Active Surveillance Network, a CDC-sponsored program known as FoodNet .

Recently, public health, agriculture, and environmental officials have expressed growing concern about keeping the nation's food and water supply safe from terrorist acts of introducing foodborne microbes. A number of U.S. agencies, including the National Institutes of Health, CDC, Food and Drug Administration, U.S. Department of Agriculture, and U.S. Environmental Protection Agency, are studying this bioterrorism threat.

## CAUSE

While there are many types of *E. coli* bacteria, only certain types cause foodborne illness. Hundreds of harmless strains of *E. coli* can be found widely in nature, including the intestinal tracts of humans and other warm-blooded animals. Disease-causing strains, however, are a frequent cause of both intestinal and urinary-genital tract infections.

In 1982, scientists identified the first dangerous foodborne strain in the United States. The type of harmful foodborne *E. coli* most commonly found in this country is called O157:H7, which refers to chemical compounds found on the bacterium's surface. Cattle are the main sources of *E. coli* O157:H7, but these bacteria can be found in other domestic and wild mammals.

Several different strains of harmful *E. coli* can cause diarrheal disease.

- Particularly dangerous types *E. coli*, such as *E. coli* O157:H7, produce one or more Shiga toxins that can severely damage the lining of your intestines and kidneys. These types of strains are called Shiga toxin-producing *E. coli* (STEC). STEC often causes bloody diarrhea and can lead to kidney failure in children or people with weakened immune systems.
- Enterotoxigenic *E. coli* (ETEC), which produce a different toxin, can cause diarrhea. These strains typically cause so-called travelers' diarrhea because they commonly contaminate food and water in developing countries.
- Enteropathogenic *E. coli* (EPEC) cause persistent diarrhea (lasting 2 weeks or more) and are more common in developing countries where they can be transmitted to humans through contaminated water or contact with infected animals.

Other types of *E. coli*, including O26:H11 and O111:H8, also have been found in the United States and can cause disease in people.

## **TRANSMISSION**

*E. coli* O157:H7 and its toxins have been found in certain foods and liquids.

- Undercooked or raw hamburgers
- Salami
- Alfalfa sprouts
- Lettuce
- Unpasteurized milk, apple juice, and apple cider
- Contaminated well water

Other ways you can get infected with *E. coli* include

- Swallowing unchlorinated or underchlorinated water in swimming pools contaminated by human feces
- Swimming in sewage-contaminated water
- Having direct contact with an infected family member
- Having direct contact with infected child in a child care center

## **SYMPTOMS**

*E. coli* O157:H7 toxin can damage the lining of your intestines and cause other symptoms including

- Nausea
- Severe abdominal cramps
- Watery or very bloody diarrhea
- Fatigue

You might develop low-grade fever or vomiting. Symptoms usually begin from 2 to 5 days after you eat contaminated food or drink contaminated liquids and may last for 8 days. You should recover completely from the disease.

## **DIAGNOSIS**

Your health care provider can use lab tests to identify *E. coli* O157:H7 or Shiga toxin in your stool if you are infected. CDC recommends that any one who suddenly has diarrhea with blood get their stool tested for *E. coli* O157:H7.

## **TREATMENT**

If you are like most people infected with *E. coli* O157:H7, you will get better within 5 to 10 days without treatment. Antibiotics are usually not helpful, and health care experts don't recommend taking antidiarrheal medicines.

## **PREVENTION**

- Wash your hands thoroughly after going to the bathroom or changing diapers.
- Eat only thoroughly cooked ground beef.
- Cook ground beef products to an internal temperature of 160 degrees Fahrenheit.

- Avoid unpasteurized milk and juices.
- Wash fresh fruits and vegetables thoroughly before eating raw or cooked.
- Keep raw meat separate from ready-to-eat foods.

## **COMPLICATIONS**

Hemolytic uremic syndrome (HUS), a serious complication of STEC, can lead to kidney failure. In North America, HUS is the most common cause of acute kidney failure in children, who are particularly prone to this complication. This life-threatening condition is usually treated in an intensive care unit of a hospital, sometimes with blood transfusions and kidney dialysis.

About 8 percent of people with HUS have other lifelong complications, such as high blood pressure, seizures, blindness, paralysis, and the effects of having part of their intestines removed.

## **RESEARCH**

Scientists at the National Institute of Allergy and Infectious Diseases (NIAID) and NIAID-supported scientists are using basic, clinical, and applied research to better understand how to detect, treat, and prevent foodborne diseases.

Basic research is helping scientists to better understand how pathogens (germs) in contaminated food or water cause disease in humans. NIAID-supported researchers are studying the bacterial genes that help pathogens establish themselves in the human body and cause disease. For example, scientists have identified genes that appear to be involved in signaling certain immune system cells to cause inflammation and may contribute to the development of diarrhea.

Other NIAID-sponsored research focuses on methods by which an organism grows and interacts in host cells. Scientists have discovered that some intestinal bacteria recognize when they are in a human host and respond by activating a particular set of powerful genes that enable the organism to live in the host and cause disease. Future studies will define new ways to intervene, whether by prevention or treatment, in the disease process.

### ***E. coli***

NIAID supports several research studies on STEC, including *E. coli* O157:H7. Researchers have sequenced the genome (group of genes) of *E. coli* O157:H7 and compared it with the genome of the harmless *E. coli* K12. Seventy percent of the two genomes are identical, and the genome of *E. coli* O157:H7 is about 30 percent larger than K12. As researchers compare and contrast these and other strains of *E. coli*, their ability to answer key questions in evolution and disease processes will become easier.

Researchers are developing and testing monoclonal antibodies to treat STEC infection, thus preventing HUS from developing. (Scientists use monoclonal antibodies as tools for attaching to specific protein molecules, such as toxins.) Investigators are further defining the ways by which the Shiga toxins produced by STEC result in the kidney damage

leading to HUS. The primary goal of this research is to better understand how kidney vascular (fluid-carrying vessels, such as blood vessels) disease progresses. Researchers are developing antitoxins that may help prevent HUS from developing in infected children. Researchers also are exploring vaccines to prevent STEC in animals and humans.

NIAID-supported scientists discovered that children with bloody diarrhea should not be treated with antibiotics. Antibiotics can lead to the release of more bacterial toxins and further kidney damage, including subsequent HUS.

## Salmonellosis

### OVERVIEW

Salmonellosis, or salmonella, is one of the most common foodborne diseases. Overall, salmonella infections are decreasing in the United States but some types are still increasing.

Salmonella may occur in small, contained outbreaks in the general population or in large outbreaks in hospitals, restaurants, or institutions for children or the elderly. While the disease is found worldwide, health experts most often report cases in North America and Europe. Every year, the Centers for Disease Control and Prevention (CDC) receives reports of 40,000 cases of salmonellosis in the United States. The agency estimates that 1.4 million people in this country are infected, however, and that 1,000 people die each year with salmonellosis. People with AIDS are particularly vulnerable to salmonellosis—often suffering from recurring episodes.

Infectious diseases spread through food or beverages are a common, distressing, and sometimes life-threatening problem for millions of people in the United States and around the world. The CDC estimates 76 million people suffer foodborne illnesses each year in the United States, accounting for 325,000 hospitalizations and more than 5,000 deaths.

Foodborne disease is extremely costly. Health experts estimate that the yearly cost of all foodborne diseases in this country is 5 to 6 billion dollars in direct medical expenses and lost productivity. Infections with *Salmonella* bacteria alone account for \$1 billion yearly in direct and indirect medical costs.

There are more than 250 known foodborne diseases. They can be caused by bacteria, viruses, or parasites. Natural and manufactured chemicals in food products also can make people sick. Some diseases are caused by toxins (poisons) from the disease-causing microbe (germ), others by the human body's reactions to the microbe itself.

To better understand the epidemiology (study of disease origin and spread) of foodborne diseases in the United States, 10 states across the country are collecting annual data on the occurrence of new cases of the most common causes of bacterial and parasitic infections through the Foodborne Diseases Active Surveillance Network, a CDC-sponsored program known as FoodNet ([www.cdc.gov/foodnet](http://www.cdc.gov/foodnet)).

Recently, public health, agriculture, and environmental officials have expressed growing concern about keeping the nation's food and water supply safe from terrorist acts. A number of U.S. agencies, including the National Institutes of Health, CDC, Food and Drug Administration, U.S. Department of Agriculture, and U.S. Environmental Protection Agency, are studying this bioterrorism threat.

## **CAUSE**

Many types of *Salmonella* bacteria cause salmonellosis in animals and people. While the occurrence of different types of *Salmonella* varies from country to country, *S. typhimurium* and *S. enteritidis* are the two most commonly found in the United States.

An antibiotic-resistant strain of *S. typhimurium*, called Definitive Type 104 (DT104), was first found in the United Kingdom and then in the United States. It is the second most common strain (after *S. enteritidis*) of *Salmonella* found in humans. This strain poses a major threat because it is resistant to several antibiotics normally used to treat people with salmonella disease.

## **TRANSMISSION**

*Salmonella* bacteria can be found in food products such as raw poultry, eggs, and beef, and sometimes on unwashed fruit. Food prepared on surfaces that previously were in contact with raw meat or meat products can, in turn, become contaminated with the bacteria. This is called cross-contamination.

In recent years, CDC has received reports of several cases of salmonella from eating raw alfalfa sprouts grown in contaminated soil. You also can get salmonella after handling pets, particularly reptiles like snakes, turtles, and lizards.

*Salmonella* can become a chronic infection even if you do not have symptoms. In addition, though you may have no symptoms, you can spread the disease by not washing your hands before preparing food for others. In fact, if you know you have salmonella, health care experts recommend you do not prepare food or pour water for others until laboratory tests show you no longer carry *Salmonella* bacteria.

## **SYMPTOMS**

The following symptoms usually begin from 12 hours to 3 days after you are infected.

- Diarrhea

- Fever
- Abdominal cramps
- Headache

These symptoms, along with possible nausea, loss of appetite, and vomiting, usually last for 4 to 7 days.

Symptoms are most severe in the elderly, infants, and people with chronic conditions such as diabetes or HIV infection.

## **DIAGNOSIS**

Your health care provider can use laboratory tests to identify *Salmonella* in your stool if you are infected.

## **TREATMENT**

If you are like most people with salmonella, the disease will clear up within 5 to 7 days and you won't need to be treated. If you have severe diarrhea, however, you may need intravenous fluids. If the disease spreads from your intestines into your bloodstream, your health care provider can treat it with antibiotics such as ampicillin.

## **PREVENTION**

- Don't drink milk that is unpasteurized.
- Don't eat foods containing raw eggs, such as homemade caesar salad dressing, cookie dough, and hollandaise sauce, or drink homemade eggnog made with raw eggs.
- Handle raw eggs carefully.
  - Keep eggs refrigerated.
  - Throw away cracked or dirty eggs.
- Cook eggs thoroughly.
- Cook poultry products to an internal temperature of 170 degrees Fahrenheit for breast meat and 180 degrees Fahrenheit for thigh meat.
- Wash thoroughly with soap and hot water all food preparation surfaces and utensils that have come in contact with raw poultry or raw eggs.
- Wash hands immediately after handling raw poultry or raw eggs.
- Wash hands immediately after handling reptiles or having contact with pet feces.

## **COMPLICATIONS**

### ***Reiter's Syndrome***

While most people recover successfully from salmonella, a few may develop a chronic condition called Reiter's syndrome. This syndrome can last for months or years and can lead to arthritis. Its symptoms are painful joints, irritated eyes, and painful urination.

Unless treated properly, *Salmonella* bacteria can escape from the intestine and spread by blood to other organs, sometimes leading to death.

### ***Typhoid Fever***

*S. typhi* bacteria can cause typhoid fever, a more serious disease. This disease, which can be fatal if untreated, is not common in the United States. Typhoid fever frequently occurs in developing countries, with the infection coming from contaminated water. It's also a risk in areas where flooding or earthquakes cause sewer systems to overflow. Appropriate antibiotics usually are effective for treating typhoid fever, although the number of cases of antibiotic-resistant *S. typhi* are increasing in some parts of the world.

### **RESEARCH**

Basic research is helping scientists to better understand how pathogens spread by contaminated food or water cause disease in humans. National Institute of Allergy and Infectious Diseases (NIAID)-supported researchers are studying the bacterial genes that help pathogens establish themselves in the human body and cause disease. For example, scientists have identified genes that appear to be involved in signaling certain immune system cells to cause inflammation and may contribute to the development of diarrhea.

Other NIAID-sponsored research focuses on methods by which the organism grows and interacts in host cells. Scientists have discovered that some intestinal bacteria recognize when they are in a human host and respond by activating a particular set of powerful genes that enable the organism to live in the host and cause disease. Future studies will define new ways to intervene, whether by prevention or treatment, in the disease process.

In addition to the genomic studies mentioned above, scientists have determined the complete genome (group of genes) sequences for *Salmonella typhi*, *S. typhimurium*, and *Campylobacter jejuni*. Sequencing studies are underway for *Shigella*, *Yersinia*, as well as harmful strains of *E. coli*. Scientists hope this new information will speed the discovery of new targets for treatments and vaccines against foodborne pathogens.

Through preliminary tests of live, attenuated (containing weakened, live virus) *S. flexneri* vaccine candidates, scientists have discovered two new toxins that may contribute to the diarrhea associated with *Shigella* bacteria species. Studies are under way to find out how these toxins cause fluid loss. The findings will provide crucial information on how to improve attenuated vaccines to prevent shigellosis, another foodborne illness caused by bacteria.

# Shigellosis

## OVERVIEW

### *Shigellosis*

Shigellosis is an infectious disease, which can be spread through contaminated food and water, and is a form of dysentery (an intestinal disease). The Centers for Disease Control and Prevention (CDC) estimates more than 400,000 cases occur every year in the United States. Health care providers report about 18,000 cases to CDC each year.

### *Foodborne disease*

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## CAUSE

Shigellosis is caused by *Shigella* bacteria. Four main types of *Shigella* cause infection: *S. dysenteriae*, *S. flexneri*, *S. boydii*, and *S. sonnei*.

## **TRANSMISSION**

You can be infected from *Shigella* by

- Eating food or drinking beverages contaminated by food handlers infected with *Shigella* who didn't wash their hands properly after using the bathroom
- Eating vegetables grown in fields containing sewage
- Eating food contaminated by flies bred in infected feces
- Swimming in or drinking contaminated water

*S. sonnei* is the most common type of *Shigella* in developed countries, including the United States. Outbreaks of shigellosis frequently occur in tropical or temperate climates, especially in areas with severe crowding and/or poor hygiene that sometimes occur in daycare and institutional settings.

Even if you have no symptoms of shigellosis, you can still pass the bacteria to others. An extremely low number of bacteria (10 to 100) is needed to transmit the infection. Therefore, it is commonly transmitted by food handlers who are sick or infected, but have no symptoms, and who do not properly wash their hands after using the toilet. If you know you have shigellosis, you should not prepare food or beverages for others until laboratory tests show you no longer carry *Shigella* bacteria.

## **SYMPTOMS**

- Fever
- Tiredness
- Watery or bloody diarrhea
- Nausea and vomiting
- Abdominal pain

Symptoms usually begin within 2 days after you come in contact with *Shigella*. Symptoms usually are gone within 5 to 7 days.

## **DIAGNOSIS**

Laboratory tests can identify *Shigella* in your stool if you are infected. Sometimes, these tests are not performed unless the laboratory is instructed specifically to look for these bacteria. The laboratory can also do special tests to tell which type of *Shigella* you have and which antibiotics, if any, would be best to treat it.

## **TREATMENT**

If you have a mild infection, you should get better quickly without taking medicine. If you need to be treated, your health care provider usually will prescribe an antibiotic such as ampicillin or ciprofloxacin. Antidiarrheal medicines may make the illness worse.

## PREVENTION

- Wash hands with soap and water before preparing foods and beverages.
- Wash hands after using the bathroom or changing infant diapers.
- Disinfect diaper-changing areas after use.
- Help young children wash their hands carefully after they use the bathroom.
- Avoid swallowing swimming pool water.

## COMPLICATIONS

People who have diarrhea symptoms usually recover completely, although their bowel habits may not return to normal until several months later.

*S. dysenteriae* type 1 bacteria produce Shiga toxin and can lead to life-threatening hemolytic uremic syndrome (HUS), which can lead to kidney failure. In North America, HUS is the most common cause of acute kidney failure in children, who are particularly prone to this complication. This life-threatening condition is usually treated in an intensive care unit of a hospital, sometimes with blood transfusions and kidney dialysis. About 8 percent of people with HUS have other lifelong complications, such as high blood pressure, seizures, blindness, paralysis, and the effects from having part of their intestines removed due to the disease.

*S. flexneri* infection can progress to Reiter's syndrome, which can last for months or years and can lead to chronic arthritis. Its symptoms are painful joints, irritated eyes, and painful urination.

## RESEARCH

Basic research is helping scientists to better understand how pathogens spread by contaminated food or water cause disease in humans. National Institute of Allergy and Infectious Diseases (NIAID)-supported researchers are studying the bacterial genes that help pathogens establish themselves in the human body and cause disease. For example, scientists have identified genes that appear to be involved in signaling certain immune system cells to cause inflammation and may contribute to the development of diarrhea.

Other NIAID-sponsored research focuses on methods by which the organism grows and interacts in host cells. Scientists have discovered that some intestinal bacteria recognize when they are in a human host and respond by activating a particular set of powerful genes that enable the organism to live in the host and cause disease. Future studies will define new ways to intervene, whether by prevention or treatment, in the disease process.

Scientists have determined the complete genome (group of genes) sequences for *Salmonella typhi*, *Salmonella typhimurium*, and *C. jejuni*. Sequencing studies are underway for *Shigella*, *Yersinia*, as well as harmful strains of *E. coli*. Scientists hope this new information will speed the discovery of new targets for treatments and vaccines against foodborne pathogens.

Through preliminary tests of live, attenuated (containing weakened, live virus) *S. flexneri* vaccine candidates, scientists have discovered two new toxins that may contribute to the diarrhea associated with *Shigella*. Studies are under way to find out how these toxins cause fluid loss. The findings will provide crucial information on how to improve attenuated vaccines to prevent shigellosis.

Researchers are exploring vaccines to prevent *Shigella* infections in animals or humans. Scientists also are developing and testing monoclonal antibodies (tools for binding to specific protein molecules, such as toxins) to treat Shiga toxin infection, thus preventing hemolytic uremic syndrome (HUS) from developing. Investigators are further defining the ways by which the toxins produced by *Shigella* result in the kidney damage leading to HUS. The primary goal of this research is to better understand how kidney vascular disease progresses. In addition, researchers are developing antitoxins that may help prevent HUS from developing in infected children.

The NIAID enteric (intestinal) diseases program also supports basic and clinical research on other water- and foodborne pathogens, including *Helicobacter pylori*, *Yersinia*, *Listeria*, *Clostridia*, *Bacteroides*, *Staphylococcus*, and the effects of toxins on the intestinal tract.