

Appendix A: Waterborne Disease Cards

Case Background #1 Male, 44 years old. Symptoms occurred ten days after attending a family reunion at a campground. While camping, discovered that camp's sewage system was faulty and leaking into water supply. Symptoms: Began feeling tired with general aches and pains. Malaise (general weakness and discomfort) and is not eating. Developed high fever, became delirious. Sore abdomen with rose-colored spots on skin.	Case Background #2 Male, 18 years old. Returned from Thailand two weeks ago. Drank un-bottled water. Symptoms: Feverish, abdominal discomfort and tenderness (especially on the lower right side). Dysentery, gets tired easily, moderate weight loss.
Case Background #3 Female, 34 years old. Recently returned from a trip to Bangladesh. Symptoms occurred two days after eating fruit thoroughly washed at outdoor water pump. Family members have been coming down with these same symptoms. Symptoms: Severe dehydration, painless diarrhea, vomiting. Severe muscular cramps in arms, legs, hands and feet. Eyes appear shrunken; hands have dishwashing appearance or prune-like appearance.	Case Background #4 Female, 22 years old. Symptoms occurred two weeks after a backpacking trip. Filled water bottle with clear, fresh-tasting water from a stream below a beaver dam. Symptoms: Abdominal cramps, intermittent dysentery, excessive intestinal gas, malaise (general weakness and discomfort), weight loss.
Case Background #5 Male, 4 years old. Symptoms began 15 hours after bobbing for apples in pre-school class. Symptoms: Severe abdominal cramps, frequent, painful dysentery, blood and mucus in stool (poop). High fever, chills, and dehydration.	Case Background #6 Male, 40 years old. Just returned from visiting friends in Mexico. Symptoms began 12 hours after drinking several swallows of water from a bucket pulled from a well. Symptoms: Experiencing dehydration caused by diarrhea. General muscular pain and tenderness. Low-grade fever, nausea, vomiting, abdominal cramps.

Case Background #7 Female, 26 years old. Visited favorite beach and swam with friends. Sick for a week. Symptoms: Malaise (general weakness and discomfort), loss of appetite, fever, nausea, mild diarrhea, jaundice (yellowing of the skin and whites of eyes).	Case Background #8 Male, 55 years old. Lives on a ranch that raises cattle and chickens. Symptoms occurred 10 hours after drinking from pump outside of barn (ground water may have been contaminated by surface water in the pasture after heavy rain). Symptoms: Malaise (general weakness and discomfort), fever, abdominal cramps, nausea, vomiting.
Case Background #9 Female, 4 years old. Attends a daycare center five days a week. Recently swam in a local pond. Has a habit of sucking her thumb. Symptoms: Diarrhea, nausea and vomiting, fever.	Case Background #10 Female, 51 years old. Had eaten raw oysters served at a party Previously diagnosed with Hepatitis C. Symptoms: Fever, nausea, muscle aches, developed septic shock and died 1 day later.
Case Background #11 Male, 8 years old. Recently attended a classmate's birthday party. Symptoms: Blood in stool (poop), abdominal cramping, vomiting.	Case Background #12 Female, 19 years old. Recently at a family reunion at a campground. Ate food prepared by a recently sick person. Symptoms: Weakness, cough, tender stomach area.
Case Background #13 Male, 30 years old. Works at a boat dock but does not eat raw seafood. Drinks tap water and recently had a boil water alert in his neighborhood. Symptoms: Diarrhea, abdominal cramps, nausea and vomiting.	Case Background #14 Male, 32 years old. Had a fish hook stuck in his finger during a recent fishing trip. Symptoms: Painful swelling of the ring finger, fever and skin rash. His wedding ring needed to be cut off to relieve the swelling. Infection then spread up the arm, which was later amputated. He eventually recovered and was released from the hospital.

Typhoid Fever, caused by <i>Salmonella typhi</i> bacterium Now uncommon in the United States, this is usually acquired during foreign travel. During the first half of this century it was the most commonly reported cause of waterborne disease in the United States. It can be acquired by contact with contaminated water, swimming, etc. In 1973 a major outbreak of typhoid fever affected 225 people in a migrant labor camp in Dade County, Florida. The well that supplied water to the camp was contaminated by surface water. Symptoms: Weakness, stomach pain, headache, red spots, diarrhea or constipation, cough, loss of appetite. Sources: Spread from person to person through food, water, or direct contact.	
Cholera, caused by <i>Vibrio cholerae</i> bacterium This disease is extremely contagious; if untreated, dehydration can lead to death. Recent outbreaks of cholera have occurred throughout the United States. Along the Gulf Coast, water and seafood were identified as contributing to the outbreaks. In Louisiana, undercooked crab was the culprit, and in Texas in 1981, people were infected by eating cooked rice that had been washed with contaminated water. Symptoms: Watery diarrhea, vomiting, and leg cramps. Sources: Contaminated drinking water, rivers and coastal waters.	
Enterotoxigenic E. coli gastroenteritis caused by <i>E. coli</i> bacterium <i>E. coli</i> is the leading cause of infant death worldwide. Visitors to Latin American countries who partake of the food and water occasionally come down with “traveler’s diarrhea,” also known as “turista” or “Montezuma’s Revenge.” A large outbreak of this disease occurred in 1975 in Crater Lake National Park and about 200 park employees became ill after consuming water that had been contaminated by sewage. Symptoms: Diarrhea (may be bloody), abdominal pain, nausea, vomiting, fever. Sources: Undercooked ground beef, imported cheeses, unpasteurized milk or juice, cider, alfalfa sprouts.	

Giardiasis, caused by the *Giardia lamblia* protozoan

Sickness results with only a low dose of the protozoan; it is the most commonly reported cause of waterborne outbreaks. *Giardia* is found even in rivers and streams that look clean and clear.

Symptoms: Diarrhea, excess gas, stomach or abdominal cramps, and upset stomach or nausea.

Sources: Swallowing water contaminated with *Giardia*.

Salmonellosis, caused by species of *Salmonella* bacteria

This is carried by humans and many animals; wastes from both can transmit the organism to water and food. The largest waterborne salmonella outbreak reported in the United States was in Riverside, California, in 1965 and affected over 16,000 people.

Symptoms: Abdominal pain, headache, fever, nausea, diarrhea, chills, cramps.

Sources: Poultry, eggs, meat, meat products, milk, smoked fish, protein foods, juice.

Shigella, caused by species of *Shigella* bacteria

Most infection is seen in children 1-10 years old; a very low dose can cause illness. Waterborne transmission is responsible for a majority of the outbreaks.

Symptoms: Frequent bouts of watery diarrhea are the main symptom of shigellosis. Abdominal cramping, nausea, and vomiting may also occur. Many people who have shigellosis also have either blood or mucus in their stool, and they may run a fever.

Sources: Spread from person to person through food, water, or direct contact.

Cryptosporidiosis, caused by *Cryptosporidium*

This was first identified as a cause of diarrhea in people in 1976. It can be transmitted through contact with animals, (particularly cattle and sheep), other humans (especially in daycare centers), and contaminated water supplies.

Symptoms: Stomach cramps, dehydration, nausea, vomiting, fever, weight loss

Sources: Fecal matter of an infected person. Can survive for days in chlorinated pools.

Hepatitis A. caused by *Hepatitis A virus*

Third most common cause of waterborne disease in U.S. The term hepatitis relates to inflammation of the liver.

Symptoms: Fever, fatigue, stomach pain, nausea, dark urine, jaundice (yellow skin and eyes)

Sources: Ready-to-eat foods, fruit and juice, milk products, shellfish, salads, vegetables, sandwiches, water.

Complications caused by *Vibrio vulnificus*

Vibrio vulnificus is a bacterium in the same family as those that cause cholera. It normally lives in warm seawater. *V. vulnificus* can cause disease in those who eat contaminated seafood or have an open wound that is exposed to seawater.

In people with poor immune systems, particularly those with liver disease, *V. vulnificus* can infect the blood stream, causing severe and life threatening illness characterized by fever, chills, decreased blood pressure (septic shock) and skin blisters. *V. vulnificus* bloodstream infections are fatal about 50% of the time. *V. vulnificus* is most commonly found in the Gulf of Mexico, but has been reported throughout the world.

Symptoms: Vomiting, diarrhea, stomach pains, severe weakness, skin rashes and blisters, shaking, chills and high fever.

Sources: Seawater, eating contaminated seafood, exposing contaminated seawater to an open cut or wound.

Activity adapted from:

Hughes, R. (2007). Waterborne diseases. Interdisciplinary Learning for High School.
Retrieved from: pulse.pharmacy.arizona.edu/10th_grade/disease_epidemics/science/waterborne_diseases

Key:

Because many waterborne illnesses can present with similar symptoms, students may have other interpretations of the evidence. This key represents the most likely scenario for each case, but consider the strength of students' arguments and evidence as well.

1. Typhoid Fever
2. Cryptosporidiosis
3. Cholera

4. Giardiasis
5. Shigella
6. E. coli
7. Hepatitis A
8. Cryptosporidiosis
9. Shigella or E. coli
10. V. vulnificus
11. Shigella
12. Typhoid (connected to case #1)
13. Cryptosporidiosis
14. V. vulnificus