Learning Objectives

- Identify the three categories of pathogens that produce water-borne diseases.
- Provide one example of each pathogen, typical sources, and health problems.
- Summarize how water-borne diseases can be prevented and treated.
- Recall areas of the world where water is not properly sanitized.
- List foods and beverages that need to be avoided when using water that is not sanitized.
- Recall how long to boil water if under an advisory.
- Realize that boiling does not remove inorganics, metals, or organics.
- Besides boiling, discuss the chemical sanitation process of how to sanitize water at home (EPA method below).

Water Borne Diseases

If water is not cleaned properly, residents of a community can contract various illnesses. Viruses, bacteria, and parasites can enter a water supply unknowingly. All three of these species are pathogenic, or disease-causing. In the United States, the Environmental Protection Agency (EPA) quantifies and monitors these pathogens in water systems that serve at least 200 consumers. The EPA classifies these contaminants as being microorganisms (even though a biologist might dispute this terminology).
The Coalition for Global Community Health is working within existing social structures in Belén, Iquitos, Peru to uphold the human rights of the community members. We speak directly with community members in an open forum to learn about their needs, desires, and ideas for creating an opportunity to change their communities for the better.

The picture below shows how a person might contract Giardiasis from *giardia*, a parasite. This particular pathogen can live in a body up to six months. Once detected through a stool sample, a patient can be prescribed specific antibiotics like Flagyl to treat the infection. Unfortunately, there is no vaccine for preventing Giardiasis.
The table below shows water-borne diseases that can result from viruses, bacteria, and parasites. In some cases, vaccines are available. When eating, drinking, or swimming, it is important to be aware of how you could be affected by these pathogens. Sanitation of drinking water with chlorine-based compounds reduces the power of these pathogens. In addition, proper handling of foods and beverages could reduce your risk of developing one or more of the following health problems.

Table 1: Pathogens that cause waterborne illnesses.

<table>
<thead>
<tr>
<th>Pathogen Name</th>
<th>Pathogen Type</th>
<th>Source</th>
<th>Health problem</th>
<th>Prevention/Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giardia</td>
<td>Parasite</td>
<td>Fecal contamination and uncooked food</td>
<td>Vomiting, diarrhea, and cramps</td>
<td>Medication afterward</td>
</tr>
<tr>
<td>Cryptosporidium</td>
<td>Parasite</td>
<td>Fecal contamination</td>
<td>Vomiting, diarrhea, fever, and cramps</td>
<td>Medication afterward</td>
</tr>
<tr>
<td>Typhoid</td>
<td>Bacteria</td>
<td>Fecal contamination</td>
<td>High fever, stomach pains, headache, and rash</td>
<td>Vaccination/Antibiotics</td>
</tr>
<tr>
<td>E. coli</td>
<td>Bacteria</td>
<td>Fecal contamination</td>
<td>Diarrhea and cramps</td>
<td>Fluids</td>
</tr>
<tr>
<td>Legionella</td>
<td>Bacteria</td>
<td>Found naturally in heated water</td>
<td>Causes Legionnaires (a type of pneumonia)</td>
<td>Medications afterward</td>
</tr>
<tr>
<td>Pathogen Name</td>
<td>Pathogen Type</td>
<td>Source</td>
<td>Health problem</td>
<td>Prevention/Treatment</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------</td>
<td>---------------------------------------------</td>
<td>----------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>Cholera</td>
<td>Bacteria</td>
<td>Related to fecal contamination or undercooked or raw shellfish</td>
<td>Diarrhea</td>
<td>Vaccine/Rehydration, antibiotics, and Zinc</td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>Virus</td>
<td>Contaminated food and water</td>
<td>Vomiting, dark urine, and yellowing of the eyes.</td>
<td>Vaccination/Fluids</td>
</tr>
<tr>
<td>Polio</td>
<td>Virus</td>
<td>Fecal contamination</td>
<td>Flu symptoms, paralysis</td>
<td>Vaccination</td>
</tr>
</tbody>
</table>

When traveling to places that do not have comprehensive water sanitation procedures, it is important to avoid certain foods and beverages. Ice and tap water should be avoided to reduce risk of exposure to pathogens. In addition, vegetables and fruits that do not have a peel could cause water borne illness. If possible, purchase bottled water from a reputable company (Nestle is common in Asia and South America)

---

**Center for Disease Control (CDC) Sanitizing Information**

Water advisories may be declared if sanitation is compromised. In these situations, boiling, halogen disinfection, or filtration could be utilized to make water **potable** (drinkable). The Centers for Disease Control has developed a document to compare these different methods of sanitation. Look below to see the most effective ways to make water
Halogen based solids can be purchased at most home improvement stores, pool stores, Walmart, and Target. These chemicals will alter taste and smell of water. These chemicals are also needed when properly sanitizing a pool or a hot tub. Halogen tablets are quite cheap and an effective way for sanitizing any type of water.

**EPA: EMERGENCY DISINFECTION OF DRINKING WATER**

In an emergency situation where regular water service has been interrupted – like a hurricane, flood, or water pipe breakage – local authorities may recommend using only bottled water, boiled water, or disinfected water until regular water service is restored. The instructions below show you how to boil and disinfect water to kill most disease-causing microorganisms that may be present in the water. However, boiling or disinfection will not destroy other contaminants, such as heavy metals, salts, and most other chemicals.

**ONLY USE WATER THAT HAS BEEN PROPERLY DISINFECTED FOR DRINKING, COOKING, MAKING ANY PREPARED DRINK, WASHING DISHES, AND FOR BRUSHING TEETH.**

Use **bottled water** or water you have properly prepared and stored as an emergency water supply.

**Boil water**, if you do not have bottled water. Boiling is sufficient to kill pathogenic bacteria, viruses and protozoa (WHO, 2015).

- If water is cloudy, let it settle and filter it through a clean cloth, paper towel, or coffee filter.
- Bring water to a rolling boil for at least one minute. At altitudes above 5,000 feet (1,000 meters), boil water for three minutes.
- Let the water cool naturally and store it in clean containers with covers.
- To improve the flat taste of boiled water, add one pinch of salt to each quart or liter of water, or pour the water from one clean container to another several times.
Disinfect water using household bleach, if you can’t boil water. Only use regular, unscented chlorine bleach products that are suitable for disinfection and sanitization as indicated on the label. The label may say that the active ingredient contains 6 or 8.25% of sodium hypochlorite. Do not use scented, color safe, or bleaches with added cleaners.

- If water is cloudy, let it settle and filter it through a clean cloth, paper towel, or coffee filter.
- Locate a clean dropper from your medicine cabinet or emergency supply kit.
- Locate a fresh liquid chlorine bleach or liquid chlorine bleach that is stored at room temperatures for less than one year.
- Use the table on the next page as a guide to decide how much bleach you should add to the water, for example, add 8 drops of 6 % bleach or 6 drops of 8.25% bleach to each gallon of water. Double the amount of bleach if the water is cloudy, colored, or very cold.
- Stir and let stand for 30 minutes. The water should have a slight chlorine odor. If it doesn’t, repeat the dosage and let stand for another 15 minutes before use.
- If the chlorine taste is too strong, pour the water from one clean container to another and let it stand for a few hours before use.

<table>
<thead>
<tr>
<th>Volume of Water</th>
<th>Amount of 6% Bleach to Add†</th>
<th>Amount of 8.25% Bleach to Add†</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 quart/liter</td>
<td>2 drops</td>
<td>2 drops</td>
</tr>
<tr>
<td>1 gallon</td>
<td>8 drops</td>
<td>6 drops</td>
</tr>
<tr>
<td>2 gallons</td>
<td>16 drops (1/4 tsp.)</td>
<td>12 drops (1/4 tsp.)</td>
</tr>
<tr>
<td>4 gallons</td>
<td>1/3 tsp.</td>
<td>1/4 tsp.</td>
</tr>
<tr>
<td>8 gallons</td>
<td>2/3 tsp.</td>
<td>1/2 tsp.</td>
</tr>
</tbody>
</table>

†Bleach may contain 6 or 8.25% sodium hypochlorite

ADDITIONAL WATER GUIDANCE FOR EMERGENCIES

Prepare and store an emergency water supply. Visit the Federal Emergency Management Agency (FEMA) website for additional guidance on preparing and storing an emergency water supply.

Look for other sources of water in and around your home. Although bottled water is your best choice, you may be able to find other sources of water by melting ice cubes or draining your hot water tank or pipes. You can also use river or lake water. It is generally better to use flowing water than still, stagnant water. However, do not use water with floating material in it or water that has a dark color or questionable odor. Regardless of the source, treat the water by following the instructions above. If you have a well on your property that has been flooded, make sure to disinfect and test the well water after the flood. Contact your state or local health department for advice or go here.

Consider how the water looks and how to filter it if needed. Disinfection does not work as well when water is cloudy or colored. If water is cloudy, let it settle. Then filter the water through a clean cloth, paper towel, or coffee filter. Store the settled and filtered water in clean containers with covers.
OTHER DISINFECTION METHODS

If you don’t have liquid bleach, you can use one of the other disinfection methods described below.

- **Granular calcium hypochlorite.** The first step is to make a chlorine solution that you will use to disinfect your water. For your safety, do it in a ventilated area and wear eye protection. Add one heaping teaspoon (approximately ¼ ounce) of high-test granular calcium hypochlorite (HTH) to two gallons of water and stir until the particles have dissolved. The mixture will produce a chlorine solution of approximately 500 milligrams per liter. To disinfect water, add one part of the chlorine solution to every 100 parts of water you are treating. This is about the same as adding 1 pint (16 ounces) of the chlorine solution to 12.5 gallons of water. If the chlorine taste is too strong, pour the water from one clean container to another and let it stand for a few hours before use. CAUTION: HTH is a very powerful oxidant. Follow the instructions on the label for safe handling and storage of this chemical.

- **Common household iodine** (or “tincture of iodine”). You may have iodine in your medicine cabinet or first aid kit. Add five drops of 2% tincture of iodine to each quart or liter of water that you are disinfecting. If the water is cloudy or colored, add 10 drops of iodine. Stir and let the water stand for at least 30 minutes before use.

- **Water disinfection tablets.** You can disinfect water with tablets that contain chlorine, iodine, chlorine dioxide, or other disinfecting agents. These tablets are available online or at pharmacies and sporting goods stores. Follow the instructions on the product label as each product may have a different strength.

Safe Drinking Water Hotline: 1-800-426-4791 water.epa.gov/drink/hotline

Example \((\PageIndex{1})\):

1. Do all waterborne pathogens cause stomach illnesses?
2. If your community is under a water advisory, then how long should you boil tap water to kill pathogens?
3. Vaccinations and preventive medications can protect you from which pathogens?
4. When properly diluted, which common household cleaner can sanitize tap water?

Solutions

1. Legionella bacteria causes respiratory problems. Also, hepatitis and polio viruses do not produce stomach illnesses.
2. Water should be boiled rigorously for at least one minute to kill most pathogens.
3. Vaccines can be used to prevent: hepatitis, typhoid, cholera, and polio. In the United States, most children have been vaccinated from hepatitis and polio. When traveling to destinations that lack sanitized water, it would be beneficial to request prescription medications from your health care professional. Refer to the chart above regarding which diseases can be treated with medications.
4. A diluted (watered down) form of bleach (sodium hypochlorite) can be used to sanitize water. Please note the different types of bleach that can be purchased. In addition, do not use color safe or scented bleach.

Contributors and Attributions

- Elizabeth R. Gordon (Furman University)