Coliform Bacteria, Fecal Coliform, and *E. coli* in Water: What to Know

HOW DOES BACTERIA GET INTO MY WATER

Coliform bacteria are a large group of bacteria that are commonly found in nature. They are in soil, lakes, creeks, and human and animal waste. Fecal coliform bacteria are a type of coliform bacteria that live in the gut and waste of warm-blooded animals (e.g., humans, dogs, deer). One example of fecal coliform bacteria is *Escherichia coli*, commonly known as *E. coli*. While most types of coliform bacteria are harmless to humans, some can cause severe illness and death.[1]

As coliform bacteria are commonly found throughout the environment, any type of crack or entry into a water system can lead to coliform bacteria entering the water. This can include floods, broken pipes or water well parts, contact with septic water, broken water treatment systems, and more. Coliform bacteria are known as "indicator organisms" because they are a sign that the water may be contaminated with other disease-causing organisms. If water has fecal coliform bacteria, then human or animal waste has come in contact with the water, which may also contain other harmful bacteria, viruses, or parasites.

A 2012 study including 701 private wells in Pennsylvania discovered coliform bacteria was the most commonly found water contaminant, with 33% of samples testing positive. *E. coli* was also found in 14% of the samples.[2]

Breakdown of the Types of Coliform Bacteria

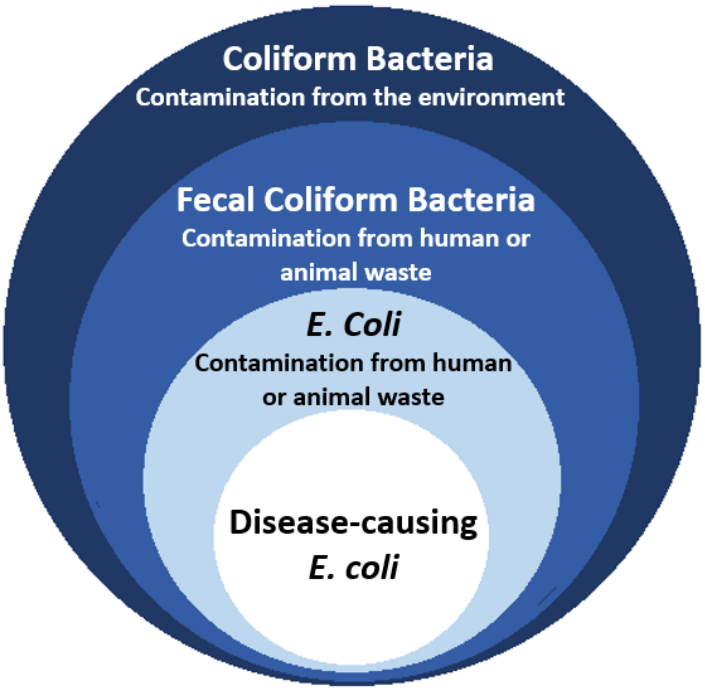


Figure 1: There are many types of coliform bacteria. Fecal coliform bacteria are one type of coliform bacteria. *E. coli* is one type of fecal coliform bacteria. Some strains of *E. coli,* but not all, can cause illness.

PUBLIC DRINKING WATER STANDARD

The U.S. Environmental Protection Agency (EPA) has various rules in place to make public water safe to use. Water supply companies regularly test for coliform bacteria, fecal coliform bacteria, and *E. coli*.[3] If bacteria are found, a boil water advisory may be issued while the problem is addressed. For specific information on the rules related to coliform bacteria in public drinking water, please refer to the EPA's Reference Guide. In Pennsylvania, public water systems may be managed by the municipality or a private company. To learn more about your drinking water quality, visit your water supplier's website.

PRIVATE WELLS

As of 2017, Pennsylvania has the highest population served by private wells in the country.[5] More than 3.5 million Pennsylvanians are served by private wells. Private wells are not regulated by the state, and it is the responsibility of the well owner to make sure the water is safe to use.[6]

It is recommended that well water be tested for coliform bacteria yearly. If coliform bacteria are found, the water should then be tested for fecal coliform bacteria and *E. coli*. Use an accredited laboratory from the PA Department of Environmental Protection's list of accredited labs to test your water.

The EPA recommends testing private well water for coliform bacteria in the following situations:

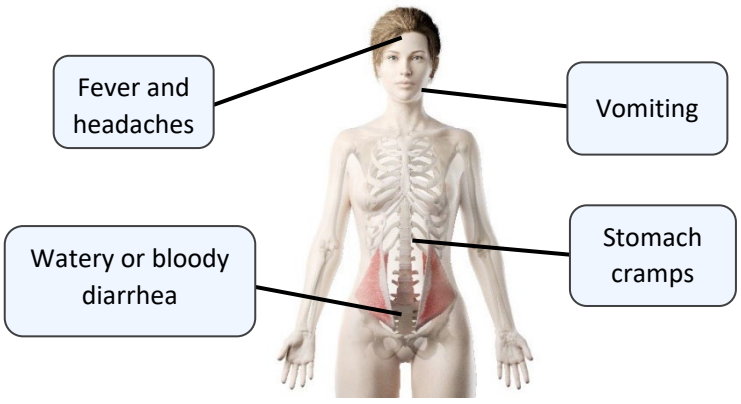
- Once a year for routine testing.
- When purchasing a new home with a private well that will be used for drinking water and/or for watering a vegetable garden.
- If drilling a new water well.
- If people are experiencing reoccurring stomach issues (including nausea, vomiting, and diarrhea).[7]
- If there are any changes to the water's taste, smell, or color.

Quick Facts:

- Not all coliform bacteria cause illness.
- There are many different strains of *E. coli*. Many will not harm health. *E. coli* O157:H7 is one example of a strain famous in the news for causing outbreaks.
- Some types of fecal coliform bacteria live in the human digestive system and help to digest food and produce vitamins.[4]
- Cleaning up after pets and livestock is important for keeping water sources clean. Animal waste is one example of how harmful organisms can get into the groundwater.
- Strains of *E.coli* that are not disease-causing are often used in middle and high school science experiments to learn about bacterial growth and antibiotic resistance.

COLIFORM BACTERIA AND HEALTH

While most coliform bacteria are harmless, their presence suggests other disease-causing organisms, such as harmful bacteria, viruses, or parasites, may also be in the water. Symptoms of exposure to disease-causing organisms (e.g., *E. coli, Salmonella, Campylobacter, Giardia*) commonly include stomach issues like stomach cramps, gas, diarrhea, and vomiting.[4] Other common symptoms are fatigue, weight loss, and fever. Infants, children, older adults, and immunocompromised individuals are more likely to get sick from disease-causing bacteria in drinking water.



The presence of coliform bacteria indicates other organisms may be in the water. This may include:

- Bacteria, viruses, and parasites that can cause dysentery. These symptoms include diarrhea, fever, nausea, vomiting, weight loss, and stomach cramps.
- Viruses that cause diseases such as hepatitis.
- Parasitic worms that cause chronic diarrhea.

PUBLIC HEALTH GUIDANCE

Coliform bacteria in drinking water means the water source has been contaminated at some point. There are recommended actions you can take in case other harmful organisms are in the water.

For preparing food, beverages, infant formula, and for brushing teeth, use boiled (rolling boil for 1 minute) or bottled water. When washing dishes with coliform-contaminated water, the following instructions are recommended:

1) After washing with soap and water, rinse with clean water (such as bottled or boiled water).
2) Soak the dishes for one minute in a sanitizing solution (make a sanitizing solution by adding one teaspoon of liquid bleach to one gallon of water).
3) Allow the dishes to air dry completely.

Water containing coliform bacteria can be used for showering and washing clothes as long as it is not swallowed. After showering with the water, wash your hands with soap and clean water. If children bathe in this water, it is recommended to use a sponge bath so that children do not incidentally ingest the water.

The table below provides additional information on acceptable water uses based on the presence of total coliform bacteria in water.

Total Coliform Bacteria Level	Overall Safety	Safe Oral Uses	Other Safe Household Uses
Not identified (0 col/100 mL)	Safe for all uses	All uses	All uses
Identified (≥ 1 col/100 mL)	Although most coliform bacteria will not harm health, it is recommended to treat the water as if it contains disease-causing organisms to be safe. This means the water should only be used for certain activities.	Not recommended for any use unless boiled first. This includes water used for cooking, drinking, preparing infant formula, brushing teeth, and any other oral use.	Bathing*, garden irrigation, washing dishes*, laundry

*Additional precautions are needed. Please follow the steps listed on the previous page if used for bathing children or washing dishes.

TREATMENT SYSTEMS

If coliform bacteria are found in well water, PA DOH recommends using a different drinking water source or installing a water treatment system to lower the chance of illness. The table below describes commonly used options to reduce coliform bacteria in drinking water and is organized by the most cost-friendly options listed first.

Remediation Type	Safe Uses	Additional Information
Bottled or boiled water	Drinking, Cooking, Brushing teeth, Baby formula	• There is an increased burden and cost when water is needed for cooking. • It may be difficult to obtain in the event of power outages, storms, or other emergencies. • Relying on bottled water as a primary drinking source increases plastic waste.
Shock chlorination	All household water uses	• There are times when coliform bacteria may enter the water source through a one-time event. Shock chlorination followed by retesting the water 10-14 days later would identify this possibility. • If the route of entry was not a temporary or one-time event, the water will continue to test positive for coliform bacteria and another method must be used. • Follow chlorination procedures closely and do not come in contact or consume the water until systems have been adequately flushed.

Remediation Type	Safe Uses	Additional Information
System maintenance and updates	All household water uses	• Sometimes the route bacteria use to enter the water source can be eliminated with maintenance or updates to the current well. This includes sloping the ground away from the casing, replacing the well cap with a better-fitting option, and more. Discuss with a water treatment company to learn more. • This may not fix all contamination issues. • Shock chlorination or another one-time method of removing the bacteria already present will need to be used after maintenance is complete.
Continuous disinfection	All household water uses	• This may include continuous chlorination or the installation of UV light if lower levels of coliform bacteria are detected. • Regular maintenance is required. • Periodic water testing to ensure proper system functioning is recommended.

ADDITIONAL INFORMATION

- CDC Frequently Asked Questions About Coliforms and Drinking Water
- EPA Revised Total Coliform Rule and Total Coliform Rule
- PA DOH How to Interpret Water Test Results
- PA DOH Private Well Water
- PA DEP Water Testing
- Penn State Extension Testing Your Drinking Water

CONTACT US

If you have any questions or concerns about coliform bacteria in your water, please contact the Division of Environmental Health Epidemiology at the PA DOH by calling **717-787-3350** or emailing us at **dehe@pa.gov**.

REFERENCES

1. Penn State Extension. (October, 2022). Coliform Bacteria https://extension.psu.edu/coliform-bacteria
2. Swistock, B., Clemens, S, & Rummel, S. (2013). Water Quality and Management of Private Drinking Water Wells in Pennsylvania. *Advancement of the Science,* 75(6). 60-67. https://www.jstor.org/stable/26329557
3. EPA. (January, 2024). National Primary Drinking Water Regulations. https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations
4. CDC. (May, 2024). E. coli Infection (Escherichia coli). https://www.cdc.gov/ecoli/about/kinds-of-ecoli.html
5. Gibson, J., Pieperz, K. (2017). Strategies to Improve Private-Well Water Quality: A North Carolina Perspective. *Environmental Health Perspectives*. https://ehp.niehs.nih.gov/doi/10.1289/EHP890#f1
6. Penn State Extension. (January, 2023). Private Water Systems FAQs. https://extension.psu.edu/private-water-systems-faqs
7. EPA. (May 2005). Home Water Testing. https://www.epa.gov/sites/default/files/2015-11/documents/2005_09_14_faq_fs_homewatertesting.pdf