



## Water: Basic Information about Regulated Drinking Water Contaminants

You are here: [Water](#) » [Drinking Water](#) » [Drinking Water Contaminants](#) » [Basic Information about Regulated Drinking Water Contaminants](#) » Basic Information about Pathogens and Indicators in Drinking Water

# Basic Information about Pathogens and Indicators in Drinking Water

To protect drinking water from disease-causing organisms, or pathogens, water suppliers often add a disinfectant, such as chlorine, to drinking water. However, disinfection practices can be complicated because certain microbial pathogens, such as *Cryptosporidium*, are highly resistant to traditional disinfection practices. Also, disinfectants themselves can react with naturally-occurring materials in the water to form byproducts, such as trihalomethanes and haloacetic acids, which may pose health risks.

A major challenge for water suppliers is how to control and limit the risks from pathogens and disinfection byproducts. It is important to provide protection from pathogens while simultaneously minimizing health risks to the population from disinfection byproducts. For more information, see fact sheets on [Disinfectants](#) and [Disinfection Byproducts](#).

- [What are pathogens?](#)
- [What pathogens does EPA regulate in drinking water, and what are their health effects?](#)
- [What are indicators?](#)
- [What indicators does EPA regulate in drinking water, and how do they reflect problems?](#)
- [What are EPA's drinking water regulations for pathogens and indicators?](#)
- [How do pathogens and indicators get into my drinking water?](#)
- [How will I know if pathogens are in my drinking water?](#)
- [How are pathogens and indicators removed from my drinking water?](#)
- [How do I learn more about my drinking water?](#)

### What are pathogens?

Inadequately treated water may contain disease-causing organisms, or pathogens. Pathogens include various types of bacteria, viruses, protozoan parasites, and other organisms.

If you are concerned about pathogens in a private well, please visit:

- [EPA's private drinking water wells website](#)
- [Water Systems Council website](#) [EXIT Disclaimer](#)

### What pathogens does EPA regulate in drinking water, and what are their health effects?

Pathogen	Definition and Health Effects <sup>1</sup>
<i>Cryptosporidium</i>	<i>Cryptosporidium</i> is a single-celled protozoan parasite commonly found in lakes and rivers, especially when the water is contaminated with sewage and animal waste. <i>Cryptosporidium</i> can cause gastrointestinal illness (e.g., diarrhea, vomiting, cramps).
<i>Giardia lamblia</i>	<i>Giardia lamblia</i> is a single-celled protozoan parasite that lives in the intestine of infected humans or animals. It is found on surfaces or in soil, food, or water that has been contaminated with the feces from infected humans or animals. <sup>2</sup> <i>Giardia lamblia</i> can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.
<i>Legionella</i>	<i>Legionella</i> bacteria are found naturally in the environment, usually in water. The bacteria grow best in warm water, like the kind found in hot tubs, cooling towers, hot water tanks, large plumbing systems, or parts of the air-conditioning systems of large buildings. <sup>3</sup> <i>Legionella</i> bacteria in water are a health risk if the bacteria are aerosolized (e.g., in an air conditioning system or a shower) and then inhaled. Inhalation can result in a type of pneumonia known as Legionnaires disease.
Viruses (enteric)	Enteroviruses are small viruses that live in the intestines of infected humans or animals. This group includes the polioviruses, coxsackieviruses, echoviruses, and other enteroviruses. In addition to the three different polioviruses, there are 62 non-polio enteroviruses that can cause disease in humans: 23 Coxsackie A viruses, 6 Coxsackie B viruses, 28 echoviruses, and 5 other enteroviruses. <sup>4</sup> Illness from viruses ranges from gastroenteritis caused by viruses such as rotavirus and norovirus (Norwalk-like virus) to meningitis caused by echovirus to myocarditis caused by Coxsackie B.

1. This health effects language is not intended to catalog all possible health effects for pathogens. Rather, it is intended to inform consumers of some of the possible health effects associated with pathogens in drinking water when the rule was finalized.
2. [Center for Disease Control and Prevention \(CDC\), "Giardiasis" fact sheet](#)
3. CDC, [Patient Facts: Learn More about Legionnaires' disease](#)
4. CDC, [Non-Polio Enterovirus Infections](#)

### What are indicators?

Indicators are physical, chemical, or other parameters whose presence at a level outside of specified limits may reflect a problem in the treatment process or in the integrity of the distribution system.

### What indicators does EPA regulate in drinking water, and how do they reflect problems?

Indicator	Description
Turbidity	Turbidity refers to cloudiness of water. Turbidity has no health effects, but can interfere with disinfection and provide a medium for microbial growth. Turbidity may indicate the presence of disease-causing organisms. These organisms include bacteria, viruses, and parasites that can

	cause symptoms such as nausea, cramps, diarrhea and associated headaches.
Total coliforms	Coliforms are bacteria that are naturally present in the environment and used as an indicator that other, potentially harmful, bacteria may be present. Coliforms found in more samples than allowed is a warning of potential problems.
Fecal coliform and <i>Escherichia coli</i> ( <i>E. coli</i> )	Fecal coliform and <i>E. coli</i> are bacteria whose presence indicates that water may be contaminated by human or animal wastes. Microbes in these wastes can cause short term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, and people with severely compromised immune systems.
Fecal indicators ( <i>Enterococci</i> or coliphage)	Fecal indicators are microbes whose presence indicates that the water may be contaminated with human or animal wastes. Coliphage are viruses that infect the bacterium <i>E. coli</i> . <i>Enterococci</i> are bacterial indicators of fecal contamination. Microbes in these wastes can cause short-term health effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, some of the elderly, and people with severely compromised immune systems.

**What are EPA's drinking water regulations for pathogens and indicators?**

In 1974, Congress passed the Safe Drinking Water Act. This law requires EPA to determine the level of contaminants in drinking water at which no adverse health effects are likely to occur. These non-enforceable health goals, based solely on possible health risks and exposure over a lifetime, with an adequate margin of safety, are called maximum contaminant level goals (MCLG). Contaminants are any physical, chemical, biological or radiological substances or matter in water. EPA sets MCLGs based on the best available science to prevent potential health problems.

For most contaminants, EPA sets an enforceable regulation called a maximum contaminant level (MCL) based on the MCLG. MCLs are set as close to the MCLGs as possible, considering cost, benefits and the ability of public water systems to detect and remove contaminants using suitable treatment technologies. When there is no reliable method that is economically and technically feasible to measure a contaminant at particularly low concentrations, a treatment technique is set rather than an MCL. A treatment technique is an enforceable procedure or level of technological performance which public water systems must follow to ensure control of a contaminant. States may set a more stringent MCL or treatment technique level for pathogens and indicators in drinking water than EPA.

**Treatment Techniques Pertaining to Pathogens**

Pathogen	MCLG	Treatment Technique and Regulation(s)
<i>Cryptosporidium</i>	Zero	Surface Water Treatment Rule requirements: Systems using surface water or ground water under the direct influence of surface water (GWUDI) must disinfect and filter their water so that 99 percent of <i>Cryptosporidium</i> oocysts are removed or inactivated (killed). Unfiltered systems (systems that meet criteria for avoiding filtration) are required to include <i>Cryptosporidium</i> in their existing watershed control provisions.
<i>Giardia lamblia</i>	Zero	Surface Water Treatment Rule requirements: Systems using surface water or GWUDI must disinfect and filter their water so that 99.9 percent of <i>Giardia lamblia</i> is removed or inactivated. Unfiltered systems (systems that meet criteria for avoiding filtration) are also required to include <i>Giardia lamblia</i> in their existing watershed control provisions.
Viruses	Zero	Surface Water Treatment Rule requirements: Systems using surface water or GWUDI must disinfect and filter their water so that 99.99 percent of viruses are removed or inactivated.  For Ground Water Rule requirements pertaining to viruses, see "Fecal Indicators" in the Indicators table below.
<i>Legionella</i>	Zero	Surface Water Treatment Rule requirements: Systems using surface water or GWUDI must (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration.  There is no limit specific to <i>Legionella</i> , but EPA believes that if <i>Giardia lamblia</i> and viruses are removed/inactivated according to the treatment techniques in the surface water treatment rules, <i>Legionella</i> will be controlled.

**Treatment Techniques and MCLs Pertaining to Indicators**

Indicator	MCLG	Treatment Techniques and MCLs and Regulation(s)
Turbidity	No MCLG	Surface Water Treatment Rule requirements: <ul style="list-style-type: none"> <li>EPA's surface water treatment rules require systems using surface water or GWUDI to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that:</li> <li>Surface water systems and GWUDI systems that use conventional and direct filtration: At no time can turbidity (cloudiness of water) be higher than one nephelometric turbidity unit (NTU); samples for turbidity must be less than 0.3 NTU in at least 95 percent of samples in any month.</li> <li>Surface water systems and GWUDI that use slow sand filtration or diatomaceous earth filtration: Follow state limits, which must be at least as stringent as the following: Turbidity must at no time exceed 5 NTU; samples for turbidity must be less than 1 NTU in at least 95 percent of samples in any month.</li> <li>Surface water systems and GWUDI that use alternative filtration (technologies for filtering other than conventional, direct, slow sand, and diatomaceous earth filtration): Follow state limits, which should be at least as stringent as the following: Turbidity must not exceed 5 NTU; samples for turbidity must be less than 0.5 NTU in at least 95 percent of samples in any month.</li> </ul> <p>These standards, in combination with disinfection, must ensure that the system reliably achieves required pathogen control on a continuing basis.</p>

Total coliforms	Zero	Total Coliform Rule requirements: Systems are required to take samples for total coliforms based on the population served, source type and vulnerability to contamination. No more than 5.0 percent of samples for total coliforms can be positive in one month. (For systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month). If a sample tests positive for total coliforms, the system must collect a set of repeat samples within 24 hours, and also analyze for fecal coliform or <i>E. coli</i> .
Fecal coliforms and <i>E. coli</i>	Zero	Total Coliform Rule requirements: <ul style="list-style-type: none"> <li>• A routine sample that tests positive for fecal coliform or <i>E. coli</i> triggers repeat samples. If any repeat sample tests positive for total coliform, the system has an acute MCL violation.</li> <li>• A routine sample that tests positive for total coliform but tests negative for fecal coliform or <i>E. coli</i> triggers repeat samples. If any repeat sample then tests positive for fecal coliform or <i>E. coli</i>, the system has an acute MCL violation.</li> </ul> <p>For Ground Water Rule requirements pertaining to <i>E. coli</i>, see <i>Enterococci</i>, and coliphage in the Indicators table below.</p>
Fecal indicators ( <i>Enterococci</i> or coliphage), and <i>E. coli</i>	Coliphage and <i>Enterococci</i> : No MCLG <i>E. coli</i> : Zero	Ground Water Rule: Public water systems that use ground water* must take corrective action if a sufficient deficiency is identified, or if the initial source sample (if required by the state) or one of the five additional ground water source samples tests positive for fecal contamination ( <i>E. coli</i> , <i>Enterococci</i> , or coliphage). The systems must implement at least one of the following corrective actions: <ul style="list-style-type: none"> <li>• Correct all significant deficiencies</li> <li>• Provide an alternate source of water</li> <li>• Eliminate the source of contamination</li> <li>• Provide treatment that reliably achieves at least 4-log treatment of viruses (using inactivation, removal, or a state-approved combination of 4-log virus inactivation and removal) before or at the first customer for the ground water source.</li> </ul>

\* Including consecutive systems, but not PWS that combine all of their ground water with surface water or with ground water under the direct influence of surface water prior to treatment.

The following drinking water regulations apply to pathogens and indicators:

- **Total Coliform Rule**  
The Total Coliform Rule set both health goals and legal limits for total coliform levels in drinking water. The rule also details the type and frequency of testing that water systems must do.
- **Surface Water Treatment Rule (SWTR)**  
The Surface Water Treatment Rule seeks to prevent waterborne diseases caused by viruses, *Legionella*, and *Giardia lamblia*. These disease-causing microbes are present at varying concentrations in most surface waters. The rule requires that water systems filter and disinfect water from surface water sources to reduce the occurrence of unsafe levels of these microbes.
- **Interim Enhanced Surface Water Treatment Rule (IESWTR)**  
The Interim Enhanced Surface Water Treatment Rule improves control of microbial contaminants, particularly *Cryptosporidium*, in systems using surface water, or ground water under the direct influence of surface water, that serve 10,000 or more persons. The rule builds upon the treatment technique requirements of the Surface Water Treatment Rule.
- **Filter Backwash Recycling Rule (FBRR)**  
The Filter Backwash Recycling Rule requires public water systems (PWSs) to review their backwash water recycling practices to ensure that they do not compromise microbial control.
- **Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR)**  
The Long Term 1 Enhanced Surface Water Treatment Rule strengthens control of microbial contaminants, particularly *Cryptosporidium*, for small systems—those systems serving fewer than 10,000 people. It is the smaller system counterpart of the Interim Enhanced Surface Water Treatment Rule.
- **Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)**  
LT2 rule is to reduce illness linked with the contaminant *Cryptosporidium* and other disease-causing microorganisms in drinking water.
- **Ground Water Rule (GWR)**  
Ground Water Rule specifies the appropriate use of disinfection while addressing other components of ground water systems to ensure public health protection.

The Safe Drinking Water Act requires EPA to periodically review the national primary drinking water regulation for each contaminant and revise the regulation, if appropriate, based on new scientific data. EPA reviewed the Total Coliform Rule as part of the Six Year Review and plans to propose revisions in 2010. EPA will include the surface water treatment rules in future Six Year Review cycles.

- **Total Coliform Rule Revisions**
- **More information on the Six Year Review of Drinking Water Standards**

#### How do pathogens and indicators get into my drinking water?

- The major source of *Cryptosporidium*, *Giardia lamblia*, and viruses in drinking water is human and animal fecal waste.
- Coliforms are naturally present in the in the environment. Fecal coliform and *E. coli* are only found in human and animal fecal waste.
- *Legionella* is found naturally in water and multiplies in hot water heating systems.
- A major source of turbidity in drinking water is soil runoff.

#### How will I know if pathogens are in my drinking water?

When routine monitoring indicates that pathogen or indicator levels are in violation of a treatment technique or above a maximum contaminant level, your water supplier must take steps to improve treatment operations such as upgrading filtration or increasing disinfection to reduce pathogens levels and indicators so that the system returns to compliance. Water suppliers must inform their customers within the period of time specified in EPA's Public Notification Rule as described below. Additional actions, such

as providing alternative drinking water supplies or recommending that consumers boil their water prior to consumption, may be required to prevent serious risks to public health.

#### When must water suppliers notify their customers of a violation?

Pathogen or Indicator	Public Notification Requirements
<i>Cryptosporidium</i> , <i>Giardia lamblia</i> , <i>Legionella</i> or viruses	Water suppliers must notify their customers as soon as practical, but no later than 24 hours after the system learns of the violation.
Total coliforms	When a non-acute/monthly MCL violation for total coliforms occurs (more than one total coliform-positive sample in a month for systems that take fewer than 40 samples/month; greater than 5.0% total coliform-positive samples for systems that take at least 40 samples/month), water suppliers must notify the state as soon as practical after the supplier learns of the violation and notify their customers no later than 30 days after the system learns of the violation.
Fecal coliform or <i>E. coli</i>	When an acute MCL violation for total coliforms occurs (if a <b>repeat</b> sample tests positive for total coliform following a fecal coliform positive or <i>E. coli</i> positive routine sample or a repeat sample tests positive for fecal coliform or <i>E. coli</i> ), water suppliers must notify the state and their customers as soon as practical, but no later than 24 hours after the system learns of the violation. When a <b>routine</b> sample tests positive for fecal coliform or <i>E. coli</i> , water suppliers must notify the state within 24 hours, but public notification is not required because this is not an acute MCL violation. The water supplier must take steps to reduce the amount of fecal coliform or <i>E. coli</i> to meet the MCL. Also, when the water system fails to test for fecal coliform or <i>E. coli</i> when any repeat sample tests positive for total coliforms, water suppliers must notify customers as soon as practical, but no later than 24 hours after the system learns of the violation.
Turbidity	When turbidity exceeds the maximum allowable limit (e.g., 1 NTU for conventional or direct filtration), water suppliers must notify the state within 24 hours. For violations of the 95th percentile limit (e.g., greater than 0.3 NTU for conventional or direct filtration), water suppliers must notify their customers as soon as practical, but no later than 30 days after the system learns of the violation.
Fecal indicators (Coliphage or <i>Enterococci</i> )	Water suppliers must notify their customers as soon as practical, but no later than 30 days after the system learns of the violation.

- [See EPA's public notification requirements for public water systems.](#)

If your water comes from a household well, check with your health department or local water systems that use ground water for information on contaminants of concern in your area.

- [For more information on wells, go to EPA's website on private wells.](#)

#### How are pathogens and indicators removed from my drinking water?

Pathogen or Indicator	Treatment methods proven to be effective for removal or inactivation
<i>Cryptosporidium</i>	Disinfection with ultraviolet light or ozone and/or filtration.
<i>Giardia lamblia</i>	Disinfection and/or filtration.
<i>Legionella</i>	Disinfection and/or filtration.
Viruses (enteric)	Disinfection and/or filtration.
Total coliforms, fecal Coliform, <i>E. coli</i> (NOT including <i>E. coli</i> O157:H7) and Fecal Indicators (Coliphage or <i>Enterococci</i> )	Disinfection with chlorine, ultra-violet light or ozone, all of which act to kill or inactivate <i>E. coli</i> . Systems using surface water sources are required to disinfect to ensure that bacteria are inactivated.

#### How do I learn more about my drinking water?

EPA strongly encourages people to learn more about their drinking water, and to support local efforts to protect the supply of safe drinking water and upgrade the community water system. Your water bill or telephone book's government listings are a good starting point for local information.

Contact your water utility. EPA requires all community water systems to prepare and deliver an annual consumer confidence report (CCR) (sometimes called a water quality report) for their customers by July 1 of each year. If your water provider is not a community water system, or if you have a private water supply, request a copy from a nearby community water system.

- [The CCR summarizes information regarding sources used \(i.e., rivers, lakes, reservoirs, or aquifers\), detected contaminants, compliance and educational information.](#)
- [Some water suppliers have posted their annual reports on EPA's website.](#)

---

Last updated on Friday, December 13, 2013

