Indicators of Drinking Water Quality

By Joan Rose, Ph.D.

Providing safe drinking water requires a multi-barrier approach that includes protecting source water from contamination, physically and/or chemically treating (including chlorine disinfection) the raw surface- and groundwater, and storing and delivering the treated water in a manner that prevents re-contamination. Every day, more than a billion glasses of tap water are consumed from over 150,000 public drinking water systems across the US, and it is often taken for granted that the water is safe and wholesome.[1]

Photo credit: *Centers for Disease Control and Prevention*

Many types of pathogenic (disease-causing) germs can be found in contaminated drinking water, including bacteria, viruses and parasites like *Cryptosporidium*—the cause of the largest documented waterborne disease outbreak in recent US history.

The Role of Indicator Organisms

Many known pathogens are both difficult and expensive to detect reliably through water sampling and testing, so it is simply not practical to monitor for every microorganism that might occur in a drinking water source. For this reason, and for more than a century, US public health personnel have relied on an "indicator organism approach" to assess the microbiological quality of drinking water.[2] Historically, the most commonly used indicator organisms are called "coliform" bacteria—particularly *Escherichia coli* (better known as *E. coli*), from which the larger group gets its name. They comprise a large and mostly harmless group of bacteria that occur naturally in large numbers in the intestines ("enteric") and feces ("fecal") of all warm blooded animals, humans, mammals and birds. Coliform bacteria can also be found in soil and throughout the environment.

Because coliforms and *E. coli* are easy and inexpensive to detect, their presence in water samples is used as an indicator of water quality, and more specifically—possible fecal contamination by humans or animals. But while coliforms and *E. coli* are useful indicators, they have limitations. For example, because some enteric protozoa and viruses are more resistant to conventional disinfection than bacteria, the absence of *E. coli* does not necessarily indicate the absence of waterborne pathogens.

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[1] EPA Outlines Actions to Improve Safety, Reliability of Nation's Drinking Water. https://www.epa.gov/newsreleases/epa-outlines-actions-improve-safety-reliability-nations-drinking-water.

[2] See National Research Council (2004). Indicators for Waterborne Pathogens. https://www.nap.edu/catalog/11010/indicators-for-waterborne-pathogens.

That's why the multi-barrier approach to drinking water provision—source water protection, treatment, and protection in the distribution system—works best.

E. coli and Drinking Water: Never a Good Thing

Detection of *E. coli* in treated drinking water directly indicates contamination from human or animal waste, and indirectly, the potential presence of enteric viruses, bacteria and parasites. And to be sure, some strains of *E. coli* are pathogenic and can cause diarrhea, urinary tract infections, intestinal hemorrhage and kidney failure, and can even result in death. Almost all enteric pathogens are released in large numbers in the excrement of infected humans and animals, and many pathogens and diseases are "shared" between species (zoonotic). So wherever there is water, animals and people, one can find *E. coli*, but whether the water contains dangerous germs and at what levels is not always known.

Indicators and Drinking Water Regulations

Several regulations under the Safe Drinking Water Act require public water systems to regularly monitor for and report levels of coliforms, *E. coli*, and other microbial (and non-microbial) indicators of drinking water quality. "Total coliforms" are indicative of a breakdown in treatment or water quality problems in the distribution system. The presence of *E. coli* in a sample indicates a more serious contamination from a fecal source. The presence of a residual level of chlorine, however, indicates that the treated water is being protected in the pipes bringing water to your house.

Other water quality parameters used to assure that your drinking water is safe include heterotrophic (plate count) bacteria (or HPC) and turbidity. HPC counts are used to monitor the efficiency of the water treatment process and undesirable changes in bacterial water quality during storage and distribution. Turbidity is a measure of the cloudiness of water and indicates water quality and filtration effectiveness.

Although the indicator organism approach has been around for more than a century, it remains a central pillar of drinking water and public health protection.

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