Surface Water:
What's Coming Out of Your Tap?

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For many health professionals based in urban centres, water-borne diseases (Table 1) are probably not at the forefront for consideration when investigating gastrointestinal (GI) illnesses. However, it is critical to assess an individual history and exposure to possible contaminants to assist in GI-related diagnoses.

Common symptoms of water-borne diseases include:

- frequent diarrhea,
- cramping,
- nausea, and
- dehydration.

Each one of the etiologic agents—bacteria, virus, and protozoan—must be considered to ensure effective treatment.

Table 1
Common water-borne diseases

- Samonellosis
- Typhoid fever
- Campylobacteriosis
- *Escherichia coli* 0157:H7
- Shigellosis
- Cholera
- Dysentery
- Hepatitis A
- Giardiasis
- Cryptosporidiosis

Don't make assumptions!

Many of us take water for granted. Drinking water taken from a municipal tap is generally assumed to be potable unless otherwise noted. Similarly, when people travel to a cottage or on a camping trip, the water is often deemed adequate for consumption based strictly on its esthetic attributes.

Whether from lakes, rivers, or streams, approximately 80% of all water systems draw from an unprotected surface water source.[1] Often, outbreaks from a ground water source can be traced to a contaminated infiltrate. As far as public health practice is concerned, surface water is considered contaminated and unfit for human consumption unless treated.

Despite public health interventions, water continues to serve as the vehicle for many outbreaks, particularly in rural areas. The tragic events in Walkerton, Ontario in May 2000 shook the foundation of governmental control over small, communal, and municipal water systems. That event not only serves as a reminder of the ever-present risk of exposure to contaminated water, but also that vigilance on the part of health-care professionals, is essential.

Reporting water-borne diseases

Many of the water-borne diseases are reportable in most health jurisdictions. Health-care practitioners, laboratories, and institutions are all obligated to alert the local medical officer of health to the suspected/confirmed disease(s). Unfortunately, this reporting structure does not provide an adequate representation of infection rates. Monitoring historical outbreaks, endemic rates, and public health interventions assist in ascertaining the true burden of illness. Furthermore, knowing the source of exposure allows health professionals to enact prevention and control strategies.

How do you know if the water is treated and maintained?

Familiarizing oneself with the basics of water treatment and analysis may assist in identifying the source of an infectious agent.

Water analysis

Chemical parameters

For larger water treatment systems, in Ontario, the chemical parameters are set out in the regulations made under the Safe Water Act, 2003. This act requires routine annual sampling for specific chemical parameters and the reporting of adverse results to the Ministry of Environment and medical officers of health.[2] Treatment options for adverse chemical parameters vary depending upon the chemical identified.

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Table 2
Descriptions of two types of bacteria

1. Total Coliform
- Found in decaying vegetation and sewage
- Indicative of normal bacterial growth
- May represent growth of pathogenic organisms

2. *E. coli*
- Representative of fecal contamination from birds, domestic animals, and humans
- Is often an indication of surface water infiltration into a ground water source

Microbiological Parameters

Bacteria: Sampling for specific bacterium should only be conducted if the bacterium is suspected in an outbreak. Microbiologic parameters generally include sampling for total coliform and *Escherichia coli* (Table 2). The determination of "safe" water in terms of microbiologic analysis is zero per 100 mL for both bacteria.[2,3] It is important to ensure water samples are sent directly to the laboratory within 24 hours and maintained at a temperature of 5 C. Frozen samples received by the laboratory will be discarded.

Viruses: There are approximately 120 human enteric viruses known to be found in water. Water sampling and analyses is time consuming, costly, and often impractical. Sampling for viruses may be prudent when searching for an infectious agent during an outbreak investiga-

tion. Identification of *E. coli* is one of the easiest methods to determine the presence of suspected enteric viruses.

Protozoa: Sampling for protozoan cysts/oocysts is not currently recommended.[4] The sampling methods currently available have low recovery rates, do not provide adequate information regarding infectivity and viability, and are costly as well as time consuming. Due to the unreliability of testing and individual susceptibility, there are currently no maximum acceptable concentrations set for protozoan cysts/oocysts.

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Rather than performing surveillance, public health departments opt to evaluate the water treatment's capabilities of removing protozoa.

For ground water supplies, watershed management is key to the protection of an aquifer from contamination. This approach is not feasible for surface water sources, with the exception of possible gross contamination (*i.e.* waste water treatment).

How can surfact water be treated?

Treatment of surface water is an evolving science. Every lake is unique and so is its water quality. The safety of a treated water supply depends on its chemical and microbiologic parameters.

However, the potential for harm to human health is difficult to ascertain from sampling because micro-organisms are distributed throughout the water column.

Water sampling and analysis should be used as a tool to determine the effectiveness and consistency of treatment. It is recommended that a bacterial water analysis be performed on a weekly basis on treated surface water supplies unless:

- there is a proven history of satisfactory results over a minimum 12-month period,
- there are satisfactory records of chemically assisted water treatment,
- no changes have occurred to the water supply system (changing lines),
- there is no evidence of human illness, or
- it is otherwise directed by a public health inspector.

What are the options?

Boiling water

Bringing water to a boil for one minute is usually required, but if the water is cloudy, five minutes is recommended. Depending upon the turbidity, some pathogens may be protected by particles and debris in the water.

Take-ho message

- Symptoms of water-borne disease include frequent diarrhea, cramping, nausea, and dehydration.
- Concerns of acute or chronic health problems suspected to be attributable to contaminated water supply should be directed to local public health departments for investigation.
- When analyzing surface water, samples must be sent to the laboratory within 24 hours and maintained at 5 C. Frozen samples will be discarded by the lab.

Chemical disinfection and filtration

Disinfectants, such as chlorine and iodine, destroy bacteria and viruses, but not protozoa. Filtration to one micron (1 mm) is required to physically remove protozoa. Filters alone are not effective to remove all bacteria and will not remove viruses.

Ultraviolet light

Ultraviolet light (UV) is routinely used to disinfect water supplies, but it must be used in conjunction with filters. Filtering the water prior to using UV light is paramount for adequate disinfection. Recent research suggests that UV is effective in inactivating protozoan cysts/oocysts, but reliability, dose, and time requirements make this method of treatment prohibitive. UV should be used for only short distribution lines.

Ozonation

Ozonation will destroy all harmful micro-organisms. Typically, these units require pre-filtration of surface water to at least five microns.

Distillation

The distillation process brings the water to a boil and condenses the steam. Distillation will destroy pathogens, but if condensation occurs in the same collection tank, chemicals may be concentrated.

Reverse Osmosis

Reverse osmosis (RO) systems provide potable water through a porous membrane filter. While this process is effective for the removal of many types of chemicals and minerals, its ability to remove viruses and some smaller bacterium has not been effectively demonstrated.

What's the bottom line?

Public education and recent outbreaks have prompted some provincial governments into action to ensure a supply of potable water. Private residential water systems, not on the municipal water distribution systems, are the homeowners' responsibility. There are a wide variety of products available for purchase, but as noted above, not all products are suitable to ensure potable water. A multi-barrier approach and proper maintenance are imperative to effective drinking water treatment.[2,4]

A physician's understanding of basic water treatment and design may aid in determining the potential source of exposure when assessing a client with a gastrointestinal illness. CME

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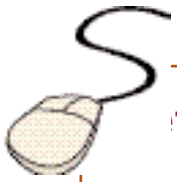
Further references available—contact The Canadian Journal of CME at cme@sta.ca.



t Readings

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