The Debate on Water Filtration

TO THE EDITOR:

I refer to two papers published in the May 2004 issue of *The Canadian Journal of CME*: "Surface Water: What's Coming Out of Your Tap?" by Wiebe L, Limerick B, and Embil J, and "Travellers Beware! Staying Healthy in the Tropics" by Plourde PJ.

On page 107, Plourde states, "Boiling is an effective and relatively inexpensive way of producing purified water. Simply bringing it to a bubbling point, irrespective of altitude, is sufficient to kill virtually all organisms that commonly cause travellers, diarrhea."

On page 110, the author opines, "the time that the water spends at temperatures above 65 C is beyond what is required." He also comments on "another relatively inexpensive and simple water purification method—the use of a halogen, such as iodine, chlorine, or chlorine dioxide." He claims adding iodine as a liquid or crystal to water can eliminate all bacterial, protozoal, and viral pathogens.

However, in the paper commencing on page 116, Wiebe *et al.* state, under the byline "How can surface water be treated?", that "Disinfectants, such as chlorine and iodine, destroy bacteria and viruses, but not protozoa." They add "filtration to 1 micron is required to physically remove protozoa." Five-micron filters seem to be commercially available and are frequently recommended to personal users.

Even ultraviolet (UV) light is apparently downgraded in that it must be accompanied by filtration (to 1 micron), presumably to kill protozoa. It is hinted that in UV systems, there are problems with reliability, dose, and time requirements. No assistance is given for the comparative evaluation of commercially available UV systems for Canadian households reliant on either a municipal water supply or a personal well.

In terms of the efficacy of boiling water as a disinfectant procedure, these authors state, "bringing water to a boil for one minute is usually required, but if the water is cloudy, five minutes is required."

While the two articles may be referring to different public health interests, there is almost certainly some good science behind the efficacy/inefficacy of methodologies that are being taken to ensure safe drinking water. This is of relevance to all governments in Canada, which are in the process of examining extant water regulations and determining what reforms may be necessary for the future.

It would be appreciated if the apparent contradictions in the two articles could be reconciled. Canadian physicians should be able to give unambiguous advice on the subject of water supply.

Ian W. D. Henderson, MD

Dr. Plourde responds:

Dr. Henderson is correct in assuming the apparent discrepancies between water purification recommendations in the two papers from the May 2004 issue of *The Canadian Journal of CME* are partly due to differing public health interests.

One paper is written from the perspective of travellers, who are faced with practical issues, such as fuel scarcity, whereas the second paper is written from the perspective of purifying municipal water supplies.

From my perspective as a travel medicine specialist, efficacy must be achieved in the most practical manner. The "one- to five-minute rule" for sterilization of water is relevant only for heat-resistant bacterial spores, which are generally not enteric pathogens and, hence, of no relevance to wilderness travellers. Enteric pathogens, including protozoal cysts, bacteria, and viruses can be killed at temperatures well below boiling. Drinking water does not need to be sterilized.

The best scientific evidence for heat treatment as a form of water purification exists in the form of pasteurization. By definition, pasteurization requires heating to 65 C for 30 minutes or 75 C for 15 seconds to effectively reduce enteric microbial flora in contaminated water by several logs. Thermal death points for enteric pathogens vary between 60 C to 80 C, with exposure durations of seconds to five minutes. Clearly, bringing water to a bubbling boil (even at an altitude of 5,500 metres/19,000 feet where water boils at 81 C) will allow exposure to temperatures above 60 C to 80 C for well over one minute. Therefore, water is safe to drink by the time it reaches a full boil.

As for chemical halogenation of water, Dr. Henderson is correct in pointing out that its efficacy is reduced with protozoa, especially cryptosporidial oocysts. Halogenation is very dependent on water temperature and turbidity.

Hence, cloudy and/or cold water requires higher concentrations and longer durations of exposure to halogens. A newer technology, chlorine dioxide (marketed as Pristine™ in Canada), is a highly effective disinfectant that kills organisms through the production of oxygen radicals. Contrary to iodine and chlorine, it is effective against cryptosporidial oocysts.

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Mr. Wiebe responds:

Dr. Henderson has highlighted several differences between the two articles on water treatment in the May 2004 issue of *The Canadian Journal of CME*.

Dr. Plourde's article focuses on the best available practices when travelling. Conversely, our paper is presented as a guide for Canadian physicians to understand the complexity of regulated water treatment systems—municipal, communal, as well as private treatment water systems—and the possible implications on human health. It is important to remember that potable water from a microbiologic perspective is defined as absent of viruses, bacteria, and parasites.

This response will discuss some of the issues raised by Dr. Henderson.

Boiling water

Although water kept at 64.2 C for a period of five minutes is effective against protozoan cysts, other bacterial spores (*i.e.*, Legionella species, bacterial spores) may persist. The public may be complacent with "boiling water", based on the esthetic value of the water. Ensuring compliance of boiling water

should be considered when advising a client or the public. Health professionals must consider the target audience when recommending a boil water advisory.

The Ministry of Health and Long-Term Care, Ontario, and the Public Health Branch of Ontario recommend water be boiled for one minute to be deemed potable (Health Protection and Promotion Act, 1990). Note, this recommendation is only for microbiologic contamination, not chemical). Other organizations, such as the World Health Organization, still recommend five minutes for boiling water.

UV systems

Manufacturers vary the flow rate, dose, and UV systems available to consumers. It is recommended that UV systems be rated according to the National Sanitation Foundation Standard (NSF) 55 to ensure consistent dosage. Since there are different UV systems available and employed, it is recommended that microbiologic water samples taken to verify their efficiency (total coliform and *E. coli*).

The efficacy of UV systems varies with respect to rendering cryptosporidium oocysts non-viable and non-infectious. Therefore, UV systems should not be relied upon to reduce parasites until accredited laboratories can certify the dose, flow rate and efficacy. Filtration (1 micron) should be used in conjunction with UV disinfection.

Chemical disinfectants

Typical chemical disinfectants, including chlorine, iodine, and bromine, require a high contact time, value, and concentration to be effective against environmentally hardy protozoan cysts and oocysts. Most commercial disinfectants are effective against bacteria and viruses, but lack efficacy against cysts and oocysts. Usually, a long contact time period and high dosages are required to reduce viability and infectivity. The concentration required to reduce these parasites often creates an undrinkable water source due to esthetics.

Another consideration in public health regarding the use of high concentrations of halogens is the production of trihalomethanes, known carcinogens.

Chlorine dioxide is not typically used in water treatment systems, but has been shown to be effective in the reduction of pathogens. The use of ozone generally requires a more expensive treatment unit, but is one of the most effective chemical disinfectants against all pathogens.

Filtration

In surface water, two log removal is required to remove cryptosporidium oocysts and three log removal of Giardia cysts are required to potable water. A nominal filter with the NSF 53, or a 1 micron absolute are required to achieve this log level of removal and ensure potable water. Filtration alone does not provide four log removal for bacteria and viruses and, thus, a disinfectant should be employed in conjunction with filtration.

Given the various claims for certain water treatment systems and the complexity of design, including operational parameters that are not referred to in this article, it is recommended that persons seek the advice of a public health inspector or a professional engineer for regulated and private water treatment systems to ensure potable water.

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