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EDITORIAL

Evidence-Based Medicine in the Wilderness: The Safety of Backcountry Water

The mantra in most areas of medicine today is the importance of ''evidence-based'' practice. Whether it is the introduction of a new diagnostic algorithm, an innovative surgical intervention, or a preventive strategy, the demands for evidence are increasingly stringent. The principles of evidence-based practice are integrated into medical school curricula, and journals devoted to the subject are beginning to proliferate.[1]

Wilderness medicine has not been a major participant in this trend. Some of the issues we deal with are actually more common in the front country, and their management principles are addressed outside the wilderness medicine literature. Frostbite is an excellent example. Some situations unique to the backcountry setting are so unusual or so varied in their presentation that no real basis exists upon which evidence-based guidelines can be established (eg, multiple trauma in very remote settings).

One might think that the handling of water for human consumption in the wilderness would be an appropriate topic for evidence-based analysis. All users of the backcountry need to drink. A variety of diseases can be caught by drinking. Many technologies treat water, and methods have been developed to evaluate the effectiveness of such treatments. Nonetheless, if we examine the usual teachings on this topic in the United States today, it is difficult to discern any evidence to support it. Moreover, the evidence that does exist generally does not support common practice and teaching.

In the current issue of *Wilderness and Environmental Medicine,* Derlet and Carlson[2] and Derlet and colleagues[3] add to the sparse yet growing body of literature on North American wilderness water. Using a commercial system designed to monitor bacterial contamination of community water supplies, they studied a variety of sites in several western national wilderness areas. As would be expected, bacterial colonization of these complex ecosystems was universal. In most cases, however, the bacteria identified were the harmless flora that are ubiquitous in surface water.[4] Indeed, these organisms are a critical first stage of the complex aquatic food chain, the foundation on which much wilderness wildlife depends. They are of no pathologic importance to healthy humans.

Some of the areas, especially those known to have heavy human or domestic animal impact, had evidence of coliform contamination. In most of these cases, the concentration of organisms was extremely low—sometimes just at the detection limit of the technology that was used. Furthermore, although the species identified were likely of mammalian origin, the investigators did not use molecular techniques that would be required to confirm these as human coliforms. Interestingly, the studies in aggregate yielded only a single colony of a potential human pathogen (*Yersinia enterocolitica*), although the lack of serotyping makes even this observation inconclusive.

Two reasons justify the examination of bacterial flora of wilderness water. The first and obvious reason is to recognize bacteria that could pose a threat to humans. Outbreaks of dysentery caused by waterborne *Vibrio* spp, *Salmonella* spp, and *Shigella* spp, for example, are scourges in many developing countries. However, no studies suggest that North American wilderness waters are a source of bacterial enteritis. In a study cited by Derlet, McCarthy et al[5] actually reported infection among swimmers at a heavily used public beach adjacent to a sewer. Of course, there are many such reports involving swimming pools and beaches, which are hardly analogous to wilderness waters.

The second reason for such a study is to use the presence of coliform bacteria as a surrogate measure of fecal contamination. In this mode, the coliforms per se are not viewed as harmful but rather as markers of water at risk for carrying other human pathogens. The problem is that the wilderness is home to mammals, both native and domesticated, that also excrete coliforms in their feces. Sophisticated molecular techniques are required to conclude if a given organism is likely to be a human coliform.

How do these data relate to other published studies on this subject? Concern about wilderness water in North America may have started with a 1976 report of an outbreak of giardiasis among a group camping in Utah.[6] Although the report implicated waterborne transmission, in retrospect this was clearly not the case. The attack rate, temporal clustering, lack of disease in other

groups using the same area, and inability to isolate cysts from the implicated water all speak against waterborne disease. In fact, the details of this case, combined with what we know 3 decades later about giardiasis, point compellingly to hand-to-mouth transmission within the group.

Within a few years of the publication of this case report, there was a virtual explosion of concern about wilderness-water quality in general and giardiasis in particular. This concern appeared almost exclusively in the lay literature but was soon accompanied by a growing emphasis on and availability of water-treatment technology suitable for backcountry use.

Regardless, studies of this topic in the peer-reviewed medical literature continued to be scarce. The only prospective study examining individuals entering an area thought to have high levels of water contamination yielded no cases of symptomatic giardiasis.[7] Interestingly, some subjects in this study did develop diarrhea, but they did not have evidence of *Giardia lamblia*. This reminds us that infection is only 1 of the myriad causes of changing bowel habits during or after a trek. Unfortunately, this lesson has not been learned by others studying the subject.[8]

A survey of state health departments confirmed the importance of giardiasis as a problem but did not support its association with consumption of wilderness water by outdoor users.[9] A recent meta-analysis also failed to find evidence in the published, peer-reviewed medical literature supporting this as a problem.[10]

The most comprehensive recent look at the problem was not in the medical literature, but rather in the lay magazine *Backpacker*.[11] The editors of this widely read publication sampled several backcountry waters for 2 pathogens (*Giardia* and *Cryptosporidium*) commonly worried about in the backcountry. Although a few areas yielded positive isolates, in each case the concentration of pathogens was below that which would be expected to result in disease with casual (as opposed to ongoing) use. The highest concentration of *G lamblia* found, for example, was 1.5 cysts per liter. Even if one happened upon this spot, it would take nearly 7 L of water consumption to achieve the minimum infective dose of this organism.

What are wilderness educators and health professionals to do with information such as this and the studies by Derlet and Carlson[2] and Derlet et al?[3] First, we need to realize that, despite unsubstantiated anecdote to the contrary, there is no good epidemiologic evidence that North American wilderness waters are inherently unsafe for consumption. In bringing this concept forward at meetings of wilderness educators, a common comment is for the need to ''prove'' that universal treatment of wilderness water is unnecessary. This creates a dilemma for evidence-based practitioners, because existing practice is apparently based upon absent or inappropriately interpreted data.

It might well be argued that it ''couldn't hurt,'' even if universal water treatment were unnecessary. This attitude, unfortunately, overlooks a major issue in wilderness education and human nature. The public's attention span for health advice is not limitless.[12] If our objective is to protect the backcountry user from enteric infection, then we should emphasize the overwhelming evidence showing that assiduous hand-washing or using alcohol-based hand cleansers is by far the most important strategy. It must be impressed upon backpackers (just as it is impressed upon health care, food industry, and day-care workers) that stopping hand-to-mouth spread is the key to preventing gastrointestinal infection. Diluting this message with unfounded concerns about wilderness water quality or the relative merits of various water-treatment methods serves no useful purpose.

Of course, prudence dictates careful attention to the source of drinking water in the same way that it dictates awareness of everything about the wilderness user's environment. Water obtained from areas of high human use, especially if a single source is to be used for an extended time, may merit chemical disinfection, with or without filtration. The time has come, however, to apply evidence-based principles to discussions of backcountry hygiene. Such principles mandate a vigorous education campaign targeted on hand-washing, coupled with a corresponding de-emphasis on routine universal water treatment.

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