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FAST TRACK

5 methods meet EPA standards for lower pathogen counts under ideal conditions:

- Boiling
- Chlorine dioxide tablets
- MIOX purifier
- SteriPEN
- Filtration

What is the best portable method of purifying water to prevent infectious disease?

Evidence-based answer

There isn't a single best method, but there are 5 that adequately purify water according to Environmental Protection Agency (EPA) standards. These include 1) boiling for 1 minute if below 2000 m (6562 feet) and 3 minutes if above, 2) chlorine dioxide tablets, 3) MIOX purifier, 4) ultraviolet light (SteriPEN), and 5) portable filtration

with a absolute pore size <1 micrometer combined with halogenation or charcoal filtration (strength of recommendation [SOR]: **C**, based on expert opinion and microbiological testing). Halogenation alone (ie, chlorine and iodine) is not effective against *Cryptosporidium* (SOR: **C**, based on microbiological testing).

Clinical commentary

Why boil water when there are so many other options?

These days, "boil it, peel it, or forget it" only goes so far with the unencumbered traveler. Experience tells me that most hear "Boil it" and instantly go right to "Forget it!" Fortunately, there is an excellent resource to assist patients in choosing a personally acceptable portable water purification system. It's called the Water Purification Database at usachppm.apgea.army.mil/WPD/CompareDevices.aspx.¹

This outstanding database was developed by an impartial third-party for the US Army and gives clear, well-organized guidance on over 60 purifiers. For each purifier, the guide covers efficacy against primary pathogens, purification mechanism, links to manufacturers, and an advantages/disadvantages breakdown (such as weight, cost, and ease of use). Add this site to your Internet "favorites" folder.

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Evidence summary

With the rise in international travel and adventure sports, individuals are at increased risk of acquiring infections by drinking water from impure water sources. Common waterborne infections that back-country and international travelers may contract include bacterial diarrhea, viruses, protozoa (such as *Giardia* and

Cryptosporidium), and parasites (such as schistosoma). The risk of infection varies based on travel location.

To prevent illness, travelers may seek medical guidance regarding safe water practice. In one study, 36% of travelers sought advice from a physician prior to international travel.² Prevent-

TABLE

Portable water purification: How do these 6 methods compare?

METHOD	EFFECTIVENESS	ADVANTAGES	DISADVANTAGES
Boiling with cooling*	Kills viruses, bacteria, protozoa, and parasites	Simple, universally accepted, no special equipment required	Time-consuming, may require large amounts of fuel
Chlorine dioxide* 	Kills bacteria, viruses, protozoa, and parasites	Same as chlorine/iodine treatment but also treats <i>Cryptosporidium</i> , good palatability	Must wait up to 4 hours to treat <i>Cryptosporidium</i> , costs more than iodine/chlorine (\$13 for 30 tabs)
Chlorine/iodine 	Kills bacteria, viruses, protozoa (not <i>Cryptosporidium</i>), and parasites	Inexpensive, easy, lightweight, treats large quantities	Does not kill <i>Cryptosporidium</i> , poor taste, must wait for water to be treated; contraindicated in pregnancy, thyroid disease; not recommended beyond few weeks of use
Filtration† 	Removes parasites, <i>Giardia</i> , <i>Cryptosporidium</i> , and bacteria	Able to use water immediately, removes sediment, many have combination of activated carbon, chemical disinfectant, or both	Can potentially be expensive, filters may clog easily, heavy, not effective against small particle viruses, therefore should supplement with chlorine or iodine
MIOX Purifier* 	Kills bacteria, viruses, protozoa, and parasites	Light (8 oz), sturdy, treats large quantities; requires camera batteries and salt	Cost \$130, must wait for 4 hours and treat with higher strength to treat <i>Cryptosporidium</i> ; requires 30 minutes to treat viruses, bacteria, and <i>Giardia</i>
UV light (SteriPEN)‡ 	Kills bacteria, viruses, protozoa, parasites in clear water	Light (8 oz), quick (treats 16 oz of water in 1 minute)	Cost \$100, does not work in turbid conditions

* Meets EPA standards.

† Some filtration systems meet EPA standards. See chppm-www.apgea.army.mil/WPD/CompareDevices.aspx for testing results of individual filters.¹

‡ Meets EPA standards in clear water.

ing waterborne infections should be a component of traveler education, in addition to other standard advice, such as mosquito avoidance and immunizations.³ (For more on travel safety, see these Clinical Inquiries: “When should travelers begin malaria prophylaxis?” in the November 2007 *Journal of Family*

Practice, pages 950–952, and “What is the most effective and safe malaria prophylaxis during pregnancy?” on page 51 of this issue.)

Which devices meet EPA standards?

The EPA has established a “minimal microbiological hazard” allowed for a

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The top 3 off-the-shelf devices in US Army tests were:

- SweetWater Purifier
- Micropur MP 1 tablets
- First Need Deluxe purifier

portable water purification system to be considered safe. Water purifiers must reduce bacteria by 99.9999%, viruses by 99.99%, and protozoa (such as *Cryptosporidium parvum*) by 99.9% to receive an EPA certification number.⁴

There are no head-to-head trials comparing the effectiveness of different methods of purification to prevent infectious disease. The majority of the evidence is based on data provided by manufacturers to the EPA, with some independent studies and expert opinion (TABLE).

Expert opinion recommends bringing water to a rapid boil for at least 3 minutes and letting it cool as an effective means of water purification.⁵ Chlorine dioxide tablets, the MIOX purifier, and UV light (SteriPEN) have all met EPA standards for lower pathogen counts under ideal conditions. Halogenation does not reduce *Cryptosporidium* below the microbiological hazard of 99.9%, but it is generally accepted to effectively treat viruses, bacteria, and other protozoa after filtering through a cloth to remove large particles.⁶

Filtration with an absolute pore size of <0.1 micrometer (10 times smaller than the EPA standard) has been generally accepted as effective against protozoa and bacteria, but it is not effective against viruses because of their small size.⁷ When combined with either halogenation or charcoal filters, filtration can be effective against all pathogens.⁸

Recommendations from others

The US Army Center for Health Promotion and Preventive Medicine (USACHPPM) published a report in 2006 on the efficacy of commercial off-the-shelf individual water purifiers.⁸ Using National Sanitation Foundation Protocol P248 and applying it to “real-world” emergency military operational conditions, USACHPPM found that no device scored high on every attribute, and that overall scores for most devices were in the moderate range. The top score for

any device was 79 (out of 100).⁸

The overall top 3 scoring products were: 1) the SweetWater Purifier from Mountain Safety Research; 2) the Micropur MP 1 tablets from Katadyn North America, Inc; and 3) the First Need Deluxe water purifier from General Ecology, Inc. ■

Acknowledgments

The opinions and assertions contained herein are the private views of the authors and not to be construed as official, or as reflecting the views of the US Air Force Medical Service or the US Air Force at large.

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