

Household water treatment and safe storage (HWTS) interventions are proven to improve water quality and reduce diarrheal disease incidence in developing countries. Five of these HWTS options – chlorination, solar disinfection, ceramic filtration, sand filtration, and flocculation/disinfection – are proven to improve microbiological quality and prevent diarrheal disease in developing countries. Other options – including boiling – are widely implemented but currently lack peer-reviewed research that specifically proves the process reduces diarrheal disease. Research is ongoing to document the health impacts of boiling. Organizations that want to develop HWTS programs are often faced with the difficult decision of selecting which option or options are appropriate for their particular circumstances, and how to choose between proven and unproven options. The most appropriate HWTS option for a location depends on existing water and sanitation conditions, water quality, cultural acceptability, implementation feasibility, availability of HWTS technologies, and other local conditions. This series of fact sheets is designed to assist organizations in comparing, and ultimately selecting, the appropriate HWTS option or options. For more information on household water treatment, please visit www.who.int/household_water.

Boiling

Boiling is arguably the oldest and most commonly practiced household water treatment method, and it has been widely promoted for decades. Organizations recommend boiling both for water treatment in developing countries and to provide safe drinking water in emergency situations throughout the world. Although boiling time recommendations vary significantly, from 0-20 minutes, to make water safe for consumption the water simply must reach the boiling point of 100 C / 212 F. The World Health Organization thus recommends that water be heated until it reaches the boiling point. Some organizations, such as the CDC, recommend a rolling boil of 1 minute, in order to ensure that users do not stop heating the water before the true boiling point is reached. Both recommendations are accurate, although boiling water longer than a few seconds is not necessary to inactivate the pathogens that cause diarrheal disease. Water should be stored in the same container in which it was boiled, handled carefully, and consumed within 24 hours to prevent recontamination.



Storage of boiled water in a Burmese refugee camp (CDC, D. Lantagne)

Lab Effectiveness, Field Effectiveness, and Health Impact

If the boiling point is reached, boiling is effective at inactivating all the bacteria, viruses, and protozoa that cause diarrheal disease. However, studies in developing countries have documented incomplete inactivation of bacteria in boiled water. This disparity between the laboratory and field results is attributed to users not heating the water to the boiling point and/or recontamination of boiled water in storage. To date, there have been no peer-reviewed studies assessing the health impact associated with boiling water, although some case-control studies in cholera outbreaks have noted boiling as being protective against cholera.

Benefits, Drawbacks, and Appropriateness

The benefits of boiling are:

- Existing presence in many households of materials needed to boil;
- Proven inactivation of all bacteria, viruses and protozoa, even in turbid or contaminated water; and,
- Socio-cultural acceptance of boiling for water treatment, particularly in tea-consuming cultures.

The drawbacks of boiling are:

- Lack of residual protection against contamination;
- Lack of epidemiologically confirmed health impact;
- Potential for burn injuries and increased risk of respiratory infections from indoor stoves or fires;
- Potentially high cost of carbon-based fuel source (with concurrent deforestation risk) and the opportunity cost of collecting fuel;
- Potential user taste objections; and,
- Potential for incomplete water treatment if users do not bring water to full boiling temperature.

Boiling is most appropriate in areas with a good fuel supply, a cultural tradition of boiling, and where water is stored safely after boiling.