



# HOUSEHOLD WATER TREATMENT METHODS- AN EFFECTIVE STRATEGY TO ENSURE HOUSEHOLD WATER QUALITY

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## ABSTRACT

According to WHO and UNICEF (2017), there have been progress in providing safely managed water services to 71% of global population, there are still 844 million people who do not have access to at least basic drinking water services. Contaminated water sources become a major source of waterborne diseases like cholera, hepatitis A, acute diarrhoeal diseases, typhoid and cholera. Household water treatment methods have shown to improve the quality of stored water and reduce the contamination and disease burden. This article briefly describe the commonly used house hold water treatment systems like boiling, domestic chlorination, solar disinfection ceramic filtration and house hold slow sands filter

**Key words:** house hold water treatment systems, boiling, domestic chlorination, solar disinfection ceramic filtration, house hold slow sands filter.

## Introduction

Safe water supply and safe sanitation are essential aspects of healthy life. As per facts sheets WHO (2019) contaminated water can transmit diseases such as diarrhoea, cholera, dysentery, typhoid, and polio. Contaminated drinking water is estimated to cause 485 000 diarrhoeal deaths each year. WHO and UNICEF (2017) states that despite much progress in recent decades extending access to safely managed water services to 71% of global population, there are still 844 million people who do not have access to at least basic drinking water services.

As cited Clasen (2010) water that is microbiologically safe at the source or other point of distribution is subject to frequent and extensive fecal contamination during collection, transport, and storage in the home. Onda, LoBuglio, & Bartram (2012) states that about 40% of improved water sources are fecally contaminated or are at high risk of contamination due to these possible reasons the World Health Organization (WHO) and others have called for alternatives that can accelerate the health gains associated with improved water supplies, especially among rural populations since they are at greatest risk of waterborne disease. This is mainly because of poor quality water sources and reduced access to water treatment. One such measure to cut short such a morbidity is household water treatment and safe storage (HWTS) methods. As per Lantagne, D (2018) Household water treatment in particular has been shown to improve the microbiological quality of stored water and reduce the disease burden. As per CDC (2020) Household water treatment (treatment that happens at the point of water collection or use, rather than at a large, centralized location) improves water quality and reduces diarrheal disease in developing countries. Five proven treatment options are widely implemented in many developing countries. As per WHO (2003) the three household water-treatment systems include boiling; household slow sand filter; domestic chlorination. As per <https://www.cdc.gov/safewater/household-water.html> the household water treatment methods include Chlorination, Flocculent /Disinfectant Powder, Solar Disinfection, Ceramic Filtration. This article mainly deals with the common household water treatment systems which include boiling, domestic chlorination, solar disinfection ceramic filtration, and household slow sand filter.

## House hold water treatment systems

### Boiling

The water is made to a rolling boil will kill most pathogens, and many are killed at lower temperatures (e.g. 70 °C). This can be expensive, however, because fuel/charcoal is needed to boil the water. Bring water to a rolling boil for at least one minute and at high altitudes above 5,000 feet (1,000 meters), boil for three minutes.as per EPA United states report (2020) if there is no bottled water boiling is sufficient to kill pathogenic bacteria, viruses and protozoa (WHO, 2015).If it is cloudy allow water to settle and then filter it through a clean cloth or paper or coffee filter. After rolling boiling, it is removed from heat and cool naturally, do not add ice, and but it need to be protected from post-treatment recontamination during storage.

### Chlorination

Chlorination is the most widely used chemical disinfection method of disinfecting drinking-water. Liquids (such as bleach), powders (such as bleaching powder) can be used. Iodine can also be used as a chemical disinfectant. The effectiveness of chlorination depends on the quality of the untreated water, which may vary according to the season.

#### Benefits

- Reduce most of bacteria and viruses in water
- Residual protection against recontamination
- Ease-of-use and acceptability
- Reduction of diarrheal disease incidence
- low cost

#### Drawbacks

- Relatively low protection against protozoa
- Less effective in turbid waters
- Potential taste and odor issues
- Potential long-term effects of chlorination by-products
- Chlorine inactivates most pathogens that cause diarrheal disease in humans

The presence of residual chlorine in drinking water indicates that: 1) a sufficient amount of chlorine was added initially to the water to inactivate the bacteria and some viruses that cause diarrheal disease; and, 2) the water is protected from recontamination during storage. The presence of free chlorine in drinking water is correlated with the absence of most disease-causing organisms, and thus is a measure of the portability of water.

### **Solar disinfection**

Ultraviolet radiation from the sun will destroy most pathogens, and increasing the temperature of the water enhances the effectiveness of the radiation. In tropical areas, most pathogens can be killed by exposing the contaminated water to sun for five hours, in mid-day. A transparent container is filled with water and exposed to full sunlight for several hours. As soon as the water temperature reaches 50 °C, the inactivation process is accelerated and usually leads to complete bacteriological disinfection an easy way to do this, is to expose (half-blackened) clear glass/ plastic bottles of water to the sun. Shaking the bottle before irradiation increases the effectiveness of the treatment. The water must be clear for this treatment to be effective. Solar disinfection (SODIS) was developed in the 1980s to inexpensively disinfect water used for oral rehydration solutions

The benefits Proven

Reduction of viruses, bacteria, and protozoa in water

Reduction of diarrheal disease incidence

Simplicity of use and acceptability

No cost if using recycled plastic bottles

Minimal change in taste of the water

Recontamination is low because water is served and stored in the small narrow necked bottles

The drawbacks

- Need to pretreat water of higher turbidity
- Limited volume of water that can be treated all at once
- Length of time required to treat water
- Large supply of intact, clean, suitable plastic bottles required

## Ceramic filters

Locally manufactured ceramic filters have traditionally been used throughout the world to treat household water. The effectiveness of ceramic filters at removing bacteria, viruses, and protozoa depends on the production quality of the ceramic filter. Most ceramic filters are effective at removing bacteria and the larger protozoans, but not at removing the viruses. As per CDC reports, studies have shown adequate removal of bacterial pathogens in water filtered through high quality locally-produced or imported ceramic filters in developing countries. A 60-70% reduction in diarrheal disease incidence has been documented in users of these filters.

The benefits of ceramic filtration are:

- Proven reduction of bacteria and protozoa in water
- Simplicity of use and acceptability
- Proven reduction of diarrheal disease incidence for users
- Long life if the filter remains unbroken
- A low one-time cost

The drawbacks

- Not as effective against viruses
- Since there is no residual protection, can lead to recontamination
- Quality depends on type of filters and producers
- Require regular cleaning

## Slow sand filters

Slow sand filtration Water passes slowly downwards through a bed of fine sand at a steady rate. The water should not be too turbid, otherwise the filter will get clogged. Pathogens are naturally removed in the top layer where a biological film builds up. A potential problem is that some households do not use this technology effectively and the water can remain contaminated.

A slow sand filter is a sand filter adapted for household use.

The version most widely implemented consists of layers of sand and gravel in a concrete or plastic container approximately 0.9 meters tall and 0.3 meters square. The water level is maintained to 5-6 cm above the sand layer by setting the height of the outlet pipe. This shallow water layer allows a bioactive layer to grow on top of the sand, which contributes to the reduction of disease-causing organisms. A diffuser plate is used to prevent disruption of the biolayer when water is added. To

use the filter, users simply pour water into the top, and collect finished water out of the outlet pipe into a bucket. Over time, especially if source water is turbid, the flow rate can decrease. Users can maintain flow rate by cleaning the filter through agitating the top level of sand, or by pre-treating turbid water before filtration. With a household slow sand filter, water is passed slowly downwards through a bed of sand, where it is treated by a combination of biological, physical and chemical processes. Fine particles in the water are filtered out by the sand, while microorganisms grow on top of the sand filter and feed on bacteria, viruses and organic matter in the water.

The benefits of slow sand filtration are:

- Proven reduction of protozoa and most bacteria
- High flow rate of up to 0.6 liters per minute
- Simplicity of use
- Visual improvement of the water
- Production of sufficient quantities of water for all household uses
- Local production (if clean, appropriate sand is available)
- One-time installation with low maintenance requirements
- Long life (estimated >10 years) with no recurrent expenses

The drawbacks

- Not as effective against viruses
- No residual protection – can lead to recontamination
- Regular cleaning can harm the bio layer and decrease effectiveness
- Establishment cost is high.

A study conducted by Rosa, Kelly & Clasen, (2016) on consistency of use and effectiveness of household water treatment practices among urban and rural populations found that seasonal use of household water treatment practices were uncommon and most of them use it throughout the year with urban reporting 78.8 % and rural 74.1%. And in the survey chlorination was the main method reported and preferred compared to boiling. Consistency in the use was also low among rural population.

A research paper by Geremew, & Damtew (2020) on household water treatment using adequate methods in sub-Saharan countries using evidence from 2013–2016 demographic and health surveys found that among 357,979 households included in the analysis 29% used unimproved water for

drinking purposes and households reported treating water were 22% and those who used adequate treatment methods were 18%. , the use of adequate treatment methods was statistically associated with household head education, owning a radio and wealth quintiles.

A five week study by Rosa, & Clasen (2010) on Microbiological effectiveness of disinfecting water by boiling among 45 households who claimed they always or almost always boiled their drinking water, boiling was associated with a 86.2% reduction in geometric mean thermo tolerant coliforms (TTC) ( $N = 206, P < 0.0001$ ). even with the consistence of fecal contamination in source water, 71.2% of stored water samples from self-reported boilers met the World Health Organization guidelines for safe drinking water (0 TTC/100 mL), and 10.7% in accepted low-risk category of (1–10 TTC/100 mL).

Cohen A, et al. (2015) conducted a study on microbiological evaluation of household drinking water treatment in rural China found that 27.1% boiling with electric kettles, 20.3% boiling with pots, 34.4% purchasing bottled water, and 18.2% drinking untreated water. Households using electric kettles had the lowest concentrations of TTC (73%) lower than households drinking untreated water.

Eftekhari, et al (2015) conducted a study on the effectiveness of home water purification systems on the amount of fluoride in drinking water in which six most frequently used commercial brands of water purifiers were evaluated and compared. It showed that the amount of fluoride was significantly different before and immediately after using home water purifier and six months later.

Sikder et al (2020) conducted a study on effectiveness of water chlorination programs along the emergency-transition-post-emergency continuum: Evaluations of bucket, in-line, and piped water chlorination programs in Cox's Bazar found that 71% of bucket, 36% of in-line, and 60% of piped water chlorination households had stored water that met free chlorine residual (FCR) criteria, and 71% of bucket, 86% of in-line, and 91% of piped water chlorination households had stored water that met *Escherichia coli* (*E. coli*) criteria ( $<10 E. coli$  CFU/100 mL).

As per CDC reports studies have shown adequate removal of bacterial pathogens in water filtered through high quality locally-produced or imported ceramic filters in developing countries. A 60-70% reduction in diarrheal disease incidence has been documented in users of these filters. CDC reports states that slow sand filter lab effectiveness studies with a mature biolayer have shown 99.98% protozoan, 90-99% bacterial, and variable viral reduction. Field effectiveness studies have

documented *E. coli* removal rates of 80-98%. Two health impact studies report 44-47% reduction of diarrheal disease incidence in users.

Solomon, et al (2020). Conducted a cluster randomized study on the effect of household water treatment with chlorine on diarrhea among children under the age of five years in rural areas of Dire Dawa, eastern Ethiopia found that water chlorination at the household level using liquid bleach (1.2% sodium hypochlorite) considerably decreased the incidence of diarrhea among children under the age of 5 years

## Conclusion

Treated water need to be kept safe. For that safe storage options are needed .It can be stored in existing water storage containers in the home or commercial safe storage containers .whichever is the type: regular hand washing, better sanitation and hygiene, safe water handling practices help to prevent contamination of treated, safely stored drinking water and reduce the risk of waterborne diseases. Teaching healthy behaviors and promoting their adoption requires education of the public and reinforcement of healthy behaviors.

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