

Household water treatment and safe storage (HWTS) interventions are proven to improve water quality and reduce diarrheal disease incidence in developing countries. Four of these proven HWTS options – chlorination, solar disinfection, ceramic filtration, and flocculation/disinfection – are widely implemented in developing countries. Organizations wanting to develop HWTS programs are often faced with the difficult decision of selecting which option or options are appropriate for their particular circumstances. 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 proven HWTS option or options. For more information on household water treatment, please visit www.who.int/household_water. For more information on the household chlorination with the Safe Water System, please visit www.cdc.gov/safewater.

Household Chlorination

The Safe Water System (SWS) was developed in the 1990's in response to epidemic cholera in South America by the Centers for Disease Control and Prevention (CDC) and the Pan American Health Organization (PAHO). The SWS has three elements:

- Point-of-use water treatment by consumers with a locally-manufactured dilute sodium hypochlorite (chlorine bleach) solution;
- Safe storage of treated water; and,
- Behavior change communications to improve water and food handling, sanitation, and hygiene practices in the home and in the community.

To use the SWS, families add one full bottle cap of the solution to clear water (or 2 caps to turbid water) in a standard sized container, agitate, and wait 30 minutes before drinking.



A woman in Delhi treats water using the SWS (WHO / Pierre Viot)

Lab Effectiveness, Field Effectiveness, and Health Impact

At concentrations that are used in HWTS programs, the hypochlorite solution is effective at inactivating most bacteria and viruses that cause diarrheal disease. However, it is not effective at inactivating some protozoa, such as *Cryptosporidium*. Numerous studies have shown complete removal of bacterial pathogens in SWS treated water in developing countries. In seven randomized, controlled trials, the SWS has resulted in reductions in diarrheal disease incidence in users ranging from 22-84%. These studies have been conducted in rural and urban areas, and include adults and children that are poor, living with HIV, and/or using highly turbid water.

Benefits, Drawbacks, and Appropriateness

The benefits of the SWS are:

- Proven reduction of most bacteria and viruses in water;
- Residual protection against contamination;
- Acceptability to users because of ease-of-use;
- Proven health impact;
- Scalability; and,
- Low cost.

The drawbacks of the SWS are:

- Relatively low protection against parasites;
- Lower disinfection effectiveness in turbid waters contaminated with organic and some inorganic compounds;
- Potential user taste and odor objections;
- Necessity of ensuring quality control of solution; and,
- Concern about the potential long-term carcinogenic effects of chlorination by-products.

The SWS is most appropriate in areas with a consistent supply chain for hypochlorite solution resupply, with relatively lower turbidity water, and in urban, rural, and emergency situations where educational messages can reach users to encourage correct and consistent use of the hypochlorite solution.



*Nurses using the SWS in a hospital ward
(CDC, A. Parker)*



*Manufacturing hypochlorite solution locally
in a rural clinic in Haiti (CDC, D. Lantagne)*

Economics and Scalability

A bottle of hypochlorite solution that treats 1,000 liters of water costs about \$0.10 using refillable bottles and \$0.11-\$0.50 using disposable bottles, for a cost of \$0.0001-\$0.0005 (0.01-0.05 cents) per liter treated. Education and community motivation add to program costs. SWS programs can achieve full cost recovery (charging the user the full cost of product, marketing, distribution, and education), partial cost recovery (charging the user only for the product, and subsidizing program costs with donor funds), or can be fully subsidized such as in emergency situations.

In the PSI/Zambia project, the average cost per bottle (treating 1,000 liters) of production, marketing, and distribution at project initiation in 1999 was \$1.88. This decreased by 82% to \$0.33 (0.033 US cents per liter treated) in 2003, when 1.7 million bottles were sold, showing that significant cost efficiencies can be gained as programs grow to scale.

Implementation Examples

The Safe Water System has been implemented in over 30 countries with numerous partners using a variety of strategies, including:

- Social marketing organizations, such as Population Services International (PSI), sell hypochlorite solution in 20 countries. Over 12 million bottles of hypochlorite solution, treating 12 billion liters of household drinking water, were sold in 2007.
- Local organizations use the social marketed hypochlorite solution in their own programming to provide safe drinking water. For example, in Western Kenya nurses are trained to use SWS water in hospitals and teach patients with diarrhea to use the PSI SWS product WaterGuard. In Uganda, people living with HIV are given WaterGuard to prevent opportunistic diarrheal diseases. In Kenya, schoolchildren are taught how and why to use the SWS, and school safe water clubs treat drinking water for all students. Also in Kenya, HIV self-help groups sell SWS solution and storage containers as an income generating activity.
- Faith-based groups, such as the Jolivert Safe Water for Families program, make and bottle their own hypochlorite solution in rural areas. Local community health workers teach community members how to use the solution, make and distribute the solution, and follow-up with families to educate them on healthy water and sanitation practices.
- Government ministries, such as the Ministry of Health in Guyana, work with local private companies to develop and market hypochlorite solution for emergency response.
- SWS hypochlorite solution has been widely used to respond to emergencies – from the 2004 tsunami in Indonesia to flooding and cholera epidemics in Africa.

For more information on Safe Water System programs, please contact safewater@cdc.gov, or visit www.cdc.gov/safewater, www.psi.org, or www.jolivert.org. Manuals for implementation are available.

*Population Services International, 1999 - 2006
Sales of SWS bottles converted to liters of treated water*

