Household Water Treatment Options in Developing Countries: Filtration & Chlorination Systems

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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 – such as filtration & chlorination systems – are widely implemented but lack peer-reviewed research that specifically proves the option reduces diarrheal disease incidence. Because filtration & chlorination systems include processes proven to reduce disease, they are presumed to be effective. 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. For more information on filtration & chlorination systems, please visit www.giftofwater.org or www.eaglespring.com.

Filtration & Chlorination Systems

Several household water treatment systems incorporate both a physical filtration step for particle removal and a chlorination step for disinfection. This dual approach leads to high quality treated water. The most common filtration & chlorination systems are the Gift of Water, Inc. and Mission purifiers. They are two-bucket systems, with a polypropylene string-wound filter in the top bucket, and a granulated activated carbon (GAC) filter in the bottom bucket. To use the system, users: 1) collect water in the top bucket; 2) add locally-purchased chlorine (liquid or tablet) and wait 30 minutes; and, 3) place the top bucket on the bottom bucket, which activates a check-valve so that water flows through the two filters and into the bottom bucket. The initial chlorination in the top bucket inactivates the bacteria that cause diarrheal disease. As water flows through the filters, turbidity, chemical contaminants, some larger disease-causing protozoa, and the chlorine are removed. Users access the treated water via a tap in the bottom bucket. Sometimes a small amount of chlorine is added to the bottom bucket to provide residual protection.

Using a filtration & chlorination system (CDC, D. Lantagne)

Lab Effectiveness, Field Effectiveness, and Health Impact

Filtration & chlorination systems have been proven to remove bacteria in laboratory and field situations. Studies of protozoal removal have been inconclusive, and viral removal has not been assessed. The systems are assumed to have health impact because of the use of two proven treatment methods, filtration and chlorination.

Benefits, Drawbacks, and Appropriateness

The benefits of filtration & chlorination systems are:

- Proven reduction of most bacteria, even in turbid waters;
- Residual protection against contamination if chlorine added to bottom bucket;
- Improved taste due to removal of the chlorine in the GAC filter;
- Ability of the string-wound filter to pre-treat turbid water;
- Acceptability to users because of ease-of-use, fast filtration rate (~20 liters/hour), acceptable taste, and visual improvement in the water; and,
- Presumed health impact.

The drawbacks of filtration & chlorination systems are:

- Potential recontamination if chlorine is not added to the bottom bucket;
- Unknown protection against parasites and viruses;
- The relatively high initial product cost and ongoing maintenance costs; and,
- Difficulties in scaling-up due to the need for ongoing maintenance and support.

Filtration & chlorination systems are most appropriate in urban and rural situations where community health workers can provide household visits to users that encourage correct and consistent use of the system and provide ongoing maintenance and filter replacement; and in areas with a consistent supply chain for chlorine treatment products.

A technician testing a families' filter in Haiti (CDC, D. Lantagne)

Rotarians fixing a broken filter in the DR (CDC, D. Lantagne)

Implementation Examples

There are two main distributors of filtration & chlorination systems – the non-governmental organization Gift of Water, Inc. (GWI) and the commercial company Eagle Springs Filtration.

- GWI is a faith-based organization headquartered in Florida, USA that assembles, distributes, and implements projects with the GWI filtration & chlorination system. The projects are community-based, with church groups in the U.S. sponsoring communities in Haiti. Once sponsorship is obtained, Haitian GWI staff work with the community to establish a water committee, install systems in 200-400 homes, and train two local Community Health Technicians to visit the users' homes weekly and perform maintenance and chlorine residual spot checks. As of December 2008, there are 70 sponsorships, covering 120 villages, and over 16,000 purifiers, with 200 paid Haitian staff in the GWI program. The strengths of this program are the fact that it offers a successful product (water treatment for a village) to sponsors (churches) who have resources and good intentions, but who lack the technical capacity to implement a water intervention. The drawback of this type of implementation is the need for ongoing subsidies for each family to pay salaries and maintenance costs.
- In northern Dominican Republic, Rotary groups from South Florida installed Eagle Springs Mission Filters in communities. Follow-up evaluations found that a low percentage of the systems were operational, as users had discontinued use due to breakage. The Rotarians then worked with the local church to hire a technician to visit the families and provide a spare parts distribution chain, and also to make the filters locally at a school they were building.

For more information on filtration & chlorination systems, please contact www.giftofwater.org or www.eaglespring.com.

Economics and Scalability

In the GWI projects, most of the cost of the initial installation (US$12-15 per filter) is subsidized by the sponsoring organization. The users pay a small fee ($1.71) to encourage ownership of the system. The ongoing costs of the program are split – with the families paying the $0.12-0.34 monthly cost for the chlorine, and the sponsoring organization paying the $3-4 per year cost for the ongoing technical support and maintenance. This system is sustainable provided there is continual outside funding. GWI is currently working to develop a model where users pay for the health worker visits (and thus their salaries) to increase project sustainability.

The commercial systems cost approximately $50. Some projects operate on a donation model with no follow-up, while other projects provide ongoing follow-up that can cost up to $15 per year per family.

Schematic of the Eagle Spring commercial system http://eaglespring.com/gallery/