Going to Scale with Household Water Treatment and Safe Storage (HWTS)

UNICEF WASH Training Module: Notes for Participants

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Contents

About this Module

Household Water Treatment and Safe Storage (HWTS) is an effective strategy for preventing diarrhoea and is an important part of the UNICEF overall strategic framework for WASH sector programming. This module was developed because HWTS is a relatively new approach within UNICEF and there is need to build capacity in this area.

The UNICEF HWTS Training Module consists of two parts, this set of notes for participants and a companion powerpoint presentation. The notes and presentation are intended to be used as part of a distance learning session (using the WebEx system), but can also be used as a stand-alone guide for self-directed training or as resource material for an ‘in-person’ training session on HWTS.

This module **is intended to**:

- introduce HWTS and its application for diarrhoeal disease prevention to UNICEF staff (both WASH staff and focal points)
- provide step-by-step guidance for developing and scaling up national HWTS programmes with partners in government, the private sector and civil society
- focus on the upstream side of HWTS programming including marketing and promotional aspects
- contextualize HWTS within UNICEF country programmes of support

This module **is *not* intended to**:

- provide detailed technical material on HWTS (but it does introduce the key technologies and includes links to more detailed information)
- present a comprehensive summary or literature review on the evidence for HWTS (but it does provide a concise summary)
- provide detailed information on the use of point-of-use treatment in emergency situations
- discuss technologies for the removal of chemical contaminants in water (this module concentrates on the reduction of microbial pathogens for diarrhoea reduction)
- be a guide for anybody interested in HWTS (the module is designed for use by UNICEF staff, but it may also be useful for government partners and other stakeholders)

The core of the module is structured around two checklists developed by two of the participants in a HWTS Consultation Meeting held in April 2008 in UNICEF New York: a step-by-step guide for UNICEF Country Offices and a checklist of issues to consider when developing and implementing an HWTS programme. The module also contains sections on the evidence for HWTS and on how HWTS fits within the UNICEF global strategies for WASH, along with a set of background materials in annex.

This module was developed by the UNICEF WASH Section in New York. It was written by a consultant based on material and guidance from HWTS Task Team members of the WASH Section, and on the inputs of participants in the HWTS Consultation Meeting including CDC, LSHTM, MIT, PSI, SANDEC, USAID, UNC, CAWST, UNICEF and WHO.

The module is part of the series of training modules being developed by the UNICEF WASH Section that includes modules on taking handwashing with soap to scale and on mainstreaming environment in programming.

What is HWTS?

Ensuring safe drinking water in the home is difficult. When there is no improved source available, water is likely to be unsafe due to microbial and especially faecal contamination. Even when water is drawn from an improved, uncontaminated point source – such as a sealed handpump on a protected borehole – it is very often re-contaminated due to unhygienic transport and home storage practices. And while somewhat less likely, water from treated piped water systems can still become re-contaminated, especially when it is delivered through the intermittent, leaky distribution networks that are common in the developing world.

Household Water Treatment and Safe Storage addresses this problem by helping to ensure the microbial safety of water at point of use. HWTS programmes develop and promote a package of improved technologies and practices for water storage and transport. The package includes cost-effective treatment systems involving the disinfection of water (using chlorine and other chemicals, and/or heat or ultraviolet radiation), the filtering of water (through a physical media such as in a ceramic filter, or through biological processes), or a combination of both. It also involves better designs for storing and handling water in the home, ranging from simple solutions involving covers and long-handled ladles to new re-designed storage containers.

Cambodia ceramic water filter (Brown, 2007)

Of course, HWTS is not about technology alone. To reliably improve drinking water quality – and ultimately reduce diarrhoea – technologies must be used correctly and consistently. Users must be knowledgeable and skilled, and have the motivation and funds to purchase products and consumables throughout the year. This in turn means that HWTS programmes are successful only when technologies are affordable, available and become desirable through effective marketing.

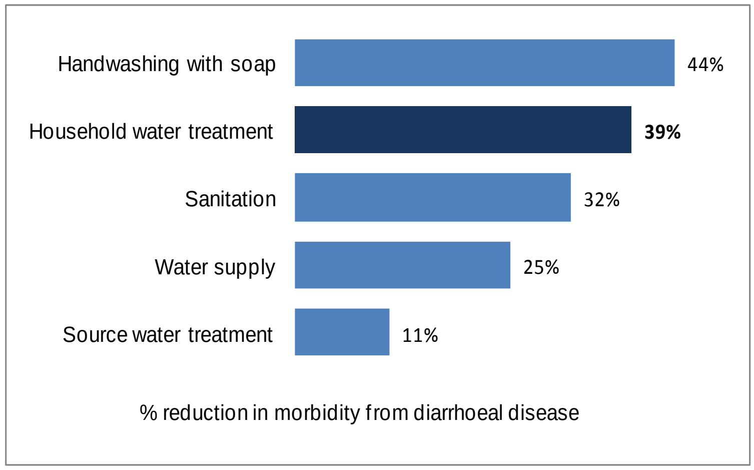
Finally, HWTS should not be carried out in isolation. It is only one part of a comprehensive WASH programme. Protected water sources continue to be of critical importance to communities: for health, for education, for gender equality and for poverty reduction. The transmission of faecal contamination can never be stopped without adequate sanitation, and unless people habitually wash their hands with soap at critical times, sanitation and water interventions – including HWTS – will not achieve their full potential.

Why HWTS?

Because it reduces diarrhoea

An ever-increasing body of evidence demonstrates that HWTS substantially reduces the pathogen load in drinking water, which can in turn result in a significant drop in diarrhoea morbidity rates.

Reduction in Diarrhoeal Disease Morbidity from WASH Interventions (Fewtrell et al., 2005) [1]



A comprehensive Cochrane Review[2] on HWTS concluded that 'interventions to improve water quality, particularly when implemented at the household level, are effective in preventing diarrhoea in settings where it is endemic' (Clasen et al., 2006). The review, which covered more than 38 randomized, controlled trials involving over 50,000 people in 19 countries, found that household-based water quality interventions were almost twice as effective at preventing diarrhoeal disease as communal water supply interventions (47% reduction from HWTS compared to 27% from improved wells, boreholes and communal standpipes). The review confirmed similar conclusions from other studies, including the widely reported World Bank review in 2005 (Fewtrell, et al.) that found that point-of-use water quality interventions are amongst the most effective WASH interventions (see chart).

Similar results have been shown in subsequent individual studies, such as a UNICEF- and WSP-supported study in Cambodia on the use of ceramic filters in the home (Brown et al., 2007). The study showed that ceramic filters were highly effective at removing pathogens from water and that the regular use of the filters by householders resulted in a 46 percent reduction in diarrhoea prevalence.

[1] Selected results from the Fewtrell study (see references), including the figure handwashing specifically (as opposed to the figure for hygiene in general) and the figure for HWT that excludes poor quality studies.

[2] Cochrane Reviews, conducted by an extensive network of researchers and practioners, use a rigorous, systematic process to analyze evidence of the effects of healthcare interventions. They are intended to help decision makers and practioners make decisions related to policy, strategy, and resource allocation. See www.cochrane.org.

Water Treatment Technologies
Commonly used in HWTS Programmes

Chlorination: The most common technology used in HWTS programmes. It is usually manufactured locally and distributed as a dilute sodium hypochlorite solution under brand names like Chlorin (Zambia). In some cases the chlorine is produced from inexpensive salt through a simple electrolysis process by local entrepreneurs or cooperatives. Can also be in the form of tablets, or as a combined flocculation/chlorine product like PuR* for turbid waters (which is mainly used in emergencies). Most common promoters: PSI, CDC, Antenna (see the partnership section of the checklist below for more information on these and other HWTS organizations).

Low-cost ceramic filters: These porous fired-clay gravity-based filters are normally manufactured by small-scale artisan factories with quality control for ensuring the correct porosity of the filter, which can be impregnated with silver to improve efficiency. Promoted by several organizations including UNICEF (initially in Cambodia, now in additional countries) and Potters for Peace.

Mini ceramic filters: Smaller manufactured units that fit inside existing storage containers and use a siphon system (rather than gravity). Originally developed in India, they are currently promoted as “CrystalPur” filters (by EnterpriseWorks/VITA) and are also marketed for use in emergencies by several companies.

See annex for more detailed information on both treatment and storage/handling technologies.

**Mention of this or any other product in these notes does not in any way imply endorsement on the part of UNICEF.*

Solar pasteurization: Is a practice that uses devices that incorporate solar reflectors and or insulation to reach temperatures of 60°C or more. Pasteurization effectively eliminates pathogens regardless of the water turbidity. An inexpensive temperature indicator called a WAPI (water pasteurization indicator) should be utilized to guarantee that the pasteurization process is complete. When using a solar cooker or the specialised AquaPak, the pasteurization process can take as little as three hours.

Solar disinfection: Also known as SODIS, is normally implemented by simply leaving bottles of water in the sun for a prescribed time period. Uses the combined effects of natural UV radiation and heat from the sun to neutralize most pathogens. Disinfection is achieved within 6 hours to 2 days, depending on sunlight intensity and water turbidity. Most common promoter is SANDEC, it is also promoted by UNICEF in some countries.

Slow sand filters: Also known as biosand filters, removes pathogens through a combination of physical and biological processes (a layer of predatory microbes that consumes pathogens). Of the four techniques listed here, this is the least commonly used in HWTS due to the relative complexity of operation and maintenance (although they have been successfully used in some countries). Promoter: Biosandfilter.org and others.

Others: Boiling is effective at killing pathogens, but not widely promoted in HWTS programmes due to the high costs of fuel and environmental effects of using firewood (although boiling can be promoted using waste heat from cooking). There are many other types of effective water treatment filters and chemicals on the market, but they are often too costly for HWTS programmes (although there are exceptions in some countries).

Because it is cost-effective

Water treatment technology can be very expensive. Some systems used in middle-class households around the world cost hundreds of dollars; even so-called inexpensive filters are beyond the reach of the poor majority of people in developing countries. To have any impact on diarrhoea and child mortality, treatment systems – both capital and running costs – must be truly affordable.

The good news is that over the last few years low-cost technology is becoming increasingly available in developing countries, including some that cost less than a dollar per person per year. Affordability, of course, isn't the only factor, but it is an important one.

In a seminal WHO study on the costs and benefits of various WASH interventions, household water treatment had the highest cost-benefit ratios, with benefits ranging from $5 to $60 for every dollar invested (Hutton and Haller, 2004).

A 2007 study looked at HWTS costs across countries in Africa and South East Asia. The four household-based water treatment systems examined all cost less than $5 per person per year, and two were less than a dollar per year (see table). All of these inexpensive technologies, when properly used, are just as effective at removing dangerous pathogens from water as more expensive systems (Clasen et al., 2007).

Water Treatment Method	**Cost/person/ year**
Solar Disinfection	US$ 0.63
Chlorination	US$ 0.66
Ceramic Filters	US$ 3.03
Combined Flocculation/ Disinfection	US$ 4.95
Clasen et al., 2007	

Because it is something people can do for themselves

The responsibility for public water supplies rests largely with governments, and even though they are cash-strapped, many countries are managing to fulfil this responsibility. The developing world as a whole is on track to meet the MDG target for water supply. However, most of the systems constructed are communal sources that involve transporting water and thus they carry the risk of water re-contamination. This risk can only be substantially reduced through reliable piped systems delivering treated water into homes – which is a long way off in many countries – or through HWTS. At the same time, the number of people without any improved water supplies at all is over 800 million – for them, HWTS is an important option.

People will continue to demand increases in water supply service levels, and governments and partners like UNICEF should continue to work towards meeting this demand. But while they wait, people should also be given the option to protect their health and the health of their children through HWTS.

Ongoing debate about HWTS

HWTS is a relatively new approach in the sector that represents a departure from established ways of working and, not surprisingly, it is the subject of some debate. There are several lines of critique within the debate: that HWTS allows governments to abdicate their responsibility for safe water, thus placing an unacceptable burden on poor people; that poor people will be victimized by unscrupulous companies – including multinationals – selling expensive or ineffective technologies; and that the body of epidemiological evidence in support of HWTS is still not conclusive enough to prove the sustainability of the approach and justify taking programmes to scale.

While all of these points have some validity, researchers and practitioners have put forward compelling counter-arguments. For example, there is no evidence that HWTS promotion programmes result in a diversion of funds from water supply programmes. Water supply continues to be prioritized by government and communities in part because the benefits of improved water sources go well beyond public health. The involvement of the private sector in any component of public health programming always has pros and cons, and it is the responsibility of governments and their partners to ensure that proper checks and balances are put into place. Some of the most successful HWTS initiatives – such as ceramic filter manufacture in Cambodia or chlorine distribution in Kenya – are the result of small-scale local private sector operators successfully providing affordable, highly effective solutions to the poor people who most need them. Finally, there is no doubt that more research is needed on HWTS, just as it is needed for most other components of WASH programming. However, the kind of comprehensive, rigorous studies needed to prove the efficacy of HWTS beyond any shadow of a doubt are expensive and time-consuming – and for the billions of people without access to piped water, there isn't time to wait.

In any case, the decision on whether or not to introduce and scale up HWTS initiatives is not one that UNICEF should make on its own. Like other major programme decisions, the introduction and design of any HWTS programme should be made jointly with government partners and other important stakeholders. In the meantime, UNICEF will continue monitor the ongoing debate and gather information on the approach.

HWTS in Emergencies

Although some of the principles and technologies are the same, the application of HWTS is different in emergencies than in development programmes. A full description of HWTS in emergencies is beyond the scope of this module, but a few key points are covered below.

Unlike in development programmes, HWTS in emergencies often involves the free distribution of supplies like chlorine tablets, and water carrying and storage devices. It is important that recipients of such materials understand that free distribution is temporary to avoid undermining existing long-term HWTS programmes. If handled correctly, emergency HWTS interventions can actually reinforce existing programmes by using and promoting the same or similar technologies and methodologies.

The most common household treatment technologies used in emergencies are combined flocculation/ disinfection sachets (e.g. PuR), chlorine tablets, mini ceramic filters and simple techniques like straining water through cloth (especially for cholera outbreaks). It is important that information on the use of technologies (leaflet distribution, training sessions) is also provided to ensure that interventions are safe and effective.

The type of technologies, distribution methods, links to existing programmes and other emergency HWTS intervention parameters should be defined in advance through national preparedness planning processes.

The IFRC field manual on HWTS in emergencies is an excellent resource for additional information: http://www.ifrc.org/Docs/pubs/health/water/142100-HWT-en_LR.pdf

UNICEF and HWTS

Since available evidence clearly points towards the value of HWTS as a strategy for reducing diarrhoeal disease, UNICEF is prioritizing its promotion within country programmes, with the goal of taking HWTS to scale at the national level. UNICEF's evidence-based approach to WASH programming stresses interventions that have the greatest potential impact on child survival and development, including HWTS along with the handwashing with soap and community approaches to total sanitation. These interventions are promoted as part of a comprehensive programming package in line with the 2006 UNICEF WASH Strategy Paper (UNICEF, 2006) that includes support to service provision, the promotion of behavioural change, and the development of countries' enabling policies and institutional environments.

Cognizant of the continuing need for research to further build the evidence base for HWTS and to improve implementation, UNICEF also supports efforts to gather data, refine technologies and methodologies, and develop innovative approaches.

In all cases UNICEF is working with partners in the area of HWTS. It is a member of the International Network to Promote Household Water Treatment and Safe Storage, hosted by WHO. UNICEF is building its capacity and enhancing its effectiveness through partnerships with organizations with a recognized competency in HWTS, both practitioner agencies like Population Services International (PSI) and the Centers for Disease Control (CDC) as well as research bodies such as the London School of Hygiene and Tropical Medicine (LSHTM). Links to publications and websites of these and other organizations is provided in the 'Additional Information' boxes throughout this document.

UNICEF-supported solar water disinfection programme poster, Nepal (UNICEF Nepal)

Additional Information

- 'Promotion of Household Water Treatment and Safe Storage in UNICEF WASH Programmes' (UNICEF with T. Clasen, 2008) provides an introduction and technology-specific implementation guidelines for the most common HWTS technologies: www.unicef.org/wash/files/Scaling_up_HWTS_Jan_25th_with_comments.pdf
- Website of the International Network to Promote Household Water Treatment and Safe Storage, hosted by WHO, which numbers over 100 participant organizations including UNICEF. (www.who.int/household_water/en/). See also the network's flagship publication 'Combating waterborne disease at the household level' for a general overview of HWTS: www.who.int/household_water/advocacy/combating_disease/en/
- 'Scaling Up Household Water Treatment Among Low-Income Populations' by T. Clasen of the London School of Hygiene & Tropical Medicine (published by WHO, 2009) is a comprehensive review of HWTS technologies and approaches with an extensive set of case studies: http://www.who.int/household_water/research/household_water_treatment/en/
- Implementation, Critical Factors and Challenges to Scale-Up Household Drinking Water Treatment and Safe Storage Systems by MIT's Susan Murcott (2006): www.hip.watsan.net/page/504
- Both the CDC publication 'Safe Water Systems for the Developing World: A Handbook for Implementing Household-Based Water Treatment and Safe Storage Projects' and the PSI publication 'Best Practices in Social Marketing Safe Water Solution for Household Water Treatment' provide detailed information on chlorine marketing programmes. The CDC literature and newer material from Antenna discuss the local manufacture of chlorine solution through electrolysis from salt.
    - www.cdc.gov/safewater/manual/sws_manual.pdf (CDC manual - a new version of this manual is planned)
    - www.psi.org/resources/pubs/usaid-wwd.pdf (PSI Best Practices)
    - http://www.antenna.ch/en/drinking_water/watasol_intro_en.html (Antenna Technologies Watasol system)
- Written in 2005 by Mark Sobsey for WHO, 'Managing water in the home: accelerated health gains from improved water supply' provides an extensive comparative review of HWTS technologies (WHO, 2005). www.who.int/water_sanitation_health/dwq/wsh0207/en/
- The USAID-funded Environmental Health Project maintains a Google groups site on HWTS: http://groups.google.com/group/household-water-treatment
- WELL Factsheets on Household Water Treatment (Clasen, 2005) and Household Water Treatment, Storage and Handling (van Wijk, 2005): www.lboro.ac.uk/well/resources/fact-sheets/fact-sheets.htm

Also see:

- the additional information boxes below for topic-specific information, and for links to key HWTS organizations
- the references at the end of this document
- additional information on HWTS technologies in annex

Launching a HWTS programme (checklist)

The checklist below is based on the outputs from a meeting on HWTS in UNICEF in April 2008 (see About this Module). It covers a set of suggested steps for developing a new HWTS programme. Additional information and resources are also included within the checklist. See the final section of this document for a complementary checklist on key issues to be considered when implementing and scaling up HWTS programmes.

√	**1.0 Country Situation – Data Collection and Analysis**
	1.1 Obtain data on public health, demographics, water and sanitation service levels, and knowledge, attitudes and practices
	Types of data potentially useful for HWTS programmes include data on demographics, public health, water and sanitation services, and the policy and institutional environment. Specific data types include: • diarrhoeal disease data (including prevalence figures from the national/sub-national health system, and household prevalence data from surveys) • hygiene practices data, including data on hygiene practices from special studies (relatively rare) and proxy data from household surveys (e.g. existence of handwashing implements and soap in households) • water and sanitation coverage data • water quality data • household income data, disaggregated • demographic data, education levels • solar insolation levels/rainfall patterns (for solar-based systems) • KAP information
	ADDITIONAL INFORMATION **Selected data sources** National household surveys: • MICS (diarrhoea, coverage and other data) • DHS - Demographic and Health Surveys (diarrhoea, hygiene proxy data, coverage, demographic, other data). Complete DHS datasets available at the Measure DHS site: www.measuredhs.com • national censuses (can contain highly detailed datasets) Data from special studies: • data from baseline, KAP and other surveys carried out for other purposes (by UNICEF, government or others) can be re-purposed or "mined" for HWTS (coverage, water quality, etc.) Data from government systems (including diarrhoea data from health systems, water quality data, etc.)

	1.2 Collect information on the policy and programming environment
	Information on relevant sectoral/cross-sectoral policies, guidelines and related programmes: • information on existing water quality surveillance and mitigation programmes, existence of national/sub-national water safety plans, etc. • national water quality standards • national WASH policies/strategies • laws and regulations concerning water safety, community sanitation, etc. • existence of related programme on which HWTS piggy-backing may be an option, such as health extension networks, cholera control systems, accelerated child survival and development (ACSD) campaigns, handwashing promotion initiatives, etc.
	ADDITIONAL INFORMATION Most of this information will be already familiar to UNICEF WASH staff, however since HWTS programmes incorporate cross-sectoral elements, it may be necessary to look beyond existing sectoral partners for information, such as in Ministry of Health, communication agencies, academic institutions, etc.

	1.3 Analyze information
	Data analysis will help to: • define priority geographic areas of intervention based on diarrhoeal disease patterns, identification of hot spots, areas where cholera and acute watery diarrhoea (AWD) are perennial problems, etc. • define priority groups by urban vs. rural, poverty level, age and gender, education levels, ethnicity, etc. • provide inputs for the determination of appropriate HWTS technologies • suggest promotion and social marketing approaches
	ADDITIONAL INFORMATION For examples of country-level research conducted to investigate the potential of HWTS, see: • Safe Water Situation in Four Countries: 2007 Findings in Brief from PATH www.path.org/files/TS_safe_water_four_countries.pdf

√	2.0 Build Partnership Frameworks

2.1 Identify existing / possible HWTS implementers

The first step is to identify existing implementers/programmes, if none exist, the second step is to identify possible implanters from the private, civil society and public sectors.

ADDITIONAL INFORMATION

Several international organizations are active in the promotion and development of HWTS at country level. These include:

Centers for Disease Control and Prevention (CDC)

- the long-running CDC Safe Water System programme promotes local production of chlorine solution (sodium hypochlorite) by cooperatives and entrepreneurs using salt as the raw material, along with a targeted community education and mobilization programme
- www.cdc.gov/safewater/

Centers for Disease Control and Prevention (CDC)

- the long-running CDC Safe Water System programme promotes local production of chlorine solution (sodium hypochlorite) by cooperatives and entrepreneurs using salt as the raw material, along with a targeted community education and mobilization programme
- www.cdc.gov/safewater/

EnterpriseWorks/VITA (EWV)

- a US-based NGO working to combat poverty through economic development, including in the area of water supply, promotes the mini ceramic CrystalPur filter in several countries
- www.enterpriseworks.org

PATH

- PATH is an global non-profit organization that works on a number of public health issues, including a large HWTS project funded by the Bill & Melinda Gates Foundation, currently active in India, Cambodia and Vietnam with plans to expand to other countries.
- www.path.org/projects/safe_water.php

Population Services International (PSI)

- PSI is a global health organization well known for its social marketing approaches. It has a comprehensive HWTS programme, notable for its marketing and distribution of dilute chlorine solution (sodium hypochlorite) currently in 18 countries.
- www.psi.org/child-survival/safewater.html

SANDEC/EAWAG

- the Swiss Federal Institute of Aquatic Science and Technology (Eawag) through its Department of Water and Sanitation in Developing Countries (Sandec) have been testing and promoting natural solar water disinfection (SODIS) since 1991. SODIS is used in more than 20 countries
- www.sodis.ch

This list is not exhaustive. Other organizations involved in HWTS at country level include UNICEF, WHO, the Centre for Affordable Water and Sanitation Technology (CAWST - www.cawst.org), Safe Water International (SWI - www.safewaterintl.org), Potters for Peace (www.pottersforpeace.org) and others.

2.2 Meet with national sectoral stakeholders

Meet with key stakeholders to understand what policies and programmes are in place and their interest and support for HWTS

- Government: Ministries of Health, Water, Agriculture, Rural Development, Gender, etc.
- Support agencies: key agencies with programmes of support in the sector including NGOs such as WaterAid, donors such as DFID, development banks (WB, AfDB, ADB) and UN agencies
- Civil society: major national NGOs, NGO umbrella groups, faith based groups involved in the sector, etc.

2.3 Work with UNICEF colleagues

Since HWTS has multi-sectoral elements, consultation and cooperation should be wide-ranging:

- country office: Communication for Behaviour and Social Change, Health, Supply
- regional office: Regional WASH adviser for support and information on regional HWTS initiatives
- headquarters: WASH Section

2.4 Consult with the private sector

Meet with private sector actors (and carry out complementary research) to determine what HWTS products are commercially available in your country. If none, consider what HWTS options are possible to manufacture or import into your country. Consider both 'home-grown' products (such as distributors of purification chemicals, manufacturers of ceramic filters) as well as international products that are marketed in-country.

ADDITIONAL INFORMATION

Examples of manufacturers and products with a multi-country presence:
(this list is limited to water purification chemicals; water filter technologies applicable for scaled-up HWTS programmes are normally manufactured in-country due to cost considerations)

- Aquatab chlorine tablets, manufactured by Medentech: www.medentech.com
- Oasis chlorine tablets, by HydraChem: http://www.oasiswaterpurification.co.uk/
- PuR coagulation-chlorination sachets by Proctor and Gamble: www.csdw.org (P&G donates PuR sachets and funds for safe water projects based on PuR through its Children's Safe Drinking Water programme

This list is not complete, and it does not constitute an endorsement of the companies or products.

2.5 Help to set standards

Work with government to set standards for eligible products based on government or independent 3rd party performance and safety testing protocols. Government bodies involved in standard setting could include:

- national bureau of standards
- ministries of water and of health
- ministry responsible for industrial development and/or consumer protection

ADDITIONAL INFORMATION

The standard setting process can be relatively simple, using existing national protocols, or it may become a more comprehensive long-running exercise. An example of the latter is the Bangladesh Environmental Technology Verification (BETV) programme for home arsenic removal technologies (included here as an example):

- www.betv-sam.org

2.6 Join the WHO-hosted International Network to Promote HWTS

The network is a good starting point both for building partnership frameworks as well as learning:

- www.who.int/household_water

	2.7 Host a HWTS Country Meeting and/or Symposium
	• A national meeting, while not an obligatory step, will help to galvanize support from government as well as encourage/formalise partnership frameworks for HWTS implementation. Invitees should include stakeholders from government, support agencies, civil society and possibly from academic institutions and the private sector. • A good exercise to conduct during the meeting is a review of existing policies, an analysis of the position of HWTS within the policy framework and – possibly – the formulation of an agreed plan of action

	2.8 Consider the inclusion of purification chemicals on the national essential medicines list
	This is an option that could help to improve the availability and quality of water treatment chemicals used in HWTS programmes (usually chlorine-based)
	ADDITIONAL INFORMATION WHO Essential Medicines site • www.who.int/topics/essential_medicines/

√	**3.0 Implementation**

	3.1 Identify and choose partners to conduct pilot
	See above section on partnerships. In most cases projects should involve multiple partners. Partners to consider include: • government • private sector companies • NGOs • social marketing organizations (e.g. Population Services International, Academy for Educational Development, other) • academic institutions

	3.2 Define and develop delivery approach
	Consider delivery approach through multiple channels, including: • commercial networks • ongoing UNICEF programmes, including hygiene promotion programmes • schools (see additional information below) • clinics • existing community outreach programmes and CBOs Seek integration with health and nutrition messages, and use events such as Child Health Days to promote and advocate
	ADDITIONAL INFORMATION Schools are a logical place to promote HWTS for UNICEF, especially in those countries where UNICEF supports WASH-in-Schools programmes. • see this short report by PSI on the use of HWTS in schools (in some cases in joint UNICEF-PSI projects): http://www.psi.org/child-survival/pdf/psi-safe-water-in-schools-2pg.pdf

	3.3 Encourage a phased multi-technology approach according to target group needs
	Normally, starting with a single technology is recommended, moving later to multiple technologies.
	ADDITIONAL INFORMATION • Annex on HWTS technology

3.4 Work towards cost recovery, even in the pilot phase

Design the pilot programme to include some degree of cost-recovery (selling the products at cost) to ensure that pilot reflects conditions (limited or no subsidy) when programme is taken to scale commercially.

- HWTS programmes often include donor or government subsidies for promotion, education and distribution costs, while selling the actual system or product to consumers at cost
- some HWTS programmes include additional subsidies for poor households

3.5 Pilot assessment, strategy revisions

Assessment may include:

- a rigorous evaluation of the pilot (including an initial comprehensive baseline, a third-party evaluation and an impact assessment on diarrhoea rates, etc.)
- or a less formal assessment drawing on results from past evaluations (e.g. if a technology has already been assessed elsewhere, diarrhoea impact assessment or a pathogen reduction assessment may not be necessary)

ADDITIONAL INFORMATION

- checklist on programme monitoring and evaluation in next section
- resources on monitoring and assessment from UNICEF on the UNICEF website and Intranet

3.6 Advocacy, national planning and scaling up

Points to consider for the scaling up process:

- instead of, or in addition to, the national meeting described in point 2.7 above, a national consultation at this stage will be essential for gathering support and resources for scaling up
- the consultation would focus on three things: the results of the pilot(s), evidence-based advocacy for HWTS in the national context, and developing a national plan for scaling up
- handing over a successful programme design to government for scaling up is not enough – UNICEF country offices should provide continuous support during the scaling up process

ADDITIONAL INFORMATION

Advocacy material:

- the International Network on HWTS publication ‘Combating Waterborne Disease at the Household Level’ is a key advocacy resource (www.who.int/household_water/advocacy/combating_disease/en/).
- use the Cochrane Review on HWTS as the key piece of evidence: mrw.interscience.wiley.com/cochrane/clsysrev/articles/CD004794/frame.html
- the presentation for this training module can be re-purposed for advocacy
- see also advocacy material from the websites of key HWTS organizations (listed in point 2.1 above).

Planning and scaling up:

- examples of national HWTS planning processes in Viet Nam and Lao PDR from WHO: http://www.wpro.who.int/health_topics/environmental_health/ (scroll down to find documents)
- see UNICEF WASH Strategy Paper (UNICEF, 2006) for additional information on UNICEF support for scaling up WASH programmes: http://www.unicef.org/about/execboard/files/06-6_WASH_final_ODS.pdf

Taking HWTS to scale: key issues (checklist)

This ‘Six Ps’ checklist provides additional information and resources on issues to consider when expanding HWTS programmes, and taking them to scale nationally.

√	**1.0 Population**
	1.1 Determine target population
	1.2 Conduct baseline survey or rapid assessment
	1.3 Identify current household management practices and consumer behaviour
	1.4 Segment the market with respect to HWTS products offered – by household income, urban or rural, age, gender, religious or ethnic identity, etc.
	ADDITIONAL INFORMATION • See data sources and other information in the Data Collection and Analysis section in the previous checklist.

√	**2.0 Product**
	2.1 Assess HWTS product(s) availability
	2.2 Determine existing and anticipated consumer preference for HWTS products and choose technology attributes appropriate to local context
	2.3 Pick the best initial technology for promotion in country context. Start with one technology. When (if) moving to multiple technologies (which is generally recommended), choose technology based on market segmentation analysis.
	2.4 Develop a product image/brand, positioning technology as a status symbol, health product, life-style product, low-cost product, etc. Address any stigmas associated with the product.
	2.5 Assess distribution channels for provision of HWTS replacement parts and/or product supply chain for fast-moving HWTS.
	2.6 Develop culturally appropriate product labels/instructions and instructions for low-literacy environment. Include product expiration dates if applicable.
	ADDITIONAL INFORMATION • see Annex for detailed information on products and technologies

√	**3.0 Price**
	3.1 Assess consumer ability and willingness to pay, use existing studies/data sources if possible
	3.2 Develop business plan, including a break-even analysis
	3.3 Determine pricing strategy based on above. Encourage full cost or partially subsidized cost recovery (see additional information, below)
	3.4 Determine necessary profit margins for value-chain based on price to end-user. (e.g. can the HWTS product profit margins compete with other fast-moving products, such as soap, cell phone card minutes, candles?)

ADDITIONAL INFORMATION

- see the CDC Safe Water Systems manual for additional information on price-setting: www.cdc.gov/safewater/manual/sws_manual.pdf
- see also PATH's 'Commercial Approaches to Providing Safe Water in India' www.path.org/publications/details.php?i=1575
- Studies indicate that when households pay for technologies themselves, sustainability improves. See this 2009 study on the Cambodia ceramic filter programme 'Sustained use of a household-scale water filtration device in rural Cambodia': www.iwaponline.com/jwh/007/jwh0070404.htm

√	**4.0 Place (Markets)**
	4.1 Prioritize target regions
	4.2 Visit potential markets and analyze key market components before entering new markets
	4.3 Decide on local manufacture vs. imported product(s). In most cases, in-country production is recommended for long term sustainability. In some cases local production at district/sub-district level by entrepreneurs/cooperatives is an option (such as in the manufacture of chlorine solution through salt electrolysis, or fired-clay ceramic filters)
	4.4 Contact manufacturers, distributors and retailers to determine how to make supply chain work.
	4.5 Use UNICEF's network of NGO and CBO partners in the country to help increase market penetration, especially in rural areas where the commercial supply chains may be weak.
	4.6 Balance product distribution channels to capture both efficiency (profit) and equity (fairness). Consider alternate channels such as community-based distribution, rural/urban, schools, clinics, etc.

ADDITIONAL INFORMATION

For more information on benefits of, and promotion of local manufacturing the WSP-UNICEF field note on the Cambodia ceramic filter programme and PSI's 'Best Practices in Social Marketing Safe Water Solution for Household Water Treatment':

- www.wsp.org/UserFiles/file/926200724252_eap_cambodia_filter.pdf
- www.psi.org/resources/pubs/usaid-wwd.pdf

√	**5.0 Promotion**
	5.1 Develop product and behaviour change messaging according to target audience. Encourage inspirational messages such as: life style, status, beauty, healthy children, and healthy family. Use humour.
	5.2 Apply social marketing principles tailoring marketing media to utilize regional customs, traditions and religious beliefs.
	5.3 Determine ideal communication channels for promoting product and behaviour messaging (e.g. mass media, radio, TV, billboards, person-to-person, mobile video units)
	5.4 The HWTS promotion campaign messages should be complementary to related campaigns, notably handwashing-with-soap messages. Coordinate such complementary campaigns and consider running joint campaigns.
	5.5 Educate all people along the supply chain about target product(s) and behaviours, who will, in turn, educate customers.
	5.6 Seek out endorsements from government, accredited labs, universities and respected organizations as marketing tools.
	5.7 Carefully link the promotion and provision of home water treatment product during emergencies to on-going use of HWTS after the emergency is over, and after free provision of products ends.

ADDITIONAL INFORMATION

- see PSI's 'Best Practices in Social Marketing Safe Water Solution for Household Water Treatment' (http://www.psi.org/resources/pubs/usaid-wwd.pdf) for more detailed information on social marketing in the context of HWTS
- see a YouTube video of a PSI TV spot for Chlorin in Zambia: www.youtube.com/watch?v=BrWoCa1Tx3g&feature=channel_page

√	**6.0 Programme Monitoring and Evaluation**
	6.1 Conduct a baseline survey before programme implementation (see Data Collection and Analysis section in the previous checklist)
	6.2 Conduct regular household surveys using HWTS-specific or indicators common to other UNICEF WASH programmes to monitor and assess HWTS dissemination.
	6.3 Implement a product tracking system, for quality control, customer complaints, and sales volumes.
	6.4 Learn from monitoring and evaluation, and make appropriate programmatic changes.

ADDITIONAL INFORMATION

- For a detailed report on both initial data gathering and design process as well as monitoring systems, see ESP's 'Action Research on Point Of Use Drinking Water Treatment Alternatives As Appropriate For Underprivileged Households In Jakarta' http://pdf.usaid.gov/pdf_docs/PNADO104.pdf

Annex: HWTS Technologies

A comprehensive discussion of HWTS technologies is beyond the scope of these training module notes. Included below are excerpts from the UNICEF Handbook on Water Quality (2008) on household water storage and treatment. Where reference is made to other chapters in the handbook, consult the full manual online:
www.unicef.org/wash/files/WQ_Handbook_final_signed_16_April_2008.pdf

Below the excerpts are references to additional sources of information on HWTS technologies

Excerpts from the UNICEF Handbook on Water Quality

4.4 Safe handling and household storage of water (partial extract)

Hundreds of millions of people do not have household water connections and must transport water from point sources or standpipes and store it in their homes. Protecting water from contamination during transport and storage is at least as important as protecting the source itself. There are a variety of pathways for faeces to enter stored water in the home, and stored water is often more contaminated than the source (see 4.1). Extending water quality protection from sources to point-of-use is an increasingly common strategy in water safety programmes worldwide.

As already noted, minimizing the amount of faeces in the household environment through sanitation interventions and raising awareness on safe water handling and personal hygiene are prerequisites for improving water quality in homes. However, the design of storage and transport receptacles is also an important factor in reducing faecal coliform levels in storage water and in the levels of household diarrhoea and other diseases. Studies show clear correlations between the type of container used and both faecal coliform levels and diarrhoea incidence in the home (Roberts et al., 2001; Sobsey, 2002).

Many types of vessels are used to store and transport water in developing countries, including traditional clay or metal containers, plastic and metal buckets, jerry cans, collapsible containers, beverage bottles and barrels. But to safely store water in homes containers should have narrow openings that can be sealed, should be made of an easily cleaned material and should have narrow spouts or taps to minimize contamination of water through hands, ladles or other vectors.

These safety criteria are not necessarily the most important from many users' point of view. Usability and user acceptance criteria are sometimes contradictory to safety criteria. For example, in many countries people prefer wide openings to make cleaning easier and thick-walled earthenware containers (which are not sealable) to keep water cool. Cost and availability are also key issues. Safe water storage containers often cost more than the alternatives or are simply not available in local markets.

An important factor is that many poor families cannot afford separate containers for transporting and storing water and therefore water storage containers must also meet users' criteria for portability – including size, shape and weight – and durability. As shown in Table 4.7, this will inevitably mean a compromise in design characteristics. Poor families also do not necessarily use containers exclusively for water storage and transport, which means that there may be even more compromises on the water safety criteria (an open bucket is a more useful receptacle for carrying a variety of material than is a plastic jerry can with a small opening).

Table 4.7 Criteria for home water storage containers

x – somewhat important xx – important xxx – very important	**Importance for water storage containers**	**Importance for water transport containers**
Criteria for minimizing contamination		
Made of easily cleaned material (plastics, most metals, ceramics, polished concrete)	xxx	xxx
Tap to draw water (must not leak or stick) or narrow spout from which to pour water	xxx	
Top opening large enough to pour water into but small enough to discourage the entry of hands, ladles and other faeces vectors (about 8 cm)*	xxx	xxx
Cap for top opening (preferably screw type)	xxx	xx
Stable with a flat bottom (so that container does not tip over allowing contaminants to enter opening)**	xxx	xxx
Usability / user acceptance criteria		
Durable	xxx	xxx
Impact resistant (some plastics are not)	x	xxx
Corrosion resistant (plastics, coated/treated metal)	xxx	xx
Portable: lightweight, less than 25-litre capacity, suitable for local methods of carrying water (e.g., handles, flat bottom for head carrying, not too tall)	x	xxx
Inexpensive	xxx	xxx
Available in local markets	xxx	xxx

* Sometimes 8 cm is too small an opening for transport containers – larger openings are required to capture the water stream when taps or pumps are mounted too high (e.g., tall handpumps mounted on dug well caps), when it is windy, when there are long queues (and so every pump stroke counts) and when water is scarce (and no water can be wasted).

** For example, collapsible plastic containers (sometimes supplied to families during emergencies) are not stable.

Rainwater harvesting tanks are a special category of home water storage containers. They tend to be larger, situated outside the home and they store water over much longer periods of time than typical home water storage tanks. The fact that rainwater tanks are large means that there are more potential contamination routes (e.g., cracks, difficult-to-seal manhole covers) and being outside, they are often more prone to animal and insect vectors. Long storage times can cause quality problems including algae growth (if not protected from light) and mosquito larvae.

Table 4.8 Water quality criteria for household rainwater storage tanks

- rainwater harvesting system (from rooftops) should include a mesh filter at the gutter, a first flush bypass system (that diverts the first few minutes of flow away from the tank – allowing the roof to be flushed of most contaminants) and a sand filter
- access hole to allow cleaning, with a tight-fitting cap
- all openings sealed to prevent light penetration and the entry of insect vectors
- tap(s) at least 5 cm above the tank floor
- drainage pipe to remove sump water
- smooth interior finish to facilitate cleaning

The safe handling and storage of water, while very important, will not, of course, improve the quality of water from contaminated sources. And contaminated sources for domestic water supply are still very common in developing countries. In situations where sources cannot be protected, the treatment of water in the home (as discussed in 5.3.3) may become the only viable option for consumers.

The safe handling and storage of water at the household level is receiving greater attention from sector professionals. This is due to a growing body of research indicating that both household storage and treatment is among the most effective of water, sanitation and health interventions (WHO, 2007a). One forum for discussion and resources on the issue is the International Network to Promote Household Water Treatment and Safe Storage (www.who.int/household_water/en).

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5.3.3 Household level treatment (partial extract)

Microbiological treatment methods

Many of the methods described in 5.1 are applicable in the home setting. This discussion focuses on a selection of low-cost technologies that are widely promoted in rural and peri-urban areas, and their applicability for poor households. See section 5.1 for additional details.

At the household level, simple sedimentation can significantly reduce turbidity, though clay particles may be too fine to settle. Large pathogens such as protozoa may also settle if stored overnight or longer. Bacteria and viruses are too small to settle by gravity, but these pathogens may be attached to suspended solids which do settle. In the absence of light and a food source, pathogens will slowly die off during storage. However, household storage can also lead to greater contamination if faecal contamination is high and water is kept in inappropriate container.

Boiling: While boiling water is highly effective at removing pathogens, due to rising fuel costs (and disappearing forests) this is increasingly out of reach for most people.

Natural solar disinfection (SODIS): When small transparent bottles of water are left out in the sun for a period of time, the combined effect of ultraviolet radiation (UV-A) and heat (pasteurization) inactivates most pathogens, making the water safe to drink. SODIS is growing in popularity because it is ultra-low cost or free (using discarded plastic bottles) and relatively simple to implement. However, because at least 6 hours of exposure to bright sunlight is required to de-activate pathogens, SODIS is not applicable in some climates and during rainy seasons. The technique also requires low-turbidity water to be effective. In some areas user acceptance has been low, due to the time it takes to disinfect water and the fact that drinking water is hot unless the bottles are left aside to cool.

Pasteurization: Pasteurization (heating to temperatures in excess of 70 degrees Celsius) of water on its own (without UV filtration) can also sufficiently reduce the number of active pathogens to make water safe for drinking. While not yet in wide use, a technique from Bangladesh that makes use of waste heat from cooking stoves is showing promise (see the Chulli Household Pasteurization box).

Chulli household pasteurization system

A UNICEF-sponsored pilot initiative in Bangladesh has supported the development of a simple flow-through system that utilizes waste-heat from household stoves (chullis) to pasteurize water for drinking.

The apparatus draws raw water from an elevated reservoir (with sand filter) through an aluminium tube coiled within the wall of the clay oven. By adjusting the flow rate, the effluent temperature can be maintained at 70 degrees Celsius. Influent and effluent laboratory testing on 420 chullis in six pilot communities showed that the system completely inactivated thermotolerant coliforms.

The chulli system can produce 90 litres of treated water per day. It is inexpensive (about $6), easy to fabricate and has no operation and maintenance costs. In the pilot area, the chullis were well accepted by users. Although developed as an alternative in an arsenic-affected area, the chulli system has the potential for wider application.

See Household Pasteurization of Drinking-water: The Chulli Water-treatment System (Islam and Johnston, 2006) for additional information.
www.icddrb.org/images/jhpn243_Household-Pasteurization.pdf

Electric UV disinfection: Using an electric system to produce ultraviolet radiation to disinfect water is much faster than relying on the sun. Many household units are available on the marketplace, but are generally too costly for poor families to purchase and operate. However, the popularity of these units (which are widely used in richer urban homes in some countries) is resulting in lower costs and, as electricity becomes more available, they may become a viable alternative for poor people. In addition, work is ongoing to develop less expensive units that use less power (and can be powered by photoelectric cells) and may be appropriate for use in rural areas.

Chlorination: Chlorine, used correctly with low- turbidity water, is a very effective disinfectant**.** Unlike the above technologies, chlorine disinfection has a residual effect – it continues to protect against the re-contamination of water over a period of time. This is the primary advantage of chlorine and the reason it is used widely in municipal systems. Chlorination also has disadvantages: chlorine products can be expensive (even bleaching powder can be too expensive for many households), difficult to market and can have a short shelf life. However new approaches to home chlorination programming are overcoming these problems, and have been shown to be successful at reducing diarrhoea rates (Quick et al., 2002; Lule et al., 2005).

The CDC Safe Water System (www.cdc.gov/safewater/) promotes local chlorine (sodium hypochlorite) production using salt and a targeted community education and mobilization programme, along with promotion of improved containers for household storage (CDC, 2001) (see also the Local Production of Chlorine Disinfectant box in section 5.1.4). CDC, the social marketing NGO PSI, UNICEF, WHO and other organizations support programmes that market ready-made sodium hypochlorite solutions in a growing number of developing countries. Continuous extensive marketing of the product is the key to the success of these programmes, and in some countries high awareness and usage rates have been achieved (Olembo et al., 2004; Stockman et al., 2007).

Coagulation and precipitation: In-home methods have been used in some regions for many years, especially with alum and vegetation extracts. While some studies have shown that good results can be obtained, the method can be difficult to use widely and consistently since it is dependent on a variety of variables, including the chemical characteristics of the water, correct dosages and careful mixing. Unlike the above methods, this method can be effective with turbid water.

Combined coagulation, precipitation and chlorination: Products that combine coagulation and chlorination chemicals in a single packet have been successfully tested in households in developing countries and used widely in emergency situations (see discussion of emergency purification in 5.3). This method can effectively treat poor quality turbid water and provide residual disinfection. It also uses significantly less chlorine than chlorination alone (because it reduces turbidity), which reduces costs. If costs can be further reduced through local manufacturing, it may become a viable alternative for poorer households.

Household chlorination in Guatemala: conventional chlorination vs. combined coagulation/chlorination techniques

In 2000 a study conducted in Guatemala (Rangel et al.., 2003) examined the impact of household chlorination on drinking-water quality. The effectiveness of a commercially formulated combined product (Procter and Gamble's PuR, which incorporates precipitation, coagulation, flocculation and chlorination) was compared to conventional chlorination with locally available bleach. Water stored using conventional clay jars was used as a control. The combined product was able to produce water with no detectable faecal coliforms, when used with an improved storage vessel. When used with the conventional clay storage jars, good removal was found in most cases, but some units contained several hundred faecal coliforms per 100 mL sample.

In a follow-up randomized control trial study amongst the same population that focused on diarrhoea morbidity rates (Reller et al., 2003), the combined product reduced incidence by 24 percent over the control population (29 percent in households that also received an improved storage vessel). However, households that received bleach alone achieved similar diarrhoea reduction levels (25 percent).

Since 2003, the PuR sachets (and similar products from other companies – see box in section 5.3.4) are in wider use, including in emergency situations. In 2005, UNICEF entered into a global partnership with Proctor and Gamble to promote water safety in UNICEF programmes worldwide, including through the use of the PuR sachets and other technologies.

Filtration: Many home water filters are available in the marketplace, and are used widely in some countries. However the filters most effective at removing pathogens (factory manufactured ceramic filters, some membrane filters and granular media filters) are often too costly to purchase and operate for poorer households. But there are exceptions. For example, some low-cost artisan-produced ceramic filters have proven to be effective (see section 5.1.3), but quality can vary widely. Effective bucket-type granular filters can be produced locally at low cost, but the maintenance requirements are fairly high and media must be replaced on a regular basis. Slow sand filters can be effective and inexpensive, but the operation and maintenance skills required to keep them functioning well make them difficult to implement at the household level.

Some successes have been reported with the BioSand filter, marketed by the Centre for Affordable Water and Sanitation Technology (www.cawst.org and www.jalmandir.com) and used in several countries, however the filters usually achieve only 90 percent virus inactivation in the field (Lantagne, 2006 and www.jalmandir.com).

Filters that are not effective at removing all pathogens can still be useful in special situations. For example, inexpensive filters are used in guinea worm endemic areas to remove copepods (microscopic host crustaceans, which are much larger than bacteria) to break the cycle of disease, and simple cloth filtration can greatly reduce the transmission of cholera. Simple filtration can also be used to reduce turbidity and improve the efficiency of other treatment processes (e.g., SODIS, chlorination).

Chemical treatment methods

In-home treatment to remove chemical contamination of water is less widespread than for microbiological contamination, but becoming more common in areas with severe contamination problems. As is the case for microbiological treatment, the main constraint is not technical – a variety of technologies exist for removing chemical contaminants. The problem is that few are sufficiently affordable, simple and robust enough to be sustainably applied in household in rural and peri-urban settings. The two most important examples are arsenic and fluoride removal (home treatment systems are also available for other contaminants, such as iron and manganese – see 5.2 for more information).

Additional Information on Technologies

- UNICEF's 'Promotion of Household Water Treatment and Safe Storage in UNICEF WASH Programmes' (UNICEF with T. Clasen, 2008) provides a technical description and technology-specific implementation guidelines for the most common HWTS technologies: www.unicef.org/wash/files/Scaling_up_HWTS_Jan_25th_with_comments.pdf

- 'Household Water Treatment and Safe Storage Options in Developing Countries: A Review of Current Implementation Practices' (Lantagne et al., 2006). This report focuses on five technologies: chlorination, filtration (biosand and ceramic), solar disinfection, combined filtration/chlorination, and combined flocculation/chlorination. www.wilsoncenter.org/topics/pubs/WaterStoriesHousehold.pdf

- Written in 2005 by Mark Sobsey for WHO, 'Managing water in the home: accelerated health gains from improved water supply' provides an extensive comparative review of HWTS technologies (WHO, 2005). www.who.int/water_sanitation_health/dwq/wsh0207/en/

- Single technology resources include the biosand filter website (www.biosandfilter.org), the solar disinfection site (www.sodis.ch), the PSI (www.psi.org/child-survival/safewater.html) and CDC (www.cdc.gov/safewater) sites for chlorine, and the Potters for Peace site for ceramic filters (www.pottersforpeace.org).

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