



Household Water Treatment and Safe Storage in Refugee Situations **v25, not field tested**



This document is intended to assist non-water, hygiene, and sanitation UNHCR and partner staffs to decide which household water treatment product is most appropriate for the situation. Please note that only bacteria, viruses, and protozoa are addressed in this document (not other potential health concerns as e.g. certain metals). Household water treatment products displayed in this document are NOT tested by UNHCR.

Background

In order to protect refugees worldwide, UNHCR safeguard, among other human rights, the right to safe water and sanitation. Household water treatment and safe storage (HWTS) can improve water quality and reduce the risk of disease in refugee situations. HWTS is any mean used by families or individuals to treat water from potential enteric pathogens, toxins, or carcinogens. HWTS can be an important element in holistic water, hygiene, and sanitation (WASH) programme in effective prevention of preventable water related diseases.



UNHCR and implementing partners may especially take advantage of HWTS in:

- First phase emergencies until a long-term solutions are established.
- Medium- to long-term emergencies where water sources are contaminated and/or water becomes re-contaminated during handling and storage. and mass water treatment is not feasible.
- WASH related disease outbreak.

Research by Lantagne and Clasen suggest that the most successful HWTS programmes are targeted to people living in unsanitary conditions where water can become re-contaminated, where people already are experienced with HWTS, local supply chain exists, and when proper training is conducted. (Lantagne and Clasen, 2010).

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HWTS = household water treatment and safe storage, WASH = Water, hygiene and sanitation



Categories of Household Water Treatment



Used for clear water (up to 5 NTU)



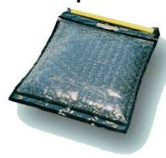
Used for cloudy water (up to 50 NTU)



Used for muddy water (more than 50 NTU)

Pre-treatment Pre-treatment settles particles in water and make cloudy and muddy water clear. Thereby enabling refugees to use HWT technologies otherwise only intended to be used for clear water.

• Straining cloth • Three pots method • Native plants • Chemicals

Category	Disinfection by sunlight and heat	Chemicals for disinfection	Ceramic and ultra-filters			Bio Sand filters	Chemicals with combined treatment	Annex 2 – HWT Cards
	Water can be disinfected by sunlight and heat. Boiling water is by far the most scaled up water treatment worldwide and is widely accepted most places. When utilising sunlight, the most famous method is SODIS, where unsafe water in clear water bottles are left in the sun for disinfection.	Water can be disinfected by chemicals. There are a variety of different chemicals but most products are chlorine-based. Excess chemicals in the water have the advantage of protecting against contamination hours after treatment. However, too high chemical levels may cause people to dislike the taste.	Filters can remove pathogens in water. Both ceramic and more advanced filters often have long life spans. Filters may then lose their effectiveness over time, which the user has to be aware of. If water is muddy filters have too be cleaned frequently.	Both a mechanical and biological process of removing pathogens. Benefits include high flow rate, long-life, and local production. Water can get recontaminated if not safely stored, and the filters are heavy. Users should be advised to wait 1-2 weeks before drinking the water. (CDC, NA)	Chemicals that both settle particles and disinfect water by using coagulant and chlorine compound. Products produce visibly improved water and residual chlorination protecting against contamination. The cost per litre is relatively high compared to other products, and users need to have two buckets, clothes, and a stirrer. (CDC, NA)			
Selected HWT technologies	Boiling  SODIS  WADI  AquaPak  Solvatten  Naiade 	Chlorine  Aquatabs  Iodine treatment  WATA  AgNP paper 	Porous Ceramic Pots  Ceramic Candle Filters  Tulip siphon water filter  LifeStraw Family  LifeStraw Community  Lifesaver  GDM filtration  Nerox®  Sawyer Point One™ 	Bio Sand Filters  Kanchan Arsenic Filter 	PuR  Water Maker 			
	Safe Storage	Oxfam Bucket  CDC SWS Container  Jerry Cans  Bucket with Lid and Tap  Modified Clay Pots 						Annex 3 – Safe Storage

Health benefits and quality products

UNHCR have explored an array of HWT but NOT tested them. New products are developed and UNHCR can thereby not assuring the list is comprehensive, therefore do if relevant consider other HWT products as well. In regard to the presented HWT the following two criteria has been in focus:



Health aspects

It is important the HWT technologies have proven reduction in bacteria, viruses and protozoa and ideally reduction in diarrhoeal disease incidence. The products should produce enough drinking water a day for an average household. UNHCR headquarter will guide the field offices on this matter.

In case incidence of diarrhoeal disease increases, WASH responses including HWTS choice should be carefully designed towards containing the infectious agents and the transmission routes.

Household water treatment improving water quality can reduce the risk of bacteria, viruses and protozoa transmitted through water. The following diseases may be prevented by HWT and HWT categories general effectiveness level are indicated:

	Caused by bacteria	Caused by viruses	Caused by protozoa
	Cholera, Shigellosis Salmonella Typhoid Paratyphoid	Hepatitis A Poliomyelitis Rotavirus	Cryptosporidiosis Giardiasis Schistosomiasis Dracunculiasis Clonorchiasis
Disinfection by sunlight	Protective	Less protective	Protective
Disinfection by heat	Highly protective	Highly protective	Highly protective
Chemicals for disinfection	Protective	Protective	Not protective
Ceramic filters	Protective	Less protective	Highly protective
Ultra-filters	Highly protective	Protective	Highly Protective
Bio Sand filters	Less protective	Not protective	Protective
Chemicals with combined treatment	Highly protective	Protective	Protective

Above table is interpreted from WHO (2011) Evaluating household water treatment options



Reputable producers of quality products

For mass distribution, household water treatment products have to be of the same quality and be delivered on time. UNHCR headquarter will keep a list of reputable producers.

WHO is currently evaluating HWT products. In 2013 WHO established an international scheme to evaluate household water treatment technologies to assess the performance of HWT in regards to removal of enteric pathogens. HWT tested under the Scheme will be classified in three levels: "highly protective", "protective", and "limited protection".

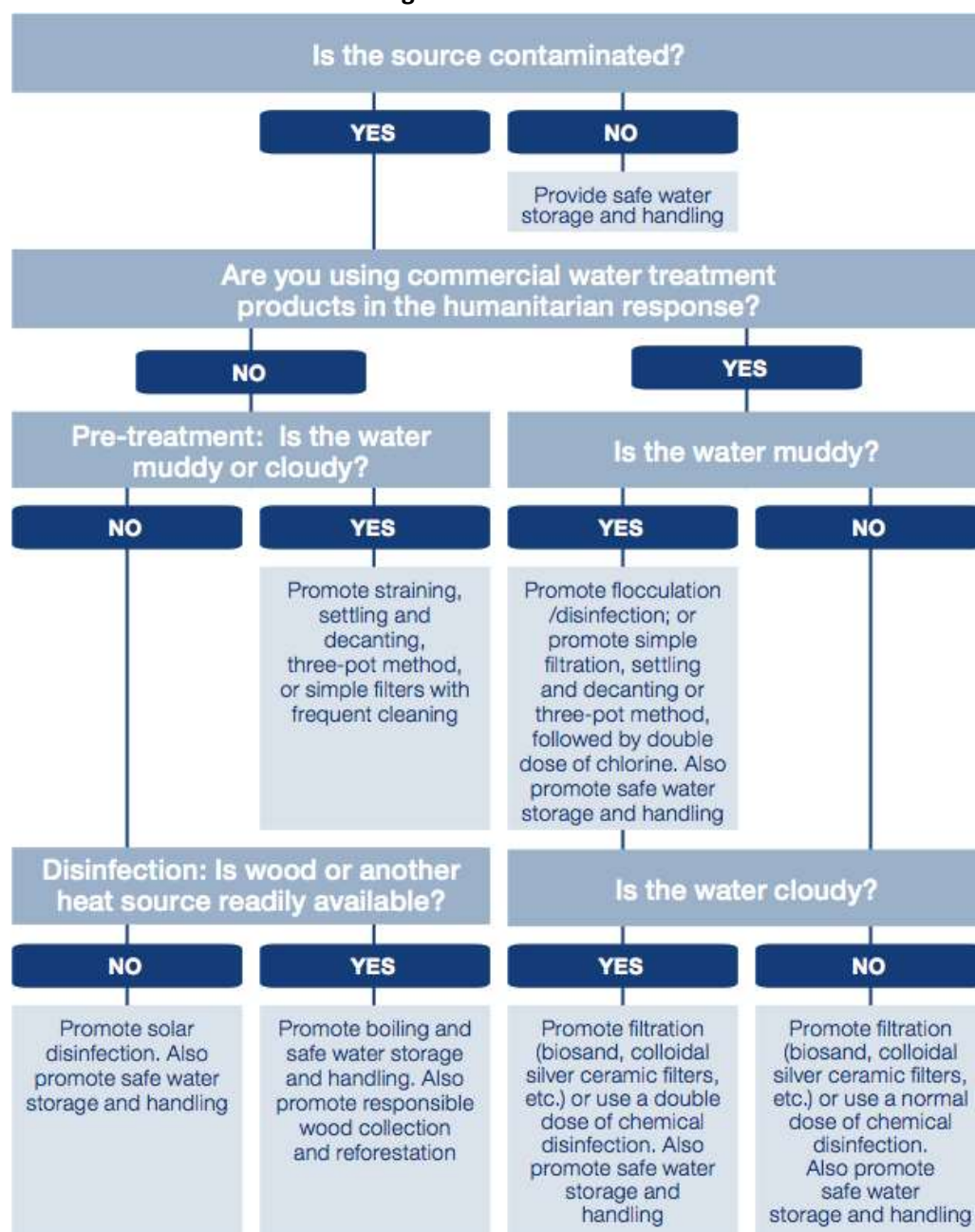
When to use HWTS and existing decision tree

HWT can be used to:

- First phase emergencies until a long-term solutions are established.
- Medium- to long-term emergencies where water sources are contaminated and mass water treatment is not feasible.
- WASH related disease outbreak.

Mass treatment by chemicals for disinfection or chemicals with combined treatment generally allows UNHCR to ensure better water quality control. It is crucial to pre-test chemicals for disinfection to find the right dose. If households practise water treatment already, efforts should be made to promote and improve existing practises. In case refugees are not accustomed to treating water, below decision tree can be used as a general guidance. The decision tree is originally developed by IFRC and adopted in the Sphere handbook 2011.

Household water treatment and storage decision tree



Source: Sphere Project (2011) page 133 - Adapted from IFRC (2008), Household water treatment and safe storage in emergencies manual.

To be analysed by the field office

The following criteria *Acceptability by the refugees, Speed of supply, Cost, and Targeting* have to be considered for the selection of an appropriate HWT by the field office. Use the list to select the most appropriate HWTS.



Acceptability

Essentially, people has to accept and find HWT technology useful to them in their dally living. Consider especially the following four aspects:

Experience	Experience with a HWT product is key to high uptake among communities. Priority should be given to HWT that people are used to. <u>Talk with refugees whether they think the HWT technology is appropriate for them.</u> Some HWT products need attention by a person while others e.g. can treat water during the night.
Context	Local context is important. People may boil water but it is not certain that there is enough fuel to promote this option.
Perception	Perception of safe water is important. All people use their best means to evaluate risks. The water quality produced by the HWT product has to be perceived as good for people to drink it. Consider visible water quality improvements regarding: •Transparency, •Taste, •Colour, •Odour. In general, a higher level of chlorine is accepted in Africa compared to Asia.
Time	The HWT product has to meet the daily drinking water needs. A family of 5 persons consuming each 7 litres of water per day for drinking and cooking require a minimum flow rate of 3 l/hour if operated for 12 hours.
Quantity	The UNHCR standard for water access in refugee settings is a minimum of 20 litres per person per day. To preserve public health, a large amount (more than 20 litre per person per day) of reasonably safe water is preferable to a smaller amount of very pure water.
Steps and ease	The way the HWTS works are different. Some are easier to use than others. Easy operation and maintenance is preferable.



Speed of supply

Authorised	Authorization of the HWT product by the national authorities may heavily affect the speed of supply. Some producers are registered in most countries. Note that it is possible to ship HWT products from UNICEF's warehouse. UNICEF has warehouses in Copenhagen, Denmark, and Dubai, United Arab Emirates. The major shipping destinations are Islamabad, Amman, Kinshasa, Johannesburg, and Nairobi.
Spare parts	Some HWT break easier than others. Local produced spare parts should be available. If this is not possible, UNHCR or the implementing partner should ensure this.



Cost

A rough cost estimation of logistical shipment is 15% of the goods value for surface transport and 25% for air transport.

Note that factory cost of HWTs is only a fraction of the total programme costs including: shipment, storage, distribution, provision of additional resources, training, and monitoring.



Targeting

When programme budget does not allow blanket distributions, prioritising has to favour the most vulnerable groups and the areas with contaminated water.

Unsafe water

Consider households using contaminated water sources. The public health assessment may scope this targeting if incidence rates are different.

Vulnerable groups

Consider population that may be more vulnerable to contaminated water as pregnant women, children less than 5 years and people living with HIV and AIDS, and malnourished people.

→ Checklist for possible HWT products (next page)

Mandatory components

All WASH programmes need to include the following mandatory components:



Evidence based trainings

All HWTs technologies should be followed by hygiene promotion activities on operation, maintenance, spare parts, usage, and do's and don'ts. Qualified trainers and evidence based training material should be available for the HWT technology. Do not introduce new HWT options without strict monitoring or piloting. See UNHCR hygiene promotion guidelines for general approaches



Safe storage

Safe water storage is critical to prevent contamination (Roberts et al., 2001). Make sure every household have a minimum of two 5 litre containers, two 10 litres containers, and one 20 litre container → **Annex 3** for explanation of appropriate and safe water containers.



Livelihood

Consider the linkage to livelihood programmes. Some HWT technologies, like porous ceramic pots can be produced locally and function and thereby function as an income generating activity.

· Q1
· Q2
· Q3

Monitoring and quality control

Monitoring should ensure that safe water storages are faecal coliform free. If HWT is chlorine-based, confirming residual levels are sufficient. Before chlorine-based products are introduced, these should ALWAYS be tested for the correct dose appropriate to the water quality. Timely and responsive monitoring has to be pre-developed for programmes to adjust to changing needs. WHO and UNICEF have developed a manual for monitoring of household water treatment and safe storage programmes. This manual, *A toolkit for monitoring and evaluating household water treatment and safe storage programmes*, can be used to evaluate whether HWT programmes are successful.



Checklist for several possible HWTS

Use the below questions (below) with the rating from fit (++) to possible (+) to bad (0) together with an argument to systematically identify advantages of available options against others. If two products are equally appropriate, the questions with “●” should be weighted highest to make the decision.

		Possible HWTS					
Performance	Is the HWT sufficiently effective against local enteric pathogens?						
	Do people have past experience with the product?						●
Acceptability	Does the HWT produce enough water for drinking and cooking (7 liters per person) for the household?						●
	Is operation of the HWT difficult?						
	Is maintenance difficult (possibilities to achieve spare parts)?						
Speed of supply	Is the HWT product already authorized in the country?						
	Is the HWT product available locally?						
	How long will it take to transport the HWT product to the site including customs clearance?						●
Cost	What is the cost per HWT for a month (including logistics and training)?						
	<i>Note that a rough estimation of logistical shipment is 15% of goods value for surface transport and 25% for air transport. Note that factory cost only is a fraction out of the total programme costs including: shipment, storage, distribution, provision of additional resources, training, and monitoring.</i>						
Storage	Is the number of safe (covered or narrow necked) water containers per household adequate for HWT product?						

Annex 1 – HWT concerns

List of HWT technologies UNHCR is familiar with

UNHCR do not have a widespread current practise of using HWT. One current HWT programme is being implemented in Ali Adde camp with approximately 10'000 Eritrean, Ethiopian and Somali refugees in Djibouti. The type of HWT technology us the ceramic water filter lined with silver (see photo).



Photo 1 – Ceramic water filter lined with silver

HWT not recommend

LifeStraw and LifeStraw Family by Vestergaard Frandsen is not recommended because:

- It based on individual ownership of the product and not household-based.
- It has shown low adaptation without likely reduction in diarrhoeal diseases (Boisson et al., 2009).
- Negative experiences by NGOs



WaterCone® by Mage Water Management is not recommended because:

- A maximum flow rate of 1,5 litres per 24 hours is too low for a scaled up water treatment programme

HWT used with caution

Aquatabs by Medentech

- Tablet size has to fit the water container size of the PoC or else the amount may either not be effective or cause adverse taste



PuR by Procter & Gamble + WATER MAKER

- Sachet content has to fit the water con-tainer size of the PoC or else amount may either not be effective or cause ad-verse taste



SODIS

- Effectiveness depending on sun light intensity

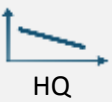


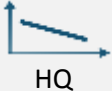
Biosand filter and Kanchan arsenic filter

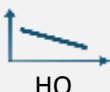
- It takes 7-21 days for the natural bio layer to grow before the Bio Sand Filter and Kanchan arsenic filter is fully effective against pathogens.

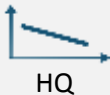


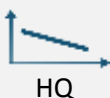
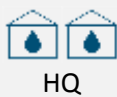
Annex 2 – Household water treatment cards

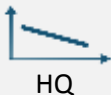
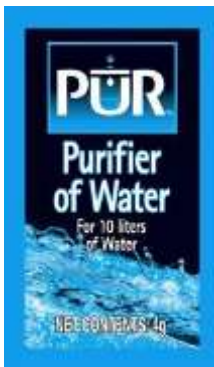
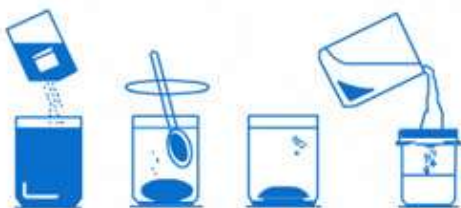
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
Chlorine				
For clear water If cloudy → pre-treatment	Disinfection		Health aspects: Bacteria: Protective Viruses: Protective Protozoa: Not protective ☉ Residual chlorine prevents recontamination hours after treatment → Turbidity and chlorine-demanding solutes inhibit this process; free chlorine × time product predicts efficacy (WHO, 2011), effectiveness affected by pH. Do not exceed of WHO guideline level of trihalomethanes THMs. (Lantagne et al., 2008)	
 <i>Example of commercial chlorination</i>			Reputable suppliers: East Africa: Waterguard	
Description Liquid chlorination products (sodium hypochlorite) are sold in many varieties. Instructions need to be followed as chlorine solution / water ratio changes. Local production is possible to set up. See CDC (2008) "A Guide for Establishing a Community-Based Safe Water System Program".			Acceptability advantages • Widely available in different countries • Scalable • Locally available • Easy to transport Acceptability disadvantages • Concentrated chlorine can be harmful • Can influence taste and colour • Consistent supply chain • Taste is unacceptable to some users • Dosage is product specific • Requires that users purchase chlorine on a continuous basis Flow rate: Depends on available water containers Shelf life/Life span: 1 year if the pH of the solution is above 11,9 Steps in operating: simple, 1 step Maintenance: None Household storage precautions: Cool, dark place in a closed container	
Instruction of use !Dose should be always be pre-tested! In normal situation 0.5 mg/L free residuals. In emergencies and in risk of outbreak 1.00 mg/l. More than 1.0 mg/l causes most PoC to dislike the water. For slightly cloudy water, hyper chlorination is possible (1.0 mg/L), however the effectiveness of chlorination is very dependent on other particles in the water. Hyper chlorination should therefore be carefully discussed before applied. If water is cloudy or muddy, water can be pre-treated.			Authorisation: Weight and volume: N/A Location to ship from: Stock capacity:	
			Cost estimation: 0,15-0,97 USD Total litres treated: 1000 Cost per 1000 litre ratio: 0.15-0.97 USD (Oxfam, NA)	
			Chlorination has to be in contact with water for at least 30 minutes. If a family of 5 persons consuming 10 liters of drinking water per day would have enough in one 10 litres container and another container to store the water.	
References				

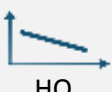
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
Aquatabs				
For clear water If cloudy→pre-treatment	Disinfection	 HQ	Health aspects: Bacteria: Protective Viruses: Protective Protozoa: Not protective ☉ Residual disinfection prevents recontamination for up to 144 hours after treatment. → The effectiveness of chlorine is affected by turbidity, organic matter, ammonia, temperature and pH.	
 Description Sodium dichloroisocyanurate or sodium troclosene (NADCC) tablets. Tablets fit different proportion of litres to treat. Medentech offers tablets to fit water containers of: 1 litre of water 5 lt of water 10 lt of water 20 lt of water 200 lt of water 1000 lt of water all volumes greater than 1000 litres Instruction of use !Dose should be always be pre-tested! Each product should have its own instructions for correct dosing. In general, the user adds the correct sized tablet for the amount of water to be treated, following the product instructions. Then the water is agitated, and left for the time instructed, normally 30 minutes (contact time). When added to water, NaDCC releases hydrochlorous acid which reacts through oxidization with microorganisms and kills them. (CAWST, NA) ! Tablet size has to fit the water container size of the PoC or else the amount may either not be effective or cause adverse taste ! If water is cloudy or muddy, water can be pre-treated.		 HQ	Reputable suppliers: Worldwide: Medentech Head Quarters , Clonard Road, Wexford, Ireland, Tel: +353 53 9117900. Medentech offers a 24 hour – 7 day – 365 days a year immediate support service. http://www.aquatabs.com/index.html Contact person: Kevin O'Callaghan +353539117915	
			Acceptability advantages •Registered in most countries •Simple to use •Can be available local Acceptability disadvantages •Cannot be produced locally •Likely need for subsidization if marked approach is used. Flow rate: All tablet sizes – water drinkable after 30 minutes Shelf life/Life span: 3-5 years Steps in operating: Simple Maintenance: N/A Household storage precautions: Harmful to eat	
			Authorisation: Non-hazard product. Are registered in most countries. Weight and volume: N/A Location to ship from: Stock of water purification tablets on hand in 20 Countries around the world to aid speedy distribution when a disaster strikes. Stock capacity: 30 million tablets	
			Cost estimation: < 2 cents per tablet (shops in Kenya). Litres treated: around one litre per 8 mg Cost per 1000 litre ratio: N/A	
			Ensure available safe water storage for collecting, treating and storing water (See Annex 3).	
References: http://www.aquatabs.com/index.html				

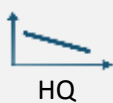
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
Iodine treatment				
For clear water If cloudy→pre-treatment		Disinfection		
 Description 1. Tincture of iodine (2% solution) 2. Iodine (10% solution) 3. Iodine tablet 4. Iodinated (triiodide or pentaiodide) resin Instruction of use !Dose should be always be pre-tested! 25 °C—minimum contact for 30 min; increase contact time for colder water Prepare according to package instructions Type and typical dosage: 1. Tincture of iodine (2% solution)—5 drops per litre 2. Iodine (10% solution)—8 drops per litre 3. Iodine tablet—1 or 2 tablets per litre 4. Iodinated (triiodide or pentaiodide) resin—room temperature according to directions and stay within rated capacity		 HQ	!The use of iodine is not recommended for long-term use by infants, pregnant women, those with a history of thyroid disease and those with known hypersensitivity to iodine unless treatment includes an effective post-disinfection iodine removal device (e.g. activated carbon) (WHO, 2008) !	
		 HQ	Reputable suppliers: N/A	
			Acceptability advantages • Easy to transport Acceptability disadvantages • Iodine can be harmful for some subgroups •Can influence taste and colour • Dosage is product specific •Requires that users purchase iodine on a continuous basis Flow rate: Depends on water containers Shelf life/Life span: 5 years (liquid), 7 years (tablets) Steps in operating: Simple Maintenance: None Household storage precautions: -	
			Authorisation: - Weight and volume: - Location to ship from: - Stock capacity: -	
			Cost estimation: - Litres treated: N/A Cost per 1000 litre ratio: N/A	
	Ensure available safe water storage for collecting, treating and storing water (see Annex 3).			
References				

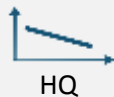
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
WATA				
For clear water If cloudy→pre-treatment		Disinfection		Health aspects: Bacteria: Protective Viruses: Protective Protozoa: Not protective ☉ Residual chlorine prevents recontamination hours after treatment → Turbidity and chlorine-demanding solutes inhibit this process; free chlorine × time product predicts efficacy. (WHO, 2011)
			Reputable suppliers: Worldwide: Fondation Antenna Technologies Av. De la Grenade 24, 1207 Genève, Suisse Contact: Carole de Bazignan, Safe water manager, Antenna Technologies, cdebazignan@antenna.ch	
Description Local production of large amounts of sodium hypochlorite by salt and electricity. Can be ordered in three sizes: - Mini WATA - WATA standard - Maxi WATA Mini WATA exists in a version with solar panels. The WATA is not for household use, but community use operated by trained personnel. Instruction of use !Dose should be always be pre-tested! 1 litre of water mixed with 25 gr of salt electrolyzed for an hour produces sodium hypochlorite (NaOCl) with a concentration of 6 grams per litre. UNHCR standard is a chlorine residual level of 0,5 mg/l at tap stands. If water is cloudy or muddy, water can be pre-treated.			Acceptability advantages •Local production •Low cost •Less logistics than importing sodium hypochlorite solutions •If produced when needed, less issues with expired solutions. Acceptability disadvantages •Only trained personnel should manage it •Needs steady electricity supply (or sun for solar panels) •Turbidity has to be less than 5 NTU •Potential taste and odour objections. Flow rate: N/A Shelf life/Life span: WATA's come with a one year guarantee. Life span depends on frequency and intensity of use and proper maintenance. Steps in operating: Should be operated by trained personal. Depending on participants background, training takes between a couple of hours to two days. Maintenance: clean/soak in acidic solution (ex. Vinegar) after every use Household storage precautions: Store in dry and dust free location.	
			Weight and volume: 26x11x11cm, 0,4 kg (Mini WATA) 26x11x11cm, 1,1 kg (WATA standard) 83x34x23cm, 7,5 kg (Maxi WATA) Location to ship from: Geneva, Switzerland Stock capacity: 200 of each product series	
			Cost estimation: 380 CHF (WATA standard) Litres treated: 1 liter produced Sodium Hypochlorite (NaOCl) solution treats 4,000 liters of water Cost per 1000 litre ratio: 0.0625CHF	
			Ensure safe water storage for collecting, treating and storing water (see Annex 3).	
References: www.antenna.ch				

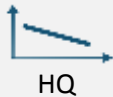
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
AgNP paper				
For clear water If cloudy→pre-treatment	Disinfection		Health aspects: No tests in real-world real world situations have been conducted.	
 Description AgNP paper is bactericidal paper impregnated with silver nanoparticles. AgNP paper has been tested by Dankovich and Gray with log reductions of <i>Escherichia coli</i> (log 6) and <i>Enterococcus faecalis</i> (log 3), and a level of ppb of silver below WHO standards. UNHCR is not aware of any developed product.		Reputable suppliers: UNHCR is not aware of any developed product		
		N/A		
		N/A		
		N/A		
		N/A		
References: Theresa A. Dankovich and Derek G. Gray (2011) <i>Bactericidal Paper impregnated with Silver Nanoparticles for Point-of-Use Water Treatment</i> . Environmental science & technology				

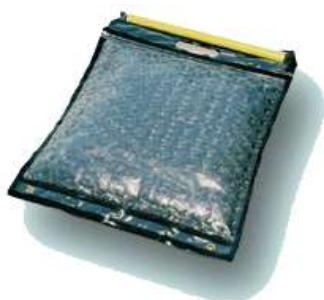
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration	
PuR					
For muddy water	Disinfection	 HQ	Health aspects: Bacteria: Highly protective Viruses: Protective Protozoa: Protective ☉ Residual chlorine prevents recontamination hours after treatment + Removal of some heavy metals and pesticides → pH between 5.5 and 7.5; disinfection is unreliable above a pH of 9		
 Description The PUR™ product is a small sachet containing powdered ferric sulphate (a coagulant) and calcium hypochlorite (a disinfectant). (CDC, 2013a) Instruction of use !Dose should be always be pre-tested! The content of the sachets is added to the water in 10 litres buckets, water should be stirred for 5 minutes and left settling for 20 minutes. The water has to be poured into another bucket using a steering cloth to filter large-sized particles.  ! Sachet content has to fit the water container size of the PoC or else the amount may either not be effective or cause adverse taste !		 HQ	Reputable suppliers: Worldwide Procter & Gamble		
			Acceptability advantages •Visual improvement in the water •Easily transported •Classified as non-hazardous material for air shipment Acceptability disadvantages •Multiple steps are necessary to use the product •Need for users to have, employ, and maintain two buckets, a cloth, and a stirring device. Flow rate: N/A Shelf life/Life span: Packet needs to be used within 3 years of manufacture Steps in operating: N/A Maintenance: N/A Household storage precautions: Unknown		
				Authorisation: Classified as non-hazardous material for air shipment Weight and volume: N/A Location to ship from: N/A Cannot be made locally; must be shipped, distributed and sold locally. No special handling required; can be shipped as non-hazardous material. Products should be protected from exposure to temperature extremes or high humidity Stock capacity: N/A	
					Cost estimation: 3.5 cents per sachet Litres treated: 10 litres Cost per 1000 litre ratio: 3.5 \$
			Ensure available safe water storage for collecting, treating and storing water (see Annex 3).		
References http://www.csdw.org/csdw/index.shtml					

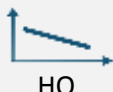
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration	
Water Maker					
For muddy water	Disinfection	 HQ	Health aspects: Bacteria: Highly protective Viruses: Protective Protozoa: Protective ☉ Residual chlorine prevents recontamination hours after treatment		
 Description Water Maker both makes particles settle and disinfect the water by using a coagulant and chlorine compound. 2.5g & 5g Sachets Instruction of use ! Dose should be always be pre-tested! The content of the sachets is added to the water in buckets of the size according to the instructions. Water should be stirred for 5 minutes and left settling for 20 minutes. The water has to be poured into another bucket using a steering cloth to filter large-sized particles.		 HQ	Reputable suppliers: Worldwide Control Chemicals (Pty Ltd)		
			Acceptability advantages - Visual improvement in the water - Easily transported - Classified as non-hazardous material for air shipment Acceptability disadvantages - Multiple steps are necessary to use the product - Need for users to have, employ, and maintain two buckets, a cloth, and a stirring device. Flow rate: N/A Shelf life/Life span: N/A Steps in operating: 2 steps Maintenance: None Household storage precautions: Unknown		
				Authorisation: Classified as non-hazardous material for air shipment Weight and volume: 2.5g & 5g Sachets Location to ship from: N/A Stock capacity: N/A	
				Cost estimation: - Litres treated: N/A Cost per 1000 litre ratio: N/A	
			Ensure available safe water storage for collecting, treating and storing water (Annex 3).		
References: http://www.watermakersachets.com/index.html					

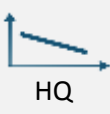
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
Boiling				
For clear water If cloudy→pre-treatment	Disinfection	 HQ	Health aspects: Bacteria: Highly protective Viruses: Highly protective Protozoa: Highly protective ☉ Risk of recontamination → treatment to reduce spores by boiling must ensure sufficient temperature and time. Max turbidity: None	
Description Boiling is the most widespread HWT practiced. Instruction of use Bring water to a rolling boil for 1 minute and allow to cool. At altitudes greater than 2,000 m, boil water for 3 minutes. (CDC, 2013b) Add salt to improve taste. If water is cloudy or muddy, water can be pre-treated.	 HQ	Reputable suppliers: N/A		
		Acceptability advantages • Effectively kills most pathogens • Simple and widely accepted Acceptability disadvantages • Taste may become flat – salt can be added •Time consuming •contributes to deforestation problems in many countries Flow rate: N/A Shelf life/Life span: N/A Steps in operating: Simple Maintenance: N/A Household storage precautions: N/A		
				
		 Authorisation: N/A Weight and volume: N/A Location to ship from: N/A Stock capacity: N/A		
		 Cost estimation: US\$ 0.272 per month for wood collectors and US\$ 1.68 per month for wood purchasers, representing approximately0.48%to1.04%, respectively, of the average monthly income of participating households in Vietnam 2008. (Clasen et al., 2008) Litres treated: N/A Cost per 1000 litre ratio: N/A		
			Ensure available safe water storage for collecting, treating and storing water (see Annex 3).	
References				

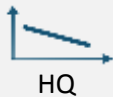
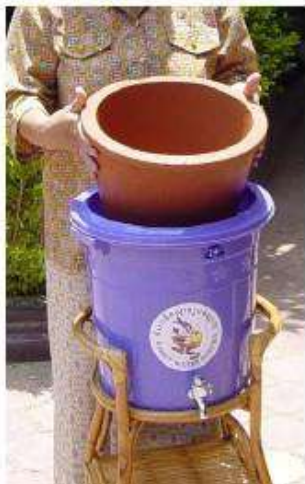
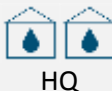
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
SODIS				
For clear water If cloudy→pre-treatment		Disinfection	Health aspects: Bacteria: Protective Viruses: Less protective Protozoa: Protective ☉ Confined storage can prevent recontamination % Requires strong sunlight during the whole day. % Oversimplification can affect users not to treat water correctly. → Varies depending on oxygenation, sunlight intensity, exposure time, temperature, turbidity and size of water vessel (depth of water). Reputable suppliers: N/A Acceptability advantages •renewable energy • Simple •Minimal change in taste •Low risk of recontamination if kept in bottle Acceptability disadvantages •Need for pre-treatment •Low flow rate •Requires intact, clean plastic bottles •Requires sufficient solar radiation •Large amounts of water is difficult to treat Flow rate: 0.01-0.25 / h / bottle Shelf life/Life span: Unknown Steps in operating: Simple but time consuming Maintenance: change of bottles Household storage precautions: Authorisation: Weight and volume: N/A Location to ship from: N/A Stock capacity: Cost estimation: Reuse of plastic bottles Litres treated: N/A Cost per 1000 litre ratio: N/A Stored in bottles	
 Description A simple and low cost technology using solar radiation from the sun to kill bacteria and viruses. The heating of the water (pasteurisation) can kill protozoa. (CAWST, 2008) Instruction of use The use of bottles made from PET instead of PVC is recommended as PET contains much less UV preventative additives than bottles made from PVC. Glass bottles can be used also transmit UV light less easily. To increase effectiveness half of the bottle vertically can be painted black. A clear and intact bottle (independent of size) with low turbidity water should be placed in the sun for 6 hours if sunny, 2 days if cloudy, and not used on rainy days. The bottles can be left on metal roofs to utilize the reflection of sun-light. ! Effectiveness depending on sun light intensity ! If water is cloudy or muddy, water can be pre-treated.		 HQ		
		 HQ		
				
				
				
References: http://www.sodis.ch/methode/anwendung/ausbildungsmaterial/dokumente_material/manual_e.pdf				

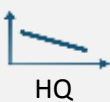
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
WADI				
For clear water If cloudy→pre-treatment	Disinfection	 HQ	Health aspects: Bacteria: Protective Viruses: Less protective Protozoa: Protective ☉ Confined storage can prevent recontamination % Requires strong sunlight during the whole day. → Varies depending on oxygenation, sunlight intensity, exposure time, temperature, turbidity and size of water vessel (depth of water).	
		 HQ	Reputable suppliers: N/A	
Description WADI a monitoring device – and do NOT disinfect itself – developed to trace the progress of solar water disinfection (SODIS) in a PET-bottle by detecting and calculating the UV-A rays of the sun, indicated by a status bar and smiley face. WADI, building on the SODIS method to purify contaminated water, makes the method more attractive among end users by visualizing its results.			Acceptability advantages •renewable energy • Simple •Minimal change in taste •Low risk of recontamination if kept in bottle • Verification mechanism Acceptability disadvantages •Need for pre-treatment •Low flow rate •Requires intact, clean plastic bottles •Requires sufficient solar radiation •Large amounts of water is difficult to treat	
Instruction of use The use of bottles made from PET instead of PVC is recommended as PET contains much less UV preventative additives than bottles made from PVC. Glass bottles can be used also transmit UV light less easily.			Flow rate: 0.01-0.25 / h Shelf life/Life span: Bottles should be changed every XX (find reference) Steps in operating: Simple but time consuming Maintenance: change of bottles Household storage precautions: None	
To increase effectiveness half of the bottle vertically can be painted black.			Authorisation: - Weight and volume: N/A Location to ship from: N/A Stock capacity: -	
Contaminated water is filled in a transparent PET-bottle and exposed to the sun for some time until it the WADI indicates the water is ready for drinking.			Cost estimation: Reuse of plastic bottles Litres treated: N/A Cost per 1000 litre ratio: N/A	
If water is cloudy or muddy, water can be pre-treated.			Stored in bottles	
References: http://www.helioz.org/en-gb/home/aboutwadi.aspx				

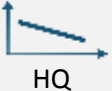
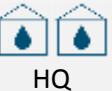
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration	
AquaPak					
For cloudy water If muddy→pre-treatment	Pasteurization	 HQ	Health aspects: Bacteria: Highly protective Viruses: Highly protective Protozoa: Highly protective ☉ Confined storage can prevent recontamination → The AquaPak will work all year long in countries within 25° of the equator and having a sunny climate. If conditions are hazy, pasteurization will take more than three hours. Pasteurization will not work on completely cloudy/rainy days.		
 Description The water purification effect of AquaPak is based on pasteurization. Water pasteurization achieves the same effect as boiling, but at a lower temperature of 60-65°C over a longer period of time. Instruction of use Three litres of water is poured into the AquaPak. The three litres of water will reach 65°C within three hours during a typical sunny day when placed perpendicular in the sun. Engineered into each AquaPak is an orange wax in a sealed glass cylinder fitting into the cap enclosure. The coloured wax melts and disappears from view when the desired water temperature has been reached.  If water is cloudy or muddy, water can be pre-treated.		 HQ	Reputable suppliers: Worldwide: Solar Solutions, LLC 10080 Willow Creek Rd. San Diego, CA 92131 Phone: 858-695-3806 ext.4703 E-mail information@solarcleanwatersolution.com With possibilities for local production, contact Solar Solutions, LLC		
			Acceptability advantages •renewable energy • High mobility •Provides its own storage container • Low cost • Possibilities for local production Acceptability disadvantages • Depends on sufficient sunlight •Low flow rate •Time consuming • Product package is fragile if children play with it Flow rate: 5 litres in 3,5 hours (sunny day) ≈ 1.5 litres per hour Shelf life/Life span: 2-3 years Steps in operating: Simple. Water temperature verification mechanism. Maintenance: No maintenance, if broken a new product is needed Household storage precautions: N/A		
				Authorisation: N/A Weight and volume: 0,2 kg , 38 x 47 cm Location to ship from: - Stock capacity: Production capacity in USA: 100 /day. Production capacity in China: 1'000 / day.	
				Cost estimation: 10 \$ (USA prices), less than 2\$ for local production Litres treated: up to 10 litres per day Cost per 1000 litre ratio: 0,27\$/1'000 litres (local production)	
				Ensure available safe water storage for collecting and storing water (see Annex 3).	
References: http://solarcleanwatersolution.com/					

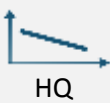
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration	
Solvatten					
For clear water If cloudy→pre-treatment		Disinfection			
 Description Solvatten is a specially designed container that uses heat, UV and a built-in filter to clean contaminated water. Instruction of use Put Solvatten in a sunny place, give it 2-6 hours and the water will be drinkable. 2-6 hours (sunny), 5-6 hours (cloudy) If water is cloudy or muddy, water can be pre-treated.		 HQ	Health aspects: Bacteria: Protective Viruses: Protective Protozoa: Protective ☉ Confined storage can prevent recontamination		
		 HQ	Reputable suppliers: Worldwide • Solvatten		
			Acceptability advantages •renewable energy •Validator lets the user know when the water is safe to drink •Does not change taste Acceptability disadvantages •Spare parts may be difficult to obtain •Difficult to clean inside Flow rate: 1.7-2.5 Shelf life/Life span: Last up to many years Steps in operating: Maintenance: Household storage precautions: Unknown		
				Authorisation: Weight and volume: 36 x 47 x 13 cm / 2.70 kg. Location to ship from: N/A Stock capacity:	
				Cost estimation: - Litres treated: 10 litres at a time, 2-3 times a day. Cost per 1000 litre ratio: N/A	
			Ensure available safe water storage for collecting, treating and storing water (see Annex 3).		
References http://www.solvatten.se/					

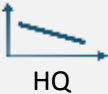
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration	
Naïade					
For clear water If cloudy→pre-treatment	Disinfection	 HQ	Health aspects: Bacteria: Protective Viruses: Less protective Protozoa: Protective ☉ Confined storage can prevent recontamination		
 Description The Naïade is a water purification device that combines solar energy systems and UV water treatment technology . Instruction of use As soon as the container is filled with water, one only has to press the button to start the purification of the water. The Naïade is powered by an integrated solar panel and uses the state of art UV technology. During hours of darkness, the electricity comes from a battery in the base of the unit. The Naïade is a stand-alone device. If water is cloudy or muddy, water can be pre-treated.		 HQ	Reputable suppliers: Worldwide: Nedap http://www.nedap-naiade.com/resellers.html		
			Acceptability advantages - renewable energy Acceptability disadvantages Flow rate: Daily capacity 3000 litres Shelf life/Life span: N/A Steps in operating: Simple but needs regular maintenance. Maintenance: The filter bags, solar panel and container needs to be cleaned every now and then. Household storage precautions: Cannot withstand freeze once used. (can withstand freeze if not used).		
				Authorisation: - Weight and volume: 44 kg, 54 x 75 x 140 cm Location to ship from: N/A Stock capacity: -	
				Cost estimation: - Litres treated: N/A Cost per 1000 litre ratio: N/A	
			Built-in safe water storage capacity of 100 litres.		
References: http://www.nedap-naiade.com/ http://www.nedap-naiade.com/technical-data/					

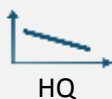
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
Porous Ceramic Pots				
For cloudy water If muddy→pre-treatment	Filtrates water	 HQ	Health aspects: Bacteria: Protective Viruses: Less protective Protozoa: Highly protective ☉ Confined storage can prevent recontamination !Will lose effectiveness after many cleanings! → The effectiveness depends of the quality of the production. Reputable producers are needed. However, local production can function as income generating activities.	
		 HQ	Reputable suppliers: http://www.stefani.com.au/	
Description N/A See Potters for Peace http://www.pottersforpeace.org/ Potters for peace are conducting trainings in Potters for Peace now conducts training in several countries including Cuba, El Salvador, Ghana, Mexico, Honduras, Indonesia, Kenya, and Guatemala among others. (CAWST, 2008)			Acceptability advantages •Simple •Potential long lifespan •Relatively low one-time cost •Perceived a valuable asset by some populations •Can be manufactured locally Acceptability disadvantages •Invisible cracks can allow pathogens to pass •Poor transportation can lead to cracks •Quality control needed •Filters needs regular cleaning if water is turbid •Limited mobility •Cannot guarantee that water is pathogen free •Cleaned using filtered or disinfected water Flow rate: 1-3 litres per hour Shelf life/Life span: Needs to be replaced every 3 years or when the flow rate is too slow after cleaning Steps in operating: Maintenance: Household storage precautions:	
Instruction of use Water is poured into the top, which the flows through the ceramic filter with a flow rate of 1-3 litres per and then stored in the below container.			Authorisation: Weight and volume: N/A Location to ship from: N/A Stock capacity:	
If water is muddy, water can be pre-treated.			Cost estimation: 7.5-30\$ Litres treated: 20.000 litres Cost per 1000 litre ratio: 0.38 to 1.5 \$	
			Ensure available safe water storage for collecting, treating and storing water (see Annex 3).	
References: http://www.pottersforpeace.org/				

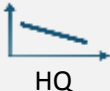
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
Ceramic Candle Filters				
For cloudy water If muddy→pre-treatment	Filtrates water		Health aspects: Bacteria: Protective Viruses: Less protective Protozoa: Highly protective ● Confined storage can prevent recontamination !Will lose effectiveness after many cleanings! → Pore size and construction quality are critical to ensure flow rate and effective treatment.	
 Description Water seeps through the hollow cylindrical formed ceramic candles. The ceramic candle filter is fastened into the bottom of the top container and is stored in the water container beneath. Instruction of use Water is poured into the top water container. By gravity and filtration, water is being treated. If water is muddy, water can be pre-treated.		 HQ	Reputable suppliers: The best known manufacturer is probably the Swiss company called Katadyn® who produces the Katadyn® Drip Filter.	
			Acceptability advantages •Simple •Potential long lifespan •Relatively low one-time cost •Perceived a valuable asset by some populations •Can be manufactured locally •Taste, odour and colour generally improved • Acceptability disadvantages •Invisible cracks can allow pathogens to pass •Poor transportation can lead to cracks •Quality control needed •Filters needs regular cleaning if water is turbid •Limited mobility •Cannot guarantee that water is pathogen free •Cleaned using filtered or disinfected water Flow rate: 0.1-1 litres/hour Shelf life/Life span: 1 year Steps in operating: Simple Maintenance: The filter has to be cleaned Household storage precautions: If possible, verify the effectiveness of the HWT	
			 Authorisation: - Weight and volume: N/A Location to ship from: N/A Stock capacity: -	
			 Cost estimation: 15-30\$ (repair 4,5\$ a year) Litres treated: 4.380 litres (based on 12 a day one year) Cost per 1000 litre ratio: 3.4-6.8\$	
			 Ensure available safe water storage for collecting, treating and storing water (see Annex 3).	
References: -				

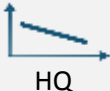
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
Tulip siphon water filter				
For cloudy water If muddy → pre-treatment	Filtrates and disinfect water		Health aspects: Bacteria: Highly protective Viruses: Protective Protozoa: Protective ● Residual silver particles prevents disinfection up to one year → Filter candles within can be replaced. High turbidity slows the flow rate but do not influence water quality.	
			Reputable suppliers: Worldwide: Basic Water Treatment Contact: Martijn Smid, +31 6 81901264 CrystalPur® (India, East Africa, Cambodia) and Tulip® (Africa, SouthEast Asia, India, Central & South America) are the brand names available in the market.	
Description The Tulip water filter is a candle-type water filter which uses gravity siphon pressure to force water through a ceramic filter element. The Siphon filter consists of a plastic hose, and a valve are needed, while existing storage containers can be used. The filter element is impregnated with silver in order to increase the bacterial removal efficiency of the filter and to reduce the recontamination risk of stored filtered water.				
Instruction of use The filter element is placed in a container with contaminated water, situated about 70 cm. above the clean water container. The siphon action is started by squeezing the rubber bulb. The siphon pressure forces the water through the filter element, ensuring a high flow of filtered water.		Acceptability advantages •Reduces turbidity •Reduces some metals •Pump enables for backwash •silver particles ensure low risk of recontamination Acceptability disadvantages •Replacement parts needed over time •Should be cleaned regularly. Flow rate: 4-5 l/per hour, in case of high turbidity 3,7 l/h Shelf life/Life span: 1 year per candle per year. One candle filter can treat 3'000 to 7'000 litres Steps in operating: Simple Maintenance: First option: backwashing. Second option: cleaning with cloth or toothbrush. Third option: scrubbing the filter element. Replacement of candle filter Household storage precautions: Cannot withstand freeze once used. (can withstand freeze if not used).		
Package includes: • Washable pre-filter • Scrub pad for filter cleaning • End of effective life indicator • Instructions of use			Authorisation: Weight and volume: 0.45kg, Location to ship from: N/A Stock capacity: 80'000 to be shipped world-wide. Current capacity to produce 150'000/month scaling up to 250'000/month.	
If water is muddy, water can be pre-treated.			Cost estimation: 6-7 \$ per device Litres treated: Around 7 000 litres Cost per 1000 litre ratio: 0.9-1 \$	
			Ensure available safe water storage for collecting and storing water (see Annex 3).	
References: http://www.basicwaterneeds.com/ Demonstration: http://www.youtube.com/watch?v=yQlc1JvIXF4				

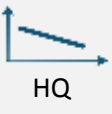
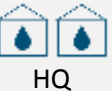
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration	
LifeStraw Community					
For cloudy water If muddy→pre-treatment	Filtrates and disinfect water		Health aspects: Bacteria: Highly protective Viruses: Highly protective Protozoa: Highly protective ☉ Confined storage can prevent recontamination		
 Description LifeStraw® Community is a point-of-use microbiological water purifier intended for routine use in community, educational, and institutional settings. It can serve four people simultaneously and has a built-in safe storage container. Instruction of use Water is poured into the water container, whereas gravity filters the water. The safe water storage container has a capacity of 25 litres. When the filter reaches its full capacity (i.e. the end of its lifetime) the membrane clogs naturally thus eliminating the possibility of drinking contaminated water from the filter. If water is muddy, water can be pre-treated.			Reputable suppliers: Worldwide: Vestergaard Frandsen www.vestergaard-frandsen.com		
		Acceptability advantages - Contains no chemicals - Reduces turbidity - Does not leave any chemical taste or odour in purified water - Backwash handle and pump enables backwash Acceptability disadvantages - Shared HWT may reduce the level of responsibility thus reducing the carefulness when using the product. Flow rate: 12 l/h Shelf life/Life span: +3 years, capacity of 100.000 litres. Tests are underway and the actual lifetime filtration capacity will be confirmed in 2013. Steps in operating: 45 minutes household education and demonstration of use with end users. Maintenance: Regular backwash of filter. Cannot be repaired Household storage precautions: Cannot withstand freeze once used. (can withstand freeze if not used).			
					
				Authorisation: Most disasters, no experienced requirements due to on-going programmes with similar products registered in most countries Weight and volume: 8kg, 580x580x560mm Location to ship from: Africa, Asia, Latin America, Europe. Stock capacity:	
				Cost estimation: 175\$ Litres treated: 100.000 Cost per 1000 litre ratio: 0.175\$	
		Built-in safe water storage capacity of 25 litres.			
References: www.lifestraw.com					

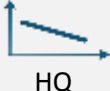
Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration	
Lifesaver					
For cloudy water If muddy→pre-treatment		Filtrates water			
 Description Water container with build-in ultra-filter and hand pump. Instruction of use With the use of a pump, water is filtered through the output of the container.		 HQ	Health aspects: Bacteria: Highly protective Viruses: Highly protective Protozoa: ? ☉ Confined storage can prevent recontamination		
		 HQ	Reputable suppliers: Worldwide: LIFESAVER Systems Ltd http://www.lifesaversystems.com/contact-us		
			Acceptability advantages - Water can be filtered at the exact point of use preventing recontamination • high flow rate Acceptability disadvantages - Expensive Flow rate: 180 litres per hour (2 litres per minute [storage of 18,5 l]) Shelf life/Life span: N/A Steps in operating: Simple Maintenance: N/A Household storage precautions: N/A		
				Authorisation: N/A Weight and volume: 47x34,5x17,5cm Location to ship from: - Stock capacity: -	
				Cost estimation: \$255 Litres treated: 10.000 Cost per 1000 litres ratio: \$25,2	
			Ensure available safe water storage for collecting and storing water as the LifeSaver in itself maximum can contain 18,5 litres (see Annex 3).		
References: http://www.lifesaversystems.com/lifesaver-products/lifesaver-jerrycan					

Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration	
GDM filtration					
For cloudy water If muddy→pre-treatment	Filtrates water		Health aspects: Bacteria: Protective Viruses: Protective Protozoa: Protective ☉ Confined storage can prevent recontamination		
 Description In gravity-driven membrane (GDM) technology, no backflushing or cleaning is used. Pressure necessary to press water through the membranes is generated by gravity generated by difference of water levels between two storage tanks. As a feed, natural water (river, spring, well or rainwater) can be used without pre- or post-treatment. Although also turbid waters can be used, a pretreatment is required if the water becomes extremely turbid (> 500 NTU). According to common membrane filtration theory, operation of such a system on a long term should result in the decline of water flux and clogging of the membrane. However, this does not occur due to the phenomenon of flux stabilization. Instruction of use Water is poured into the water container, whereas gravity filters the water If water is muddy, water can be pre-treated.		 HQ	Reputable suppliers: UNHCR is unaware of producers, but the inventors are Eawag, Water and Sanitation in Developing Countries (Sandec), Switzerland Contact person: Maryna Peter-Varbanets maryna.peter@eawag.ch		
			Acceptability advantages •Highly turbid water can be used •Long life span •No back-flushing, cleaning or addition of chemicals is required Acceptability disadvantages •Not robust Flow rate: 5 litres per hour (10 litre per two hours) Shelf life/Life span: 5-8 years Steps in operating: Simple Maintenance: No cleaning needed Household storage precautions: Unknown		
				Authorisation: - Weight and volume: N/A Location to ship from: N/A Stock capacity: -	
				Cost estimation: - Litres treated: N/A Cost per 1000 litre ratio: N/A	
				Ensure available safe water storage for collecting, treating and storing water (see Annex 3). Possibilities for a built-in safe water storage.	
		References: http://www.eawag.ch/forschung/eng/gruppen/gdm/index_EN			

Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
Nerox®				
For cloudy water If muddy→pre-treatment	Filtrates water	 HQ	Health aspects: Bacteria: Highly protective Viruses: ? Protozoa: ? Needs more information is needed about viruses and protozoa	
 Description The Nerox®-02 filter is a patented technology. The filter system is comprised of a chamber containing the membrane, with an outlet hose and nozzle. The membrane is a thin polymeric film with pore size of 0.21, 0.282 or 0.43 microns. The filter operates mechanically using gravity. ¹⁰ Instruction of use The height of the water surface in the inlet water container must be kept a minimum of 30 cm above the end of the outlet tube. ¹⁰ If water is muddy, water can be pre-treated.		 HQ	Reputable suppliers: Simplex http://www.filter-systems.com/en/nerox.html	
			Acceptability advantages - Reduction in turbidity and colour - Does not require replacement cartridges - More elements can be added to increase flow rate Acceptability disadvantages - Slow flow rate Flow rate: Typically 15 to 25 L/day, turbid water gives lower output Shelf life/Life span: Unknown Steps in operating: Simple Maintenance: Occasional cleaning Household storage precautions: Unknown	
			Authorisation: - Weight: 300 grams Volume: 16 cm x 17.5 cm x 2.5 cm. Location to ship from: - Stock capacity: -	
			Cost estimation: US\$ 12-15 Litres treated: 2,500 litres depending on source water turbidity Cost per 1000 litre ratio: US\$ 5-6	
			Ensure available safe water storage for collecting, treating and storing water (see Annex 3).	
References: http://www.filter-systems.com/en/index.html				

Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
Sawyer Point One™				
For cloudy water If muddy→pre-treatment	Filtrates water		Health aspects: Bacteria: Highly protective Viruses: Highly protective Protozoa: Highly protective	
		 HQ	Reputable suppliers: AIT Worldwide Logistics. Tampa call center office phone number is 813.247.6797. http://www.sawyer.com/sawyersaves/FAQ.html	
Description The Sawyer Point One® filter is a gravity membrane filtration technology that uses hollow fibre membranes to remove pathogens. It has a pore size of 0.1 microns, making it effective for removing bacteria, protozoa and helminths. The Point One® filter does not remove viruses (see Sawyer Point Zero Two Product Sheet for virus removal). ¹⁰			Acceptability advantages • High flow rate Acceptability disadvantages • - Flow rate: 46.5-54 litres/hour Shelf life/Life span: +10 years Steps in operating: Simple Maintenance: When the filter starts to slow down or clog, simply backwash it with clean water using the syringe provided in the kit; it takes less than 2 minutes. Household storage precautions: Unknown	
Instruction of use 1) Obtain a clean bucket or plastic container. 2) Use the hole cutter to drill a hole 1.5 inches from the bottom of the bucket (you can do this by hand). 3) Screw the connector, hose and filter onto the bucket. 4) Fill the bucket with water from any source, lower the filter head below the water line, and let gravity do the rest.			Authorisation: - Weight and volume: 0.3 kg Location to ship from: N/A Stock capacity: -	
			Cost estimation: US\$60 Litres treated: - Cost per 1000 litre ratio: N/A	
If water is muddy, water can be pre-treated.			Ensure available safe water storage for collecting, treating and storing water (see Annex 3).	
References: http://www.sawyer.com/sawyersaves/products-pointone.html				

Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
Bio Sand Filters				
For cloudy water If muddy → pre-treatment	Filtrates water and biological removal			Health aspects: Bacteria: Less protective Viruses: Not protective Protozoa: Protective ☉ Confined storage can prevent recontamination → Varies with filter maturity, operating conditions, flow rate, grain size and filter bed contact time ⁷ . It takes time before the natural level of bacteria is established therefore sand filters are first optimal after 7-30 days. Max turbidity: 50 NTU
 Description Water is poured in the top of the sand filter, it passes through a number of layers of fine sand to rough gravel. A natural bio layer will develop in few weeks. This mechanical filter and the natural bio layer removes pathogens. As of June 2009, CAWST estimates that over 200,000 concrete biosand filters have been implemented in more than 70 countries. Instruction of use Water flows from the top pipe to a container next to the Bio Sand Filter. ! It takes 7-30 days for the natural bio layer to grow before the Bio Sand Filter is fully effective (Ngai et al., 2007)! If water is muddy, water can be pre-treated.				Reputable suppliers: Hydraid
				Acceptability advantages - Potential long lifespan - Relatively low one-time cost - Can be manufactured locally - One-time installation with low maintenance requirements Acceptability disadvantages and warnings: - Heavy and no mobility - Cannot assure pathogen free water - May be re-contaminated
				Flow rate: 60 litres per hour Shelf life/Life span: Still performing satisfactorily after 10+ years Steps in operating: Maintenance: Household storage precautions:
				Authorisation: Weight and volume: 70-75 kg for thin wall version and 135 kg for heavy wall version (empty with no sand), 0.9 m tall by 0.3 m Location to ship from: N/A Stock capacity:
				Cost estimation: 12-100 USD Litres treated: N/A Cost per 1000 litre ratio: N/A
				Some models have built-in water container about 12-18 litres. Otherwise one water container is needed for catching the water. Another water container is needed to fetch water from the water source
References http://www.hydrad.org/ http://www.biosandfilter.org/biosandfilter/				

Chemicals for disinfection	Chemicals with combined treatment	Disinfection by UV/heat	Ceramic and ultra filters	Bio Sand Filtration
Kanchan Arsenic Filter				
For cloudy water If muddy→pre-treatment	Filtrates water, biological and chemical removal	 HQ	Health aspects: Bacteria: Less protective Viruses: Not protective Protozoa: Protective ☉ Confined storage can prevent recontamination +Can decrease arsenic levels → See Bio Sand filter	
 Description The Bio Sand Filter with an add on of iron rust material (~5kg). The iron rust (ferric hydroxide) adsorbs arsenic. The iron particles are filtered at the sand filter. The Kanchan™ filter can remove 85% to 95% of arsenic from source water. (Ngai et al., 2007) Instruction of use ! It takes 7-21 days for the natural bio layer to grow before the Bio Sand Filter is fully effective (Ngai et al., 2007)! If water is muddy, water can be pre-treated.		 HQ	Reputable suppliers: N/A	
			Acceptability advantages •Potential long lifespan •Relatively low one-time cost •Can be manufactured locally •One-time installation with low maintenance requirements •Can remove arsenic Acceptability disadvantages •Heavy and no mobility •Cannot assure pathogen free water •May be re-contaminated Flow rate: 60 litres per hour Shelf life/Life span: The iron nails will lose their capacity in 3 to 5 years if the source water has up to 500 ug/L of arsenic. (Ngai et al., 2007) Steps in operating: Maintenance: Household storage precautions:	
			Authorisation: Weight and volume: 70-75 kg for thin wall version and 135 kg for heavy wall version (empty with no sand), 0.9 m tall by 0.3 m Location to ship from: N/A Stock capacity:	
			 Cost estimation: 12-100 USD Litres treated: N/A Cost per 1000 litre ratio: N/A	
			Built in water container about 12-18 litres	
References				

Annex 3 – Safe Storage

Among Mali refugee population, safe storage alone reduced diarrhoea in children by 31% (Roberts et al., 2001). The characteristics of a safe water storage container can be summarized in the following three points. (CDC, 2013c)



- Small opening to pour water in the container preventing hands and objects to contaminate water, and still possibly to clean
- Small opening for pouring water out of the container.
- Appropriate size for family size, transportation and treatment method

If local containers meeting these criteria are available, this should be the preferred option. Each household should have a minimum of two containers of 10–20 litre capacity (The_Sphere_Project, 2011). If they are not available, efforts should be made to provide this. The most common commercial products are the presented in box 2, which is a direct copy from. (CDC, 2013c)

UNHCR finds that the lifespan of collapsible jerry cans is short and alternatives should be sought.

If only water storage containers not meeting the criteria is available, efforts should be made to carry out evidence based health education training in order for people to decrease the possibility of re-contaminate stored water. (CDC, 2013c)

Containers should be cleaned regularly in order to prevent recontamination after treatment. The containers should be drained and scrubbed inside using abrasive and cleaning agents (chlorinated water or soap) – especially make sure the area around the filling and discharge openings are cleaned. Clean the container with clean water to rinse it from cleaning agents. Oxfam for example recommends periodic mass chlorination of all containers. (Oxfam, NA)

According to UNHCR standards to increase safe water storage and handling at household level, each household should have a minimum of:

- Two** 5 litre containers, and
- Two** 10 litres containers, and
- One** 20 litre container.

Type of water containers

Box 2 – Common commercial products (direct copy from CDC (2013c))

Oxfam Bucket	The 14-litre Oxfam Bucket was designed to provide a safe storage option to organizations working on water safety in the home or refugee camps. It is manufactured in England, and sold unassembled to NGOs for use in program implementation. The lids snap on to prevent entry of the hands or objects into the container. The Oxfam Bucket costs approximately US\$10, excluding transport from England to the program site. A minimum order of 200 is required. Contact fieldlog@oxfam.org.uk to order	
CDC SWS Container	In the initial Safe Water System programs, CDC designed 20-litre modified jerry cans and provided them to users. This jerry can is now produced in Uganda, Afghanistan, Kenya, and the United States. Each jerry can costs approximately \$5, excluding transport. Contact safewater@cdc.gov for more information.	
Jerry Cans	In many countries in Africa, 20-litre jerry cans, initially used to transport vegetable cooking oils, are cleaned and used to transport and store water. They are easy to carry on the head and are a good option for safe storage. The opening is too small to allow hands or utensils into the water, and thus the water is poured out. They can be modified by drilling a hole in the plastic and adding a tap, which offers easier access to the treated water and provides a handwashing station in the home. Used jerry cans cost approximately \$1-5 on the open market in Africa.	
Bucket with Lid and Tap	Five gallon (19-litre) buckets are widely available in many countries and are often used for water transport and storage. Buckets can be modified for safe storage by ensuring there is a tight-fitting lid, drilling a hole through the plastic and installing a sturdy tap, placing a label with instructions for water treatment on the bucket, and teaching people to use the tap instead of dipping into the bucket. Taps and labels can be imported or locally made.	
Modified Clay Pots	In many cultures, clay pots are the preferred storage container, because as water evaporates through the clay the water inside the container is cooled. In some rural areas, water is transported in clay pots, but in most areas water is transported in plastic containers and then stored in clay pots. By working with local potters, it is possible to modify clay pots to have a tap, as seen in the example. Contact safewater@cdc.gov for technical assistance on manufacturing the pots.	

Annex 4 - Further reading

Health benefits

WHO (2011) Evaluating household water treatment options: health-based targets and microbiological performance specifications

WHO (2011) Guidelines for Drinking-water Quality

→ WHO http://www.who.int/household_water/en/

Current evidence and lessons learnt

Daniele Lantagne (2009) Point of Use Water Treatment in Emergency Response

Daniele Lantagne (2010) Assessing the Sustained Uptake Of Selected Point of Use Water Treatment Methods PoUWT In Emergency Settings

Daniele Lantagne (2011) Assessing the Implementation of Selected Household Water Treatment and Safe Storage HWTS Methods in Emergency Settings

Meta review

Thomas F. Clasen (2009) Scaling Up Household Water Treatment Among Low-Income Populations.

For non-technical audience

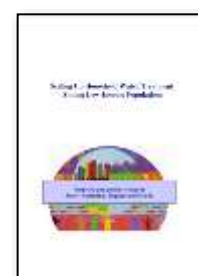
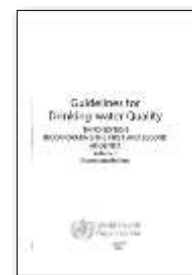
IFRC (2008) Household water treatment and safe storage in emergencies - A field manual for Red Cross/Red Crescent personnel and volunteers

Monitoring

WHO and UNICEF (2012) A toolkit for monitoring and evaluating household water treatment and safe storage programmes

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