

Results of Round II of the WHO International Scheme to Evaluate Household Water Treatment Technologies

HIGHLIGHTS



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The figures and tables included in this report do not provide an exhaustive overview of available household water treatment (HWT) products. They reflect those products that were submitted to WHO for evaluation in Round II of the Scheme, were found to meet the eligibility criteria for such evaluation and were subsequently evaluated. The fact that certain products are not mentioned in this report does not mean that they are not eligible for evaluation; nor does it mean that, if evaluated, they would not be found to meet any of the WHO-recommended performance levels.

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Water safety and point-of-use/household water treatment

A preventable crisis

2 billion people

drink water that is contaminated with faeces

2.9 million people

are affected by cholera and other waterborne disease outbreaks annually

829 000 deaths

deaths are due to diarrhoeal disease annually

26% of health care facilities lack basic water services

31% of schools

lack an improved^{*} source of drinking-water

* Improved drinking water sources are those that have the potential to deliver safe water by nature of their design and construction, and include: piped water, boreholes or tubewells, protected dug wells, protected springs, rainwater, and packaged or delivered water.

Improving water safety

Waterborne diarrhoeal disease is largely preventable through interventions aimed at identifying and managing water safety risks, including water safety planning. Household/point-of-use water treatment as an interim measure, allows households, schools and health care facilities to take charge of water safety



HWTS

When effective products are used correctly and consistently, HWTS can reduce diarrhoeal disease by as much as 61%

Promoting maximum, sustained diarrhoeal disease reductions

HWT Scheme

Coordinate independent evaluation of HWT products against WHO norms, and strengthen capacity of countries to regulate and conduct complementary testing of HWT

HWTS Network

Support effective, collective action, share implementation strategies and disseminate knowledge $% \left({{{\rm{S}}_{{\rm{s}}}}} \right)$

WHO's work on HWTS



Establish norms on HWT performance and evaluate products of global relevance



implementing norms through risk-based approaches



Convene stakeholders on water safety

HWT: household water treatment; HWTS: household water treatment and safe storage; HWT Scheme: WHO International Scheme to Evaluate Household Water Treatment Technologies; HWTS Network: International Network on Household Water Treatment and Safe Storage; WHO: World Health Organization



1 Highlights

Since the establishment of the International Scheme to Evaluate Household Water Treatment Technologies (the Scheme) in 2014, WHO has been independently evaluating the performance of household water treatment (HWT) technologies in removing microbial contaminants from drinking-water. The Scheme is one part of WHO's normative programme of work on drinking-water quality. It provides the evidence to inform Member States and United Nations procuring agencies' selection of effective HWT technologies to reduce the risk of diarrhoeal disease from unsafe drinking-water. In particular, the Scheme helps to ensure that products that provide limited or no pathogen removal are kept off the market.

This Round II report of the Scheme adds to the growing number of HWT products for which comprehensive, health-based performance evaluations are available. The report summarizes the results of 19 of 20 HWT products evaluated in Round II of the Scheme¹. These represent a range of treatment methods, including chemical, solar and ultraviolet (UV) disinfection and ceramic and membrane filtration.

1.1 Improving water safety

Unsafe drinking-water still accounts for over half of the diarrhoeal disease burden globally

Although significant progress has been made in increasing access to drinking-water services, these do not always provide water that is safe at the point of consumption, including in homes, schools and health care facilities. Over 2 billion people globally lack access to safely managed drinking-water services, and approximately 485 000 diarrhoeal deaths in low- and middle-income countries each year are attributable to unsafe drinking-water.

Sustainable Development Goal (SDG) 6.1 calls for safe drinking-water along the entire water service delivery chain

SDG 6.1 represents a higher level of ambition than the previous Millennium Development Goal target related to drinking-water. SDG 6.1 focuses on the type of infrastructure available and emphasizes the quality of the service that is delivered, including safety of drinking-water. This necessitates ensuring that water safety risks are minimized from catchment to consumer, including in households where unsafe collection, storage and handling can result in contamination.

Drinking-water safety can be improved through effective household water treatment and safe storage

Household water treatment and safe storage (HWTS) can reduce the risk of diarrhoeal disease by as much as 61% when *effective* HWT methods are used *correctly and consistently* by *populations at risk* of waterborne disease (Box 2). HWTS should therefore be targeted to where the safety of water supplies is uncertain; in emergencies and outbreaks of waterborne disease such as cholera; and among vulnerable populations relying on unsafe water sources, such as young children, the malnourished and people living with HIV/AIDS. Through the Scheme, WHO works to maximize health gains from HWT by ensuring that products on the market meet global, health-based performance criteria. Governments are ultimately responsible for progressive improvements to safe drinking-water and towards achieving universal access.

¹ Testing is in progress and results are pending for one product. The results from this product will be published in a product-specific test report in Q3 2019.

BOX 2 Achieving health gains from HWTS

Both quantitative microbial risk modelling and epidemiological evidence indicate that appreciable health gains from HWTS are achieved under three main conditions. These are: (i) the water treatment method sufficiently removes contaminants; (ii) rates of use are high that is, over 90% of the time; and (iii) HWTS is actually needed.

Treating water that has low levels of contamination to begin with does not result in appreciable health gains. Supporting correct and consistent use of accepted technologies through, for example, regular promotional messaging and user training is particularly important for achieving health gains. Results of recent field trials from Bangladesh and Kenya suggest that not sufficiently engaging users in HWTS selection as well as intermittent messaging results in incorrect and inconsistent use and little to no reduction in childhood diarrhoea. Thus, significant effort is required in understanding contextual factors, including the most appropriate HWTS technology in a given setting, supporting correct and consistent use, and how technologies perform with specific source water quality characteristics.

FIG.1

1.2 Round II of the Scheme

Increased demand for product evaluation under the Scheme

In Round II, 39 expressions of interest (EoIs) for evaluation were received. Of these, 20 products were evaluated – twice the number evaluated in Round I (Fig. 1).

More HWT products meet WHO performance criteria

The performance criteria are shown in Table 1. Of the 19 products for which results are available, 15 meet these performance criteria.

TABLE 1

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WHO performance criteria for HWT technologies

Performance classification	Bacteria (log₁₀ reduction required)	Viruses (log ₁₀ reduction required)	Protozoa (log ₁₀ reduction required)	Interpretation (with correct and consistent use)	
***	≥ 4	≥5	≥ 4	Comprehensive protection	
**	≥ 2	≥3	≥2		
*	Meets at least 2-sta	r (★ ★) criteria for two o	Targeted protection		
_	Fails to	meet WHO performance	Little or no protection		

Building on the 10 products evaluated in Round I, a total of 30 products have been evaluated under the Scheme to date, and 23 of these meet WHO performance criteria² (Table 2).





² Testing is in progress and results are pending for one product. The results from this product will be published in a product-specific test report in Q3 2019.

TABLE 2

Products that meet WHO performance criteria

Treatment technology	Product	Manufacturer	Evaluation Round	Performance classification
Membrane filtration	LifeStraw Family 1.0	LifeStraw (part of the Vestergaard Group)	I	Comprehensive protection $\star \star \star$
	LifeStraw Family 2.0	-	I	Comprehensive protection $\star \star$
	LifeStraw Community		I	Comprehensive protection $\star \star \star$
	Uzima Filter UZ-1	Uzima Water Filters	II	Targeted protection (bacteria and protozoa only) ★
Ceramic filtration	Nazava Water Filters	PT Holland for Water/Nazava	II	Targeted protection (bacteria and protozoa only) ★
	SPOUTS Water Purifaaya Filter	SPOUTS of Water Ltd	II	Targeted protection (bacteria and protozoa only) ★
	Tulip Table Top Water Filter	Basic Water Needs B.V.	II	Targeted protection (bacteria and protozoa only) ★
Flocculation-biofiltration	BlueQ™ Two-Stage	Amway Corporation	II	Targeted protection (bacteria and protozoa only) ★
Flocculation-disinfection	AquaSure Tab10	AquaSure	II	Comprehensive protection $\star \star$
	P&G [™] Purifier of Water	The Procter & Gamble Company	I	Comprehensive protection $\star \star$
Flocculation-disinfection- filtration	DayOne Waterbag™	DayOne Response, Inc.	II	Comprehensive protection $\star \star$
UV disinfection	Mesita Azul®	Fundación Cántaro Azul	II	Targeted protection (bacteria and protozoa only*) ★
	Water Elephant	Years of Water	II	Targeted protection (bacteria and protozoa only) ★
	Waterlogic	Qingdao Waterlogic Manufacturing Company	I	Comprehensive protection $\star \star$
Solar disinfection	AquaPak	Solar Solutions	II	Comprehensive protection $\star \star \star$
	JAMEBI Solar Water Pasteurizer	Relevant Projects Ltd	I	Comprehensive protection $\star \star$
	SolarBag®	Puralytics	II	Comprehensive protection $\star \star \star$
	WADI	Helioz GmbH		Targeted protection (bacteria and protozoa; some protection against viruses) ★

 * Effective removal of bacteria and protozoa in non-turbid water only

TABLE 2

Products that meet WHO performance criteria (continued)

Treatment technology	Product	Manufacturer	Evaluation Round	Performance classification
Chemical disinfection	Aquatabs®	Medentech Ltd	I	Targeted protection (bacteria and viruses only) ★
	Aquatabs Flo		II	Targeted protection (bacteria and viruses only) ★
	H2gO Purifier	Aqua Research, LLC	I	Targeted protection (bacteria and viruses only) ★
	Oasis Water Purification Tablets	Hydrachem Ltd	II	Targeted protection (bacteria and viruses only) ★
	WATA-Standard™	Antenna Technologies	II	Targeted protection (bacteria and viruses only) ★

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UV: ultraviolet Results pending for one product



A number of available products, however, do not sufficiently protect the health of users

Of the 30 products tested in Rounds I and II, six fail to meet minimum performance criteria. It is likely that their performance under actual use conditions, especially where use instructions are not followed or are unclear, is worse. *Informed selection* by procurers based on detailed consideration of candidate product performance data, and *strengthened regulation* by governments to keep poor performing HWT products off the market, are essential.

Quality of HWT products is variable and should be strengthened

The performance of several of the products that do not meet the performance criteria varies widely across production lots or units. This highlights the importance of strengthening manufacturing quality assurance/ quality control measures and ensuring that products consistently treat water at or above minimum performance standards.

Effective chlorination requires appropriate dosing and regular monitoring of free residual chlorine (FRC)

The effectiveness of chlorine products depends on the characteristics of the water being treated, including the presence of natural organic matter (NOM), temperature and pH. As these parameters vary in natural waters, the chlorine demand and, ultimately, the required chlorine dose varies. These findings underscore the importance of appropriate site-specific dosing that is based on the chlorine demand of the water to be treated and regular monitoring to ensure that FRC concentrations of 0.2–0.5 mg/L are maintained. Making these adjustments requires competent technical support and regular monitoring, which may be difficult to achieve in individual households. Efforts are therefore needed to shift towards safely managed central chlorination at point of collection, in tanker trucks, in community/health care facility water storage tanks or in piped water systems.

1.3 Interpretation and application of results

Health gains from two-star (\star \star) and three-star (\star \star) products are similar although three-star products provide some added protection

The results of a quantitative microbial risk assessment (QMRA) modelling study (Bivins et al., 2019) undertaken in Round II indicate that while three-star products offer superior pathogen protection, under most water quality conditions similar health gains can be achieved from two-star products when these are used correctly and consistently. Essentially,

- both two- and three-star products provide comprehensive protection and are effective when a range of pathogens causing diarrhoeal disease is present or when the causative pathogen(s) is(are) unknown; and
- when choosing between two- and three-star products, the focus should not be on the product with a higher classification but on the product most likely to achieve high rates of correct and consistent use, and factors that support effective implementation, including supply chains, cost, etc.

Selection of one-star (\star) products should be informed by an understanding of water quality characteristics and risks

Findings from the aforementioned modelling study also highlight that some one-star products can achieve health gains comparable to two-star products, depending on the source water quality and pathogen classes they protect against. For example, for water quality of low risk (i.e. <10 *Escherichia coli* colony-forming units/100 mL) and very high adherence (that is, used correctly and over 90% of the time), health gains from a one-star product that protects against bacteria and viruses are similar to those from a two-star product that protects against all three classes of pathogens. Thus, selection of one-star products requires more careful analyses of microbial contamination in source water and the limitations of the product.

Along with microbial performance, HWT selection should be informed by the likelihood of achieving correct and consistent use

Achieving health gains from HWT depends on multiple factors; microbial performance is critical, but not the sole factor. Once it is confirmed that a product meets minimum performance targets, other factors to consider include specific relevant water quality conditions, safe storage and the likelihood of correct and consistent use and the factors that influence such use (Fig. 2).

FIG. 2 Using Scheme results in HWT selection



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1.4 Strengthening national capacity and impact of the Scheme

A global evaluation scheme fills an important gap in limited national testing capacity

Unlike other health interventions, HWT technologies are diverse and must work against a number of different pathogens and different types of waters. This complicates the testing and requires highly skilled technicians and extensively equipped laboratories. As such, many low- and middle-income countries have limited capacity to conduct HWT performance testing. While WHO is working to simplify protocols for use in low-resource settings, research is ongoing and requires continued investment.



National regulatory oversight of HWT is vital and must be strengthened

National regulatory authorities can play a vital role in ensuring that available HWT products are effective and safe through assessment, certification and control of the products. However, many low-resource countries that commonly use HWT do not yet have comprehensive assessment and certification criteria on product performance, highlighting the need to continue strengthening capacity in this area.

Laboratory capacity in HWT evaluation should be improved and mainstreamed within broader efforts to strengthen water quality surveillance and regulation

Efforts to strengthen the technical expertise, infrastructure and mandate of national water quality laboratories and research institutions should be comprehensive to make effective use of resources and to ensure sustainability of capacity-building efforts. Efforts to support stronger HWT national assessments should be carried out alongside broader efforts to assess and improve safe drinking-water services and regulation as part of efforts to meet SDG 6.1 targets and improve water safety for all consumers.

HWTS should be targeted for among high-risk groups and within key health and water safety efforts

HWTS has the greatest health impacts in populations that use water with high levels of faecal contamination and/ or those who are particularly at risk for waterborne diseases. At risk populations include pregnant women and young children; people living with HIV/AIDS; malnourished individuals and those living in cholera hotspots. Thus, policies and programmes should integrate effective HWTS options into water safety efforts and comprehensive health programmes to maximize gains.

WHO's work on household water treatment and safe storage



Establish norms on household water treatment performance and evaluate products of global relevance



Support countries in implementing norms through risk-based approaches



Convene stakeholders on water safety

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