LifeStraw®


Safe drinking water
interventions for *home*
and outside use

Contents

The LifeStraw® Concept

The Millennium Development Goals (MDGs) call for a reduction of the proportion of people without sustainable access to safe drinking water by half between 1990 and 2015. Yet, an estimated 884 million people in the world, 37% of whom live in Sub-Saharan Africa, still use unimproved sources of drinking water[1].

Lack of access to safe drinking water contributes to the staggering burden of diarrhoeal diseases worldwide, particularly affecting the young, the immuno-compromised and the poor. Nearly one in five child deaths – about 1.5 million each year – is due to diarrhoea. Diarrhoea kills more young children than AIDS, malaria and measles combined[2]. Drinking contaminated water also leads to reduced personal productive time, with widespread economic effects.

Approximately 43% of the global population, especially the lower-income populace in the remote and rural parts of the developing world, is deprived of household safe piped water. Thus, there is a pressing need for effective and affordable options for obtaining safe drinking water at home. Point-of-use (POU) treatment is an alternative approach, which can accelerate the health gains associated with the provision of safe drinking water to the at-risk populations. It empowers people to control the quality of their drinking water. Treating water at the household level or other point of use also reduces the risk of waterborne disease arising from recontamination during collection, transport, and use in the home, a well-known cause of water-quality degradation[3]. In many rural and urban areas of the developing world, household water-quality interventions can reduce diarrhoea morbidity by more than 40%[4,5]. Treating water in the home offers the opportunity for significant health gains at potentially dramatic cost savings over conventional improvements in water supplies, such as piped water connections to households[6].

Water filters have been shown to be the most effective interventions amongst all point-of-use water treatment methods for reducing diarrhoeal diseases. The Cochrane review[7] demonstrates that it is not enough to treat water at the point-of-source; it must also be made safe at the point-of-consumption.

LifeStraw® and LifeStraw® Family are both point-of-use water interventions – truly unique offerings from Vestergaard Frandsen that address the concern for affordably obtaining safe drinking water at home and outside. These complementary safe water tools have the potential to accelerate progress towards the MDG target of providing access to safe drinking water, which would yield health and economic benefits; thus contributing to the achievement of other MDGs like poverty reduction, childhood survival, school attendance, gender equality and environment sustainability.

The Link between LifeStraw® Water Filters and Millennium Development Goals

Goal 1: Eradicate Extreme Poverty and Hunger

LifeStraw® safe water interventions minimise the risk of waterborne disease, promoting economic gain by reducing healthcare expenses and increased productivity.

Goal 2: Achieve Universal Primary Education

The consumption of safe drinking water through LifeStraw® water filters prevent children from acquiring diarrhoea and other waterborne diseases, helping ensure that children wake up healthy each morning to continue their education.

Goal 3: Promote Gender Equality and Empower Women

LifeStraw® water filters empower women and girls by facilitating access to safe drinking water. LifeStraw® Family works on highly turbid water, which allows women to convert 'dirty' water collected from any nearby source into safe drinking water. Saved time, particularly for women and young girls, is a major benefit. Beneficiaries of water and santiation projects in India reported benefits like less tension/conflict in homes and communities; community unity, self-esteem, women's empowerment (less harassment) and improved school attendance (WaterAid 2001).

Goal 4: Reduce Child Mortality

The consumption of contaminated water exposes children to waterborne diseases like hepatitis A and E, cholera, typhoid, poliomyelitis and other diseases that cause diarrhoea. By affecting normal consumption of food and reducing the adsorption of nutrients, diarrhoea is also an important cause of malnutrition, which can lead to impaired cognitive development and physical growth[8], reduced resistance to infection[9], and potentially, long-term gastrointestinal disorders[10]. The use of LifeStraw® point-of-use water filters prevent morbidity and mortality resulting from diarrhoea among infants and children under five.

Goal 5: Improve Maternal Health

Diarrhoea is amongst the indirect medical causes that weaken pregnant women's immune systems. Provision of clean drinking water through LifeStraw® has a positive impact on maternal health.

Goal 6: Combat HIV/AIDS, Malaria and Other Diseases

Globally, there are about four billion cases of diarrhoea each year[11]. It is a leading cause of child mortality, morbidity and malnutrition. Diarrhoea is also a very common symptom of HIV/AIDS and a cause of significant morbidity and mortality amongst the HIV-infected. Safe drinking water through LifeStraw® filters ensures healthier lives for the immunocompromised, including children under five, pregnant women, the elderly and those living with HIV/AIDS.

Drinking Water Crisis

884 million*
deprived of improved sources of drinking water[1]

4 billion
annual cases of diarrhoeal illness[11]

1.8 million
lives lost each year due to diarrhoeal disease[11]

443 million
school days lost each year from water-related illness[12]

117 million
disability adjusted life years (DALYs) lost annually due to diarrhoea and intestinal worm infections[13]

*Hundreds of millions more rely on "improved" water sources that are nevertheless subject to frequent and extensive microbial contamination.[4]

The Link between Diarrhoea and HIV

- Diarrhoea affects 90% of people living with HIV/AIDS and results in significant morbidity and mortality[14,15].
- Diarrhoea is one of the leading causes of morbidity and mortality among HIV-infected children[16].
- In HIV-positive children, diarrhoea is often the result of frequently aggressive common childhood infections caused by pathogens such as *Campylobacter, E. coli, Salmonella, Shigella* or rotavirus[17].
- Persistent diarrhoea occurs with increased frequency in HIV-infected children, and is associated with an 11-fold increase in mortality compared to uninfected children[18].
- In Africa, diarrhoea is four times more common among children with HIV and seven times more common among adults with HIV than their HIV-negative household members[19].
- A study found that although common diarrhoea-causing enteric pathogens are found in many babies, HIV-positive babies with acute diarrhoea were six times more likely to develop persistent diarrhoea. HIV-negative babies born to HIV-positive mothers were also at 3.5 times greater risk of developing recurrent bouts of diarrhoea than babies born to HIV-negative mothers[20].
- A study that compiled case reports of cryptosporidiosis found a mortality rate of 46% in AIDS patients and 29% in patients with 21 other immunodeficiencies[21].
- A study of HIV-infected persons and their families in Uganda showed that use of a simple, home-based safe water system reduced the incidence of diarrhoeal episodes by 25%, the number of days with diarrhoea by 33%, and the frequency of visible blood or pus in stool[22].
- In a study among HIV-infected persons in Uganda, use of safe water decreased diarrhoeal illness by 36%[22].

The Health Impact of Water Filtration

In the year 2006, the Cochrane Collaboration published a systematic review of 38 randomised, controlled trials of various water quality interventions to prevent diarrhoea titled, "Interventions to Improve Water Quality for Preventing Diarrhoea." These trials covered more than 53,000 subjects from 19 countries over 20 years.

The objective of this review was to assess the effectiveness of interventions to improve water quality for preventing diarrhoea. This review, which covered both point-of-source and point-of-use household-level interventions, found that household interventions were twice as effective in preventing diarrhoea as common source-based interventions (wells, boreholes and communal tap stands).

Among household interventions, filters were consistently the most effective in preventing diarrhoea, with an average 63% reduction.

Filtration vs. other Point-of-Use Interventions[7]

Intervention Type (no. of trials)	% Reduction (1-RR) in Diarrhoea	95% Confidence Interval of Estimate*
Filtration (6)	**63%**	**0.28 to 0.49**
Chlorination (16)	37%	0.52 to 0.75
Solar Disinfection (2)	31%	0.63 to 0.74
Flocculation/Disinfection (7)	52%	0.20 to 1.16
Flocculation/Disinfection (ex Doocy)	31%	0.58 to 0.82
Improved storage (1)	21%	0.61 to 1.03

*Estimates outside this range have a likelihood of less than 5%

"Household interventions were twice as effective in preventing diarrhoea as common source-based interventions"

LifeStraw® Family

LifeStraw® Family – Product Features

Instant Microbiological Water Purifier

- Is a point-of-use water treatment system intended for routine use in low-income settings
- Filters up to 18,000 litres* of water, enough to supply a family of five with microbiologically clean drinking water for three years, thus removing the need for repeat intervention
- Ensures high flow rate and high volume of purified water
- Complies with US Environmental Protection Agency 1987 Guide Standard and Protocol for Testing Microbiological Water Purifiers:
  - Removes minimum 99.9999% of bacteria (>LOG 6 reduction)*
  - Removes minimum 99.99% of viruses (>LOG 4 reduction)*
  - Removes minimum 99.9% of protozoan parasites (>LOG 3 reduction)*
- Removes turbidity
- Requires no electrical power, batteries or replacement parts
- Requires no running water or piped-in water supply
- Has an easy-to-clean prefilter and purification cartridge
- All raw materials are US Food and Drug Administration compliant or equivalent

*Clasen, T. *et al*. 2009. Laboratory assessment of a gravity-fed ultrafiltration water treatment device designed for household use in low-income settings. *Am. J. Trop. Med. Hyg*., 80(5), 2009, pp. 819–823

LifeStraw® Family – Functioning

① **Feed water bucket with prefilter**
2.5L capacity container for filling with unpurified water

② **Prefilter**
the 80 micron textile prefilter removes coarser turbidity and is easy to clean

③ **Halogen chamber**
releases low-level chlorine to prevent membrane fouling

④ **Plastic hose (one metre long)**
gravity creates sufficient pressure on the membrane cartridge in order to reach a high flow rate

⑤ **Membrane cartridge**
ultra filtration takes place in the membrane cartridge – a pore size of 20 nanometre retains bacteria, viruses, parasites and fine dirt particles

⑥ **Blue tap**
outlet for purified water

⑦ **Cleaning bulb**
backwashing of the membranes is done by squeezing the bulb three times

⑧ **Exit valve**
disposes the dirt and impurities

At the time of first use, opening the exit valve removes all the air trapped inside the hollow-fibre membrane and moistens the membrane surface, allowing an optimal filtration of the untreated water. The exit valve must be closed after 5 seconds.

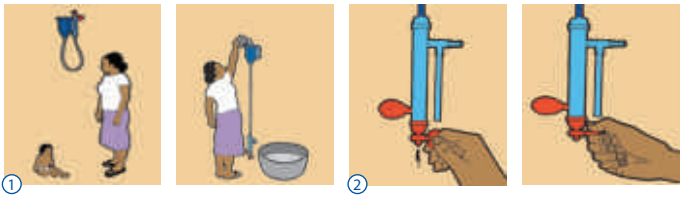
When untreated water is poured into the feed water bucket, the textile prefilter removes coarse particles larger than 80µm. Gravity pushes the water with particles finer than 80µm to flow down the plastic hose towards the purification cartridge. The purification cartridge, which contains an ultrafiltration (hollow-fibre) membrane of 20nm porosity, stops all particles larger than 20nm (including all microbes: protozoan parasites, bacteria and viruses). Turbidity particles are also stopped by the membrane by size exclusion. The untreated water is pushed through the ultrafiltration (hollow-fibre) membrane by gravity, i.e. by the pressure applied by the 1m long plastic hose, which corresponds to 0.1 bar pressure. This 0.1 bar pressure forces the water through the pores of the hollow-fibre membrane; particles and microbes larger than 20nm stay on the dirty side of the membrane and clean/purified water passes through the membrane. Purified water can be collected from the blue tap. When the cleaning bulb is squeezed, dirt particles on the dirty side of the membrane are lifted by backpressure and then removed by flushing through the exit valve.

Since all microbes are stopped by the 20nm membrane, the purified water complies with the USEPA requirements of LOG 6/4/3 reduction of microbes concentrations for water purifiers. The 0.1 bar pressure which allows the purification process to take place also leads to a flow-rate of 12-15L/hour of purified water.

The LifeStraw® Family filter also contains a chlorine chamber located below the top container. This chamber elutes low amounts of active chlorine, which protect the ultrafiltration membrane from fouling (small amounts of active chlorine slow down the bio film formation on the hollow-fibre membrane). The low amounts of active chlorine protect the ultrafiltration cartridge and that way lead to an extended lifetime of the LifeStraw® Family water purifier.

LifeStraw® Family – Usage

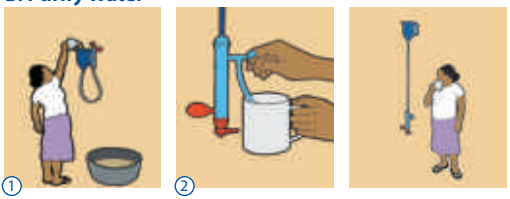
A. Before Use



A1. Hang the filter up. Fill the feed water bucket with water.

A2. Open the exit valve until some water is released.

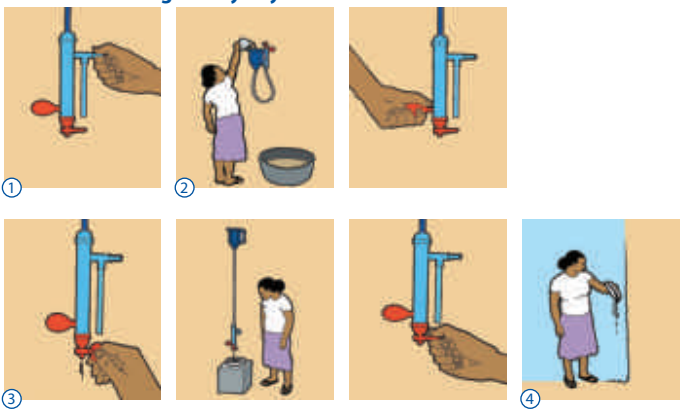
B. Purify Water



B1. Fill the feed water bucket with water.

B2. Drink safe water from the blue tap using a clean cup.

C1. Clean Cartridge Every day



C1-1. Close the blue tap.

C1-2. Fill the feed water bucket and squeeze cleaning bulb 3 times. Wait each time until the bulb refills.

C1-3. Open the exit valve and wait for 5 seconds before closing. **Do not drink the water released from the exit valve.**

C1-4. Dispose of the dirty water.

C2. Clean Prefilter Every day

C2-1. Take the prefilter out.
C2-2. Clean it with a cloth and water.

LifeStraw® Family – Comparison to other Point-of-Use Interventions for Safe Drinking Water

Microbiological Performance

Intervention	Bacteria	Virus	Protozoan Parasites	Meets Environmental Protection Agency protocol
LifeStraw® Family	Minimum 99.9999%	Minimum 99.99%	Minimum 99.9%	Yes
Boiling	99.9999%	99.99%	99.9%	Yes
Flocculation disinfection (Pur)	99.9999%	99.99%	99.9%	Yes
Chlorination	Depends upon the contact time and quantity of variable chlorine			No
Bio sand filter	90%-99%	50%-90%	99.9%	No
Ceramic filter	>99%	Low	99.9%	No
SoDis	99.999%	99.99%	50%-99%	Unclear

Physical Performance

Intervention	Water treatment capacity	Flow rate/ processing time	Factors affecting performance	Impact on water taste/ appearance	Repeat intervention required
LifeStraw® Family	18,000 litres	Average 9 litres/ hour	Safe storage if water not consumed directly	Neutral for taste; positive for appearance	No
Boiling	Not applicable	20 minutes (includes heating water to 100°C, 1 min. boiling, cooling)	Boiling temperature and safe storage	Neutral or negative for taste; neutral for appearance	Yes
Flocculation disinfection	10 litres	30 minutes	Exposure time, chemical concentration in mix	Negative for taste; positive for appearance	Yes
Chlorination (dilute $NaOCl_2$)	1000 litres	30 minutes contact time after preparation and dosing	Exposure time, turbidity, chlorine demand	Negative for taste; neutral for appearance	Yes
Bio sand Filter	Up to 50 litres/day	0.1/ 0.3 metre/ hour (when the average depth of sand filter is 0.7 metres)	Proper construction, operation and maintenance	Neutral for taste; positive for appearance	No
Ceramic filter	5000-10,000 litres	1-3 litres/ hour	Pore size and consistency: bacteriostasis; maintenance	Neutral for taste; positive for appearance	No
SoDis	1-2 litre per bottle average	6 hours	Sunlight, turbidity, dissolved solids	Neutral for taste and appearance	No

LifeStraw® Family – Microbiological Performance

Field study: **Clasen, T. *et al.* 2010. Field assessment of a novel household-based water filtration device: a randomised controlled trial in the Democratic Republic of Congo *(under publication)***

Study design: 12-month RCT among 240 households (1144 persons) in remote, rural Congo

Outcome: Very high antimicrobial efficacy: While 75% of 580 source water samples had contamination levels >1000 TTC/100ml, 64% of filtered samples taken at the household level were free of TTC and 27% had levels between 1-10 TTC/100ml

Field study: **LifeStraw® Family use, acceptability and performance – Phase I (Kenya)**

Partner: Centers for Disease Control – SWAP

Outcome: High antimicrobial efficacy: 70% or more of water samples from the LifeStraw® Family taken into consideration were free of contamination (faecal coliforms)

Field study: **LifeStraw® Family pilot project in Ethiopia**

Partner: Christian Children Fund of Canada

Outcome: Extremely high antimicrobial efficacy; extremely high water aesthetics improvement: turbidity removal, improvement of taste

Laboratory test: **Clasen, T. *et al.* 2009. Laboratory assessment of a gravity-fed ultrafiltration water treatment device designed for household use in low-income settings. *Am. J. Trop. Med. Hyg.*, 80(5), 2009, pp. 819–823**

Outcome: >LOG 6/4/3 reduction on bacteria, virus and parasites; 18,000L capacity (tested up to 110% i.e. 20,000L)

Laboratory test: **Various laboratory assessments of LifeStraw® Family in various countries**

Partners: Pro-Lab (Brazil), Universidad de Antioquia (Colombia), Ministry of Water Resources Lab (Ethiopia), Water Research Institute (Ghana), Delhi Test House (India), Water Aid Lab (Madagascar), Qualibet (Philippines), Rwanda Bureau of Standards (Rwanda), Umgeni Water Amanzi (South Africa), Environmental Engineering Lab (Zambia)

Outcome: 100% reduction in total and faecal coliforms; when assessed, high reduction in turbidity and improvement of taste and colour

LifeStraw® Family – Health Impact

Field study: **Dye, T.D. 2009. "You can take water any place you are:" A qualitative assessment of water-related illness beliefs, behaviors, and community acceptance of novel personal water filtration devices *(under publication)****

Partner: Department of Public Health and Preventive Medicine, SUNY Upstate Medical University, New York

Outcome: 35% of the study group reported decrease in diarrhoeal cases

Field study: **Investigating the functioning and acceptability of LifeStraw® Family by its intended target group in the Democratic Republic of Congo**

Partner: USAID-funded project AXxes (2007)

Outcome: Several participants mentioned that their children had no diarrhoea since using the product

Field study: **Clasen, T. *et al.* 2010. Field assessment of a novel household-based water filtration device: a randomised controlled trial in the Democratic Republic of Congo *(under publication)***

Study design: 12-month RCT among 240 households (1144 persons) in remote, rural Congo

Outcome: Health impact: 15% reduction in risk of diarrhoea, though not statistically significant. Investigators emphasised that the measured reduction may underestimate the actual effect because the comparison group used an intended placebo that actually removed more than 90% of TTC from their water. The study was not powered to achieve statistical significance at the 15% level

*study included both LifeStraw® and LifeStraw® Family

LifeStraw® Family – Durability

Test:

Assessment of the performance of LifeStraw® Family after exposure to conditions representing lifetime of field use (durability testing)

The testing program was especially designed to ensure that the basic functionality of the product (namely producing clean purified drinking water in the anticipated quantities) was not compromised by these lifetime representative conditions. LifeStraw® Family is considered to be exposed to all these conditions during its lifetime and therefore all tested samples were subjected to all the below tests:

- Simulation of transport conditions
- Simulation of a drop during transport
- Aging/ weathering of the product under elevated temperature (50°C) and elevated humidity (30, 50 and 100% RH)
- Simulation of a drop of the LifeStraw® Family at home
- Simulation of static load on the ultrafiltration cartridge
- Endurance of all moving parts: blue tap, red tap, and red plastic bulb
- Over-pressurization of the ultrafiltration cartridge
- Antimicrobial efficacy, final control

Partner: BPO, The Netherlands

Outcome: LifeStraw® Family was able to withstand all the tests specified in the product durability testing program; ≥ 97.5% of the products functioned well after being exposed to all these tests: the membrane units were still intact, all parts and components were functioning, cleaning/ backwashing of the product could be performed properly and enough clean purified water could be drawn from the blue tap

LifeStraw® Family – Customer Acceptability*

Field study: **Clasen, T. *et al.* 2010. Field assessment of a novel household-based water filtration device: a randomised controlled trial in the Democratic Republic of Congo *(under publication)***

Study design: 12-month RCT among 240 households (1144 persons) in remote, rural Congo

Outcome: Very high acceptability
76% current users after 14 months
83% adults and 95% children reported drinking from LifeStraw® Family the previous day
56% correct use (understood instructions of use)
High flow-rate (12L/h)

Field study: **To investigate the functioning and acceptability of LifeStraw® Family by its intended target group in the Democratic Republic of Congo**

Partner: USAID-funded project AXxes (2007)

Outcome: After the purpose and usage of the product was explained and demonstrated, the product was greatly appreciated and accepted by all families. The products showed no malfunction or damage after a month's usage, and showed impressive flow rate of one litre in less than five minutes. The participants found them easy to use and maintain

Field study: **LifeStraw® Family pilot project in Ethiopia**

Partner: Christian Children Fund of Canada

Outcome: Good product uptake: 50% same day or regular use
High perception: 70% products hanging in house, product considered desirable/ prestigious.
Customers understood the instructions of use and found the product easy to use

Field study: **Dye, T.D. 2009. "You can take water any place you are:" A qualitative assessment of water-related illness beliefs, behaviors, and community acceptance of novel personal water filtration devices *(under publication)*****

Partner: Department of Public Health and Preventive Medicine, SUNY Upstate Medical University, New York

Outcome: High product uptake: 83% current users after 2 months
Savings in firewood consumption

*based on self-reported data
**study included both LifeStraw® and LifeStraw® Family

LifeStraw® Family – Certificate of Quality

Each shipment of LifeStraw® Family is accompanied with a Certificate of Quality (COQ).

COQ summarises quality control testing data, including antimicrobial efficacy and physio-chemical parameters for every batch or shipment of LifeStraw® Family. It is sent to the customer at the time of shipment.

A sample of the COQ can be seen below:

Certificate of Quality

Product information

Customer: Customer Company, Country
Product: LifeStraw® Family
Order N°: SPOXXXXX
Quantity: 2,000 pieces
Batch N°: 13D17, 13D20, 13D26

Quality control conclusion

Antimicrobial efficacy

Test organism / Reference method*	Microbe concentration reduction requirements		Conclusion
E. coli ISO 9308 (membrane filtration method)	USEPA / NSF P 231	≥ 99.9999%	Passed
MS2 virus US EPA Method 1602 (modified)	USEPA / NSF P 231	≥ 99.99%	Passed
Protozoan cysts (3µm spheres surrogate): US EPA Method 1623 (modified)	USEPA / NSF P 231	≥ 99.9%	Passed

Physico-chemical parameters

Test / Reference method*	Requirements		Conclusion
Turbidity 2130B American Standard Method for the examination of water and waste water	NSF/ANSI 53	≤ 0.5 NTU	Passed
Active chlorine residuals (free or combined) 4500-Cl G American Standard Method for the examination of water and waste water	USEPA / NSF/ANSI 61	≤ 4 mg/L	Passed
Initial flow-rate Internal method SOP LSF 5.2	SOP LSF 5.2	≥ 12 L/h	Passed

* Test methods and specific water testing conditions are available upon request

QUALITY CONTROL PASSED
VESTERGAARD FRANDSEN LABORATORIES

We, the undersigned, hereby declare that the products under the batch numbers stated above conform to Vestergaard Frandsen S.A. quality control criteria.

Date and signature

Cao Thu Le
Laboratory Manager,
Waterborne Disease Control

Date and signature

Sicco Roorda
Chief Production Officer

VESTERGAARD FRANDSEN
DISEASE CONTROL TEXTILES

LifeStraw® Family – Guarantee

LifeStraw® Family Guarantee

Vestergaard Frandsen conducts 100% testing and inspection of LifeStraw® Family when the filters leave the factory. While some field failures can be attributed to the challenging environments in which this product is used, we guarantee that at least 90% of the units will meet 90% of the specified microbiological performance levels for three years based on purifying capacity of 18,000 litres after invoicing, if used and maintained in accordance with the manufacturer's instructions. If any shipment of LifeStraw® Family filters fails to meet this guaranteed performance threshold, Vestergaard Frandsen will satisfy this guarantee by making up the deficiency with replacement filters.

Lausanne, Feb. 3, 2010

LifeStraw® – Complementary Tool to LifeStraw® Family

LifeStraw®, a portable water filter, is a complementary tool to LifeStraw® Family. It provides access to safe and clean drinking water away from home.

The following study indicates the need and frequency of water consumption away from home:

Field study	**Onyango-Ouma, W. and Gerba, C.P. 2010. Away-from-home drinking water consumption practices and the microbiological quality of water consumed in rural western Kenya *(under publication)***
Key Findings	• Frequency of away-from-home water consumption is 97%. • Main sources of water are rivers (31%) and boreholes (14%). • Volume of water consumed away-from-home is in average 260mL, which is equivalent to two glasses. • Overall microbiological quality of water is poor and unfit for consumption, especially water from unprotected springs (protected springs are contaminated as well, to a lesser extent).
Outcome	There is a need for innovative approaches to address away-from-home drinking water consumption in resource-poor settings in order to complement and maximize the benefits of point-of-use water treatment at the household level. It is very clear that local populations in resource poor settings consume water outside home as dictated by daily activities patterns; and that the microbiological quality of this water is very poor. Population awareness of the poor away-from-home water quality has to be improved.

The first portable water filter takes its origin in the PVC pipe filters used for the eradication of Guinea Worm disease.

Dr. Ernesto Ruiz-Tiben, Technical Director of the Carter Center Guinea Worm Eradication Program (GWEP) quotes: *"Persons who travelled away from the household for extended period of times did not have a way of protecting themselves from the Guinea Worm Disease. In 1994, we tested (at CDC) the efficacy of PVC pipe filters in the removal of copepods, and what length and diameter would be ideal for their use. Those results led to their large scale use in the Guinea Worm Eradication Programs."*

LifeStraw® – Product Features

Portable Water Filter

- Offers easy access to clean and safe drinking water away from home
- Filters* at least 1000L of contaminated water
- Removes minimum 99.9999% of waterborne bacteria (>LOG 6 reduction)
- Removes minimum 99.9% of waterborne protozoan parasites (>LOG 3 reduction)
- Reduces turbidity by filtering particles of approximately 0.2 microns
- Contains no chemicals
- Has a high flow rate
- Requires no electrical power, batteries or replacement parts

*Note: The quality of the filtered water is not guaranteed if the product is submitted to other conditions than the ones encountered during its normal use.

LifeStraw® – Longevity and Efficacy

Laboratory test **Evaluation of Vestergaard Frandsen's hollow fiber LifeStraw® for the removal of *Escherichia Coli* and Cryptosporidium according to the US Environmental Protection Agency guide standard and protocol for evaluation of microbiological water purifiers**

Partner Naranjo, J. and Gerba, C.P. Department of Soil, Water and Environmental Science, University of Arizona, USA (2010)

Outcome **Longevity** of LifeStraw® was successfully assessed in laboratory conditions (harsher conditions than what is required by the EPA in terms of turbidity and organic matter), up to 1600L (approximately 160% of design life)

.

Backwash frequency used was once every 5L (corresponds to more or less a daily cleaning during real use)

.

Flow-rates varied as follows in average:
280mL/min at the beginning
280mL/min between 10 and 200L
250mL/min between 200 and 500L
170mL/min between 500 and 1000L
200 mL/min overall between 0 and 1000L

Antimicrobial efficacy of LifeStraw® was successfully assessed in the same laboratory conditions (EPA 1987 protocol for microbiological water purifiers testing) and showed that LifeStraw® meets the EPA requirements of LOG 6 reduction for bacteria and LOG 3 reduction for protozoan parasites:

Micro-organism	LifeStraw® efficacy*	EPA requirements*
Escherichia coli	>7.3	6.0
Cryptosporidium oocysts	>3.9	3.0

*Note: results in Log reduction values (LRV)

Turbidity was removed during the challenges by 99.6% in average:
influent challenge water turbidity: 104 NTU
effluent challenge water turbidity: 0.4 NTU

LifeStraw® – Health Impact

Field study	**Clasen, T. *et al.* 2009. Randomized controlled trial in rural Ethiopia to assess a portable water treatment device. *Environ. Sci. Technol.*, 43 (15), pp 5934–5939**
Study design	8-month randomized controlled trial among 313 households (1516 individuals) in remote, rural Ethiopia.
Outcome	High health impact: 25% statistically significant reduction in diarrhoeal prevalence.

Field study	**Elsanousi, S. *et al.* 2009. A study of the use and impacts of LifeStraw in a settlement camp in southern Gezira, Sudan. *Journal of Water and Health*; 07.3**
Study design	647 people from 134 households participated. Study design included no control group, seasonal influence on diarrhoea not taken into account.
Outcome	15.3% of participants reported a diarrhoeal incident (recalled for the previous 2 weeks) at 3–4 months before distribution of LifeStraw®, whereas only 2.3% reported diarrhoea (recalled for the previous 2 weeks) at the follow-up survey four months after distribution of LifeStraw®.

LifeStraw® – Customer Acceptability

Field study	**Elsanousi, S. *et al.* 2009. A study of the use and impacts of LifeStraw in a settlement camp in southern Gezira, Sudan. *Journal of Water and Health*; 07.3**
Study design	647 people from 134 households participated. Study design included no control group, seasonal influence on diarrhoea not taken into account.
Outcome	Compliance rates were good with 86.5% of people saying they always used the LifeStraw®. 9.8% saying they were occasional users and 3.7% saying they had never used it.

Field study	**Dye, T.D. 2009. "You can take water any place you are:" A qualitative assessment of water-related illness beliefs, behaviors, and community acceptance of novel personal water filtration devices *(under publication)*****
Partner	Department of Public Health and Preventive Medicine, SUNY Upstate Medical University, New York
Outcome	High product uptake: 83% current users after 2 months.17% stopped using the product because they found it was too difficult to draw up water through it.

** study included both LifeStraw® and LifeStraw® Family

LifeStraw® – Usage

Place LifeStraw® in water and sip through the mouthpiece.

Regularly blow through LifeStraw® after drinking to keep the filters clean and to prevent them from clogging.

LifeStraw® – Awards and Accolades

"Good design should have a positive effect on the user and if possible on society. LifeStraw® meets these basic criteria, truly an excellent design solution. LifeStraw® offers a simple, elegant solution to a large and complicated problem that profoundly affects many people's lives around the world. By addressing this problem the designers are opening possibilities of limiting the number of people without clean water – and thereby reducing deaths resulting from this lack, especially in the developing world."
- Jury of INDEX: 2005 International Design Award (September 2005)

"LifeStraw® is a very simple and elegant solution to a problem that kills millions of people. Let's get it out there."
- Saatchi & Saatchi Award for World Changing Ideas Judge Peter Gabriel (February 2008)

Awards

2008 Saatchi & Saatchi Award
for World Changing Ideas

'INDEX: 2005'
International Design Award

'Well-Tech 2006'
Innovation Technology Award

Accolades

'Best Invention of 2005'
Time Magazine (November 2005)

'Europe's Best Invention'
Reader's Digest (July 2006)

'Innovation of the Year'
Esquire Magazine (December 2005)

'Invention of the Century'
Gizmag (December 2005)

'A Water Purifier for the Masses'
Popular Science Magazine (December 2005)

'A Water Purifier That Could Save Lives'
New York Times (October 2006)

'Gadget Produces Safe Drinking Water'
Newsweek (June 2007)

One of the 'Ten Things That Will Change The Way We Live'
Forbes Magazine (February 2006)

'Tools for Better Living'
Fortune Magazine (December 2006)

'Design for the Rest of the World: LifeStraw®'
The New York Sun (May 2007)

Product Delivery and Customer Support

Delivery
Vestergaard Frandsen works with a multitude of local partners to provide the exceptional service of delivering products to in-country destinations rather than simply shipping them to the container port, as is the case with most other suppliers.

We have developed a distribution network across the African continent, establishing delivery channels for deeper penetration inlands and ensuring a seamless delivery to the end destination.

Warehousing
Vestergaard Frandsen also has warehouse facilities in the remotest parts of the world, allowing the company to help international aid agencies provide rapid relief in times of natural or man-made disasters.

Customer Support
With 11 regional offices across Africa, Asia, Europe and the Americas, Vestergaard Frandsen provides an exceptional local and international customer service. Being close to the market is an unequivocal benefit for our customers and partners, allowing rapid and proactive service and market intelligence.

This unique profile makes Vestergaard Frandsen the optimal partner for disease-control needs.

Acronyms/ Definitions

Aging water: Water passed through the filter with determined known PH-TOC-total dissolved solids and turbidity to measure the filter's resistance to clogging, flow-rate and lifetime.

CDC: Centers for Disease Control, USA.

CFU: Colony-Forming Unit (CFU) is a measure of viable bacterial numbers. It allows users to assess the degree of contamination in samples of water.

Challenge water: Water passed through the filter for microbiological efficacy tests. In this water, disinfectant is completely removed and residue level should be non-detectable. This is to ensure that there is no interference from residual chlorine (most tap water is chlorinated) on the contaminants introduced in the water and give a more accurate measure of the filter's microbiological efficacy.

Environmental Protection Agency: The Environmental Protection Agency (EPA or USEPA) is an agency of the federal government of the United States charged with protecting human health and safeguarding the natural environment, namely air, water, and land.

Log reduction: -"LOG" stands for the logarithm function: 1, 2, 3 and 4 LOG reductions correspond to 90%, 99%, 99.9% and 99.99% reduction respectively, and so on.

LRV: Log Reduction Value.

MS2: A virus which is easily cultivated in laboratories and used to measure viral reduction efficacy of the filter.

NSF International: The Public Health and Safety Company™, a not-for-profit, non-governmental organization based in the United States, is the world leader in standards development, product certification, education, and risk-management for public health and safety.

NTU: Nephelometric Turbidity Units. Turbidity refers to how clear the water is. The greater the amount of total suspended solids (TSS) in the water, the murkier it appears and the higher the measured turbidity.

PFU: Plaque-Forming Unit (PFU) is a measure of viable numbers of viruses in the water.

Point-of-use interventions: For those who have access to sufficient quantities of water but whose water is of poor microbiological quality, an alternative is to treat water at the household or other point of use. Such a household treatment may minimise recontamination in the home, a well-known cause of water quality degradation[21]. Interventions used in the studies include: filtration (ceramic), solar disinfection, chlorination, flocculation/disinfection and improved storage.

RR: Rate of reduction.

RTC: Randomized Control Trial.

TOC: Total organic carbon: material in the water derived from decaying vegetation, bacterial growth, and metabolic activities of living organisms or chemicals.

TTC: Thermo Tolerant Coliforms.

Turbidity: Turbidity is the cloudiness or haziness of a fluid caused by individual particles (suspended solids) that are generally invisible to the naked eye, similar to smoke in air.

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