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WASH SERVICES IN THE TRANSITION FROM EMERGENCY TO DEVELOPMENT

Evaluation of household drinking water filter distribution programmes in Haiti

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BRIEFING PAPER 2462

Household water treatment can reduce diarrhoeal disease in populations without safe water access. We evaluated five programmes that distributed biosand, ceramic, or Sawyer household water filters in Haiti after the 2010 earthquake. We conducted household surveys, collected water samples, and tested water quality at ~50 houses from each programme. Across programmes, self-reported filter use ranged from 27-78%; confirmed use (met reported use and showed the filter with water in it) ranged from 20-76%; and, effective use (stored water quality was improved to international guideline values using the filter) ranged from 0-54%. More successful programmes: 1) distributed an effective technology; 2) provided safe storage; 3) required cash investment; 4) provided initial training; 5) provided follow-up; 6) provided supply-chain access; 7) targeted households relying on contaminated water sources; and, 8) had experience working in the local context. These findings suggest that well implemented programmes can result in sustained filter use in Haiti.

Introduction

Household water treatment and safe storage (HWTS) can be cost effective at improving drinking water quality (Clasen *et al.* 2007) where access to water and sanitation infrastructure is limited (Fewtrell *et al.* 2005; Clasen *et al.* 2006; Clasen 2015). In Haiti, 48% of rural and 65% of urban populations have access to an improved water source (WHO/UNICEF 2015). In a 2012 national survey, 71% of households self-reported treating their water, only 1% of which reported using filtration-based technologies. However, household filter promotion in Haiti has increased since the 2010 earthquake and cholera outbreak, with more than 140,000 biosand, ceramic, Sawyer®, and Lifestraw® filters having been distributed. There is currently little evidence on the effectiveness and sustainability of filtration-based HWTS programmes in Haiti. In this research, we evaluated five programmes that distributed filters in Haiti since 2010 to identify and share lessons learnt about implementing household filtration programmes in Haiti.

Methods

Programmes that distributed filters in Haiti between 2010-2014 were identified and invited to participate. Participating programmes provided distribution lists, from which 50 households were randomly selected to carry out surveys and water sampling. Surveys were carried out in Haitian Creole by trained Haitian enumerators in August 2014. The two-part survey included 48 background questions, followed by 46-48 technology-specific questions. Three water samples: untreated, direct-from-filter, and stored treated, were collected aseptically, placed on ice, and analysed within 12 hours using membrane filtration for simultaneous detection of total coliforms and *Escherichia coli (E. coli)* using m-ColiBlue24 media.

Primary programme evaluation metrics were: reported use, confirmed use, and effective use (Lantagne and Clasen 2013). Reported use was calculated as the percentage of the surveyed population that provided a drinking water sample and self-reported it had been filtered with the programme filter. Confirmed use was the percentage that met reported use criteria plus showed the filter with water in it. Effective use was calculated as the percentage of target households that provided a water sample treated by the filter that was improved from contaminated (in the untreated sample) to uncontaminated (in the stored treated sample) as measured by the number of *E. coli* coliform forming units (CFU) per 100mL sample.

Results

Of the six organisations invited, four elected to participate in the study. The participating organisations implemented five filter programmes: two distributed locally manufactured biosand filters, two distributed locally manufactured ceramic filters, and one distributed imported Sawyer hollow-fibre membrane filters (Photographs 1-5). Distribution locations are presented in Image 1. Regular follow-up visits were carried out only in the biosand programmes; and recipients paid a subsidised price for the filters in both biosand and one ceramic filter programme. The average time since filter distribution was <6 months to 1.3 years.

Photograph 1. WEDC – Biosand filter (1)

Photograph 2. WEDC – Biosand filter (2)

Photograph 3. WEDC – Ceramic filter (3)

Photograph 4. WEDC – Ceramic filter (4)

Photograph 5. WEDC – Sawyer filter (5)

Source : Rayner

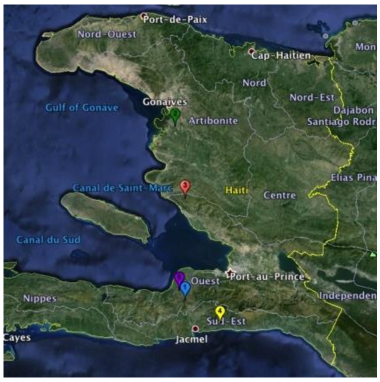

Image 1. WEDC – Distribution locations

Source: Google Earth 2015

A total of 223 household surveys were carried out (44-46 per programme). Overall, 98% and 100% of biosand, 82% and 89% of ceramic, and 96% of Sawyer households surveyed reported receiving the filter; and 78% and 80% of biosand, 27% and 50% of ceramic, and 57% of Sawyer filter households were provided a filtered water sample on the day of the unannounced visit. Breakage was the primary reason for disuse in one ceramic filter programme. Safe storage was observed in 7% and 100% of biosand, 95% and 100% of ceramic, and 66% of Sawyer filter households. Across all respondents, 77% reported sometimes drinking untreated water.

For biosand filters, geometric mean *E. coli* concentrations were 29.3 and 691.3 CFU/100mL in untreated, 1.1 and 1.5 in direct-from-filter, and 2.3 and 6.1 in stored treated waters. In ceramic filters, concentrations were 6.6 and 78.5 in untreated, <1 and 21 in direct-from-filter, and 1.2 and 16.4 in stored treated waters. For Sawyer filters, concentrations were 12.6 in untreated, 1.0 in direct-from filter, and 2.2 in stored treated waters (Figure 1).

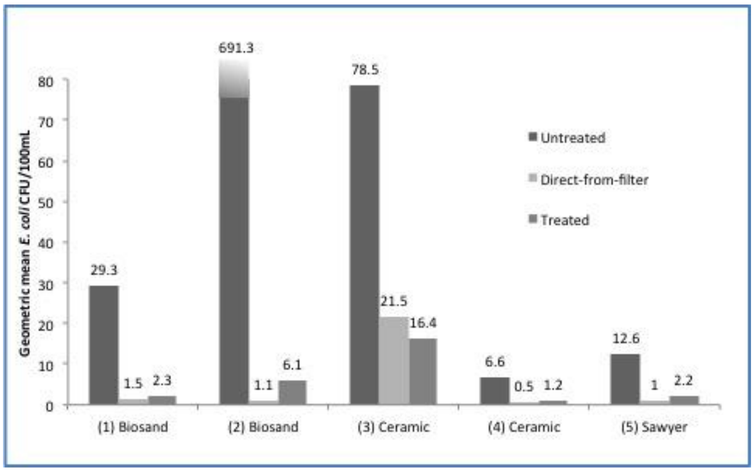

Figure 1. Geometric mean *E. coli* CFU/100 mL by programme

Source: (Rayner *et al.* 2016)

Effective use is the estimate of the percentage of households targeted by the program that were using filters to improve their water quality at the time of the unannounced household visit and is based on the percentage of households that provided a water sample treated by the filter that was improved from >1 CFU/100 mL *E. coli* in the untreated sample of household water to <1 CFU/100 mL *E. coli* in the stored treated drinking water sample provided. For biosand filters, effective use was 20% and 34%, for ceramic filters, it was 0% and 29%, and for Sawyer filter programmes, it was 27%. Using 10 CFU/100 mL as the breakpoint, effective use was estimated at 37% and 54% in biosand, 9% and 22% in ceramic, and 23% in Sawyer filter programmes.

Discussion

Our results suggest potential for effective use of filtration-based technologies in Haiti. However, results were variable, as were programme characteristics. We identified themes and challenges consistent with and expanding upon previous literature. These include: 1) geometric mean water quality was low risk across programmes, with the exception of one ceramic filter programme, where it is hypothesised poor quality control in manufacturing led to distribution of poor quality filters; 2) geometric mean *E. coli* in treated stored water was greater than direct-from-filter samples in one programme, where safe storage was not included; 3) two of the three programmes that required cash investment had highest reported and confirmed use; 4) all programs provided at least some initial training, but the percentage of respondents that reported sometimes drinking untreated water was high across all programmes; 5) disuse of ceramic filters was high where no follow-up or supply chain existed to replace broken filters; 6) two of the three programmes distributed filters to populations that relied on high risk source water; and 7) two programmes had been working in Haiti since before the 2010 earthquake and cholera outbreak (Table 2) (Rayner *et al.* 2016). These are further discussed below.

Table 2. Program characteristics

	(1) Biosand	(2) Biosand	(3) Ceramic	(4) Ceramic	(5) Sawyer
Average time since distribution	11 months	1.3 years	1.2 years	<6 months	8 months
Technology effective	+	+	−	+	≈
Safe storage container	+	−	+	+	≈
Cash investment by household	+	+	≈	−	−
Received initial training	+	+	≈	+	+
Follow-up provided	+	+	−	−	≈
Supply chain present / knows who to contact	+	−	−	≈	≈
Primary water source is unimproved	≈	+	+	−	−
Program experience in local context	+	+	≈	−	−

Extent to which program addressed: + high; − low; ≈ average

The distribution of a technology that is effective at improving water quality is fundamental and geometric mean treated stored water quality was low risk across programmes with the exception of one ceramic filter programme. It is hypothesised that poor quality control in manufacturing led to the distribution of poor quality filters. Additionally, post-contamination of treated drinking water is widely documented (Wright et al. 2004) and occurred across programs, however, it was greatest in the technology that did not include a safe storage container. In this programme, geometric mean E. coli in treated stored water was relatively greater than direct-from-filter samples in comparison with households that had safe storage containers.

In previous studies, cash investment has been associated with long-term filter use (controlling for time since distribution) (Brown and Sobsey 2006) – two of the three programmes that required cash investment had highest reported and confirmed use. While all programs provided at least some initial training, the percentage of respondents that reported sometimes drinking untreated water was high across all programmes – which could limit health benefits (Hunter et al. 2009; Brown and Clasen 2012). Market based supply chains were not present in any of the distribution areas, however, follow-up programmes addressed the supply chain need in two of the programmes. Disuse of ceramic filters was high where time since distribution was greater and no supply chain or follow-up was provided.

Two of the three programmes distributed filters to populations that relied on high-risk source water; while water quality can vary as a result of the use of multiple sources, an emergency, or seasonality, low-risk water quality at the time of the household visit limited measureable improvement, and therefore, effective use estimates. Two of the programmes had been working in Haiti since before the 2010 earthquake and cholera outbreak. These programs have developed and modified their programme strategies over time and their experience likely contributed to programme characteristics that contributed to sustained filter use.

While results were variable, our findings suggest potential for long-term effective use of filters in Haiti. As measured by reported, confirmed, and effective use, programme effectiveness is likely related to the extent to which programmes: 1) distributed an effective technology; 2) provided safe storage; 3) required cash investment; 4) provided initial training; 5) provided follow-up; 6) provided supply-chain access; 7) targeted households relying on contaminated water sources; and, 8) had experience working in the local context. Organisations implementing household filtration programmes in Haiti are advised to distribute a high-quality filter with follow-up, supply chain, education, and safe storage containers. The extent to which programme strategies address these themes will likely contribute to programme success in achieving health gains and reducing the burden of diarrhoeal disease.

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