Surrounding Households and Continued Water Treatment Use

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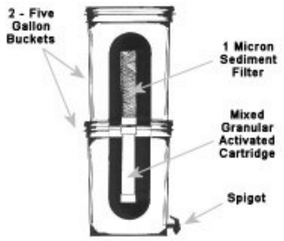
Household Water Treatment

Diarrheal disease is the leading cause of child morbidity and mortality in the world, with its burden largely borne by developing countries lacking in water and sanitation infrastructure. According to the World Health Organization (WHO), approximately 9.1% of the global burden of disease could be prevented through improved water sanitation and hygiene (WASH). WASH is essential to preventing diarrheal disease.

Gift of Water Intervention

Gift of Water is a non-governmental organization (NGO) committed to providing clean drinking water in low-income communities. In Haiti, the organization distributes, through a community based model of education and technician support, a treatment system that uses both filtration and chlorine treatment.



To use this two bucket system, users add chlorine to the top bucket of water, place the bucket on top of the bottom bucket to run the water through a polypropylene string round filter and a carbon filter, and then add more chlorine[1].

In the Field: Impact of Social Support

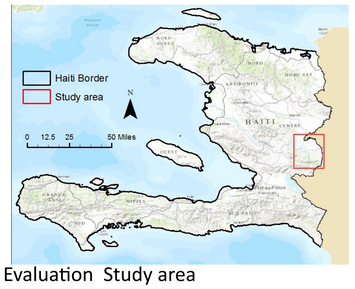
A growing body of randomized control trials (RTC) have shown household water treatment systems (HWTS) – including chlorination, flocculation/ disinfection, solar disinfection, and filtration - to be effective in reducing water contamination and the burden of diarrheal disease[2,3]. Fewer studies have shown real-world HWTS implementations to result in diarrheal disease reduction. This may be due, in part, to the social support within the community of water treatment with a HWTS[4].

This project explores the relationship between confirmed use of Gift of Water and of a proxy for social support of the intervention: the number of households surrounding a household that also received the intervention.

Methodology

Data source and preparation

To understand the relationship between social support and confirmed use of the intervention I used data from an evaluation of Gift of Water that was conducted using a baseline survey, distribution of the filter, and three follow up surveys at 1 week, 3 months and 7 months after distribution of filters.



Evaluation Study area
Source: CNIGS, 2013

From each follow up of the evaluation data I pulled the following information:

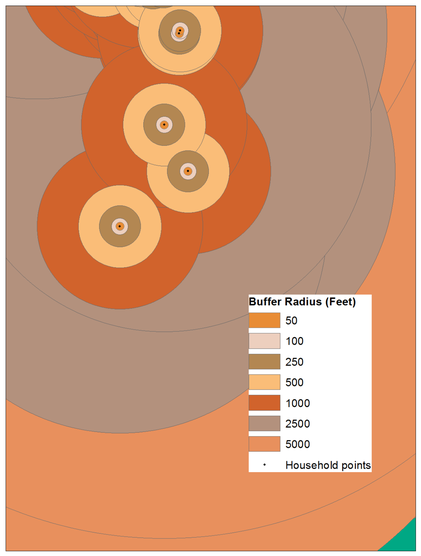
- Household GPS coordinates
- If a test of Free Chlorine Residual (FCR) had been taken at the household during the survey
- If there was FCR in both the top and bottom buckets of the water system

I used presence of FCR in both the top and bottom buckets of the water system as an indicator of confirmed use. All households without where FCR was not tested were excluded from my data set

Spatial Analysis

After creating a basic map outlining Haiti, I conducted the following steps in ArcMap for each of the 3 follow up data sets.

- Made a layer of household points
- Created multiring buffers around each household point with radii of 50, 100, 250, 500, 1000, 2500, 5000 feet
- Made a second layer of household points
- Joined buffer layer to layer of household points based on spatial location
- Exported the attribute table of the resulting layer to excel



Example of buffers created

Statistical Analysis

Using the attribute table exported from ArcMap, I conducted the following steps for each follow up in excel

- Inserted a column named countsub1. The values in this column were the results of the count column from joining the layers minus 1. This prevented counting the household itself as social support.
- Separated data according to buffer radius
- Using the countif function in excel, determined the number of households that have 1, 2, 3, 4+ other intervention households in each buffer.
- Determined, according to buffer size and number of other households within that buffer, the number of households with confirmed use of the Gift of Water system, using Fcrbothpos and the countif function
- Using this data, I created 84 2X2 tables that displayed my data in the following way:

Has _ HH in buffer		Has FCR in top and bottom bucket	
		Yes	No
	Yes		
	No		

These tables were then examined for statistical significance in STATA using Chi Squared Test. If any table cell had a value less than 5, Fisher's exact test was used as it is more appropriate for small sample size

Discussion

This analysis is limited in how it does not account for other factors that could contribute to continued use of the Gift of Water intervention. These factors include but are not limited to: the training received by the household on use of the device, education of recipients, and access to chlorine. The purpose of the analysis was to explore if there may be a correlation between location and continued use. Before drawing conclusions, this data would need to be examined with con-

These results suggest that there is some correlation between presence of other intervention households and continued use of the intervention. However, this significance does not carry to the third follow up, 7 months after distribution of the water system. This may indicate that social support, as indicated by the number of other intervention households close by, is not influential enough to sustain use.

There is very little research on analysis of spatial data and continued use. A similar study, using a smaller data set, in a less densely populated area also found results that indicate a correlation[5]. More research is needed to verify the results of this analysis.

Works Cited

1. www.giftofwater.org
2. Borucke, M. (2002) Filtration of Giardia cysts from Haitian Drinking Water. *MEng MIT.*
3. Varghese, A. (2002). Point-of-Use Water Treatment Systems in Rural Haiti: Human Health and Water Quality Impact Assessment. *MEng MIT.*
4. Figueroa, M.E. and Kincaid, D. (2010). Social, Cultural and Behavioral Correlates of Household Water Treatment and Storage. *Johns Hopkins Bloomberg School of Public Health Center for Communication Programs*
5. Lantagne, D., Hoar, C., Baise, L., & Clasen, T., The Influence of Household Spatial Relationship on Household Water Treatment. *NOT YET PUBLISHED*

Results

In the first follow up survey, 47% households had FCR present in both the top and bottom bucket of their Gift of Water system. The second and third follow up surveys had similar, though decreasing rates of confirmed use with 45% and 42% of households having FCR present in both buckets. Across all three follow ups, very few households had more than two other intervention households within a 50 foot radius.

Likewise, few households had less than 3 households within a 5000 foot radius.

As is shown in the tables to the right, there was no consistent buffer and household count at which the relationship between household count and continued use was statistically significant. In follow up 1 and 2, there is a statistically significant relationship between households with 2 other intervention households within a 100 foot radius and FCR presence. Follow up 3 had no cases of statistical significance at the p< 0.05 level.

Dark Orange = Statistically significant at p <0.05

Bright Orange = Statistically significant at p<0.1

Unable to run statistical test

Follow up 1

Buffer radius (ft)	Other households in buffer # (min-max, median, stdev)	1 HH	2 HH	3 HH	4+ HH
50	.38(0-3, 0, .72)	21 17 71 86	8 1 84 102	3 3 89 100	0 0 92 103
100	.76(0-4, 0, 1.03)	16 42 76 61	17 8 75 95	10 6 82 97	2 0 90 103
250	2.21(0-10, 2, 2.19)	15 15 77 88	11 16 81 87	16 16 76 87	26 20 66 83
500	5.05(0-16, 4, 4.34)	11 13 81 90	6 7 86 96	8 10 84 93	55 52 37 51
1000	12.75(0-41, 11, 10.55)	4 6 88 97	3 5 89 98	3 5 89 98	74 77 18 26
2500	33.29(0-76, 23, 25.74)	1 0 91 103	0 3 92 100	2 8 90 95	85 87 7 16
5000	54.70(0-93, 40, 32.55)	0 0 0 0	0 2 92 101	4 2 88 1	87 96 5 7

Follow up 2

Buffer radius (ft)	Other households in buffer # (min-max, median, stdev)	1 HH	2 HH	3 HH	4+ HH
50	.23(0-2,0,.51)	9 23 79 109	5 4 83 128	0 0 88 132	0 0 88 132
100	.79(0-5,0,1.15)	17 22 71 110	17 5 71 127	3 9 85 123	4 4 84 128
250	2.77(0-10, 2, 2.85)	16 29 72 103	11 13 77 119	8 8 80 124	43 33 45 99
500	6.65(0-25, 5, 5.92)	7 9 81 123	3 15 85 117	4 8 84 124	60 78 28 54
1000	16.17(0-51, 12, 14.54)	7 2 81 130	2 10 86 122	4 9 84 123	69 100 19 32
2500	44.12(0-89, 34, 32.04)	1 0 87 132	2 1 86 131	1 3 87 129	81 125 7 7
5000	69.01(0-113, 72,4 0.42)	0 0 88 132	0 0 88 132	0 0 88 132	85 130 3 2

Follow up 3

Buffer radius (ft)	Other households in buffer # (min-max, median, stdev)	1 HH	2 HH	3 HH	4+ HH
50	.25(0-5, 0, .78)	10 13 83 114	3 1 90 126	0 2 93 125	2 2 91 125
100	.85(0-6, 0, 1.34)	26 29 67 98	10 11 83 116	3 5 90 122	7 6 86 121
250	2.65(0-9, 2, 2.51)	18 21 75 106	16 22 77 105	9 10 84 117	30 40 63 87
500	6.10(0-20, 6, 4.65)	7 12 86 115	6 14 87 113	10 11 86 116	60 75 33 52
1000	14.93(0-49, 14, 11.51)	3 3 90 124	4 6 89 121	3 5 90 122	77 93 16 34
2500	42(0-84, 36, 28.47)	3 1 90 126	0 5 93 122	1 1 92 126	89 118 4 9
5000	68.04(2-109, 55, 35.01)	0 0 93 127	0 0 93 127	0 1 93 126	93 126 0 1