

Evaluation of International Action Water Chlorinators in Port-au-Prince, Haiti

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Background

Haiti is the poorest country in the western hemisphere¹ and 70% of the population lives on less than 1 USD per day.² Access to safe drinking water is an important concern for all citizens of Haiti, especially after the earthquake of January 12, 2010, and the cholera outbreak beginning in October 2010.

The WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation (JMP) defines “unimproved” drinking water as any source that is not protected from outside contamination such as unprotected wells and surface water sources. Although only 6% of households in metropolitan areas of Haiti such as Port-au-Prince are using “unimproved” drinking water sources,² even use of an “improved” source does not necessarily imply that the water is treated and safe to drink. Drinking water that has been properly treated with chlorine is safe to drink and will not become re-contaminated in the process of being transferred from the collection point to the drinking glass. Chlorinators that are provided at the community level can ensure that households who come to collect water have an appropriate dosage of chlorine for a set quantity of water, in contrast to household self-chlorination in which appropriate dosage measurement cannot be externally verified. Chlorinators are relatively simple, low-cost systems that work by chlorinating a portion of the water that passes through a tank and mixing this water with the remaining water so that the effluent water from the tank has an appropriate dosage of chlorine. The minimum standard level of chlorine by the time the water reaches the storage vessel in a household should be 0.2 mg/L.³ The advantage of chlorinators over other treatment systems is that only one point of intervention is necessary to ensure safe drinking water for households. However, an overseeing Water Board and an operator are needed to maintain the chlorinators and ensure that they work properly.

Monitoring and evaluation of programs is important to be able to measure the progress of organizations in achieving their objectives and contributing to improved health. Specifically, monitoring and evaluation helps organizations determine whether their programs are being implemented efficiently, respond to the needs of their beneficiaries, achieve their intended objectives, and detect and correct problems as they arise.⁴ Many large global health agencies such as the Bill & Melinda Gates Foundation, UNICEF, the World Bank, and the World Health Organization agree that improving monitoring and evaluation of health data is critical for better accountability of organizations and improved performance.⁵

Quantitative research can be strongly complemented by qualitative research, which provides an alternative set of tools for research and analysis. The small *N* of qualitative research allows for the study of cases in an exhaustive manner, promoting theory-driven objectives.⁶ While surveys are useful for identifying general population trends and to make precise outcome predictions, focus group discussions serve a different purpose.⁷ Focus group discussions allow us to understand the effects of group interactions in a community, especially in regards to community-utilized resources such as chlorinator taps. Focus group discussions can also serve as a check on accuracy to ascertain whether individuals are being completely honest in completing individual surveys, when they were not being held accountable to a larger group of which they were an active member. The focus group discussion provides a tool for assessing broader themes as well as individual and group perceptions, which the survey instrument cannot do because of constraints of space and time. Additional advantages of this method are those of researcher control of questioning, the acquisition of data in the respondent's contextual situation, and flexibility.⁸

The limitations of qualitative data must also be addressed, however. Some argue that

qualitative data are ambiguous in nature and that a purely verbal account might be difficult to interpret⁸. Furthermore, respondents vary in their ability to articulate and provide meaningful insights, and they may provide biased responses. These problems are somewhat mitigated by the fact that the focus group discussions happens in a controlled space and individuals are accountable to the entire group for what they say.

Measures can be taken to limit researcher/respondent bias, and even poorly expressed thoughts can prove to be useful in discerning themes. The effectiveness of focus group discussions in obtaining the necessary data outweighed the possible disadvantages in planning this particular research.

Introduction

International Action, a non-profit organization based in D.C., has been working on installing water chlorination systems in Haiti since 2006. Approximately 60 chlorinators have been installed throughout the greater Port-au-Prince area by International Action in order to treat water at the community level. Community members in each neighborhood where a chlorinator has been installed come to collect water from the collection point for a small fee, usually 1 to 5 gourds. The purpose of this study was to evaluate the use of the chlorinators in neighborhoods where the systems have been installed and determine the health impact in these sites compared with sites where there have been no installed chlorinators .

We learned about International Action through the Center for Global Safe Water, which is associated with the Rollins School of Public Health at Emory University, and accepted an invitation to conduct an evaluation with this organization. Our expectations were to evaluate the utilization of the chlorinators, provide recommendations to International Action to assist with

their Clean Water Campaign, and to estimate the health impact of the use of the chlorinators by measuring diarrheal disease incidence.

Methods

Quantitative

In order to complete the research evaluation, we designed a mixed-methods qualitative and quantitative study. The primary research tool for the quantitative component was a 33-question survey that included questions on topics such as household demographics, water source and toilet type, treatment practices and perceptions, and diarrheal incidence within the household. The original copy of the survey was designed and translated in the U.S. but later back-translated and modified by the translator on staff in the Haiti office. With the help of the translator Jean Patrick, we finalized the survey questions and conducted a pilot test with five enumerators chosen by the Haiti office staff. The enumerators were taught how to test for free chlorine residuals of drinking water samples using a Hach Chlorine Test Kit provided by International Action, record GPS coordinates for households using a Garmin eTrex GPS handheld device, and conduct the survey with heads of households. They were instructed to visit each household, explain the purpose of the survey and invite the household to participate, obtain consent, and ask the questions on the survey in the same format for each household. Furthermore, the enumerators were instructed to walk three houses to the right of each household, following the same road, in order to locate the next household to potentially survey. Although they were expected to complete a minimum of 15 surveys a day and received enough printed copies for two days at a time, the enumerators did not always meet this goal. We received between 15 and 30 surveys each time we collected surveys, which occurred every 2 to 3 days. The pilot surveys produced by each enumerator was evaluated individually with each

enumerator, to ensure that each question was being asked as indicated on the form and to correct any mistakes of word choice elucidated by the pilot test.

The International Action staff selected eight “chlorinator” sites, which were defined as areas where chlorinators were installed and shown to be working, and three “non-chlorinator” sites, which were defined as areas without chlorinators. The sites were located in the cities of Pétion-Ville, Port-au-Prince, Cité Soleil, Delmas, and Carrefour. The chlorinator sites were chosen to be Jalousie located in Pétion-Ville, Mont Jolly in Port-au-Prince, Drouillard in Cité Soleil, Cité aux Cayes in Delmas, two neighborhoods of Baillergeau in Port-au-Prince, and Bertin in Carrefour. The non-chlorinator sites were chosen to be Brochette in Cité Soleil, Simon Pele in Carrefour, and Bas Bertin in Carrefour. The sites were selected by the staff in a non-random fashion according to what the staff thought would best demonstrate the effectiveness of the current program. The enumerators surveyed households in each of these sites in order to be able to make statistical comparisons between the two types of sites.

We entered the survey data in Excel 2010 (Microsoft Corp., Redmond, WA) and analyzed the dataset in Stata 11.1 (StataCorp LP, College Station, TX). After importing the dataset in Stata, we cleaned the data by checking for impossible or improbable responses and verifying the entered responses with the actual paper surveys. Any errors detected were corrected in the Excel database. The data were analyzed by determining the frequencies of categorical variables and means of continuous variables. Variables were further stratified by chlorinator or non-chlorinator site.

A wealth index was developed using assets that households own, since these have been shown to be more reliable indicators of wealth than asking about income in many developing countries.⁹ Each of the household assets we measured—namely, the number of beds, bicycles,

motorcycles, radios, and phones owned by the household; the material used to construct the walls, floor, and roof; and whether the house was owned or rented—was normalized to a common scale and analyzed using principal components analysis.¹⁰ Wealth quintiles were constructed from the resulting assets index. The proportion of households in each wealth quintile were compared across numerous variables such as use of drinking water sources, belief that household drinking water is safe, type of toilet used, and free chlorine residual detected in each household's current drinking water source.

Questions related to diarrheal disease were asked for each individual living in every household, rather than for the household overall. Therefore, analysis of health outcomes was conducted using each individual as an observation rather than each household. Thus, if a household was a participant, then all individuals in that household were considered participants with identical household characteristics but with unique responses to age, gender, diarrhea, and the presence of blood in the stools.

Qualitative

For the qualitative component of the study, we developed a Focus Group Discussion Guide which included questions on water supply and collection, water treatment, contamination exposure, water flow and drainage, and transmission of health messages. The original guide was developed in the U.S. and then approved by the staff of International Action upon arrival. The translator, Jean Patrick, helped us translate the guide into Haitian Creole. We then trained a summer volunteer, Lynn, to moderate the focus group discussions, and Jean Patrick to be the official note-taker. This training included guidance in explaining the purpose of the focus group to participants, differentiating among various question types (e.g., leading questions, transition

questions, optional probes, concept questions), maintaining professionalism within a group setting, and dealing with unexpected challenges arising in the process.

The sample population for the focus groups was taken directly from the survey population, in a randomized fashion. The survey included a question asking the head of household if he/she would be interested in participating in a focus group discussion, and if so, to provide a reliable phone number for future contact. Data from these responses were recorded so that all interested individuals were grouped into sub-lists by their neighborhood location and gender. We planned to randomize these sub-lists and to call eight to ten individuals from each sub-list to participate in a discussion.

A pilot discussion was conducted to test the questions for relevancy, to gain preliminary data on the aforementioned topics, and to identify corrections. The pilot focus group consisted of several water board members and the five enumerators who were working on the survey, as discerned by the International Action supervisor on staff. With the consent of the participants, the discussion was recorded with a RCA hand-held digital recording device. This pilot discussion covered all topics on the guide and lasted approximately seventy-five minutes.

Our original goal was to conduct at least two focus group discussions for each “chlorinator” and “non-chlorinator” site so that the sample would match that used for the survey design, with one of these groups being all female and the other being all male. Gender was chosen as a dependent grouping variable so that individuals would feel more comfortable discussing sensitive topics such as toilet practices and hygiene in a group setting. Upon the advice of our supervisor, we decided that the focus group discussions should take place at the International Action office and to compensate the participants for travel expenses as well as provide a complementary meal. However, lack of commitment from the summer volunteer

facilitator, lack of administrative interest, and insufficient funding from International Action mid-way through the project prevented the focus group discussions from taking place post the pilot study. Consequently, the study was scaled back to being purely quantitative.

The audio recording from the pilot focus group discussion was translated into Haitian Creole by Jean Patrick and transcribed directly into Creole in a Microsoft Office Word using the transcription tool Express Scribe (NCH Software, Greenwood Village, CO). The transcript was then analyzed using MaxQDA (VERBI GmbH, Marburg, Germany), in which thematic codes were created to match the comments of interest made by participants, such as “knowledge,” “water source,” “health,” and “opinions about International Action.” Once data were categorized and labeled, comparison tables were made to show the difference between problems and solutions identified by participants, positive and negative opinions about International Action, and recommendations for the future. In addition, statements about water source/providing agency and treatment type were quantified and converted into bar graphs. However, the primary analysis of this data included a categorization of direct quotations made by participants.

Results: Quantitative

Household surveys were conducted in eight chlorinator sites and three non-chlorinator sites. An overall map of all of the International Action chlorinators in Haiti is shown in Figure 1, with each chlorinator indicated by a pink circle. One chlorinator appears to be in the middle of the ocean because International Action provided incorrect coordinates for this location. A map of Port-au-Prince is shown in Figure 2, where the blue dots correspond to household surveys that were conducted in chlorinator sites, and the green dots correspond to household surveys that were conducted in non-chlorinator sites.

Figure 1: Map of International Action chlorinators in Haiti

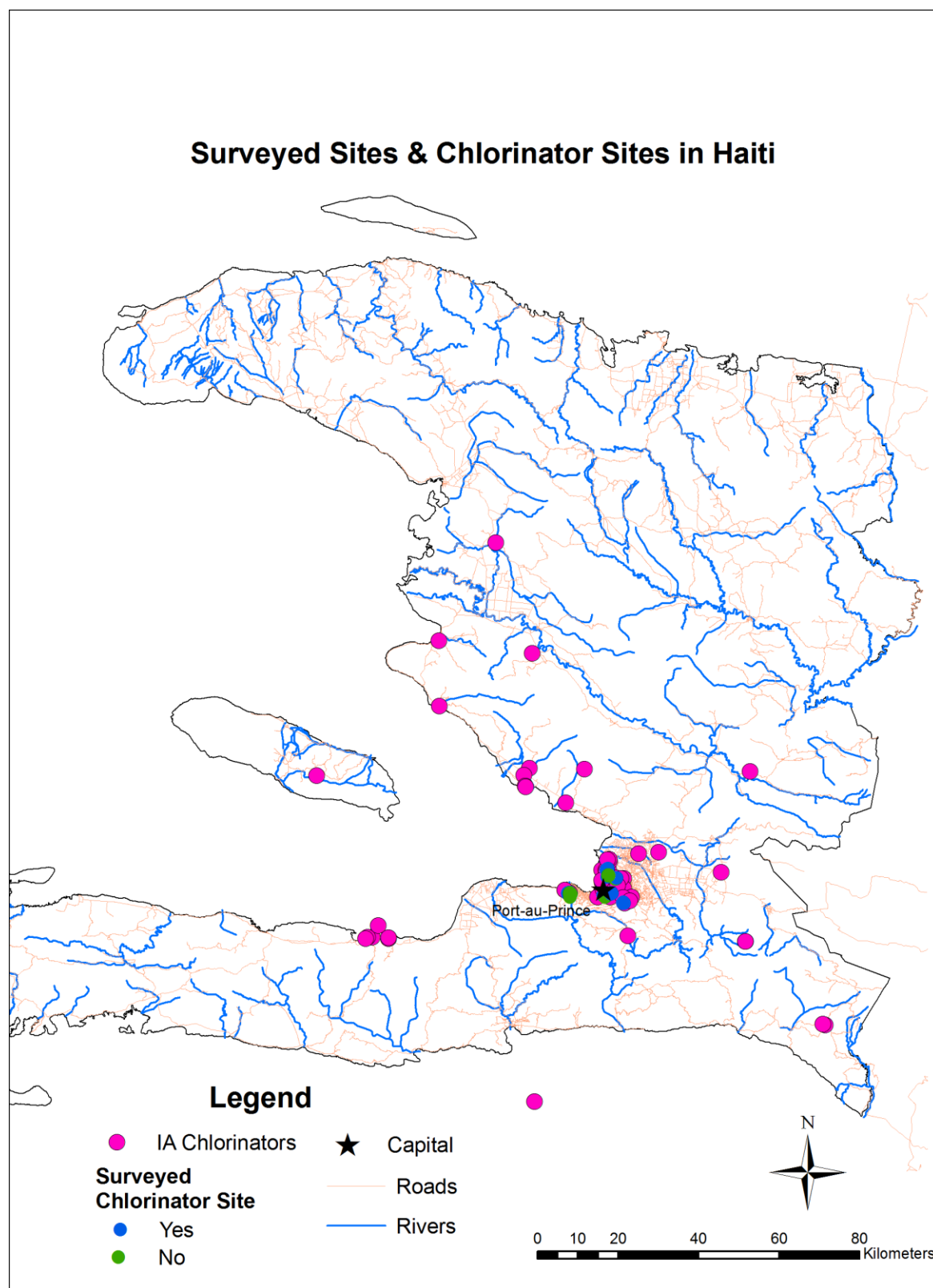
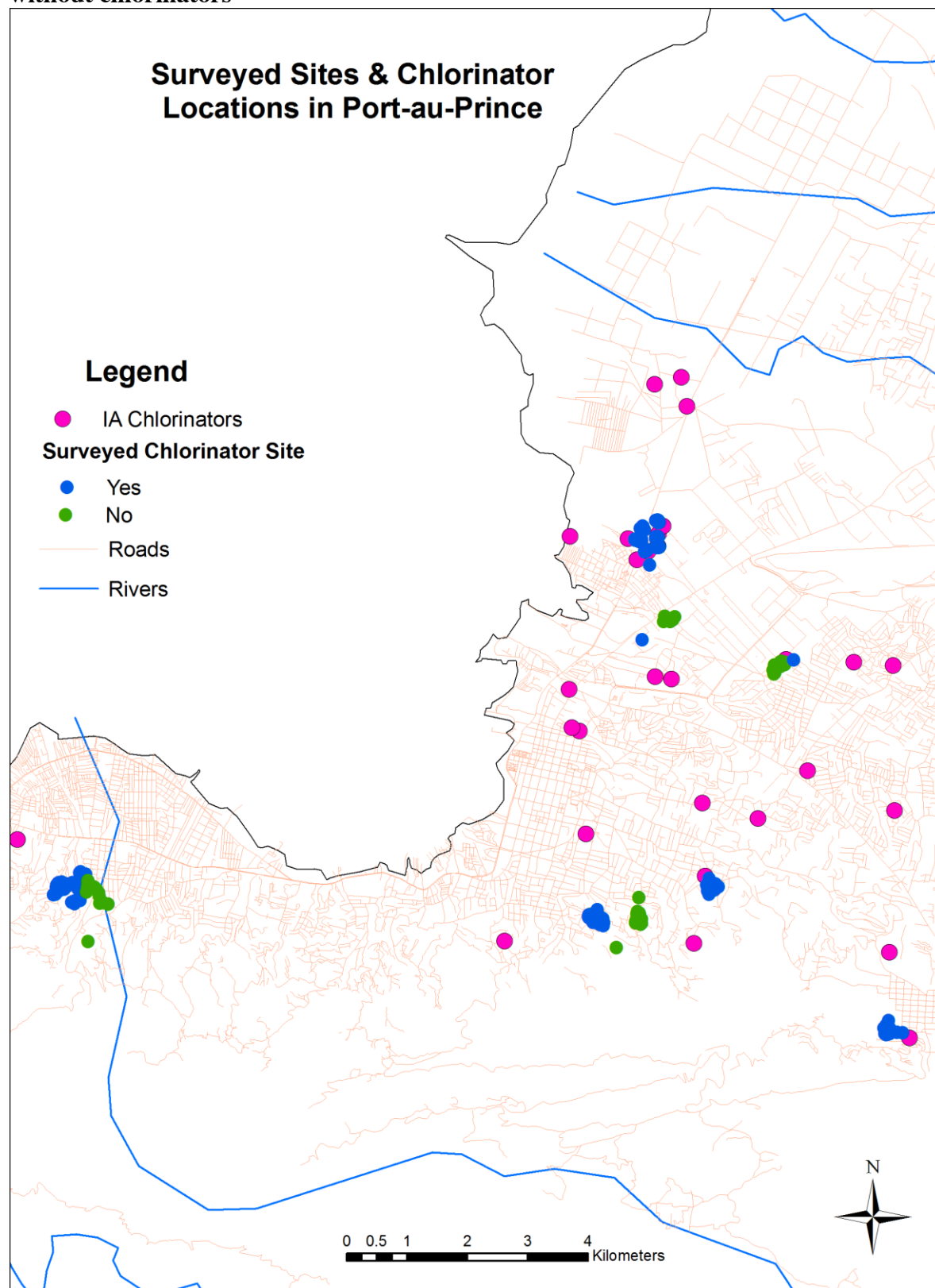


Figure 2: Map of International Action chlorinators and surveyed households with and without chlorinators



Demographics

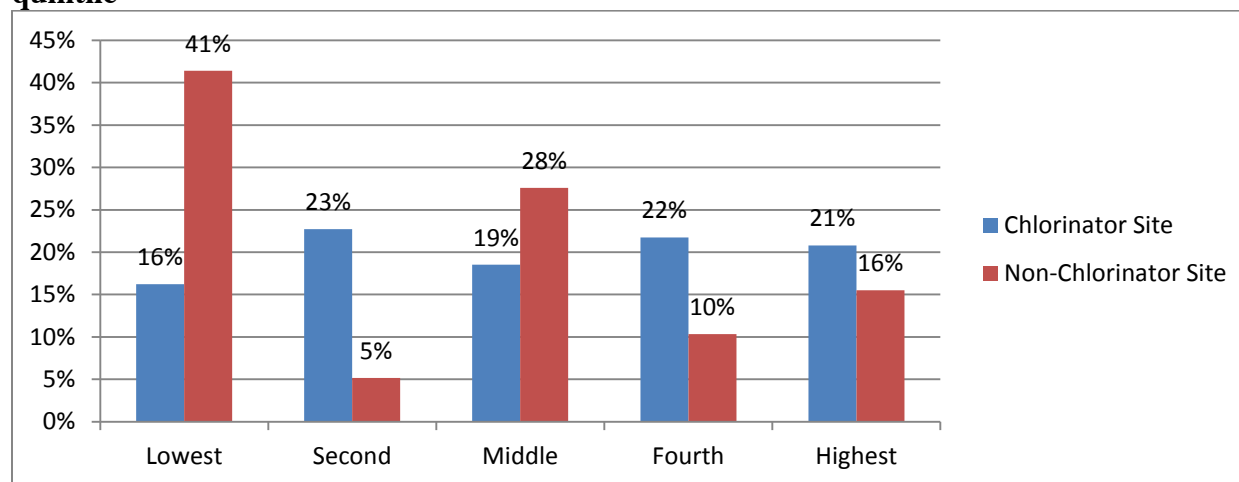
Demographics were similar for both chlorinator and non-chlorinator sites (Table 1).

While the sample size of the non-chlorinator sites was much smaller than that of the chlorinator sites (78 households vs. 350 households), chi-square tests and two-sample t-tests showed no significant differences in most demographic variables. The only exception was that significantly fewer households in chlorinator sites practiced voodoo. However, the small number of respondents who answered “yes” to practicing voodoo means that the significant difference between chlorinator and non-chlorinator sites may not be meaningful.

Table 1: Demographics of households in chlorinator and non-chlorinator sites

Variable	Chlorinator Site	Non-Chlorinator Site	p-value
Respondent female gender: n (%)	239 (69.5%)	54 (69.2%)	0.966
Respondent age: mean (SD)	34.8 (14.5)	36.2 (15.8)	0.458
Respondent attended school: n (%)	289 (82.6%)	67 (85.9%)	0.478
Male household head can read: n (%)	257 (73.9%)	60 (76.9%)	0.108
Female household head can read: n (%)	219 (63.5%)	51 (65.4%)	0.292
Religion: Catholic: n (%)	134 (38.6%)	29 (37.7%)	0.876
Religion: Protestant: n (%)	181 (52.2%)	40 (52.0%)	0.973
Religion: Other: n (%)	32 (9.2%)	8 (10.4%)	0.751
Practice voodoo: n (%)	23 (6.8%)	15 (19.2%)	0.001

The proportion of households in each wealth quintile did not vary substantially in chlorinator sites, but in non-chlorinator sites there was a high proportion of surveyed households in the lowest wealth quintile (Figure 3). However, since selection of chlorinator sites and non-chlorinator sites was not random, we cannot say that use of the International Action chlorinators had any association with wealth. The sites that were selected by the International Action staff may not have been representative of the household wealth distribution of sites throughout the rest of the program.

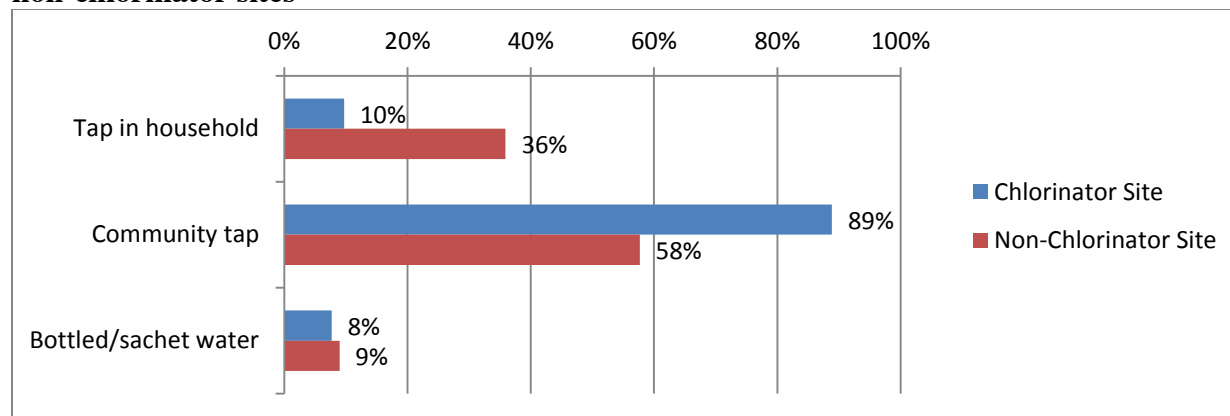
Figure 3: Proportion of households in chlorinator sites and non-chlorinator sites by wealth quintile*Drinking water sources*

The most commonly used drinking water source was community taps, used by 88.9% of households in chlorinator sites and 57.7% of households in non-chlorinator sites (Figure 4). The high usage of community taps in non-chlorinator sites indicates that other types of community taps besides International Action tanks were likely available, or that the non-chlorinator sites were located within a reasonable distance from a chlorinator. Households who lived in a site without a chlorinator traveled 28.5 min further on average to collect drinking water than those who lived in a chlorinator site (44.8 min vs. 16.3 min, $p < 0.001$). Households in non-chlorinator sites, therefore, might have been traveling to sites with chlorinators to collect water, which is why they had to travel further. Means of transportation was not asked on the survey but could include walking, motorcycle, private car, or public tap-tap.

The proportion of households using community taps did not significantly vary by wealth quintile ($p = 0.075$). The second most commonly used source was taps in the home or yard, used by 9.7% of households in chlorinator sites and 35.9% of households in non-chlorinator sites, which also did not significantly vary by wealth quintile ($p = 0.584$). Bottled water was only used

by 34 (7.9%) households. Although this was a very small number of surveyed households so the findings may be negligible, there were variations by wealth as the largest proportion of households using bottled water was in the lowest wealth quintile (16.2%). Only 7 surveyed households obtained water from a truck and 3 used river water.

Figure 4: Reported primary drinking water sources used by households in chlorinator and non-chlorinator sites



Beliefs about drinking water

The majority of respondents believed their water was safe to drink because it was treated (86.0%), so correct knowledge of what constitutes safe drinking water was widespread. There was no significant difference in the proportion of households with this belief based on whether or not they lived in a site with a chlorinator ($p=0.054$), and there were also no differences based on wealth quintile ($p=0.291$).

Use of toilet facilities

Toilet use varied significantly across surveyed neighborhoods both with and without chlorinators ($p<0.001$). Out of those households without a toilet, 46.9% lived in Drouillard, which is a neighborhood in the slum area of Cité Soleil, and 31.3% lived in Baillergeau. Covered latrines were used more frequently than “modern” flush or pour-flush toilets. Out of those using covered latrines, 17.4% lived in Bertin, 17.0% lived in Mont Jolly, and 16.1% lived

in Baillergeau. Most households using modern toilets were in the highest wealth quintile (43.6%). Use of covered latrines did not vary across wealth quintiles (ranged between 18-24%). Out of those without toilets, the majority were in the lowest two wealth quintiles (32.7% and 40.0%, respectively).

Use of International Action chlorinators

The proportion of households who reported getting water from a chlorinator did not significantly vary by wealth quintile ($p=0.546$), but significantly more households reported getting water from a chlorinator in “chlorinator” sites than in non-chlorinator sites (93.7% vs. 72.1%, $p<0.001$). It cannot be fully explained by the data, however, why use of the chlorinators in non-chlorinator sites was still so high at 72.1%. It is possible, as mentioned earlier, that households surveyed in the non-chlorinator sites were still using chlorinators or that they interpreted the question in a different way.

The majority of surveyed households had positive chlorine residuals (73.2%). Out of those with positive chlorine residuals, 91.9% reported getting water from an International Action chlorinator. Even out of households without positive chlorine residuals, 81.8% reported getting water from an International Action chlorinator. This could indicate that respondents misunderstood the question, enumerators made an error in recording the response, or that respondents’ current drinking water was not treated with chlorine. Looking at these data by chlorinator/non-chlorinator sites as shown in Table 2, in chlorinator sites the majority of households (76.9%) had positive chlorine residuals, and in non-chlorinator sites 56.7% of households had positive chlorine residuals ($p=0.001$).

Table 2: Reported and actual use of chlorinated drinking water in chlorinator and non-chlorinator sites

Variable	Chlorinator Site	Non-Chlorinator Site	p-value
Reported getting water from International	327 (93.7%)	44 (72.1%)	<0.001

Action chlorinator: n (%)			
Reported typically adding chlorine products to treat their drinking water: n (%)	255 (94.8%)	62 (98.4%)	0.213
Reported current water was treated: n (%)	285 (84.1%)	72 (93.5%)	0.032
Positive chlorine residual in current drinking water: n (%)	206 (76.9%)	34 (56.7%)	0.001

Since over half of households in non-chlorinator sites had positive chlorine residuals, these findings may indicate that even in non-chlorinator sites people were treating their water using methods other than the International Action chlorinators, such as Clorox, Jif, or Aquatabs. Out of households who reported getting water from the International Action chlorinators, 95.2% reported that they typically add chlorine products such as Clorox or Aquatabs. Boiling, filtration, and other water treatment methods that lack chlorine residuals were very uncommon in both chlorinator and non-chlorinator sites. Regardless of whether households lived in a chlorinator site, 95.5% of households reported adding chlorine ($p=0.213$). The proportion of respondents who reported that in general they add chlorine products such as Clorox or Aquatabs to treat their water was not significantly different in chlorinator vs. non-chlorinator sites ($p=0.213$) and did not vary by wealth quintile ($p=0.336$). Since the proportion of households who reported that their drinking water was treated was significantly less in chlorinator sites (84.1% vs. 93.5%, $p=0.032$), respondents may have assumed that this question was asking if they had added a product to treat their water themselves rather than asking if their water was treated, regardless of who may have treated it. It is not clear if this difference was due to wealth quintile; the proportion of respondents who reported that their current drinking water was treated significantly varied by wealth quintile, as there were higher proportions of respondents in the lowest and two highest wealth quintiles ($p=0.006$). However, these differences may not be meaningful since so few households (51) reported that their current drinking water was not treated. The true

explanation as to why more households in non-chlorinator sites than in chlorinator sites said their current drinking water was treated cannot be determined.

The most reliable method of determining if household drinking water is actually treated is, of course, not respondent reporting but rather the presence of positive free chlorine residuals in a sample of water collected in the home at the time of the survey. The proportion of households with positive chlorine residuals was significantly greater in chlorinator (76.9%) than in non-chlorinator (56.7%) sites ($p=0.001$). The proportion of respondents with positive chlorine residuals was significantly less in the lowest wealth quintile (53.9%) compared with all the other wealth quintiles (between 72-84%).

Health impact

The proportion of households who reported having diarrheal disease was too small to make a statistical comparison. Only 50 individuals had diarrhea out of the 2,008 individuals in the 428 surveys that were analyzed. In chlorinator sites, 2.3% of individuals had diarrhea in the 48 hours preceding the survey, compared with 2.9% of households in non-chlorinator sites ($p=0.429$). While this finding means that no significant improvements in diarrheal disease can be attributed to the International Action program, from a public health perspective it was excellent that the overall proportion of surveyed households with diarrhea was low.

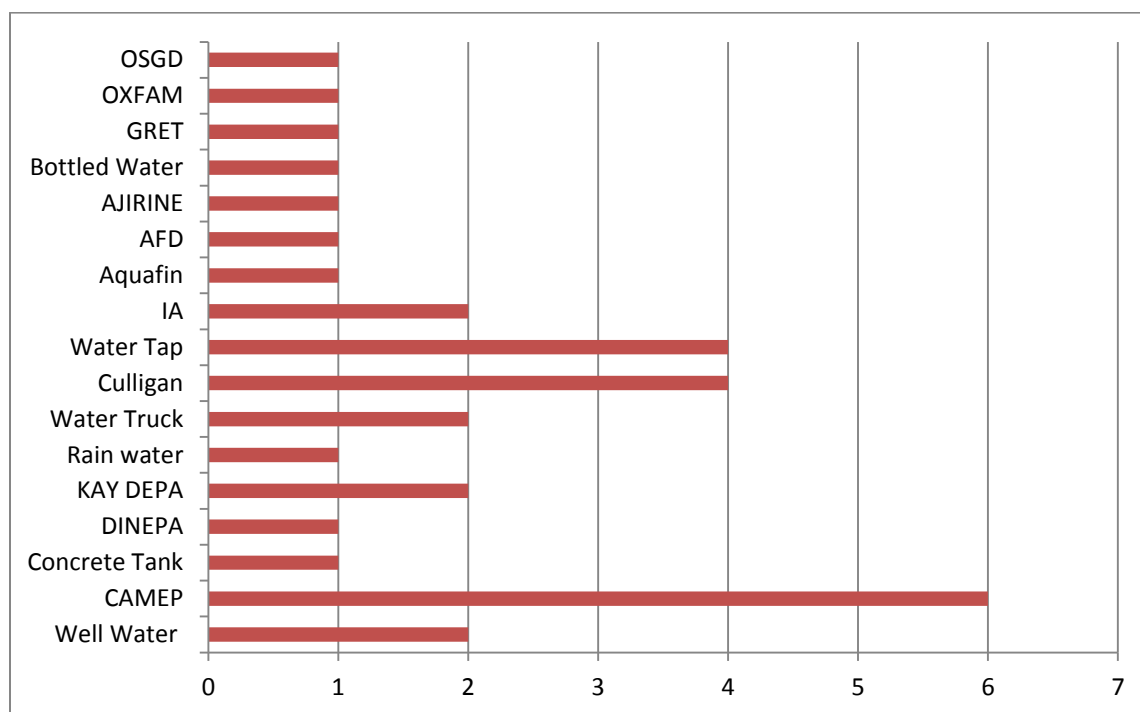
Results: Qualitative

Analysis of the pilot focus group revealed a set of key topic areas that were discussed by the majority of participants. The key topics that were brought up throughout the focus group discussion centered around water sources, water treatment types, health concerns, opinions about International Action, knowledge about water treatment practices, and recommendations for

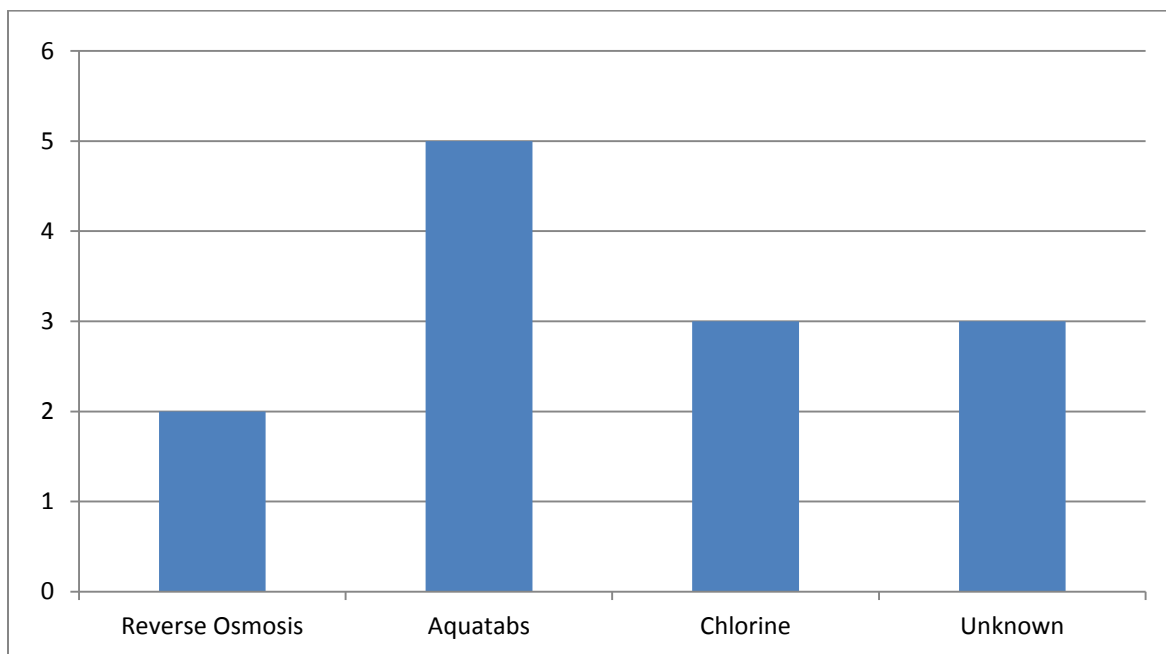
International Action. The responses were coded to reflect the appropriate theme and then analyzed using the data organization tool MAXQDA.

Water sources and Water treatment

The main water sources and/or water treatment-providing agencies that individuals in the pilot focus group identified were CAMEP, KAY DEPA, DINEPA, wells, piped water. Based on Figure 3, CAMEP is the source and agency that was mentioned the most number of times in the discussion, with Culligan water and water taps in general representing the second highest source mentioned. It is important to note that International Action is not mentioned as much as we had expected it to be. Some of the enumerators who participated in the focus group discussion indicated that they were surprised to learn that many of the individuals whom they surveyed had never heard of International Action previously and were unfamiliar with the community taps they had installed, yet these same individuals were still chlorinating their water using Aquatabs in a minority of cases. This may also help to explain the reason why some households that were surveyed in non-chlorinator areas showed a positive chlorine residual test between the proper range of 0.2-2.0 mg/L.

Figure 3. Frequency of Water Sources Mentioned in Focus Group Discussion

The water treatment methods that individuals identified were reverse osmosis, Aquatabs, chlorine, and other unknowns. Based on Figure 4, no significant inferences can be made from the data collected on this measure, which may have yielded more interesting findings had there been more focus group data to include in the analysis. It is notable, though, that Aquatabs were the most highly mentioned treatment type and that treatments were discussed in their own right thirteen times in the span of a 75-minute discussion. It is apparent by the comments of the participants that there exists much misconception about how water treatment works and what it accomplishes from a purely scientific background. Some of the participants, for example, indicated that they thought the chlorine would not necessarily ensure the water was safe to drink. If the Water Board members and the enumerators themselves do not know how chlorination treatment works, this presents an ethical problem when they go out into the community to educate others about the chlorinator systems and water treatment in general.

Figure 4. Frequency of Water Treatment Type Mentioned in Focus Group Discussion

Health Concerns and Perceptions

The principal concern brought up by participants of the focus group discussion was that people are too dependent on handouts rather than long-term health solutions and that they become negligent over time – more willing to take health risks – when danger does not seem imminent and outside organizations are not making a visible effort to advise them on treatment. As one participant stated: “We don’t find anyone coming to the neighborhoods to tell us that we should treat our water in order to avoid being sick.” It is apparent by this statement that many people depend on constant advertisement, supervision, and outside help. Knowing this, International Action should do more to be publicly visible educating communities about cholera prevention and proper hygiene. On the other hand, it is also important for the long-term future of the organization as well as the health of the citizens that International Action does not spoon-feed its clientele but rather helps them help themselves. By giving people Aquatabs and showing them how to use them, by holding training workshops to incorporate more voluntary “Water

Boards,” and by having educational trainings with employees and staff who can go out and educate their own communities, a more sustainable goal for water treatment and purification can start to be realized. It is clear that there are persisting misconceptions that exist about water treatment and cleanliness. Two different discussion participants, both of them enumerators, mentioned the following: “After treating the water you will see that the water is light (*legè*). When it’s not treated, it’s heavy (*lou*).” “The water is *legè* and when you drink it, it doesn’t have an impact on you.” While it is good that they recognize that a standard exists for safe drinking water, it would be better if this standard could be more externally verifiable to others. Evaluating water in terms of its “lightness” and “heaviness” is not sufficient to characterize the safety of it.

In light of the recent cholera epidemic that persists in bouts all across Haiti, it is similarly important for International Action to work with other NGOs to educate people about infectious disease agents, not just the water alone. As one participant noted, people often do not understand how the microbe in the water may hurt them: “From 2006 to 2010 the people had been using the same way of getting water without treating it because they used to say that the microbe doesn’t kill Haitians.” When a disaster does strike, these same individuals become increasingly vigilant and take extra precautions to avoid getting sick as indicated by the following commentary: “After the earthquake and the cholera epidemic that have been killing so many people in several places, such as Gonaives, they saw that the best way to avoid getting infected is to treat the water that they are drinking with Chlorine and Jif. Having diarrhea doesn’t mean that you have cholera.” If International Action works to alleviate health burdens caused by cholera in the communities it serves and continues to educate the local people, more people will gain confidence that the chlorinators are helpful and feel obliged to use them. As one

participant stated, the chlorinator makes it possible to treat water in a timely fashion and prevents disease and death: “There was a lot of disease back in the day, but the system that International Action is using is helping to decrease infectious disease in the community, and it helps people in the community to have clean water quickly instead of waiting for someone to give them an Aquatabs to treat their water, which would have taken too long and caused them to maybe die from the disease in the meantime.”

Knowledge

Some people seemed to have reasonably accurate knowledge about the nature of “treated” versus “non-treated” water, from both a general perspective as well as a more scientifically defined perspective. For instance, one participant mentioned that they could taste the presence of the chlorine to know if the water was safe: “As for me, if I taste the water and the water is not treated I will know. And if it is treated, I will also know.” It is important that International Action coordinates with other local NGOs in greater Port-au-Prince to provide more education about how to reliably know that water is treated and what the advantages and disadvantages of various treatment procedures are. Participants also mentioned the importance of testing the water to be sure that it was treated: “They prefer to go and buy water from a place where they have reverse osmosis. Everybody believes in this place because they know when they get the water there, the water is safe and they won’t get sick.” Another participant stated, “I know that Culligan water is treated and I buy it because I know it is treated. And it might not actually be good because when I test it it’s not treated.”

It is important that people know that the chlorinators installed by International Action are regularly monitored and that the water is tested for its chlorine dosage to ensure proper treatment levels. This would help increase the trust people put into the chlorinators and eliminate some

individuals' concerns about water safety. It is clear that people value a company based on its transparency in treating and testing its products: "I trust the person who is selling the water because other people selling the water aren't testing the water, but he always goes to find someone to come and treat the water that he is selling." In another vein, International Action should work to ensure that people are knowledgeable about how treatment works so that any underlying misconceptions caused by lack of education can be dispelled. One participant in the discussion, an enumerator himself, said this statement reflecting an inaccurate knowledge about the safety of drinking water: "I don't trust anybody unless I know that the water is treated. Culligan water is not a complete water source because the hydrogen doesn't stay in the water, so I don't drink it." If International Action makes it a priority in the future to train local communities before a chlorinator is set up in that locality, problems of incorrect usage and maintenance will not arise in the first place.

Self-agency is critical in terms of allowing a resource provision to become sustainable for the long-term future. Although International Action is able to target some areas through chlorinator installation and maintenance, the organization cannot reach every household in every community. As one participant mentioned, it is important for the individual to know that his/her water is treated: "In my house there is safe water because I have notions of how to treat the water." Moreover, as another participant explained, community training helps to increase trust in the water treatment and has the potential to see organizational expansion into other regions, as other communities become convinced that their neighbors are improving health and well-being. This participant stated the following: "It would be better to make an appointment with people by training them to know the importance of water testing and how to test water for chlorine residual and show them how to know the water is treated. That way they can trust the water and make

sure they expand the system by putting the system in different locations.” To close the gap in resource disparities between areas as starkly different as Cité Soleil and Pétion-Ville, it will be important for the organization to increase efforts to educate individuals in the communities they serve on how to treat the water and to show them first-hand what the chlorine residual test indicates and why this is important. Sharing the responsibility for maintenance and expanding accountability to the entire community will help create a strong bond between International Action and its local partners.

It is not only important for the water itself to be clean and treated but for all aspects of International Action’s image to maintain a clean and polished appearance in the public’s eye. One participant of the discussion made the following statement indicating that his/her perception of the safety of drinking water is greatly determined by the cleanliness of the source that delivers it: “Before they come to bring the water they should wash the truck, because when the truck is dirty I don’t know if the water is dirty or not.” If all aspects of the chlorinator system are presented as clean and safe to the larger community, International Action’s reputation can become more positive and gain more clout in other regions. One participant stated it this way: “The system connected to it is clean. If this area has this type of system, other areas will ask to have this same type of system, and they will know the importance of water treatment. Also, they will stop wasting the water.” In general, it is important that International Action re-evaluate its techniques and cleanliness standards at both its production site as well as at the chlorinator sites, to ensure that no contradictory messages regarding hygiene are being transmitted to the larger public.

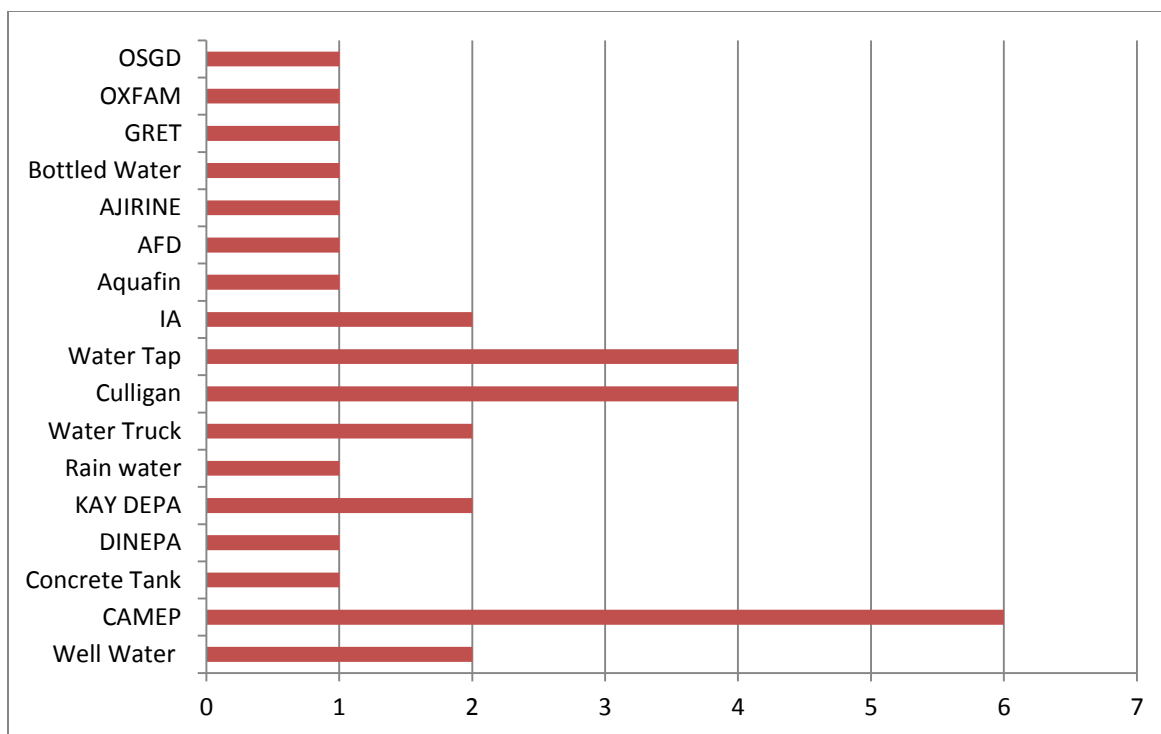
Results: Qualitative

Analysis of the pilot focus group revealed a set of key topic areas that were discussed by the majority of participants. The key topics that were brought up throughout the focus group discussion centered around water sources, water treatment types, health concerns, opinions about International Action, knowledge about water treatment practices, and recommendations for International Action. The responses were coded to reflect the appropriate theme and then analyzed using the data organization tool MAXQDA.

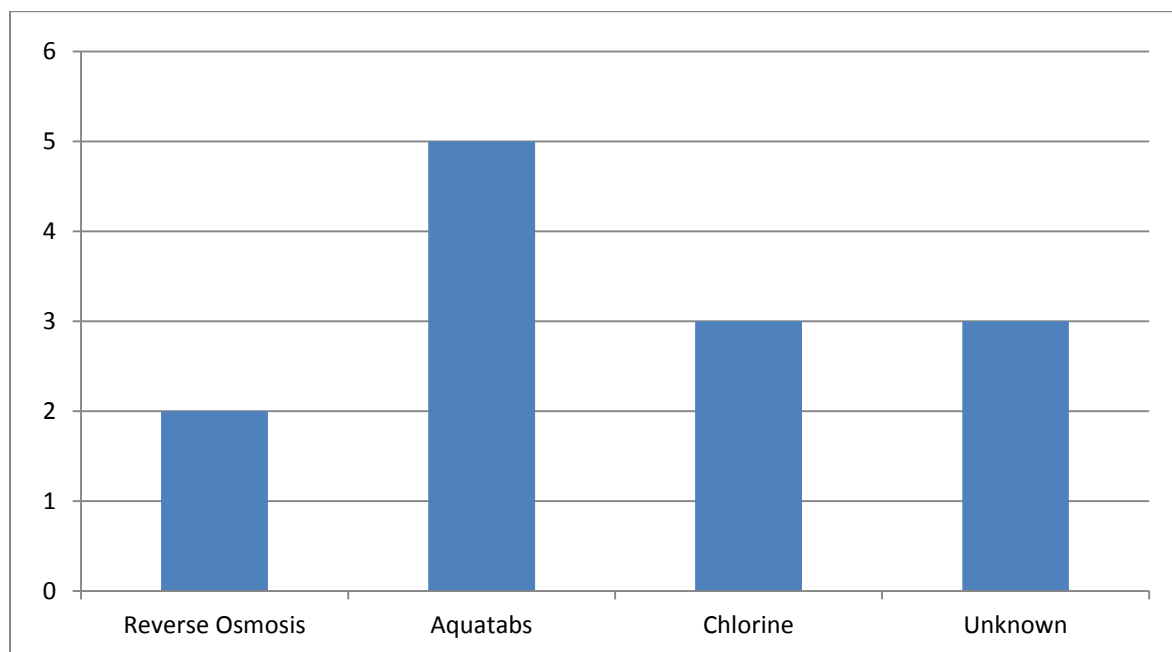
Water sources and Water treatment

The main water sources and/or water treatment-providing agencies that individuals in the pilot focus group identified were CAMEP, KAY DEPA, DINEPA, wells, piped water. Based on Figure 3, CAMEP is the source and agency that was mentioned the most number of times in the discussion, with Culligan water and water taps in general representing the second highest source mentioned. It is important to note that International Action is not mentioned as much as we had expected it to be. Some of the enumerators who participated in the focus group discussion indicated that they were surprised to learn that many of the individuals whom they surveyed had never heard of International Action previously and were unfamiliar with the community taps they had installed, yet these same individuals were still chlorinating their water using Aquatabs in a minority of cases. This may also help to explain the reason why some households that were surveyed in non-chlorinator areas showed a positive chlorine residual test between the proper range of 0.2-2.0 mg/L.

Figure 3. Frequency of Water Sources Mentioned in Focus Group Discussion



The water treatment methods that individuals identified were reverse osmosis, aquatabs, chlorine, and other unknowns. Based on Figure 4, no significant inferences can be made from the data collected on this measure, which may have yielded more interesting findings had there been more focus group data to include in the analysis. It is notable, though, that aquatabs were the most highly mentioned treatment type and that treatments were discussed in their own right thirteen times in the span of a 75-minute discussion. It is apparent by the comments of the participants that there exists much misconception about how water treatment works and what it accomplishes from a purely scientific background. Some of the participants, for example, indicated that they thought the chlorine would not necessarily ensure the water was safe to drink. If the Water Board members and the enumerators themselves do not know how chlorination treatment works, this presents an ethical problem when they go out into the community to educate others about the chlorinator systems and water treatment in general.

Figure 4. Frequency of Water Treatment Type Mentioned in Focus Group**Discussion***Health Concerns and Perceptions*

The principal concern brought up by participants of the focus group discussion was that people are too dependent on handouts rather than long-term health solutions and that they become negligent over time – more willing to take health risks – when danger does not seem imminent and outside organizations are not making a visible effort to advise them on treatment. As one participant stated: “We don’t find anyone coming to the neighborhoods to tell us that we should treat our water in order to avoid being sick.” It is apparent by this statement that many people depend on constant advertisement, supervision, and outside help. Knowing this, International Action should do more to be publicly visible educating communities about cholera prevention and proper hygiene. On the other hand, it is also important for the long-term future of the organization as well as

the health of the citizens that International Action does not spoon-feed its clientele but rather helps them help themselves. By giving people aquatabs and showing them how to use them, by holding training workshops to incorporate more voluntary “Water Boards,” and by having educational trainings with employees and staff who can go out and educate their own communities, a more sustainable goal for water treatment and purification can start to be realized. It is clear that there are persisting misconceptions that exist about water treatment and cleanliness. Two different discussion participants, both of them enumerators, mentioned the following: “After treating the water you will see that the water is light (*legè*). When it’s not treated, it’s heavy (*lou*).” “The water is *legè* and when you drink it, it doesn’t have an impact on you.” While it is good that they recognize that a standard exists for safe drinking water, it would be better if this standard could be more externally verifiable to others. Evaluating water in terms of its “lightness” and “heaviness” is not sufficient to characterize the safety of it.

In light of the recent cholera epidemic that persists in bouts all across Haiti, it is similarly important for International Action to work with other NGOs to educate people about infectious disease agents, not just the water alone. As one participant noted, people often do not understand how the microbe in the water may hurt them: “From 2006 to 2010 the people had been using the same way of getting water without treating it because they used to say that the microbe doesn’t kill Haitians.” When a disaster does strike, these same individuals become increasingly vigilant and take extra precautions to avoid getting sick as indicated by the following commentary: “After the earthquake and the cholera epidemic that have been killing so many people in several places, such as Gonaives, they saw that the best way to avoid getting infected is to treat the water that they are drinking with Chlorine and Jif. Having diarrhea

doesn't mean that you have cholera." If International Action works to alleviate health burdens caused by cholera in the communities it serves and continues to educate the local people, more people will gain confidence that the chlorinators are helpful and feel obliged to use them. As one participant stated, the chlorinator makes it possible to treat water in a timely fashion and prevents disease and death: "There was a lot of disease back in the day, but the system that International Action is using is helping to decrease infectious disease in the community, and it helps people in the community to have clean water quickly instead of waiting for someone to give them an aquatabs to treat their water, which would have taken too long and caused them to maybe die from the disease in the meantime."

Knowledge

Some people seemed to have reasonably accurate knowledge about the nature of "treated" versus "non-treated" water, from both a general perspective as well as a more scientifically defined perspective. For instance, one participant mentioned that they could taste the presence of the chlorine to know if the water was safe: "As for me, if I taste the water and the water is not treated I will know. And if it is treated, I will also know." It is important that International Action coordinates with other local NGOs in greater Port-au-Prince to provide more education about how to reliably know that water is treated and what the advantages and disadvantages of various treatment procedures are. Participants also mentioned the importance of testing the water to be sure that it was treated: "They prefer to go and buy water from a place where they have reverse osmosis. Everybody believes in this place because they know when they get the water there, the water is safe and they won't get sick." Another participant stated, "I know that Culligan water is treated and I buy it because I know it is treated. And it might not actually be good because when I test it it's not treated."

It is important that people know that the chlorinators installed by International Action are regularly monitored and that the water is tested for its chlorine dosage to ensure proper treatment levels. This would help increase the trust people put into the chlorinators and eliminate some individuals' concerns about water safety. It is clear that people value a company based on its transparency in treating and testing its products: "I trust the person who is selling the water because other people selling the water aren't testing the water, but he always goes to find someone to come and treat the water that he is selling." In another vein, International Action should work to ensure that people are knowledgeable about how treatment works so that any underlying misconceptions caused by lack of education can be dispelled. One participant in the discussion, an enumerator himself, said this statement reflecting an inaccurate knowledge about the safety of drinking water: "I don't trust anybody unless I know that the water is treated. Culligan water is not a complete water source because the hydrogen doesn't stay in the water, so I don't drink it." If International Action makes it a priority in the future to train local communities before a chlorinator is set up in that locality, problems of incorrect usage and maintenance will not arise in the first place.

Self-agency is critical in terms of allowing a resource provision to become sustainable for the long-term future. Although International Action is able to target some areas through chlorinator installation and maintenance, the organization cannot reach every household in every community. As one participant mentioned, it is important for the individual to know that his/her water is treated: "In my house there is safe water because I have notions of how to treat the water." Moreover, as another participant explained, community training helps to increase trust in the water treatment and has the potential to see organizational expansion into other regions, as other communities become convinced that their neighbors are improving health and well-being.

This participant stated the following: “It would be better to make an appointment with people by training them to know the importance of water testing and how to test water for chlorine residual and show them how to know the water is treated. That way they can trust the water and make sure they expand the system by putting the system in different locations.” To close the gap in resource disparities between areas as starkly different as Cité Soleil and Pétion-Ville, it will be important for the organization to increase efforts to educate individuals in the communities they serve on how to treat the water and to show them first-hand what the chlorine residual test indicates and why this is important. Sharing the responsibility for maintenance and expanding accountability to the entire community will help create a strong bond between International Action and its local partners.

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to ensure that no contradictory messages regarding hygiene are being transmitted to the larger public.

Problems and solutions

Focus group participants identified the following problems with water use and treatment, as well as the following solutions (Table 3). Note that the same participants who identified certain problems did not necessarily come up with the corresponding solutions listed in the table. It is important to note that many of these problems and solutions as we have coded them were brought up multiple times by different participants. In some cases, the solutions are very general, such as in the case of telling people to stop wasting water in response to the problem of water waste. However, what is, perhaps, more helpful is that participants presented unique solutions to help solve general problems. For example, it was brought up by one individual that parents are not necessarily following the same hygiene practices they stress upon their children: “So, you might see the parents are going to eat without washing their hands but they always advice their child to wash their hands.” To help parents educate their children, it was presented by one participant that educational songs about hand washing can stimulate learning proper hygiene habits in a fun way. In a few other cases, people mentioned the utility of radio and television advertisements in getting the message about water treatment across to the larger population. Four individuals complained about the decrease in community training provided by NGOs and governmental organizations and said they saw an increase in water treatment in their respective regions when this training was being offered at the time of the outbreak of the cholera epidemic in October of 2010.

A major problem identified by most of the participants was the high price of water and the lack of proper dumping sites for contaminated water and sewage. One participant

characterized the expensive price of the water by making the following comment: “All the people in my neighborhood have difficulty getting water except me. They buy a *galon* of water for 25 gourds because they don’t have anyone to train them that the water tank they have in their neighborhood can treat the water.” A majority of the focus group participants mentioned that the price of water should be reduced in general so that more individuals have access to safe drinking water. In regards to the problem of improper dumping, one participant made the following statement: “Usually they are dumping water in the street. Laundry and kitchen water usually gets dumped into the street.” To combat this problem, two individuals mentioned dumping water into vegetable gardens as a useful alternative to dumping in a latrine or ditch. Another individual mentioned dumping the water in a protected, covered hole instead of the open canal, and yet another individual mentioned dumping the water safely into a valley in the mountains where he/she resides. One participant explained that the current drainage problems would be reduced if International Action partnered with the Haitian government as well as private landowners: “The employees of International Action can go to the Haitian government by telling them that they would like to help improve current drainage. Because I know there are certain places in Pétion-Ville. If International Action asks the Haitian government, or the owners of the land because most of the land is private.”

Another recurring theme was distrust of NGOs and the Haitian government based on hearsay from friends and colleagues and past incidents of polluted water. Participants were keen to point out that they trusted International Action because of the reliability of the drinking water they provide and the long-standing relationship they have maintained in certain areas such as Jalousie. However, one woman from Le Plain had never heard of International Action before working for them as an enumerator, and she mentioned that this was the case for many people in

her region, so it may be that International Action should focus more attention on installing chlorinators in that region. It is useful to analyze the problems and solutions that participants brought up in the discussion because doing so can enable International Action to more precisely identify what it must do to meet its current demand of services more effectively before starting on the new goal of expansion.

Table 3: Problems and solutions associated with water use and treatment identified by focus group participants

Problems	Solutions
People are wasting water	Tell people to stop wasting water
Sources are bad/not treated	Add chlorine to treat water; Use reverse osmosis
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Expensive to get water	Decrease price of water; Save money to buy water
People aren't testing water	Provide training how to test water
Water might be dirty/contain silt	Clean the water tap; Cover the bucket; Clean the bucket; Wash cup that you use to drink water
People aren't learning how to treat their water	Provide training how to treat water; Do advertisements on water treatment
Have to wake up early to get water because of long lines	Install more chlorinators
Truck bringing water might be dirty	Wash truck that brings water
Children get water without supervision	Provide youth education
Not many tanks available	Install more chlorinators
Lack of NGO cooperation	Establish water board
Supervisors not doing their job	Establish water board
Poor drainage	Improve drainage; Dump water safely
Parents not teaching children healthy practices	Provide youth education through songs about hygiene

Opinions expressed about International Action

There were far more positive than negative opinions expressed about International Action by the focus group participants. This may be related to the fact that the Focus Group Discussion Guide had more questions that leaned towards explaining what International Action is doing well rather than trying to uncover organizational problems explicitly, or that the participants in the

pilot were mostly enumerators who were working for International Action already, or that the focus group took place at the International Action headquarters in Haiti.

However, despite these limitations only four negative comments were made about International Action, as follows:

- IA is ignoring an area where there are water problems
- IA is not providing sufficient education and outreach about the chlorinators
- Obtaining the water is expensive because the chlorinators are too far away
- IA needs to install more chlorinators

The following positive comments were made, in order of the number of times they were mentioned:

- IA treats water (4)
- IA is making a large impact (3)
- Getting to know IA more because of experience working with them (2)
- Feels obliged to use IA system because they have the chlorinator system for Haiti (1)
- IA has decreased the price of water (1)
- IA has helped to reduce infectious disease (1)
- IA can prove that the water they distribute is treated (1)
- I have learned about IA from my colleagues (1)
- IA is the only organization that has benefited people (1)
- Many people use IA chlorinators (1)

International Action should capitalize on what its clientele finds most positive about the organization currently. For example, it is very important that more people associate the chlorinator taps that it sets up with the organization itself. It would also be helpful if the organization can augment efforts to advertise their service in the regions where chlorinators are already set up, and to post more billboard messages concerning treatment procedures. Many people complained that they do not get the proper training from the Water Board members who come to set up and maintain a chlorinator in their neighborhood. The role of the Water Board member should ideally be to monitor the chlorinator at the site and help train the community to

make proper use of it so that eventually the community is self-sufficient at maintaining the chlorinator on their own. One of the key solutions a discussion participant mentioned to help make the chlorinators more sustainable was to train a few local community members to help the Water Board member and serve as advisers for their neighborhood. Having more local community members involved with the training may also garner more respect and positivity for the organization as a whole.

Recommendations

The following bulleted list is a summary of the recommendations that were made by focus group participants. The most frequently mentioned recommendations are that International Action should 1.) install more chlorinators in areas that do not yet have community-based chlorinator systems, especially in the more rural countryside localities; 2) that supervisors such as Water Board members should visit households in the neighborhoods where they work to ensure they know how to use chlorine residual test kits properly; 3) that more radio and television advertisements need to be made throughout greater Port-au-Prince explaining the benefits of Dlo Pwop; 4) and that more attention needs to be paid to repairing drainage and cleaning up the environments where the community taps are established. International Action should evaluate these recommendations based on their relevance and accuracy to see how the organization's goals match against their employees' as well as the larger community's expectations.

- IA should start water production in addition to water purification
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- Give community members water test kits
- Supervisors should visit community member's homes to make sure they know how to test their water and are teaching others
- Install more chlorinators in areas that don't yet have them

- Train people to treat water, to use testing kits, to understand chlorine residuals, to teach others
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Problems and solutions

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Limitations

Inherent to any study design and implementation are limitations that may restrict the extent to which inferences can be drawn from the data. For this study, the sample size was relatively small for what is typical of large-scale quantitative study, so it is difficult to assess the degree to which patterns that were observed in the data analysis are generalizable to the entire network of "chlorinator" and "non-chlorinator" sites from which these samples were drawn. The study samples were drawn in a non-randomized fashion at the discretion of the International Action Director in the Haiti office, but this method also limits the generalizability that can be drawn from analysis. Furthermore, because the number of "non-chlorinator" sites did not match

the number of “chlorinator” sites, comparisons between survey data for these two types of sites is limited in statistical strength and may not be an accurate reflection of the true differences between these types of sites in greater Port-au-Prince. Nonetheless, the survey data do confirm many of the expectations we had based on our background knowledge of the water sanitation sector in metropolitan Haiti. As expected, diarrheal disease incidence was reported to be low among the entire survey population, although it is difficult to make any strong ascertains with the data presented here due to such low counts of household members reporting diarrheal disease. This may partially be due to individual hesitancy about answering honestly or due to the definition we used for diarrhea: “diarrhea is defined as loose or watery stools three or more times in 24 hours.” Although this is the standard WHO definition used in nearly all public health research, it is a complicated definition that has its limitations. Also, it follows that as expected there are no significant demographic differences between chlorinator and non-chlorinator sites in the same neighborhood or locality. This is especially important given that a majority of the data analysis is based on distinguishing between household location within a “chlorinator” site and a “non-chlorinator” site.

Another main limitation was project funding for both methodological components. It would have been ideal if we could have conducted the same number of surveys in each chlorinator and non-chlorinator site and if the enumerators had been able to have more time to do practice surveys in sites. Usually, at least an entire week needs to be set aside for pilot surveys to be conducted properly so that enumerators have the opportunity to learn from previous mistakes and correct their technique before conducting the actual surveys. In this study, only two days were allotted by the organization to have the enumerators complete training, and furthermore, the practice surveys they completed were done near the International Action office and not at a

chlorinator site. Our supervisor at the Haiti office indicated that funds only allowed for a two-week study to be completed, which is quite different from the expectations we set out in the proposal. We intended to do at least 600-700 surveys total to have the proper statistical power to make valid characterizations and generalizations of the study population, yet we received only 428 surveys from the enumerators. This was primarily due to the fact that we were limited by the funds we could pay the five enumerators and had them work two weeks, which gave them only enough time to survey a total of twelve sites. Furthermore, because their training and background experience was limited, they were unfamiliar with the standard protocol to ask questions. Despite rounds of individual training with each of them, mistakes such as blank questions and incorrect labeling continued to be made in the actual survey phase.

While this study was designed to be a mixed-methods analysis utilizing the focus group discussion methodology, the qualitative component was removed later due to lack of sufficient funding and administrative interest. It was challenging to complete the focus group discussions given that our project supervisor at the Haiti office felt uncomfortable about inviting randomized lists of individuals from the survey population to conduct the discussions at the office site, yet he also did not want us to travel to each neighborhood to conduct each focus group discussion. These safety concerns are presently unavoidable given the lack of security in Port-au-Prince; nonetheless, this makes it difficult to conduct truly objective, randomized, and controlled qualitative research. Moreover, the summer volunteer, Lynn, who said she would help facilitate the focus group discussions was unavailable for the majority of the time, and the translator had difficulty translating the recordings on his own. All of these combined factors as well as lack of funding set aside at the beginning by the organization made it necessary to remove the qualitative component of this study. We chose to include a preliminary qualitative analysis in this report to

serve as a tool for future research design International Action may undertake and to highlight the rich findings from the pilot group. It must be noted that these results are in no way indicative of the larger population we studied in the survey because participants for the pilot did not come from that study population. Because the enumerators and Water Board members employed by International Action were the pilot participants, insights they offer may be biased based on their professional association with the organization and because the discussion was conducted at International Action headquarters. These elements were left out of our control, though, at the discretion of our project supervisor.

Conclusions

International Action has been working to install water chlorinators in Port-au-Prince and other areas of Haiti since 2006. Remarkable progress has been seen since that time. The vast majority of surveyed households in chlorinator sites indicated that they are using the chlorinators and they reported that in addition, they usually treat their water with chlorine. These findings are supported by the fact that over three-fourths of households in chlorinator sites had positive free chlorine residuals in samples of their drinking water collected in the home. Over half of surveyed households in non-chlorinator sites also had confirmed positive chlorine residuals, which is also promising.

To complement the survey data, the preliminary qualitative data shows that individuals are generally satisfied with the chlorinated water provided by International Action, which they are collecting on a regular basis. However, the general opinion is that International Action can do more in terms of educating and training their Water Board supervisors to educate local community members, to reach out to people in the countryside and establish more chlorinators in more regions, and to help in the clean-up efforts to improve drainage in the regions where it

already provides community taps. It seems that many people in the community are knowledgeable about chlorine treatment, especially because of the NGO outreach and electronic media advertisements that were widespread after the cholera outbreak in October of 2010. However, in order for these individuals to stay committed to using proper water treatment practices, it will be important for organizations such as International Action to include a more neighborhood-focused education and community training component as part of their project campaigns.

Recommendations for International Action

- International Action should make sure that researchers are provided with the ability to select study sites randomly to add more statistical rigor to the survey.
- International Action should strongly consider the value of qualitative research in analysis and make sure that this component is included in future studies.
- International Action should install more chlorinators in more sites, especially in countryside regions.
- International Action should train supervisors to educate community members in sites where chlorinators are installed about how the chlorinators work, why they are important, and how to treat water properly.
- International Action should communicate with their delegated Water Boards on a regular basis to be able to monitor the status of the chlorinators more easily and make repairs on a timelier basis.
- International Action should increase radio and television advertisements in the areas it serves, as well as more educational promotion

- International Action should ensure that its trucks and production facility present a safe and clean working atmosphere for its employees so that general trust in the IA water is maintained

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