Consilience: The Journal of Sustainable Development
Vol. 18, Iss. 2 (2017), Pp. 29–59

Evaluation of WASH Implementation in Nama Sub-County

Caroline Fernandes, Claudia Flores, Gabrielle Montalbano, Harveen Sekhon
Advisor: Dr. Gregory Pierce, Ph.D.
GlobeMed at UCLA
University of California, Los Angeles

Email:
csfernandes@ucla.edu
cpflores@ucla.edu
gabriellem2097@gmail.com
harveens@ucla.edu

Abstract

Villages that had underwent GlobeMed and MCHI water access, sanitation, and hygiene (WASH) interventions tended to exhibit better sanitation and hygiene practices compared to control villages. Survey participants were directly recruited from households in eight rural villages that had previously received community-based WASH interventions in Nama sub-county, Uganda. All participants were adults (above eighteen) of varying ages and genders. The other participants were directly recruited from two rural villages who had not received any WASH intervention within Nama sub-county and served as our control groups. Participants were surveyed on various topics including water source quality and distance, prevalence of sickness, latrine management, and sanitation and hygiene practices. The effectiveness of WASH programs in GlobeMed and MCHI sponsored villages compared to control villages was measured using *t*-tests and Pearson Correlation Coefficients (R).

Improved safe water and hygiene practices is fundamental to improving quality of life. Improved WASH related practices not only correlate with health, they ameliorate other frequently encountered inequities—like low school attendance—as education is a major factor in economic growth and alleviating poverty. Addressing WASH related problems can be challenging as they affect people from diverse communities and demographics. However, the most promising solutions arise when collaboration emerges between NGOs, governments, communities, and individuals.

Keywords: WASH, WUC, Uganda, water, infrastructure, health, hygiene, NGO, latrine

Authors' Note:

GlobeMed and MCHI's vision of success is to not only improve WASH in the community, but to have our efforts continued by community members long after the implementation. The purpose of our study was to evaluate the progress we have made thus far, but also look for weaknesses in this particular aid model. Only with the knowledge of our initiative's strengths and weaknesses, can the efficacy of our WASH efforts substantially be improved. We strive for a day when Water User Committees can effectively function to manage their respective village's water source and promote sanitation and hygiene without the support of GlobeMed.

We would like to acknowledge Dr. Gregory Pierce for his assistance throughout this study. We would also like to appreciate the members of the Mpoma Community HIV/AIDS Initiative for their support throughout the project. We would especially like to thank Wandera Peter (MCHI Manager), Frieda, Betty, Dennis, Kenneth, and Lydia for their participation in the outreaches. We also acknowledge the dedication of the members of GlobeMed at UCLA in their relentless efforts to raise money and support the WASH project.

Introduction

The goal of water access, sanitation, and hygiene (WASH) interventions is to improve access to water as well as educate people on the importance of sanitation and hygiene. These projects also aim to reduce the incidence of waterborne and water-related diseases throughout the region that it is implemented. One such water-borne disease is diarrhea, which persists as a leading cause of mortality amongst children under five in developing countries.

This type of project also focuses on sustainability for improved water security for future years. Ideally, this is done in part through the formation of Water User Committees (WUCs) for each water source. These committees are elected by the community in which the water source has been funded. The role of the WUC is to collect a household water user fee, as determined by the community, and to create an emergency fund in a bank. They are also responsible for tracking community usage of water, identifying problems, and brainstorming solutions. The WUC is responsible for allocating funds appropriately in repair and upkeep of the water source. Another part of the WUC are the two Health Promoters, who are responsible for conducting trainings and outreaches to educate the community about safe sanitary and hygiene practices.

These Water User Committees, in essence, mimic the duties of the Water User Groups that are supposed to be formed under the Water Statute of 1995, specifically in Uganda. This enactment was the beginning of water access laws in the largely rural country of Uganda. Studies have shown that improved water access, sanitation, and hygiene result in lower diarrheal rates, lower mortality, and better quality of life. A 2004 study by World Health Organization found lower mortality and diarrhea rates after the implementation of WASH. Formation of WUCs, which mirrors Elinor Ostrom's theory of common pool resource institutes, shows beneficial contributions to community empowerment. However, studies such as the *Analysis of Water User Committees in Uganda* have also shown the ineffectiveness of WUCs. This is usually the result from improper or lack of training. Nonprofit organizations (NGO) have played a vital role in providing access to potable water. However, a study conducted in Ghana showed potential challenges that could arise from a NGO funded water source. Overall, the long term benefits of WASH projects have shown to balance the inequality that exists in communities from economic statuses to empowering women.

In the summer of 2016, we conducted a survey based on sanitation and hygiene practices for 209 households in ten different villages in Uganda with Mpoma Community HIV/AIDs Initiative (MCHI). In the results section of this report, we focus on analyzing the most interesting or significant topics from the survey. We found that in general WASH villages tend to perform better than control villages in water access and sanitation practices. WASH villages tend to have less problems with their source in terms of water quality and source upkeep. Moreover, there were significantly less reports of illness in WASH villages than in control villages. A similar trend was found when analyzing the relationship between handwashing stations and diarrhea—the two variables had a stronger positive correlation for WASH villages than control villages. However, when comparing the WASH villages to the control village Kyampisi no significant results were found based on latrine management criteria. This suggests that these topics should be more emphasized in WASH curriculum. Additionally, within WASH villages there was variation in WUC performance, with Waluga having the most effective committee and Buyuki having arguably the worst.

After reviewing the results and comparing qualitative data received from the surveys, we considered the future steps for WUCs in villages that already have WASH interventions. WUCs should be further trained on borehole maintenance and be connected with resources to repair these waters sources. Also, a greater emphasis should be placed on the importance of latrine sanitation and the use of a permanent handwashing station near the latrine. We also propose expanding MCHI's partnership to the two control villages, Kyampisi and Namwajollo, in the coming months to implement a WASH intervention there as well.

The goal of this research was to evaluate the effectiveness of GlobeMed and MCHI's WASH interventions and then seek ways to improve our efforts to achieve maximum impact. While our data provided evidence which suggested that most villages with MCHI interventions performed significantly better in WASH related areas, it is evident that there is still room for improvement. First, data collection must be altered by conducting a baseline assessment prior to villages receiving a WASH intervention. Additionally, in moving forward with MCHI and GlobeMed WASH projects, WUCs must be the primary area of focus for improvement. It is imperative to increase villagers' awareness and understanding of the importance of WUCs. In addition to connecting WUCs with each other, MCHI

must engage the local government to gain support for their projects and potentially inspire WASH-related policy. While WASH issues in developing countries are far from being completely resolved, the best chance at significant advancement is through collaboration between NGOs, governments, communities, and individuals.

Literature Review

Water access, sanitation, and hygiene (WASH) projects have been implemented by both governments and non-governmental organizations in many developing countries--especially in Uganda. Unfortunately, improper water, sanitation, and hygiene practices and facilities in the developing world are extremely prevalent and cause major hardship. Poor water, sanitation, and hygiene account for roughly ten percent of all deaths annually as 1 in 6 people do not have access to clean water (Prüss-Üstün, 2008). Currently, diarrheal diseases are one of the main causes of high mortality rates in developing countries (Boschi-Pinto, et al., 2008). Specifically in Uganda, a 2004 study from the World Health Organization stated that the rate of mortality from diarrheal diseases was at thirty percent. Furthermore, the United Nations Millennium Development Goal states that Sub-Saharan African countries have the highest rate of the disease compared to other countries.

With such a large amount of people experiencing WASH related hardship, it is important to understand the effects of such issues to appreciate the importance of WASH improvement initiatives. Unsafe water sources coupled with poor sanitation practices serve as a vector for disease transmission. In fact, two million deaths per year are attributed to waterborne illnesses.

The role of nonprofit organizations (NGO) in expanding the proportion of populations that have access to water has shown to be tremendously successful (Alexander and et al., 2015). Due to population growth and limited funding, governments have shown the inability to provide this access. A study conducted in Ghana studied seven villages where NGOs had built water sources. Questionnaires were then conducted in each village to evaluate the effect each source had on the community's access to water. The study also looked at four villages who acted as controls. The health levels and sanitary practices of the controls were compared to the NGO intervene villages. The addition of basic infrastructure to the communities resulted in a reduction of thirty minutes for water collection

(Alexander and et al., 2015). Earlier attendance in schools were also noted. Because children are regularly held responsible for the retrieval of water, higher attendance in schools could have resulted. In the study, residents proclaimed a lesser concern for acquiring water borne diseases. Yet, the addition of a safe water source in the community did not lower diarrheal rates. This could have been caused because of wrong assumptions from the community or lack of sensitization.

The intervention of NGO built water sources has benefited many communities. However, the study conducted showed that challenges from NGO funded water sources can easily arise (Alexander and et al., 2015). Proper training for borehole or water source maintenance must be conducted. The dependency on NGOs from these villages could potentially result in nonfunctional sources. That is where Water User Committees (WUC), as stated before, could intervene and take on the role of dependency. This brings in the sustainable factor, which is what the study suggests in in its discussion. NGOs efforts could also be redundant, in the sense where lack of communication between local officials or government could provide boreholes for already served communities (Alexander and et al., 2015).

Not only do WASH interventions have remarkable direct impacts on people's daily lives, but the indirect, long term benefits of these interventions are as well extraordinary. WASH interventions have the potential to make serious advancements in combatting inequality.

First, WASH efforts have significant economic benefits. The World Health Organization reports that in high income countries most people die of conditions like heart disease, stroke, cancer, Alzheimer's, and diabetes. Whereas, in low income countries people are more commonly affected or even die from preventable diseases that are virtually nonexistent in developed countries like diarrheal disease, malaria, tuberculosis and waterborne illnesses (Weissman, 2003).

Thus, productive members of society who have the capacity to contribute to the nation's economy are no longer able to because they are burdened by illness. In fact, a Harvard study reveals that with WASH interventions, occurrence of minor, adolescent intestinal infections decreased and the time adults in the community studied usually would have spent caring for children was reallocated to farming or work. (Meeks, 2015). With more time for work, a greater

opportunity exists for economic development. In addition, the healthier children contribute to the economy as well. Children in developing countries miss an estimated three days of school per each episode of diarrhea they experience (Chatterley, 2013). Thus if access to sanitation and clean water were improved, school attendance can logically be expected to increase, improving the economy as education is commonly considered a major factor responsible for fiscal growth.

Lastly, not only do WASH efforts improve low income nations' economies relative to other countries, these interventions reduce economic disparity within developing countries. Higher income families can often afford to pay for clean water, whereas poor families are forced to drink inconvenient and unsafe water (Weissman, 2003). This disparity only widens the economic gap between the rich and poor in developing nations as the poor will continue to be burdened by time intensive water collection and water related illnesses, while the higher income citizens continue to avoid these issues.

Furthermore, in addition to aiding the economies of developing nations, WASH interventions can improve aspects of these countries' social environments. WASH projects empower women in societies where they are often traditionally oppressed. In rural areas the responsibility of water collection typically falls on women (Meeks, 2013). With long pumping times or distant water sources, women naturally have less time to earn their own income or attend school. A study in Ghana conducted by the World Bank concluded that reducing girls' water collection time expense by fifteen minutes a day would raise girls' school attendance by eight to twelve percent (Weissman, 2003). In addition, WASH in school programs also promotes gender equality through relieving girls of the burden of enduring menstruation without proper sanitation and hygiene facilities (Weissman, 2003). Allowing women the opportunity for education through reducing water collection times and providing infrastructure for menstrual management creates an environment where women can be financially independent, empowering them by giving them more ownership over their lives. Additionally, educating women means that the other fifty percent of the population is now able to contribute to the economic productivity of the country.

As well as changing a developing country's social environment in terms of gender equality, WASH interventions,

especially in schools, have been known to change the broader culture of household sanitary practices. A study examining WASH education in Kenyan schools found that after the intervention, there was an increase in consumption of treated drinking water, latrine construction, and handwashing in the students' households (Weissman, 2003). These families adopting hygiene conventions is clear evidence that WASH interventions are not only working but sustainable. The children passing the information they have learned on to their parents, which changes the social habits of the families, ensures that the WASH education does not end in the school and is truly sustainable.

Methods

Demographics

Survey participants were directly recruited from households in eight rural villages that had previously received community-based WASH interventions in Nama sub-county, Uganda. All participants were adults (above eighteen) of varying ages and genders (Figure 1). The other participants were directly recruited from two rural villages who had not received any WASH intervention within Nama sub-county.

We thus had two groups, one was a control group of villages that did not receive a WASH intervention. The second group consisted of the eight communities that received WASH interventions through the GlobeMed-Mpoma Community HIV/AIDS Initiative (MCHI) partnership. Using secondary data, a report compiled by the local country district report and information from the manager of MCHI, we were able to make estimates of the population size of each village that we surveyed.

According to local government reports and verbal responses from local leaders, the total population of the entire Nama sub-county has 16,513 males and 16,491 females. There are approximately 143 springs and dug wells, but there is a problem with a lack of funding for those water sources and some have problems with functioning. Table A (See Appendix) represents estimates that we obtained through conversations with local leaders and leaders of MCHI. Through MCHI's WASH program, there are an estimated 6,022 direct beneficiaries and 1,500 estimated indirect beneficiaries in all villages.

Ethics and Dissemination

Our survey protocols have been reviewed and approved by the Institutional Review Board of the University of California, Los Angeles (IRB#-16-000773).

Consent for this study was obtained from the local Ugandan government and also from each participant. Before beginning the interviews the participants were told the purpose of the study, that the results are confidential, and that they do not have to answer anything they do not wish to respond to. Participants were informed that we would be conducting an in-depth qualitative interview about their village water source, current sanitation practices, and latrine quality. Also, they were informed that the GPS coordinate of their household would be recorded. Consent was indicated by signing their name and in the case of illiteracy using their thumb print. The consent form is attached to the end of this report (Appendix C).

How the Survey or Interview was Conducted (Translation Methods Included)

In summer 2016, we conducted 209 interviews in ten villages: eight communities that had WASH interventions and in two communities that served as control villages. A minimum of twenty surveys were taken in each village. These interviews were conducted by GROW interns in the Luganda language with the presence of a Mpoma team member who served as the translator. The translator had a physical copy of the translated survey and the interns recorded the responses on a paper. GPS coordinates were taken at every household and GlobeMed funded water source. The researchers collected data through the survey on household demographics, sanitation and hygiene practices, and water source availability and quality. Researchers also directly observed household latrines, water sources, and handwashing stations.

Part one of the survey asked questions about the water source that was funded by MCHI in the specific village. These were questions pertaining to water clarity, taste, accessibility, and more. There were a total of five questions, each with several parts (a-e) for a total of twenty-two questions.

Part two of the survey focused on sanitation and hygiene practices within the household. These questions were focused on handwashing practices, latrine conditions, soap usage, cleaning of utensils, sickness in the family, and training on WASH. There were seven questions with several parts for a total of twenty-five questions.

Part three assessed households' current behavioral practices in four areas: disposal of feces, disposal of children's feces, latrines and handwashing stations, and safe water handling. The participants ranked themselves from pictures one through three (disposal of children's feces and latrine practice) or pictures one through four (disposal of feces and safe water handling), with Picture one ranked as the least sanitary behavior and Picture three or four ranked ranked as the most sanitary. For example, in latrine practices, Picture one had no handwashing station near the latrine and Picture three had a tippy tap (a "no hands" handwashing station made from local materials) near the latrine.

This survey lasted approximately fifteen to twenty minutes per household and a minimum of twenty households were surveyed in each of the ten villages. Although most participants completed the full survey, there were three villagers that either refused to finish the survey or to even begin the survey. The MCHI and GlobeMed team conducted the outreaches (and surveys) over a six week period. Approximately two survey rounds were conducted each week (one in the first week and three in the last). These outreaches lasted approximately four to five hours, including travel time.

Statistical Analysis

This report draws on several aspects of a larger survey that was conducted in these villages. All tests of statistical significance were measured using conventional standards and a p-value less than .05 was considered significant. Using weighted averages, we obtained the combined averages for the control villages and the combined averages for WASH villages.

Results

Although the entire WASH survey encompassed many topics, we focus on the most interesting and significant findings in this report. We explore first, a summary of the results found about the water sources themselves (Figure 1). We further analyze the time that it takes to walk to a water source (Figure 2) and the immediate implications of building basic infrastructure. We then discuss study latrine sanitation practices (Figure 4) and handwashing stations (Figure 3). Throughout the results, there is a general trend that WASH villages tend to perform better than control villages in both waters access and sanitation practices. This is the biggest takeaway from this section.

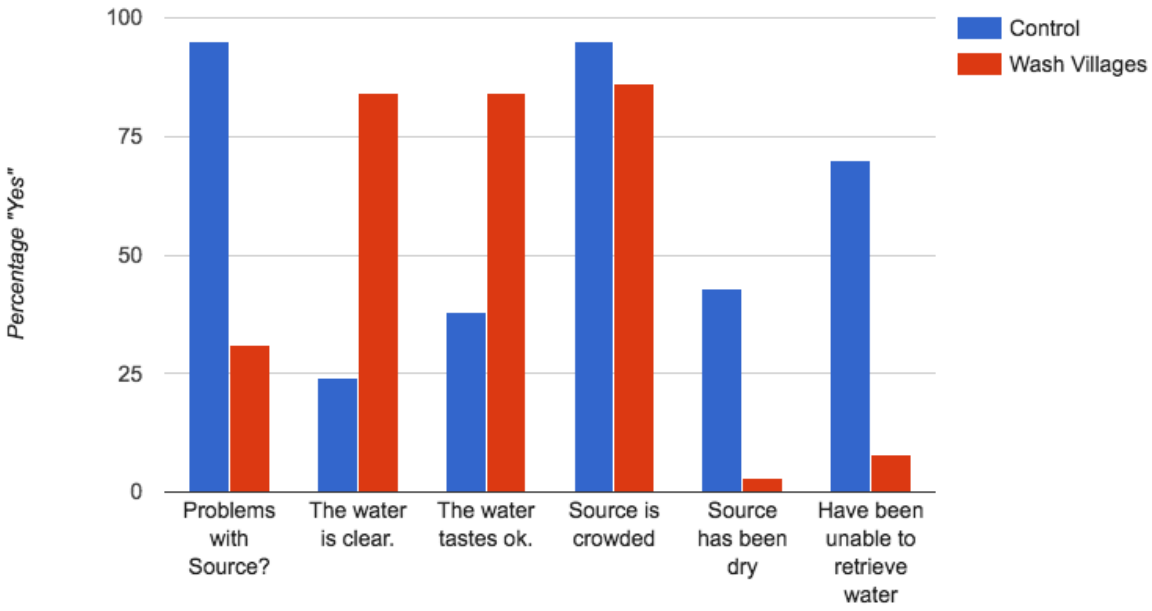


Figure 1: Water Source Survey across Control and WASH villages

In Figure 1, we explore some of the basic issues associated with the water source that were surveyed. The horizontal axis shows questions that were asked in the survey such as "Do you think the water is clear?" and "Does the water taste ok?" The vertical axis shows the average percentage of "Yes" replies to each question. The control group includes Namawajollo and Kyampisi's responses as weighted averages. The other group represents a weighted average of "Yes" replies from the eight WASH villages, incorporating the population surveyed in each village. In order to explore the data fully, the entire WASH group was often compared to each control village.

The graph shows that villages with WASH interventions had fewer problems with their water source than the control villages. The difference was significant between Namawajollo and all WASH villages ($p<.05$) and between Kyampisi and all WASH villages ($p<.05$). Some common problems that were mentioned in the villages included: dirty water (Kyampisi), rain water mixing with the ground water (Waluga), problems with the drainage system (Takkajjunge), water scarcity in the dry season (Lukalu 2), problems with animal contamination (Kyampisi), crowding (several), and the rusting of pipes (Buyuki).

It can be seen from the graph that villages that received

funding from GlobeMed and MCHI had more satisfaction with water clarity in comparison to control villages, where the water came from an unprotected water source. For Namawajollo, seven of the eight WASH villages had significantly more responses of "Yes" ($p<.05$) The only WASH intervention that was not significant was Buyuki ($p=0.3972$), which also had a low response of "Yes" to "Do you think the water is clear?." In comparison to Kyampisi, each WASH village was considered statistically different ($p<.05$). WASH intervention villages generally had clearer water than the unprotected sources in control villages.

As water taste is concerned, it is again easily observable that WASH villages had fewer problems with the taste than control villages. Namawajollo did not show a significant difference between WASH villages Lukalu 2 and Buyuki. Buyuki actually had a lower responses of "Yes" to "Does the water taste ok?" than Namawajollo (Buyuki mean=25%, Namawajollo mean= 55%).

Kyampisi had a significant difference with all of the WASH villages ($p<.05$) except Buyuki. Kyampisi had a lower average response of "Yes" than Buyuki (Buyuki mean= 25%, Kyampisi mean= 20%). Some of the problems with Kyampisi's water clarity and taste were due to mud mixing with the unprotected water source and animal's drinking and defecating near the source.

Both control and WASH villages agreed that the water sources were used by too many people. This is true in many WASH villages as well, because the new borehole often becomes the main water source for the households surrounding it, as many other sources remain unprotected. However, as can be seen from Figure 1, WASH villages were still able to retrieve water on a more regular basis than control villages, even though both say that the sources were crowded. Explanations for this could include faster pumping time with a borehole and the water levels remaining consistently high in WASH villages.

The graph also shows that the unprotected water sources in the control villages had been dry more so than those in WASH villages. Namawajollo has an average of 65% of those surveyed that said that the water source had indeed been dry. This was significantly different from the other WASH villages. Kyampisi had an average of 20%, which was not significantly different from Busaale (average=10%), Katoogo (average=5%), and Lukalu 1 and 2 (average=5%). This could imply that even some of the villages that received WASH interventions had some trouble with water scarcity

in the boreholes. At the same time, this water scarcity may have affected the control villages more, as more people had difficulty retrieving water in those villages.

The control villages, on average, had more villagers that were unable to retrieve water, for various reasons. Many of these reasons are included on the chart as well, such as problems with overcrowding, water clarity, and a dry source. An average of 90% of those surveyed in Namawajollo had been unable to retrieve water at some point. This was significantly higher than any of the WASH villages ($p<.05$). An average of 50% of those surveyed in Kyampisi had been unable to retrieve water. This was significantly higher than all of the WASH villages except Katoogo (average=27%). The most common reason stated in Katoogo for being unable to retrieve water was because the source was overcrowded.

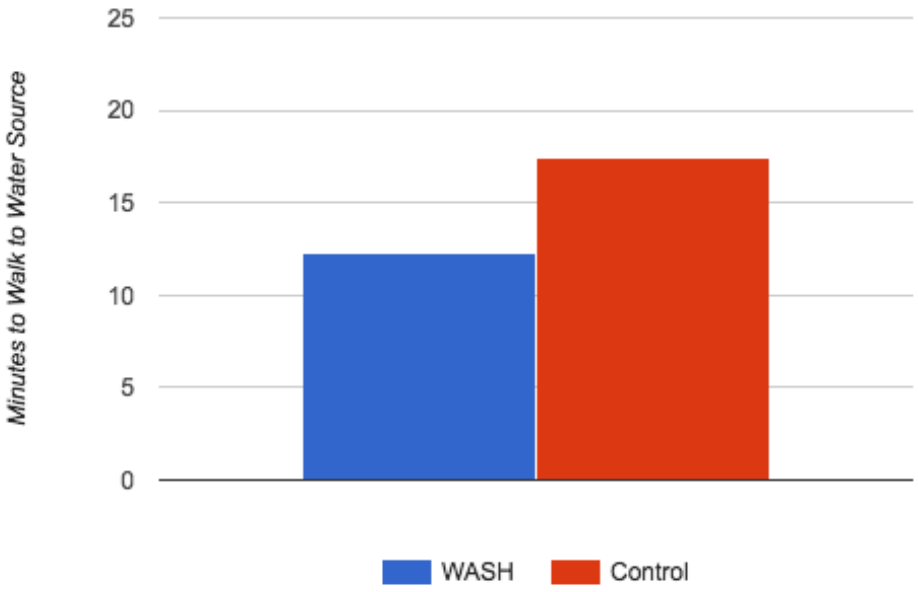


Figure 2: Time to Walk to Water Source in Control and WASH villages

Figure 2 shows the average time to walk to the water source in WASH villages (12 minutes) and in Control Villages (17 minutes). It is important to consider that this walking time only includes going to the water source and not the way back, nor does it include pumping and waiting times at the water source. It also important to consider that the data for the WASH villages is a bit skewed towards a higher average due to the average time to walk to the source found

in Lukalu 1 (21 minutes). However, it can still be seen that providing basic infrastructure such as a borehole can decrease the time spent walking to the water source.

Next, we explore the sanitation and hygiene aspect of WASH. Figure 3 demonstrates the possibility of a correlation between WASH training and the prevalence of sickness amongst the villagers. Figure 3 includes both the control and WASH villages, for a total of ten villages. Of the total individuals surveyed, we combined the data for all individuals who said that they or a family member had been sick in the past three months. Then, we totaled those within that group who had training on WASH and those who had not had any training. It is important to consider that this training did not always come from Mpoma. Only 52% of all training was conducted by MCHI. Other trainings came from the government, other nonprofits, and schools. It is also important to consider that these illnesses ranged from a simple cough to a water-borne disease. Therefore, it is difficult to conclude that WASH training directly impacted how often an individual became sick. However, as can be seen from the graph, a larger percentage (67%) of those who had been sick had not received WASH training of any kind.

Most interviewees who had WASH training not conducted by WUCs noted that it was typically from the government. Out of the

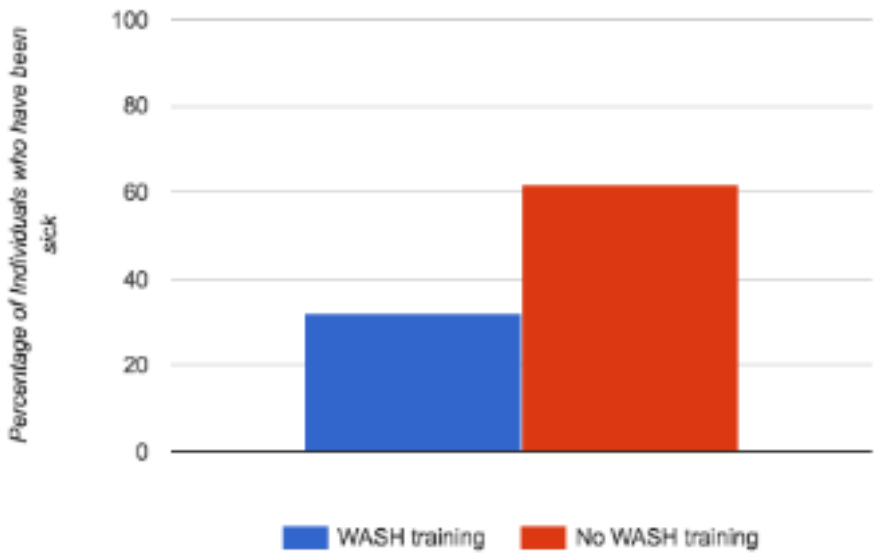


Figure 3: WASH Training and Prevalence of Illness amongst Participants

seven households which said they had WASH training, four said the

training came from the government, one said an NGO, another received training via radio, and one household could not remember who conducted the training. For these villages, the topics covered ranged from personal hygiene to boiling water plus keeping utensils and water vessels clean. By comparison, all GlobeMed sponsored households said their training came from village Water User Committees which were trained by Mpoma. Although these households mentioned the same topics, interviewees usually stated that they learned about the importance of topics like hand washing and boiling water; this may suggest that the prevention aspect to WASH training was emphasized to them unlike control households where they may have vaguely been told that hand washing and boiling water were important with the focus being on the steps to do both actions. A discussion about prevention of waterborne illnesses to elucidate why such precautions are so imperative could have made WUC trainings more effective than government trainings. However, the findings may not be accurate as we were only able to survey two control villages. Perhaps the difference between control and WASH villages would have been stronger if more non-WASH villages had been interviewed.

In order to further explore sanitation and hygiene practices, it is important to consider the state of the hand washing stations present in each household, and their proximity to the latrine to promote handwashing. The pictures in Figure 5 of the survey, which can be found in Appendix D, correspond to the labels on Figure 4. As can be seen, the first picture represents no type of hand washing station near the latrine. The second picture shows a permanent handwashing station, not a tippy tap. The third picture shows a tippy tap near the latrine. This chart shows that a large percentage of households in the control villages do not have permanent handwashing stations near the latrine (83%) as compared to (54%) in WASH villages. Using this data, we can consider the impact that implementing a WASH program has on actual behavior change. However, it is also important to consider each individual WASH

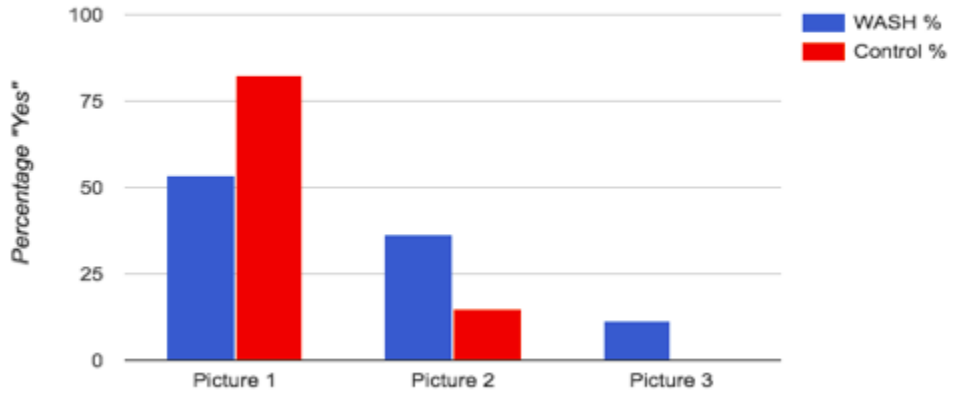


Figure 4: Types of Handwashing Stations amongst WASH and Control villages

village and how long the program has been implemented in it. For example, the village with the highest percentage of no handwashing stations was Busaale (75%). Busaale is the newest village in which WASH has been implemented, and the Water User Committee there has yet to be elected. Representatives from this village attended their first WUC Biannual training in July 2016. If we do not include Busaale, the average for WASH villages with no handwashing station is 45%. Moreover, no households in the control villages had tippy taps, the preferred method of handwashing stations. This could be due to a lack of training and education about the usefulness and low cost of tippy taps. The WASH program aims to emphasize the importance of handwashing stations and also teaches WUCs about the use of tippy taps.

The horizontal axis in Figure 5 shows questions that were asked in the survey such as "Do you have a handwashing station?." A handwashing station was considered to be any permanent fixture only used for hand washing. The vertical axis shows the average percentage of "Yes" replies to each question. The blue bars represent the weighted averages of "Yes" replies from the eight WASH villages. The control group in blue includes two villages, Namawajollo and Kyampisi, that did not have MCHI WASH programs. The responses are displayed in the graph as weighted averages.

Figure 5 demonstrates that WASH villages tended to exercise better latrine management based on the criteria surveyed. There was a significant difference between all WASH villages and control villages ($p < .05$) for "There is a handwashing station" and "The handwashing station is near the latrine" but not "The latrine is covered" ($p > .05$). Furthermore, there was no significant difference between all WASH villages and Kyampisi or Namawojjolo for having a latrine cover

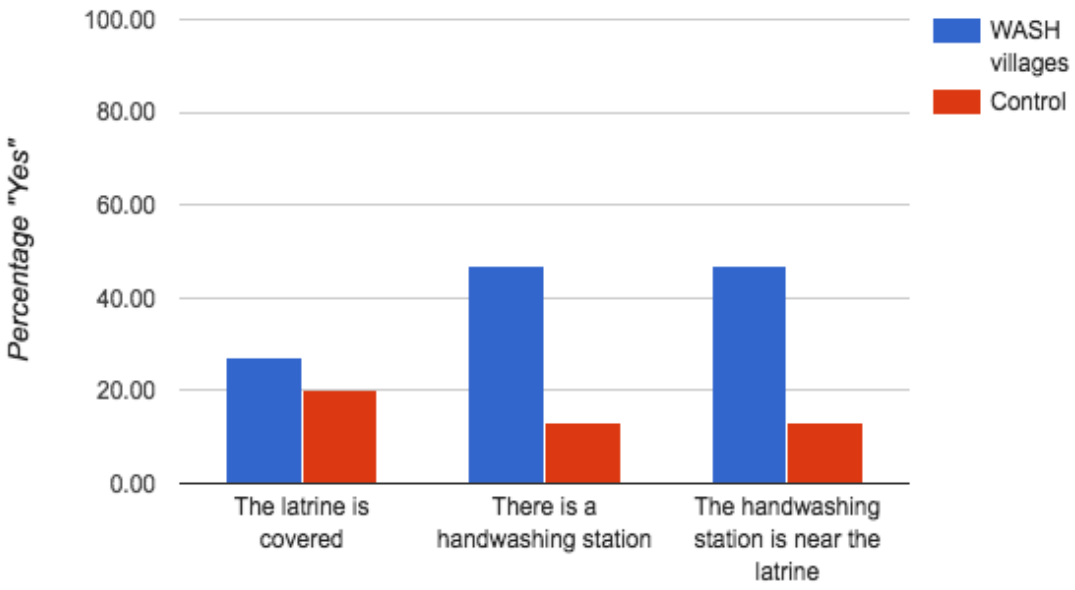


Figure 5: Latrine Management Criteria across WASH and Control villages

(p >.05). There was almost a significant difference between all WASH villages and Kyampisi (p=0.071) and a significant difference (p <.05) between all WASH villages and Namawojollo for whether a household had a handwashing station. There was a significant difference between all WASH villages and Kyampisi (p <.05) plus all WASH villages and Namawojjolo (p<.05) for whether households placed handwashing stations near the latrine.

Interestingly enough, when each WASH village was separately compared to each control village, not many significant results were found when comparing them to Kyampisi. For "Is your latrine covered?" Takkajjunge was the only village out of the eight total WASH villages with a significant comparison (p=0.0432). The question "Do you have a handwashing station" only yielded two significant comparisons: Katoogo (p=0.0209) and Waluga (p=0.0402). The last question, "Is the handwashing station near the latrine" had three significant comparisons: Katoogo (p=0.0012), Namatogonya (p=0.0089), and Buyuki (p=0.0381).

However, across all villages surveyed there was a low percentage of interviewees that used latrine covers and had permanent handwashing stations. For the WASH villages and control villages, 54% and 83% respectively did not have a permanent handwashing station. Similarly, not many interviewees used latrine

covers: only 27% of WASH villages and 20% of control villages used them.

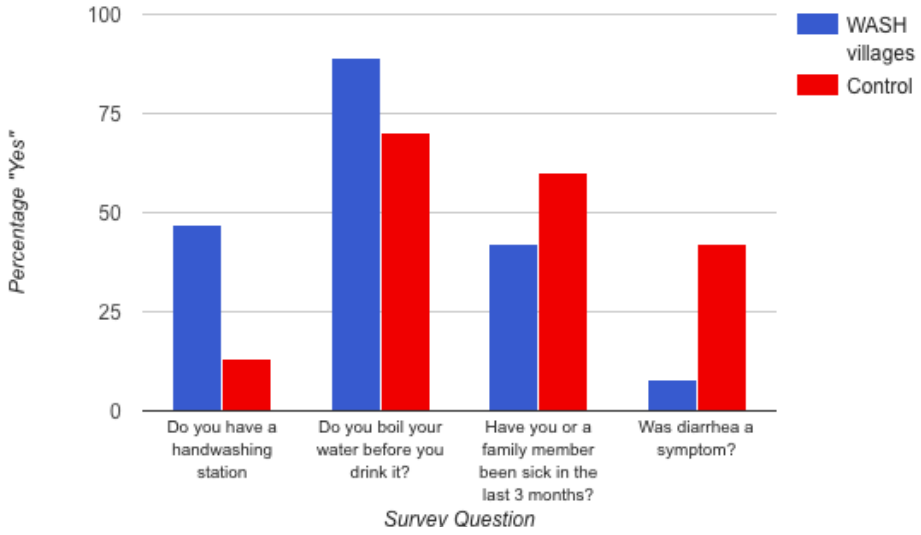


Figure 6: Handwashing Stations, Boiling water and Prevalence of Sickness across WASH and Control villages

The importance of latrine covers and handwashing stations as well as how to build them was not a topic that was emphasized during WASH village trainings last year. In addition to their significance, village members may not know how to build a latrine cover or permanent handwashing station like a tippy-tap with low cost, local materials that fit within their budgets. During the interviews, some village members also expressed concern about building tippy taps outside as jerry cans are sometimes stolen. These challenges may explain why so few interviewees had such fixtures in their households.

The horizontal axis in Figure 6 shows questions that were asked in the survey such as "Do you boil your water before you drink it." The vertical axis shows the average percentage of "Yes" replies to each question. The group in blue represents a weighted average of "Yes" replies from the eight WASH villages. The control group in blue includes two villages, Namawajollo and Kyampisi, that did not have MCHI WASH programs. The responses displayed are weighted averages.

A Pearson Correlation Coefficient (R) was calculated for both WASH villages and control villages. This test determined the

presence and type of a relationship between boiling water and sickness within families. Based on these two variables for WASH villages R= 0.3029. In the control villages the same relationship was analyzed with R= 0.913. Out of the WASH households surveyed that were sick or had a family member that was ill within three months, 8.45% had diarrhea as a symptom. For the control households, 54% said diarrhea was a symptom that accompanied a recent illness. For the relationship between handwashing station and sickness for all WASH villages, the R= 0.898. In the control villages the same relationship was analyzed with, the R= 0.429.

Although there is a positive relationship between boiling water and sickness for WASH villages, the results suggest the correlation was stronger for control villages. Additionally, diarrhea was a symptom for over half of the illness in the control villages. This information is important as diarrhea is considered a waterborne illness and thus may be more directly related to the practice of boiling drinking water as opposed to general sickness. For example many respondents said they or a family member had a "cough" or "flu" recently. Respondents used the term "flu" and "cough" to describe having a mild sickness or "cold." These illnesses may not have originated via water before transmission between people.

The lower correlation between the two variables for WASH villages suggests that other factors apart from the practice of boiling water were more influential in the sicknesses present in village members. However, it's important to note that other sanitation practices, like frequently washing water vessels and hand washing with soap, are also influential in the prevention or presence of illnesses.

Across all GlobeMed sponsored villages and control villages the majority of households interviewed boiled their water before drinking it--89% of WASH villages and 70% of control villages. Additionally, interviewees responded that they 'always' used soap and that they thought it was important to use soap (93% of WASH villages and 98% of control villages). These points were heavily emphasized by the WUCs and Mpoma during WASH trainings held throughout the year. In order to aid the discussion, last year's GROW team designed several posters with information about different water borne diseases like Schistosomiasis, Typhoid, and Cholera. Daily habits like hand washing and boiling water were discussed as simple but important tactics to prevent the contraction of such illnesses.

These changes in the educational materials provided as well as further discussion of prevention techniques may explain why there was a higher positive response rate for the above mentioned questions regarding GlobeMed sponsored villages. However, the control villages also had a high response rate, although slightly lower compared to the other villages.

Both variables for sickness and handwashing station also appeared to positively correlate, although we expected the relationship between the variables to be stronger for the control villages. There appears to be an inverse relationship between hand-washing stations and diarrhea as a symptom—as the presence of handwashing stations in households increases the prevalence of diarrhea decreases. This may suggest that handwashing stations help decrease sickness and diarrhea. However, as these households may carry out other favorable sanitation and hygiene practices, we cannot solely attribute the outcome to having a handwashing stations.

For the households that stated that they did have a handwashing station, most said that they were located near the latrine. Handwashing stations, ideally a tippy-tap, are vital in the prevention of illnesses as they promote hand washing immediately after using the latrine or even before meals. Thus, the sensitization of latrine management can result in lower diarrheal rates across villages.

Policy and Practical Considerations

Using indicators of water source issues such as clarity, taste, dryness, and inability to retrieve water, it is apparent that WASH interventions have had a positive impact on the communities in which they are enacted. At the same time, by looking at specific villages, we are able to see problems within both WASH intervention villages, and control villages. For example, in the consideration of Buyuki, under Figure 1, it is observed that several villagers are requesting a replacement of the pipes in the borehole to prevent rusting. This weakness of the WUC may be caused by a lack of proper training of WASH information, as was determined in the study of sixty different WUCS in Uganda (McParlton, 2016). It is therefore suggested that WUCs are trained further in the repair and management of boreholes, and connected to resources that will help the WUCs find professionals to repair the source.

Observing Figure 5, we can see that latrine sanitation practices need improvement even in WASH villages, although WASH villages still fare better than the control villages combined.

However it can be noted that no significant results were found when comparing the WASH villages to Kyampisi based on the latrine management criteria previously discussed. These results are counterintuitive because Kyampisi seemed less rural compared to Namawojjolo. It is therefore suggested that latrine sanitation practices are further emphasized in WASH trainings, especially the use of latrine covers. After speaking to members of the MCHI team, we realized that the lack of the use of latrine covers are more due to a lack of education than a lack of resources. Collaborating with the MCHI team, we have decided to make latrine sanitation practices, including latrine covers, more of a priority in training meetings.

Next, we explore Water User Committees in depth. As can be seen from Figure 8, Takkajjunge has a low rate of village members who generally pay the water user fee. In this case, it is important to communicate with the village members and the WUC members. In this specific case, many villagers responded that there was not yet an established water user fee, and that the committee only has two members. It is very important that these WUCs are well established and functioning. In this case, it is important that MCHI re-partners with this specific committee in order to re-establish a water user fee that can be used to repair the borehole in the future.

More generally, using the feedback from villagers, we have compiled a list of suggestions for improvements to water user committees. First, it is important that WUCs collect fees on a monthly basis, so that it is less of a financial burden on villagers. It was also suggested by a few villagers that an income based water user fee be enacted, as some villagers are able to contribute more than others. This is a suggestion that can be contemplated by the respective WUCs. Many water sources also lack a fence, which should be a priority use of the water user fees.

Another important finding in this study was the decrease in water retrieval time in WASH villages (Figure 1). This is important as it allows both women and children more time to attend to chores or to attend school. An interesting opportunity for a future WASH study, or improvement to this study, would be to observe the change in school attendance patterns amongst children before and after the installation of a water source and the sensitization of WASH in the community. Because children are often given the chore of retrieving water, it could be inferred that providing safe water nearby may have an effect on attendance, and thus would be interesting to study.

It may be proposed that WASH is not a truly sustainable program. For example, if the borehole undergoes a major functional problem, it is very possible to drain the entire Water User Committee collected fund. Since the fee collected is so small, the money in the fund can be depleted very quickly, leaving behind a broken water source and failed intervention. Moreover, it may be difficult to incentivize WUCs to collect this fee if they do not believe that their fund will be capable of sustaining the water source.

However, it is to be noted that our WASH program has created a matching model to both incentivize WUCs and create a sufficient fund for repairs. For the first three years, GlobeMed matches the amount of money collected by the WUC for a village nine times the amount raised by each village for the first year, three times, and one time for the following years. Thus, a larger fund is created within the first few years of WASH implementation to strengthen its resilience. Although an expensive repair may still diminish a village's fund, it is impossible to guarantee sustainability for such a project. Overall, it is suggested that a WASH intervention include a matching model that gradually lowers the WUC's dependency on the partner, but which also bolsters the repair fund.

Conclusion

The intent and the outcome of WASH interventions do not always match up. As explored in the literature review, there have been diverse interventions with varying success. Our study aimed to assess the effectiveness of MCHI and GlobeMed's WASH efforts.

Generally, villages with GlobeMed and MCHI implemented programs tended to exhibit better sanitation and hygiene practices. These villages had better water quality, such as improved clarity and taste, as well as lower incidences of water scarcity, overcrowdedness and shorter walking distances to reach the water source.

Furthermore, control villages had higher rates of sickness in the last three months than villagers that received WASH training. While not all training came from MCHI-- so the difference cannot entirely be attributed to their efforts-- it can be reasonably assumed that WASH training led to a decreased rate of illness. However, due to a broad definition of an illness, we may not have garnered an accurate representation of sickness within villages. Moreover, there was a behavior change observed in terms of sanitation and hygiene. Between the control and non-control villages, results implied that non-control villages had better latrine management, measured by the

possession of latrine covers, a handwashing station, and the handwashing station's proximity to the latrine. Additionally, an increased practice of sanitary efforts including boiling water and handwashing were also noted in control villages and correlated to decreased rates of diarrheal disease.

For a better understanding of WASH interventions' impact, potential villages should be surveyed before any intervention to obtain baseline data. This would complement control village surveys, providing a more accurate depiction of WASH related problems most villages face than the data from the two control villages could provide. As aforementioned, reported "illness" should be clearly defined in order to gather more accurate data. With more precise data, GlobeMed and MCHI will better understand the impact of our WASH interventions and potential improvements.

While the results emphasized the importance of GlobeMed and MCHI WASH intervention, the data also provides invaluable insight into how the initiatives can be improved. Strengthening the Water User Committees, the actors who in theory implement WASH themes, would substantially improve WASH efforts. Many villages do not know about their water user committee or do not pay their water user fee every month. Thus the importance of active participation of Water User Committees must be emphasized. With more people aware of their water user committees' importance and responsibilities in maintaining the municipal water source, more people are likely to consistently pay their water user fee, which would provide an ongoing reserve of funds, allowing the water sources to be sustained.

Furthermore, Water User Committees have the potential to improve each other. Our data showed that some water user committees are actually functioning quite well like in Waluga village, while others are not like in Buyuki village. Water User Committees could gather more frequently than twice a year or have small support networks of villages where they could discuss problems they had been facing and other villages could offer solutions that had worked in their respective villages. Lastly, the weaknesses found on outreaches in villagers' sanitation and hygiene practice, such as a lack of latrine covers and permanent handwashing stations near the latrines, should be emphasized in future MCHI conducted trainings.

In addition to strengthening water user committees, MCHI and GlobeMed must maximize its resources for the greatest possible impact. This MCHI has begun to engage the local government in its

initiatives. This has drawn more attention to the severity of WASH issues and could have an impact on influencing policy to improve WASH conditions.

Governments, local or national, can use WASH interventions to help build basic infrastructure more effectively. WASH uses a community based approach that works from a bottom up design and seeks to modify behavioral patterns. This design can be more effective than a top down approach where much information can be lost in transit from the government to the community. This is due to the fact that each community faces different challenges in water access, sanitation, and hygiene. WASH tailors the approach for each specific community to improve their general sanitation and hygiene, which contributes to an overall improved community health.

WASH related problems continue to be neglected by the international health community. While it is daunting to tackle an issue of this magnitude, it is possible, but not by one individual or government or organization. The most promising solutions arise when collaboration emerges between NGOs, governments, communities, and individuals.

References

Alexander, D., N. Wilson, R. Giesker, E. Bartlett, N. Rosseau, E. Amuzu, D. Ansonia, O. Olopade, and C. Olopade. 2015. "Drinking Water Infrastructure in the Ashanti Region of Ghana: Developing a Model for Sustainable Interventions by Non-Governmental Organizations." *Journal of Water Sanitation and Hygiene for Development*.

Boschi-Pinto, Cynthia, Lana Velebit, and Kenji Shibuya. 2008. "Estimating Child Mortality Due to Diarrhoea in Developing Countries." *World Health Organization*. N.p., n.d.

Chatterley, C. 2013. "Identifying pathways to well-managed school sanitation services in low-income countries." *ProQuest Dissertations & Theses Global*.

Meeks, R. C. 2012. "Essays on the economics of household water access in developing countries." *ProQuest Dissertations & Theses Global*.

Ostrom, Elinor. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. N.p.: n.d. Print.

Prüss-Üstün A, Bos R, Gore F, Bartram J. 2008. "Safer water, better health: costs, benefits and sustainability of interventions to protect and promote health." *World Health Organization, Geneva*.

Weissman, R. 2003. "Grotesque inequality: Corporate globalization and the global gap between rich and poor." *Multinational Monitor*.

Appendix

Appendix A: Village Statistics

Village (Water Source)	Population: 2002 census or (Estimate population served by Water Source)	Years since WASH implemented	Population Surveyed
Namawajollo	900	0	20
Kyampisi	250	0	20
Busaale	330	3 months	20
Lukalu 1 (Bernado)	200	2	20
Buyuki(Kiwana)	670	2	20
Waluga (Nabirye)	755	2	24
Takkajjunge	872	1	23
Namatagonya	500	2	20
Lukalu 2	150	6 months	20
Katoogo Health Center	675	1	22
Lukojjo (Johnson Nkosi)	Not surveyed	3	0
Lwanyonyl	Not surveyed	1	0
Lutengo	Not surveyed (720)	2	0
Katoogo (St. Ponsion)	Not surveyed	1	0

The first two rows contain information about the villages Namawojollo and Kyampisi that did not have WASH programs and served as our control villages in the study. We surveyed a sample of all WASH villages except the last four mentioned in the table: Lukojjo, Lqanyonyl Lutengo, Katoogo (St. Ponsion) due to time constraints.

Appendix B: Nama Sub-County Map (Uganda)

Appendix C: Consent Form

Mpoma Community HIV/AIDS Initiative
in partnership with Globemed at UCLA

WASH Program Assessment Date:

Introduction and Consent:

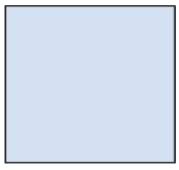
Hello. My name is _____. I am working with Mpoma Community in partnership with Globemed at UCLA. Gregory Pierce, Ph.D., a professor at the UCLA Luskin School of Public Affairs, is the Principal Investigator. We are conducting a survey about the water source located in your village, your current sanitation practices, and the quality of your latrine. The information we collect will help us develop projects that address your needs. It will also be used in a research report. The questions usually take about 15-20 minutes. We will also mark the coordinate points of your household using a Global Position Systems handheld device. The GPS coordinate points and all of the answers you give will be anonymous and confidential. Participation is voluntary. You don't have to take the survey, but we hope you will agree to answer the questions because your views can help us determine how to improve your community's health. You can refuse to answer any question or stop the interview at any time. Refusal to participate will not result in a penalty. If you have any questions or concerns about the research you may contact: GlobeMed at UCLA at ucla@globemed.org. For any questions about your rights, please contact:

OHRPP at +1 (310) 8257122
UCLA Office of the Human Research Protection Program
11000 Kinross Avenue, Suite 211, Box 951694
Los Angeles, CA 90095

Uganda National Council for Science and Technology:
P.O. Box 6884 Kampala
Tel: +256 414 705 500
Fax: +256 414 234 579
Email: info@uncst.go.ug

Do you have any questions? May I begin the interview now?

_____
Signature of Interviewee



Thumbprint

Appendix D: Survey

Location (Village): Date:

Sex: M F Age: _____

Part 1: Water Source

1. What's the name of your closest water source?
    a. Is the water source more than 1 km Yes No
    b. How many minutes does it take you to walk to the source?
    c. Are there problems with this water source? Yes No
        i. If yes, what are the problems with the source (no fence, long pumping time, crowded, broken)?

2. For your water source:
        i. Do you think that the water is clear?
        ii. Do you think that the water tastes ok?
    a. Are too many people using it? Yes No
    b. Has the source ever been dry? Yes No
    c. Have you ever been unable to retrieve water? Yes No
        i. Why?

3. Do you know about your water user committee? Yes No
    a. Do you generally pay your water user fee? Yes No
        i. If no, why not?
        ii. In the last 6 months, how many times have you paid your water user fee? _____
    b. Do you think the water user fee is: Too Low Just Right Too High
    c. Do you have any complaints with the water user committee?

    d. Do you have any suggestions for changes to the water user committee?

4. How many sources of water are within the village? _____
    a. Do all of the water sources work? Yes No
        i. If no, what are the problems with the source?

5. Do you have any more comments?

Part 2: Hygiene and Sanitation Condition

1. Family Information
    a. Adults_____ Children_____ Girls_____ Boys_____

2. Is there a fence around your water source? Yes No
    a. In the last 6 months, Are there any problems with animals near the water source (waste, animals drinking, etc.)? Yes No

3. Do you boil your water before you drink it? Yes No
    a. How many times a month do you clean your jerry cans? _____
    b. How many times a month do you clean the containers you store your drinking water in?_____
    c. How many times a month do you clean the cup you use to drink water?_____
    d. How do you clean these items?_____

4. Is your latrine more than 10 m from your home? Yes No
    a. Is it more than 30 m from the water source? Yes No
    b. Is your latrine covered? Yes No

5. How do you clean your hands?
    a. Do you have a handwashing station? Yes No
    b. If no, where do you clean your hands regularly? _____
    c. Is the hand washing station/ other method used to clean hands near the latrines? Yes No
    d. Do you think it is important to use soap? Yes No
    e. How often do you use soap? Never Sometimes Always

6. Have you or a family member been sick in the last 3 months? Yes No
    a. If yes, do you know the illness? Yes No
        i. If, yes: _____
    b. Was diarrhea a symptom? Yes No

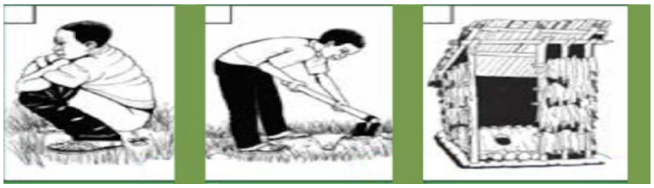
7. Have you had training on water/sanitation? Yes No
    a. If yes, what did you learn?

    b. Where did this training come from? Gov't WUC Health Promoters NGOs

Mpoma Community HIV/AIDS Initiative
in partnership with Globemed at UCLA

Part 3: Assess with the householders their current behaviors and choose the picture that is most applicable to their current practice.

Disposal of Feces



Latrine cover? Yes No
Hand washing station nearby? Yes No