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Approval Sheet

Understanding the Perceptions and Uptake of Water Filters of Three Rural Villages in Northern Malawi

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By

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B.S. Vanguard University of Southern California, 2016

Emory University, 2018

Thesis Committee Chair: Andes, Karen, PhD

An abstract of a thesis submitted to the faculty
of the Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree
of Master of Public Health in Global Health
2018

Abstract

Understanding the Perceptions and Uptake of Water Filters of Three Rural Villages in Northern Malawi

By Levi Moellering

Background: Malawi is considered a water stressed country and with an ever-rising population growth a greater burden is placed on those living not only in urban areas but also the rural areas to gain access to clean water. Merely 65 percent of Malawi's population has access to improved water and sanitation.

Methods: This project was focused on the evaluation of the water filters, through a mixed methods approach. A survey was used to assess the uptake, functionality, and demonstration of the water filters, while interviews and focus groups were used to get at the understandings and perceptions of water filters. The purpose of this impact evaluation was to inform the specific NGO's responsible for distributing filters on the perceptions and beliefs of the recipients in rural villages on the water filters.

Results: The key findings came directly from the data as it was evident that participants held preconceived beliefs towards water filters, specifically the belief that "clear" water equates to "safe" water, and as such their illnesses could not be coming from the water. Major themes included education, training and distribution, along with filter utilization. Water quality was another major theme with regards to access, temperature of water as it affects the uptake of the water filters, as well as past history with water purification techniques. The final theme that was evident was the relationship with NGOs.

Conclusions: The declared beliefs regarding water filters varied from each village, mostly due to factors such as different filters, environment, and culture. Each village expressed varied concerns about certain topics, however the relationship with NGO's was a common concern. One key recommendation that can be made from this research is for NGO's and/or organizations to change their mindset when implementing intervention strategies in foreign countries. Rather than assuming what is needed and merely providing supplies or tools, it is deemed necessary to instead, take the time to learn the cultures and lifestyle of the community beforehand, and of equal importance, to provide thorough training with accessible instructions.

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Acknowledgments

I would like to thank my committee chair, Karen Andes, PhD for her insightful feedback, expertise, and mentorship throughout the process of conducting this research, and Juan Leon. PhD for helping me with the leg work to get forms and grants finalized before arriving in Africa. I would also like to thank CCAP of Malawi for allowing me to conduct the research as well as the three villages of Malawi, Embombeni, Luhomero, and Karonga, for allowing me to live amongst them and conduct research. Additionally, I would like to thank my translator and team at the SMART Center in Mzuzu, specifically Reiner, Daniel, Alien and Jim who all played an important role while in Malawi.

I am also especially grateful and blessed for my girlfriend, Morgan for being extremely patient, loving, and helpful during this process. I would also like to thank my loving parents Bill and Kim for all that they have done for me over the years and never ceasing to encourage me during this process as well.

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Introduction:

Malawi is considered a water stressed country and with an ever-rising population growth, greater burden is placed on those living not only in urban areas but also the rural areas to gain access to clean water. Merely 65 percent of Malawi's population has access to improved water and sanitation. This percentage value for Malawi was well below the target goal set by the Millennium Development Goals for water and sanitation. Furthermore, several enhancements need to be done to reach the targets for goal six of the Sustainable Development Goals: clean water and sanitation. Attempting to reach some of the targets (i.e. universal and equitable access to safe and affordable drinking water for all; improving water quality by reducing pollution; eliminating dumping and minimizing release of hazardous chemicals and materials worldwide) seems highly formidable especially considering that only 12 years remain on the set goal date. Thus, more is needed to achieve not only these goals but to see an improvement overall in people's health (SDGs).

Populations without access to clean water have an increased risk of developing serious diseases including cholera, giardia, and legionella. The estimated rural population in Malawi is approximately 83 percent and every rural inhabitant faces the rising burden of these diseases. These diarrheal diseases rank second highest for cause of death in Malawi, right behind HIV/AIDS, still the leading killer. Over 4,500 children die each year in Malawi to diarrhea, and a combined death toll to over 6,000 annually (Diarrheal Diseases in Malawi). In addition to these deaths, poor sanitation and hygiene also affect the economy of Malawi, costing Malawi nearly 8.8 billion Malawi Kwacha each year, which equates to 57 million dollars (US$) a year. A major economic consequence of disease in children is the need for medical, clinic visits, hospitalization, and loss of work by the parents. Notwithstanding, there is no specific economic

information concerning costs associated with the mortality and morbidity relative to diarrheal disease in Malawi. The country of Malawi is just one developing country in Africa that is facing these problems, therefore, there is an urgent need for inexpensive point-of-use methods to purify drinking water in developing countries as a way to reduce the incidence of illnesses caused by waterborne pathogens (Totaro, 2016 and Sittoni, 2012). If more point-of-use methods to purify drinking water were readily available in these countries, mortality to diarrheal diseases would decrease and simultaneously relieve the financial burden for many of these countries.

In Malawi, a three-pronged water filter distribution program was conducted in 2015 and 2016 whereby Sawyer Water filters were distributed by an NGO, Love a Village, with the goal to improve water safety and reduce disease. Additionally, the Development Department of Malawi distributed Tulip Filters in Northern Malawi; while another Non-Government Organization, Barefoot Mile Foundation, distributed Halo Source filters in the central region of Malawi. These filters were introduced to lower the incidence of cholera and diarrheal diseases. There is currently a gap in the communication between these local and global distributers of point-of-use water filters and the villages that are the recipients of them.

An impact evaluation was used to gauge program implementation and understand the utilization of point-of-use filters in rural villages of Malawi. Impact evaluations do not focus on the program development or strategies, but instead focus on long term, sustained changes as a result of the program activities. In order to evaluate the impact of a program several components are analyzed. First, the changes in the program participants' behaviors which are attributable to the program needs to be assessed. Additionally, an evaluation of this kind examines the impact in longitudinal studies with comparison groups. An impact study can also be utilized to influence

policy and future developments. Together these components help determine if a program is being implemented effectively with intent to affect long term interventions.

Problem Statement:

Many water filters have been distributed in rural villages of Malawi, however the expected reduction in the incidence of diarrheal cases has not occurred. The project aims to illuminate the effectiveness of filtered water in sanitation-association diseases, and better understand why people do or do not use filters from various filter-distribution programs to reduce disease at the community level.

Purpose Statement:

The purpose of this Masters' thesis is to assess challenges, successes and best practices in the implementation of water filter distribution programs in three rural villages of Northern Malawi through the use of a mixed methodology approach.

Research Question:

The primary research question for this project was, what are the perceptions of water filters among rural residents in Malawi? The secondary question was to understand the utilization of water filters and the functionality of them in a rural setting. To answer these questions certain objectives were designed to help with this evaluation process.

Objectives:

1. To assess the water filters and the capacity at which they are functioning.
2. Discern how people in the villages of Karonga, Luhomero, and Embombeni perceived their water filters and what stigmas may be present.

3. Determine the extent of follow-up done by the local and global organizations
4. Document the challenges and successes of each filter distribution.

Significance statement:

Through an impact evaluation of three water filters that were distributed in Northern Malawi, other local and global point-of-use water filter distributors will be able to understand how to implement water filters that will be used in developing countries. This will be done by understanding the distribution process through the emic perspective of the recipients. This evaluation will also provide a springboard for more comprehensive impact evaluations done in other rural villages not just Malawi, but Africa. With the knowledge gained from this project, the Non-Governmental Organization's Love a Village, and Barefoot Mile Foundation, along with the local organization, The Development Department of Malawi will be able to better understand the perceptions of water filters among the target population which will help future distributions. This collection of information can lead to a longer lasting impact on the communities, help the local NGOs understand and better distribute filters, and understand the needs of the community. Through this study, partner organizations will gain a greater knowledge on how the community perceives and uses the filter, which in turn will lead to improved distribution and future implementations. This in turn will allow for the knowledge to be spread to other implementing partners in Malawi, which will help lower and reduce the number of deaths to diarrheal disease in Malawi.

Definitions of Terms

Non-government organization (NGO) is any non-profit, voluntary citizens' group which is organized on a local, national or international level.

In-depth interview (IDI) is a qualitative research technique which is used to conduct intensive individual interviews that focuses on the narrative and personal story of the participant.

Key Informant interview (KII) is a qualitative research technique which is used to conduct in-depth interviews with people who know what is going on in the community, such as village heads, chiefs, and elders.

Focus Group (FG) is another type of qualitative research technique that brings together a demographically diverse group of people to participate in a guided discussion about a particular topic.

Borehole is a deep, narrow hole made in the ground to locate water.

Grounded Theory is a systematic methodology involving the construction of theory through methodic gathering and analysis of data.

In vivo coding is the practice of assigning a label to a section of data such as an interview transcript, using a word or short phrase taken from that section.

Inductive coding relies on inductive research involving the conversation of raw, qualitative data, this then allows the theory to emerge from the content of the raw data instead of coming from pre-conceived hypotheses.

Literature Review

Introduction

The United Nations (UN) set multiple target goals in the Sustainable Development Goals (SDGs) that are related to water and water quality, some of which include universal and equitable access to safe and affordable drinking water for all, a substantial increase in water-use efficiency across all sectors, ensure sustainable withdrawals and supply of freshwater to address water scarcity, and substantially reduce the number of people suffering from water scarcity by 2030 (UN, 2015). Everyone in the world should have access to safe drinking water that is free from bacteria, viruses, and parasites while meeting the guidelines for safe consumable drinking water. This is not the case though, especially for developing countries, with many areas having inadequate sanitation and fecal contamination of water sources that cause the large percentage of people to not have access to microbiologically safe drinking water, which then causes them to suffer from diarrheal diseases (WHO, 2002). Poor water quality continues to affect over 783 million people worldwide, comprising over 84 percent of those living in rural areas who lack access to safe water, and with over 75 percent of the population in Africa reliant on groundwater for drinking (WHO 2012, UNEP 2011). Diarrheal diseases are responsible for over 2.5 million deaths annually, predominantly affecting children younger than five, especially in the areas that have no access to potable water supply and sanitation (Keusch GT et al., 2006). Many of the people in developing countries that live in rural communities are having to travel far distances to collect drinking water and deliver it back to their house in a myriad type of containers. This transportation and carrying of water leads to a higher microbiological contamination of the water, which can occur from either the collection point to the household level due to unhygienic practices that cause water to be contaminated (Sobsey, 2002).

To better improve and protect the microbiological quality and to reduce the potential health risk of water to these households in rural, developing countries, intervention strategies are needed that are easy to use, effective, affordable, functional, sustainable and culturally appropriate (CDC, 2001; Sobsey, 2002). Many such interventions have been developed to do a wide variety of things, such as providing clean water collection and storage containers as well as allocating physical and chemical treatment methods for water purification. The succeeding sections will discuss the general issues of safe water, filtration as an approach to purifying water, and then it will tie in to the aim of this project which was to assess the uptake but also understand the perceptions behind membrane filters in rural villages of Malawi.

Water Quality

Before understanding and addressing all the issues pertinent to waterborne diseases, water quality first needs to be discussed and acknowledged to truly understand those diseases. Water quality refers to the chemical, physical, and biological characteristics of water. The quality of water is affected by both natural and human influences, such as climate features, animal feces, natural disasters, and pollution. The majority of water supplies in developing countries, specifically the study villages of this project in Malawi, are devoid of water purification treatments. Many of these water supplies are unprotected and susceptible to external contamination from surface runoff, windblown debris, human and animal fecal pollution, and unsanitary collection methods (Moyo, 2004). One such water source that is very common in Africa are boreholes, which are typically a hydraulic structure that enables the withdrawal of water from an aquifer. Even though a borehole may be a protected source, it cannot be presumed the water is completely clean and pure. The source for boreholes is ground water, which is the water found under the surface of the earth and thus is the primary source of springs, wells,

streams and boreholes. The quality of the water at each of these sources depends on the geological conditions of the soil through which the ground water flows (Ukpong and Okon, 2013). A borehole is protected from sanitation issues such as fecal matter, whereas a river or stream on the other hand is not as protected from outside influences.

Clean Water Access in Rural African Villages:

As evidenced, many rural areas especially those in Africa, are at the greatest risk to water borne diseases for the lack of clean water that is available to them. One study that assessed drinking water quality in rural villages of South Africa examined 39 communities, with ground water being the main supply of water. The study revealed 71 percent of those supplies were non-functional which left the people having to travel and use untreated water supplies in the Eastern Cape villages (Mackintosh 2003). In contrast, in the Western Cape villages, all the groundwater schemes were functional. The conclusions of the paper are very important in regards to any research done with water quality in rural villages, specifically Africa as it can be relatable to these rural villages of both the Eastern and Western Cape villages. The Mackintosh research confirmed that the drinking water quality is very poor in rural communities, and also substantiated the belief that in both regions the drinking water quality management is inadequate or even non-existent. Future recommendations highlighted the need for a community accepted drinking water quality management as well as an equally accepted way to purify water. Another issue addressed within the research validated that the most important reason for failure of groundwater supply quality is the issue of boreholes and/or pumps breaking down. In many communities, specifically rural villages, if a pump breaks down it will be months or possibly years until it is fixed or a new one is replaced by an NGO or other organization. They concluded

that training locals on uptake of boreholes is crucial as well as the construction of additional boreholes in rural villages.

One research briefing paper presented at the 39th WEDC International Conference (Maltha 2016) examined availability and sustainable management of water and sanitation in the country of Tanzania. Over half the population of Tanzania live in rural areas and do not have access to improved water sources (WHO and UNICEF 2015). Often times people who do not have an improved water source often live in small communities where gravity systems or machine-drilled boreholes are not possible or likely too expensive. The authors of this research paper suggest that one way to reach the need is to improve water supply via low cost technologies such as Rope or treadle pumps that can be produced in local private sectors. The Rope pump can be used on hand-dug or hand-drilled wells down to 35 meters, and the actual pump costs less to operate and maintain than previous technologies. The article also presents results of a study on the business aspect for local entrepreneurs through the use of open interviews with employees of SHIP SMART Centre and 12 other local entrepreneurs in Njombe and Morogoro regions. The authors found that when a local family purchased a Rope pump often many households used it and benefitted. Some of these pumps were partially subsidized by NGO and other organizations with 1500 units installed between the years 2011 and 2015. Approximately 60-70 percent of the installed Rope pumps were installed for private use with the claim that 80 percent were still functional at the time of the report (Maltha 2016). The authors conclude their work by suggesting that incorporating a maintenance insurance program, such as Pumps for Life, promoted by the NGO MSABI, and could prove beneficial to enhance the sustainability of the Rope pump for communal supply.

Similarly, the country of Malawi has endured water problems over the years, mostly regarding access to safe drinking water, and this challenge is especially prominent in the rural villages of Malawi. The University of Malawi did an assessment of the groundwater quality from shallow wells in 9 rural villages, each being tested for biological, chemical, and physical contaminants parameters. Testing of the samples were performed over the course of one year in order to collect samples during both the dry and wet seasons of Malawi. The findings indicated that each well showed high consistency of both total and fecal coliforms, however, the wet season data displayed a higher count compared to the dry season. All samples that were tested during the wet season did not meet the Malawi Ministry of Water Development standards for drinking water of 50 total coliforms per 100ml; and only 22 percent of the samples collected during the dry season met those same guidelines. The levels of contamination between the wet and dry season are not statistically significant for total coliforms with a p-value of 0.13 (Mkandawire 2008). This study done by Dr. Mkandawire in 2008 was again replicated in 2013 at Mzuzu University by assessing similar shallow well water but in high density areas in the city of Mzuzu.

Shallow wells remain the most prominent source for drinking water in Malawi. This is a problem though because many of these wells are not covered, leading to an increase in contamination which can also be related to the lack of proper sanitation in Malawi. This study that was carried out by Mzuzu University and the Water and Sanitation Center of Excellence, started with mapping out the water sources through Arc-view GIS, and then later conducted a questionnaire survey that inquired about the characteristics of drinking water sources. Water samples were also collected and tested for microbial and chemical parameters; results showed 96.3 percent of the shallow wells had readings between 129 to 920 colony forming count per

100ml of fecal coliform, which is extremely high (Msilimba 2013). They also noted that 100 percent of the wells are at high risk to pollution due to the proximity of the wells to the sanitary facilities. The concluding remarks from Dr. Msilimba and Dr. Wanda from Mzuzu University said that the shallow well water in this particular area is unsuitable for direct human consumption.

Water Purification and Treatment Technologies

Water treatment is the process of making water quality acceptable for drinking, industrial use, irrigation, river flow maintenance and other uses. Global inventions in the area of water treatment promise reduced investment and operational costs for improved water systems (WIPO 2012). There are many different water treatment technologies from both physical and chemical treatment processes that are currently being used globally. Malawians, however, are currently utilizing a combination of physical and chemical treatments, now that they have been given water filters, while in the past it was typically chlorine or no treatment method.

Many studies have been done to test the effectiveness on the reduction of microbial level in water, but chemical water treatment has appeared to be the most effective method when trying to destroy dissolved solids and microorganisms in drinking water (Sobsey, 2002). Chlorine solutions inactivate greater than 99.99 percent of eccentric bacteria and viruses. Other benefits of using chlorine in large amounts include that a portion of it will remain free in the water, and that free chlorine effectively inactivates waterborne microbes (FAO, 2011).

Table 1: Physical Methods for Water Treatment at the Household Level. Adapted from Sobsey (2002).

Method	Availability and Practicality	Technical Difficulty	Cost	Microbial Efficacy
Boiling or Heating with Fuel	Varies	Low-Moderate	Varies	High
Exposure to Sunlight	High	Low-Moderate	Low	Moderate
UV Irradiation (Lamps)	Varies	Low-Moderate	Moderate-High	High
Plain Sedimentation	High	Low	Low	Low
Filtration	Varies	Low-Moderate	Varies	Varies
Aeration	Moderate	Low	Low	Low

This study focused on the use of physical methods for water purification, with emphasis on water filters. This is mainly due to the many different types of water filters, but also how they are kept and clean which ultimately affects the efficacy of the removal of microbes. Filtration is a method that has been used for thousands of years and is the process of removing particles and some microbes from the water. Some point-of-use water filtration devices include that of cloth, fiber, ceramic, carbon, and membrane filters (WHO, 2011). Membrane filtration, which were the types of filters examined in this study, is generally used to remove suspended and dissolved

solids such as salt and microorganisms, however it is expensive and typically used to a greater extent in developed countries.

Summary of current problem and study relevance

Contaminated drinking water, along with inadequate supplies of water for personal hygiene are the main contributors to an estimated four billion cases of diarrhea each year, causing 2.5 million deaths (Kosek 2003). Among children less than five years of age in developing countries, diarrheal disease accounts for 21 percentof all deaths (Parashar 2003). This issue is still being faced in many developing countries, specifically those people living in rural areas with little or no access to safe drinking water. Prior research has addressed issues of cultural stigmas, various intervention strategies, different countries, and numerous types of communities. However, some limitations to this literature review found that the majority of research on water filters is focused on ceramic water filters with very little on other filter types, such as gravity fed membrane filters. My impact evaluation research project helps fill that void and complement the existing literature on poor water quality in rural villages through the assessment of three membrane filters in three rural villages of Northern Malawi. This research will add to the literature on membrane filters, as well as address the qualitative aspect, something that much of the pre-existing literature lacks. Another concern addressed in this research project is the short-term versus long-term approach to water quality remedies. Specifically, one goal is to concentrate on the village dwellers' attitudes and views on being the target population for NGOs and other organizations to do short-term studies or interventions with little or no follow up. Research has shown that filter interventions in remote areas can be detrimental over the long haul as follow up studies and support is minimal or non-existent. The findings in my study will supplement the existing literature by evaluating different filters and demonstrating the usefulness of follow up studies.

Methods Chapter

1. Introduction

This project was focused on the evaluation of the water filters, through a mixed methods approach. A survey was used to assess the uptake, functionality, and demonstration of the water filters, while interviews and focus groups were used to get at the understandings and perceptions of water filters. The purpose of this impact evaluation was to inform the specific NGO's distributing filters in the region on the perceptions and beliefs that the population in recipient rural villages has regarding the water filters that were distributed.

2. Population and sample

This study focused on three different water filters that were distributed in three different villages in Northern Malawi. The NGO's Love a Village, Barefoot Mile Foundation and The Church of Central African Presbyterian (CCAP) have been actively involved in specific villages for a few years now. These organizations distributed filters at the household level; the Tulip Filter was distributed by the CCAP in Karonga, Sawyer filter by Love a Village in Luhomero, and the HaloSource filter was given out by The Barefoot Mile Foundation in Embombeni. These villages were chosen for the evaluation because of how recently the filters were distributed, since no assessment has yet been done on these filters. The study population consisted of households in the three rural villages of Mzuzu that received the different water filters in 2015, representing a total of approximately 450 water filters dispersed. (Figure 1)

The research team assessed three areas that had received water filters, the village of Embombeni and Luhomero, as well as the district of Karonga. Each village had received

different water filters from different organizations; each filter was designed to be used for different purposes. The filters given out in Embombeni and Luhomero were distributed for free or at a subsidized cost. The filters distributed in Karonga were done to fight against a cholera outbreak and were freely distributed for multiple households to share the water filter. The Sawyer Filter is a membrane filter and was distributed by the NGO Love a Village, in the village of Luhomero. The Sawyer Filter uses two buckets, with the filter attached to the elevated bucket and allows for the dirty water to be poured into the top bucket, travel through the filter and then drip down into the second bucket being to produce clean, drinkable water. In Embombeni, the NGO the Barefoot Mile distributed the Halo Source filter, a gravity fed membrane filter, which is suited for a countertop. The top of the filter can be opened to allow water to be poured in, the water will then go through the membrane and sit at the bottom of the water filter. This filter is designed with a spigot to allow for clean and safe access to the purified water. The final filter that was assessed was the Tulip Siphon Water filter, which is another membrane filter that is placed into a bucket. This filter requires the use of two buckets, one to filter the dirty water, then another one to collect the purified water. This Tulip filter was distributed by the Development Department of Malawi in the district of Karonga. Prior to starting the research in each village, the village chief and elders were met with to ask for the permission to begin the surveys, interviews and focus groups. The chiefs and elders were the first participants as they wanted to see what types of questions their people would be asked.

Karonga was the village furthest north, which consisted of predominately fishing villages since it was only 8-10 miles away from Lake Malawi. This village was a challenge to travel to, after a 6 hour drive on the tarmac, and another 80 miles on the dirt road. The houses

within the village were clustered for the most part, which is why it was intended for them to share the Tulip water filter between families. Not all were clustered though, some of the houses were spread out over 10 miles from each other.

Embombeni and Luhomero were approximately 20 miles away from each other, with a Mountain separating them. It remained a challenge travelling to each of these villages, even though they were closer to Mzuzu, as they were located deep in the bush through rough and rocky terrain. The households in both villages were scattered across a 60 mile range, making it a challenge to reach those that had received the HaloSource and Sawyer filters. With only 20 miles separating the villages of Embombeni and Luhomero, trade was common between the two villages. They were both located too far from the main town to do any selling or trading, this distance to the town also played in role in their health.

The water sources varied for each village, with some areas having to travel over 2 miles to retrieve water. Karonga had the most difficult time getting to water sources, clean water at least. There was an outbreak of cholera in 2016, which caused horrible drinking water conditions, and left families with no option but to leave their homes if they wanted any chance of getting better and getting cholera out of their village. They had very few boreholes within the village, causing them to leave their village to travel to the lake to obtain drinking water. The other two villages, Embombeni and Luhomero both had a better supply for drinking water. There were many sources of streams, ponds, boreholes and even some public taps. These still are not enough as they often dry out throughout the day, or end up breaking. The lack of training within these rural villages have caused many issues pertaining to these water sources, as there is no knowledge on how to fix broken boreholes or dig new ones. This causes multiple issues with regards to clean water and a healthy lifestyle.

3. Research design

An impact evaluation was used to gauge program implementation and understand the utilization of point-of-use filters in rural villages of Malawi. Impact evaluations do not focus on the program development or strategies, but instead focus on long term, sustained changes as a result of the program activities. In order to evaluate the impact of a program several components are analyzed. First, the changes in the program participants' behaviors which are attributable to the program need to be assessed.

An impact evaluation was undertaken as the study design to inform decisions about whether to continue, discontinue, replicate, or scale up the intervention of point-of-use filter distribution. The study is intended to produce findings about "what works" and also provide information on potential pathways to make the intervention work for different groups in different settings. One major focus for this study is to glean the impacts that have been produced from the point-of-use filter intervention. This study is the first evaluation since the original distribution of filters and thus will provide necessary information of the program's success and future. More information about the efficacy to reduce disease from point-of-use filter interventions is desired by many organizations wishing to replicate similar programs in different areas.

4. Procedures

The objective of this project was to evaluate the perceptions and possible barriers that are present within the 450 families that had received the water filters in three rural villages in northern Malawi utilizing the following aims:

<u>Aims</u>

1. To assess the water filters and the capacity at which they are functioning.
2. Discern how people in the villages of Karonga, Luhomero, and Embombeni perceived their water filters and what stigmas may be present.
3. Determine the extent of follow-up done by the local and global organizations
4. Document the challenges and successes of each filter distribution.

Aim 1 Methods: Surveys were administered by trained enumerators who collected the data and information by using the *mWater* app, currently in use by CCAP. The enumerator was equipped with a smart phone with access to the *mWater* app which showed the questions to ask with space to fill in the responses. The information that was gathered from the surveys provided the background topics for the interviews and focus group discussion. The survey covered topics such as how long they have had the filter, what was taught to them when they had received it, knowledge on replacement parts, if the filter is still working, if neighbors were using the filter, and observations on the filter and water storage to verify if the filter is being used.

Aim 2 Methods: To describe community views of each filter, the research team conducted one focus group discussions with individuals using each type of filter. Each focus group was recorded for data collection purposes and was then transcribed and translated into English. Key informant interviews as well as in-depth interviews included seven interviews from local chiefs and gatekeepers within the community.

The interviews and focus groups provided a large amount of qualitative data that has allowed the team to better understand the perceived notions of water filters. Once the interview with the chief was completed, the research team walked through the village seeking out those that had received the water filters. Two of the villages had a list of recipients of the

water filters, which facilitated locating the families, for the other village recruitment was harder, yet the families were found by asking person to person.

5. Instruments

The survey guide was a 30-question survey that posed questions to the participant in order to determine uptake and utilization of the filters. These questions focused on water collection, distance to water source, type of water source, level of education of the participant, use of filter, and how often the filter was used. The interview guide covered similar topics that the survey covered, however this guide allowed for a deeper understanding of issues that the participants face (see Appendix 1). One example was to understand if their water is clean or dirty and what that means to them. Other questions including the distance they walk, and how far they would walk to get water. Questions regarding the safety of the person who fetches water, if going at a certain time of day is preferred. The interview guide and focus group guide also focused in on the knowledge of illness and what causes illness (see Appendix 3). As well as the discussion of their thoughts of having a water filter, the trainings that were with it, or lack thereof. These guides also focused on the relations between the participant and the donor who did the distribution.

The instruments which were used to collect the survey data needed to have the *mWater* app on each device so a cell phone and a tablet were used. The survey was created and then uploaded to the app so that the questions could be asked remotely by the research team answers were recorded into the app. The questions were open ended so that the enumerator would not lead the participant (survey instrument can be found in Appendix 2). The interviews and focus groups

were done by myself and the translator, with each interview and focus group being audio recorded to review and translate at a later time.

One hundred and forty families were selected to complete the survey to reach the 95 percent confidence level with an anticipated response rate of 80 percent. Of the selected families, 125 families were reached which lead to a response rate of 90 percent. Recruitment was voluntary, and each different filter yielded a focus group that was led by a trained moderator. Recruitment varied for each village, with some villages having documentation of participants who had received filters, and then those families were chosen, other village recruitment was done through a gatekeeper such as the village head. All of the focus groups and interviews were led by a trained moderator.

6. Plans for data analysis

A comprehensive analysis was performed on the amassed transcripts from this study by examining the codes, key themes and concepts that were linked to the grounded theory approach. This approach provided insight and understanding into the behaviors and perceptions of the participants through rigorous scientific approach.

A basic description of the evaluation begins the data analysis section. This focuses on an overview of how the data was collected, the software to help analyze the interviews and the methods used to go over the qualitative data. The in-depth interviews, key informant interviews and focus groups were all uploaded into MaxQDA. From there, each transcript was thoroughly looked over and read to begin the first draft of putting in memos in the data. This included going over the text and writing key information about what was being discussed. These memos then helped the process of coding the data to further understand the deeper meaning of the transcript.

These codes were a combination of inductive and in vivo codes. After coding and analyzing the memos, I was able to go through with the perspective from the Grounded Theory Approach to determine some of the key themes and concepts that the data was pointing to. Once these themes and concepts were discussed and looked back over, a concept map was created to see the linkages and disconnect between the larger issues.

7. Ethical considerations

The project was submitted to Emory University's Institutional Review Board, and after further examination the IRB deemed the study to be exempt from further IRB review and approval (see Appendix 2).

8. Limitations and delimitation

One limitation was trying to locate families that had received water filters, since one of the villages had no list of families that had received them. This was also an issue where some of the participants had to leave the interviews to take care of children, had meetings with the chief or go into the field to harvest. It was a challenge to come back at a later time and find the participant to finish the interview. Another challenge was that depending on the time or day of the week, the adults would be out in the field and not able to be reached. The final limitation was associated with the cultural activities surrounding funerals. As it happened, on one of my village visits, there were multiple funerals that had happened on the previous day before I went to the village and was unware of the funeral until my actual arrival there. This caused a large problem for my surveys as everyone was gathered there at the funeral due to the fact that they last all week. Naturally I did not want to interfere, and it was not culturally appropriate to conduct the research when families and friends were mourning. The research team ended up having to travel

back into the villages to collect the stories from those that had received the water filters. Overall, these limitations affecting the quality of the project due to the smaller sample size of participants who had received the water filters, as well as the lack of complete randomization is recruitment.

Results Chapter

Introduction

The key findings came directly from the data as it was evident that participants held preconceived beliefs towards water filters, specifically the belief that clear water equates to safe water, and as such their illnesses could not be coming from the water because it is clear and not dirty, so therefore it must be safe to drink. Some of the major themes included education, training and distribution, as well as filter utilization. Another major theme was water quality with regards to access, and temperature of water and how it affects the uptake up the water filters, as well as past history with water purification techniques and more specifically their connections to their ancestry, and water quantity. The final theme that was evident was the relationship with NGOs.

Findings

The primary research question for this project focused on the perceptions of water filters among the rural villages in Northern Malawi. The secondary research question was to understand the utilization of water filters and the functionality of these filters in a rural setting. The results of these research questions demonstrated some variability for each of the three villages; however, major issues were consistent for all the villages. Each of the three villages in this study were quite different from each other, mainly because of the type of filter that was received and their perceptions about the filters. The results are broken down by information that was gained from

key informant interviews first, such as village chiefs, heads, and elders, followed by findings based on the in-depth interviews provided by the villagers, and lastly the data from the focus groups which allowed for the topics to be flushed out more completely.

Education, Training, and Distribution

The villagers of Luhomero showed a keen interest with the Sawyer water filter. This filter was distributed through multiple phases over the course of a few years by an NGO called Love a Village. These filters were distributed at key points through the village to allow for easier access to reach people, such as different health centers or schools in the village. Luhomero is a very large village that is spread across over 20 kilometers, with many streams and ponds scattered about the village. One key distinct feature of Luhomero is the presence of a mountain in the center of the village that has a large boulder on the top that can be seen as you drive by on the tarmac. To reach this village, you must travel off the main road and then over 40 miles on dirt and rocky roads. Before beginning the interviews, the research team met with the village chief to discuss the broad topic and goals of this project, as well as to also be the first KII of the village. The dialogue began with the chief's explanation of the lack of education which is a current problem within the village, and thus, likely an issue with comprehension of the filter process and subsequent filter uptake.

> *Many of the villagers just have primary education, some not even have that.*
>
> (Luhomero Village Chief)

Table 2: Education Status by village.

Village	Primary School	Secondary School	Tertiary School	None

Embombeni	35	8	1	7
Luhomero	39	12	0	4
Karonga	40	6	4	0

The table above shows the education status of the participants that were interviewed, illustrating the quote from the Luhomero Village Chief that the majority of the villagers have only achieved the level of primary education.

All village heads expressed concerns for their people's understanding of the process for using and cleaning the water filters, as if it was too complicated for them to comprehend. Even though two of the villages received a demonstration on how to properly use, clean and take care of the water filter, the chiefs felt that this single demonstration did not have a lasting impact on the villagers.

In Embombeni, the filters were disseminated in two separate distributions, both by the NGO, and this distribution consisted of a training as well. Although the NGO was in communication with the village chief of Embombeni and had talked about giving them a water filter, the NGO needed assistance in translating the training from English to Tumbuka, which caused confusion. The chief described it differently. The village chief needed to translate the training from English to Tumbuka and then send it to India where the filters and training information sheets were being produced. However, when they received the filters with the instructions, they were written in English. This was a dilemma for many of the recipients of the water filters as they did not understand the training material since it was in English with few pictures.

Despite the language difficulties and contrary to the village chief's uncertainty, many of the households in Embombeni were able to show that they still were using the Halo filter, perhaps due to its simplicity. I heard repeatedly from the users during the in-depth interviews that they have been enjoying it and were appreciative for the apparent improvement in their own health and that of their children. They expressed the perceptions that the filter was simple and easy to use in a rural setting, which was not the case for the two other villages, so the trainings and instructions appeared to be effective in Embombeni.

This topic was further discussed during an in-depth interview with the local health center coordinator, who had helped with the primary distributions of the Sawyer filters. He was able to provide us with an overview of what each distribution process was like and the training that was given to filter recipients in both English and in Tumbuka. It was clear that a thorough training was performed, but the distribution process for the filters did vary (See figure 1). At first the Sawyer filters were simply given out for free to the households that showed up on the training day, however they were later given out at a subsidized cost of 5,000 Kwacha ($7 USD). One of the filter distributor's hypotheses was that the people who paid money for the filter would take better care of the filter and use it longer, compared to those that had just received it for free, due to their investment.

Figure 1: Sawyer Water Filter Demonstration

Even though these participants were more involved in the distribution process, other villagers that took part in the focus groups were not aware of all the details. With regards to the Luhomero distribution, recipients talked about the training being more like a church service.

> *She talked about God, and how our life was like the water. Dirty from the stream and then clean after the filter. God is the filter and we need him in our life to be clean* (Luhomero Villager).

Perhaps this villager saw the distributor to be taking the opportunity to evangelize and compare the importance of having clean water with having God in one's life as a way to validate both.

In the village of Karonga, the distribution was carried out after a cholera outbreak. The local organization that distributed them focused on distributing the filters at the community level to allow multiple families access to one filter. This approach had honorable intentions, however it was not well received by the village of Karonga. Findings from the focus groups revealed that for most of the families, the primary owner who had possession of the filter kept it for themselves and did not allow other households to use it. The household that was given the Tulip

water filter felt privileged and even though it was meant to be shared with their neighbors, they didn't want to share. In limited instances, other families did let friends come and use the filter, however they had to bring their own water. This seemed to deter certain families to use the filter because they would need to haul the water over to the house that possessed the filter, wait for the water to be filtered and then return with the water.

Filter Utilization

The organization originally distributing the Tulip filters in Luhomero assumed that they would still be in use since the distribution occurred less than a year earlier. When the research team reached a village, we first spoke with the chief to review our intended interviewing procedure and the types of questions going to be asked. The chief of Luhomero noted the lack of utilization of the water filter throughout the village. This was confirmed as we observed many filters just sitting around and in one case, the filter buckets being used to store milk in the home. Another unintended outcome was the buckets being used to store food or take things to market to sell instead of using it as a water filter component. Many of the households were not able to remember how to properly clean the filter, or how to use it suitably, and so they transitioned the buckets to another use. In Karonga, during the in-depth interviews, they initially enjoyed having the filter and saw a decrease in the number of times they felt sick, especially with diarrhea. After the cholera outbreak everyone was scared due to the deaths that had occurred in their village, so everyone was using the filters that were distributed. Over time though, as people saw that cholera cases were on the decline in the village they stopped using the filters. Their perception was that the cholera incidences and filter usage were not connected. This study didn't evaluate the incidence of cholera, but it appeared the decline in cholera may have been attributable to the filter usage.

Despite the language difficulties, many of the households in Embombeni were able to show that they still were using the Halo filter mostly due to its simplicity. I heard repeatedly from the users in the focus groups that they have been enjoying it and were appreciative for the apparent improvement in their own health and that of their children. The filters distributed in Embombeni were perceived by the users to be simple to use, which contributed to their continued utilization, which was not the case for the two other villages.

One problem that was clear from the data was the set-up of the filtration process. For example, the Sawyer filter system utilized in Luhomero involved two buckets, one located higher than the other, and a membrane filter in between. For this filter to work effectively, the two buckets must be placed at different heights so gravity can draw the dirty water down through the filter and into the other bucket. This gravity-fed process was demonstrated in the trainings with one bucket on top of a table and the other bucket on the ground, however tables are uncommon in these villages. As I walked through the households within Luhomero and Karonga, I saw many buckets sitting side-by-side on the ground, limiting the gravity force needed to move the water through the filter, extending the filtration process to several hours to filter just one liter of water (Figure 2). Participants complained about how long the filter takes to purify the water. In addition, many of these families have chickens and other animals that roam in and out of the house, which is a possible source of contamination when the bucket is on the ground, particularly if the lid is not on the filter. It further led to the possibility of knocking it over or damaging it. These findings were similar to those of Karonga, where the filtration process was comparable; two buckets were attached by a membrane filter and gravity led the flow of water. This village expressed the same difficulties during focus groups, noting that the water filtered slowly because of the limited ability to put the first bucket higher than the other.

Figure 2: Tulip Water Filter System in Karonga

Table 3: Summary Table

	Karonga	Luhomero	Embobeni
Filter Type	Tulip	Sawyer	Halo
Trainings performed	1	1 per distribution	1
Distributor	CCAP Development Department (Local organization)	Love a Village (NGO)	The Barefoot Mile (NGO)
Original concerns	Lack of interest in sharing the filters, which they were told to do	How to filter out very dirty/sandy water	Lack of knowledge behind the use of a water filter
Perceived uptake	Hardly in use	Used somewhat	Used somewhat
Reasons for lack of success	Poor Logistics (two bucket system)	Poor logistics (two bucket system)	Temperature of water

Positive attributes	Reduced cholera cases over short period of time	Connections from NGO to the village	Great functionality with a spigot

Past Experiences

In the northern village of Karonga, key informants expressed worries about the safety of women and children who collect water. These concerns were derived from past experiences, but also from stories from their fathers and grandfathers of abductions, rape, and killings of young girls that went to get water.

> *Like if it is dark out I do not let her go to the borehole since it is farther away. The stream is closer so that is nice. Sometimes bad things happen when you go out at night; that is why we don't collect water when it is dark. Only go in mornings and like midday; that is best*.
> (Karonga Village Head)

Water filters are a new technology to these villages, and the new intervention was implemented without understanding villagers' preconceptions.

> "*We have never heard of water filters. This was the first of its kind. We have lived for many, many years on these lands just fine. Either by treating or even not treating the water, we live. We have not heard of or even the knowledge of such a way to treat water*". (Embomeni Chief)

The prevalent attitude was that past ancestors had lived for many years on the same lands with the same water sources as they do now, and that they had healthy lives. Villagers

highlighted the life-health-water relationship during the IDIs in all three villages. Even as the NGO's were originally distributing the filters in the rural areas, they did not perceive that villagers did not correlate that water causes illness since it was not known to do so historically. This concept of following family traditions was evident in the focus groups as well. Many participants made similar comments, including with the example of work.

> *Since my father was a tobacco farmer, and we have land, I will become a farmer too. His father also worked these lands and it has been passed down in generations*. (Karonga Villager)

Prevailing topics discussed in the focus groups included work, farming, using medicines, seeing medical or traditional doctors; and commonly, suggesting that their families had never had water filters before and lived healthy lives.

Quantity Verses Quality

An additional area of common concern that was expressed in all three villages was the difference between water quality and quantity. While these were the two main topics discussed by participants, opinions varied from village to village. Discussions on water quality was most extensive in the village of Karonga, which was recovering from a cholera outbreak a few years back. This village was the only one that was given filters as a direct response to an outbreak of waterborne disease. As such they were much more aware and talked more openly about water quality. Some of the village heads even went in depth to discuss the benefits of the filter and how it rids the water of bacteria and other harmful pathogens that cause illness. This village was much more knowledgeable on the disadvantages of poor water quality, and cognizant of the fact that cholera and diarrhea, for example, come from drinking unclean water.

The chief of Embombeni made a central point on water quantity verse water quality, that water is used for so many things. Most of the families have farms and need water for their crops or animals; then water is used for bathing, cooking, dishes and drinking. This ties back to the earlier discussion of collaboration between the villages and NGO's to be aware of what others are doing in neighboring, if not the same, village. The village chiefs agreed that having access to more water would be more favorable than a water filter for their people currently, because more water would mean more crops, more food, and a healthier and wealthier life. For a water filter to truly be efficient and effective, water needs to be readily available, yet, that was not the case for these three villages.

> *More water is needed, yes for not just crops to grow but for our health. Water is not available as much as we would like. It is something that is needed more in our village and other villages I am sure.* (Embombeni Village Head)

Water scarcity was mentioned less often in Karonga, as this village was the closest to Lake Malawi and had better access to water. The other two villages commented less on water quality than water quantity, perhaps because they had not experienced an outbreak like cholera, but also because they experienced limited access to water year-round. Many participants described in detail their struggles to get water during the dry season, especially when only one or two boreholes were functioning within the whole village. The concerns with these villages were related dying due to dehydration or starvation due to the lack of water for their crops. These villagers spoke with great passion, acknowledging water as the root for their health and happiness. In their opinion, after solving the water quantity issue then a filter system would be more suitable for them.

Participants in the focus groups confirmed that access to water was a major problem for the village of Embombeni, with many having to walk upwards of two kilometers to get water and return to their house.

> *There is a shortage of water. With so many people and the water sources dry out often and quickly. Sometimes if go very early in the morning before the sun comes up, you get a little water but by mid-day or later there is no water. This happens often. (*Embombeni Villager*)*

Collaboration with NGOs

Even though there was some confusion on the question of translation in Embombeni, the chief had the utmost respect towards The Barefoot Mile NGO and was thankful for the collaboration. He expressed how much he appreciated the NGO coming to talk to him first before coming to the village with the filters. Despite this respect and appreciation, there were some opinions about the NGO and the distribution process, particularly surrounding the general lack of communication and understanding of their culture.

This is something that future NGO's, as well as local government organizations need to understand, as both outside factors and internal norms affect the uptake of an intervention.

> *That is why we need to work together. It has to be community friendly. Go to the communities, see how they live. Because you will not be changing the style of their lives, but only add value to their lives. So let them come, we will discuss how this can be improved*. (Luhomero Elder)

The lack of communication between water filter distribution campaigns by NGO's located just 10 kilometers apart was particularly surprising. With Luhomero and Emombeni

being a relatively short distance apart, many villagers and even the Chief of Embombeni knew of the water filter distribution in Luhomero. However, the NGO that distributed filters in Luhomero had no knowledge that there was a similar distribution program in the neighboring village. During the in-depth interviews, some participants said that they wish they had the filter from the other village because it seemed simpler to use and clean.

Participant in the focus groups spoke very highly of Love a Village and expressed how thankful they were for the filters and the trainings. Many showed where they keep the filter in their homes, and in many households the Sawyer instruction guide was posted behind the filter on the wall. Even though many of the families still possessed and used the filter, they did express concern about it being what the village needed.

> *Everyone in Africa suffers, water is big problem. The world knows like with all the church people and help that is sent with water stuff. Other things are important too, besides water. That is hard though to say - we enjoy the help but […it would be good] if we are talked with before getting things or people visiting. It's why when someone comes to the village with an idea, they talk to chief. He knows village concerns and needs.* (Karonga Villager)

Additional Findings

The temperature of the water played an important role in the uptake and use of the water filters, and is tied to the theme of water storage. Many families had ceramic jars, plastic buckets, or large drums outside their house for storing water (Figures 3 and 4). A majority of households however did not have adequate covers for the containers, which can lead to contamination and/or provide breeding grounds for mosquitoes. These storage containers were important as

participants described that when the boreholes were out of water, they used water stored in their drums and buckets for daily necessities. The ceramic pots were favored for storing water because they kept the water colder as compared to the water filter plastic buckets.

Figure 3: Water Storage Drums

Figure 4: Water Storage Ceramic Jar

An unexpected finding had to do with negative feelings that some participants expressed towards the NGOs or local organizations. Some users felt they were test subjects, being given these filters to use when it wasn't needed in their opinions. It was expressed multiple times that their families and grandparents have been living in those villages for many years and that they lived healthy long lives, so there was no need for a water filter. This led to a pushback against those that distributed the filters because they felt there was an absence of communication between the villages and the organizations.

Summary

Malawi is a country that has faced many issues, with the biggest being access to water, specifically clean and safe water. While traveling throughout three rural villages of Northern Malawi to understand their perceptions and comprehend the uptake of the distributed filters, it was clear that access to water in general was a major concern. Many of the households were still using the filters, however it varied based on village and other contributing factors such as educational levels and the training that was given. It appeared that the training in Luhomero was the most helpful because of the repeated visits from Love a Village, compared to the other villages who only were visited once or twice by the organization that distributed the filter. Another benefit to the trainings that lead to an increase in usage was through visual reminders in the form of pictures as part of instruction guides.

The people of Karonga had initially used their filter a lot, but eventually stopped using them. They never abided by the instructions to share the filter among multiple families. While access to water was not an issue here, they had forgotten how to clean the filters and decided to use the filter buckets for more practical or important purposes. Karonga is located near Lake Malawi; villagers have access to streams and ponds, as well as the lake which is only a kilometer

away. Luhomero villagers were the most successful at incorporating the filters, with a majority of the recipients still using the filter. However, they prioritized the availability of water over filtration, as filters are unwarranted if water is not available. Embombeni expressed similar concerns. The chief and elders expressed respect for the NGO that distributed filters, however that feeling was not commonly expressed by the villagers, as they believed that something else – namely better access to water – could have benefited their people more than water filters.

Discussion and Conclusion

The objective of this project was to evaluate the perceptions and possible barriers that are present among the families that received the specific water filters in three rural villages in northern Malawi. Through this project we heard the personal narratives and experiences the local villagers had with the water filters and also their personal opinions on similar topics regarding water.

The declared beliefs regarding water filters varied from each village, mostly due to factors such as different filters, environment, and culture. The three villages that participated in this project are diverse in their geographic location, with one village being close to a large water source (Lake Malawi) and two other more remote villages having modest access to water. The key themes that surfaced from the interviews and focus groups were the perceived barriers towards the use of water filters, philosophies regarding water in general; outsider influences, such as neighbors, friends, and NGOs; as well as cultural practices and beliefs. These themes led to major conceptions that were expressed in each village, specifically, the need for more water in order to use a filter, clear water means it is good enough to consume, and that education plays an important role in the use of water filters.

The three water filters that were distributed (Halo, Sawyer, and Tulip) were all membrane filters made of plastic and none of them beta-tested, or spot-tested, for a trial period prior to the mass distribution to the villages. The filters were clearly not sustainable as evidenced throughout the three villages via the many complaints about the tap leaking, water being too warm while sitting in the buckets to be filtered, or the undue length of time it took to filter the water. Two of these filters, Sawyer and Tulip, were both a two-bucket system which required the dirty water to travel from one bucket situated at a higher elevation to travel down through the filter and pour into the second bucket as clean water. However, most households do not have a table or an elevated surface to place the first bucket, thus, they were left placing one bucket on top of two bricks and the second bucket right beside it. Through training the villagers realized the need to utilize gravity to force the water through the filter but they simply did not have adequate equipment and this is what caused the long time to filter the water. The other observed quandary with this scenario was the water would begin to warm up while sitting inside the first bucket for hours, which caused many complaints from the families who drank the filtered water but found it less enjoyable to drink since it was no longer cool but tepid. This often led many households in Luhomero and Karonga to take the filtered water and pour it into a ceramic pot, so that it could be cooled off before drinking. Although this is a good thought, they were essentially pouring clean water into a possibly contaminated container, thus eliminating the overall intended effect of using the filter in the first place.

Access to clean water is critical to global health improvement, especially in sub-Saharan Africa. Large-scale interventions require an infrastructure that is not commonly found in low-resource regions, perhaps necessitating a more personal, household solution for the provision of clean water while physical infrastructure grows. Point-of-use water filtration devices for

households and individuals provide an opportunity to access clean water for consumption in low-resource settings. Such devices have demonstrated their effectiveness in reducing pathogen load and diarrhea incidence. In fact, filtration may offer the most effective household water treatment (Brown 2008, Sobsey 2009).

The journey to truly understand the beliefs and perception of the recipients of water filters was not only eye opening, but inspiring. Being able to understand the thoughts of the villagers from an emic perspective allowed for an honest interpretation of their beliefs and wants, which formulated these conclusions. While many of the participants expressed candid issues with regards to the water filters, each person was genuinely grateful for the NGO or organization that had given them the water filter, and basically spoke highly of the experience of receiving one. Through listening to their stories, living among them within their village, and understanding who they are not just as an individual but also as a culture, I was able to witness the sensitivities and insights that were present throughout the villages towards the perceived barriers, views of water, outsider influences, cultural practices and beliefs. While these were the main themes, additional areas of focus were substantiated regarding the need for more water in general, along with the mixed feelings and emotions that were present with being the recipients of an intervention.

Implications/Recommendations

Further qualitative research should be done on filtered water samples with regards to these three water filters that were distributed in Northern villages of Malawi. These filters have been in the homes of the recipients for approximately one year, longer in certain households, and the effectiveness of the filters themselves has not been measured even once since the original distribution. Statistical analysis of this kind would help understand how long these specific

membrane filters might last in a rural setting, as well as determine if they are adequately serving the intended purpose for those that still use them. Another future project would be to examine the water quality from the sources that the villages are receiving the water, such as boreholes, streams, ponds, and the lake. This has not been done with these specific villages and could lead to future interventions of water purification, if it is needed. By testing the water quality from both the filters and natural sources it will be able to provide comparative feedback to not only the villages but the local government as well. Furthermore, additional qualitative research should be done in other villages that have received water filters to assess their perceptions and uptake, but also to expand it to include any type of intervention. This will allow for a more complete analysis on the perceptions rural villages have towards NGO's or other organizations when furnished with an intervention strategy.

Additionally, further research should be done that focuses on the aspect of participatory approaches, such as ten seeds technique. This technique was first introduced by Dr. Ravi Jaykaran as a tool that enables illiterate community members to participate in the discussions about their community's needs. This is a task that has been carried out by many research teams and has seen great success with projects, since it relies on the community to think and work together to figure out their own needs. Furthermore, a participatory monitoring and evaluation plan should be done with projects that NGO's as well as local and global organizations do. This type of evaluation is a process that allows stakeholders at various levels to engage in the monitoring and evaluation of a particular project, program, or policy (Sirker 2001). This type of approach will improve capacity building, lead to empowerment within the local community and promote sustainability. Some of the techniques used to accomplish this are both qualitative and quantitative methods such as ranking items or focus group discussions.

The act of cleaning water is something that has been known and practiced for thousands of years, with the first known attempts by Hippocrates in 500 B.C. when he practiced sieving water to separate out the sediments. Ever since then the technology has never ceased to expand, and now we have many different types of water filters including activated carbon filters, reverse osmosis, UV filters, and membrane filters to just name a few. Even though plenty of options exist, not all are suitable and appropriate for everyone in the world. For example, rural villages in Africa do not have the capability to have a filter that requires electricity, or something that requires elevation as they lack tables, desks, or other common appliances that might be used for this purpose. This concept is something that needs to be better understood and addressed specifically by NGO's or international agencies that are trying to provide help to developing countries, specifically Africa. Many of these groups send teams of people abroad to introduce some kind of intervention that they have and think since it is a rural village in a developing country they must need it, but that is not always the case. That type of approach is not the correct way to try and help others, it is not culturally appropriate. Instead of having all these assumptions about how others live, specifically in a rural village in Africa, one can do many other things instead of just showing up to a place that they have never been before.

1. Do research on the specific area where you are wanting to travel and help. Find out what other NGO's or organizations are currently working in that country or village to better understand what others have already started and the successes/failures already found. This will allow for a better awareness so that similar projects/interventions are not repeated within the same village or neighboring village.
2. Travel to the area where you intend to do an intervention or project. Without travelling there yourself you will never know the true needs of that area, the village and the people

living there. A majority of times the pre-conceived notions and beliefs will be blown out of the water. Talk to the village chief and elders to see what they need, since they know what their people truly need. Not only will they be able to guide the NGO or organization on ways to help, but also by opening this channel of communication, they will be able to understand what is actually feasible with working within the village, or at the household level. This can only be done by visiting the desired location. Come with an empty mind, heart, and open hands, ready to receive and listen first and then the opportunity to help will arise.

3. Once you visit, stay with the village or community and get to know their lifestyle. Do not just show up, drop off an intervention or start a project and leave. Build friendships and relationships, this trust will then show a greater yield into the amount of people that use the desired intervention. Follow up months or years later and re-visit the same area to hear from the users what can be improved for future interventions.

These three tasks are essential when trying to go into another community, with a completely different background and culture. The lifestyle and culture needs to be understood for any type of intervention to work. Your assumptions may not be true and the need could be far greater or completely different than what you had intended to do. Thus, when traveling to a developing country and visiting a rural village, many have heard of examples where western technology was introduced and a dependency developed in the area. The villages soon feel reliant on the technology or resource providers where they possibly become habituated with a certain expectancy that goods like water, food, and medicine will be provided. This dependency is not healthy, nor is it right. The villages that are visited consist of actual people, families who have been living on those exact same lands for hundreds of years, with no outside help. Are they

actually wanting the help, the advanced technologies, or is it something that is taking them away from their culture, their history and trying to change them to become like the Western world?

The two NGO's that distributed water filters had the right mindset by desiring to bring cleaner water to a rural village, however the approach could have been better by observing some of the methods described previously. Some of the adverse repercussions with the Love a Village project, the distributors of the Sawyer filter, came about directly from the variations in the filter dissemination protocol. During the first couple of distributions the water filters were given out for free, however for all subsequent distributions, the villagers had to pay for the filter albeit at a subsidized cost. Having an identical filter being distributed in the village is great, yet the disparity of having some people get them for free and others pay for them is not appropriate because it puts disconnect and confusion within the village as recipients try to rationalize the process. A project should be done to follow up more closely with this village and see the use on filters by those who paid verse given out for free. It was the NGO's belief that if they paid for the filter, they would be more inclined to take care of it longer and use it more. This should be further examined through a mixed methods study by understanding not only the perceptions but examining the water filter closely. One of the strengths though with this particular NGO's approach is the sustained efforts in the village of Luhomero. Love a Village has continued to visit, follow up, and bring in new projects to this village. A strong relationship was built between the village and the NGO, and that was evident during the interviews as well.

The other NGO, Barefoot Mile, supplied the Halo water filter through multiple rounds of distributions. One of the strengths with this NGO and the distribution process was the relationship that was first established with the Embombeni village chief. The NGO first came to him to seek his approval and understand how to make the Halo filter most suitable for the village

and how the distribution should be done. This was a better approach, but also had some complications. The first was that instead of coming with the predetermined intentions to give out water filters they thought would work best, the NGO should have come seeking what the village needed. Second was the lack of follow-up with the village; once the filters were all given out there was no assessment or return visit done by the NGO. The relationships originally forged were not sustained and thus many of the villager's heart became hardened towards not only this NGO, but other potential NGO collaborators in the future.

Additionally, a proper monitoring and evaluation plan should be conducted. This would allow the organization to see what the needs are of the community prior to beginning the intervention, and to follow and track the progress over the course of the program. By monitoring the uptake during set intervals, the organization will be able to understand and make changes to the program so that it is functioning properly and well received by the participants. By conducting an evaluation at the end of the project, the organization will be able to determine if the intervention was a success, why or why not, and what could be done in the future to make it more successful.

Another key recommendation would be to build on what India is doing with their NGO's and volunteer organizations (Raj, R). India has an NGO Partnership System, which allows for NGO's as well as volunteer organizations to join this system, then it allows them to get details of already existing organizations across all of India. Ireland also has a similar system for the communication of multiple NGO's. In Ireland, the NGO's reach out and partner with community groups or other NGO's that are currently in the field so that they can work together with what is already being done in the region to provide a longer lasting impact (Flac, 2013). This idea speaks to one challenging concept though, the aspect of having NGO's work together. Most often these

organizations are set in a specific field, such as reducing malaria, WASH, and dental care to name a few. With only being focused in certain areas it does not allow for many of these NGO's to branch out and spread their capital to partner with other organizations in the same area. This type of mentality is derived from that competition, which may not be inherit but it is present between other NGO's. When NGO's and other organizations are able to put this mindset behind them and hone in on the efforts to collaborate and compromise, there will be better, faster, and longer lasting results seen throughout the world.

Appendices

Appendix 1: Interview Guide

Introduction

Good afternoon, and thank you for agreeing to an interview today. My name is Levi Moellering and I am from Emory University in America. We are conducting a research project on the personal beliefs and interactions you have with the water filter that you were provided in the past. We feel it is very important to speak with local families about the filter and will be conducting interviews with other families throughout the community as well.

During this interview today we will simply be talking about your experience with the filter, water and storage. I am most interested to hear about your own personal experiences, opinions and views on these issues that we discuss, so please don't be shy, your views are very valuable to us, and we are here to learn from you.

I would like to tape record our discussion that that the rest of the research team can also hear your views exactly and don't miss anything you say. Our discussion will remain completely confidential, only the research team will listen to the recording and the information you give will only be used for this research project to improve and scale up water filters. Is it okay to tape-record the discussion?

Our interview will last about one hour. Are there any questions before we start?

First let's talk about your personal life?

1. How old are you?
2. How long have you lived here?
3. Where are you from?
4. Set-up of household (# of household members, male/female, etc).

A. **Water Knowledge**

So, let's talk about water now and your interactions with water.

5. Where does your family get water from?

   How long does it normally take to get the water?

6. How far do you travel to get water?
7. Does the quality of water affect where you collect water?
   a. Example
8. Who normally gets the water?
9. How often do you go to this place to get water? (Per day/week/month)
10. Do you store the water?
    a. If so where and how?
    b. How long is it stored before using?
    c. Is the water storage covered?

11. Do you have piped water in your house?
12. Has anyone of the family had illness from bad water in the past month?
    a. Malaria, diarrhea
13. What, to your knowledge, are the causes of these diseases?

B. **Filter**

I know would like to understand more of your thoughts regarding the water filter.

14. When was the filter received?
15. How has the filter been introduced to you?
    a. By who and when?
16. Were you trained how to use and maintain the filter?
    a. If yes, was the training clear/sufficient?
17. Has the distributing organization made any follow-up visits to the community?
18. Can you show how to maintain the filter?
19. How often do you clean the filter?
20. Did anyone in the family treat water before drinking it before having the filter?
    a. If so, in what way (cloth, chlorine, boiling, etc).
21. How often is the filter used? (hours/day)
22. How long does it take to filter 1 bucket of water?
23. How does the filter change the water?
24. When using the filter, does the taste change compared to unfiltered water or boiled water?
25. Do others know that you received this water filter?
    a. If no, then why not?
26. Do you feel like you need to hide the water filter?
    a. If yes, then why?
27. Has the filter caused a change in your daily life?
    a. How so?
28. Have you heard about water filters before?
29. Why do you use the water filter?
30. Do you know what water filters do?
    a. What are the benefits of using a water filter?
31. Would you have funds to buy another one if this one broke?
    a. If no, why not?
    b. If yes, where would you buy and what is the price?
32. How much would you spend/are willing to spend on a water filter?
33. If the filter is not used any more, what is the reason?
34. If you stopped using the filter, how long did you use it before stopping?
35. Would you recommend this filter to others?
    a. If so, why?
    b. If no, why not?
36. How can the technology be improved in your view?

I appreciate you taking the time to provide me with insights about your life, water use and the filter. Thank you for your participation.

Appendix 2: Survey

1. What is your gender?
    a. Male
    b. Female
2. What is your age?
    a. 5-16
    b. 17-25
    c. 26-35
    d. 36-45
    e. 45>
3. How long have you lived here?
    a. Less than 1 year
    b. 1-3 years
    c. More than 3 years
4. How many people live in the same household with you?
    a. 0
    b. 1-3
    c. More than 3
5. Where is water collected from?
    a. Stream
    b. Borwell
    c. Other
6. How often is water collected a day?
    a. Once
    b. Twice
    c. Three times or more
7. Who collects the water?
    a. Father
    b. Mother
    c. Child
    d. Aunt
    e. Other
8. How far away is this water source?
    a. 0-2 km away
    b. 3-5 km away
    c. More than 5 km away
9. Where is the water stored?
    a. Bucket
    b. Sink
    c. Outside
    d. Other
10. Have you used the filter that was given to you?

    a. Yes
    b. No
11. Used in the last month?
    a. Yes
    b. No
12. How often in the last month?
    a. Once a day
    b. Once a week
    c. Multiple times a week
    d. Other
13. How many times a day do you use the filter?
    a. Once
    b. Twice
    c. Three or more times
14. How long does it take to filter 1 liter of water?
    a. Less than 1 hour
    b. More than 1 hour
    c. Half the day
    d. Other
15. Were you taught how to use the water filter?
    a. Yes
    b. No
16. If yes, what were you taught on?
    a. How to clean filters
    b. How to fil filters
    c. How to replace filter parts
    d. How the filters work
    e. Other
17. Was the training helpful?
    a. Yes
    b. No
18. How does the water taste?
    a. Sour
    b. Sweet
    c. Dirty
    d. Other
19. How does the water smell?
    a. Good
    b. Bad
    c. Weird
20. Have you replaced any parts?
    a. Yes
    b. No
21. Does the water filter still work?

    a. Yes
    b. No
22. Do you store filtered water?
    a. Yes
    b. No
23. Would you purchase replacement parts?
    a. Yes
    b. No
24. Would you buy a new filter?
    a. Yes
    b. No
    c. It depends on the cost
25. Has the filter been helpful?
    a. Yes
    b. No
    c. Somewhat
26. Have you noticed less illness in the family since you started using the filter?
    a. Yes
    b. No
    c. I don't know
27. Do your neighbors ever come to use the filter?
    a. Yes
    b. No
    c. Sometimes
28. Has the filter caused a change in your daily life?
    a. Somewhat
    b. Yes
    c. No
29. Did you treat your drinking water before having the filter?
    a. Yes
    b. No
30. If yes, how did you treat the water at home before the filter?
    a. Boil Water
    b. Chlorine Solution
    c. Strain through cloth
    d. Other

Appendix 3: Focus Group Guide

I would like to thank you all for coming today. My name is Levi and it is nice to meet everyone, and I am interested to hear your thoughts about water and water filters. Your personal experience, opinions, and views on the certificate are of interest so please don't feel shy to bring up an issue that you think is important. Let me tell you a little about how we will conduct the group discussion today. As we have already told you, your participation in this group is voluntary, so if you prefer not to be part of this discussion you are completely free to leave. However, we value all your opinions and hope that you will stay and share your views. Whatever we discuss today will be confidential and used only for this research project. I would like to say there are no right or wrong answers, we will simply be asking for your own opinions and experiences, so please feel comfortable to say what you really think. I would just like to say that it is okay to disagree, and talk about it but I ask that we all respect each other and our own beliefs. We will not be going around the room, just join in when you have something to say or you want to respond to someone else's point, but it is also important that only one person talks at a time so that we don't miss anything on the recording. I would like to record our discussion so that I don't miss anything and can communicate all of your views exactly. Our discussion will remain completely confidential; I will be the only person listening to the recording and the information you give will only be used for this research project. Is it ok to record this discussion? Our discussion will last about one hour. Do you have any questions before we start?	**Interviewer Instructions** Introduction (To explain objectives and establish ground rules)

As an introduction, let's go around so that you introduce yourselves, and perhaps tell us your favorite hobby.	**Introduction Questions:**
1. What would you say some popular things are for people of your age in this area are?	
2. In your opinion, what are the main health issues that you face when it comes to drinking water on a daily basis?	
3. What do you do before drinking water?	**Opening Questions:**
4. Talk to me about any illnesses you feel?	Probe • Diarrhea • Colds • Malaria • Typhoid • Fever
5. What do you think causes diseases/illness?	Probe • Dirt water • Dirty hands • Mosquitoes • Dirty food
6. How do you prevent these diseases?	Probe • Handwashing • Boiling water • Washing food
7. Tell me about what you know about water filters?	Probe • Know how to use? • When to use? • What it does?
8. Tell me about your thoughts with the filter you received?	Probe • Hard to use? • Didn't get training?
Thank you for your participation. Please let us know if you have any questions.	

Appendix 4: IRB Approval

EMORY UNIVERSITY | Institutional Review Board

June 28, 2017

Levi Moellering
Principal Investigator
*Ethics Center

RE: **Exemption of Human Subjects Research**
IRB00095982
Evaluation of the perceptions among rural villages of Mzuzu, Malawi that recieved water filters.

Dear Principal Investigator:

Thank you for submitting an application to the Emory IRB for the above-referenced project. Based on the information you have provided, we have determined on **6/27/2017** that although it is human subjects research, it is exempt from further IRB review and approval.

This determination is good indefinitely unless substantive revisions to the study design (e.g., population or type of data to be obtained) occur which alter our analysis. Please consult the Emory IRB for clarification in case of such a change. Exempt projects do not require continuing renewal applications.

This project meets the criteria for exemption under 45 CFR 46.101(b)(2). Specifically, you will conduct focus group discussions and interviews, and administer surveys regarding water filter usage and perceptions in the rural villages of Mzuzu, Malawi.

- While not needed until the English version is finalized and approved, before you commence study activities, you will need to submit a translated consent form so we can make it part of the study record and stamp it. For translated consents, we need one of the following supporting documents:
  - Certificate of Translation or Receipt for Services Rendered from a Certified Translator or Translation Service.
  - Have anyone translate into the destination language, have someone not affiliated with the study then perform a "back-translation" from the translated destination language version back into English, and have the PI make an affirmative statement that the back-translation retains the message of the original English version.

The following documents were reviewed in association with this exemption:

- Consent script/Information sheet, English, undated
- Protocol Version 1, version date 04/25/17
- Research Instruments, all undated:
  - Focus Group Guide
  - Interview Guide
  - Survey Guide
- Cultural Competency letter, dated 12 May 2017

Please note that the Belmont Report principles apply to this research: respect for persons, beneficence, and justice. You should use the informed consent materials reviewed by the IRB unless a waiver of consent was granted. Similarly, if HIPAA applies to this project, you should use the HIPAA patient authorization and revocation materials reviewed by the IRB unless a waiver was granted. CITI certification is required of all personnel conducting this research.

Unanticipated problems involving risk to subjects or others or violations of the HIPAA Privacy Rule must be reported promptly to the Emory IRB and the sponsoring agency (if any).

In future correspondence about this matter, please refer to the study ID shown above. Thank you.

Sincerely,

Sam Roberts, BA
Research Protocol Analyst, Sr.
This letter has been digitally signed

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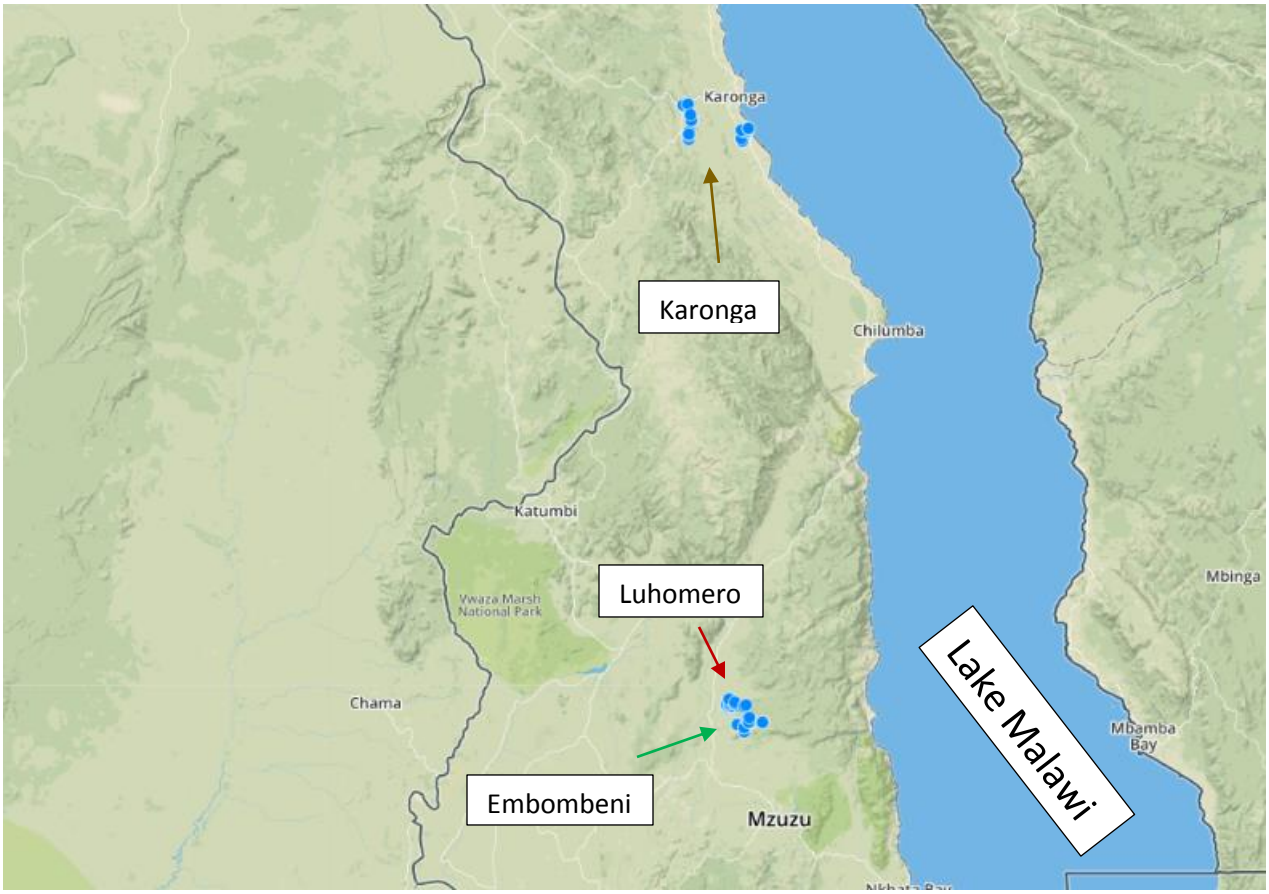
Appendix 5: Map of Northern Villages of Malawi



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