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Sustainability Evaluation of Water Filtration Systems in Honduran Hospitals to Inform The General Electric Foundation's Donation Strategy

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Sustainability Evaluation of Water Filtration Systems in Honduran Hospitals to Inform The General Electric Foundation's Donation Strategy

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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 the Hubert Department of Global Health

2014

Abstract

Sustainability Evaluation of Water Filtration Systems in Honduran Hospitals to Inform The General Electric Foundation's Donation Strategy

By Samantha M. Lie-Tjauw

Background: In Honduras, 1-5% of deaths annually are attributable to disease or injury related to water, sanitation, and hygiene (WASH) [1]. Although 87% of Honduras has access to an improved water source, access to *safe* water is unknown and vulnerable populations continue to be disproportionately affected by WASH-related disease [2-4]. The General Electric Foundation (GEF) has chosen to focus on improving access to safe water in healthcare facilities through the donation of decentralized water filtration systems (DWFS) to four hospitals in Honduras. A baseline sustainability evaluation conducted in June/July 2012 found that two of the four hospitals had environments that would enable long-term sustainability of the DWFS. Considering the post-2015 Millennium Development Goal agenda will include targets for the provision of safe water in healthcare facilities, there is a need for research on the institutional use and long-term sustainability of DWFS in these settings [5].

Objective: This in-depth, follow-up evaluation aimed to provide a deeper understanding of challenges and opportunities related to the sustainable access to and provision of safe water in Honduran hospitals operating GE DWFS. Evaluating operation and performance based on four sustainability domains will inform the GEF's future water filtration system donation strategies.

***Methodology*:** A systematic mixed-methods approach was used to collect quantitative data through surveys, water quality testing, and infrastructure observations, and qualitative data through in-depth interviews in order to calculate a sustainability score for each hospital. Scores were determined using a refined sustainability metric developed through a literature review and field-tested during the baseline study. Each hospital was scored from 0 to 4 in four sustainability domains: on-site capacity, technical feasibility, accountability, and institutional engagement. Each domain contributed equally to an overall sustainability score between 0 and 4.

Principal Findings: Following the 2013 sustainability evaluation, three of four hospitals demonstrated increased sustainability scores since 2012. The remaining hospital did not exhibit a sustainable environment for the GE DWFS. While each site was unique in context, and exhibited variable water quality, sustainability gaps were identified within each of the four domains for each hospital.

Conclusion: The identification of these sustainability gaps allows key stakeholders to understand enabling and limiting factors for sustainable operation of water filtration systems in healthcare facilities in low-resource settings. Furthermore, this knowledge can inform actions to increase access to safe water globally.

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Acknowledgements

This research study would not have been possible without the generous funding from The General Electric Foundation, Dr. Eugene and Rose Gangarosa, and the Global Field Experience Committee. Thank you for your financial support.

I would like to thank the staff and patients at the hospitals in Honduras for their willingness to participate in this study, their insight, and their commitment to increasing the access to and provision of safe water in their institutions.

Additionally, I would like to thank Dr. Christine Moe and all staff in the Center for Global Safe Water at Emory University. I truly appreciate the opportunity to begin my career as a public health professional with the General Electric (GE) project. I am most grateful to the amazing team GE team – Ledor Igboh, Katharine Robb, and Marisa Gallegos. Thank you Ledor for being with me through every high and low. Thank you Kate for encouraging me in my strengths and teaching me the beauty and reward of work in public health. And thank you to Mia for your relentless encouragement and support.

I am incredibly grateful to Dr. Juan Leon at the Rollins School of Public Health. As a mentor, he challenges me personally and professionally while training me to be a humble, bold, and collaborative leader. Thank you Dr. Leon for recognizing my strengths and for believing in me.

Lastly, a special thank you to my family who has given me infinite encouragement and support, especially my mother. She instilled in me the desire to serve others both locally and globally. She is the model of passion, courage, and generosity I continue to strive toward.

Thank you to each of you for journeying with me on this incredible learning experience. From proposal to deliverable, your support and guidance has been appreciated more than words can express.

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Introduction and Background

Global estimates report that diarrhea and other diseases related to inadequate safe water infrastructure, lack of sanitation, and poor hygiene cause 4% of all deaths and contribute to more illness and death than any other single cause worldwide [2, 6]. Improvements in drinking water, sanitation, and hygiene can prevent approximately 10% of the global disease burden resulting from diarrhea, malnutrition, intestinal nematode infections, lymphatic filariasis, trachoma, schistosomiasis, and malaria [3]. This associated burden of disease disproportionately affects vulnerable members of society such as children [2, 7]. Furthermore, 19% of child mortality worldwide is attributed to unsafe drinking water, lack of sanitation, and inadequate hygiene, with diarrhea alone causing 1.4 million annual child deaths [3, 8].

A 2005 systematic review of literature on diarrheal disease analyzed 50 studies and found that interventions in water supply and water quality reduced the frequency of diarrhea in intervention communities by 25% and 31% respectively [9]. Increasingly, evidence demonstrates that improvements in drinking water quality are more impactful when the intervention occurs close to the point of use (POU) [3]. Water treatment and safe storage at POU has been associated with significant health gains (i.e. decreased cases of diarrhea and improved nutritional uptake) where water was previously contaminated [10]. Historically, POU sites have been synonymous with use at the household level, but increasingly, public health leaders are understanding the importance of water safety at POU in community institutions such as schools and hospitals [6].

In 2012, the United Nations (UN) stated that unsafe water is a serious health issue in rural healthcare facilities in low-resource countries. Among healthcare facilities in countries listed in the 2012 *UN Water Global Analysis and Assessment on Sanitation and Drinking-Water* (GLAAS) report, rural facilities demonstrated 20% less drinking water coverage as compared to urban facilities [6]. The diminished drinking water coverage is often attributed to an inconsistency in municipal water source, supply, and lack of POU treatment technology in low-resource countries [8]. Recognizing

this inconsistency in healthcare facilities, organizations such as the General Electric Foundation (GEF) have sought to address these issues over the past decade.

General Electric Foundation Projects

The GEF is the philanthropic branch of General Electric (GE) and focuses its work in health, education, the environment, and disaster relief in order to solve some of the world's most pressing global development issues. Since the 1950s, the GEF has committed hundreds of millions of dollars to these diverse efforts. They currently work in four major program areas: Developing Futures™ in Education, Disaster and Humanitarian Relief, Developing Health™ U.S., and Developing Health Globally™. Program efforts are undertaken through partnerships with non-governmental organizations (NGOs), academic institutions, think tanks, government agencies and private companies. The GEF's Developing Health Globally™ program launched in 2004 and works in 14 countries and 222 hospitals in Sub-Saharan Africa, Latin America, and Southeast Asia to improve healthcare access and provision [11]. Safe water is a large focus of the program and includes the donation of decentralized water filtration systems (DWFS) to hospitals and community clinics in several countries, including Honduras. Other aspects of the safe water projects include the development and dissemination of simple water quality analysis protocols and visual tools to help build capacity and improve the management of safe water [11].

Global consensus among the UN and the World Health Organization (WHO) recognizes an urgent need for further treatment of water from improved sources and a need for support and engagement in infrastructure and policy change at national and regional levels [3]. In collaboration with the Ministry of Health and Assist International (AI), the GEF has donated and installed DWFS equipment in government-run hospitals in Honduras, Ghana, Senegal, Kenya, Rwanda, and Mali. One aspect of governmental engagement is a focus on making access to safe water reliable, technically feasible, and overall, sustainable [12]. The GEF's donation of DWFS, functioning

independently of public water treatment, demonstrates an opportunity for increased access to safe water.

Although the DWFS were originally designed for use in high-income household settings, the GEF has donated these systems to healthcare facilities in order to increase access to safe water in low-resource settings. However, there is minimal research that evaluates their effectiveness in these settings. The GEF has funded a study conducted under the management of the Center for Global Safe Water (CGSW) at Emory University, which aims to evaluate the sustainability of safe water provision and use as it relates to the DWFS that were donated to government-run hospitals in Ghana in 2004 – 2006 and in Honduras from 2007 – 2011. The ultimate goal of the study is to improve strategies for increasing sustainable access to safe water through the use of DWFS around the world, thereby reducing the burden of waterborne disease [13].

Baseline Study

During July of 2012, a baseline study evaluating impact and sustainability was conducted by Emory's CGSW in four Honduran hospitals with GE water filtration systems. The four government-run hospital sites are located in Gracias, La Esperanza, Olanchito, and San Lorenzo, Honduras. The baseline study evaluated the impact of the donated DWFS compared to two control hospitals (Denalí and La Paz) without GE water filtration systems. Investigators evaluated sustainability using a unique and structured sustainability metric developed to measure four domains of sustainability adapted from previous work on the sustainability of safe water access in schools [14], and refined through literature review and field testing [15]. The four sustainability domains include: on-site capacity, technical feasibility, accountability, and institutional engagement. One of many aspects of safe water provision that contributed to the sustainability scores as measured by the metric was microbiological (i.e. total coliforms and *Escherichia coli*) and chemical (i.e. chlorine) water quality. Results of the baseline study found that the water was frequently untreated due to

bypasses of the water filtration systems. Using the sustainability metric, areas for improvement and areas of strength were identified with regard to safe water provision and use within each hospital. Aligned with the identified areas of improvement, actionable recommendations were made to the hospitals, the GEF, and AI. The demonstrated need for continued work in Honduras following the baseline evaluation led to a 2013 follow-up evaluation.

The CGSW also partnered with the GEF and AI to work in district hospitals in Ghana with donated GE water filtration systems. During the baseline study in Ghana, conducted in March of 2013, hospital administration expressed interest in conducting water testing and analysis for possible *Pseudomonas aeruginosa (P. aeruginosa*) contamination in the hospital's piped network. *P. aeruginosa*'s association with hospital-acquired infections led to its addition to the list of microbiological organisms tested in the 2013 follow-up evaluation in Honduras [16-18].

Problem Statement

Healthcare facilities in low-resource settings frequently lack access to safe water. DWFS can improve access to safe water, however, there is minimal research regarding the use and long-term sustainability of DWFS in healthcare facilities in low-resource settings.

Purpose

The purpose of this study was to conduct an in-depth, follow-up evaluation to provide a deeper understanding of challenges and opportunities related to the sustainable provision of safe water in Honduran hospitals operating GE water filtration systems. Evaluating the operation and performance of these systems on four sustainability domains will inform the GEF's future water filtration system donation strategies.

Research Objectives

This follow-up study seeks to achieve the following objectives:

Objective 1 – Evaluate knowledge, attitudes, and practices (KAP) of hospital staff and patients surrounding the provision and use of safe water

Objective 2 – Determine water quality at the four hospital sites

Objective 3 – Assess the sustainability of safe water provision and use at each hospital related to four domains of sustainability: on-site capacity, technical feasibility, accountability, and institutional engagement.

Research Questions

Since the completion of the 2012 baseline study, actionable recommendations were made to each hospital, the GEF, the CGSW, and AI. Given that the recommendations, if executed properly, were structured to improve a hospital's sustainability score, this follow-up study aims to answer the following research questions:

Research Question 1

1a. Is there an association between awareness of the water filtration system and thinking the hospital tap water is safe to drink among staff at each hospital in 2013?

1b. Is there an association between thinking the hospital tap water is safe to drink and drinking from the hospital tap among staff at each hospital in 2013?

Research Question 2

2a. Does the proportion of samples that met guidelines for total coliforms, *E. coli*, and free chlorine residual at POU for medical and drinking purposes in 2013 differ significantly from the proportion of samples that met guidelines in 2012 for each hospital?

2b. Is a water sample that met drinking water quality guidelines for free chlorine residual more likely to meet drinking water quality guidelines for total coliforms in 2013?

2c. Is a water sample that met drinking water quality guidelines for free chlorine residual more likely to meet drinking water quality guidelines for *E. coli* in 2013?

Research Question 3

3a. Do the 2013 hospital domain sustainability scores differ significantly from the 2012 hospital domain sustainability scores?

3b. Do the 2013 hospital sub-domain sustainability scores differ significantly from the 2012 hospital sub-domain sustainability scores?

Significance Statement

Understanding the environments that enable or limit the sustainability of DWFS will aid in improving strategies to promote sustainable use and operation of DWFS in healthcare settings in developing countries and improving health outcomes associated with these facilities.

Literature Review

Global Burden of Waterborne Disease

It is estimated that diarrhea and other diseases related to inadequate sanitation and clean-water infrastructure cause more illness and death than any other single cause worldwide [2, 6]. Diarrheal disease alone is responsible for 1.8 million deaths per year, 88% of which can be attributed specifically to poor water supply, sanitation, and hygiene [19]. The disease burden related to water, sanitation, and hygiene (WASH) is estimated at 4.0% of all deaths and 5.7% of the total disease burden (in disability-adjusted life years) globally[1]. Additionally, WASH-related diseases disproportionately affect those of low socioeconomic class within a society [2]. These disparities are further seen in the three quarters of people who globally experience a lack of access to safe drinking water and basic sanitation, particularly those who live in rural areas of low-resource countries [3, 6].

Despite the significant health burden due to water and sanitation, the World Health Organization (WHO)/United Nations Children's Fund (UNICEF) Joint Monitoring Programme (JMP) claims gains toward meeting Millennium Development Goal (MDG) 7c, which addresses the aim to "halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation" [4]. The 2012 MDG progress report indicates the MDG target for drinking water was met in 2010 when globally, the proportion of people without access to safe drinking water was halved from 24% to 11% since 1990. According to the UN, in the 20 years from 1990 to 2010, "over 2 billion people gained access to improved water sources and 1.8 billion gained access to improved sanitation facilities" [6]. Furthermore, UN experts believe that achievement of the MDG drinking-water target is driven by the institution of the goal itself and the increased attention, aid, and other resources given to the WASH sector since its conception [20].

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[1] The disability-adjusted life year (DALY) combines burden from both death and disability into a single index allowing for comparison between the burdens due to WASH related disease with that of other risk factors or disease [2].

Global Access to Safe Water

Access to safe drinking water is a global issue and is intimately linked to the health and development of a country. Safe drinking water, as defined by WHO's *Guidelines to Drinking Water Quality*, "does not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages" [21]. Although the guidelines are intended as scientific basis for the creation of contextually unique, strategic national and regional standards across the globe, they may not be widely known or widely used for the creation of such standards. Furthermore, the MDG 7c indicator does not incorporate the WHO guidelines.

The indicator used to measure access to safe drinking water is the proportion of the population using an improved drinking-water source [4]. The unit of measure in the population is the household, and water source classification as improved or unimproved is dependent on whether or not the source is protected from outside contamination [22]. The WHO/UNICEF JMP for Water Supply and Sanitation used this indicator and its metrics to determine that the MDG 7c improved drinking-water source target was met. Table 1 further details the spectrum for drinking-water source classification according to JMP [23].

Table 1. JMP Classification of drinking-water sources [23].

Unimproved Drinking-Water Source		**Improved Drinking-Water Source**	
Surface water	**Other unimproved**	**Piped water on premises**	**Other improved**
River, dam, lake, pond, stream, canal, and irrigation channels.	Unprotected dug well, unprotected spring, cart with small tank/drum, surface water, and bottled water.	Piped household water connection located inside the user's dwelling, plot or yard.	Public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection.

Access to safe drinking water is half of the focus of MDG 7c, and progress made toward meeting this target results in significant implications in the achievement of several other MDGs such as: MDG 1 – poverty reduction, MDG 2 – universal enrollment in primary education, MDG 4 – infant mortality, MDG 5 - maternal health, and MDG 6 – reduction in major infectious diseases [4, 24]. An additional subsequent impact of progress toward MDG 7c is the financial burden of the efforts toward progress and the potential cost savings once achieved.

In 2008, two years prior to the announcement of meeting the safe drinking water target, cost estimates showed that it would cost $42 billion (USD) to meet the MDG 7 target for improved water source in low-resource countries. It was further estimated that the cost of maintaining existing water supply services at that time would cost $322 billion (USD). In assessing financing requirements, estimates of cost included the operation, maintenance, and replacement of existing coverage as well as new services and program costs [24]. A WHO study aimed at further estimating economic costs and benefits of specific water supply improvement interventions, examined the 17 WHO sub-regions and determined the initial investment and annual recurring cost per capita in USD for six improved water supply interventions. The costs across different improved water sources for Latin America and the Caribbean are shown in Table 2.

Table 2. Cost per capita for initial investment and annual recurring cost for improved water source in Latin American and the Caribbean in 2000 [23, 25].

Water Improvement	Cost Per Capita Initial Investment (US$ Year 2000)	Cost Per Capita Annual Cost (US$ Year 2000)
Piped household water connection	144	15.29
Standpipe	41	3.17
Borehole	55	4.07
Dug well	48	3.55
Rainwater collection	36	2.66
Point of use disinfection	0.27	0.58

A 2004 WHO study states that improvement of a water source does not indicate that the water is safe, but that improved water sources are more accessible and that measures have been taken to protect the source from contamination. A 2012 study sought to monitor progress toward the MDG drinking water target through indicators of water safety. Through their analysis, they estimated that "1.8 billion people (28% of the global population) used unsafe water in 2010…[and] an additional 1.2 billion (18%) used water from sources or systems with significant sanitary risk" [26]. Utilization of accessibility and water source protection as indicators for safe water likely results in an overestimation of access to safe water that meets microbiological standards [20].

The WHO establishes microbiological, chemical, radiological, and acceptability[2] guidelines in their 4th edition of the *Guidelines to Drinking Water Quality*. Of most practical relevance to drinking water in low-resource countries, are pathogen indicator organisms such as total coliforms and *Escherichia coli (E. coli).* The use of indicator bacteria detection in place of direct pathogen detection allows for easier quantification because tests can be less specific and indicator bacteria are commonly found in larger volumes [27].

Indicator organisms are useful in determining the safety of drinking water because their presence in water is of high health significance in regards to the incidence and severity of disease caused by the pathogens they indicate. Total coliforms include species of *Enterobacteriaceae* regularly found in human and animal feces, but also include bacteria of non-fecal origin. Total coliforms are used as a broad indicator of water treatment efficacy [27]. *E. coli* is a more fecal-specific indicator commonly used in determining microbiological water quality. The presence of *E. coli* in water indicates fecal contamination of the water and is therefore more specifically associated with the presence of harmful pathogens [21]. WHO's guidelines for total coliforms and *E. coli* indicate that samples of drinking water must exhibit a concentration < 1 MPN (most probable

[2] Acceptability aspects of drinking water include taste, odor, and appearance. The WHO Guidelines to Drinking Water Quality indicate that "water should be free of taste and odours that would be objectionable to the majority of consumers" [5].

number)/100mL [21]. Previous studies quantified that the number of *E. coli* microbes commonly found in raw water ranges from 100 – 100,000 *E. coli/L* of water [28]. Although, this range is smaller than that commonly found in feces (10^7/g) or untreated wastewater (10^6 – 10^7/L), it is still a health concern due to the inferred pathogen load [21].

An additional microbiological pathogen of concern among the public health community is *Pseudomonas aeruginosa* (*P. aeruginosa*), a gram-negative bacillus common to biofilm frequently found in sinks, sink drains, faucet aerators, and sink faucet tubing in hospital settings [29]. Several studies conducted in intensive care units throughout United States (U.S.) hospitals found contradictory or inclusive evidence in identifying *P. aeruginosa* as a direct causal agent in hospital-acquired infections [16-18]. The WHO classifies *P. aeruginosa* as an "organism for which transmission through drinking-water has been suggested but for which evidence is inconclusive" [21]. However, it is considered common in water supplies, can multiply in water supplies, can be aerosolized, demonstrates a moderate resistance to chlorine (1 -30 minutes required for organism inactivation in water pH 7-8 at 20˚ C), and is considered a possible health threat in healthcare facilities where there are vulnerable immunocompromised populations [21].

In addition to WHO's drinking water quality guidelines, the Centers for Disease Control and Prevention (CDC) recommends specific levels for chlorine residual in drinking water. The addition of chlorine to water should result in a chlorine residual measurement within the range of 0.2mg/L – 2.0mg/L. This range indicates that: i) a sufficient amount of chlorine was added to the water in order to inactivate a majority of disease-causing microorganisms, ii) the water is protected from recontamination during short-term (4-24 hours) storage [30]. It is recommended that chlorine treatment occur alongside other treatment methods such as filtration because factors such as turbidity and chlorine-resistant microorganisms can reduce the effectiveness of chlorine disinfection [30].

Access to Safe Water in Honduras

In Honduras, 1-5% of annual deaths are attributable to WASH-related disease or injury such as the multiple enteric diseases transmitted through contaminated drinking water from unsafe water sources [1, 2, 6]. Although a majority of Latin America (86%) uses an improved water source, the benefits of these sources are unevenly distributed with increased coverage in urban areas and in countries experiencing increased economic stability [4, 6, 20]. The 86% is likely an overestimation of the actual number of people using a safe-water source, because the indicator for improved water source is only a proxy indicator for safe water, neglecting to include dimensions of safety, reliability, or sustainability [4].

In most high-income countries, central governments continue to be a major source of funding for water and sanitation. However, low- and middle-income countries remain highly dependent on external aid to fund WASH programs and systems. Honduras spends 1.2% of its gross domestic product (GDP) on sanitation and drinking water, while they spend 4.6% of their GDP on health. According to the *UN-Water Global Analysis and Assessment of Sanitation and Drinking Water 2012 Report,* 12% of sanitation and drinking water aid worldwide is targeted toward Latin America and the Caribbean. Honduras has low financial capacity to dedicate to WASH programs while experiencing high needs for external funding [21].

Honduras experiences a lack of reliable and sustainable access to safe drinking water due to power outages, inconsistent water pressure, and pipe breakage in the central distribution systems [4, 31]. In Honduras, the proportion of the population using an improved drinking water source has increased from 76% in 1990 to 87% in 2010 [4]. However it is unknown how much of the population actually has access to *safe* water. Additionally, while 25-75% of primary healthcare centers in Honduras have reported widespread implementation of national hygiene promotion programs, there is no data on the percentage of healthcare centers that have improved water supplies or sanitation facilities. This lack of knowledge demonstrates a need for a greater

understanding of safe water access in health care facilities, which is a vital component of a healthy community [6].

Water Quality in Healthcare Facilities

As the current MDGs progress through the remaining year of their 2000 – 2015 timeline, the UN General Assembly and other key stakeholders are developing the post-2015 agenda and the movement toward the Sustainable Development Goals (SDGs) whose timeline will run from 2016-2030 [32]. The proposed SDGs exhibit an increased interest in expanding universal access to safe drinking water beyond the home to additionally include schools, health centers, and refugee camps. Although specific indicators have not yet been determined, SDG 6 addresses the goal to "achieve universal access to water and sanitation" through the following targets [5]:

> 6a. Provide universal access to safe drinking water at home, and in schools, health centers, and refugee camps
>
> 6b. End open defecation and ensure universal access to sanitation at school and work, and increase access to sanitation at home x%
>
> 6c. Bring freshwater withdrawals in line with supply and increase water efficiency in agriculture by x% industry by y% and urban areas by z%
>
> 6d. Recycle or treat all municipal and industrial wastewater prior to discharge [5]

Target 6a will directly impact the provision of safe water at healthcare facilities globally through increased attention to ensure that both off-site and on-site interventions are implemented to provide safe water at the institutional level. According to WHO, drinking water in healthcare facilities such as hospitals and clinics, "should be suitable for human consumption and for all usual domestic purposes, including personal hygiene. However, it may not be suitable for all uses or for some patients, and further processing or treatment or other safeguards may be required" [21]. At this time, little is known about the quality of water used for drinking or medical purposes in

hospitals in low-resource nations. However, drinking water sources in hospital settings are likely to meet the classification for an improved source as seen in Table 1 (i.e. piped water on premises, bottled water, and other protected sources). However, classification of a water supply used by a healthcare facility as an "improved drinking water source", does not guarantee that the water quality from this source will meet WHO or CDC safe drinking water quality guidelines [4, 26].

The provision of safe drinking water in hospitals provides an opportunity to serve the underserved and meet individual needs at the institutional level [33]. Using an economic cost-benefit analysis, a WHO-funded study determined that both healthcare facilities and their patients can experience economic benefits from improvements in water and sanitation (Table 3) [25].

Table 3. Healthcare facility and patient economic benefits from water and sanitation improvements [25].

Beneficiary	Direct economic benefits of avoiding diarrheal disease	Indirect economic benefits of health improvement
Healthcare Facilities	Decreased spending on diarrheal disease treatment	Decreased use of health worker sick days due to diarrhea
Patients	- Decreased spending on diarrheal disease treatment and less related costs - Decreased spending on transport in seeking treatment - Decrease in time lost due to seeking treatment	- Decrease in missed work or school - Decrease in parent/caretaker time lost due to sick children or elders - Decrease in avoidable deaths

Decentralized Water Filtration Systems

Unlike in the U.S. and other high-income countries, the responsibility for the provision of centralized drinking water and sanitation services is most often at the local level in lower-income countries. This form of decentralization presents an opportunity for the operation and maintenance of services and facilities to appropriately and specifically meet local needs, while still requiring the support from higher levels of administration such as the environmental department of their

national government [6]. This need for continued support is demonstrated through the 2012 *UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water* (GLAAS) country survey which concluded that "only 40% of countries that have decentralized service delivery have decentralized fiscal responsibilities" [6]. Therefore, a majority of countries in which municipalities govern local-level decentralized water provision, rely on the financial support of the national government in order to operate the drinking water and sanitation services.

Studies demonstrate that due to the unreliability of centralized water treatment systems and the practical inability to treat water at the national and municipal levels in low-income countries, further decentralized water treatment can provide an alternative solution to provide safe drinking water [31]. Additional studies have shown that low-cost decentralized water treatment systems, such as solar disinfection, chlorination, and slow sand filtration, have improved the microbial quality of drinking water and demonstrated public health benefits at the household-level [31, 34]. The provision of drinking water can be further decentralized from the local level to the institutional level. Institutions, such as schools and hospitals, offer an opportunity to provide safe drinking water to their constituents through decentralized water treatment such as DWFS.

Membrane filtration technology is more frequently used in high-income countries at all levels of water treatment (i.e. central, institutional, and household) and is considered one of the most significant advances in water treatment by the U.S. Environmental Protection Agency [31]. Since its invention, membrane filtration technology has decreased in cost and is becoming increasingly affordable in low-income countries. Additional benefits of membrane filtration versus conventional water treatment (i.e. chlorination, slow sand filtration, etc…) include the following:

- Treatment of raw water in one step with or without the addition of chemicals
- Decreasing membrane costs
- Decreasing energy requirements with technology improvements over time
- Flexible design for diverse system setup and scale [35].

The most frequent limitation of DWFS using membrane technology is the decreased technological sustainability of these systems. The lifespan of membrane technology has not been tested in the low-resource setting, but the addition of pre-membrane filtration treatment may be necessary to prolong the life of the equipment [31]. Additionally, membrane fouling prevention measures can be resource costly in both time and supplies. Regular backwashing and chemical cleaning is necessary as part of equipment maintenance and is completed via an automatic or manual process depending on system design and/or setup [35].

The DWFS used by the GEF in their Developing Health Globally™ safe water project is the GE Homespring™ Water Filtration System. It is a commercially available unit of equipment that was originally designed as a household point-of-entry purifier in high-income countries. The system uses activated carbon and hollow-fiber ultrafiltration membranes fabricated with polyvinylidene fluoride to physically remove contamination from raw water [31]. The filter fiber pore size is 0.01-0.05um, and it removes >99.999% of bacteria and viruses. The GE Homespring™ filter units have a 10 minute daily cleaning cycle set up as either as an automatic or manual backwash function, which is dependent on the installation design of the DWFS. Systems designed with the automatic backwashing require secure electricity (i.e. main power source and a backup generator). Table 4 contains additional GE Homespring™ Water Filtration System specifications [36, 37].

Table 4. GE Homespring™ Water Filtration System Specifications [36, 37].

Maximum peak flow rate	42L/minute
Maximum continuous flow rate	17L/minute
Temperature range	>0˚C – 38˚C
Flush volume (approximate)	45L
Controller voltage (VAC)	120V
Annual water treatment volume (approximate)	0.49L x 10^6

Sustainability

Global acknowledgement of the importance of sustainability in the WASH sector has resulted from the awareness that although communities in low-resource countries may be "served" by an intervention, project, or program, failures in access and discontinuity of service are common experiences a few years after implementation. Although exact definitions of sustainability vary, a common theme is a change in the measure of intervention success from number of implementations to the continuous, regular, and long-term execution of all activities related to the intervention [14, 38, 39]. More specifically, sustainability for a WASH intervention involving the installation of infrastructure can be defined as "the degree to which the device is serviceable with locally available materials and does not cause significant harm to the environment in either production or daily operation" [36]. This definition highlights the multidimensional nature of sustainability.

The emergence of sustainability assessment tools specific to the WASH sector demonstrates a global response transitioning WASH sector interventions from basic infrastructure implementation, to the "long-term sustained provision of permanent services" [40]. Shifting the focus beyond building infrastructure creates opportunity to support continuity of services associated with the infrastructure. Additionally, increased sustainability of WASH interventions can work toward reversing negative outcomes that hinder community health benefits and stakeholder desired return on investment. Such outcomes include equipment non-functionality rates, as well as premature and chronic failures [40, 41].

Sustainability is key in ensuring the future of safe drinking water sources as well as the health of its users. A 2011 study examining the sustainability of school hand washing and water treatment programs identified six aspects of enabling environments which promote sustainability: financial capacity, technical feasibility, accountability, community support, institutional leadership and management, and participant engagement [14]. This and other studies have demonstrated that

basic domains such as these are necessary in order to continue the activities related to the intervention and create environments which enable sustainability [14, 40].

Studies specific to DWFS in low-resource community settings have demonstrated that there are aspects unique to DWFS as an intervention that are necessary for sustainability. These aspects include access to replacement parts or materials, which can be difficult to procure in low-resource settings, especially when using equipment produced in the U.S. Access to other resources, such as dependable electricity, is an important factor contributing to sustainability [36]. Researchers also found that social acceptability[3] is vital for long-term use of the equipment in addition to the "willingness and ability to cover operation and maintenance costs, [which] is not only a reflection of the financial capacity of the institution, but also of the buy-in and local sense of ownership and value of the system" [36]. Themes of investment, engagement and support are common among the few WASH sustainability assessment tools [14, 40].

Currently, several frameworks and sustainability assessment tools exist for monitoring and evaluation of WASH interventions. Some tools are designed for specific technology, and others for the organizational aspects of sustainability. A 2013 study examined five tools that capture sustainability holistically. The majority of the five tools have been validated and utilized in the African and Asian contexts with each application of a single tool costing an average $35,000 (USD) [40]. The following two approaches are often used to capture the holistic complexity of sustainability:

1. Using available and relevant evidence
2. Engaging stakeholders in order to understand interrelationships between systems [38].

Existing sustainability assessment tools vary in the identification of the specific domains that either support, or hinder and create barriers to sustainability-promoting environments. The

[3] Social acceptability can be defined as "the degree to which the community where the device is placed supports the device and its use" [28].

assessment is conducted based on a developed model of sustainability for the unique intervention, its context, or both. The data collected in a sustainability assessment are the outcome measures of chosen metrics of sustained use. These metrics can be quantitative or qualitative and are each associated with an identified domain in the developed model. Research using these tools in the field, and those comparing tools side-by-side, have found that each identified domain cannot alone ensure sustainability [14]. Therefore, each domain plays a critical role in creating a sustainability-promoting environment. If utilized most effectively, there exists opportunity for such assessment tools to strengthen community, regional, and national monitoring systems beyond unique projects and programs while continuing to remain contextually adapted and appropriate [40, 42].

Study Relevance

The use of DWFS has the potential to improve affordability, reliability, quality, and access to safe drinking water at an institutional level in resource-poor settings. However, critical gaps in knowledge, awareness, and accountability amongst Honduran hospital staff were identified during the baseline evaluation. These gaps result in limited effectiveness of these systems [9, 43]. It is vital that both Honduran and international stakeholders understand the impact and sustainability of DWFS in hospitals due to the high concentration of vulnerable populations in these settings and the increase in global attention given to safe water access in healthcare facilities. This attention is supported by Cairncross *et al* and fellow authors who proposed an agenda for action in 2010, which included a call to the World Health Organization (WHO) to establish international benchmarks for WASH needs in healthcare facilities [8].

The baseline study completed in the summer of 2012 identified areas for improvement and areas of strength within each hospital, with regard to the sustainability of safe water provision and use. A second in-depth, follow-up evaluation will: i) determine what changes have been made in the past year, ii) assist in maximizing the domains of sustainability within each hospital, and iii)

reevaluate the sustainability scores at each hospital to determine whether the scores have improved or declined. The study aims to provide a deeper understanding of challenges and opportunities related to the sustainable access to and provision of safe water in Honduran hospitals operating GE water filtration systems. Evaluating operation and performance of these systems on four sustainability domains (on-site capacity, technical feasibility, accountability, and institutional engagement), will inform the GEF's future water filtration system donation strategies and improve strategies to increase sustainable access to safe water globally.

Methods

Research Design

During July - August 2013, a mixed methods study design was used to perform a follow-up sustainability evaluation of water filtration systems donated to four hospitals in Honduras by the GE Foundation. Methods consisted of: i) Quantitative water testing methods to determine water quality pre- and post- filtration, and ii) Mixed methods (quantitative and some qualitative) to collect data on the knowledge, practices, and attitudes (KAP) of the hospital staff, patients, and visitors on safe water provision and use at the hospital level. Each study site was visited twice between July and August 2013, with water quality testing, interviews, and surveys conducted during each round of site visits. Measurements collected in the 2013 evaluation were compared to data collected during the 2012 baseline study. Lastly, data from each year were used holistically to calculate annual sustainability scores for safe water provision and use in each hospital using the sustainability metric developed by the CGSW at Emory University.

Project site and study population

Four hospitals in Honduras where the GE Foundation donated GE water filtration systems were selected as project sites (Figure 1): Juan Manuel Galvaz Hospital in Gracias, Enrique Aguilar Cerrato Hospital in La Esperanza, San Lorenzo Hospital in San Lorenzo, and Anubal Murillo Escobar Hospital in Olanchito. Each hospital is a district-level government hospital serving a variety of socioeconomic groups, with catchment populations between 120,000 and 350,000, and serving 150 to 180 patients per day.

Recruitment of survey participants occurred within various departments of each hospital through convenience sampling. Surveys were conducted with 18-21 staff at each hospital, including: doctors, nurses, patients, visitors, and other staff members (kitchen, stock room, laundry room). All consenting individuals, 18 years and older, were considered for interviews regardless of

ethnicity, socioeconomic status, religion, or sex. The in-depth interviews were targeted towards the hospital director, administrator, members of the maintenance team, and laboratory staff whose role it is to test the chlorine residual levels of the water.

Figure 1: Map of Honduran Hospital Sites with GE Water Purification Systems [44]

Tool Development

The structure and standardization of the survey and interview tools were based on the results from surveys conducted in the summer 2012 baseline evaluation. Survey and interview tools were reviewed and revised in May and June of 2013 in order to strategically collect richer data for a more informative follow-up evaluation. Tools were first developed in English (Appendix 1) and then translated into Spanish (Appendix 2). Databases were created in Microsoft Excel for in-country data entry using final data collection tools.

Interviews and KAP Surveys

Structured and standardized individual in-depth interviews and surveys were used in the evaluation and determination of the KAP of hospital staff about water use practices. KAP surveys consisting of 12 to 20 questions were administered orally in Spanish by the researchers to clinical staff, non-clinical staff (i.e. kitchen, janitorial, administrative, etc…), patients, and visitors. Both open-ended and closed-end questions collected demographic information and information on personal and observed water use practices. Together, the KAP were examined in terms of sustained water provision and use [45].

Structured in-depth interviews were conducted in Spanish with the hospital director, hospital administrator, key maintenance staff, and key laboratory staff at each hospital. Key staff were defined as those with direct responsibilities related to the water purification system. Topic areas for both open-ended and closed-end in-depth interview questions included:

- Demographic Information
- Water Sources, Water Availability, and Water Demand
- Water Treatment
- Training and Capacity Building
- Maintenance, Repairs, and Replacements
- Finance Mechanisms
- Satisfaction and Perceived Value
- Educational Messaging

Data collected from the surveys and interviews were translated verbatim into English after each hospital visit and entered into computer databases. Any need for clarification after translation, was addressed on the second day or during the second visit to the respective hospital.

Water Sample Collection

Water samples were obtained from 7-25 specific access points in each hospital over the course of two site visits. Sample collection points included: original water source (i.e. cisterns), sites directly after treatment, POU throughout the hospital, and bottled water provided in the hospital (from the water filtration system or purchased). Each sample was assessed for total coliforms, *E. coli*, *P. aeruginosa,* chlorine residual, and turbidity. The process of sample collection involved the use of two Whirl-Pak® bags (with sodium thiosulfate to neutralize chlorine) to collect (2) 100mL samples for microbiological analysis. An additional (1) 100mL sample was collected in a Whirl-Pak® bag (without sodium thiosulfate) to be tested for chlorine residual and turbidity. Samples were transported on ice to a temporary laboratory established in the investigator's lodging, and then processed within 1 hour of sample collection. Negative controls using sterilized, autoclaved water from the U.S. were used to confirm the validity of each test.

Water Quality Testing

Water quality was assessed through determining the concentration of total coliforms, *E. coli*, and *P. aeruginosa* in water samples as well as measuring levels of chlorine residual and turbidity. Chlorine residual is the total chlorine concentration in water, an aggregate of the concentrations of free chlorine and combined chlorine [30]. Turbidity is a measure of water clarity and is calculated as a measurement of the quantity of light that is scattered by suspended particles in the water. A majority of suspended particles range in size from 0.004mm to 1.0mm and can include soil particles (i.e. clay, silt, and sand), algae, plankton, and microbes [46].

Tests for microbial analysis of water samples were performed according to IDEXX (Westbrook, ME) manufacturer instructions. The IDEXX Quanti-Tray®/2000 (Westbrook, ME) provides quantification of total coliforms, *E. coli*, and *P. aeruginosa* based on the Standard's

Method's Most Probable Number (MPN)[4] Model using IDEXX Colilert-24® and Pseudalert® reagents [47].

For each set of samples collected from the same access point, the following steps for microbial analysis were taken:

1) Using sterile technique, IDEXX Colilert-24® was added to a sample collected in one of the Whirl-Pak® bags (with sodium thiosulfate) and IDEXX Pseudalert® was added to the sample collected in the other Whirl-Pak® bag (with sodium thiosulfate). The reagents were thoroughly mixed with the sample until dissolved.

2) The undiluted contents of each Whirl-Pak® bag was then emptied into two uniquely labeled Quanti-Trays®, avoiding touching the opening of the tray or creating bubbles in the sample.

3) Each tray was then sealed in a Quanti-Tray® sealer.

4) Each tray was placed in an incubator at 37.5˚C for 18 hours for samples tested for total coliforms and *E. coli* using IDEXX Colilert-24®, and 24 hours for samples tested for *P. aeruginosa* using IDEXX Pseudalert®.

5) Following the necessary incubation time, trays were removed from the incubator and examined under normal and UV light to calculate the MPN/100mL of each sample for total coliforms, *E. coli,* and *P. aeruginosa.* The disposable IDEXX Quanti-Tray® allows for MPN counts from 1/100 mL to 2,419/100 mL in an undiluted sample.

Samples collected in the Whirl-Pak® bag (without sodium thiosulfate) were analyzed for chlorine residual and turbidity and tests were performed according to manufacturer instructions. Chlorine residual levels were tested using a LaMotte Single Test Colorimeter® Model 1200 (Chestertown, MD). Turbidity was measured using a Hach 2100P Portable Turbidimeter® (Loveland, CO). The portability and simple function of these tools make them well suited for fieldwork and low-resource environments [28].

[4] Most Probable Number is a statistical method used to estimate the concentration of microbiological organisms in a known volume.

During analysis, water was assessed against WHO drinking water quality guidelines for safe drinking water (<1 MPN/100mL of total coliforms and *E. coli*) and CDC guidelines for chlorine residual levels for safe drinking water (0.2-2.0 ppm) [21, 30].

Hospital Facility Inspections

Standardized observations of the WASH infrastructure were conducted throughout each hospital. These facility inspections consisted of systematic observations of the taps through which water could be delivered. Water taps were consistently observed in the same seven departments of each hospital: Pediatrics, Labor and Delivery, Surgery, Pharmacy, Laboratory, Out Patient, and Kitchen. These departments were chosen based on the vulnerable nature of the populations in those departments, vital need for water in daily operations, and accessibility. Each tap was observed for the following characteristics: functionality, presence of a leak, presence of soap, and staff or patient use/access. Additional facility inspections included observations of the cisterns where municipal water was stored, chlorine solution tanks, numbers and types of toilets, the water purification systems and the surrounding areas, and any visible educational messages about WASH found throughout the hospital.

Sustainability Scoring

The original sustainability metric was designed by the CGSW in 2012 and used in the baseline study [14, 15]. In the summer of 2013, the metric was modified with guidance of the previous evaluators to better fit the scope of this follow-up study (Appendix 3). The metric measures sustainability of four domains (Figure 2): *on-site capacity, technical feasibility, accountability, and institutional engagement*. The domains are further separated into four sub-domains each. Each sub-domain is additionally divided into several broad questions targeting different aspects of sustainability identified in the literature. As survey and in-depth interview

participants could not be directly asked these broad questions, more specific interview and survey questions were created to inform each broad question. Quantitative (i.e. water quality and survey) and qualitative (i.e. in-depth interviews) data contribute to the determination of a sustainability score between 0.0 and 4.0 for each broad question according to pre-defined definitions. Each individual broad question is weighted to contribute evenly to sub-domain sustainability scores (Figure 3). The domain score for a hospital is the calculated mean of the corresponding four sub-domain scores (Figure 3). The overall sustainability score for each hospital is the calculated mean of each domain.

Each hospital receives an overall sustainability score between 0.0 and 4.0. A score of 2.0 is defined as the cut-off for sustainability. Below this point there is little or no evidence of enabling environments for sustained safe water provision and use in regards to the donated water filtration systems. A score of 4.0 is the highest attainable and indicates greatest sustainability. Each of the four domains is weighted equally. Sustainability scores are represented through radar plots created in Microsoft Excel.

Figure 2: The Four Domains of Sustainability and Sub-Domains.

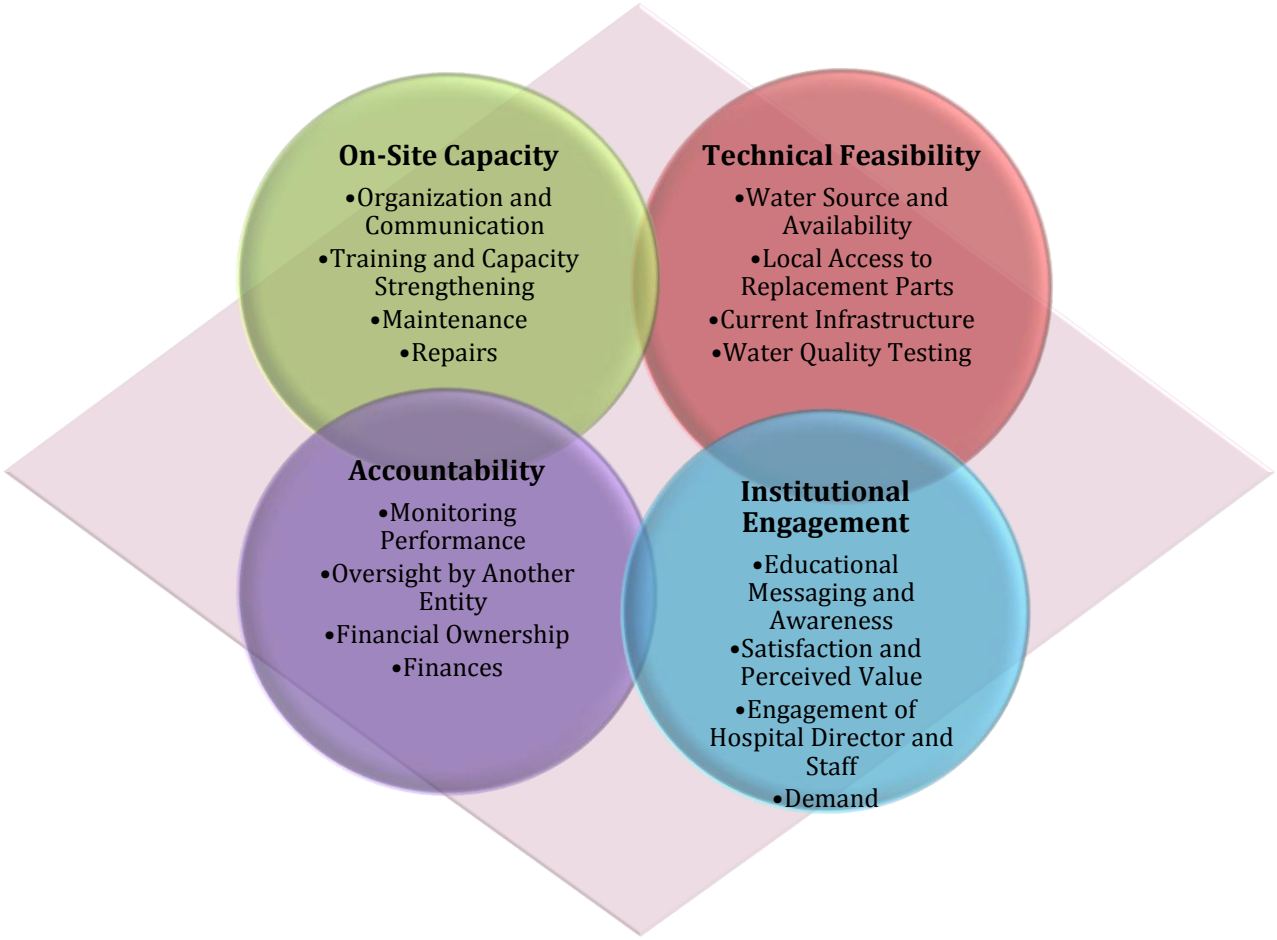


Figure 3: Calculation Table for Accountability Domain in 2013.

Domain	Sub-Domain	Broad Questions	Gracias	La Esperanza	Olanchito	San Lorenzo
Accountability	Monitoring Performance	Does the hospital perform monitoring activities?	3	4	2	2
	Oversight by another entity	Is there oversight by another entity?	3	2	2	1
		Do the hospital and GE successfully communicate with each other?	2	3	4	1
	Sources of Funding	Does the hospital rely on external funding for its water system?	2	4	2	3
	Finances	Is the hospital able to pay reoccurring costs for the system and does it maintain a record of their finances regarding the water system?	3	3	2	2
	Accountability Average Sustainability Scores		**2.6**	**3.4**	**2.3**	**2.0**

Data Management and Analysis

Samples tested for water quality were analyzed on the same day as collection. After appropriate processing, the results were shared with each respective hospital on the second day of each visit. Results dissemination functioned as an important educational tool to help staff understand the hospital water quality and consider potential courses of action to improve or maintain water quality.

Both quantitative and qualitative results were coded and manually entered into the Microsoft Excel databases created in May and June 2013. While in the field, databases were stored on secure personal computing devices.

Analysis took place at the CGSW using Microsoft Excel and *SAS* 9.2 (Cary, NC). Analysis involved basic descriptive analyses and tests for statistical associations as described in the sections below. Together, these analyses in combination with key themes determined using qualitative data, contributed to the determination of the final sustainability score for each hospital.

Water-Use Practices and Perceptions

For the purposes of analysis, the quantitative description of water-use practices and perceptions is limited to hospital staff. Staff was defined to include the hospital director, hospital administrator, key maintenance staff, key laboratory staff, clinical staff, and general staff whom participated in a water-use survey at each hospital. Using quantitative binary responses to questions specific to water-use practices and perceptions, analysis included the determination of the frequency of responses. Responses were aggregated and quantified at the hospital level and at the combined level across all hospitals. Chi-square tests of association using *SAS* 9.2 (Cary, NC) were conducted in order to determine whether or not statistically significant associations existed between the self-reported KAP among hospital staff – specifically the association between staff being aware of the water filtration system and thinking the tap (treated or untreated) water was safe to drink, and then between staff

thinking the tap (treated or untreated) water was safe to drink and drinking the tap (treated or untreated) water. Investigators displayed data using bar charts created in Microsoft Excel.

Total coliforms, E. coli, and P. aeruginosa Concentration Trends: 2012 vs. 2013

Using the processes described earlier in *Water Sample Collection* and *Water Quality Testing,* results were used to determine the trends in the concentrations of total coliforms, *E. coli*, and *P. aeruginosa* at each hospital site in each year of evaluation. Using a logarithmic scale, samples were categorized by concentration as a measurement of MPN per 100mL of sample for each microbiological organism investigated. Categories included: <1MPN/100mL, 1-10MPN/100mL, 10-100MPN/100mL, 100-1,000MPN/100mL, and >1,000MPN/100ML. Frequencies were calculated for each category and displayed on bar charts in order to observe trends using Microsoft Excel.

Water Quality According to Drinking Water Quality Guidelines: 2012 vs. 2013

Following determination of microbiological concentration of total coliforms and *E. coli* in each water sample, as well as the chlorine residual level, water quality data were coded "yes" or "no" depending on whether or not the individual sample met drinking water quality guidelines (<1 MPN/100mL for total coliforms, *E. coli,* and 0.2-2.0 ppm for chlorine residual) [21, 30]. Inclusion and exclusion criteria were created to determine which samples would be categorized as POU samples, as those samples were the focus of this analysis.

- Inclusion criteria: all samples taken from the system and throughout the piped network of the hospital where water is accessed for drinking or medical purposes. Analysis of samples according to drinking water quality guidelines only included samples tested for total coliforms, *E. coli*, and chlorine residual. *P. aeruginosa* was not included POU samples were not tested for *P. aeruginosa* in 2012.

- Exclusion criteria: pre-filtered samples (i.e. directly from cistern) or purchased water
- Note: 2012 baseline evaluation included duplicate samples taken from the same location. The concentration values for these duplicate samples were averaged and included in analysis as one sample.

Using categorical dichotomous variables, a chi-square test of proportions was performed using *SAS* 9.2 (Cary, NC) in order to determine whether or not significant differences existed between the proportions of samples that met guidelines in 2012 vs. 2013. Additionally, a chi-square test of association was performed to determine the relative risk of samples not meeting drinking water quality guidelines for microbial contamination if they did not meet guidelines for chlorine residual. Investigators displayed analysis in bar charts using Microsoft Excel.

Sustainability Evaluation

Following the calculation of the sub-domain, domain, and overall sustainability scores for each hospital, a Wilcoxon Signed Rank Sum test was performed using *SAS* 9.2 (Cary, NC) in order to determine if the changes in sustainability scores between 2012 and 2013 were statistically significant. The use of this non-parametric version of a paired sample T-test allowed for the assumption that the scoring system according to the sustainability metric was not normally distributed. Sustainability scores were compared at the domain and sub-domain level within each hospital at two time points (2012 and 2013). Sustainability scores were then further compared between hospitals at a single time point (2012 or 2013).

Human Subjects and Ethical Considerations

Participation in all interviews and surveys was voluntary and no monetary incentive was offered. Verbal consent was received from all participants following a brief oral description of the study and a explicit request for consent. Prior to arriving in Honduras, the research plan was reviewed by the Institutional Review Board (IRB) at Emory University and determined to meet the criteria for exemption (IRB00057332) (Appendix 4).

Results

In total, 71 water samples were collected analyzed, 17 in-depth interviews were conducted, and 58 surveys were administered in the four hospital sites with GE water filtration systems. The results of water quality analysis and sustainability evaluation are described below in separate sections:

- Section One describes the water-use practices and perceptions at each hospital in 2013
- Section Two compares the 2012 and 2013 water quality results in terms of the concentration of microbiological organisms (total coliforms, *E. coli*, and *P. aeruginosa*) in the POU water samples
- Section Three compares 2012 and 2013 water quality at POU in reference to drinking water quality guidelines
- Section Four compares the results from the sustainability evaluations in 2012 and 2013

Water-Use Practices and Perceptions

Hospital staff routinely used tap water (treated and untreated) for personal and medical purposes. Although all data is self-reported, capturing the water-use practices at each hospital allowed for the understanding of the everyday uses of water at the tap or POU. Data was collected via a job-specific and structured water-use survey administered at the end of every survey and in-depth interview. Table 5 displays the frequency of tap water use for various activities in percentage of staff responses aggregated by hospital and all four hospitals combined.

Gracias, La Esperanza, and Olanchito hospitals were most similar in their practices related to tap water (treated and untreated) use among staff, with the proportion of staff reporting drinking tap water ranging from 50-75% across the three hospitals (Table 5). San Lorenzo differed in their tap water use in that 0% of staff reported drinking tap water or providing tap water to patients to take with medication. Consistent findings across all hospitals demonstrated that 100%

of staff reported using tap water for hand washing, food preparation, and cooking (Table 5). It can be concluded that while a majority of staff across all hospitals exhibited similar water-use practices, San Lorenzo hospital staff reported largely different practices in regards to personal and recommended consumption of water from the tap.

Table 5. Tap water (treated and untreated) use practices among staff by hospital and combined.

Water Use Activity	Gracias % (N)	La Esperanza % (N)	Olanchito % (N)	San Lorenzo % (N)	Combined % (N)
Hand Washing	100 (16)	100 (12)	100 (15)	100 (15)	100 (57)
Food Preparation and Cooking	100 (1)	100 (1)	100 (1)	100 (1)	100 (4)
Drinking	69 (16)	75 (12)	50 (14)	0 (15)	24 (57)
Giving Medications	60 (5)	50 (4)	40 (5)	0 (5)	23 (19)
Wound and Burn Care	0 (5)	0 (4)	0 (5)	0 (5)	0 (19)

An evaluation of staff KAP and an assessment of the diverse uses of tap water provided the opportunity to further determine the impact of knowledge and attitudes on water-use practices. The KAP surrounding tap water (treated and untreated) were evaluated using a job-specific and standardized set of questions administered in each survey and in-depth interview. Each bar in Figure 1, charts A-D, displays a unique element of the staff KAP related to tap water:

Knowledge - % of staff that were aware of the water treatment system

Attitudes - % of staff that thought the tap water was safe to drink

Practices - % of staff that drank tap water

Across all four hospitals a majority of staff reported that they were aware that the water filtration system existed, and the proportion of staff that thought the water was safe was less than the proportion aware of the water filtration system (by 33-86%) (Figure 4). Additionally, in each hospital except San Lorenzo (Figure 4D), a higher proportion of staff reported drinking tap water than the proportion that thought the water was safe. No statistically significant associations (*p*-

value: <0.05) were found between staff being aware of the water filtration system and thinking the tap water was safe to drink at any of the four hospitals. Furthermore, no statistically significant associations were found between staff thinking the tap water was safe to drink and drinking the tap water at any of the four hospitals.

Figure 4. Staff knowledge, attitudes, and practices surrounding hospital water at the four Honduran hospitals with GE water filtration systems in 2013.

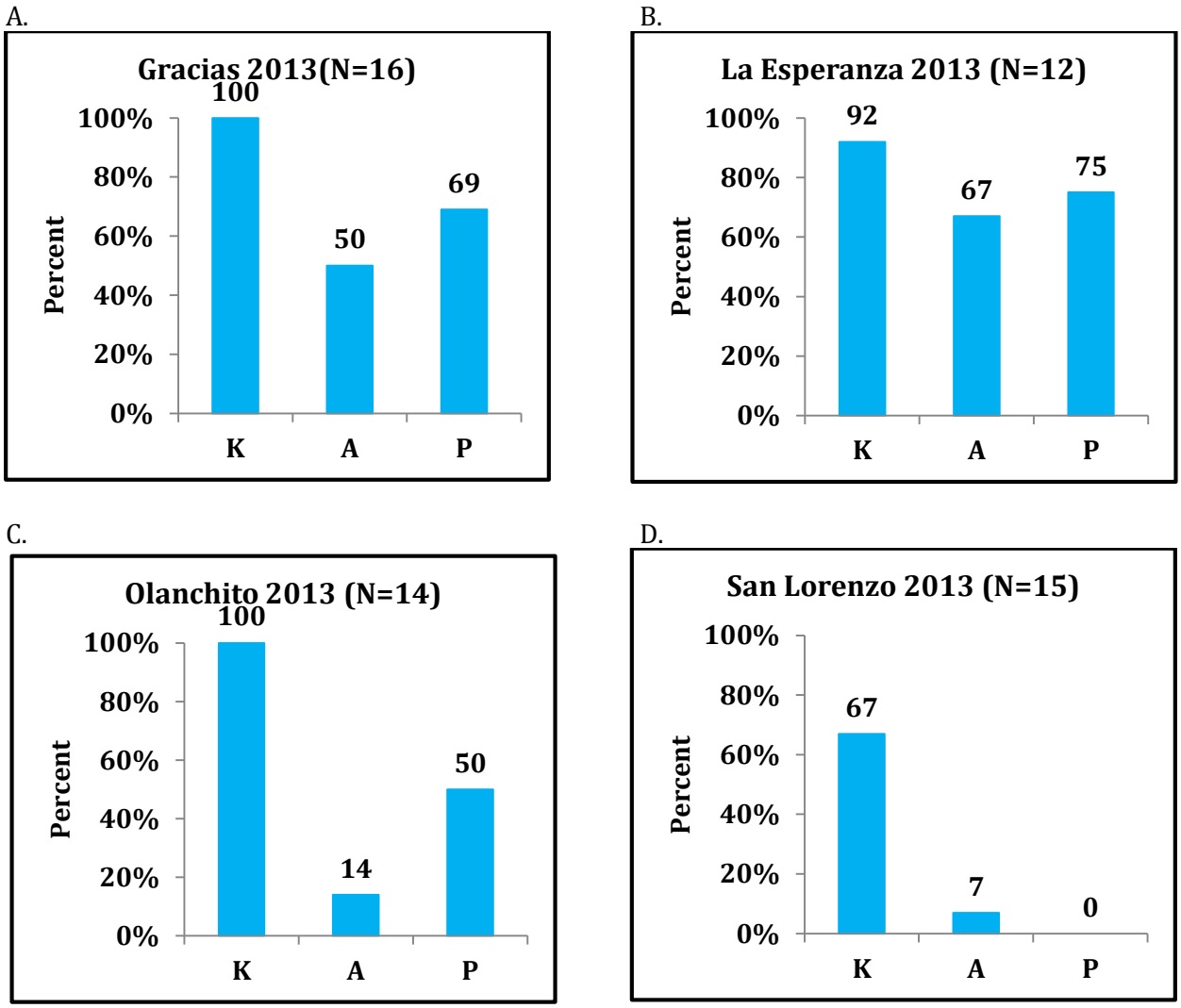


Figure 4 – Legend
K - % of staff that were aware of the water filtration system
A - % of staff that thought the tap water was safe to drink
P - % of staff that drank the tap water

Total coliforms, E. coli, and P. aeruginosa Concentration Trends: 2012 vs 2013

An examination of trends in the concentrations of total coliforms, *E. coli*, and *P. aeruginosa* was conducted to determine whether there were changes in water quality at POU between 2012 and 2013. Using a logarithmic scale, samples were categorized by concentration (see x-axis of Figures 5-9) as a measurement of MPN per 100mL of sample. The y-axis denotes what percentages of samples were categorized in each concentration range and the bars denote each target microorganism. Samples that exhibited non-detectable levels of microbiological contamination were categorized in concentration range of <1MPN/100mL.

Figure 5 demonstrates the concentration distribution of total coliforms, *E. coli*, and *P. aeruginosa* in POU samples taken at the four hospitals in July 2013. For all hospital sites, a majority of samples had <1 MPN/100mL for total coliforms and *E. coli*. All hospital sites also had samples with concentration levels >1 MPN/100mL (Figure 5). A majority of samples tested (72 – 100%) for *P. aeruginosa* had no detectable (<1 MPN/100mL) levels in three of the four hospitals – Gracias, La Esperanza, and Olanchito (Figures 5a-c). Olanchito hospital was the only site where 100% of samples tested for *P. aeruginosa* had <1 MPN/100mL (Figure 5c).

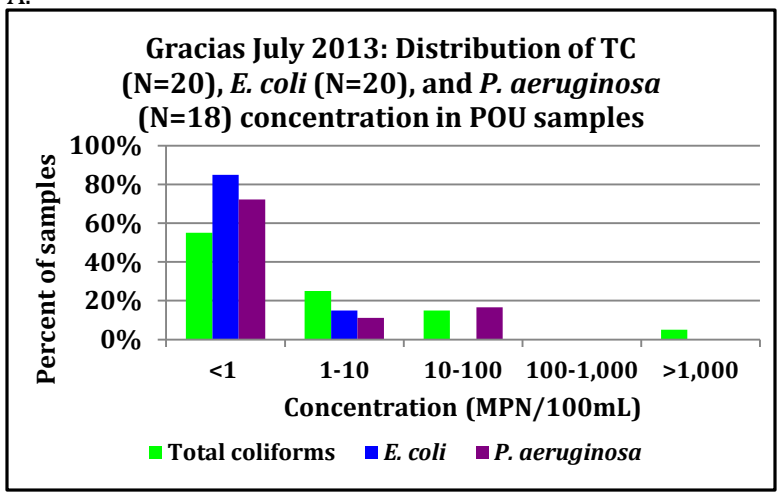
Figures 6 - 9 demonstrate the distribution of total coliforms and *E. coli* concentrations in POU samples taken at the four hospitals at three time points: April 2012, July 2012, and July 2013. April 2012 data for Olanchito hospital is not displayed because water quality samples were not taken at that time point due to scheduling conflicts. Trends demonstrate that for Gracias, La Esperanza, and Olanchito hospitals, the proportion of samples with non-detectable concentrations of total coliforms or *E. coli* either remained fairly constant or increased across the three time points from April 2012 to July 2013 (Figures 6a-c, 7a-c, 8a-c). Additionally, Olanchito hospital displayed a distribution of samples across all concentration ranges in both 2012 and 2013 for total coliforms and across a majority of concentration ranges for *E. coli* (Figures 8). San Lorenzo exhibited the most variable changes toward poor water quality between April 2012 and July 2013 – in April

2012, the proportion of samples in the non-detectable concentration range was 60% for both total coliforms and *E. coli*, these proportions increased to above 80% in July 2012 but then decreased to below 60% in July 2013 (Figure 9). The concentrations of total coliforms and *E. coli* in water samples from San Lorenzo hospital ranged from non-detectable to between 100 – 1,000 MPN/100mL in July 2013 (Figure 9).

Overall, the distributions of total coliforms and *E. coli* concentrations in water samples collected in 2012 and 2013 were similar in all hospitals except San Lorenzo. Additionally, in 2013 the concentration of *E. coli* was <1 MPN/100mL in a majority of samples (55 – 100%) for all hospitals. *P. aeruginosa* concentrations were also <1 MPN/100mL in a majority of samples (72 – 100%) in three of the four hospitals – Gracias, La Esperanza, and Olanchito while total coliform concentrations were variable across all hospitals in 2013 (Figure 5).

Figure 5. Distribution of total coliforms, *Escherichia coli*, and *Pseudomonas aeruginosa* concentration in POU samples taken at each of the four hospitals in July 2013.

A.



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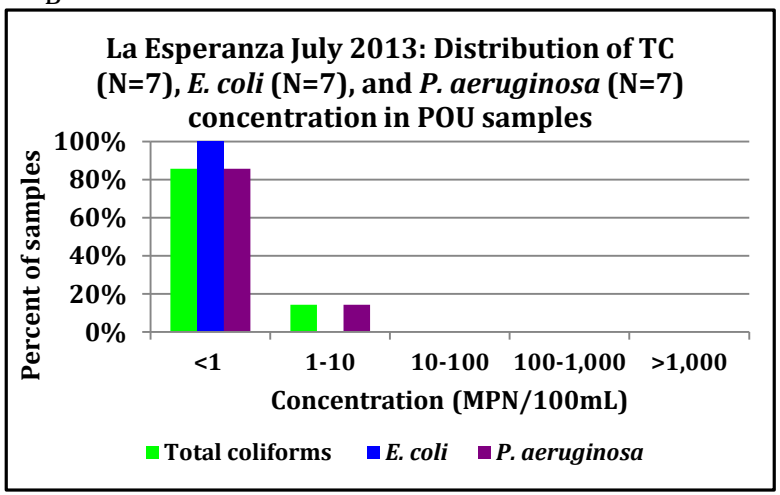
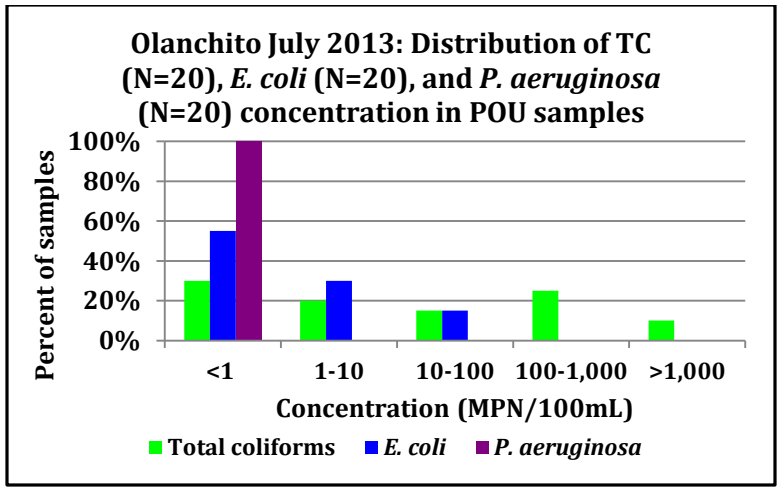


C.



D.

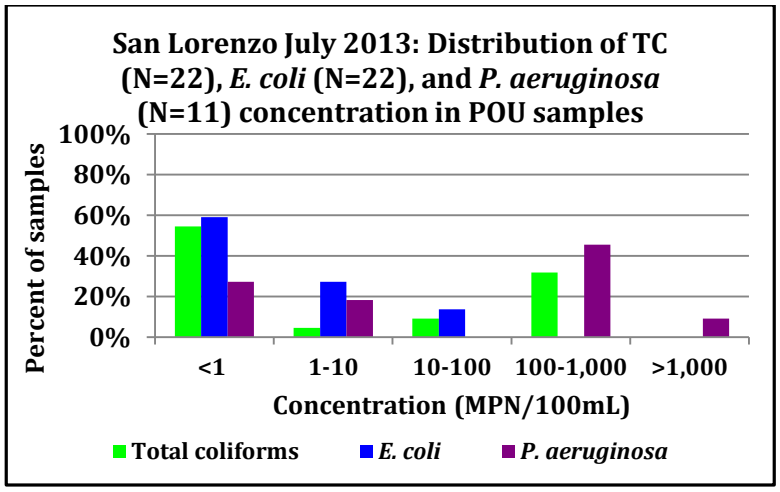
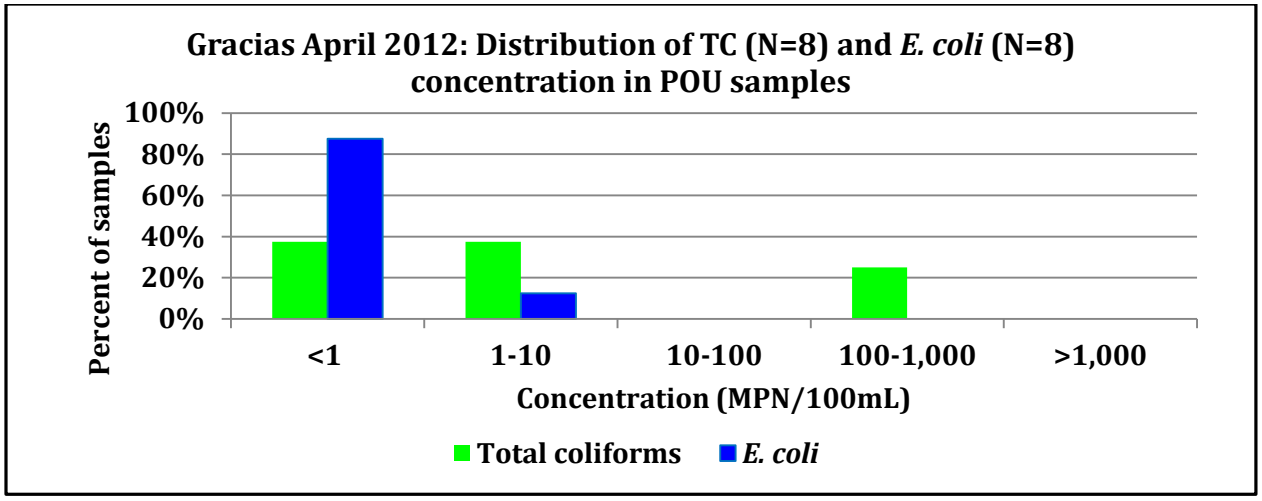


Figure 6. Distribution of total coliforms and *Escherichia coli* concentrations in POU samples taken at Gracias hospital in April 2012, July 2012, and July 2013.

A.



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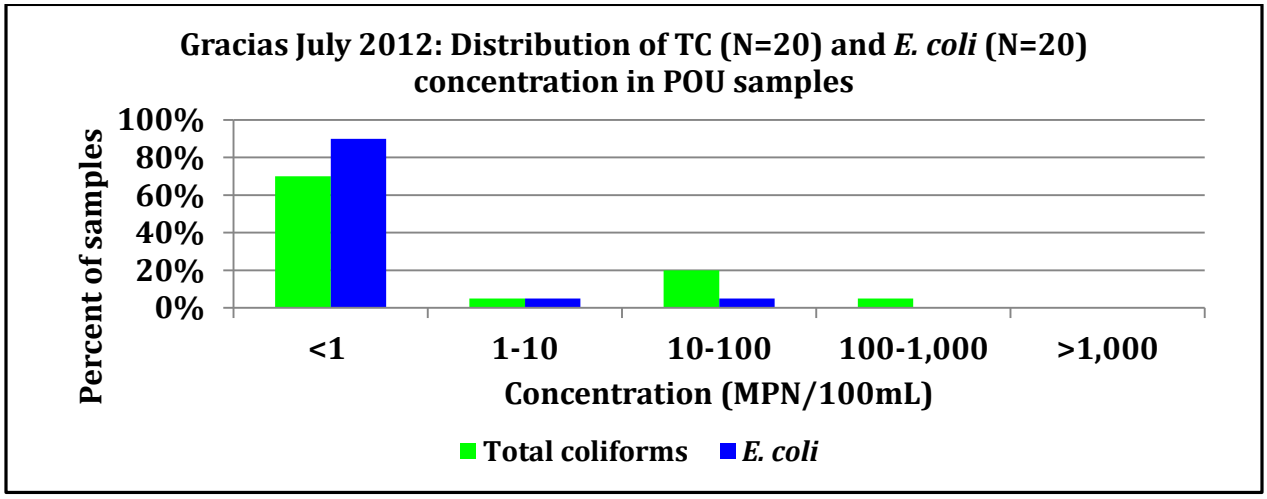


C.

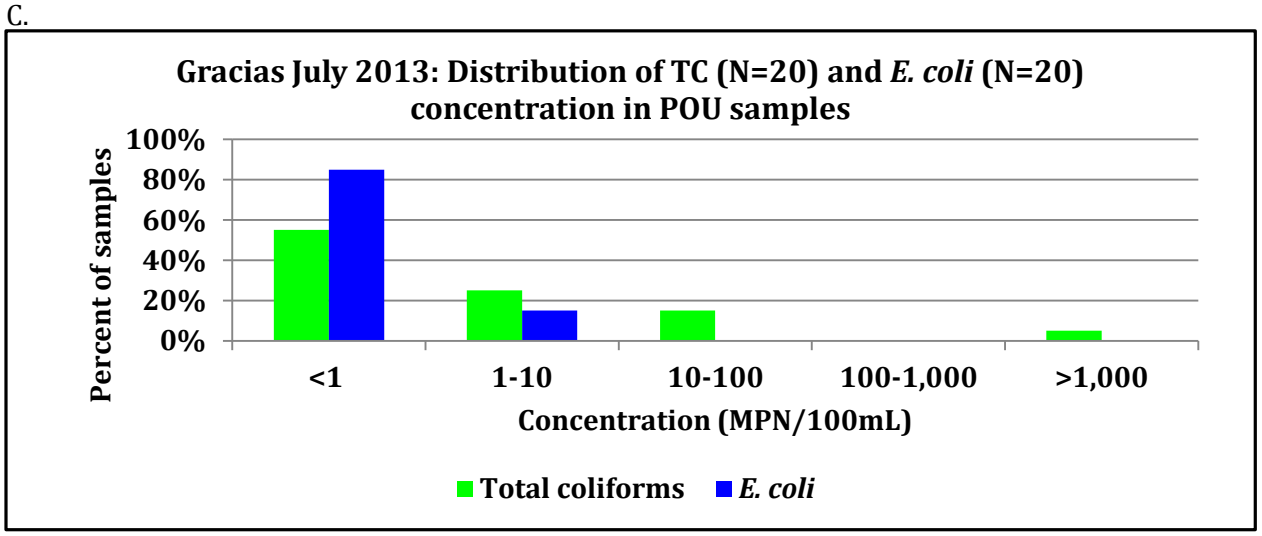
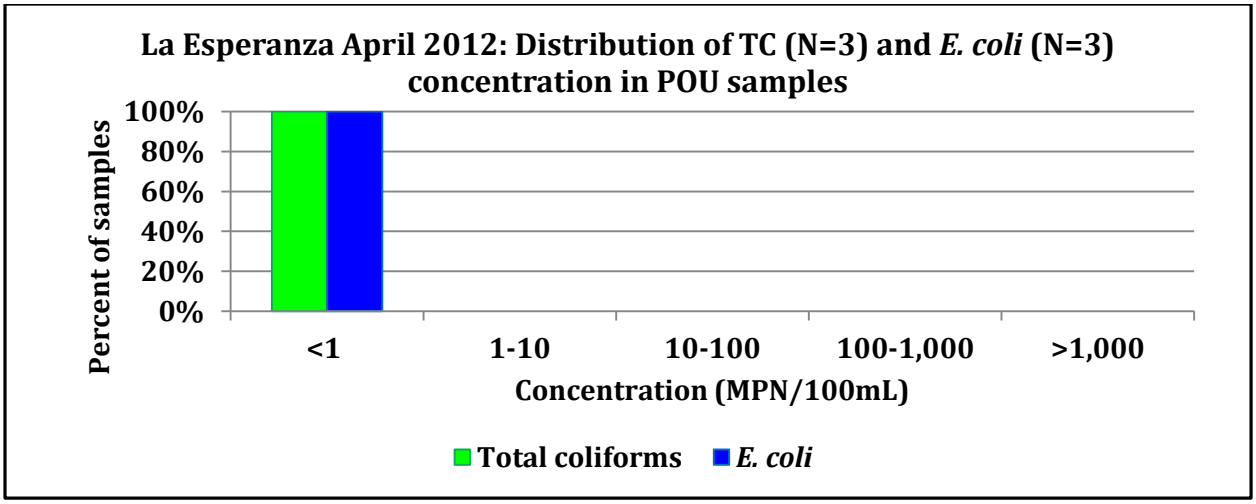
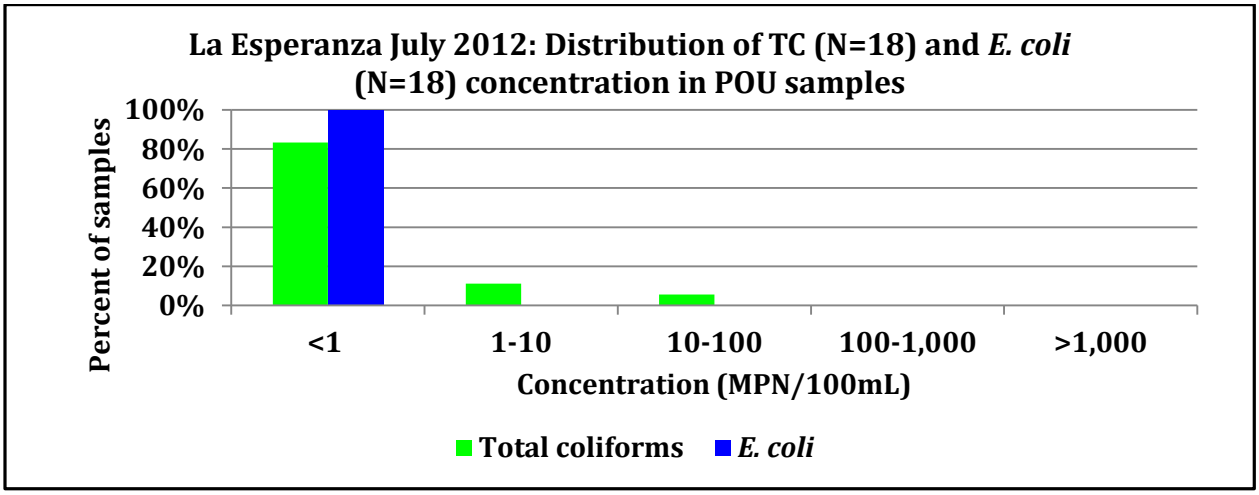


Figure 7. Distribution of total coliforms and *Escherichia coli* concentrations in POU samples taken at La Esperanza hospital in April 2012, July 2012, and July 2013.

A.



B.



C.

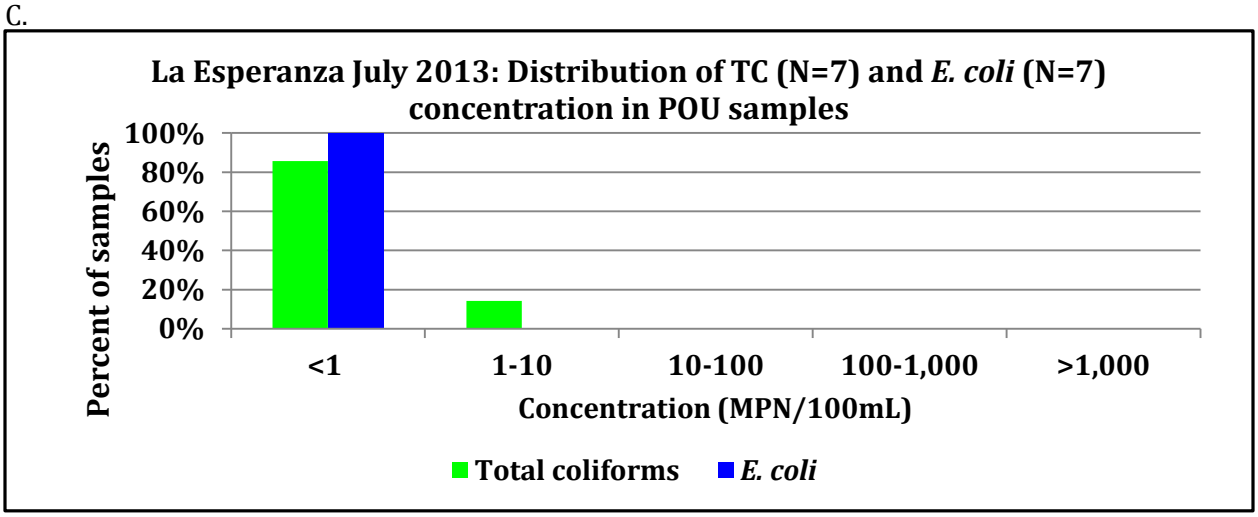
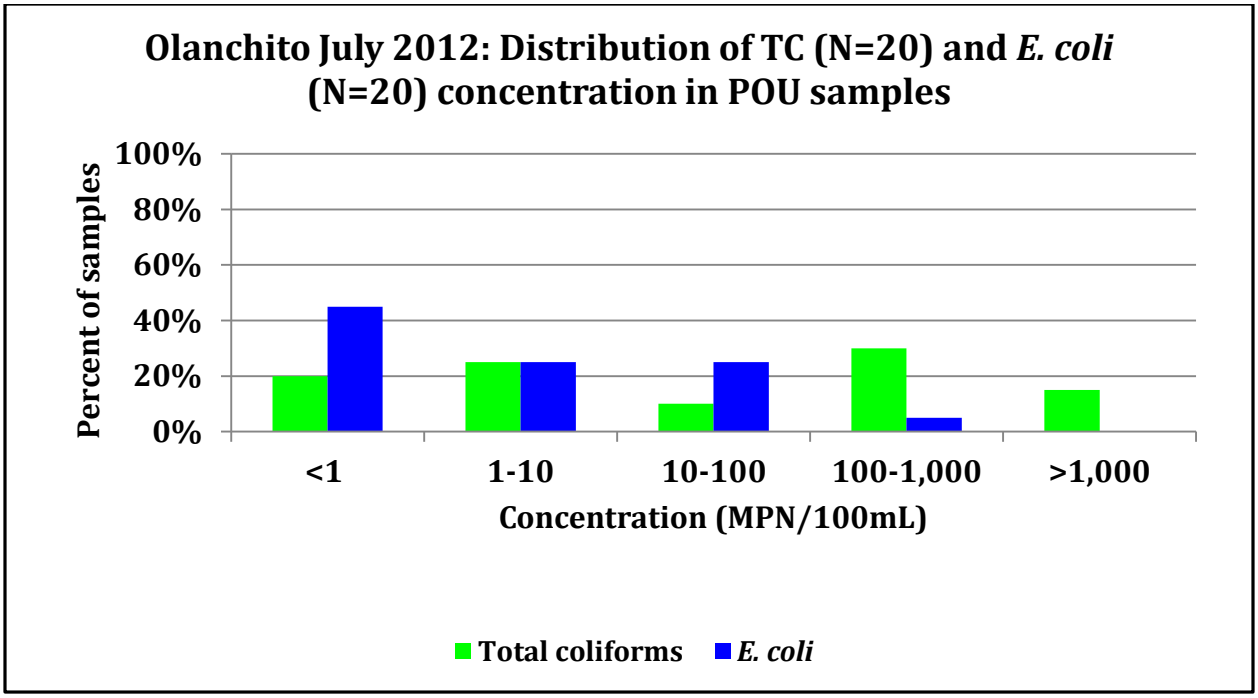
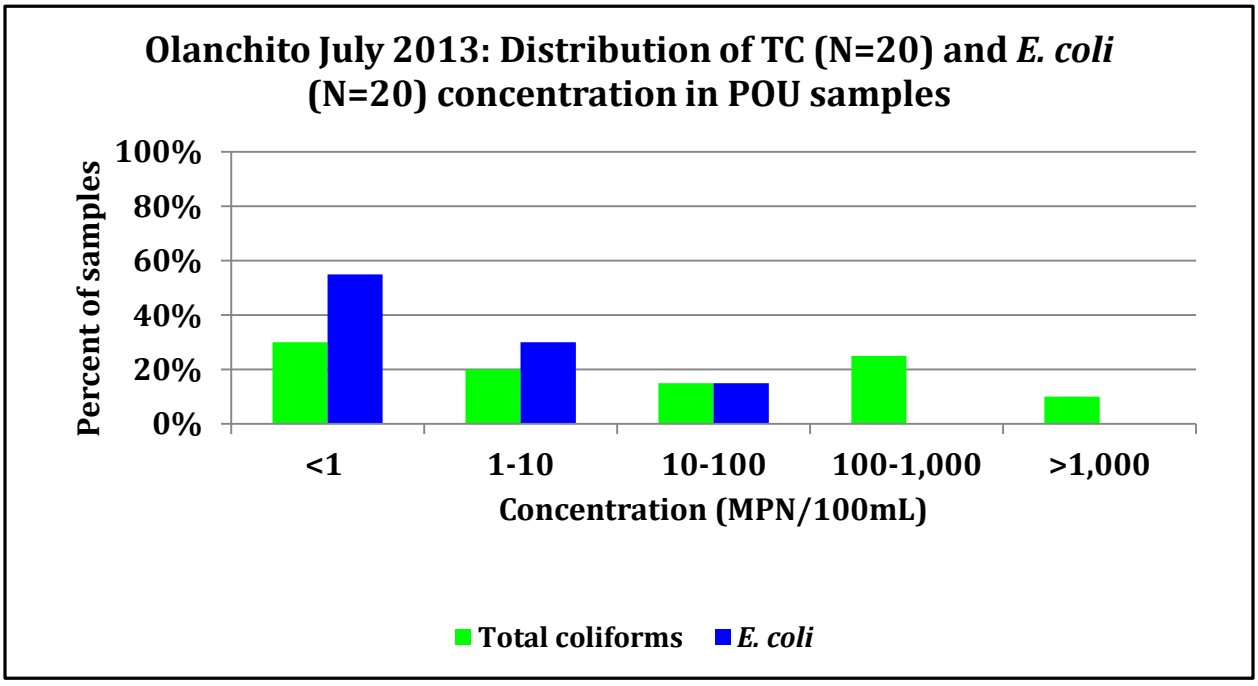


Figure 8. Distribution of total coliforms and *Escherichia coli* concentrations in POU samples taken at Olanchito hospital in July 2012 and July 2013*

A.



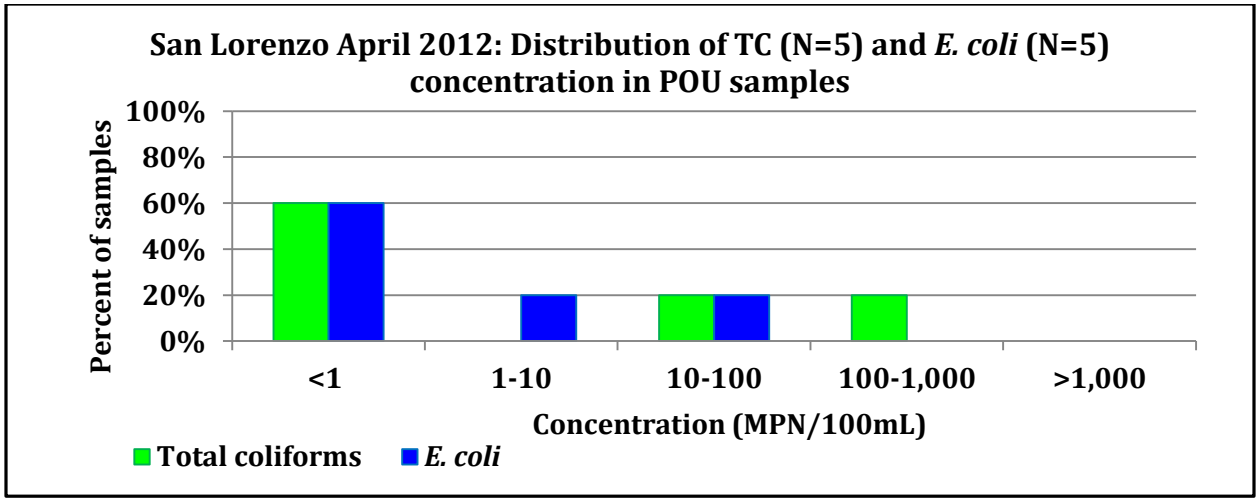
B.



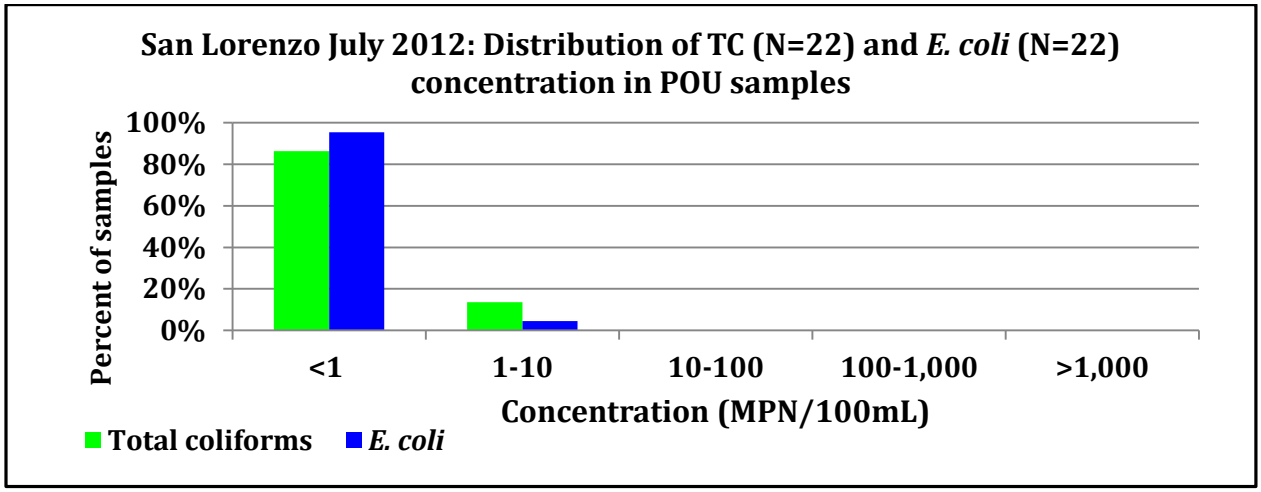
*Olanchito hospital was not visited in April 2012 therefore data are unavailable.

Figure 9. Distribution of total coliforms and *Escherichia coli* concentrations in POU samples taken at San Lorenzo hospital in April 2012, July 2012, and July 2013.

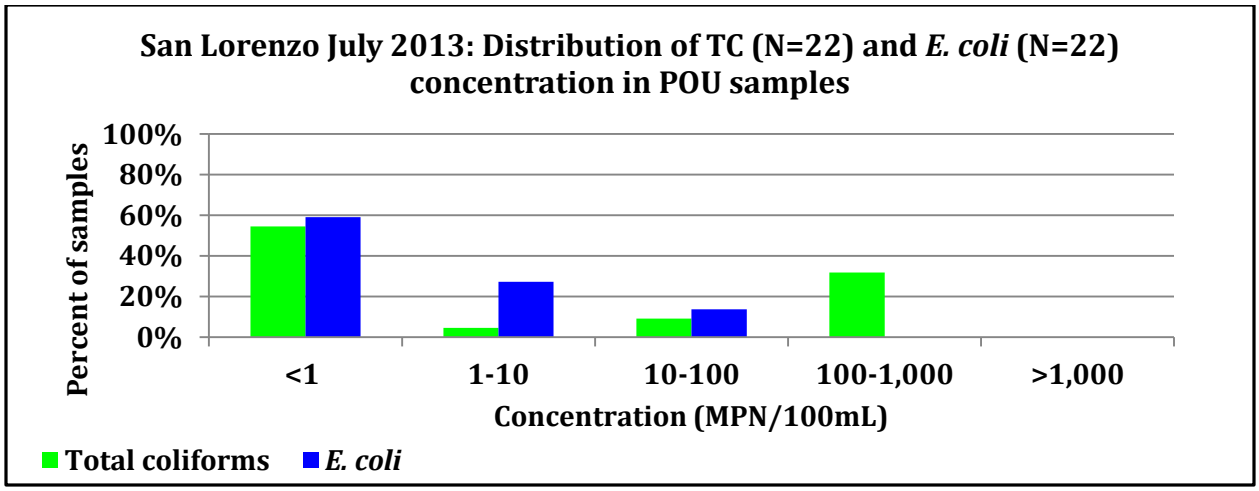
A.



B.



C.



Water Quality According to Drinking Water Quality Guidelines: 2012 vs. 2013

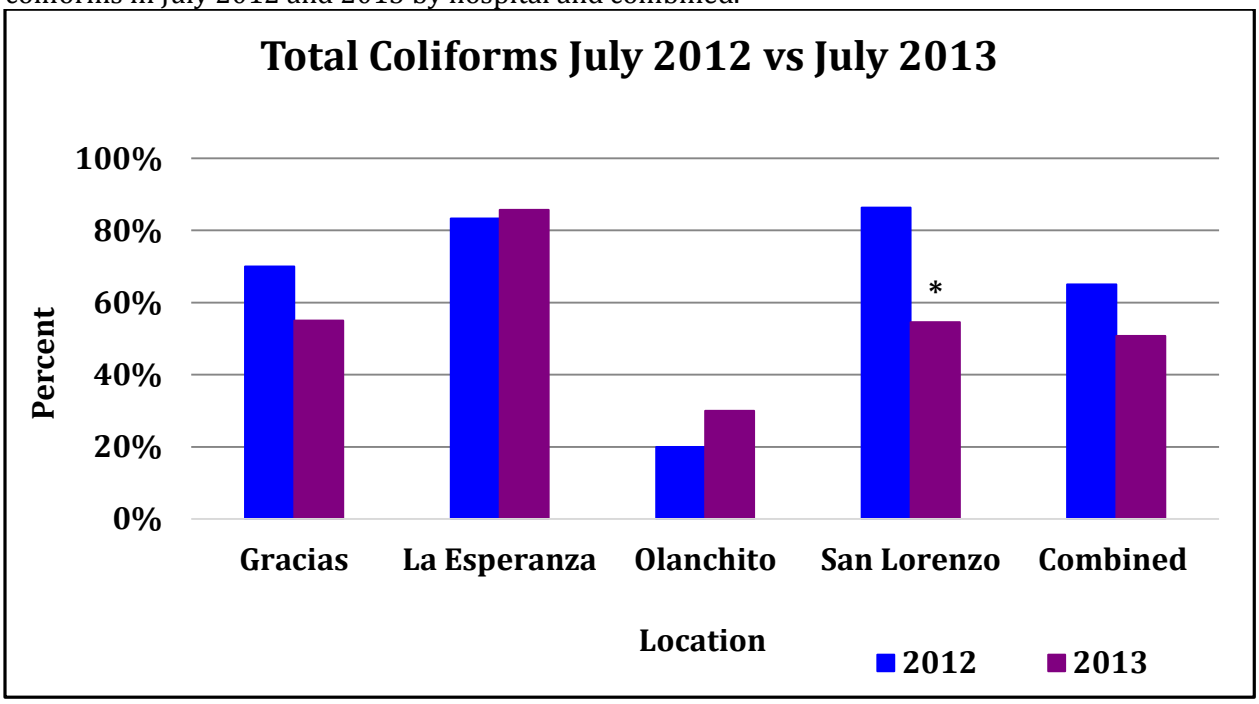
Evaluation of POU water samples according to the WHO and CDC drinking water quality guidelines allowed for the determination of the water's safety for human consumption. The research goal was to examine the differences in percentage of samples that meet drinking water quality guidelines in 2012 and 2013 at the POU where water was accessed for medical and drinking purposes.

Figures 10, 11, and 12 each display the water quality results from individual hospitals for each year as well as the aggregate data combined across hospitals on the x-axis. The y-axis displays the percentage of samples that met WHO microbiological guidelines or CDC chlorine residual guidelines for total coliforms, *E. coli*, and chlorine residual. The asterisk denotes that at a 5% significance level, the proportion of samples that met guidelines for the specific attribute of water quality was significantly different in 2013 as compared to 2012.

The proportion of POU water samples that were in compliance with WHO and CDC recommendations for microbiological quality and free chlorine residual differed across hospitals. La Esperanza was the only hospital to maintain or experience an increase in percentage of samples that met drinking water quality guidelines from 2012 to 2013 for total coliforms, *E. coli*, and chlorine residual. In contrast, San Lorenzo was the one hospital where there was a statistically significant decreases in the proportion of samples that met guidelines from 2012 to 2013 for all three attributes tested. While the changes in proportion of samples that met guidelines differed by hospital, overall, the proportion of samples that met drinking water quality guidelines decreased from 2012 to 2013 for each parameter tested (Figures 10, 11, 12). Lastly, most of the hospitals had statistically significant differences in the proportion of samples that met recommended chlorine residual levels between 2012 and 2013 (Figure 12). However, the direction of the difference varied by hospital. Three of the four hospitals had functioning chlorine treatment systems at the time of

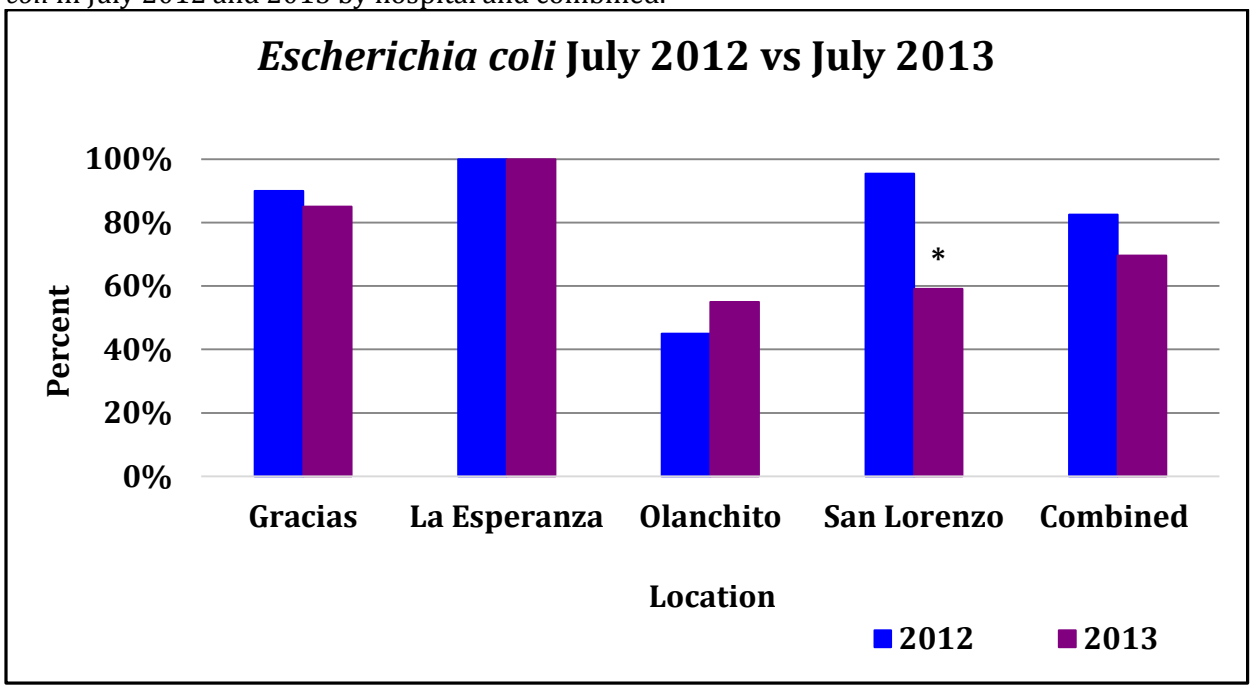
water sample collection in 2013 (Gracias, La Esperanza, and Olanchito). San Lorenzo hospital was not providing chlorine treatment during either site visit in 2013 due to a faulty chlorine pump.

Figure 10. Comparison of percent of POU water samples that met WHO guidelines for total coliforms in July 2012 and 2013 by hospital and combined.



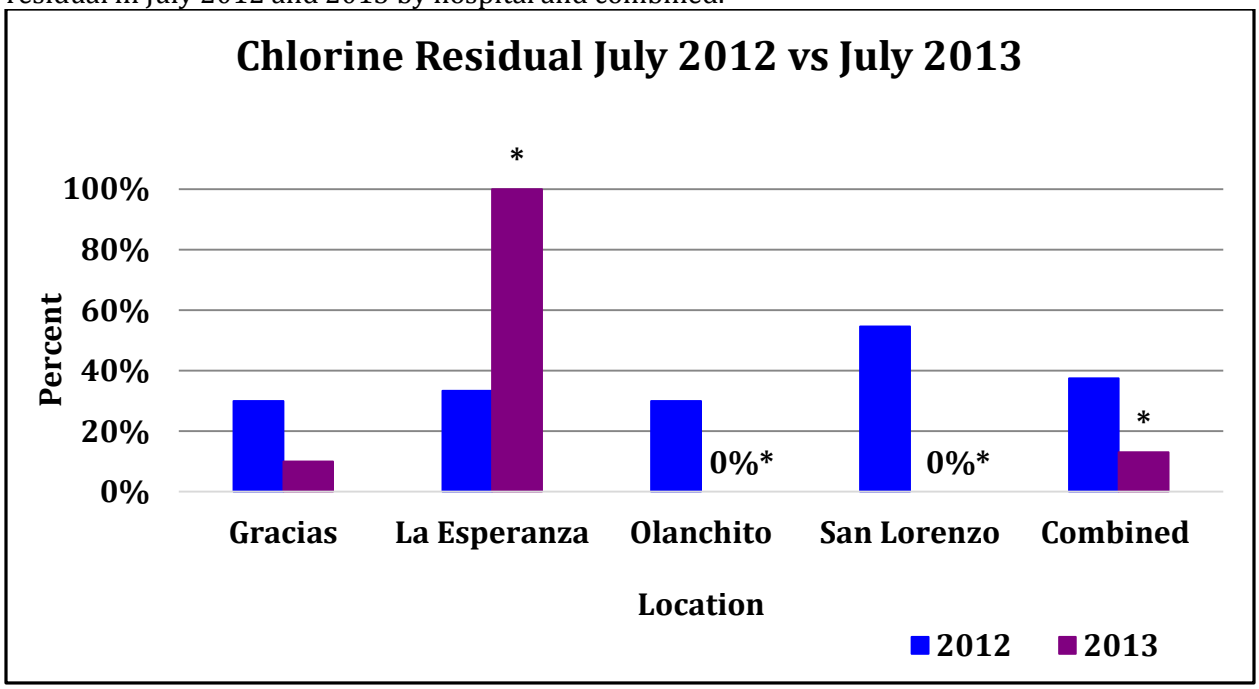
* At a 5% significance level, the proportion of samples that met guidelines for total coliforms was significantly different in 2013 compared to 2012.

Figure 11. Comparison of percent of POU water samples that met WHO guidelines for *Escherichia coli* in July 2012 and 2013 by hospital and combined.



* At a 5% significance level, the proportion of samples that met guidelines for *Escherichia coli* was significantly different in 2013 compared to 2012.

Figure 12. Comparison of percent of POU water samples that met CDC guidelines for chlorine residual in July 2012 and 2013 by hospital and combined.



* At a 5% significance level, the proportion of samples that met guidelines for chlorine residual was significantly different in 2013 compared to 2012.

Sustainability Evaluation

Identifying the specific areas of sustainability in which a hospital demonstrated either excellence or an area for improvement will inform next steps to improve the current water filtration system donation programs and strategic planning for future donations. Using the sustainability metric specifically designed for this study, informed by the literature and its previous use in the field, each hospital was systematically evaluated and an overall sustainability score on a scale of 0 – 4 was calculated (Table 6). These scores were then displayed on radar plots for 2012 and 2013 by domain (Figures 13 - 18) and for 2012 and 2013 by sub-domain (Figures 19 - 26) for each hospital.

The overall sustainability scores for Gracias, La Esperanza, and Olanchito hospitals improved from 2012 to 2013 by 0.1 to 1.2 points (Table 6). The lowest sustainability score was 1.7 in both years (Table 6) and was received by Olanchito hospital in 2012 and San Lorenzo hospital in 2013. San Lorenzo hospital had been evaluated as just below the cutoff for sustainability in both 2012 and 2013 with scores of 1.9 and 1.7, respectively.

The increases and decreases in domain scores between hospitals across the two time points of evaluation were variable and without an obvious trend (Figures 13 and 14). While each hospital demonstrated improvement toward increased sustainability scores in at least one domain, many domain scores were close to the cut-off for sustainability, especially in the domain of technical feasibility, which is commonly one of the lowest domain scores across hospitals and evaluation years (Figures 13 and 14). Hospital specific results are below:

- *Gracias:* Gracias hospital had increased scores in each of the four domains since 2012 (Figure 15). In 2013, Gracias met the sustainability cutoff score in each domain (Figure 15b). Technical feasibility continued to be the domain with the lowest score due to a decreased score in the sub-domain of *water quality testing* (i.e. poor water quality results) from 2.5 in 2012 to 0.5 in 2013 (Figure 19b and 23b). Additionally, in 2013, the *water*

quality testing sub-domain was the only sub-domain of sixteen where Gracias did not at minimum meet the sustainability cutoff score of a 2 (Figure 23b). Most of the sub-domain scores for Gracias hospital in the three remaining domains (on-site capacity, accountability, and institutional engagement) were scored 3 or higher in 2013 (Figure 23).

- *La Esperanza:* La Esperanza hospital had improved scores in each of the four domains since 2012, and surpassed the sustainability cutoff score in each domain in 2013 (Figure 16). In 2013, La Esperanza did not exhibit a single sub-domain sustainability score below the cutoff score (Figure 24). The only two sub-domains with scores less than a 3 in 2013 were *local access to replacement parts* and *oversight by another entity* with scores of 2 and 2.5 respectively (Figure 24b and 24c). The largest improvements in sub-domain scores were seen in the sub-domains of *sources of funding* and *demand*, each increasing from 1 in 2012 to 4 in 2013 (Figure 20c, 20d, 24c, and 24d).
- *Olanchito:* Although the Olanchito hospital had a decrease in the score for institutional engagement from 2012 to 2013, the hospital met the sustainability cut-off in each domain in 2013 (Figure 17). In 2013, Olanchito scored a minimum of the cutoff of sustainability score in each of the eight sub-domains under on-site capacity and accountability (Figure 25a and 25c). Olanchito scored 0 in the sub-domain of *water quality testing* in both 2012 and 2013 (Figure 21b and 25b). The score difference across all sub-domains between 2012 and 2013 did not increase or decrease by more than one point, suggesting that Olanchito hospital had a moderately consistent increase in sustainability across a majority of domains as compared to Gracias and La Esperanza hospitals (Figure 21 and 25).
- *San Lorenzo:* San Lorenzo hospital only demonstrated improvement in one of the four domains – accountability (Figure 18). Sustainability scores for technical feasibility and on-site capacity decreased since 2012 and in 2013 the hospital did not meet the sustainability cutoff in either domain (Figure 18). San Lorenzo hospital only had two of sixteen sub-

domains above the cutoff score in 2013: *current infrastructure* and *sources of funding* (Figure 26b and 26c). Seven of the sixteen sub-domains were scored exactly at the cutoff score in 2013 (Figure 26). The most variable change was seen in the on-site capacity domain where in 2012 three of the four sub-domains met the minimum cutoff sustainability score and in 2013 only one sub-domain (*repairs*) met the minimum cutoff (Figure 22a and 26a).

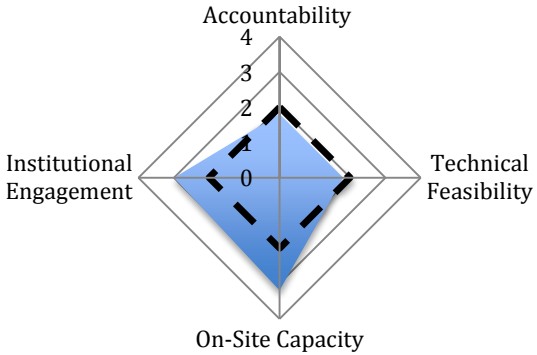
Table 6. Overall average sustainability score in 2012 and 2013 by hospital.

Hospital	Sustainability Score 2012	Sustainability Score 2013
Gracias	2.5	2.6
La Esperanza	2.3	3.5
Olanchito	1.7	2.2
San Lorenzo	1.9	1.7

Figure 13. 2012 Domain specific sustainability scores by hospital.

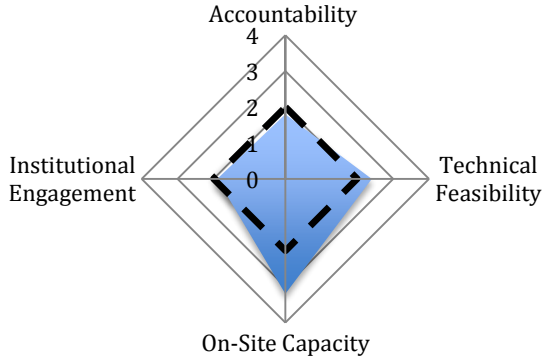
A.

Gracias 2012



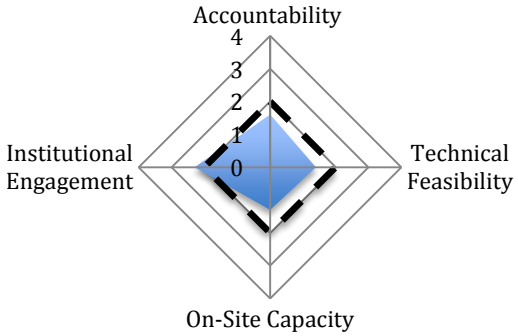
B.

La Esperanza 2012



C.

Olanchito 2012



D.

San Lorenzo 2012

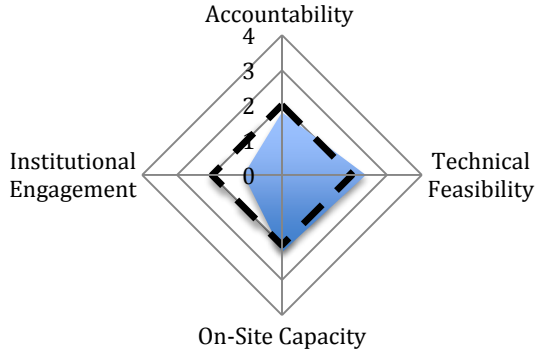
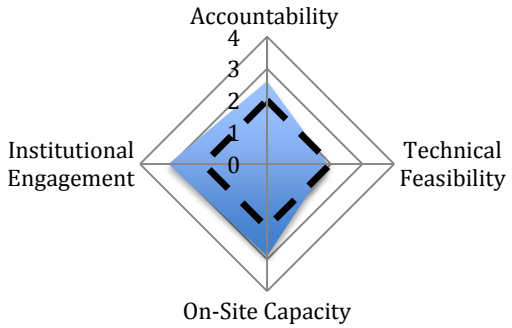


Figure 14. 2013 Domain specific sustainability scores by hospital.

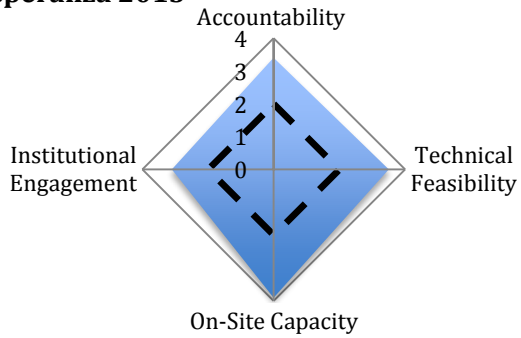
A.

Gracias 2013



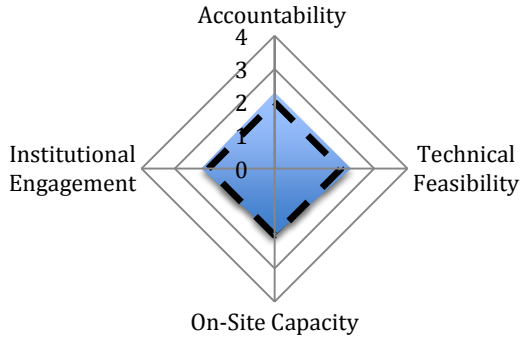
B.

La Esperanza 2013



C.

Olanchito 2013



D.

San Lorenzo 2013

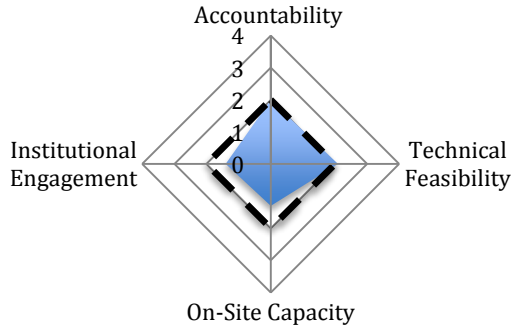
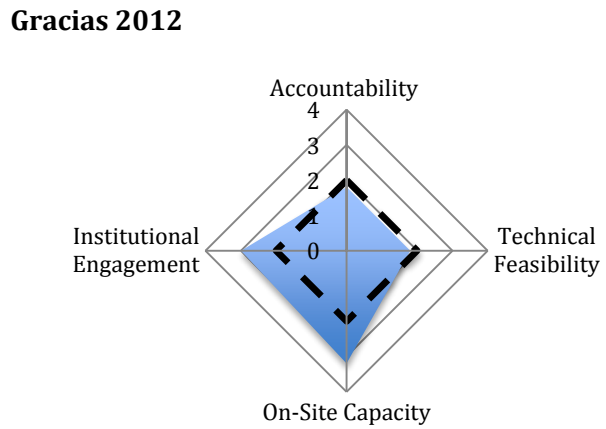


Figure 15. Gracias Hospital – Sustainability domain scores 2012 vs 2013.

A.



B.

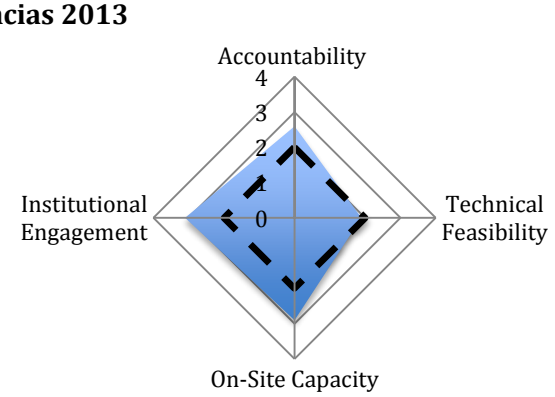
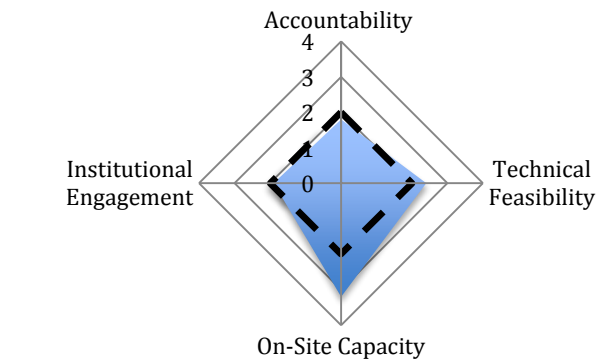


Figure 16. La Esperanza Hospital – Sustainability domain scores 2012 vs 2013.

A.



B.

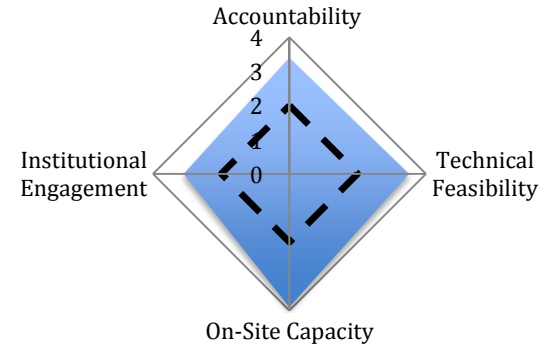
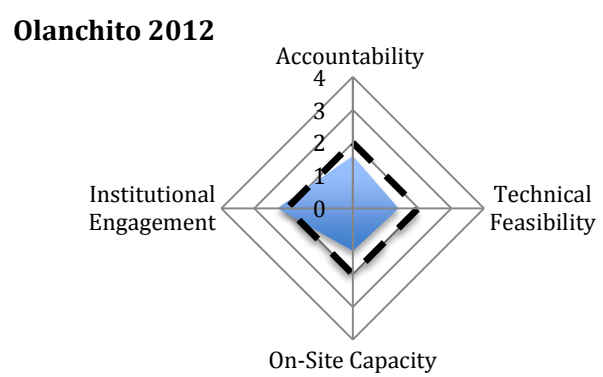


Figure 17. Olanchito Hospital – Sustainability domain scores 2012 vs 2013.

A.



B.

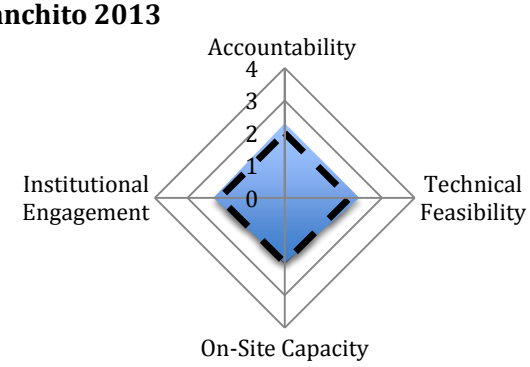
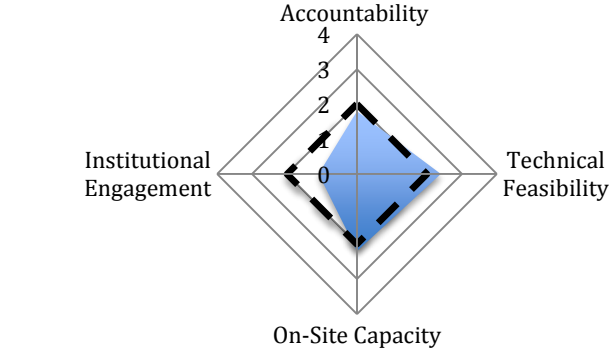


Figure 18. San Lorenzo Hospital – Sustainability domain scores 2012 vs 2013.

A.



B.

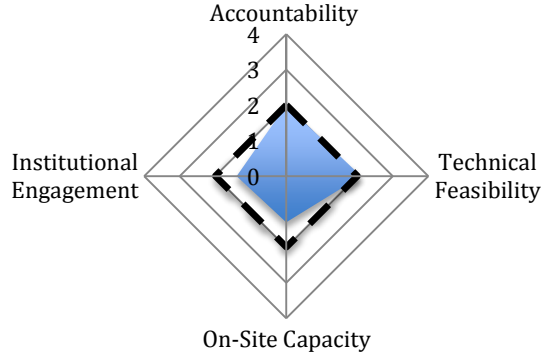
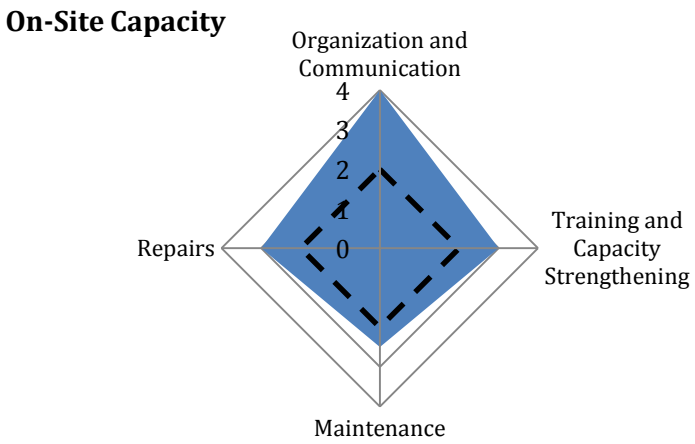
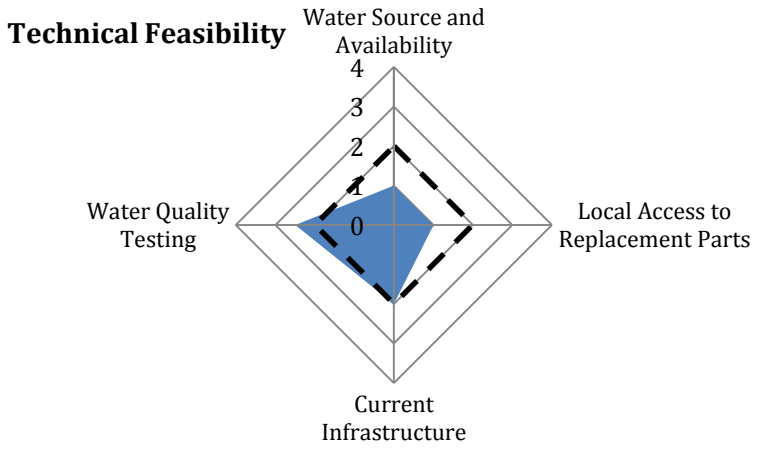


Figure 19. Gracias Hospital 2012 Sub-domain specific sustainability scores.

A.



B.



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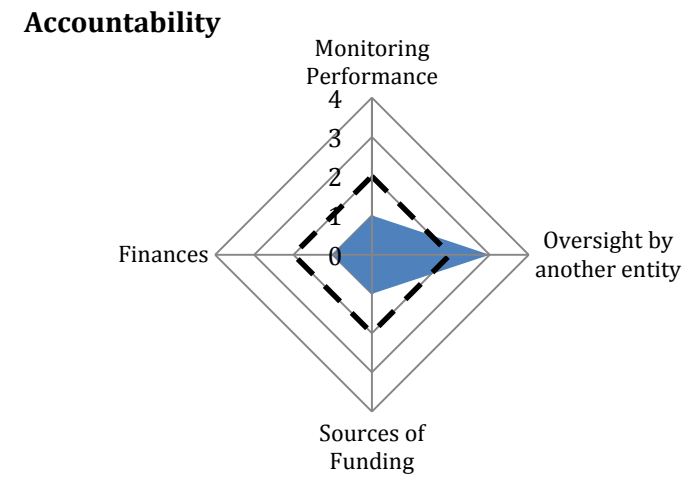


D.

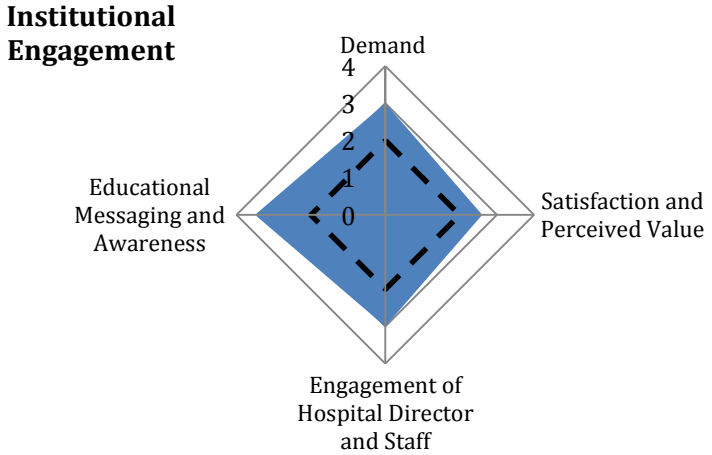
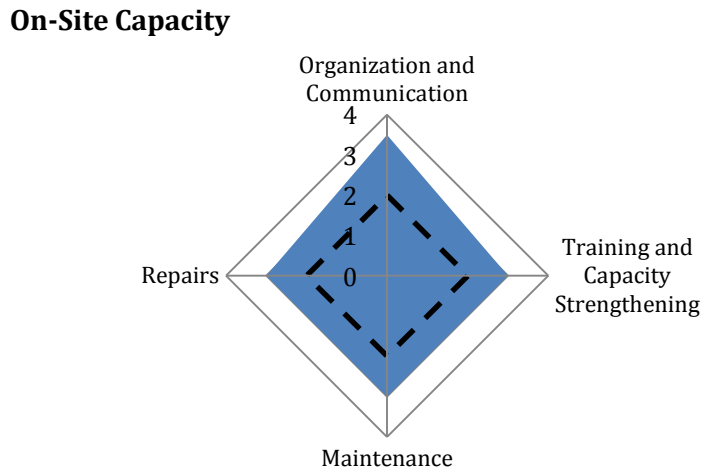
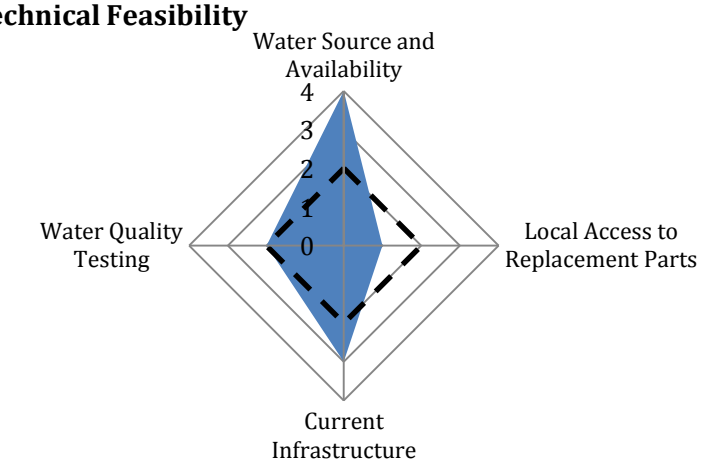


Figure 20. La Esperanza Hospital 2012 Sub-domain specific sustainability scores.

A.



B.



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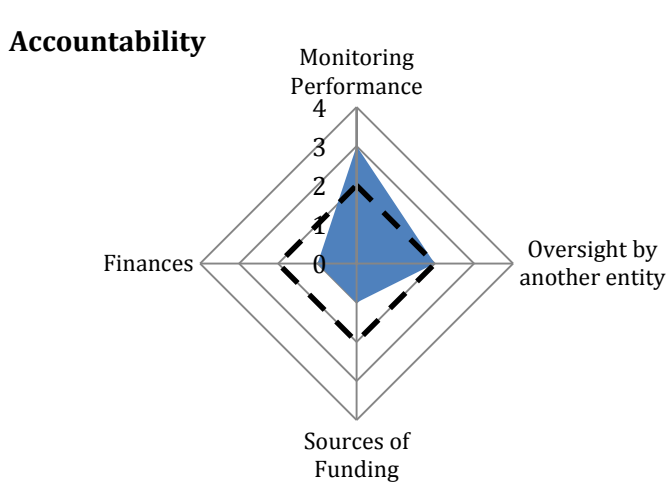


D.

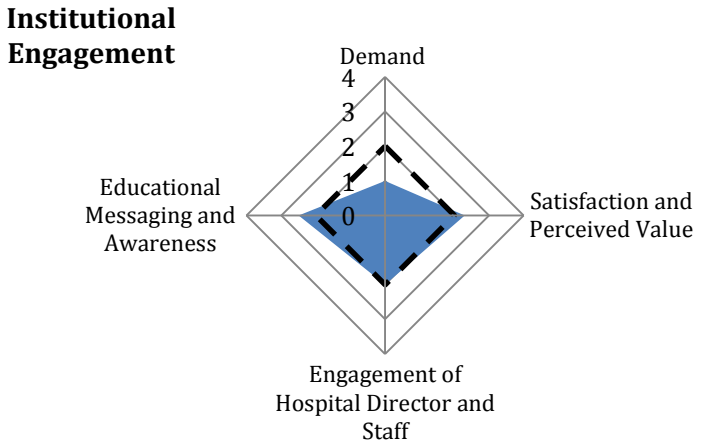
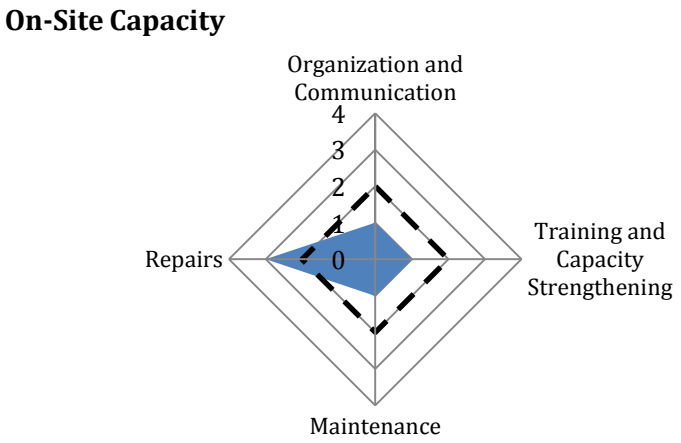
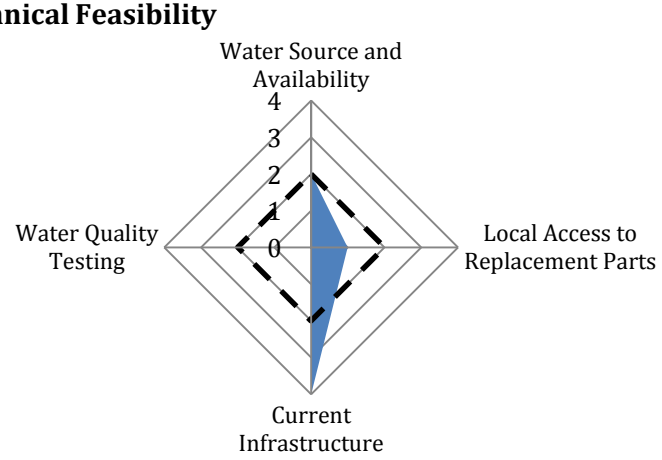


Figure 21. Olanchito Hospital 2012 Sub-domain specific sustainability scores.

A.



B.



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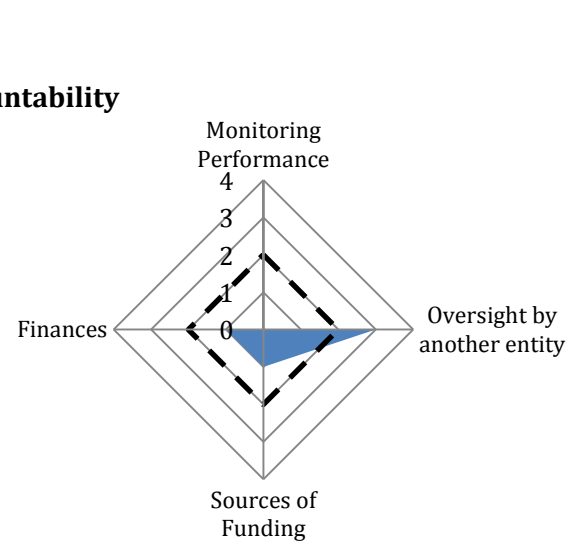


D.

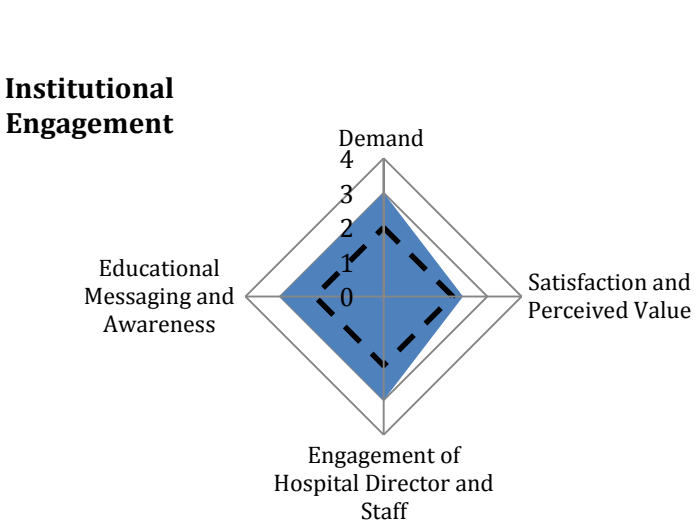
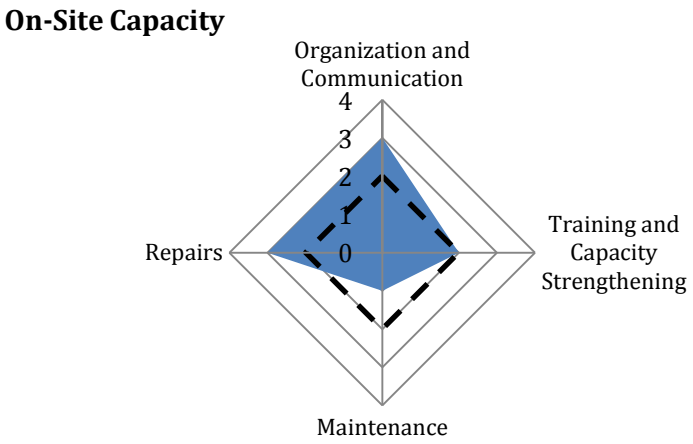
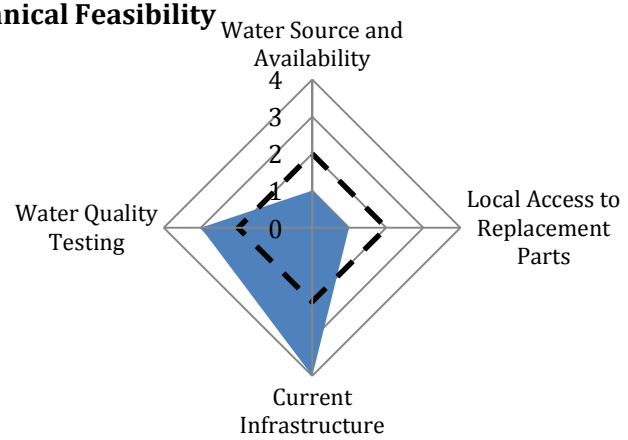


Figure 22. San Lorenzo Hospital 2012 Sub-domain specific sustainability scores.

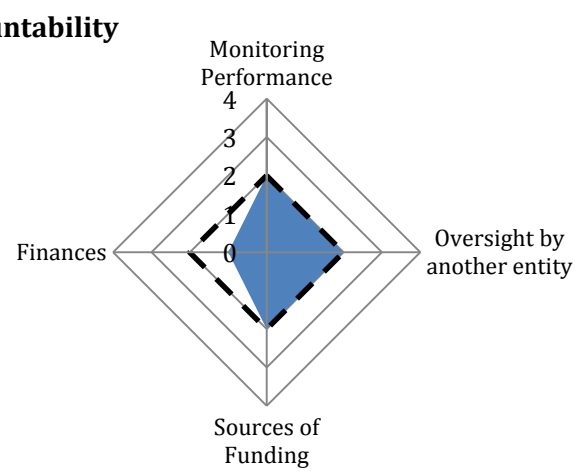
A.



B.



C.



D.

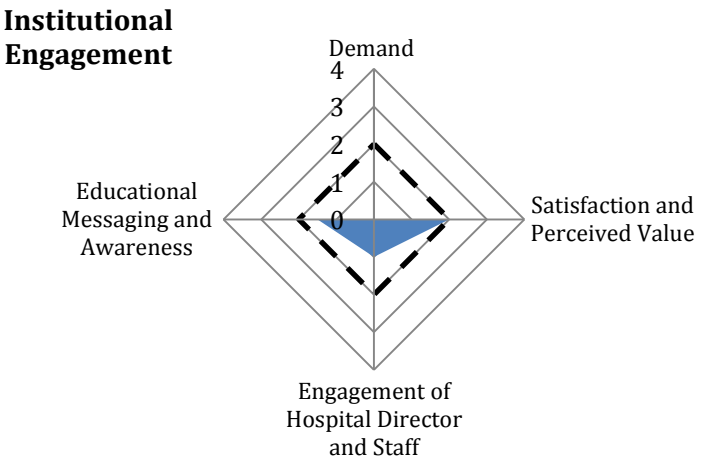
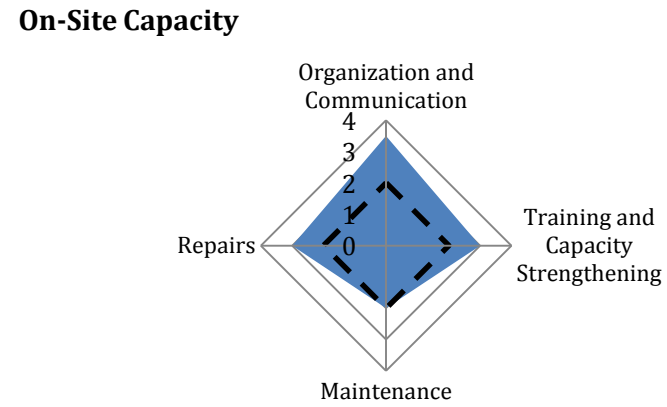
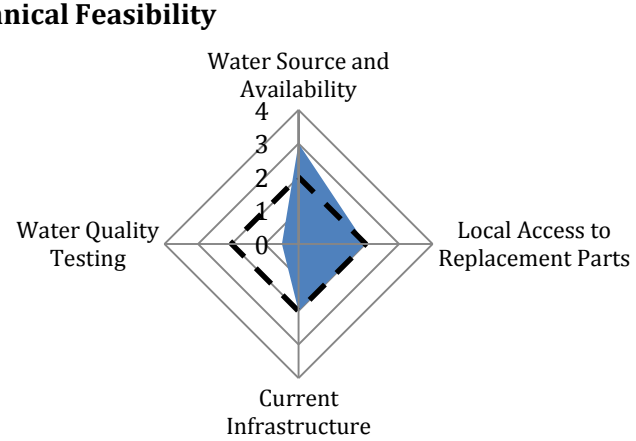


Figure 23. Gracias Hospital 2013 Sub-domain specific sustainability scores.

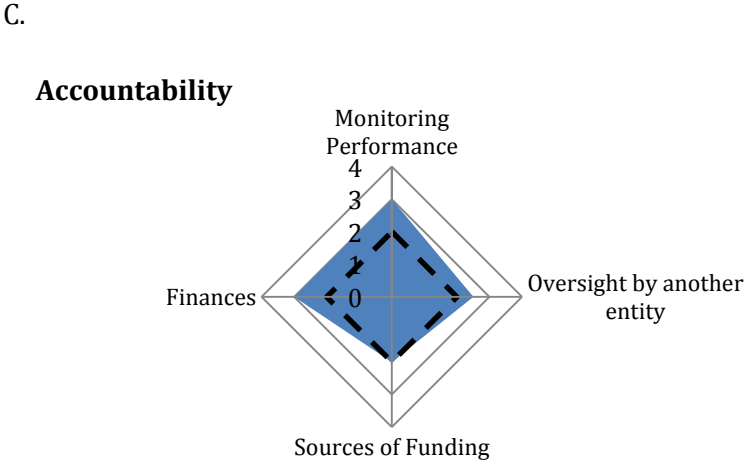
A.



B.



C.



D.

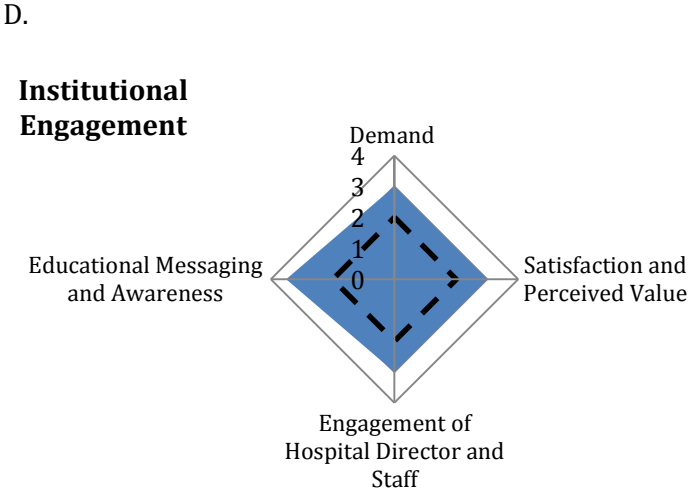
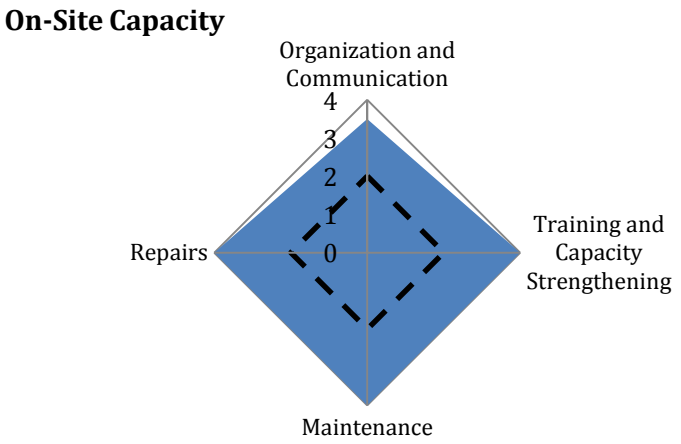
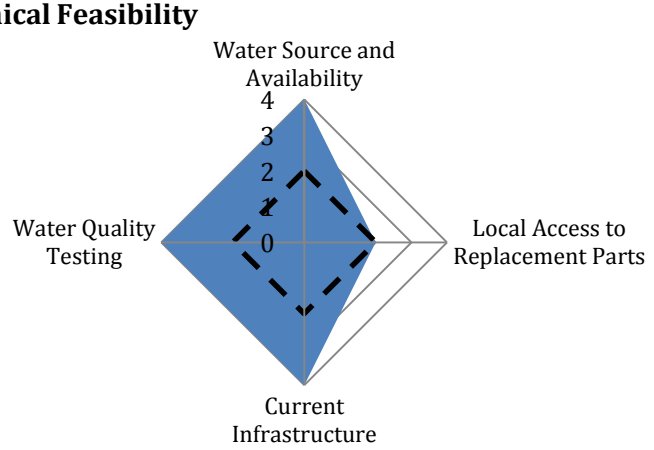


Figure 24. La Esperanza Hospital 2013 Sub-domain specific sustainability scores.

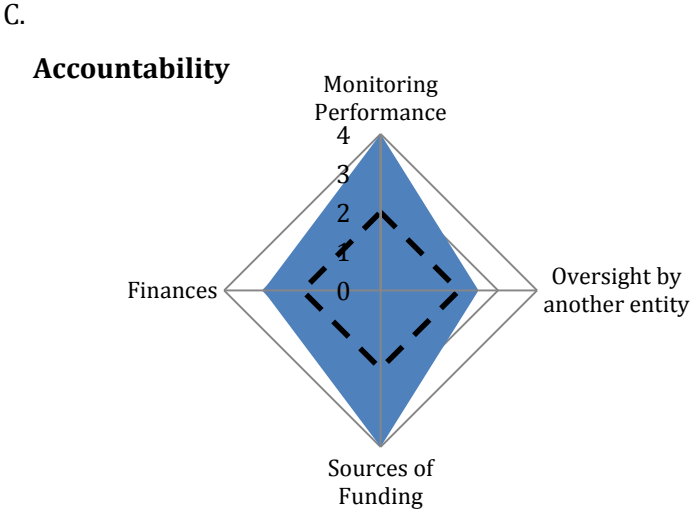
A.



B.



C.



D.

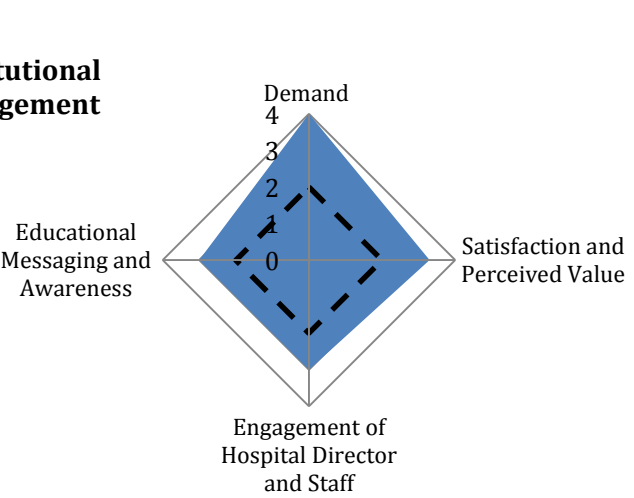
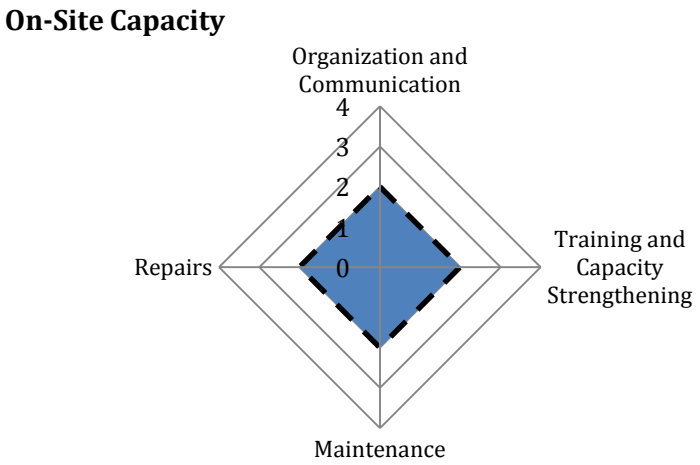
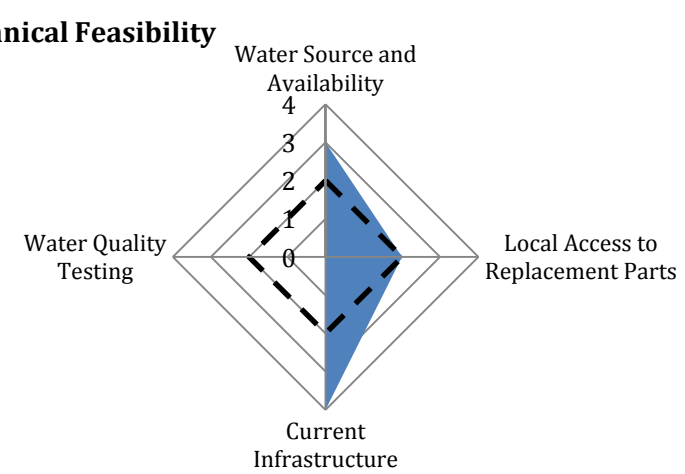


Figure 25. Olanchito Hospital 2013 Sub-domain sustainability scores.

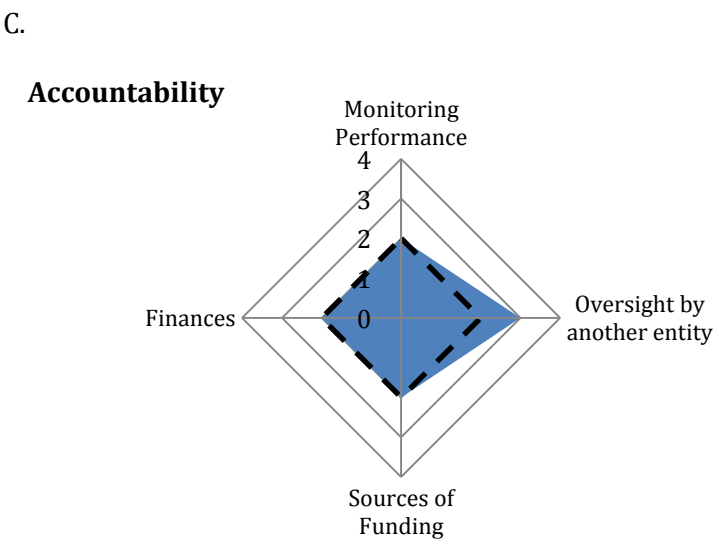
A.



B.



C.



D.

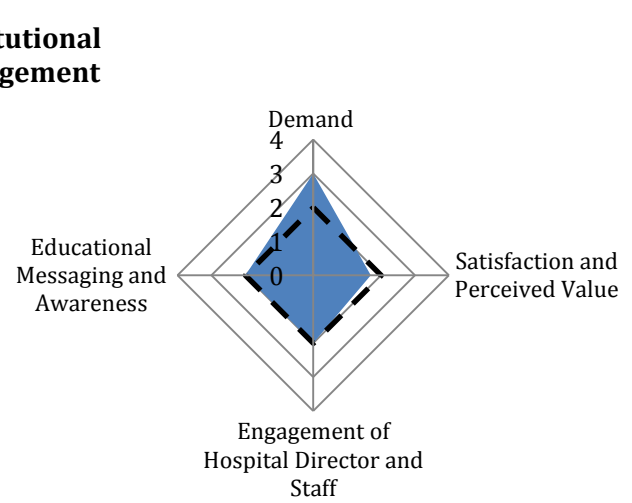
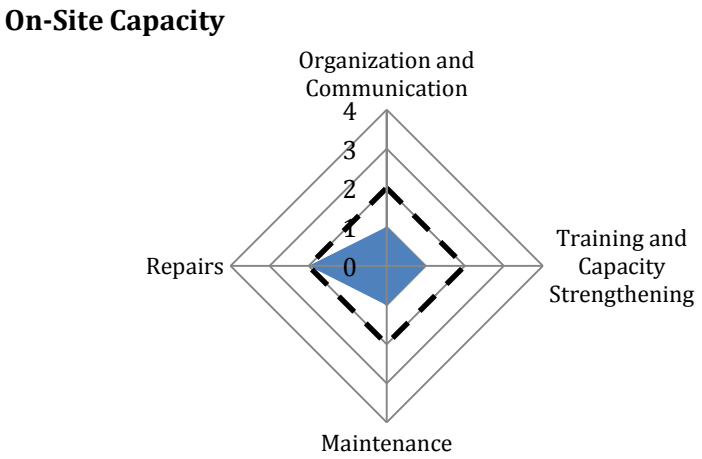
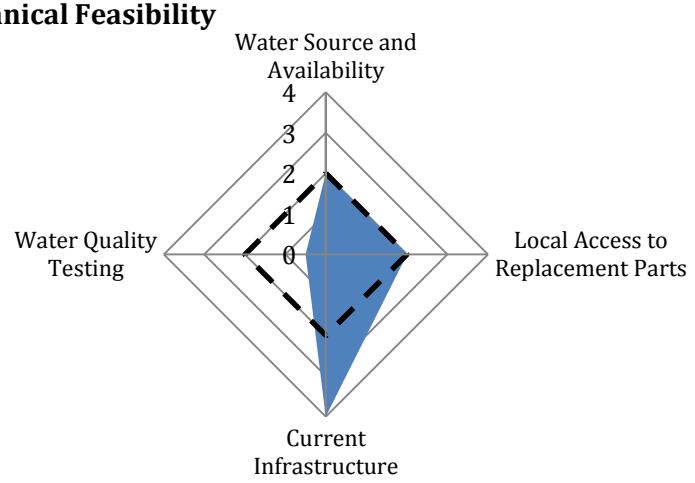


Figure 26. San Lorenzo Hospital 2013 Sub-domain sustainability scores.

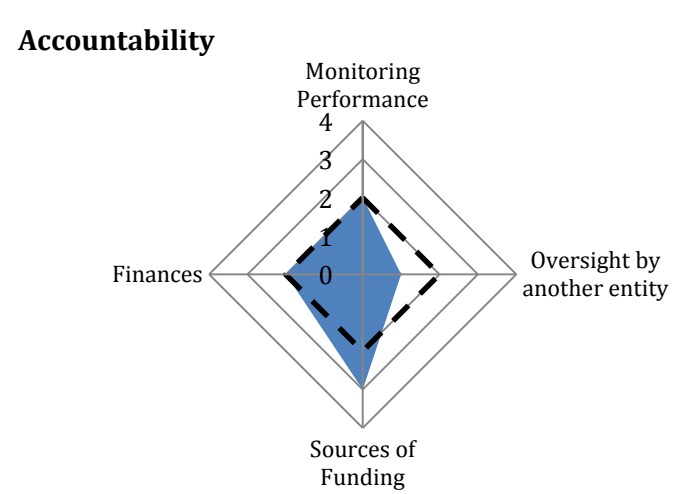
A.



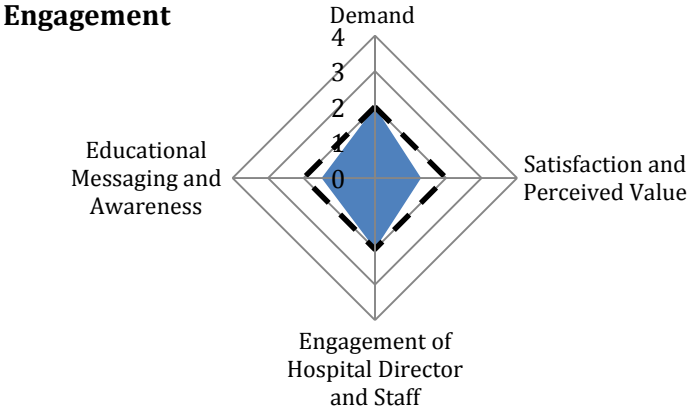
B.



C.



D.



The difference between the 2012 and 2013 domain sustainability scores was not statistically significant for any hospital, but at the sub-domain level, there was a statistical difference in scores for La Esperanza hospital between 2012 and 2013 (Table 7). When examining the scores combined by year across all hospitals, the sustainability scores did differ significantly between the two time points at both the domain and sub-domain levels (Table 7).

When examining the difference between sustainability scores between hospitals within the same year, no comparison demonstrated a statistically significant difference at the domain level for either 2012 or 2013 (p-values: >0.05). Even at the sub-domain level, no hospital exhibited a statistically significant difference in 2012 (p-values: >0.05), but in 2013, La Esperanza hospital's sub-domain scores differed significantly from each of the other three hospitals' sub-domain scores (p-value: <0.002).

Table 7. Results of Wilcoxon signed rank sum test for sustainability score comparison at the domain and sub-domain level between 2012 and 2013 by hospital and combined.

Hospital	Domains	2012 Domain Scores	2013 Domain Scores	*P*-value Domain	Combined P-value Domain	2012 Sub-domain Scores				2013 Sub-domain Scores				P-value Sub-domain	Combined P-value Sub-domain
Gracias	On-Site Capacity	3.2	2.9	>0.05	<0.05	3.5	3	2	3	3.5	3	2	3	>0.05	<0.05
	Technical Feasibility	1.8	1.9			3	2	2	0.5	3	2	2	0.5		
	Accountability	1.8	2.6			1	3	1	1	3	2.5	2	3		
	Institutional Engagement	3.0	3.1			3	3	3	3.5	3	3	3	3.5		
La Esperanza	On-Site Capacity	3.2	3.9	>0.05		3.5	4	4	4	3.5	4	4	4	<0.05	
	Technical Feasibility	2.4	3.5			4	2	4	4	4	2	4	4		
	Accountability	1.8	3.4			3	2	1	1	4	2.5	4	3		
	Institutional Engagement	1.9	3.1			4	3.3	3	3	4	3.3	3	3		
Olanchito	On-Site Capacity	1.3	2.0	>0.05		2	2	2	2	2	2	2	2	>0.05	
	Technical Feasibility	1.4	2.3			3	2	4	0	3	2	4	0		
	Accountability	1.6	2.3			0	3	1	1	2	3	2	2		
	Institutional Engagement	2.3	2.2			3	1.7	2	2	3	1.7	2	2		
San Lorenzo	On-Site Capacity	2.2	1.3	>0.05		1	1	1	2	1	1	1	2	>0.05	
	Technical Feasibility	2.4	2.1			2	2	4	0.5	2	2	4	0.5		
	Accountability	1.8	2.0			2	2	2	1	2	1	3	2		
	Institutional Engagement	1.1	1.4			2	1.3	2	1.5	2	1.3	2	1.5		

In summary, water-use practices and perceptions, and water quality results each contributed to the sustainability scores received by each hospital in both 2012 and 2013. All of the hospital sites had similar self-reported water use practices such as hand washing and food preparation while they differed in tap water consumption related activities. A majority of staff reported awareness of the water filtration system at all sites, but perceptions on whether or not the tap water was safe to drink varied by site.

All four hospitals operated the water filtration systems in varying capacities at the time of data collection. However, frequent activities, such as system bypasses where either the system is circumvented or unfiltered and filtered water are mixed at the point of entry into the hospital, negatively impacted the quality of the water at the point of use. Bypassing was often done to improve water pressure and flow in the hospital taps. Microbiological contamination was found post-filtration at all sites; however, the degree of contamination varied by site. Although a majority of hospital sites (three of four) showed improved sustainability scores from the baseline to the follow-up evaluation, the improvements were variable between sites and every site continued to have some challenging areas that needed improvement.

Discussion and Conclusion

The goal of this study was to conduct a follow-up evaluation in July and August 2013 in order to determine if the sustainability of General Electric water filtration systems in four hospitals in Honduras had improved since the baseline evaluation in July 2012. The following objectives were set to achieve the goal:

Objective 1 – Evaluate knowledge, attitudes, and practices (KAP) of hospital staff and patients surrounding the provision and use of safe water

Objective 2 – Determine water quality at the four hospital sites

Objective 3 – Assess the sustainability of safe water provision and use at each hospital related to four domains of sustainability: on-site capacity, technical feasibility, accountability, and institutional engagement

Additionally, the study identified the key areas of strength and opportunities for improvement in each hospital site in regards to the four domains of sustainability.

Water use practices and perceptions

Investigators hypothesized that hospital staff perceptions of the water filtration system drive and impact the water-use practices among staff in the hospital. However, no statistically significant associations were found between knowledge, attitudes, and subsequent practices surrounding the water filtration system. This finding is contrary to a recent study on KAP of safe water management among members of a rural Bangladesh community, where investigators report that practices did follow knowledge [48]. In the study's WASH intervention villages there was a clear association between the WASH-related education (knowledge) and engagement in safer hygiene practices. In the study, both knowledge and practice were self-assessed through a survey [48]. Although both studies collected self-reported data, the difference in findings between the Bangladesh study and this study can be attributed to the classification of knowledge. Unlike the

Bangladesh study, this study evaluated knowledge as awareness of the DWFS existence and not as verified WASH-related knowledge in regards to disease transmission, water treatment, and WASH-related risk behavior. Additionally, the Bangladesh study included an explicit WASH education component in intervention villages [48]. This study did not engage survey participants in WASH education.

While a majority of surveyed staff reported being aware of the system within all hospitals, opportunity for increased awareness exists. Lack of knowledge or awareness of the water filtration system among staff in the hospitals demonstrates an opportunity for hospital-driven hygiene education and educational messaging surrounding the water filtration system itself. A WASH study in schools in rural South Africa found that among KAP survey respondents, 77% claimed knowledge of waterborne disease, but only 35% understood unsafe drinking water as a route for transmission of waterborne disease [49]. Although the study was undertaken in a different low-resource context, it supports the need for increased knowledge and awareness as an opportunity to improve practice and provide increased access to and use of safe drinking water.

In each hospital except San Lorenzo, a higher proportion of staff reported drinking tap water than thought the water was safe. This may be due to the number of staff engaged in the practice of drinking from a *botellon* (plastic water cooler). In Gracias and Olanchito hospitals, *botellones* are accessible to all staff and are filled with filtered water from the tap. Therefore, staff at these hospitals may not view drinking from the *botellon* as drinking from the tap either because they may not be aware that the *botellones* are in fact filled from the tap, or they do not view the *botellon* as a tap because it does not serve the same function as a traditional tap. Of the 24% of staff that reported drinking from the tap, 54% drank from a *botellon*. Overall, the small percentage of staff that drank from the tap either directly or via a *botellon*, is evidence that staff may actually have an increased understanding of waterborne disease transmission routes than was observed among respondents in the rural WASH study in South Africa [49]. Unlike the respondents in the South

Africa study, the majority of respondents in this study have high levels of education (technical training, secondary, or higher) that may contribute to their increased understanding of waterborne disease transmission, especially among medical staff. Furthermore, the majority of hospital staff may not drink from the tap due to the common lack of trust of the piped municipal water supply. Intermittent reliability of water at the municipal level often translates to mistrust of the tap water among community members due to poor water quality as a result of power outages, inconsistent water pressure, and pipe breakages [6].

Less than 25% of staff consumed the tap water themselves, provided tap water for patients to consume with medications, or used the tap water in wound or burn care procedures. The decreased use of tap water for these purposes may be due to an understanding among a majority of staff about the importance of reliable safe water in regards to consumption and medical procedures. This particular medical-related understanding was not specifically measured in this study.

Water quality

The parameters of water quality -- microbiological and chemical -- demonstrated whether the DWFS is functional and operational. In terms of functionality, the systems did function (i.e. the filters remove debris and microbial contamination) at each hospital. The system performance was not precisely determined due to the sample collection strategy, because samples were not consistently taken at the system directly after filtration. While the majority of samples did not have detectable levels (<1MPN/100mL) of microbiological total coliforms or *E. coli* contamination, the levels of contamination that were present varied by hospital site. Samples from La Esperanza hospital were the only samples that did not demonstrate concentration levels for total coliforms, *E. coli*, or *P. aeruginosa* above 100MPN/100mL at any of the three sampled time points. Additionally, samples from La Esperanza never exhibited detectable levels of *E. coli* in any of the three sampled

time points (April 2012, July 2012, and July 2013). There is a lack of research on water quality in low-resource healthcare facilities leading to a gap in the literature and diminished capacity for study comparison.

It is important to note that variability in water quality from the taps in the hospital can be impacted by both institutional-level issues and the quality of the municipal source water. Variability in water quality can present itself in the amount of time and distance water travels through the piped network from the DWFS to its POU. Increases in time and distance can demonstrate increased potential for water to acquire contamination along the piped network resulting in inadequate protection of the piped network and/or POU [39]. For water samples taken from *botellones*, variability in water quality between *botellones* can be due to introduction of contamination during the processing of filling/cleaning and/or the microbiological environment of the *botellon* dispenser used to distribute drinking water, assuming all *botellones* were filled from the same reliable safe water source. The risks associated with contamination in *botellones* are similar to those seen in the storage of drinking water at the household level (i.e. improper cleaning of storage containers) [9, 10, 39].

Over time, none of the four hospitals demonstrated statistically significant improvement in water quality. Furthermore, a majority of hospitals experienced decreases in water quality according to drinking water quality guidelines at the July 2012 time point vs July 2013 time point. Most notable are the statistically significant differences in percentage of samples that met CDC chlorine residual guidelines in July 2012 vs July 2013. The decline in the percentage of samples that met chlorine residual recommendations, in combination with the association between samples that did not meet microbiological drinking water quality guidelines and samples that did not meet free chlorine residual recommendations (observed in Gracias hospital), underpins the importance of chlorine residual in maintaining reliable access to safe water [39].

In 2013, no hospital provided reliable access to safe water for drinking or medical purposes. The inability to provide this necessary resource will continue to put the health of hospital staff and patients at risk. As the UN's Sustainability Development Goals (SDGs) take effect in 2016, increased scrutiny will be placed on institutional-level water quality and water access. SDG 6a directly addresses health centers with the goal to "provide universal access to safe drinking water at home, and in schools, health centers, and refugee camps" [5]. Moving forward, hospitals globally will be encouraged to put safe water management practices into action in order to meet proposed hospital-specific safe water indicators.

Sustainability

The use of a structured sustainability metric for this evaluation is supported by the increased momentum seen in the WASH sector toward transitioning WASH sector interventions such as water treatment technology from simple implementation to sustained provision of WASH services [14, 38, 40]. The sustainability metric serves as a tool to compare each hospital's strengths and challenges regarding the impact and sustainability of their water treatment systems. Additionally, the metric allows for the opportunity to focus efforts of the hospitals and key stakeholders (i.e. GEF, CGSW, and AI) to improve the impact and sustainability of water treatment systems through targeting specific sustainability domains.

Three of the four hospital sites (Gracias, La Esperanza, and Olanchito) demonstrated increases in sustainability scores between 2012 and 2013. These score increases resulted in one more hospital (Olanchito) meeting at minimum, the sustainability cut off score in 2013. San Lorenzo is the hospital site whose sustainability score decreased between 2012 and 2013, moving further away from an environment that enables sustainability. Between the two time points, San Lorenzo only maintained the sustainability cut-off score in the technical feasibility domain. Score improvements in all hospitals can be attributed to growing understanding and comfort with system

use and maintenance among key hospital staff, increasing awareness, trust, and use of the system among a majority of staff throughout the hospital, and additional institutional support in both finances and oversight. Low scores near the cutoff for sustainability signify that enabling environments for sustainability were not maintained due to key areas of vulnerability. Understanding the factors that drive or limit sustainability in regards to each sub-domain is crucial to developing a holistic view of sustainability at each hospital site. Each sub-domain is specifically discussed below:

On-Site Capacity

Organization and Communication – Consistent communication among key hospital staff (director, laboratory, administrator, and maintenance staff) is vital for the success of the water filtration systems and their ultimate sustainability. High sustainability scores were seen in hospitals where either most or all key tasks related to the water filtration system were accounted for among key staff. San Lorenzo was the only hospital to score under the sustainability cutoff due to the high turnover in maintenance staff. During the transition to new staff, the previous institutional knowledge related to the management of the water filtration system was lost and associated responsibilities were not clearly assigned among new and remaining staff. Continuity of communication and organization are important determining factors for long-term sustainability. The WHO and IRC Water and Sanitation Centre identified communication as a vital role in creating an enabling environment for sustainability [39]. Communication will likely serve as one of the lynchpins to attaining and maintaining sustainability of the DWFS at each hospital.

Training and Capacity Strengthening - Maintenance staff at Gracias and La Esperanza hospitals reported attending job-specific trainings in the year prior to the evaluation thus strengthening their capacity to perform. Although the training was not DWFS

specific, a review of trainings for community health workers around the globe has shown to support the cascade effects of training in one area of expertise into other areas [50]. San Lorenzo and Olanchito hospitals exhibited lower scores than their counterparts in 2013 due to lack of continuity in maintenance personnel and training. The differences in scores among the four hospitals highlight the need for continuous maintenance education in order to facilitate a sustainable environment.

Maintenance – Changes in scores in this sub-domain were variable across the four hospitals due to the unique contexts in which each water filtration system is maintained at each site. In three of the four hospitals (Gracias, Olanchito, and San Lorenzo) there is opportunity for improved sustainability scores related to on-going preventive maintenance. La Esperanza is a model for maintenance because all preventive maintenance tasks are regularly completed (i.e. cistern cleaning, filter backwashing, etc). Additionally, maintenance staff at La Esperanza highlight the importance of confidence in, commitment to, and training on the water filtration system. In some previous WASH interventions in low-resource settings, operation and maintenance were given little attention, but the WASH literature displays a growing emphasis on the importance of maintenance as a component of long-term sustainability [3, 39, 41].

Repairs – This is the one on-site capacity sub-domain where each of the hospitals scored above the sustainability cutoff score. Improvements in the score were seen in Gracias and La Esperanza hospitals due to the operational consistency and increased familiarity with the water filtration system among maintenance staff. The capacity to repair the DWFS is critical, because without appropriate maintenance, including repair, the equipment would be not be functional. This lack of capacity to perform repairs is common to the maintenance of implemented water-supply

systems as demonstrated in a 2003 study that estimated 30-60% of existing rural water-supply systems are inoperative at any time worldwide [39]. The proportion of supplies in disrepair hinders attempts to increase global access to safe water and will require further investment of scarce resources in low-income settings such as Honduras.

Technical Feasibility

Water Source and Availability – In 2013, each hospital's score for this sub-domain either remained consistent (La Esperanza) or improved to meet or exceed the sustainability cutoff score (Gracias, Olanchito, and San Lorenzo). Olanchito hospital's improvement in score was due to effective efforts to bottle water from the water treatment system for drinking water provision for staff in specific hospital departments. San Lorenzo's increased score between the two evaluations was in part due to the installation of three new GE ultra-filtration member filters, thus increasing the availability of safe water in the hospital. The score improvements at all four hospitals can be attributed to a diminished reliance on tanker truck water at each hospital in the year prior to the July 2013 evaluation. This is actually a demonstration of success at the municipal level where local municipal authorities were responsible for ensuring service provision to their populations [51].

Local Access to Replacement Parts – In 2013, key maintenance staff at each hospital reported on time, distance, and effort required to procure replacement parts related to the water filtration system or water infrastructure. While all hospital scores increased to the meet the sustainability cutoff in this sub-domain, there remains an unmet need to improve the supply chain logistics in order to facilitate local access to needed replacement parts for the DWFS. Diminished access to appropriate and necessary replacement parts will negatively impact the sustainability of other sub-

domains such as *repair* and *maintenance,* and the long-term sustainability of the DWFS in each hospital [39].

Current Infrastructure - In 2013, the pipe infrastructure between the water filtration system and different hospital departments was crudely mapped in order to determine the extent to which the hospital was connected to the water filtration system. The connectivity of the system with hospital departments, in combination with the functionality of taps throughout the hospital contributed to the sub-domain score for *current infrastructure*. In 2013, La Esperanza, Olanchito and San Lorenzo each scored maximum sustainability scores in this sub-domain. An increased commitment to repairing broken and leaking taps facilitated the consistently high and improved scores in this sub-domain. Commitment to maintaining existing WASH-related infrastructure and opportunities to upgrade infrastructure will directly contribute to sustained access to safe water throughout each hospital.

Water Quality Testing – In both 2012 and 2013, frequent bypassing of the water filtration system was observed during the site visits. During the follow-up evaluation, bypassing was limited to Gracias and Olanchito hospitals. Regular bypasses of the water treatment system occurred most frequently during times of high water demand in the hospital (6am – 8pm Monday through Friday). Decisions to bypass were made by key maintenance staff and their reason for doing this was often due to complaints of low water pressure or flow in departments of the hospital downstream of the water filtration system, issues common to low-resource contexts [6, 39].

Accountability

Monitoring Performance – Across all hospitals, the record keeping varied and was often inconsistent due to time demands on staff involved in record keeping,

miscommunication concerning recording-keeping responsibilities, and lack of record-keeping tools. However, some hospitals keep several records regarding the water treatment system (i.e. chlorine residual testing, work orders related to water infrastructure). Need for increased monitoring of water in healthcare facilities is globally supported by the UN, who claims a 60% non-response rate among countries reporting to GLAAS. Poor response rates indicate the lack of monitoring systems to track sanitation and drinking water in healthcare facilities [6]. Furthermore, the challenges in monitoring performance (i.e. unclear monitoring and evaluation roles of various stakeholders and lack of funding) at the hospital level are recognized by the World Bank as barriers to WASH sustainability [52].

Oversight by Another Entity – Each hospital can improve their score for this sub-domain. The opportunity for improvement is marked by a lack of communication between the hospital and the Ministry of Heath regarding hospital water management and inconsistency of third-party hospital inspections. This is a key domain for accountability. Oversight by another entity should be conducted by an in-country institution such as the Ministry of Health in order to promote long-term sustainability. The World Bank states that the "responsibility for WASH service sustainability lies with the government" [52]. The World Bank goes further to encourage NGOs and donors to be aware of and leverage, existing in-country structures and functions in order to involve the government in a WASH intervention from its onset [52].

Sources of Funding – All four hospitals scored a minimum of the sustainability cutoff score in this sub-domain in 2013 compared to only one hospital (San Lorenzo) in 2012. Most of the hospitals lacked sources of funding outside those received from the Ministry of Health. Monies from the Ministry of Health are prioritized for bio-

medical-related needs instead of a hospital's water supply, particularly in rural areas of Honduras where the hospital water supply is often financially and systematically supported by development partners such as NGOs [51]. The need to close the gap between the current scores in this sub-domain and those of maximum sustainability is supported by the findings of an International Water and Sanitation Centre initiative in Honduras that demonstrated that the WASH sector lacks adequate funding and remains largely donor dependent [51].

San Lorenzo hospital is better positioned to financially sustain the DWFS without GEF funding due to their relationship with the San Lorenzo Foundation. In addition to funding from the Ministry of Health, the San Lorenzo Foundation, a dedicated patron to the hospital, provides annual funding budgeted for the DWFS. Additionally, the foundation has funded a majority of the improved WASH infrastructure in the hospital. San Lorenzo's intimate partnership with the San Lorenzo Foundation is one of finances, but also of ownership, which is cited to be a factor in sustainability and a shift from capital expenditure to continual service delivery [52].

Finances – While each hospital lacked a budget solely dedicated to paying costs related to the water system, each hospital utilized recuperated funds that were internally generated at the hospital in order to pay for recurring, system-related costs such as chlorine. Though not a secure form of financing, the increased use of recuperated funds demonstrates a form of investment at the hospital level. Such innovative and institutionally-driven financing solutions demonstrate the actions recognized in the Honduran context as those needed to sustainably promote the operation and managements of WASH interventions [51].

Institutional Engagement

Demand – Demand for tap water for drinking and medical use either remained the same or increased in each of the hospitals. Demand is manifested through staff and patients and their use of tap water while at the hospital. Contextually, demand appeared differently in hospitals where tap water was available in *botellones* as in Gracias and Olanchito compared to where safe water was only available at seven taps in the hospital (as in San Lorenzo). Many staff and patients across all hospitals reported their willingness to save money and drink from the tap if they knew the tap water's safety was guaranteed. Additionally, the WHO and IRC Water and Sanitation Centre note that a sense of ownership of the WASH technology among the community supports demand for the technology and its services [39]. In order to increase demand for, and sustainability of, the provision for safe water, awareness and water security must also be targeted through strategic hospital-led action, thereby simultaneously encouraging increased ownership of the DWFS.

Satisfaction and Perceived Value – While both staff and patients exhibited variable responses about whether they thought the tap water was safe to drink, those that had tasted the water reported overall satisfaction with attributes such as taste, smell, and color. Only Gracias hospital commented negatively on the color of the water, which often had a light brown/yellow hue. At this site, the water color was due to rain run-off, which discolored their municipal supply. The GE water filtration systems are not designed to remove discoloration from water. Furthermore, the key staff closely align the perceived value of the water filtration system with the system's ability to consistently deliver safe water at any point and place water is required. Other studies cite the communities' willingness to pay for safe water as a proxy indicator for perceived value [39]. Although the hospitals have no plans to

collect user fees from patients and staff, taking steps to ensure the regular provision of safe water to meet variable demand will positively impact the sustainability scores for *satisfaction and perceived value* for all hospitals.

Engagement of Hospital Director and Staff – Hospital director and staff engagement in, and commitment to, the water filtration system is highly dependent on the performance of the system. Gracias demonstrated the same sustainability score for 2012 and 2013 in this sub-domain, which can be attributed to the balance in victories and challenges experienced in the year prior to the follow-up evaluation. Olanchito's sustainability score decreased from between 2012 and 2013, and although the hospital remains at the cutoff score, their lower score is due to growing frustration with pressure drops across the water filtration system. The pressure drops often manifest as an inability to meet water demand throughout the hospital during peak hours. Frustrations such as these often lead to diminished engagement, which will negatively impact the sustainability of the DWFS as supported by a study on rural water supply reform in Nambia. That study highlighted the importance of community-based, polycentric water management as "maximising economic and social welfare in an equitable manner and without compromising the sustainability" of the water supply [53].

La Esperanza and San Lorenzo both experienced increased scores from 2012 to 2013. La Esperanza's increase in engagement is a consequence of the uninterrupted operation of the system and the opportunity for cost savings if the hospital were to bottle its own water. Unlike La Esperanza, San Lorenzo's increase in sustainability score can be attributed to the strengthened engagement of the interim director in hospital water management issues. In conclusion, factors contributing to hospital

director and staff engagement are extremely variable and often artifacts of other sustainability sub-domains.

Educational Messaging and Awareness – While a majority of staff reported being aware of the water filtration system across all hospitals, the volume of educational messaging varied. Gracias hospital displayed the largest amount of educational messaging on diverse topics throughout the hospital. San Lorenzo only displayed some messaging, but the production and consistency of the messages were professional in appearance and practical in use. None of the four hospitals exhibited messaging specific to the water filtration system or access to, and importance of, safe water. Consistent findings in WASH studies in the African context support the importance of messaging to increase awareness and knowledge around WASH interventions and WASH-related health outcomes [49, 54]. Increased targeted messaging is an opportunity to advise staff and patients on the importance of safe water, the existence of the system, and what actions the hospital and its partners are taking to increase access to safe water at the institutional level.

Although three of the four hospital sites exhibited overall improvements in sustainability, there remains opportunity for continued improvement and for hospitals to attain a maximum sustainability score of a 4 at the sub-domain and domain levels. It is interesting to note that although water quality is a dimension that contributes to the calculation of each hospital's sustainability score, the decreases in water quality seen in 2013 did not substantially hinder the sustainability scores in 2013. Examining sustainability at multiple sub-domains and unique broad questions within each sub-domain, allows for the ability to form targeted, actionable recommendations in regard to a specific metric. Some dimensions of low sustainability scores can be improved by hospital-driven action (i.e. increased oversight), but others must be addressed by GEF or government ministries (i.e. technical issues with chlorine pumps, intermittent water

supply). Other aspects of low scores are the result of the contextual issues that affect all hospitals with these filters (i.e. supply chain concerns, limited funding).

Other Interesting Findings – Financial burden and opportunities for cost savings

In San Lorenzo, all neonatal nurses surveyed reported that water used in the cleaning and maintenance of the incubators is purchased in plastic bottles or bags by the infant's parents. The lack of reliable safe water in the hospital diminishes the safe water availability for use in vital medical procedures, therefore creating a financial burden on the hospital and on the patients.

A majority of patients and visitors surveyed (82%) reported bringing purchased water with them to the hospital for drinking purposes for themselves and their loved-ones. According to prices reported by patients and visitors, the average cost of a bag of water is 10 cents (USD) and the average cost for a one liter bottle of water is $1 (USD). In a country where 60% of the population live below the national poverty line, the daily expenditure of several dollars (USD) can result in significant burden on family or individual income [55].

The DWFS donated by GEF represent an opportunity to reduce the financial burden on individuals and families in regards to drinking water-related expenditures incurred while at the hospital. At the institutional level, Gracias hospital reported a cost savings of $7,500 (USD) per year due to their practice of bottling drinking water on-site using filtered water directly from the system. They used this cost savings to purchase higher quality food in the hospital kitchen for staff and patients. These cost savings can additionally be transferred to the patients and visitors due their increased ability to access safe drinking water at the hospital. Cost saving opportunities such as this are supported by a WHO funded study that demonstrated economic benefits for both health facilities and their patients due to improvements in water and sanitation [25].

Furthermore, regular costs related directly to the use of the DWFS are seen in the chlorine expenditures. Average expenditure on chlorine across all four hospitals is $105 (USD) per month.

The hospitals are not consistently maintaining chlorine residual levels according to CDC Drinking Water Guidelines, therefore this estimate is not representative of the expenditure required for proper maintenance for the DWFS. The cost of maintaining appropriate chlorine residual levels is likely to be substantially higher.

Other Interesting Findings – Opportunities for Strategic Partnerships for Sustainability

Like the GEF, the Inter-American Development Bank (IDB) is an additional global entity working toward improving health outcomes in Honduran hospitals through strategic financing. The IDB was established in 1959 under the Articles of Agreement by the Organization of American States. Shareholders include 48 member countries, 26 of which are Latin American and Caribbean borrowing members. In 2012, the bank approved $11.4 billion (USD) in loans and grants to Latin American and Caribbean clients, establishing IDB as the leading source of development financing in Latin America and the Caribbean [56]. With an evolving reform agenda seeking to increase the IDB development impact in the region, IDB has seen measureable improvements in social indicators such as literacy, nutrition, and life expectancy over years of continued investment [57]. There is opportunity to strategically align the work of the GEF with the IDB's on-going investment in Latin American countries, including Honduras.

IDB has conducted 786 projects in Honduras since 1961 [56, 57]. Since 2010, IDB has conducted five projects in the health sector and one project in water and sanitation in Honduras [56]. In 2013, IDB began collaborating with three government-run hospitals in Gracias, La Esperanza, and Olanchito as part of their Mother and Child Hospital Network Strengthening Program (HO-L1072). IDB aims to provide a $30 million (USD) loan over the 3-year duration of the program from 2013 – 2016. The program's goal is to "help reduce maternal and neonatal mortality in hospital and improve coverage and quality of services through an innovative management model" [58]. IDB selected these three hospitals because the hospitals are located in the

departments of Lempira, Intibuca, and Valle respectively, which have the highest maternal and neonatal mortality rates in the country [58].

The three hospitals selected by IDB in Gracias, La Esperanza, and Olanchito are the same three hospitals in this GEF and CGSW research study. Under the program, these three hospitals have been encouraged to strategically apply the management model to other services throughout the hospital. The expansion of the model included the on-site management of water at the hospitals, a system with a daily impact on more than maternal and child health [59]. Improving water management at the hospital level will strengthen the capacity of hospital staff to increase the sustainability of the GE DWFS. Leveraging existing partnerships and forming new partnerships has been recognized as a necessary action toward sustainability in a large UNICEF WASH study conducted in 5 counties in Liberia in 2010 [54]. If the hospitals approach this new water management model in a holistic manner, there is opportunity to improve sustainability in each of the four domains. If GEF and IDB continue to work in the same hospitals, it is critical that they engage in a strategic partnership moving forward to enhance the long-term sustainability of each of their efforts.

Study Strengths

The use of structured and systematic protocols for all data collection (survey, in-depth interview, and water samples) increased continuity in the data and allowed greater comparison of results both within hospitals and across hospital sites. Additionally, the use of a refined and adapted version of the data collection tools from the 2012 baseline study allowed increased comparison of results between the baseline and follow-up study.

The use of structured protocols applied to the water quality testing procedures as well. Quality control/quality assurance measures included the use of sterile water as negative controls for each microbiological water quality test (i.e. total coliforms, *E. coli*, *P. aeruginosa*) and to set a

zero standard for turbidity and chlorine residual tests for each site visit. None of the negative controls exhibited positive results (>1 MPN/100mL) for microbiological tests, suggesting that these protocols were performed correctly and the testing procedures did not introduce contamination into the water samples.

The sustainability metric used in this follow-up study was improved based on previous field tested during the baseline study. The improvements allowed greater capture of critical factors contributing to sustainability. Additionally, the use of a sustainability metric unique to the installation and use of the GE Homespring™ Water Filtration System allowed for a more accurate sustainability evaluation of this specific water treatment technology.

Study Limitations

This study was limited in its size and non-random design due to the nature of the GEF donation strategy. Only the four hospitals with GE water filtration systems could be included as sites in the study. Furthermore, the small number of water samples collected at each hospital site did not provide a comprehensive understanding of water quality throughout every part of each hospital, nor at each different point in the piped network. Therefore, there was limited ability to determine unique characteristics of certain areas of each hospital that may explain the differences observed in water quality results between departments within the same hospital.

The timing of the study and data collection did not allow for seasonal variability to be accounted for in the data analysis. Water quality samples were only collected at one point in the year and not throughout the year and different seasons. Any trends in water quality due to seasonal changes such as rainfall or dry seasons, were not captured.

An additional limitation is that no water treatment system was identical at any of the hospital sites. The differences in system set-up were due to two factors: i) The GEF donation strategy and their interest in experimenting with different installation formats in various hospitals,

and ii) the hospital infrastructure that directs the feasibility of particular installation formats. These differences resulted in variation in water treatment capacity for each system at each hospital, thereby impacting the water quality results of the study.

All survey and in-depth interview data collected in the study were self-reported and subject to recall bias. This was especially true for the self-reported water-use data that was not collected via direct, real-time observation. Additional bias could be due to the association of researchers with key stakeholder and implementing partners (GEF or AI). The association bias may have led to false reporting of either high-use or performance of the system, or of low use and performance of the system.

Lastly, working in a low-resource environment leads to contextual limitations. Inconsistencies in electricity hindered the ability to maintain appropriate and consistent incubation times and temperatures thereby potentially impacting the water quality testing. This may have caused under or overestimation of microbiological contamination in the collected water samples.

Recommendations for future research

To fill the gap in literature and develop an increasingly holistic view of the impact and sustainability of these water filtration systems, the following recommendations are made for future research:

- Conduct real-time observations of water-use activities of hospital staff and patients of interest in order to collect more accurate water-use practice data in lieu of the self-reported data collected in surveys.
- Increase the frequency of data collection in order to better assess changes in sustainability throughout the year and determine if any seasonality factors affect sustainability.
- Increase the number of water samples collected, tested, and analyzed at each hospital site in order to improve the statistical power of the study and enhance the opportunity for robust

predictive statistical model building. Consider collecting additional data for other predictors and outcomes (i.e. distance of POU sample from water filtration system, incidence of hospital-acquired diarrhea, etc).

- Conduct increasingly in-depth literature reviews and gather professional input for the consideration of reweighting water quality within the sustainability metric in order to better capture the impact of hospital water quality on the health of staff and patients.

Study Implications and Recommendations

The purpose of this study was to conduct an in-depth follow-up evaluation to provide a deeper understanding of challenges and opportunities related to the sustainable access to, and provision of, safe water in Honduran hospitals operating GE water filtration systems. The following recommendations, based on knowledge gathered in this research study, are actionable next steps that center on the four domains of sustainability and are suggested to the four hospitals, GEF, CGSW, and AI:

On-Site Capacity

- Develop and implement a maintenance training program specific to the GE DWFS in order to strengthen the capacity of hospital staff and technicians to provide technical assistance in country and on site at each hospital.
- Develop and implement laboratory training on microbiological water quality testing in order to strengthen the on-site capacity of hospital laboratories to evaluate water quality for human consumption and appropriate medical use. It is important to note that this recommendation may require the procurement of laboratory equipment necessary for water sample collection, testing, and analysis.

Technical Feasibility

- Engage in partnership and discussion with the Ministry of Health in order to change municipal water policy and practice thereby working to improve the water source and water availability for high demand institutions such as hospitals.
- Replace or repair any faulty equipment related to the DWFS and general WASH infrastructure, specifically chlorine pumps and leaking taps. Completing necessary repairs

to chlorine pumps will enhance a hospital's ability to maintain chlorine residual levels appropriate for human consumption.

- Install additional POU filters in San Lorenzo hospital in order to increase staff and patient access to safe water.

Accountability

- Design and implement a structured monitoring plan in order to ensure the regular completion of key tasks related to the DFWS. Some tasks to be specifically monitored are water availability, cistern cleaning, filter backwashes, system bypasses, and tap and sink repairs.
- Leverage the IDB's current work regarding management models in three of the four hospitals through a strategic partnership with GEF in order to integrate the DWFS into future water management plans. The synergy between the two entities would increase both outside oversight and sources of funding.

Institutional Engagement

- Design hospital-driven educational messaging surrounding WASH and the DWFS itself. Increased knowledge and awareness among staff and patients will improve practice and provide increased access to, and use of, safe drinking water. Additionally, accurate messaging appropriately targeted toward staff and patients has the potential to increase confidence in and commitment to the DWFS.

Successful engagement in the recommendations for improvement will enhance the sustainability of the DWFS and have the potential to positively impact the health outcomes of hospital staff and patients through the reduction of WASH-related disease burden. Furthermore, evaluating the operation and performance of these systems on four sustainability domains (on-site capacity, technical feasibility, accountability, and institutional engagement) will inform the GEF's future water filtration system donation strategies.

Strategic donation by GEF will likely increase the cost effectiveness of GEF donation efforts and allow for greater continuity in the global expansion of donation programs. The GEF will continue to engage in sector-specific global development work through the on-going donation of water filtration equipment. While the initial donations can be costly to GEF, the repercussions (i.e. on-going maintenance) of the donation programs can incur increased costs to both GEF and the hospital. These increased costs are most frequently in the form of necessary technical assistance and replacement parts due to equipment failure given the challenging context. Knowledge and best practices from this research study can inform future donation strategies to evaluate the sustainable context of a future donation site prior to installation of the DWFS. Applying best practices to all future donation sites will improve the continuity of donations and reduce the historic trial and error nature of donation strategies. This transformation of research into action will result in the long-term sustainability of GEF donation efforts.

This sustainability metric has additional implications for the evaluation of sustainability for diverse interventions across the WASH sector. The continued refinement and validation of the sustainability metric designed for this study will add to the pressing need for tools to evaluate sustainability of WASH interventions in the field. Furthermore, transforming the data collection tools and sustainability metric into a comprehensive rapid assessment tool will allow the tool to be used with increased frequency at each hospital site. This would enable evaluation at several time

points to provide a comprehensive picture of the year-round operation and performance of the DWFS.

Lastly, it is crucial that, all partners (GEF, CGSW, and AI) leverage the recommendations to engage current and future hospital sites in hospital-driven efforts to improve sustainability of DWFS. Although continuity should be optimized throughout the donation program, it is essential that the program be adaptable to differing contexts and challenges that may be present at the donation sites. Allowing activities related to the DWFS to be hospital led and stakeholder supported, will increase the sense of hospital ownership of the systems as well as the sustainability in the each of the four domains [39]. Not only will understanding the environments that enable or limit the sustainability of DWFS in each specific hospital's context aid in improving the sustainability at each site, but also inform strategies for increasing sustainable access to safe water globally. Improving universal access to safe water in all nations will facilitate the attainment of development targets and decrease the burden of WASH-related disease among citizens of the world.

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Appendices

Appendix 1: 2013 Survey and Interview Tools (English)

AH1	Date		AH4	Hospital Name	
AH2	Start Time		AH5	Name of Investigator(s)	
AH3	End Time	Name:			

General Information		
Demographics		
	Ask director or administrator for annual report.	
A1	How long have you worked here as the director?	
A2a A2b	What is the population of the town surrounding the hospital? **Only ask in Honduras	Area: Population:
A3	How many patients are attended to daily at this hospital? (in annual report)	
A4 A5 A6	How many doctors are employed in this hospital? Nurses? Other staff? (in annual report)	_____ doctors _____ nurses _____ other staff
A7 A7a A7b A7c	What is the primary drinking water source for the population in A) This town? B) The rural communities surrounding this town? To the best of your knowledge, what is a common household water treatment method used in this town and rural communities surrounding this town?	 A) _____ 99) I do not know B) _____ 99) I do not know Comments:
A8	How often does water not flow from the taps in the hospital in the average week?	_____times a week/month/year 99)I do not know Comments:
A9 A9a A9b A9c A9d A9e A9f	What causes the water to stop flowing?(circle all that apply, specifying if necessary)	1) Electrical issues 2) Construction issues 3) Water rationing 4) Faulty pumps 5) Dry season 88) Other _____
Water Sources, Availability, and Demand		
A10 A10a	What water sources are available in this hospital? (circle all that apply, specifying if necessary)	1) Municipal water 2) Well water from improved source

A10b A10c A10d A10e A10f A10g		3) Tanker truck water 4) Surface water 5) Rain water 6) Bottled water 88) Other _____
A11	Are there any wards/sections of the hospital that do not have running water today? [Why not?] Which ones?	1) Yes 2) No 99) I do not know Comments:
A12	Are there any wards/sections of the hospital that are not connected to the water filtration system? [Why not?] Which ones?	1) Yes 2) No 99) I do not know Comments:
A13a A13b	A) Typically how much unfiltered/untreated water do you store? B) Typically how much filtered/treated water do you store?	A) _____ 99) I do not know Comments: B) _____ 99) I do not know Comments:
A14	How often is unfiltered/untreated water pumped into the elevated tank/cistern? **N/A for Honduras	_____times a day/week/month 1) Never 99) I do not know Comments:
A14a	How often is filtered/treated water pumped into the clean side of the elevated tank/cistern? **N/A for Honduras	_____times a day/week/month 1) Never 99) I do not know Comments:
A14b	When the elevated tank/cistern is full of treated water, how long does it take to empty? **in Honduras, ask about untreated water	_____ Hours _____ Days _____ Weeks _____ Months
A14c	When the polytanks are full of treated water, on average, how long do they take to empty? **N/A for Honduras	_____ Hours _____ Days _____ Weeks _____ Months
A14d	Are the elevated tanks/cisterns cleaned? If yes, how often?	1)Yes 2)No 99) I do not know Comments:

A14e	Are the polytanks cleaned? If yes, how often? **N/A for Honduras	1)Yes 2)No 99) I do not know Comments:
A15 A15a	Have you ever had to bring in water from a tanker truck due to lack of water? If yes, how often in the past year? Where is the water from the tanker –truck usually stored? (specify location, check if location is before or after filtration system)	1) Yes 2) No 99) I do not know Comments: Location: _____ 1) Before filtration 2) After filtration 99) I do not know
A15b A15b.1 A15b.2 A15b.3 A15b.4 A15b.5	What is the water brought in from the tanker truck used for? (circle all that apply, specify if necessary)	 1) Grounds and maintenance uses 2) Hospital taps 3) Laundry 4) Staff/student quarters 88)Other_____ 99) I do not know Comments:
A16	What are sources of drinking water in the hospital? (circle all that apply, specify if necessary)	1) Bottled/sachet (provided by the hospital) 2) Bottled/sachet(purchased by patient/staff) 88) Other _____
 A17a A17b A17c A17d	Who drinks the tap water? **Staff** **Patients** **Visitors/Care Takers** **Others**	 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know Specify:_____

A18 A18a A18b A19 A20 A21	Are there times when people collect water from the hospital to take home with them? **If yes**, approximately how many people each day? Are they staff or patients/visitors? When people do take water home with them, from which collection points within the hospital do people collect the water? Does the hospital support or discourage people collecting water from the hospital taps? How much do people pay (per liter) when they purchase water from vendors for household purposes?	1) Yes 2) No →SKIP to Ax 99) I do not know →SKIP to Ax _____ people/day Comments: 1) Staff 2)Patients/Visitors 3) Both 99) I do not know 1) Support 2) Discourage 99) I do not know Comments: _____ Ghc/L
On-Site Capacity		
Water Treatment		
A22 A22a A22b A22c A22d A22e A22f A22g	Is there a person responsible for: A. Maintaining the filtration system B. Repairing the filtration system C. Ensuring there is chlorine available to treat the water D. Purchasing chlorine to treat the water E. Testing the chlorine residual levels F. Ensuring that storage tanks and bucket taps are filled with water when the taps are not flowing G. Shutting off the filtration system when necessary	A. 1) Yes 2) No [Name/Role_____] B. 1) Yes 2) No [Name/Role_____] C. 1) Yes 2) No [Name/Role_____] D. 1) Yes 2) No [Name/Role_____] E. 1) Yes 2) No [Name/Role_____] F. 1) Yes 2) No [Name/Role_____] G. 1) Yes 2) No [Name/Role_____]
A23	Who assigns and ensures the above responsibilities are completed? (A22)	
A24 A24a A24b	When the treatment system is shut off or bypassed, are you informed? Before or after shut off? Who informs you?	1) Yes 2)No 99)I do not know 1) Before 2)After 99) I do not know Comments:
A25	Do you believe your hospital staff have the (capacity) knowledge to manage the system?	1) Yes 2)No 99)I do not know Comments:

	Why or why not?	
A26	Do you believe your hospital staff have the knowledge (capacity) to train new staff on the management, maintenance, and operation of the system? Why or why not?	1) Yes 2)No 99)I do not know Comments:
A27	What is your role in relation to the water treatment system?	
A28	What are your goals for the water treatment system? Do you feel as though you are achieving those goals? Why or why not?	
A29	What do you do to promote the use of safe water use in the hospital?	
A30	In your opinion, what could be done to improve access to safe water in the community surrounding this hospital?	
A31	How can the hospital's water treatment system improve access to safe water in the community surrounding this hospital?	
A32	If the hospital had the ability to sell safe water, do you think people would buy it? Why or why not?	1) Yes 2) No 99) I do not know Comments:
Accountability		
A33 A33a A33b A33c A33d A33e A33f A33g A33h A33 a-h.a	Does your hospital keep records of the following activities related to water provision? Who is responsible for each? A. Availability of water B. Water treatment C. Cleaning water containers (polytanks, bucket tap, cisterns) D. Repairing taps and broken sinks E. Backwashing F. Chlorine residual testing G. System bypasses H. Other (on a scale from 1 -5, 1=not well maintained 5= maintained) **Observation:** Are the records up to date? **Observation:** Are the records well maintained?	 A. 1) Yes 2) No 3) N/A _____ B. 1) Yes 2) No 3) N/A _____ C. 1) Yes 2) No 3) N/A _____ D. 1) Yes 2) No 3) N/A _____ E. 1) Yes 2) No 3) N/A _____ F. 1) Yes 2) No 3) N/A _____ G. 1) Yes 2) No 3) N/A _____ H. 1) Yes 2) No 3) N/A _____ 1 2 3 4 5 Comments:

A33 a-h.b	(Ask if there is record and where it is located. Find records later. Take a picture of the record)	1 2 3 4 5 Comments:
A34 A34a A34b A34c	Are there any organizations or institutions that are monitoring water quality within the hospital? [probe for specific names] How often do you have contact with x officials? What is the name of the x official? What is his/her title? Contact info:	1) Yes →SKIP to Ax 2) No →SKIP to Ax 99) I do not know →SKIP to Ax
A35 A35a	**If yes**, how frequently do they take samples? Do they share their findings with the hospital?	_____ times a week/month/year/ever 1) Yes 2) No 99) I do not know Comments:
A36	What is the closest city were water samples could be sent to for analysis? Where and what institution?	_____ 99) I do not know Comments:
A37 A37a A37b A33c	How often do you talk to GE Ambassadors/ Kwame Akorsa? What do you talk to them about? [Probe for specific examples] Are these meetings regularly scheduled? When you bring up issues, are they addressed?	___ times/week/ month/year 99) I do not know Comments: 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know
A38 A38a A38b A38c	Do you communicate with Assist International and Kwame Akorsa about the filtration system? How often? What do you discuss? [Probe for specific examples] Are these meetings regularly scheduled? When you bring up issues, are they addressed?	1) Yes 2) No 99) I do not know _____ times/week/month/year Comments: 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know
A39 A39a A39b	How frequently do you talk to maintenance staff about the filtration system? Are your meetings with the maintenance staff scheduled? What did you discuss the last time you spoke?	_____ times a day/week/month 1) Yes 2) No 99) I do not know Comments:

A41 A41a A41b	How frequently do you talk to laboratory staff about the filtration system? Are your meetings with the laboratory staff scheduled? What did you discuss the last time you spoke?	_____ times a day/week/month 1) Yes 2) No 99) I do not know Comments:
A42 A42a A42b	How frequently do you talk to the administrator (bookkeeper) about the filtration system? Are your meetings with the administrator scheduled? What did you discuss the last time you spoke?	_____ times a day/week/month 1) Yes 2) No 99) I do not know Comments:
A43 A43a	Have you ever spoken with the staff about the filtration system? What have you talked about?	1) Yes 2) No 99) I do not know
A44 A44a A44b	Does the hospital have a quality assurance committee? If yes, is safe water one of the themes they discuss? Have they taken any action with regard to improving the provision of safe water in the hospital? What actions? **Note**: may not be called biosafety committee in Ghana	1) Yes 2) No →SKIP to Ax 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know Comments:
A55 A55a A55b A55c A55d	Do you communicate with the GHS about the water treatment system? How often? What do you discuss? [Probe for specific examples] Are these meetings regularly scheduled? When you bring up issues, are they addressed?	1) Yes 2) No 99) I do not know _____ times a week/month/year 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know
A85 A85a A85b A85c A85d	Do you communicate with the MOH about the water treatment system? How often? What do you discuss? [Probe for specific examples] Are these meetings regularly scheduled? When you bring up issues, are they addressed?	1) Yes 2) No 99) I do not know _____ times a week/month/year 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know

A 86 A86a A86b	How frequently do you talk to the bottling company about the filtration system? Are your meetings regularly scheduled? What did you discuss the last time you spoke? **N/A for Ghana	_____ times a day/week/month 1) Yes 2) No 99) I do not know Comments:
Institutional Support (the MOH and GE)		
Training and Capacity Building		
A45	Who was trained (within the hospital) in maintaining the filtration system?	Name: _____ Role: _____ Name: _____ Role: _____ Name: _____ Role: _____ Name: _____ Role: _____ 99) I do not know
A46 A46a	Did hospital staff receive an information session about the water filtration system? (e.g. why the system was provided / water borne disease) What information sessions would be useful? (waterborne disease, water quality and treatment)	1) Yes 2) No 99) I do not know Comments:
A47 A47a	For how long do you expect GE to continue to offer their assistance? In what capacity? Why? If GE were to stop providing assistance, would you be able to continue to provide safe water? How?	Comments: 1) Yes 2) No 99) I do not know Comments:
Support for Operations and Maintenance, Repairs, and Replacements		
 A48a A48b A48c A48d A48e A49	Does GE or the MOH/GHS offer: A. Funds for the water bill B. Funds for water treatment C. Funds for infrastructure (tubing, sinks) D. Staff training E. Other (Specify): If yes, How much?	 A. 1) Yes 2) No 99) I do not know **Who:** 1) GE 2)MOH B. 1) Yes 2) No 99) I do not know **Who:** 1) GE 2)MOH C. 1) Yes 2) No 99) I do not know **Who:** 1) GE 2)MOH D. 1) Yes 2) No 99) I do not know **Who:** 1) GE 2)MOH E. Other _____ Who: 1) GE 2) MOH A. _____GHc B. _____GHc C. _____GHc D. _____GHc

A50 **Deleted**		E. _____GHc Comments:
A51a A51b A51c	Does the hospital set aside funds for: A. Water treatment B. Infrastructure (tubing, sinks) C. Other (specify):	 A. 1) Yes 2) No 99) Don't know B. 1) Yes 2) No 99) Don't know C. Describe:
A52	Are there any outside organizations (apart from GE) that have financed infrastructure for the provision of water and sanitation within the hospital? (For example: wells, toilets, etc.)	1) Yes 2) No 99) I do not know Comments:
A53	What are other sources of external funding for the hospital? *Add question about communication with water bottling companies (Honduras Only)	
A54	**DELETED QUESTION**	**DELETED QUESTION**
Finance Mechanisms		
A56 A56a	Who reviews expense reports? Where are they sent? How often?	_____ 99) I don't know Comments:
A57	How much does chlorine (bleach) cost on a monthly (or quarterly) basis for the filtration system? (probe for cost/unit time)	____ Ghc/monthly/quarterly/yearly 99) I do not know
A58	How often are repairs to the water treatment system completed? [please explain the system used to obtain consumables and parts]	____ Weekly ____ Monthly ____ Yearly 99) I do not know Comments:
A59	Who funds the cost of repairs associated with the system?	1)MOH 2)GE 3)No one 4) Hospital 99)I do not know Comments:
A60	What process does the hospital have in place to track the expenses required for the water treatment system operating? (Ask to see expense tracking system)	Comments:

	(on a scale from 1 -5, 1=not well maintained 5= maintained)	
A60a	**Observation:** Is the record up to date?	1 2 3 4 5 Comments:
A60b	**Observation:** Is the record well maintained?	1 2 3 4 5 Comments:
A61	Has there been a time when chlorine was not purchased for the filtration system? Why?	1) Yes 2) No 99) I do not know Comments:
A62	How frequently is chlorine not purchased for the system? Why?	_____ times a week/month/year/ N/A Comments:
A63	Is the hospital able to cover the recurring costs associated with the filtration system (i.e. chlorine, staff time, small repairs)?	1) Yes 2) No 99) I do not know Comments:
Satisfaction and Perceived Value		
A64	In your opinion, what are the benefits of having a safe water source here in the hospital?	
A65	For who in the hospital is safe water most important? For what purpose? Can you give me an example?	
A66	What actions does the hospital take to promote the availability and awareness of safe water for staff, patients, and visitors?	
A67	How is the water quality in the hospital compared to the water you use at home? Why?	1) Worse 2) Equal 3) Better 99) I do not know Comments:
A68	In your opinion is the water from the tap safe to drink?	1) Yes 2) No 99) I do not know
A69	Do you drink from the tap?	1) Yes 2) No 99) I do not know
	On a scale of 1-5, 5=very satisfied 1=not satisfied:	
A70	How would you rate your satisfaction with the taste of the water? [If no, why not?]	1 2 3 4 5 Comments:

A71	How would you rate your satisfaction with the color of the water? [If no, why not?]	1 2 3 4 5 Comments:
A72	How would you rate your satisfaction with the water pressure of the system? [If no, why not?]	1 2 3 4 5 Comments:
A73	How would you rate your satisfaction with the maintenance cost of the filtration system? [If no, why not?]	1 2 3 4 5 Comments:
A74	How would you rate your satisfaction with the filtration system to provide the need of safe water to the hospital? [explain]	1 2 3 4 5 Comments:
A75	Would you recommend this filtration system to other hospitals? Why or why not?	1) Yes 2) No 99) I do not know Comments:
A76	In your opinion, what distinguishes this hospital from other public hospitals?	
A77	Do you believe that there are benefits to safe water?	1) Yes 2) No 99) I do not know
Educational Messaging		
A78 A78a A78b	If an hour long information session or training regarding safe water was held in your hospital, would you attend? If yes, what would you like to learn about water? If yes, how would you like to learn about it? (role play, lecture, demonstration, poster)	1) Yes 2) No 99) I do not know Comments: Comments:
A79	If no, would you attend if you were given a certificate of completion?	1) Yes 2) No 99) I do not know
A80	If an hour long information session was given, when would be a good time during the day to have it? (i.e. During lunch or after work?)	
A81 A81a	What would be an effective way tLo tell others about water and the benefits of safe water? What Language should it be in?	
Personal Information (Observations)		
A82	Sex of the director:	1) Male 2) Female

A83	Age of the director:	1) ≤ 30 years 2) >30 years 3) ≥ 60 years
A84a A84b A84c A84d	**Opinion of the investigator:** On a scale of 1-5, 5=very committed 1=not committed: A. How committed was the participant to respond to the questions asked? B. What was the participant's level of knowledge about the practices at this hospital? C. How willing was the participant to give examples and additional information? D. What was the participant's level of commitment to the provision of clean water?	A. 1 2 3 4 5 B. 1 2 3 4 5 C. 1 2 3 4 5 D. 1 2 3 4 5 Comments and observations:

Director/Clinical Staff

1) Doctor 2) Nurse 3) Pharmacist 4) Midwife 5) Dula 10)Director 88) Other, specify:

1. **What sources of water are available to you at the hospital for all of your daily activities (list them)?**

2. **Which other of your daily activities at the hospitals require you to use water (*list them*)?**

Which of these sources of water do you use for the following activities:

	Bottled	**Tap untreated**	**Tap treated**					**N/A**
Drinking								
Hand Washing								
Hand washing before surgery								
During surgery (surgical staff only)								
Water given to patients to consume with oral medications (probe for how decision is made to use which water source)								
Bathing newborn babies								
Sponge-bathing								
Cleaning wounds								
Cleaning Burns								
Teeth clean rinse (for dentists)								
Reconstitution of medications								

Comments & Observations:

BH1	Date		BH4	Hospital Name	
BH2	Start Time		BH5	Name of Investigator(s)	
BH3	End Time				

B1	Role of Participant:	1) Doctor 2) Nurse 3) Pharmacist 88) Other, specify:
B2	Sex of Participant:	1) Male 2) Female
B3	Age of Participant:	1) ≤ 30 years 2) >30 years 3) ≥ 60 years
B4	In your opinion, is the water from the hospital tap safe to drink? Why or why not? [Probe for more information]	1) Yes 2) No 99) I do not know Comments:
B5	How is the water quality in the hospital in comparison to the water you use at home?	1) Worse 2) Equal 3) Better 99) I do not know Comments:
B6 B6a	Prior to being informed today, were you aware of the water treatment system at the hospital? How did you learn this information?	Treated: 1) Yes 2) No 99) I do not know Comments:
B7	Is contaminated water a problem for the communities living near this hospital? Why or why not?	1) Yes 2) No 99) I do not know Comments:
B8a B8b B8c B8d	Who drinks water directly from the tap? **Staff** **Patients** **Visitors/Care Takers** **Others**	 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know Specify:_____
B9	Do patients comment about the water in the hospital? If yes, what do they say? (probe for water quality) [explain]	1) Yes 2) No 99) I do not know Comments:
B10	What are the benefits of having safe water for your job?	99) I do not know Comments:
B11	Do you recommend that your patients drink tap water in the hospital?	1) Yes 2) No If no, why _____

1) Doctor 2) Nurse 3) Pharmacist 4) Midwife 5) Dula 88) Other, specify:

3. **What sources of water are available to you at the hospital for all of your daily activities (list them)?**

4. **Which other of your daily activities at the hospitals require you to use water (*list them*)?**

Which of these sources of water do you use for the following activities:

	Bottled	Tap untreated	Tap treated					N/A
Drinking								
Hand Washing								
Hand washing before surgery								
During surgery (surgical staff only)								
Water given to patients to consume with oral medications (probe for how decision is made to use which water source)								
Bathing newborn babies								
Sponge-bathing								
Cleaning wounds								
Cleaning Burns								
Teeth clean rinse (for dentists)								
Reconstitution of medications								

Comments & Observations:

CH1	Date		CH4	Hospital Name	
CH2	Start Time		CH5	Name of Investigator(s)	
CH3	End Time				

C1	Role of Participant:	1) Administrative Staff (Receptionist, finance, etc.) 3) Cook 5) Laundry 6) Sanitation/Janitorial 88) Other, specify: **Laboratory (2) and Administrator (4): see separate surveys**
C2	Sex of Participant:	1) Male 2) Female
C3	Age of Participant:	1) ≤ 30 years 2) >30 years 3) ≥ 60 years
C4	In your opinion, is the tap water safe to drink? Why or why not?	1) Yes 2) No 99) I do not know Comments:
C5	How is the water quality in the hospital in comparison to the water you use at home?	1) Worse 2) Equal 3) Better 99) I do not know Comments:
C6 C6a	Prior to being informed today, were you aware of the water treatment system at the hospital? How did you learn this information?	1) Yes 2) No 99) I do not know Comments:
C7	What do you know about the water treatment system at the hospital?	
C8a C8b C8c C8d	Who drinks water directly from the tap? **Staff** **Patients** **Visitors/Care Takers** **Others**	1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know Specify:_____
C9	Do you drink from the tap?	1) Yes 2) No 99) I do not know Comments:
C10	What are the benefits of having safe water for your job?	
C11	Is contaminated water a problem for the communities living near this hospital? Why or why not?	1) Yes 2) No 99) I do not know Comments:
C12 C12a	If an hour long information session or training regarding safe water was held in your hospital, would you attend? If yes, what would you like to learn about water?	1) Yes 2) No 99) I do not know Comments:

C12b	**If yes**, how would you like to learn about it? (role play, lecture, demonstration, poster)	Comments:
C13	**If no**, would you attend if you were given a certificate of completion?	1) Yes 2) No 99) I do not know
C14	If an hour long information session was given, when would be a good time during the day to have it? (ie. During lunch or after work?)	
C15 C15a	What would be an effective way to tell others about water and the benefits of safe water? What Language should it be in?	
  C16a C16b C16c C16d	Opinion of the investigator: On a scale of 1-5, 5=very committed 1=not committed: A. How committed was the participant to respond to the questions asked? B. What was the participant's level of knowledge about the practices at this hospital? C. How willing was the participant to give examples and additional information? D. What was the participant's level of commitment to the provision of clean water?	 A. 1 2 3 4 5 B. 1 2 3 4 5 C. 1 2 3 4 5 D. 1 2 3 4 5 Comments and observations:

Various Hospital Staff
5). Laundry **3). Cook** **6). Janitorial**

88) Other, specify:

1. What sources of water are available to you at the hospital for all of your daily activities (list them)?

2. Which other of your daily activities at the hospitals require you to use water (list them)?

Which of these sources of water do you use for the following activities:

	Bottled	**Tap untreated**	**Tap treated**					**N/A**
Drinking								
Hand Washing								
Laundry (including hospital bedding) (Laundry)								
Washing floors and other surfaces (Janitorial/Sanitation)								
Flushing toilets (Janitorial/Sanitation)								
Watering plants and gardening (Janitorial/Sanitation)								
Washing hospital vehicles (ambulances, other) (Janitorial/Sanitation)								
Wash foods and vegetables (Kitchen)								
Preparing food (Kitchen)								
Washing dishes, utensils, glasses								

Comments & Observations:

JH1	Date		JH4	Hospital Name	
JH2	Start Time		JH5	Name of Investigator(s)	
JH3	End Time				

J1	Role of Participant:	4) Administrator (bookkeeper) 88) Other, specify:
J2	Sex of Participant:	1) Male 2) Female
J3	Age of Participant:	1) ≤ 30 years 2) >30 years 3) ≥ 60 years
J4a J4b	What is the population of the municipality:	Area: Population:
J5	In your opinion, is the tap water safe to drink? Why or why not?	1) Yes 2) No 99) I do not know Comments:
J6	Do you drink from the tap?	1) Yes 2) No 99) I do not know Comments:
J7	How is the water quality in the hospital in comparison to the water you use at home?	1) Worse 2) Equal 3) Better 99) I do not know Comments:
J8 J8a	Prior to being informed today, were you aware of the water treatment system at the hospital? How did you learn this information?	Treated: 1) Yes 2) No 99) I do not know Comments:
 J9a J9b J9c J9d	Who drinks the tap water? **Staff** **Patients** **Visitors/Care Takers** **Others**	 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know Specify:_____
J10	What are the benefits of having safe water for your job?	
J11	Is contaminated water a problem for the communities living near this hospital? Why or why not?	1) Yes 2) No 99) I do not know Comments:
J12 J12a J12b J12c	What influences your decision to purchase (or not purchase) chlorine for the water treatment system? On a scale of 1-5, 5=influences 1= does not influence A. Cost B. Impact on water quality C. % of funds already spent on water	 A. 1 2 3 4 5 B. 1 2 3 4 5 C. 1 2 3 4 5
J13	Approximately how much do you spend monthly to obtain consumables and parts needed to fix repairs	_____ Ghc

	for the water treatment system?	
J14 J14a J14b J14c	What influences your decision to finance (or not finance) the maintenance of infrastructure for the hospital's water system, for example repairs or substitutions of broken sinks and taps or fittings on the water treatment system? On a scale of 1-5, 5=influences 1= does not influence A. Cost B. Impact on water quality C. % of funds already spent on water	 A. 1 2 3 4 5 B. 1 2 3 4 5 C. 1 2 3 4 5
J15	Is there a specific budget for inputs and repairs for the water treatment system? [if not, please explain the system used to obtain consumables and parts]	1) Yes 2) No 99) I do not know Comments:
J16 J16a J16b J16c J16d J16e J16f J16g J16h J16a-h.a J16a-h.b	Does your hospital keep records of the following activities related to water provision? Who is responsible for each? A. Availability of water B. Water treatment C. Cleaning water containers (polytanks, bucket tap, cisterns) D. Repairing taps and broken sinks E. Backwashing F. Chlorine residual testing G. System bypasses H. Other (on a scale from 1 -5, 1=not well maintained 5= maintained) **Observation:** Are the records up to date? **Observation:** Are the records well maintained? (Ask if there is record and where it is located. Find records later. Take a picture of the record)	A. 1) Yes 2) No 0) N/A 99) I do not know _____ B. 1) Yes 2) No 0) N/A 99) I do not know _____ C. 1) Yes 2) No 0) N/A 99) I do not know _____ D. 1) Yes 2) No 0) N/A 99) I do not know _____ E. 1) Yes 2) No 0) N/A 99) I do not know _____ F. 1) Yes 2) No 0) N/A 99) I do not know _____ G. 1) Yes 2) No 0) N/A 99) I do not know _____ H. 1) Yes 2) No 0) N/A 99) I do not know _____ 1 2 3 4 5 Comments: 1 2 3 4 5 Comments:
J17	What system does the hospital have in place to track the expenses required for the filtration system operating? (Ask to see expense tracking system) (on a scale from 1 -5, 1=not well maintained 5=	Comments:

J17a J17b	Maintained) **Observation:** Is the record up to date? **Observation:** Is the record well maintained?	1 2 3 4 5 Comments: 1 2 3 4 5 Comments:
J18 J18a J18b	Does the hospital have a quality assurance committee? If yes, is safe water one of the themes they discuss? Have they taken any action with regard to improving the provision of safe water in the hospital? What actions? **Note**: may not be called biosafety committee in Ghana	1) Yes 2) No →SKIP to Ax 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know Comments:
J19 J19a	What is the closest city were water samples could be sent to for analysis? Where and what institution?	
J20 J20a J20b J20c	How often do you talk to GE Ambassadors/ Kwame Akorsa? What do you talk to them about? [Probe for specific examples] Are these meetings regularly scheduled? When you bring up issues, are they addressed?	___ times/week/ month/year 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know
J21 J21a J21b J21c	Do you communicate with Assist International and \ about the filtration system? How often? What do you discuss? [Probe for specific examples] Are these meetings regularly scheduled? When you bring up issues, are they addressed?	1) Yes 2) No 99) I do not know ____ times/week/month/year 99)I do not know Comments: 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know
J22 J22a J22b	How frequently do you talk to the director about the filtration system? Are your meetings with the director scheduled? What did you discuss the last time you spoke?	___ times a day/week/month 99)I do not know 1) Yes 2) No 99) I do not know Comments:

J23 J23a J23b J24	How frequently do you talk to maintenance staff about the filtration system? Are your meetings with the maintenance staff scheduled? What did you discuss the last time you spoke? Does the maintenance staff inform you when they shut off the filtration system?	_____ times a day/week/month 99)I do not know 1) Yes 2) No 99) I do not know Comments: 1) Yes 2) No 99) I do not know
J25 J25a J25b J25c	Are there any organizations or institutions that are monitoring water quality within the hospital? [probe for specific names] How often do you have contact with x officials? What is the name of the x official? What is his/her title? Contact info:	1) Yes 2) No 99) I do not know Comments:
J26 J26a	**If yes**, how frequently do these outside organizations take samples? Do they share their findings with the hospital?	_____ times a week/month/year/ever 99)I do not know 1) Yes 2) No 99) I do not know Comments:
J27	How much does chlorine (bleach) cost on a monthly (or quarterly) basis for the filtration system? (probe for cost/unit time)	_____ Ghc
J28 J28a	Has there been a time when chlorine was not purchased for the filtration system? Why? How frequently is chlorine not purchased for the system? Why?	1) Yes 2) No 99) I do not know Comments: _____ times a week/month/year/ N/A 99)I do not know Comments:
J29 J29a J29b	If an hour long information session or training regarding safe water was held in your hospital, would you attend? **If yes**, what would you like to learn about water? **If yes**, how would you like to learn about it? (role play, lecture, demonstration, poster)	1) Yes 2) No 99) I do not know Comments: Comments:
J30	**If no**, would you attend if you were given a certificate of completion?	1) Yes 2) No 99) I do not know
J31	If an hour long information session was given, when would be a good time during the day to have it? (i.e. During lunch or after work?)	

J32 J32a	What would be an effective way to tell others about water and the benefits of safe water? What Language should it be in?	
J33a J33b J33c J33d	**Opinion of the investigator:** On a scale of 1-5, 5=very committed 1=not committed: A. How committed was the participant to respond to the questions asked? B. What was the participant's level of knowledge about the practices at this hospital? C. How willing was the participant to give examples and additional information? D. What was the participant's level of commitment to the provision of clean water?	A. 1 2 3 4 5 B. 1 2 3 4 5 C. 1 2 3 4 5 D. 1 2 3 4 5 Comments and observations:

Administrative Staff

1. What sources of water are available to you at the hospital for all of your daily activities (list them)?

2. Which other of your daily activities at the hospitals require you to use water (list them)?

Which of these sources of water do you use for the following activities:

	Bottled	**Tap untreated**	**Tap treated**					**N/A**
Drinking								
Drinking water provided for visitors								
Hand-Washing								

Comments & Observations:

KH1	Date		KH4	Hospital Name	
KH2	Start Time		KH5	Name of Investigator(s)	
KH3	End Time	Name: Daniel			
K1	Role of Participant:			2) Laboratory Technician 88) Other, specify:	
K2	Sex of Participant:			1) Male 2) Female	
K3	Age of Participant:			1) ≤ 30 years 2) >30 years 3) ≥ 60 years	
K4	In your opinion, is the tap water safe to drink? Why or why not?			1) Yes 2) No 99) I do not know Comments: (See pilot data)	
K5	Do you drink water from the tap?			1) Yes 2) No 99) I do not know Comments:	
K6	How is the water quality in the hospital in comparison to the water you use at home?			1) Worse 2) Equal 3) Better 99) I do not know Comments:	
K7 K7a K7b	Where does the water in this hospital come from? (See pilot data) Is it treated before use? How? Where did you learn this information?			Source: Treated: 1) Yes 2) No 99) I do not know Method of treatment: Comments:	
K8a K8b K8c K8d	Who drinks water directly from the tap? **Staff** **Patients** **Visitors/Care Takers** **Others**			1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know Specify:_____	
K9	What are the benefits of having safe water for your job?				
K10	Is contaminated water a problem for the communities living near this hospital? **Why or why not?**			1) Yes 2) No 99) I do not know Comments:	
K11	Who was trained in water sample collection and testing?			99) I do not know	
K12	How many laboratory staff members have been trained to perform chlorine residual testing by another staff member?			____ Laboratory Staff 99) I do not know	
K13	How often do you measure chlorine residual levels?			__ times/week/month/year	

K13a K13b K13c	Where do you measure them? Do you document this information? Where and how often? (Follow up on testing records – last time were not present due to a move)	1) Yes 2) No 99) I do not know
K14 K14a	How often do you give advice (feedback) to the maintenance staff to adjust the chlorine levels in the water treatment system? How do they react? (probe for updates)	___ times/week/month/year Comments:
K15 K15a	When was the last time you discussed water chlorine levels with the director? (See pilot data) How often do you communicate with the administrator about the chlorine residual levels in the water treatment system?	Comments: ___ times/week/month/year
K16 K16a K16b	How often do you meet with the administrator about the water treatment system? (See pilot data) Are these meetings scheduled? What did you discuss the last time you talked?	____ times/day/week/month 1) Yes 2) No 99) I do not know Comments:
K17 K17a K17b	How often do you talk to the maintenance staff about the filtration system? How many times have the maintenance staff respond to your (the laboratory staff) advice? How many times did you (lab staff) retest the chlorine residual levels after, maintenance adjusted levels?	____ times a day/week/month Comments:
K18 K19	Does your laboratory have incubators? Are the laboratory technicians in this hospital trained on environmental microbiology? Culture methods? What did the training include?	1) Yes 2) No 99) I do not know Comments: 1) Yes 2) No 99) I do not know Comments:
K20 K20a K20b	If an hour long information session or training regarding safe water was held in your hospital, would you attend? If yes, what would you like to learn about water? If yes, how would you like to learn about it?	1) Yes 2) No 99) I do not know Comments: Comments:

	(role play, lecture, demonstration, poster)	
K21	If no, would you attend if you were given a certificate of completion?	1) Yes 2) No 99) I do not know
K22	If an hour long information session was given, when would be a good time during the day to have it? (i.e. During lunch or after work?)	
K23 K23a	What would be an effective way to tell others about water and the benefits of safe water? What Language should it be in?	
  K24a K24b K24c K24d	**Opinion of the investigator:** On a scale of 1-5, 5=very committed 1=not committed: A. How committed was the participant to respond to the questions asked? B. What was the participant's level of knowledge about the practices at this hospital? C. How willing was the participant to give examples and additional information? D. What was the participant's level of commitment to the provision of clean water?	 A. 1 2 3 4 5 B. 1 2 3 4 5 C. 1 2 3 4 5 D. 1 2 3 4 5 Comments and observations:

1. What sources of water are available to you at the hospital for all of your daily activities (list them)?

2. Which other of your daily activities at the hospitals require you to use water (list them)?

Which of these sources of water do you use for the following activities:

	Bottled	Tap untreated	Tap treated	DI water	Auto-claved water			N/A
Drinking								
Hand washing								
Mixing Reagents								
Washing and cleaning laboratory supplies and equipment								
Sterilization of laboratory equipment								

Comments & Observations:

DH1	Date		DH4	Hospital Name	
DH2	Start Time		DH5	Name of Investigator(s)	
DH3	End Time				

D1	Role of Participant:	1) Patient 2) Visitor 88) Other _____
D2	Sex of Participants:	1) Male 2) Female
D3	Age of Participant:	1) ≤ 30 years 2) >30 years 3) ≥ 60 years
D4 D5	How much time did it take you to get to the hospital from where you are coming from? How did you get to the hospital?	____hours ____minutes 1) Walk 2) Bus/public transport 3) Bike 4) Car 5) Motorcycle 88) Other:
D6	How long have you been here at the hospital since you arrived for this visit?	___hours ___minutes
D7	Did you drink water from the hospital tap today?	1) Yes 2) No 3) I do not know
D8	**If they did drink hospital tap water today**: How does the hospital tap water compare to the water you use in your house? Taste? Security?	1) Worse 2) Equal 3) Better 99) I do not know Comments:
D9	**If they did not drink hospital tap water**, why not?	
D10	**If they have children**, did your children drink the hospital tap water today?	1) Yes 2) No 99) I do not know
D11	Is the hospital tap water safe (good) to drink? Why or why not?	1) Yes 2) No 99) I do not know Comments:
D12	Did you know there is a water treatment system at this hospital? What do you know about the system?	1) Yes 2) No 99) I do not know Comments:
D13	Do you have a water tap in your house [or compound]?	1) Yes 2) No 99)I do not know
D14	Where do you collect your water from at home?	
D15 D15a	Do you treat your drinking water in your house [or compound]? **If yes**, How?	1) Yes 2) No →SKIP to D14 99) I do not know→SKIP to D14 Comments: Treatments [in the affirmative case] 1) Boil 2) Filter 3) Chlorine 88) Other

D16	In your opinion, is contaminated water a problem in your community? Why or why not?	1) Yes 2) No 99) I do not know Comments:
D17 D17a	What would be a good way to share information about water and the benefits of safe water to the public? What language should it be in?	

Patient/Visitor/Caregiver
1) Patient
2) Visitor/Caregiver
88) Other, specify:

1. What sources of water are available to you at the hospital for all of your daily activities (list them)?

2. Which other of your daily activities at the hospitals require you to use water (list them)?

Which of these sources of water do you use for the following activities:								
	Bottled	**Tap untreated**	**Tap treated**					**N/A**
Drinking while at hospital								
Hand washing while at hospital								
Washing raw foods, fruits or vegetable before eating								
Preparing food								
Bathing								
Taking oral medications								
Laundry								
Other?								
Comments & Observations:								

EH1		Date		EH4		Hospital Name	
EH2		Start Time		EH5		Name of Investigator(s)	
EH3		End Time					

		Sinks									
Number	Functions	Leaks	Soap	Staff	Patients	Number	Functions	Leaks	Soap	Staff	Patients
1						43					
2						44					
3						45					
4						46					
5						47					
6						48					
7						49					
8						50					
9						51					
10						52					
11						53					
12						54					
13						55					
14						56					
15						57					
16						58					
17						59					
18						60					
19						61					
20						62					
21						63					
22						64					
23						65					
24						66					
25						67					
26						68					
27						69					
28						70					
29						71					
30						72					
31						73					
32						74					
33						75					
34						76					
35						77					
36						78					
37						79					
38						80					
39						81					

40						82					
41						83					
42						84					

FH1	Date			FH4	Hospital Name	
FH2	Start Time			FH5	Name of Investigator(s)	
FH3	End Time					

Taps						
Number	Functions	Leaks	Locked	Soap	Staff	Patients
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Maintenance		
G1	How many liters of chlorine are in the chlorine tank?	3)N/A
G2	Is there chlorine stocked specifically for the water system? How much is there?	1) Yes 2) No 3) N/A 99) I do not know
G3	What is the pressure difference between the entry and the exit of the filter bank? (note: not all systems have pressure gauges)	1) Yes 2) No 3) N/A 99) I do not know
G4	Is the outside of the equipment (filters) clean?	1) Yes 2) No 99) I do not know
G5	Is the area around the filter system clean and clear of non-filter related items?	1) Yes 2) No 99) I do not know
G6	Are there any leaks in the system that has not been repaired?	1) Yes 2) No 99) I do not know

Educational Messages			
G7		Were any messages about safe water observed?	1) Yes 2) No → SKIP to G3 99) Don't Know → SKIP to G3

G8 G9 G10		Are the messages visible to staff? Are the messages visible to patients/visitors? Are the messages engaging/ catchy?	1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know
G11		Were any messages about hand-washing observed?	1) Yes 2) No →SKIP to G5 99) Don't Know → SKIP to G5
G12 G13 G14		Are the messages visible to staff? Are the messages visible to patients/visitors? Are the messages engaging/ catchy?	1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know
G15		Were any messages about bathroom use observed?	1) Yes 2) No →SKIP to H1a 99) Don't Know → SKIP to H1a
G16 G17 G18		Are the messages visible to staff? Are the messages visible to patients/visitors? Are the messages engaging/ catchy?	1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know
G19		Which (organizations or projects) supported the hospital in developing the educational messages?	List Organizations/Projects

HH1	Date		HH 4	Hospital Name	
HH2	Start Time		HH 5	Name of Investigator(s)	
HH3	End Time	**Name: Paul (Ask Benetton the electrician as well)**			

Demographic Information		
	Ask Maintenance person for a water map/ water treatment map for the hospital. (May be in the form of blue prints)	
H1	Role of Participant:	7)Maintenance 8)Plumber 11) Electrician 88) Other
H2	Sex of Participant:	1) Male 2) Female
H3	Age of Participant:	1) ≤ 30 years 2) >30 years 3) ≥ 60 years
H4	What is the highest education level you have completed?	
H5	How long have you been working here at this hospital?	_____months/years

Electricity		
H6	In the last week, how many times has the electricity gone out?	_____ time/day/week/month
H6a	On average, how long does the electricity stay out when it does go out?	Comments:
H6b	Who is responsible for deciding to turn on the generator?	
H6c	When do you choose to turn the generator on? For what specific reasons?	

Sanitation		
H7	What types of toilets are available in the hospital? (circle all that apply)	1) Tank flush toilet 2) Pressure flush toilet 3) Pour flush toilet 4) Tap flush toilet 5) Latrine 88) Other (specify):
H8	What are the common maintenance problems associated with toilets in the hospital? [probe for specific examples]	1) Low water pressure 2) Broken ceramic parts 88) Other (specify): Comments:

On-Site Capacity
Training

H9	Who was trained by GE in the operations and maintenance of the filtration system? Do they all still work here?	Name _Paul ___ Role_____ 1) Yes 2) No Name _ Bentton__ Role_____ 1) Yes 2) No Name _____ Role_____ 1) Yes 2) No Name _____ Role_____ 1) Yes 2) No Name _____ Role_____ 1) Yes 2) No
H10 H10a H10b H10c	How often do you talk to GE Ambassadors/ Kwame Akorsa? What do you talk to them about? [Probe for specific examples] Are these meetings regularly scheduled? When you bring up issues, are they addressed?	___ times/week/ month/year 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know
H11 H11a H11b H11c	Do you communicate with Assist International and Kwame Akorsa about the filtration system? How often? What do you discuss? [Probe for specific examples] Are these meetings regularly scheduled? When you bring up issues, are they addressed?	1) Yes 2) No 99) I do not know _____ times/week/month/year Comments: 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not
H12	How many visits did GE, Assist, and Kwame Akorsa make in the last year?	GE ___ Assist ___ Kwame Akorsa _____
H13	What are the issues you discussed during these visits?	
H14	Who is responsible for the GE water treatment system? (See pilot data)	
H15	Normally, how many people complete maintenance tasks associated with the filtration system? (See pilot data)	
H16	Has any staff member been trained to maintain the filtration system by another staff member?	1) Yes 2) No 99) I do not know
H17	How many days a week is there someone here that knows how to operate the filtration system?	___days/week
H18	How many days in the last month have you not used the filtration system? Why?	___days/month

H19 H19a H19b	If the system is not working, when was the last time it was used? Why are the filters not being used? Have there been any attempts to fix the filters? If no, why not?	
H20 H20a H20b H20c H20d	Do you communicate (on the phone/email) with Kwame Akorsa / GE Ambassadors about the water the filtration system? How often? What do you discuss? [Probe for specific examples] Are these meetings regularly scheduled? When you bring up issues, are they addressed?	1) Yes 2) No 99) I do not know ____ times a day/week/month 1)Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know
H21 H21a H21b H21c H21d	Do you communicate (on the phone/email) with Assist International about the filtration system? How often? What do you discuss? [Probe for specific examples] Are these meetings regularly scheduled? When you bring up issues, are they addressed?	1) Yes 2) No 99) I do not know ____ times a week/month/year 1)Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know
H22 H22a H22b	Do you communicate with the MoH/GHS about the filtration system? How often? What do you discuss? [Probe for specific examples]	1) Yes 2) No 99) I do not know ____ times a day/week/month Comments:
H23 H23a H23b 	What system do you have in place to track the expenses required for the water treatment system operating? (Ask to see expense tracking system) **Observation:** Is the record up to date? **Observation:** Is the record well maintained?	1) Yes 2) No 99) I do not know Comments: 1 2 3 4 5 Comments: 1 2 3 4 5 Comments:
H24	What is your role in the provision of safe water within the hospital?	

H25 H25a H25b H25c	How often do you meet with the director about the filtration system? Are your meetings scheduled? What did you discuss the last time you met? Do you inform the director when you shut off the filtration system?	____ times a day/week/month 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know
H26 H26a H26b H26c H26d	How often do you meet with the laboratory staff about the filtration system? Are your meetings scheduled? What did you discuss the last time you met? Do you inform the laboratory when you shut off the filtration system? Do you inform the laboratory when you change to a new chlorine concentration?	____ times a day/week/month 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know 1) Yes 2) No 99) I do not know
H27 H27a H27b	How often do you talk to the administrator about the filtration system? Are these meetings scheduled? What did you discuss the last time you talked?	____ times a day/week/month 1)Yes 2) No 99) I do not know
H28 H28a	Have you ever spoken with the staff about the filtration system? (See pilot data – probe for more info) What have you talked about? (Probe for if he tells staff about raw water)	1) Yes 2) No 99) I do not know
H29 H29a H29b H29c H29d H29e	How often do you have to buy chlorine for the water system? Where do you buy chlorine? How much chlorine do you usually buy What type of chlorine do you use? (Liquid, powdered) Is it difficult to buy chlorine? Why? How many hours does it take you to buy chlorine?	____ times a day/week/month __ Market __ Chemical shop (pharmacist) __ Other (describe) _____liters __ Liquid chlorine __ Powdered chlorine __ Other (describe) 1) Yes 2) No Comment:

H29f	How much does chlorine (bleach) cost on a monthly (or quarterly) basis for the filtration system? (probe for cost/unit time)	_____Ghc
H30	Do you talk with other maintenance teams at other hospitals with GE filter systems? (See pilot data)	1) Yes 2) No 99) I do not know
H31 H31a H31b H31c H31d H31a-d.a	Does this hospital have a written record for any of the following activities? Who is responsible? A] when a by-pass is run B] measuring chlorine levels C] cleaning the water containers D] repairing taps and broken sink **Observation:** Are these records up to date? Are they well maintained?	A] 1) Yes 2) No 3) N/A _____ B] 1) Yes 2) No 3) N/A _____ C] 1) Yes 2) No 3) N/A _____ D] 1) Yes 2) No 3) N/A _____ 1 2 3 4 5 Comments:
H32 H32a	For how long do you expect GE to continue to offer their assistance? In what capacity? Why? If GE were to stop providing assistance, would you be able to continue to provide safe water? How?	Comments:
Regular Maintenance		
If any of the below responses are "never," Why never? Is it not necessary? Is it too difficult? Does it cause too much stress on the equipment? Is there not enough time?		
H33	**[For manual systems]** How often is a backwash performed?	_____times per day/week/month 0) Never
H34	**[For PLC systems]** How often are the filters checked to make sure the backwash is functioning?	_____times per day/week/month 0) Never
H35	How often is more chlorine added to the system?	_____times per day/week/month 0) Never
H36	Does the hospital always have enough chlorine for the system	1) Yes 2) No 99) I do not know
H37	How often is the pressure at the entrance and exit checked to see if there is a significant drop in pressure across the filters?	__ Weekly __ Monthly __ Yearly __ Never __ N/A
H38	Have you ever removed the tops of the filters and washed the filters in a chlorine bath?	1) Yes 2) No 99) I do not know _____times per day/week/month 0) Never

	If yes, how often? (See pilot data – interesting responsibility deligation)	
H39	What do you do when there is a drop in pressure? [Probe about backwashing] **Only ask if pressure is a concern	
Repairs and Institutional Support		
H40	Is it one of your responsibilities to repair the water treatment system? Why or why not?	1) Yes 2) No Comment:
H41	Given the following scenarios, do you have the capacity to repair the water treatment system? Why or why not? A) What do you do (or would you do) when there is low flow or low pressure from the filters? Answer: Filters should be cleaned and flow and pressure inspected. Filters are cleaned by repeated backwashing. Flow can be measured using the flow meter in Ghana and pressure measured by the pressure gauges in Honduras. B) What do you do when a pump fails? Answer: The maintenance staff likely does not have the capacity to repair a pump. Therefore, the answer to this question should involve initiating a decision making process that involves assessing the situation and then seeking outside help to resolve the problem. C) What do you do if the laboratory tells you that the chlorine concentration is too low? Answer: The maintenance staff should either 1) increase the ratio of chlorine to water in the chlorine solution container 2) increase the size of the dose of chlorine injected into the water or 3) reduce chlorine storage time through better managing water supply.	A. 1) correct 2) incorrect Comment: B. 1) correct 2) incorrect Comment: C. 1) correct 2) incorrect Comment:
H42 H42a H42b	Who do you call when there is a problem with the water treatment system? (See pilot data – probe for how often) How often do you complete repairs to the water treatment system? How accessible are replacement parts (tubing, connectors – elbows, fittings,	Comments: Kwame __ Weekly __ Monthly __ Yearly __ Never 99) I do not know Comments:

H42c H42d	reducers, glue) for the water treatment system? How far do you have to travel to find the replacement parts you need to repair the water treatment system? Where have you been able to find the replacement parts needed to repair the water treatment system when they break down?	___ Locally ___ Within the district ___ Within the region 99) I do not know Comments:
H43	Have you ever sought external help for repairs? If so, why?[explain]	
H44 H44a H44b H44c H44d	Have any of the parts of the system been repaired or replaced? Which part? When? By who? Where did you get the parts for the repair? (Ask to see repair log. Take a picture of log)	 ___/___/_____ Name: _____ Role: _____
H45 H45a	Which parts of the water system can you fix without help from an external support structure? Which parts of the water system cannot be fixed without help from an external support structure?	
H46	In your opinion, what specific aspects of maintenance would you want more training on?	
Satisfaction		
H47	What can GE do to improve the filtration system? (See pilot data – likes the idea of PLC manual controls)	
H48	Would you recommend the filtration system to other hospitals? Why or why not? (See pilot data)	1) Yes 2) No 99) I do not know
H49	What advice would you give others who operate the same water filtration system that you have here? (See pilot data)	
H50	Do you have other questions for GE about the filtration system? Kates note [no – ask Kate if she related that information]	
Educational Messaging		

H51	If an hour long information session or training regarding safe water was held in your hospital, would you attend?	1) Yes 2) No 99) I do not know
H51a	If yes, what would you like to learn about water?	Comments:
H51b	If yes, how would you like to learn about it? (role play, lecture, demonstration, poster)	Comments:
H52	If no, would you attend if you were given a certificate of completion?	1) Yes 2) No 99) I do not know
H53	If an hour long information session was given, when would be a good time during the day to have it? (i.e. During lunch or after work?)	
H54	What would be an effective way to tell others about water and the benefits of safe water?	
H54a	What Language should it be in?	
Awareness/ Demand/ Attitudes		
H55	Why is it important to treat the water?	
H56	In your opinion is the water from the tank safe to drink?	
H57	Do you drink from the tap?	
H58	What are your (maintenance) goals for the water filtration system? Do you feel like you are achieving them? Why?	
Other (opinion of the investigator)		
H59a H59b H59c H59d	**Opinion of the investigator:** On a scale of 1-5, 5=very committed 1=not committed: A. How committed was the participant to respond to the questions asked? B. What was the participant's level of knowledge about the practices at this hospital? C. How willing was the participant to give examples and additional information? D. What was the participant's level of commitment to the provision of clean water?	A. 1 2 3 4 5 B. 1 2 3 4 5 C. 1 2 3 4 5 D. 1 2 3 4 5 Comments and observations:

Maintenance Survey – Cisterns and Polytanks

NH1 # of cisterns: NH2 total volume of cistern:
NH3 # of polytanks: NH4 total volume of polytanks:
NH5 # of taps leaking: NH6 volume over 5 hours: (mL)
NH7 # of cisterns that are leaking at a wasteful rate (measure volume over 5 hours) ____ # ____ (mL)
NH8 Are the cisterns cleaned? Yes/No **If yes**, how often? _____time/week/month/year
NH9 Location of chlorination points:

Cistern #1 N1a Above ground/Below ground
N1b In use? Yes/No
N1c Divided in two sections? Yes/No
N1d Leak? Yes/No
N1e Screen present? Yes/No
N1f Tap? Yes/No N1g Tap functional? Yes/No
N1h Connected to piped water supply? Yes/No
N1i Filtered? Yes/No N1j Chlorinated?

N1l
Cement
Plastic
Metal
Other
_____

N1m Cistern #1: If the water source ceased, how long would the water in cistern last?
1) < 1 day 2) 1-3 days 3) > 3 days

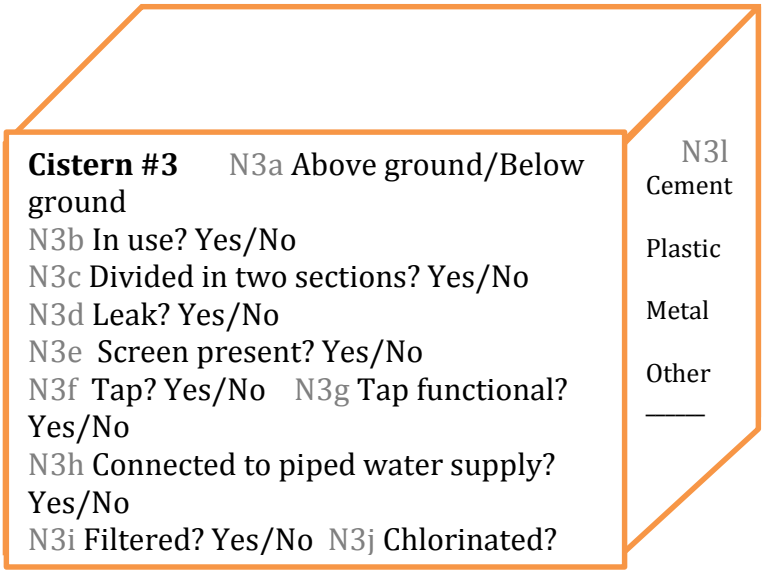
Notes on Cistern #1:

Cistern #2 N2a Above ground/Below ground
N2b In use? Yes/No
N2c Divided in two sections? Yes/No
N2d Leak? Yes/No
N2e Screen present? Yes/No
N2f Tap? Yes/No N2g Tap functional? Yes/No
N2h Connected to piped water supply? Yes/No
N2i Filtered? Yes/No N2j Chlorinated? Yes/No

N2l
Cement
Plastic
Metal
Other
_____

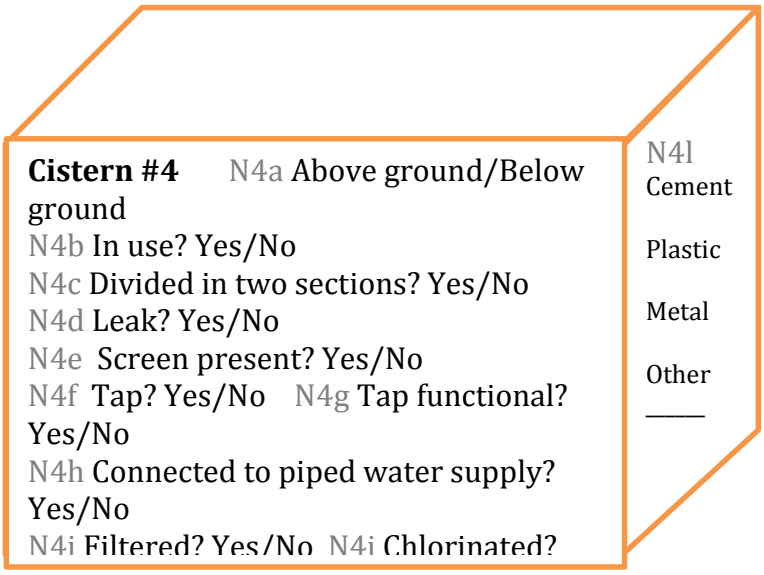
N2m Cistern #2: If the water source ceased, how long would the water in cistern last?
1) < 1 day 2) 1-3 days 3) > 3 days

Notes on Cistern #2



N3m Cistern #3: If the water source ceased, how long would the water in cistern last?
1) < 1 day 2) 1-3 days 3) > 3 days

Notes on Cistern #3



N4m Cistern #4: If the water source ceased, how long would the water in cistern last?
1) < 1 day 2) 1-3 days 3) > 3 days

Notes on Cistern #4

Polytanks

1 P1a **Connected to Cistern # ___**	P1b Leak? Yes/No P1c Lid present? Yes/No P1d Tap? Yes/No P1e Tap functional? Yes/No P1f Connected to piped water supply? Yes/No P1g Ever filled by tanker-truck? Yes/No P1h Filtered? Yes/N P1i Chlorinated? Yes/No P1j Chlorine residual level: _____
2 P2a **Connected to Cistern # ___**	P2b Leak? Yes/No P2c Lid present? Yes/No P2d Tap? Yes/No P2e Tap functional? Yes/No P2f Connected to piped water supply? Yes/No P2g Ever filled by tanker-truck? Yes/No P2h Filtered? Yes/No P2i Chlorinated? Yes/No P2j Chlorine residual level: _____
3 P3a **Connected to Cistern # ___**	P3b Leak? Yes/No P3c Lid present? Yes/No P3d Tap? Yes/No P3e Tap functional? Yes/No P3f Connected to piped water supply? Yes/No P3g Ever filled by tanker-truck? Yes/No P3h Filtered? Yes/No P3i Chlorinated? Yes/No P3j Chlorine residual level: _____
4 P4a **Connected to Cistern # ___**	P4b Leak? Yes/No P4c Lid present? Yes/No P4d Tap? Yes/No P4e Tap functional? Yes/No P4f Connected to piped water supply? Yes/No P4g Ever filled by tanker-truck? Yes/No P4h Filtered? Yes/No P4i Chlorinated? Yes/No P4j Chlorine residual level: _____
5 P5a **Connected to Cistern # ___**	P5b Leak? Yes/No P5c Lid present? Yes/No P5d Tap? Yes/No P5e Tap functional? Yes/No P5f Connected to piped water supply? Yes/No P5g Ever filled by tanker-truck? Yes/No P5h Filtered? Yes/No P5i Chlorinated? Yes/No P5j Chlorine residual level: _____
6 P6a **Connected to Cistern # ___**	P6b Leak? Yes/No P6c Lid present? Yes/No P6d Tap? Yes/No P6e Tap functional? Yes/No P6f Connected to piped water supply? Yes/No P6g Ever filled by tanker-truck? Yes/No P6h Filtered? Yes/No P6i Chlorinated? Yes/No P6j Chlorine residual level: _____
7 P7a **Connected to Cistern # ___**	P7b Leak? Yes/No P7c Lid present? Yes/No P7d Tap? Yes/No P7e Tap functional? Yes/No P7f Connected to piped water supply? Yes/No P7g Ever filled by tanker-truck? Yes/No P7h Filtered? Yes/No P7i Chlorinated? Yes/No P7j Chlorine residual level: _____

Notes:

Polytanks

8 P8a **Connected to Cistern # ___**	P8b Leak? Yes/No P8c Lid present? Yes/No P8d Tap? Yes/No P8e Tap functional? Yes/No P8f Connected to piped water supply? Yes/No P8g Ever filled by tanker-truck? Yes/No P8h Filtered? Yes/No P8i Chlorinated? Yes/No P8j Chlorine residual level: _____
9 P9a **Connected to Cistern # ___**	P9b Leak? Yes/No P9c Lid present? Yes/No P9d Tap? Yes/No P9e Tap functional? Yes/No P9f Connected to piped water supply? Yes/No P9g Ever filled by tanker-truck? Yes/No P9h Filtered? Yes/No P9i Chlorinated? Yes/No P9j Chlorine residual level: _____
10 P10a **Connected to Cistern # ___**	P10b Leak? Yes/No P10c Lid present? Yes/No P10d Tap? Yes/No P10e Tap functional? Yes/No P10f Connected to piped water supply? Yes/No P10g Ever filled by tanker-truck? Yes/No P10h Filtered? Yes/No P10i Chlorinated? Yes/No P10j Chlorine residual level: _____
11 P11a **Connected to Cistern # ___**	P11b Leak? Yes/No P11c Lid present? Yes/No P11d Tap? Yes/No P11e Tap functional? Yes/No P11f Connected to piped water supply? Yes/No P11g Ever filled by tanker-truck? Yes/No P11h Filtered? Yes/No P11i Chlorinated? Yes/No P11j Chlorine residual level: _____
12 P12a **Connected to Cistern # ___**	P12b Leak? Yes/No P12c Lid present? Yes/No P12d Tap? Yes/No P12e Tap functional? Yes/No P12f Connected to piped water supply? Yes/No P12g Ever filled by tanker-truck? Yes/No P12h Filtered? Yes/No P12i Chlorinated? Yes/No P12j Chlorine residual level: _____
13 P13a **Connected to Cistern # ___**	P13b Leak? Yes/No P13c Lid present? Yes/No P13d Tap? Yes/No P13e Tap functional? Yes/No P13f Connected to piped water supply? Yes/No P13g Ever filled by tanker-truck? Yes/No P13h Filtered? Yes/No P13i Chlorinated? Yes/No P13j Chlorine residual level: _____
14 P14a **Connected to Cistern # ___**	P14b Leak? Yes/No P14c Lid present? Yes/No P14d Tap? Yes/No P14e Tap functional? Yes/No P14f Connected to piped water supply? Yes/No P14g Ever filled by tanker-truck? Yes/No P14h Filtered? Yes/No P14i Chlorinated? Yes/No P14j Chlorine residual level: _____

Notes:

Maintenance Staff

1. What sources of water are available to you at the hospital for all of your daily activities (list them)?

2. Which other of your daily activities at the hospitals require you to use water (list them)?

Which of these sources of water do you use for the following activities:								
	Bottled	**Tap untreated**	**Tap treated**					**N/A**
Drinking								
Hand washing								
Chlorine Filter Solution								
Washing water storage containers (cisterns, bottles, etc)								
Other?								

Comments & Observations:

MH1	Date		MH4	Hospital Name	
MH2	Start Time		MH5	Name of Investigator(s)	
MH3	End Time				
Sample 1					
M1.1	Is the water flowing today?	1) Yes 2) No →SKIP			
M1.2 M1.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____			
M1.4	Describe the location of the tap				
M1.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open			
M1.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):			
Sample 2					
M2.1	Is the water flowing today?	1) Yes 2) No →SKIP			
M2.2 M2.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____			
M2.4	Describe the location of the tap				
M2.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open			
M2.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):			
Sample 3					
M3.1	Is the water flowing today?	1) Yes 2) No →SKIP			
M3.2 M3.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____			
M3.4	Describe the location of the tap				

M3.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M3.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 4		
M4.1	Is the water flowing today?	1) Yes 2) No →SKIP
M4.2 M4.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M4.4	Describe the location of the tap	
M4.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M4.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 5		
M5.1	Is the water flowing today?	1) Yes 2) No →SKIP
M5.2 M5.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M5.4	Describe the location of the tap	
M5.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M5.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 6		
M6.1	Is the water flowing today?	1) Yes 2) No →SKIP
M6.2 M6.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M6.4	Describe the location of the tap	

M6.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M6.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 7		
M4.1	Is the water flowing today?	1) Yes 2) No →SKIP
M4.2 M4.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M4.4	Describe the location of the tap	
M4.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M4.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 8		
M5.1	Is the water flowing today?	1) Yes 2) No →SKIP
M5.2 M5.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M5.4	Describe the location of the tap	
M5.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M5.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 9		
M6.1	Is the water flowing today?	1) Yes 2) No →SKIP

M6.2 M6.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M6.4	Describe the location of the tap	
M6.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M6.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 10		
M4.1	Is the water flowing today?	1) Yes 2) No →SKIP
M4.2 M4.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M4.4	Describe the location of the tap	
M4.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M4.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 11		
M5.1	Is the water flowing today?	1) Yes 2) No →SKIP
M5.2 M5.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M5.4	Describe the location of the tap	
M5.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M5.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad

		3) No 88) Other (specify):
Sample 12		
M6.1	Is the water flowing today?	1) Yes 2) No →SKIP
M6.2 M6.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M6.4	Describe the location of the tap	
M6.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M6.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 13		
M4.1	Is the water flowing today?	1) Yes 2) No →SKIP
M4.2 M4.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M4.4	Describe the location of the tap	
M4.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M4.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 14		
M5.1	Is the water flowing today?	1) Yes 2) No →SKIP
M5.2 M5.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M5.4	Describe the location of the tap	

M5.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M5.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 15		
M6.1	Is the water flowing today?	1) Yes 2) No →SKIP
M6.2 M6.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M6.4	Describe the location of the tap	
M6.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M6.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 16		
M4.1	Is the water flowing today?	1) Yes 2) No →SKIP
M4.2 M4.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M4.4	Describe the location of the tap	
M4.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M4.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 17		
M5.1	Is the water flowing today?	1) Yes 2) No →SKIP

M5.2 M5.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M5.4	Describe the location of the tap	
M5.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M5.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 18		
M6.1	Is the water flowing today?	1) Yes 2) No →SKIP
M6.2 M6.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M6.4	Describe the location of the tap	
M6.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M6.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 19		
M4.1	Is the water flowing today?	1) Yes 2) No →SKIP
M4.2 M4.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M4.4	Describe the location of the tap	
M4.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M4.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad

		3) No 88) Other (specify):
Sample 20		
M5.1	Is the water flowing today?	1) Yes 2) No →SKIP
M5.2 M5.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M5.4	Describe the location of the tap	
M5.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M5.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 21		
M6.1	Is the water flowing today?	1) Yes 2) No →SKIP
M6.2 M6.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M6.4	Describe the location of the tap	
M6.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M6.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 22		
M4.1	Is the water flowing today?	1) Yes 2) No →SKIP
M4.2 M4.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M4.4	Describe the location of the tap	

M4.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M4.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 23		
M5.1	Is the water flowing today?	1) Yes 2) No →SKIP
M5.2 M5.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M5.4	Describe the location of the tap	
M5.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M5.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 24		
M6.1	Is the water flowing today?	1) Yes 2) No →SKIP
M6.2 M6.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M6.4	Describe the location of the tap	
M6.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M6.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 25		
M4.1	Is the water flowing today?	1) Yes 2) No →SKIP

M4.2 M4.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M4.4	Describe the location of the tap	
M4.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M4.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 26		
M5.1	Is the water flowing today?	1) Yes 2) No →SKIP
M5.2 M5.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M5.4	Describe the location of the tap	
M5.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M5.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 27		
M6.1	Is the water flowing today?	1) Yes 2) No →SKIP
M6.2 M6.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M6.4	Describe the location of the tap	
M6.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M6.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 28		
M4.1	Is the water flowing today?	1) Yes 2) No →SKIP

M4.2 M4.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M4.4	Describe the location of the tap	
M4.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M4.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 29		
M5.1	Is the water flowing today?	1) Yes 2) No →SKIP
M5.2 M5.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M5.4	Describe the location of the tap	
M5.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M5.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):
Sample 30		
M6.1	Is the water flowing today?	1) Yes 2) No →SKIP
M6.2 M6.3	Collect two water samples	ID 1: _____ _____ _____ ID 2: _____ _____ _____
M6.4	Describe the location of the tap	
M6.5	Measure the flow	___ seconds to fill 100 mL with the tap totally open
M6.6	Is the water filtered? Select all that apply.	1) Membrane 2) Amiad 3) No 88) Other (specify):

Appendix 2: 2013 Survey and Interview Tools (Spanish)

AH1	Fecha		AH4	Nombre del hospital	
AH2	Hora de inicio		AH5	Nombre del Investigador(es)	
AH3	Hora de finalización	Nombre:			

Información General		
Demografía		
	Define water treatment system at start of interview Pregunta el director o administrador para el informe anual	
A1	¿Cuánto tiempo ha trabajado aquí como director? ¿Estaba aquí cuando el sistema se instaló por primera vez?	1) Sí 2) No 99) No sé Comentarios:
A2a A2b	¿Cuál es la población de la ciudad que rodea al hospital? **Only ask in Honduras	Area: Población:
A3	¿Cuántos pacientes son atendidos a diario en este hospital? (En el informe annual)	
A4 A5 A6	¿Cuántos medicos están empleados en este hospital? Las enfermeras? Otros miembros del personal? (En el informe anual)	_____ médicos _____ enfermeras _____ otros miembros del personal
A7 A7a A7b A7c	¿Cuál es la fuente primaria de agua para tomar para la población de A) Este pueblo? B) Las comunidades rurales alrededor este pueblo? ¿A lo major de su conocimiento, lo que es un método de tratamiento de agua común utilizado en casa en esta pueblo y las comunidades rurales que rodean a este pueblo?	A) _____ 99) No sé B) _____ 99) No sé Comentarios:
A8	¿En una semanda promedia, con qué frecuencia el agua no fluye de las llaves en el hospital?	_____veces a la semana/mes/año 99) No sé Comentarios:
A9	¿Por que deje de fluir el agua? Marque todo lo que corresponda, especificando si es	

A9a A9b A9c A9d A9e A9f	necesario)	6) Cuestiones eléctricas 7) Cuestiones de constucción 8) Racionamiento de agua 9) Bombas defectuosas 10) Estación seca 89) Otro _____
Fuentes de agua, disponibilidad y demanda		
A10 A10a A10b A10c A10d A10e A10f A10g	¿Cuales fuentes de agua están disponibles en este hospital? (Marque todo lo que aplique, especificando si es necesario) Gracias (llave publica) La Esperanza (llave publica) San Lorenzo (pozo publica con linea directa) Olanchito (dos llaves publicas)	7) Agua municipal 8) Agua del pozo (mejorado?) 9) Camión (con tanque) 10) Rio, lago (agua supervicial) 11) Agua de lluvia 12) Botellas de agua 89) Otro _____
A11	¿Existen salas/secciones del hospital que hoy no tiene agua corriente? [¿Por qué no?] ¿Cuáles?	1) Sí 2) No 99) No sé Comentarios:
A12	¿Existen salas / secciones del hospital que no están conectados al sistema de filtración de agua? [¿Por qué no?] ¿Cuáles?	1) Sí 2) No 99) No sé Comentarios:
A14b	Cuando la cisterna está llena de agua no tratado, ¿cuánto tiempo se tarda en vaciarse?	_____ Horas _____ Días _____ Semanas _____ Meses
A15 A15a	¿Alguna vez (en el ano pasado) ha tenido que traer agua de un camión con tanque, debido a la falta de agua? **En caso afirmativo**, ¿cuántas veces en el último año? ¿Dondé almacena el agua que viene del camion con tanque? (Especificar la ubicación, compruebe si la ubicación es antes o después de sistema de filtración)	1) Sí 2) No 99) No sé Comentarios: Ubicación: _____ 1) Antes de la filtración 2) Después de la filtración 99) No sé
A15b A15b.1 A15b.2 A15b.3 A15b.4 A15b.5	**En caso afirmativo** ¿Cuáles son los usos del agua que viene del camion con tanque? (Marque todo lo que aplique, especificando si es necesario)	5) Jardines y mantenimiento 6) Llaves de hospital 7) Lavandería 8) Cuartas del personal/estudiantes 89)Otro_____ 99) No sé

		Comentarios:
A16	¿El hospital porporciona agua embotellada para los pacientes y/ o el personal? (Marque todo lo que aplique, especificando si es necesario) ¿Los botellones se compran or se llenan del sistema?	3) Sí, solomente personal 4) Sí, pacientes y personal 5) No 89) Otro _____ 1) Se compran 2) Se llenan 3) Los dos 4) N/A 88) Otro 99) No sé
A17a A17b A17c A17d	¿Quiénes toman el agua de la llave? **Personal** **Pacientes** **Visitantes/Cuidadores** **Otros**	1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé Especifique: _____
A18 A18a A18b A19 A20 A21	¿Hay momentos en que la gente recoge agua del hospital para llevar a casa con ellos? **En caso afirmativo,** ¿aproximadamente cuántas personas cada día? ¿Son personal o pacientes/visitantes? ¿Cuando la gente toma agua a su casa, qué son los puntos de recogida dentro del hospital que la gente usan para recoger el agua? ¿Apoya el hospital o disuadir a la gente de recolección de agua de las llaves del hospital? **MOVED TO PATIENT SURVEY**	1) Sí 2) No →SKIP to Ax 99) No sé →SKIP to Ax _____ personas/día Comentarios: 1) Personal 2)Pacientes/Visitantes 3) Ambos 99) No sé 1) Apoyo 2) Disuade 99) No sé Comentarios:
Capacidad en el Sitio		
Tratamiento de Aguas		
A22 A22a	¿Hay una persona responsable de: A. Mantener el sistema de filtración	A. 1) Sí 2) No [Nombre / Papel _____]

A22b A22c A22d A22e A22f A22g	B. Reparar el sistema de filtración C. Garantizar el cloro está disponible para tratar el agua D. Comprar cloro para tratar el agua E. Prueba los niveles de cloro residual F. Llenar los botellones de agua filtrada (solo para los que llenan botellones del sistema) G. Apagado del sistema de filtración cuando sea necesario	B. 1) Sí 2) No [Nombre / Papel _____] C. 1) Sí 2) No [Nombre / Papel _____] D. 1) Sí 2) No [Nombre / Papel _____] E. 1) Sí 2) No [Nombre / Papel _____] F. 1) Sí 2) No [Nombre / Papel _____] G. 1) Sí 2) No [Nombre / Papel _____]
A23	¿Quién asigna y garantiza que las responsabilidades antes mencionadas se han completado? (A22)	
A24 A24a A24b	¿Cuando el sistema de tratamiento se corta o se hacen un bypass (circunvala), se le informa a Ud.? Antes o después de apagar? ¿Quién le informa?	1) Sí 2) No 99) No sé 1) Antes de 2) Después de 99) No sé Comentarios:
A25	¿Cree que el personal del hospital tiene el conocimiento (capacidad) para manajar el sistema? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé Comentarios:
A26	¿Cree que el personal del hospital tiene el conocimiento (capacidad) para entrenarse a nuevo personal en la dirección, mantenimiento y operación del sistema? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé Comentarios:
A27	¿Cuál es su papel en relación con el sistema de tratamiento de agua?	
A28	¿Cuáles son sus metas para el sistema de tratamiento de agua? ¿Siente que está logrando estas metas? ¿Por qué o por qué no?	
A29	¿Qué se hace para promover el uso de agua potable en el hospital?	
A30	En su opinión, ¿qué se podría hacer para mejorar el acceso al agua potable en las clinicas rurales?	

A32	Si el hospital tenía la posibilidad de vender agua potable, ¿crees que la gente lo compraría? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé Comentarios:
Accountability		
A34 A34a A34b A34c	¿Existen organizaciones o instituciones que monitorean la calidad del agua en el hospital? [Investiga para nombres específicos] ¿Con qué frecuencia tiene contacto con los funcionarios de x? ¿Cuál es el nombre del funcionario de x? ¿Cuál es su / su título? Datos de contacto:	1) Sí →SALTE to Ax 2) No →SALTE to Ax 99) No sé →SALTE to Ax
A35 A35a	**En caso afirmativo,** ¿con qué frecuencia se toman muestras? ¿Comparten sus resultados con el hospital?	____ veces a la semana/mes/año /alguna vez 1) Sí 2) No 99) No sé Comentarios:
A36	¿Cuál es la ciudad más cercana donde podían enviar las muestras de agua para el análisis? ¿Dónde y qué institución?	_____ 99) No sé Comentarios:
A37 A37a A37b A33c	¿Con qué frecuencia habla con los embajadores de GE? ¿De qué hablaron? [Investiga para ejemplos específicos] ¿Son estas reuniones programadas con regularidad? ¿Si usted discute los problemas se abordan?	___ veces a la semana/mes/año 99) No sé Comentarios: 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé
A38 A38a A38b A38c	¿Se comunica con Assist International sobre el sistema de filtración? ¿Con qué frecuencia? ¿De qué hablaron? [Investiga para ejemplos específicos] ¿Son estas reuniones programadas con regularidad? ¿Si usted discute los problemas se abordan?	1) Sí 2) No 99) No sé _____ veces a la semana/mes/año Comentarios: 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé
A39 A39a A39b	¿Con qué frecuencia habla con el personal de mantenimiento sobre el sistema de filtración? ¿Son estas reuniones con el personal de mantenimiento programadas con regularidad? ¿De qué hablaron la última vez?	_____ veces al día/semana/mes 1) Sí 2) No 99) No sé Comentarios:

A41	¿Con qué frecuencia habla con el personal de laboratorio sobre el sistema de filtración?	_____ veces al día/semana/mes
A41a	¿Son estas las reuniones con el personal de laboratorio programadas con regularidad?	1) Sí 2) No 99) No sé
A41b	¿De qué hablaron la última vez?	Comentarios:
A42	¿Con qué frecuencia hablas con el/a administrador(a) sobre el sistema de filtración?	_____ veces al día/semana/mes
A42a		1) Sí 2) No 99) No sé
A42b	¿Son estas las reuniones con el administrador programadas con regularidad? ¿De qué hablaron la última vez?	Comentarios:
A43	¿Alguna vez ha hablado con el personal sobre el sistema de filtración?	1) Sí 2) No 99) No sé
A43a	¿De qué hablaron?	
A44	¿Tiene el hospital un comite de bioseguridad?	1) Sí 2) No →SKIP to Ax 99) No sé
A44a	**En caso afirmativo**, es agua potable uno de los temas que se discuten?	1) Sí 2) No 99) No sé
A44b	¿Se han tomado medidas para mejorar la provisión de agua potable en el hospital? ¿Qué medidas?	1) Sí 2) No 99) No sé Comentarios:
A85	¿Se comunica con MdS sobre el sistema de filtracion de agua?	1) Sí 2) No 99) No sé
A85a	¿Con qué frecuencia?	_____ veces a la semana/mes/año
A85b	¿De qué hablaron? [Investiga para ejemplos específicos]	
A85c	¿Son estas reuniones programadas con regularidad?	1) Sí 2) No 99) No sé
A85d	¿Si usted discute los problemas se abordan?	1) Sí 2) No 99) No sé
A 86	¿Se ha comunicado con una empresa que vende los botellones de agua filtratda?	1) Sí 2) No 99) No sé
A86a	¿Que aprendio/discutieron?	Comentarios:
A86b		
Apoyo institucional (Ministerio de Salud y GE)		

Capacitación y fortalecimiento institucional		
A45	¿Quién fue entrenado (en el hospital) en el mantenimiento del sistema de filtración de agua?	Nombre: _____ Papel: _____ Nombre: _____ Papel: _____ Nombre: _____ Papel: _____ Nombre: _____ Papel: _____ 99) No sé
A46 A46a	¿Hubo una sesión de información sobre el sistema de filtración de agua para el personal cuando se instalo el sistema? (por ejemplo, por qué el sistema se proporcionó / enfermedades transmitidas por el agua) ¿Qué sesiones de información sería útil? (Enfermedades transmitidas por el agua, la calidad y tratamiento de aguas)	1) Sí 2) No 99) No sé Comentarios:
A47 A47a	¿Por cuánto tiempo cree que GE va a continuar ofreciendo asistencia ¿En qué capacidad? ¿Por qué? ¿Si GE dejó de proveer asistencia, ¿sería capaz de seguir proporcionando agua potable? ¿Cómo?	Comentarios: 1) Sí 2) No 99) No sé Comentarios:
Apoyo a las Operaciones y Mantenimiento, reparaciones y reemplazos		
A51a A51b A51c	¿Tiene el hospital un presupuesto especifico (o manera para manejar los costos recurrentes para): A. Tratamiento de agua B. Infraestructura (tubos, lavabos) C. Otros (especificar):	 A. 1) Sí 2) No 99) No sé B. 1) Sí 2) No 99) No sé C. Comentarios:
A52	¿Existen organizaciones externas (aparte de GE), que han financiado infraestructuras para el agua y saneamiento en el hospital? (Por ejemplo: pozos, baños, etc)	1) Sí 2) No 99) No sé Comentarios:
A53	¿Cuáles son otras fuentes de financiación externa para el hospital?	
Mecanismos de financiación		
A56 A56a	¿Quién revisa los informes de gastos? ¿Dónde se envían? ¿Con qué frecuencia?	_____ 99) No sé Comentarios:
A57	¿Cuánto costo de cloro (lejía) en una base mensual (o trimestral) para el sistema de filtración? (tiempo costo / unidad)	___ HNL/ mensual / trimestral / anual 99) No sé

A58	¿Con qué frecuencia completan las reparaciones del sistema de tratamiento de agua? [Explique el sistema utilizado para obtener los consumibles y piezas]	____ Semanal ____ Mensual ____ Anual 99) No sé Comentarios:
A59	¿Quién financia el costo de las reparaciones relacionadas con el sistema?	1)MOH 2)GE 3)Nadie 4) Hospital 99)No sé Comentarios:
A60	¿Qué sistema tiene el hospital para monitorizar los gastos necesarios para la operacion del sistema de filtración? (Pida ver el sistema de monitorización de gastos)	Comentarios:
A60a	(on a scale from 1 -5, 1=not well maintained 5= maintained) **Observation:** Is the record up to date?	1 2 3 4 5 Comentarios:
A60b	**Observation:** Is the record well maintained?	1 2 3 4 5 Comentarios:
A61	¿Ha habido un momento en el ano pasado en que el cloro no fue comprado para el sistema de filtración? ¿Por qué?	1) Sí 2) No 99) No sé Comentarios:
A62	¿Con qué frecuencia no compra cloro para el sistema? ¿Por qué?	_____ veces/semana/més/año/N/A Comentarios:
A63	¿Tiene el hospital la capacidad de cubrir los costos recurrentes asociados con el sistema de filtración (es decir, cloro, tiempo del personal, reparaciones pequeñas)?	1) Sí 2) No 99) No sé Comentarios:
La satisfacción y el valor percibido		
A64	En su opinión, ¿cuáles son los beneficios de tener una fuente de agua segura aquí en el hospital?	
A65	Porque ¿quién en el hospital es de agua potable más importante? ¿Con qué propósito? ¿Me puede dar un ejemplo?	
A66	¿Qué acciones toma el hospital para promover la disponibilidad y el conocimiento de agua potable para el	

	personal, los pacientes y los visitantes?	
A67	¿Cómo es el agua en el hospital en comparación al el agua que utiliza en su casa? ¿Por qué?	1) Peor 2) Igual 3) Mejor 99) No sé Comentarios:
A68	¿En su opinión, es el agua de la llave en el hospital segura para tomar? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé
A69	¿Bebe de la llave?	1) Sí 2) No 99) No sé
A70	En una escala de 1 a 5, 5 = muy satisfecho 1 = no satisfecho: ¿Cómo calificaría su satisfacción con el sabor del agua? [Si no, ¿por qué no?]	1 2 3 4 5 Comentarios:
A71	¿Cómo calificaría su satisfacción con el color del agua? [Si no, ¿por qué no?]	1 2 3 4 5 Comentarios:
A72	¿Cómo calificaría su satisfacción con la presión del agua del sistema? [Si no, ¿por qué no?]	1 2 3 4 5 Comentarios:
A73	¿Cómo calificaría su satisfacción con el costo de mantenimiento del sistema de filtración? [Si no, ¿por qué no?]	1 2 3 4 5 Comentarios:
A74	¿Cómo calificaría su satisfacción con el sistema de filtración para proporcionar la necesidad de agua potable al hospital? [Explicar]	1 2 3 4 5 Comentarios:
A75	¿Recomendaría este sistema de filtración a otros hospitales? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé Comentarios:
A76	En su opinión, lo que distingue este hospital desde otros hospitales públicos?	
A77	¿Cree usted que hay beneficios para agua potable?	1) Sí 2) No 99) No sé
Mensajería Educación		

A78 A78a A78b	¿Qué tipo de información sería más útil para su hospital sobre la provisión de agua segura y el uso de agua segura? ¿cómo le gustaría aprender? (juego de rol, conferencias, demostraciones, carteles)	Comentarios: Comentarios:
Información Personal (Observaciones)		
A82	Sexo del director:	1) Hombre 2) Mujer
A83	Edad del director:	1) ≤ 30 años 2) >30 años 3) ≥ 60 años
   A84a A84b A84c A84d	**Opinión de la investigadora:** En una escala de 1-5, 5=muy comprometida 1=no muy comprometida: E. ¿Qué tan comprometido era el participante al responder las preguntas? F. ¿Qué tan experto fue el participante acerca de las prácticas en el hospital? G. ¿Qué tan dispuesto era el participante a dar ejemplos específicos e información adicional? H. ¿Cuál es el nivel de compromiso del participante a la provisión de agua limpia?	 E. 1 2 3 4 5 F. 1 2 3 4 5 G. 1 2 3 4 5 H. 1 2 3 4 5 Comentarios y observaciones:

Director/Personal Clínico

1) Médico 2) Enfermera 3) Farmacéutico 4) Matrona/Paterna 5) Dula 10)Director

88) Otros, especifique:

1. ¿Qué fuentes de agua están disponibles para usted en el hospital para todas sus actividades diarias (lista de ellos)?

2. ¿Qué otra de sus actividades diarias en los hospitales requieren el uso de agua *(enumerarlos)?*

¿Cuál de estas fuentes de agua que se usa para las siguientes actividades:

	Botella	Llave No Tratado	Llave Tratado					N/A
Beber								
Lavarse las manos								
Lavarse las manos antes de la cirugía								
Durante los procedimientos de cirugía (lavando el interior del cuerpo)								
El agua que reciben los pacientes a consumir con medicamentos orales (Sonda de cómo se hace la decisión de utilizar el que la fuente de agua)								
Bañar a los bebés recién nacidos								
Baño de esponja								
Limpieza de las heridas								
Limpieza de la quemaduras								
Enjuagar los dientes (para los dentistas)								
La reconstitución de medicamentos								

Comentarios y Observaciones:

BH1	Fecha		BH4	Nombre del hospital	
BH2	Hora de inicio		BH5	Nombre del Investigador(es)	
BH3	Hora de finalización	Nombre:			

B1	Papel del participante:	1) Medico/a 2) Enfermero/a 3) Farmacéutico 88) Otro, Enumere:
B2	Sexo del participante:	1) Hombre 2) Mujer
B3	Edad del participante:	1) ≤ 30 años 2) >30 años 3) ≥ 60 años
B4	¿En su opinión, es el agua de la llave en el hospital segura para tomar? ¿Por qué o por qué no?[Investiga para más informacion]	1) Sí 2) No 99) No sé Comentarios:
B5	¿Cómo es el agua en el hospital en comparación al el agua que utiliza en su casa? ¿Vive en los cuartos del personal?	1) Peor 2) Igual 3) Mejor 99) No sé 1) Sí 2) No 99) No sé Comentarios:
B6 B6a	Antes de ser informado hoy, estaba consciente del sistema de tratamiento de agua en el hospital? ¿Cómo aprendió esta información? ¿Qué sabe sobre el sistema de tratamiento de agua en el hospital?	1) Sí 2) No 99) No sé Comentarios:
B7	¿Es el agua potable contaminado un problema en la comunidad cerca de este hospital? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé Comentarios:
B8a B8b B8c B8d	¿Quién beba agua de la llave? **Personal** **Los pacientes** **Los visitantes/cuidadores** **Otro**	 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé Enumere:_____
B9	¿Comentan los pacientes sobre el agua en el hospital? **En caso afirmativo**, ¿qué dicen? (Investiga para la calidad del agua) [explicar]	1) Sí 2) No 99) No sé Comentarios:
B10	¿Cuáles serían los beneficios de tener agua potable para su trabajo?	99) No sé Comentarios:

B11	¿Recomienda que sus pacientes beban agua de la llave en el hospital?	1) Sí 2) No Si no, por qué_____
B12	¿De dónde reciben los pacientes el agua cuando la llave no está fluyendo?	
B13 B13a	¿Qué le gustaría aprender sobre el agua	Comentarios:
    B17a B17b B17c B17d	**Opinión de la investigadora:** En una escala de 1-5, 5=muy comprometida 1=no muy comprometida: A. ¿Qué tan comprometido era el participante al responder las preguntas? B. ¿Qué tan experto fue el participante acerca de las prácticas en el hospital? C. ¿Qué tan dispuesto era el participante a dar ejemplos específicos e información adicional? D. ¿Cuál es el nivel de compromiso del participante a la provisión de agua limpia?	A. 1 2 3 4 5 B. 1 2 3 4 5 C. 1 2 3 4 5 D. 1 2 3 4 5 Comentarios y observaciones:

Director/Personal Clínico

1) Médico 2) Enfermera 3) Farmacéutico 4) Matrona/Paterna 5) Dula 10)Director

88) Otros, especifique:

1. ¿Qué fuentes de agua están disponibles para usted en el hospital para todas sus actividades diarias (lista de ellos)?

2. ¿Qué otra de sus actividades diarias en los hospitales requieren el uso de agua *(enumerarlos)?*

¿Cuál de estas fuentes de agua que se usa para las siguientes actividades:

	Botella	**Llave No Tratado**	**Llave Tratado**				**N/A**
Beber							
Lavarse las manos							
Lavarse las manos antes de la cirugía							
Durante los procedimientos de cirugía (lavando el interior del cuerpo)							
El agua que reciben los pacientes a consumir con medicamentos orales (Sonda de cómo se hace la decisión de utilizar el que la fuente de agua)							
Bañar a los bebés recién nacidos							
Baño de esponja							
Limpieza de las heridas							
Limpieza de la quemaduras							
Enjuagar los dientes (para los dentistas)							
La reconstitución de medicamentos							

Comentarios y Observaciones:

CH1	Fecha		CH4	Nombre del hospital	
CH2	Hora de inicio		CH5	Nombre del Investigador(es)	
CH3	Hora de finalización	Nombre:			

C1	Papel del participante:	1) Administrative Staff (Receptionist, finance, etc.) 3) Cook 5) Laundry 6) Sanitation/Janitorial 88) Other, specify: **Laboratory (2) and Administrator (4): see separate surveys**
C2	Sexo del participante:	1) Hombre 2) Mujer
C3	Edad del participante:	1) ≤ 30 años 2) >30 años 3) ≥ 60 años
C4	¿En su opinión, es el agua de la llave en el hospital segura para tomar? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé Comentarios:
C5	¿Cómo es el agua en el hospital en comparación al el agua que utiliza en su casa? ¿Vive en los cuartos del personal?	1) Peor 2) Igual 3) Mejor 99) No sé 1) Sí 2) No 99) No sé Comentarios:
C6 C6a	Antes de ser informado hoy, estaba consciente de que el sistema de tratamiento de agua en el hospital? ¿Cómo aprendió esta información?	1) Sí 2) No 99) No sé Comentarios:
C7	¿Qué sabe sobre el sistema de tratamiento de agua en el hospital?	
 C8a C8b C8c C8d	¿Quién beba agua de la llave? **Personal** **Los pacientes** **Los visitantes/cuidadores** **Otro**	 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé Enumere:_____
C9	¿Bebe de la llave?	1) Sí 2) No 99) No sé Comentarios:
C10	¿Cuáles serían los beneficios de tener agua potable para su trabajo?	99) No sé Comentarios:

C11	¿Es el agua contaminado un problema en la comunidad cerca de este hospital? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé Comentarios:
C12 C12a C12b	¿Qué le gustaría aprender sobre el agua?	Comentarios:
	Opinión de la investigadora: En una escala de 1-5, 5=muy comprometida 1=no muy comprometida:	
C16a	A. ¿Qué tan comprometido era el participante al responder las preguntas?	A. 1 2 3 4 5
C16b	B. ¿Qué tan experto fue el participante acerca de las prácticas en el hospital?	B. 1 2 3 4 5
C16c	C. ¿Qué tan dispuesto era el participante a dar ejemplos específicos e información adicional?	C. 1 2 3 4 5
C16d	D. ¿Cuál es el nivel de compromiso del participante a la provisión de agua limpia?	D. 1 2 3 4 5 Comentarios y observaciones:

Varios Personal hospitalario

5). Servicio de lavandería **3). Cocinero** **6). Portero**

88) Otros, especifique:

1. ¿Qué fuentes de agua están disponibles para usted en el hospital para todas sus actividades diarias (lista de ellos)?

2. ¿Qué otra de sus actividades diarias en los hospitales requieren el uso de agua *(enumerarlos)?*

¿Cuál de estas fuentes de agua que se usa para las siguientes actividades:

	Botella	**Llave No Tratado**	**Llave Tratado**					**N/A**
Beber								
Lavarse las manos								
Servicio de lavandería (incluyendo ropa de cama del hospital) (lavandería)								
Lavado de pisos y otras superficies (Limpieza / Saneamiento)								
Vaciarse los inodornos(Limpieza / Saneamiento)								
Riego de plantas y la jardinería (Limpieza / Saneamiento)								
Lavado de vehículos (ambulancias de hospitales, otros) (Limpieza / Saneamiento)								
Lavar las comidas y verduras (Cocina)								
Preparación de alimientos (Cocina)								
Lavar los platos, utensilios, vasos (Cocina)								

Comentarios y Observaciones:

JH1	Fecha		JH4	Nombre del hospital	
JH2	Hora de inicio		JH5	Nombre del Investigador(es)	
JH3	Hora de finalización	Nombre:			

J1	Papel del participante:	4) Administrator (bookkeeper) 88) Other, specify:
J2	Sexo del participante:	1) Hombre 2) Mujer
J3	Edad del participante:	1) ≤ 30 años 2) >30 años 3) ≥ 60 años
J4a J4b	¿Cuál es la población del municipio?	Área: Población:
J5	¿En su opinión, es el agua de la llave en el hospital segura para tomar? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé Comentarios:
J6	¿Bebe de la llave?	1) Sí 2) No 99) No sé Comentarios:
J7	¿Cómo es el agua en el hospital en comparación al el agua que utiliza en su casa? ¿Vive en los cuartos del personal?	1) Peor 2) Igual 3) Mejor 99) No sé 1) Sí 2) No 99) No sé Comentarios:
J8 J8a	Antes de ser informado hoy, estaba consciente del sistema de tratamiento de agua en el hospital? ¿Cómo aprendió esta información? ¿Qué sabe sobre el sistema de tratamiento de agua en el hospital?	1) Sí 2) No 99) No sé Comentarios:
 J9a J9b J9c J9d	¿Quién beba agua directamente de la llave? **Personal** **Los pacientes** **Los visitantes/cuidadores** **Otro**	 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé Enumere:_____
J10	¿Cuáles serían los beneficios de tener agua potable para su trabajo?	
J11	¿Es el agua contaminado un problema en la comunidad cerca de este hospital? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé Comentarios:

J12 J12a J12b	¿Qué influye en su decisión de comprar (o no compra) cloro para el sistema de tratamiento de agua? En una escala de 1-5, 5 = influye mucho 1 = no influye A. Costo B. Impacto en la calidad del agua	 A. 1 2 3 4 5 B. 1 2 3 4 5
J13	Aproximadamente, ¿Cuánto gasta mensualmente para obtener los consumibles y piezas necesarias para hacer las reparaciones para el sistema de tratamiento de agua?	_____ HNL
J14 J14a J14	¿Qué influye su decisión de financiar (o no financiero) el mantenimiento de la infraestructura para el sistema de agua hospital, por ejemplo, reparaciones o sustituciones de lavabos y llaves rotos o conexiones en el sistema de tratamiento de agua? En una escala de 1-5, 5 = influye 1 = no influye A. Costo B. Impacto en la calidad/ disponibilidad /flujo del agua	 A. 1 2 3 4 5 B. 1 2 3 4 5
J15	¿Existe un presupuesto específico para los consumibles y las reparaciones para el sistema de tratamiento de agua? [Si no, por favor explique el sistema utilizado para obtener los consumibles y piezas]	1) Sí 2) No 99) No sé Comentarios:
 A48a A48b A48c A48d A48e A49	GE o la MdS ofrece: A. Fondos para la cuenta de agua B. Fondos para el tratamiento de agua C. Fondos para infraestructura (tubería, lavabos) D. Entrenamiento para personal E. Otro (Enumere): En caso afirmativo, ¿cuánto?	 A. 1) Sí 2) No 99) No sé **Quién:** 1) GE 2)MOS B. 1) Sí 2) No 99) No sé **Quién:** 1) GE 2)MOS C. 1) Sí 2) No 99) No sé **Quién:** 1) GE 2)MOS D. 1) Sí 2) No 99) No sé **Quién:** 1) GE 2)MOS E. Otro _____ Quién: 1) GE 2) MOS A. _____HNL B. _____ HNL C. _____ HNL D. _____ HNL E. _____ HNL

		Comentarios:
J16 J16a J16b J16c J16d J16e J16f J16g J16h J16a-h.a J16a-h.b	¿Su hospital mantiene registros de las siguientes actividades relacionadas con la provisión de agua? ¿Quién es el responsable de cada uno? A. Disponibilidad de agua B. Tratamiento de agua C. Limpiando de los recipients de agua (botellones, tanque, cisternas) D. Reparación de llaves y lavabos rotas E. Retrolavado F. Pruebas de cloro residual G. Cuando hacen un "bypass" (Circunvalar) H. Otro (on a scale from 1 -5, 1=not well maintained 5= maintained) **Observation:** Are the records up to date? **Observation:** Are the records well maintained? (Ask if there is record and where it is located. Find records later. Take a picture of the record)	A. 1) Sí 2) No 0) N/A 99) No sé _____ B. 1) Sí 2) No 0) N/A 99) No sé _____ C. 1) Sí 2) No 0) N/A 99) No sé _____ D. 1) Sí 2) No 0) N/A 99) No sé _____ E. 1) Sí 2) No 0) N/A 99) No sé _____ F. 1) Sí 2) No 0) N/A 99) No sé _____ G. 1) Sí 2) No 0) N/A 99) No sé _____ H. 1) Sí 2) No 0) N/A 99) No sé _____ 1 2 3 4 5 Comentarios: 1 2 3 4 5 Comentarios:
J17 J17a J17b	¿Qué sistema tiene el hospital para monitorizar los gastos necesarios para la operacion del sistema de filtración? (Pida ver el sistema de monitorización de gastos) (on a scale from 1 -5, 1=not well maintained 5= Maintained) **Observation:** Is the record up to date? **Observation:** Is the record well maintained?	Comentarios: 1 2 3 4 5 Comentarios: 1 2 3 4 5 Comentarios:
J18 J18a J18b	¿Tiene el hospital un comite de bioseguridad? **En caso afirmativo**, es agua potable uno de los temas que se discuten? ¿Se han tomado medidas para mejorar la provisión de agua potable en el hospital? ¿Qué medidas?	1) Sí 2) No →SALTE to Ax 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé Comentarios:
J19	¿Cuál es la ciudad más cercana dónde puede	

J19a	enviar muestras de agua para análisis? ¿Dónde y qué institución?	
J20 J20a J20b J20c	¿Con qué frecuencia hablas con GE? ¿De qué hablan? [Investiga para ejemplos específicos] ¿Son estas reuniones programadas con regularidad? ¿Si usted discute los problemas se abordan?	___ veces/semana/mes/año 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé
J21 J21a J21b J21c	¿Se comunica con Assist International sobre el sistema de filtración? ¿Con qué frecuencia? ¿De qué hablaron? [Investiga para ejemplos específicos] ¿Son estas reuniones programadas con regularidad? ¿Si usted discute los problemas se abordan?	1) Sí 2) No 99) No sé _____ veces/semana/mes/año 99)No sé Comentarios: 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé
J22 J22a J22b	¿Con qué frecuencia hablas con el director sobre el sistema de filtración? ¿Son estas reuniones programadas con regularidad? ¿De qué hablaron la última vez?	____ veces al día/semana/més 99)No sé 1) Sí 2) No 99) No sé Comentarios:
J23 J23a J23b J24	¿Con qué frecuencia hablas con el personal de mantenimiento sobre el sistema de filtración? ¿Son estas reuniones programadas con regularidad? ¿De qué hablaron la última vez? ¿Está informado por el personal de mantenimiento cuando se apague el sistema de filtración?	____ veces al día/semana/més 99)No sé 1) Sí 2) No 99) No sé Comentarios: 1) Sí 2) No 99) No sé
J25 J25a J25b J25c	¿Existen organizaciones o instituciones que monitorean la calidad del agua en el hospital? [Investiga para nombres específicos] ¿Con qué frecuencia tiene contacto con los funcionarios de x? ¿Cuál es el nombre del funcionariol de x?	1) Sí 2) No 99) No sé Comentarios:

	¿Cuál es su / su título? Datos de contacto:	
J26 J26a	**En caso afirmativo,** ¿con qué frecuencia se toman muestras? ¿Comparten sus resultados con el hospital?	____ veces /semana/més/año/alguna vez 99)No sé 1) Sí 2) No 99) No sé Comentarios:
J27	¿Cuánto cuesta el cloro (lejía) en una base mensual (o trimestral) para el sistema de filtración? (tiempo costo / unidad)	_____ HNL time period _____
J28 J28a	¿En el ano pasado, ha habido un momento en que el cloro no fue comprado para el sistema de filtración? ¿Por qué? ¿Con qué frecuencia el cloro no fue comprado para el sistema? ¿Por qué?	1) Sí 2) No 99) No sé Comentarios: ____ veces /semana/més/año/ N/A 99) No sé Comentarios:
J29 J29a J29b	¿Qué le gustaría aprender sobre el agua?	Comentarios:
    J33a J33b J33c J33d	**Opinión de la investigadora:** En una escala de 1-5, 5=muy comprometida 1=no muy comprometida: A. ¿Qué tan comprometido era el participante al responder las preguntas? B. ¿Qué tan experto fue el participante acerca de las prácticas en el hospital? C. ¿Qué tan dispuesto era el participante a dar ejemplos específicos e información adicional? D. ¿Cuál es el nivel de compromiso del participante a la provisión de agua limpia?	 A. 1 2 3 4 5 B. 1 2 3 4 5 C. 1 2 3 4 5 D. 1 2 3 4 5 Comentarios y observaciones:

Personal Administrativa

1. ¿Qué fuentes de agua están disponibles para usted en el hospital para todas sus actividades diarias (lista de ellos)?

2. ¿Qué otra de sus actividades diarias en los hospitales requieren el uso de agua *(enumerarlos)?*

¿Cuál de estas fuentes de agua que se usa para las siguientes actividades:								
	Botella	**Llave No Tratado**	**Llave Tratado**					**N/A**
Beber								
Agua potable proporcionado para visitantes								
Lavarse las manos								
Comentarios y Observaciones:								

KH1	Fecha		KH4	Nombre del hospital	
KH2	Hora de inicio		KH5	Nombre del Investigador(es)	
KH3	Hora de finalización	Nombre:			

K1	Papel del participante:	2) Técnico de laboratorio 88) Otro, enumere:
K2	Sexo del participante:	1) Hombre 2) Mujer
K3	Edad del participante:	1) ≤ 30 años 2) >30 años 3) ≥ 60 años
K4	¿En su opinión, es el agua de la llave en el hospital segura para tomar? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé Comentarios:
K5	¿Bebe de la llave?	1) Sí 2) No 99) No sé Comentarios:
K6	¿Cómo es el agua en el hospital en comparación al el agua que utiliza en su casa? ¿Vive en los cuartos del personal?	1) Peor 2) Igual 3) Mejor 99) No sé 1) Sí 2) No 0) N/A 99) No sé Comentarios:
K7 K7a K7b	¿De dónde viene el agua en este hospital? ¿El agua está tratada antes de su uso? ¿Cómo? ¿Dónde aprendió esta información?	Fuente: Tratado: 1) Sí 2) No 99) No sé Metedo de tratemiento Comentarios:
	¿Quién beba agua de la llave?	
K8a	**Personal**	1) Sí 2) No 99) No sé
K8b	**Los pacientes**	1) Sí 2) No 99) No sé
K8c	**Los visitantes/cuidadores**	1) Sí 2) No 99) No sé
K8d	**Otro**	1) Sí 2) No 99) No sé Enumere:_____
K9	¿Cuáles serían los beneficios de tener agua potable para su trabajo?	
K10	¿Es el agua potable contaminado un problema en la comunidad cerca de este hospital? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé Comentarios:
K11	¿Quién fue entrenado en la recogida de muestras de agua y las pruebas?	99) No sé
K12	¿Cuántos miembros del personal de laboratorio han sido entrenados a hacer las pruebas de cloro residual por otro miembro del personal?	____ Técnico de laboratorio 99) No sé

K13 K13a K13b K13c	¿Con qué frecuencia se miden los niveles de cloro residual? ¿Dónde se los miden? ¿Documenta esta información? ¿Dónde y con qué frecuencia?	___ veces/semana/més/año 1) Sí 2) No 99) No sé
K14 K14a	¿Con qué frecuencia usted le da consejos (comentario) al personal de mantenimiento para ajustar los niveles de cloro en el sistema de tratamiento de agua? ¿Cómo reaccionan?	___ veces/semana/més/año Comentarios:
K15 K15a	¿Cuándo fue la última vez que habló sobre los niveles de cloro del agua con el director? ¿Con qué frecuencia se comunica con el administrador sobre los niveles de cloro residual en el sistema de tratamiento de agua?	Comentarios: ___ veces/semana/més/año
K16 K16a K16b	¿Con qué frecuencia se reúne con el/la administrador(a) sobre el sistema de tratamiento de agua? ¿Son estas reuniones programadas con regularidad? ¿De qué hablaron la última vez?	___ veces/día/semana/més 1) Sí 2) No 99) No sé Comentarios:
K17 K17a K17b	¿Con qué frecuencia habla Ud. con el personal de mantenimiento sobre el sistema de filtración? ¿Cuántas veces han seguido el personal de mantenimiento a sus consejos (el personal de laboratorio)?¿Cuántas veces ha Ud. (personal de laboratorio) tenia que volver a probar los niveles de cloro residual después del mantenimiento había ajustado los niveles?	___ veces/día/semana/més Comentarios:
K18 K19	¿Tiene incubadoras en su laboratorio? ¿Son los técnicos de laboratorio en el hospital capacitado en microbiología ambiental? Métodos de cultivo? ¿Qué incluye el entrenamiento?	1) Sí 2) No 99) No sé Comentarios: 1) Sí 2) No 99) No sé Comentarios:
K20 K20a K20b	¿Qué le gustaría aprender sobre el agua?	Comentarios:
	Opinión de la investigadora: En una escala de 1-5, 5=muy comprometida 1=no muy comprometida: A. ¿Qué tan comprometido era el participante	 A. 1 2 3 4 5

K24a K24b K24c K24d	al responder las preguntas? B. ¿Qué tan experto fue el participante acerca de las prácticas en el hospital? C. ¿Qué tan dispuesto era el participante a dar ejemplos específicos e información adicional? D. ¿Cuál es el nivel de compromiso del participante a la provisión de agua limpia?	B. 1 2 3 4 5 C. 1 2 3 4 5 D. 1 2 3 4 5 Comentarios y Observaciones:

Personal de laboratorio

1. ¿Qué fuentes de agua están disponibles para usted en el hospital para todas sus actividades diarias (lista de ellos)?

2. ¿Qué otra de sus actividades diarias en los hospitales requieren el uso de agua *(enumerarlos)?*

¿Cuál de estas fuentes de agua que se usa para las siguientes actividades:

	Botella	**Llave No Tratado**	**Llave Tratado**	**Agua Desionizada**	**Agua Autoclave**			**N/A**
Beber								
Lavarse las manos								
Mezclando reactivos								
Lavado y limpieza de equipo y suministros de laboratorio								
Esterilización de equipos de laboratorio								

Comentarios y Observaciones:

DH1	Fecha		DH4	Nombre del hospital	
DH2	Hora de inicio		DH5	Nombre del Investigador(es)	
DH3	Hora de finalización				

D1	Papel del participante:	1) Paciente 2) Visitante 88) Otro _____
D2	Sexo del participante:	1) Hombre 2) Mujer
D3	Edad del participante:	1) ≤ 30 años 2) >30 años 3) ≥ 60 años
D4 D5	¿Cuánto tiempo le tomo llegar al hospital hoy? ¿Cómo llego Ud. al hospital?	____horas ____minutos 1) Caminar 2) Bus/tranportes públicos 3) Bicicleta 4) Coche 5) Moto 88) Otro:
D6	¿Cuánto tiempo ha estado aquí en el hospital desde que llego a esta visita?	___horas ___minutos
D7	¿Ha usted bebido el agua de la llave en el hospital hoy?	1) Sí 2) No 99) No sé
D8	**Si ha bebido el agua**: ¿Cómo es el agua en el hospital en comparación con el agua que utiliza en casa? ¿Sabor? ¿Seguridad?	1) Peor 2) Igual 3) Mejor 99) No sé Comentarios:
D9	**En el caso negativo**, ¿por qué no ha tomado el agua de la llave?	
D10	**Si tiene hijos**, ¿beben sus hijos el agua de la llave en el hospital hoy?	1) Sí 2) No 99) No sé
D11	¿En su opinión, es el agua de la llave en el hospital segura para tomar? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé Comentarios:
D12	Antes de ser informado hoy, estaba consciente del sistema de tratamiento de agua en el hospital? ¿Cómo aprendió esta información? ¿Qué sabe sobre el sistema de tratamiento de agua en el hospital?	1) Sí 2) No 99) No sé Comentarios:
D13	¿Tiene llave de agua en su casa?	1) Sí 2) No 99) No sé
D14	¿Dónde se recoge agua en su casa?	

D15 D15a	¿Trata el agua para tomar en su casa? **En el caso afirmativo**, ¿Cómo?	1) Sí 2) No →SALTE to D14 99) No sé →SALTE to D14 Comentarios: Tratamientos [en caso afirmativo] 1) Hervir 2) Filtra 3) Cloro 88) Otro
D16	¿Es el agua contaminado un problema en su comunidad? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé Comentarios:
A21	¿Compra agua? ¿Cuánto paga (por litro) al comprar agua a vendedores para uso doméstico?	1) Sí 2) No 99) No sé _____ HNL/L

Paciente/Visitante/Cuidador
1) Paciente
2) Visitante/Cuidador
88) Otro, especifique:
1. ¿Qué fuentes de agua están disponibles para usted en el hospital para todas sus actividades diarias (lista de ellos)?
2. ¿Qué otra de sus actividades diarias en los hospitales requieren el uso de agua *(enumerarlos)?*

¿Cuál de estas fuentes de agua que se usa para las siguientes actividades:								
	Botella	**Llave No Tratado**	**Llave Tratado**					**N/A**
Beber cuando esta en el hospital								
Lavarse las manos en el hospital								
Lavar los alimentos crudos, frutas o verduras antes de comer								
Preparación de comida								
Baños								
Tomar medicamentos orales								
Lavandería								
Otro								
Comentarios y Observaciones:								

Observaciones

EH1		Fecha		EH4		Nombre del hospital	
EH2		Hora de inicio		EH5		Nombre del Investigador(es)	
EH3		Hora de finalización					

Lavabos											
Numero	Funciona	Fuga	Jabón	Personal	Pacientes	Numero	Funciona	Fuga	Jabón	Personal	Pacientes
1						43					
2						44					
3						45					
4						46					
5						47					
6						48					
7						49					
8						50					
9						51					
10						52					
11						53					
12						54					
13						55					
14						56					
15						57					
16						58					
17						59					
18						60					
19						61					
20						62					
21						63					
22						64					
23						65					
24						66					
25						67					
26						68					
27						69					
28						70					
29						71					
30						72					
31						73					
32						74					
33						75					
34						76					
35						77					
36						78					
37						79					
38						80					

39						81					
40						82					
41						83					

Maintenance		
G1	¿Cuántos litros de cloro se encuentran en el tanque de cloro?	3)N/A
G2	¿Hay cloro específicamente para el sistema de agua? ¿Cuánto hay?	1) Sí 2) No 3) N/A 99) No sé
G3	¿Cuál es la diferencia de presión entre la entrada y la salida del banco de filtros? (Nota: no todos los sistemas tienen manómetros)	1) Sí 2) No 3) N/A 99) No sé
G4	¿Es el exterior del equipo (filtros) limpio?	1) Sí 2) No 3) N/A 99) No sé
G5	¿ Es la zona que rodea el sistema de filtro limpio y libre de elementos no relacionados con el filtro?	1) Sí 2) No 3) N/A 99) No sé
G6	¿Hay alguna fuga en el sistema que no ha sido reparado?	1) Sí 2) No 3) N/A 99) No sé
Educational Messages		
G7	¿Observo algún(os) mensaje(s) de agua segura?	1) Sí 2) No →SALTE a Gx 99) No sé →SALTE a Gx
G8 G9 G10	Son visibles al personal los mensajes? Son visibles a los pacientes / visitantes de los mensajes? ¿Los mensajes involucrando / pegadiza?	1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé
G11	Se observaron los mensajes sobre el lavado de manos?	1) Yes 2) No →SKIP to Gx 99) Don't Know → SKIP to Gx
G12 G13 G14	Son visibles al personal los mensajes? Son visibles a los pacientes / visitantes de los mensajes? ¿Los mensajes involucrando / pegadiza?	1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé
G15	¿Observo algún(os) mensaje(s) del uso de baño?	1) Sí 2) No→SALTE a Hx 99) No sé →SALTE a Hx
G16 G17 G18	Son visibles al personal los mensajes? Son visibles a los pacientes / visitantes de los mensajes? ¿Los mensajes involucrando / pegadiza?	1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé
G19	¿Cuáles (organizaciones o proyectos) apoyó el hospital en el desarrollo de los mensajes educativos?	Lista de Organizaciones / Proyectos

HAVE FORMS FROM ASSIST BEEN COMPLETED? (WRITE OUT YOUR FEELINGS ABOUT THE FORMS)

HH1	Fecha		HH 4	Nombre del hospital	
HH2	Hora de inicio		HH 5	Nombre del Investigador(es)	
HH3	Hora de finalización	Nombre:			
Información Demográfica					
	Pida a la persona de mantenimiento para un mapa / mapa de tratamiento de agua para el hospital. (Puede ser en forma de planos)				
H1	Papel del participante:	7)Mantenimiento 8)Plomero 11) Electricista 88) Otro			
H2	Sexo del participante:	1) Hombre 2) Mujer			
H3	Edad del participante:	1) ≤ 30 años 2) >30 años 3) ≥ 60 años			
H4	¿Cuál es el nivel más alto de educación que ha completado?				
H5	¿Cuánto tiempo ha trabajado aquí en este hospital? ¿Estabas aquí cuando el sistema se instaló por primera vez?	_____méses/años			
Electricidad					
H6	En la última semana, ¿cuántas veces ha salido de la electricidad?	_____ veces/día/semana/més			
H6a	En promedio, ¿cuánto tiempo permanece sin luz cuando se va la electricidad?	Comentarios:			
H6b	¿Quién tiene la responsabilidad de decider para encender el generador?				
H6c	¿Cuándo se decide preder el generador es por razones específicas?				

Saneamiento		
H7	¿Qué tipos de inodoros están disponibles en el hospital? (Marque todo lo que corresponda)	1) Tank flush toilet (inodoro con tanque) 2) Pressure flush toilet (inodoro con alta presion) 3) Pour flush toilet (inodoro que necesita un balde para vaciarse) 4) Tap flush toilet (inodoro con llave arriba) 5) Latrina 88) Other (specify):
H8	¿Cuáles son los problemas comunes de mantenimiento asociados con inodoros en el hospital? [Investiga para ejemplos	1) Presión de agua baja 2) Las piezas de ceramic rotas 88) Otro (especificar):

	específicos]	Comentarios:
Capacidad en el Sitio		
Entrenamiento		
H9	¿Quién fue entrenado (en el hospital) por GE en la operación y mantenimiento del sistema de filtración de agua? ¿Todos siguen trabajando aquí?	Nombre _____ Papel_____ 1) Sí 2) No Nombre _____ Papel_____ 1) Sí 2) No Nombre _____ Papel_____ 1) Sí 2) No Nombre _____ Papel_____ 1) Sí 2) No Nombre _____ Papel_____ 1) Sí 2) No
H10 H10a H10b H10c	¿Con qué frecuencia habla con los embajadores de GE? ¿De qué hablaron? [Investiga para ejemplos específicos] ¿Son estas reuniones programadas con regularidad? ¿Si usted discute los problemas se abordan?	___ veces/semana/més/año 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé
H11 H11a H11b H11c	¿Se comunica con Assist International sobre el sistema de filtración? ¿Con qué frecuencia? ¿De qué hablaron? [Investiga para ejemplos específicos] ¿Son estas reuniones programadas con regularidad? ¿Si usted discute los problemas se abordan?	1) Sí 2) No 99) No sé ___ veces/semana/més/año Comentarios: 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé
H12	¿Cuántas visitas ha hecho GE y Assist en el último año?	GE ____ Assist ____
H13	¿Cuáles son los temas que discutieron durante estas visitas?	
H14	¿Quién es responsable del sistema de tratamiento de agua?	
H15	Normalmente, cuantos personas completan trabajos de mantenimiento asociados con el sistema de filtración?	
H16	¿Hay personal que ha sido entrenado para mantener el sistema por otro personal?	1) Sí 2) No 99) No sé
H17	¿Cuántos días durante la semana, ¿hay alguien aquí que sepa operar el sistema de filtración?	____días/semana
H18	¿Cuántos días en el último mes no han utilizado el sistema de filtración? ¿Por qué?	____días/més

H19 H19a H19b	**Si el sistema no está funcionando**, ¿cuándo fue la última vez que se utilizó? ¿Por qué los filtros no están utilizados? Ha tratado de repararlo? **Si no**, ¿por qué no?	
H22 H22a H22b	¿Se comunica con MdS sobre el sistema de filtracion de agua? ¿Con qué frecuencia? ¿De qué hablaron? [Investiga para ejemplos específicos]	1) Sí 2) No 99) No sé ____ veces/día/semana/més Comentarios:
H23 H23a H23b	¿Qué sistema tiene el hospital para monitorizar los gastos necesarios para la operacion del sistema de filtración? (Pida ver el sistema de monitorización de gastos) (on a scale from 1 -5, 1=not well maintained 5= Maintained) **Observation:** Is the record up to date? **Observation:** Is the record well maintained?	1) Sí 2) No 99) No sé Comentarios: 1 2 3 4 5 Comentarios: 1 2 3 4 5 Comentarios:
H24	¿Cuál es su papel en el suministro de agua potable?	
H25 H25a H25b H25c	¿Con qué frecuencia habla con el director sobre el sistema de filtración? ¿Son estas reuniones programadas con regularidad? ¿De qué hablaron la última vez? ¿Informa el director cuando se apaga el sistema de filtración?	____ veces al día/semana/mes 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé
H26 H26a H26b H26c H26d	¿Con qué frecuencia habla con el personal de laboratorio sobre el sistema de filtración? ¿Son estas reuniones programadas con regularidad? ¿De qué hablaron la última vez? ¿Informa el laboratorio cuando se apaga el sistema de filtración? ¿Informa el laboratorio cuando se cambia a una nueva concentración de cloro?	____ veces al día/semana/mes 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé 1) Sí 2) No 99) No sé

H27 H27a H27b	¿Con qué frecuencia habla con el/la administrador(a) sobre el sistema de filtración? ¿Son estas reuniones con el administrador programadas con regularidad? ¿De qué hablaron la última vez?	_____ veces al día/semana/mes 1) Sí 2) No 99) No sé
H28 H28a	¿Alguna vez ha hablado con el personal sobre el sistema de filtración? ¿De qué hablaron?	1) Sí 2) No 99) No sé
H29 H29a H29b H29c H29d H29e H29f	¿Con qué frecuencia tiene que comprar cloro para el sistema de agua? ¿Dónde compra cloro? ¿Cuánto cloro compra normalmente? ¿Qué tipo de cloro se utiliza? (Líquido, polvo) ¿Es difícil para comprar cloro? ¿Por qué? ¿Cuántas horas le toma para comprar cloro? ¿Cuánto cuesta el cloro (lejía) en una base mensual (o trimestral) para el sistema de filtración? (tiempo costo / unidad)	_____ veces al día/semana/mes __ Mercado __ Tienda de química (farmacéutico) __ Otro (describe) _____litros __ Cloro líquido __ Cloro en polvo __ Otro (describe) 1) Sí 2) No 99)No sé Comentarios _____HNL
H30	¿Habla con otros equipos de mantenimiento en otros hospitales con sistemas de filtros de GE?	1) Sí 2) No 99) No sé
H31 H31a H31b H31c H31d H31a-d.a	¿Su hospital mantiene registros escritos de las siguientes actividades? ¿Quién es el responsable de cada uno? A] Cuando hacen un "bypass" (Circunvalar) B] Medición de los niveles de cloro C] Limpieza de los botellones D] Reparación de llaves y lavabos rotos **Observation:** Are these records up to date? Are they well maintained?	A] 1) Sí 2) No 3) N/A _____ B] 1) Sí 2) No 3) N/A _____ C] 1) Sí 2) No 3) N/A _____ D] 1) Sí 2) No 3) N/A _____ 1 2 3 4 5 Comentarios:

H32 H32a	¿Por cuánto tiempo cree que GE va a continuar ofreciendo asistencia ¿En qué capacidad? ¿Por qué? ¿Si GE dejó de proveer asistencia, ¿sería capaz de seguir proporcionando agua potable? ¿Cómo?	Comentarios: 1) Sí 2) No 99) No sé Comentarios:
Mantenimineto Regular		
Si alguna de las respuestas a continuación son "no", ¿Por qué no? ¿No es necesario? ¿Es muy difícil? ¿Causa demasiada tensión en el equipo? ¿No hay suficiente tiempo?		
H33	**[Para sistemas manuales]** ¿Con qué frecuencia se realiza un "backwash"?	_____veces/día/semana/més 0) Nunca
H34	[Para sistemas PLC] ¿Con qué frecuencia son los filtros examinados para asegurarse de que el "backwash" está funcionando?	_____ veces/día/semana/més 0) Nunca
H35	¿Con qué frecuencia añada más cloro al sistema?	_____ veces/día/semana/més 0) Nunca
H36	¿Tiene el hospital siempre suficiente cloro para el sistema?	1) Sí 2) No 99) No sé
H37	¿Con qué frecuencia es la presión a la entrada y salida examinada para ver si hay una caída significativa de presión a través de los filtros?	__ Semanal __ Mensual __ Anual __ Nunca __ N/A
H38	¿Alguna vez ha quitado las tapas de los filtros para lavar los filtros en un baño de cloro? **En caso afirmativo**, ¿Con qué frecuencia?	1) Sí 2) No 99) No sé _____ veces/día/semana/més 0) Never
H39	¿Qué hace cuando hay una caída de la presión? [Investiga sobre backwashing] ** Sólo pregunte si la presión es una preocupación	
Reparaciones y el apoyo institucional		
H40	¿Es una de sus responsabilidades para reparar el sistema de tratamiento de agua? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé Comentarios:
H41	Considerando los siguientes escenarios, ¿tiene la capacidad de reparar el sistema de tratamiento de agua? ¿Por qué o por qué no?	A. 1) Sí 2) No 99) No sé Comentarios:

	A) ¿Qué es lo que haga (o haría) cuando hay flujo bajo o presión baja de los filtros? Answer: Filters should be cleaned and flow and pressure inspected. Filters are cleaned by repeated backwashing. Flow can be measured using the flow meter in Ghana and pressure measured by the pressure gauges in Honduras. B) ¿Qué hace (haría) cuando falla una bomba? Answer: The maintenance staff likely does not have the capacity to repair a pump. Therefore, the answer to this question should involve initiating a decision making process that involves assessing the situation and then seeking outside help to resolve the problem. C) ¿Qué hace (haría) si el laboratorio indica que la concentración de cloro es demasiado bajo? Answer: The maintenance staff should either 1) increase the ratio of chlorine to water in the chlorine solution container 2) increase the size of the dose of chlorine injected into the water or 3) reduce chlorine storage time through better managing water supply.	A. 1) correcto 2) incorrecto Comentarios B. 1) correcto 2) incorrecto Comentarios C. 1) correcto 2) incorrecto Comentarios
H42 H42a H42b H42c	¿A quién llama cuando hay un problema con el sistema de tratamiento de agua? ¿Con qué frecuencia complete Ud. las reparaciones al sistema de tratamiento de agua? ¿Qué tan accesible son piezas de repuesto (tubos, conectores, accesorios - codos, reductores, pegamento) para el sistema de tratamiento de agua? ¿Hasta dónde tiene que viajar para	Commentarios: __ Semanal __ Mensual __ Anual __ Nunca 99) No sé Comentarios: ___ localmente ___ En el distrito ___ Dentro de la región

	encontrar las piezas de repuesto necesarias para reparar el sistema de tratamiento de agua? H42d ¿Dónde ha encontrado las piezas de repuesto necesarias para reparar el sistema de tratamiento de agua cuando se rompen?	99) No sé Commentarios:
H43	¿Alguna vez en el ano pasado ha buscado ayuda externa para las reparaciones? **En caso afirmativo**, ¿por qué? [Explicar]	
H44 H44a H44b H44c H44d	¿Han reparado o reemplazado algunos de los componentes del sistema en el ano pasado? ¿Qué parte? ¿Cuándo? ¿Por quién? ¿Dónde encontro las piezas para la reparación? (Ask to see repair log. Take a picture of log)	____/____/_____ Nombre: _____ Papel: _____
H45 H45a	¿Cuales partes del sistema de agua se puede reparar sin la ayuda de apoyo externo? ¿Cuáles partes del sistema de agua no se puede reparar sin la ayuda de apoyo externo?	
H46	En su opinión, ¿En cuáles aspectos específicos de mantenimiento le gustaría más entrenamiento?	
Satisfacción		
H47	¿Qué puede hacer GE para mejorar el sistema de filtración?	
H48	¿Recomendaría el sistema de filtración de otros hospitales? ¿Por qué o por qué no?	1) Sí 2) No 99) No sé
H49	¿Qué consejo le daría a otros que operan el mismo sistema de filtración de agua que tiene aquí?	
H50	¿Tiene otras preguntas para GE sobre el sistema de filtración?	
Mensajería Educativo		

H51 H51a H51b	¿Qué le gustaría aprender sobre el agua? ¿Cómo le gustaría aprender sobre el agua? (juego de rol, conferencias, demostraciones, carteles) Si hubiera un manual de capacitación para el sistema de filtracion, ¿qué cree que se debe incluir? ¿Cuánto detalle debe incluir? (Fotos, información técnica, instrucciones, etc)	Commentarios:
Conciencia/Demanda/Actitudes		
H55	En su opinión, ¿Por qué es importante tratar el agua?	
H56	En su opinión, es el agua de la llave segura para beber?	1) Sí 2) No 99) No sé
H57	¿Bebe de la llave?	1) Sí 2) No 99) No sé
H58	¿Cuáles son sus metas (mantenimiento) para el sistema de filtración de agua? ¿Se siente que está lograndolos? ¿Por qué?	
Other (opinión del investigador)		
   H59a H59b H59c H59d	**Opinión de la investigadora:** En una escala de 1-5, 5=muy comprometida 1=no muy comprometida: A. ¿Qué tan comprometido era el participante al responder las preguntas? B. ¿Qué tan experto fue el participante acerca de las prácticas en el hospital? C. ¿Qué tan dispuesto era el participante a dar ejemplos específicos e información adicional? D. ¿Cuál es el nivel de compromiso del participante a la provisión de agua limpia?	A. 1 2 3 4 5 B. 1 2 3 4 5 C. 1 2 3 4 5 D. 1 2 3 4 5 Comentarios y observaciones:

1. ¿Qué fuentes de agua están disponibles para usted en el hospital para todas sus actividades diarias (lista de ellos)?

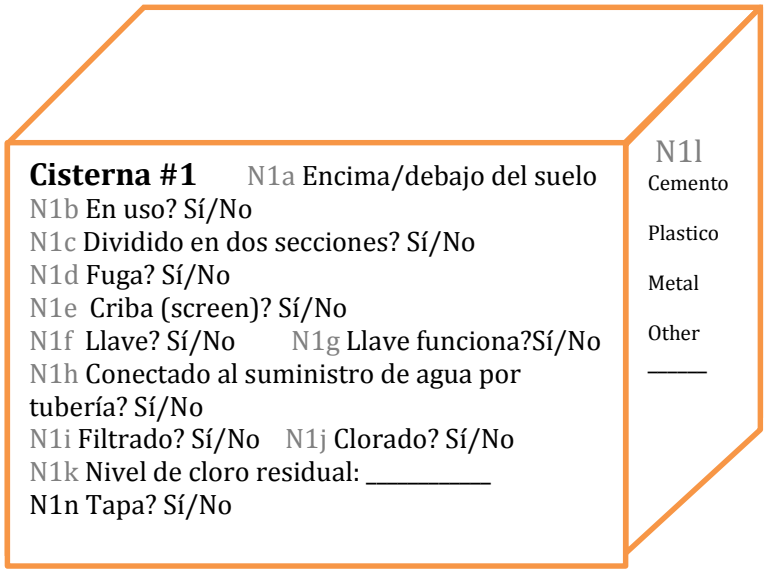
2. ¿Qué otra de sus actividades diarias en los hospitales requieren el uso de agua *(enumerarlos)?*

¿Cuál de estas fuentes de agua que se usa para las siguientes actividades:								
	Botella	**Llave No Tratado**	**Llave Tratado**					**N/A**
Beber								
Lavarse las manos								
Preparar la solución de cloro para el filtro								
Lavar los cisternas, tanques, botellones, etc…								
Otro								

Comentarios y Observaciones:

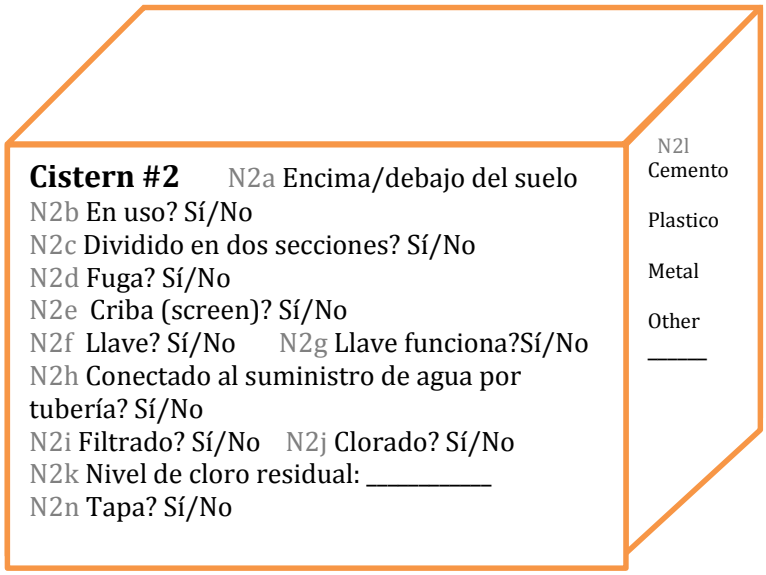
Maintenance Survey – Cisterns and Polytanks

NH1 # de cisternas:
NH2 volumen total de cisternas:
NH3 # de tanques:
NH4 volumen total de tanques:
NH5 # de llaves que fugan:
NH8 Cisternas están limpiados? Sí/No **En caso afirmativo**, con qué frequencia?
_____veces/semana/més/año
NH9 Ubicación de las puntas de cloración:
NH10 # total de tapas en cisternas:
NH11 # total de tapas en tanques:



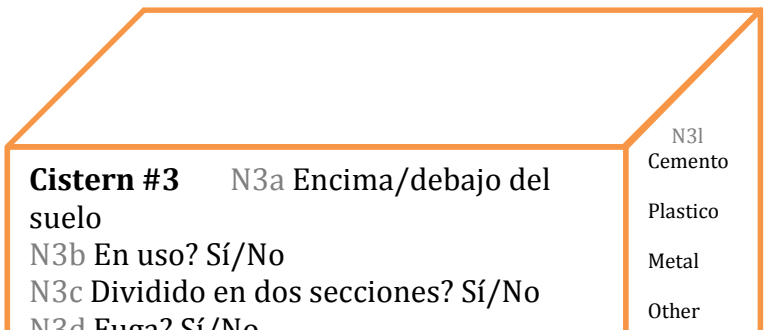
N1m Cisterna #1: Si la fuente de agua cesó, cuánto tiempo pasa para utilizar toda el agua en la cisterna?
1) < 1 dîa 2) 1-3 dîas 3) > 3 dîas

Notes on Cisterna #1:



N2m Cisterna #2: Si la fuente de agua cesó, cuánto tiempo pasa para utilizar toda el agua en la cisterna?
1) < 1 dîa 2) 1-3 dîas 3) > 3 dîas

Notes on Cisterna #2



N3m Cisterna #3: Si la fuente de agua cesó, cuánto tiempo pasa para utilizar toda el agua en la cisterna?
1) < 1 dîa 2) 1-3 dîas 3) > 3 dîas

Notes on Cistern #3:

Notes on Cisterna #3

Cistern #4 N4a Encima/debajo del suelo
N4b En uso? Sí/No
N4c Dividido en dos secciones? Sí/No
N4d Fuga? Sí/No
N4e Criba (screen)? Sí/No
N4f Llave? Sí/No N4g Llave funciona?Sí/No
N4h Conectado al suministro de agua por tubería? Sí/No
N4i Filtrado? Sí/No N4i Clorado? Sí/No

N4l
Cemento
Plastico
Metal
Other
____

N4m Cisterna #4: Si la fuente de agua cesó, cuánto tiempo pasa para utilizar toda el agua en la cisterna?
1) < 1 dîa 2) 1-3 dîas 3) > 3 dîas

Notes on Cisterna #4

1
P1a **Cisterna # ____**
Volumen_____
Ubicación _____
Material _____

P1b Fuga? Sí/No P1c Tapa? Sí/No
P1d Llave? Sí/No P1e Llave funciona? Sí/No
P1f Conectado al suministro de agua por tubería? Sí/No
P1g Alguna vez llenado por camion on tanque? Sí/No P1h Filtrado? Sí/No
P1i Clorado? Sí/No P1i Nivel de cloro residual:

Polytanks

2 P2a **Cisterna # ____** **Volumen_____** **Ubicación _____** **Material _____**	P2b Fuga? Sí/No P2c Tapa? Sí/No P2d Llave? Sí/No P2e Llave funciona? Sí/No P2f Conectado al suministro de agua por tubería? Sí/No P2g Alguna vez llenado por camion on tanque? Sí/No P2h Filtrado? Sí/No P2i Clorado? Sí/No P2j Nivel de cloro residual:
3 P3a **Cisterna # ____** **Volumen_____** **Ubicación _____** **Material _____**	P3b Fuga? Sí/No P3c Tapa? Sí/No P3d Llave? Sí/No P3e Llave funciona? Sí/No P3f Conectado al suministro de agua por tubería? Sí/No P3g Alguna vez llenado por camion on tanque? Sí/No P3h Filtrado? Sí/No P3i Clorado? Sí/No P3j Nivel de cloro residual:
4 P4a **Cisterna # ____** **Volumen_____** **Ubicación _____** **Material _____**	P4b Fuga? Sí/No P4c Tapa? Sí/No P4d Llave? Sí/No P4e Llave funciona? Sí/No P4f Conectado al suministro de agua por tubería? Sí/No P4g Alguna vez llenado por camion on tanque? Sí/No P4h Filtrado? Sí/No P4i Clorado? Sí/No P4j Nivel de cloro residual:
5 P5a **Cisterna # ____** **Volumen_____** **Ubicación _____** **Material _____**	P5b Fuga? Sí/No P5c Tapa? Sí/No P5d Llave? Sí/No P5e Llave funciona? Sí/No P5f Conectado al suministro de agua por tubería? Sí/No P5g Alguna vez llenado por camion on tanque? Sí/No P5h Filtrado? Sí/No P5i Clorado? Sí/No P5j Nivel de cloro residual:
6 P6a **Cisterna # ____** **Volumen_____** **Ubicación _____** **Material _____**	P6b Fuga? Sí/No P6c Tapa? Sí/No P6d Llave? Sí/No P6e Llave funciona? Sí/No P6f Conectado al suministro de agua por tubería? Sí/No P6g Alguna vez llenado por camion on tanque? Sí/No P6h Filtrado? Sí/No P6i Clorado? Sí/No P6j Nivel de cloro residual:
7 P7a **Cisterna # ____** **Volumen_____** **Ubicación _____** **Material _____**	P7b Fuga? Sí/No P7c Tapa? Sí/No P7d Llave? Sí/No P7e Llave funciona? Sí/No P7f Conectado al suministro de agua por tubería? Sí/No P7g Alguna vez llenado por camion on tanque? Sí/No P7h Filtrado? Sí/No P7i Clorado? Sí/No P7j Nivel de cloro residual:

Notes:

8 P8a **Cisterna # ____** **Volumen_____** **Ubicación _____** **Material _____**	P8b Fuga? Sí/No P8c Tapa? Sí/No P8d Llave? Sí/No P8e Llave funciona? Sí/No P8f Conectado al suministro de agua por tubería? Sí/No P8g Alguna vez llenado por camion on tanque? Sí/No P8h Filtrado? Sí/No

Polytanks

9 P9a **Cisterna # ____** **Volumen_____** **Ubicación _____** **Material _____**	P9b Fuga? Sí/No P9c Tapa? Sí/No P9d Llave? Sí/No P9e Llave funciona? Sí/No P9f Conectado al suministro de agua por tubería? Sí/No P9g Alguna vez llenado por camion on tanque? Sí/No P9h Filtrado? Sí/No P9i Clorado? Sí/No P9j Nivel de cloro residual:
10 P10a **Cisterna # ____** **Volumen_____** **Ubicación _____** **Material _____**	P10b Fuga? Sí/No P10c Tapa? Sí/No P10d Llave? Sí/No P10e Llave funciona? Sí/No P10f Conectado al suministro de agua por tubería? Sí/No P10g Alguna vez llenado por camion on tanque? Sí/No P10h Filtrado? Sí/No P10i Clorado? Sí/No P10j Nivel de cloro residual:
11 P11a **Cisterna # ____** **Volumen_____** **Ubicación _____** **Material _____**	P11b Fuga? Sí/No P11c Tapa? Sí/No P11d Llave? Sí/No P11e Llave funciona? Sí/No P11f Conectado al suministro de agua por tubería? Sí/No P11g Alguna vez llenado por camion on tanque? Sí/No P11h Filtrado? Sí/No P11i Clorado? Sí/No P11j Nivel de cloro residual:
12 P12a **Cisterna # ____** **Volumen_____** **Ubicación _____** **Material _____**	P12b Fuga? Sí/No P12c Tapa? Sí/No P12d Llave? Sí/No P12e Llave funciona? Sí/No P12f Conectado al suministro de agua por tubería? Sí/No P12g Alguna vez llenado por camion on tanque? Sí/No P12h Filtrado? Sí/No P12i Clorado? Sí/No P12j Nivel de cloro residual:
13 P13a **Cisterna # ____** **Volumen_____** **Ubicación _____** **Material _____**	P13b Fuga? Sí/No P13c Tapa? Sí/No P13d Llave? Sí/No P13e Llave funciona? Sí/No P13f Conectado al suministro de agua por tubería? Sí/No P13g Alguna vez llenado por camion on tanque? Sí/No P13h Filtrado? Sí/No P13i Clorado? Sí/No P13j Nivel de cloro residual:
14 P14a **Cisterna # ____** **Volumen_____** **Ubicación _____** **Material _____**	P14b Fuga? Sí/No P14c Tapa? Sí/No P14d Llave? Sí/No P14e Llave funciona? Sí/No P14f Conectado al suministro de agua por tubería? Sí/No P14g Alguna vez llenado por camion on tanque? Sí/No P14h Filtrado? Sí/No P14i Clorado? Sí/No P14j Nivel de cloro residual:

Notes:

MH1	Fecha		MH4	Nombre del hospital	
MH2	Hora de inicio		MH5	Nombre del Investigador(es)	
MH3	Hora de finalización				

Muestra 1		
M1.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M1.2 M1.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M1.4	Describe el lugar de la llave	
M1.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M1.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 2		
M2.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M2.2 M2.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M2.4	Describe el lugar de la llave	
M2.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M2.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 3		
M3.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M3.2 M3.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____

M3.4	Describe el lugar de la llave	
M3.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M3.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 4		
M4.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M4.2 M4.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M4.4	Describe el lugar de la llave	
M4.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M4.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 5		
M5.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M5.2 M5.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M5.4	Describe el lugar de la llave	
M5.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M5.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 6		
M6.1	¿El agua está corriendo hoy?	1) Sí

		2) No →SALTE
M6.2 M6.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M6.4	Describe el lugar de la llave	
M6.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M6.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 7		
M4.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M4.2 M4.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M4.4	Describe el lugar de la llave	
M4.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M4.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 8		
M5.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M5.2 M5.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M5.4	Describe el lugar de la llave	
M5.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M5.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No

		88) Otro (enumere):
Muestra 9		
M6.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M6.2 M6.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M6.4	Describe el lugar de la llave	
M6.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M6.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 10		
M4.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M4.2 M4.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M4.4	Describe el lugar de la llave	
M4.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M4.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Sample 11		
M5.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M5.2 M5.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M5.4	Describe el lugar de la llave	
M5.5	Mida el flujo	___ segundos para llenar 100 mL con la llave

		totalmente abierto
M5.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 12		
M6.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M6.2 M6.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M6.4	Describe el lugar de la llave	
M6.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M6.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 13		
M4.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M4.2 M4.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M4.4	Describe el lugar de la llave	
M4.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M4.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 14		
M5.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M5.2 M5.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____

M5.4	Describe el lugar de la llave	
M5.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M5.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 15		
M6.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M6.2 M6.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M6.4	Describe el lugar de la llave	
M6.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M6.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 16		
M4.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M4.2 M4.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M4.4	Describe el lugar de la llave	
M4.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M4.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 17		
M5.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE

M5.2 M5.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M5.4	Describe el lugar de la llave	
M5.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M5.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 18		
M6.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M6.2 M6.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M6.4	Describe el lugar de la llave	
M6.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M6.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 19		
M4.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M4.2 M4.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M4.4	Describe el lugar de la llave	
M4.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M4.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):

Muestra 20		
M5.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M5.2 M5.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M5.4	Describe el lugar de la llave	
M5.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M5.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 21		
M6.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M6.2 M6.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M6.4	Describe el lugar de la llave	
M6.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M6.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 22		
M4.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M4.2 M4.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M4.4	Describe el lugar de la llave	
M4.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto

M4.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 23		
M5.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M5.2 M5.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M5.4	Describe el lugar de la llave	
M5.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M5.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 24		
M6.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M6.2 M6.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M6.4	Describe el lugar de la llave	
M6.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M6.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 25		
M4.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M4.2 M4.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____

M4.4	Describe el lugar de la llave	
M4.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M4.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 26		
M5.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M5.2 M5.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M5.4	Describe el lugar de la llave	
M5.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M5.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 27		
M6.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M6.2 M6.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M6.4	Describe el lugar de la llave	
M6.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M6.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 28		
M4.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M4.2	Coleccione dos muestras de	ID 1: _____ Cloro total: _____

M4.3	agua	Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M4.4	Describe el lugar de la llave	
M4.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M4.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 29		
M5.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M5.2 M5.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M5.4	Describe el lugar de la llave	
M5.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M5.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):
Muestra 30		
M6.1	¿El agua está corriendo hoy?	1) Sí 2) No →SALTE
M6.2 M6.3	Coleccione dos muestras de agua	ID 1: _____ Cloro total: _____ Cloro liberado: _____ ID 2: _____ Turbiedad:_____
M6.4	Describe el lugar de la llave	
M6.5	Mida el flujo	___ segundos para llenar 100 mL con la llave totalmente abierto
M6.6	¿El agua se filtra? Seleccione todo los que apliquen	1) membrana 2) amiad 3) No 88) Otro (enumere):

Appendix 3: 2013 Sustainability Metric by Domain

Domain - On-Site Capacity

Sub-Domain	Broad Question	Code	Survey Questions and Metrics	0	1	2	3	4
Organization and Communication	Is there a clearly defined organizational structure? Are all key tasks accounted for?	A22	Is there a person responsible for: Who?	There is no organizational structure for activities related to the water system within the hospital. Most key tasks are not accounted for or responsibility for each task is uncertain.	There is little organizational structure for activities related to the water system. While people may know their role, the tasks are not accomplished.	There is a loose organizational structure in place but most key tasks are accounted for and most staff know their role.	There is basic organizational structure in place at the hospital, and all key tasks are accounted for and the majority of staff know their roles.	There is a clear organizational structure within the hospital, everyone knows their specific roles with regard to the water filtration system, and all key tasks are accounted for.
		A22a	Ensuring the filtration system is maintained					
		A22b	Repairing the filtration system					
		A22 c	Purchasing chlorine to treat the water					
		A22f	Ensuring that storage tanks and bucket taps are filled with water when the taps are not flowing					
		A22c	Ensuring that there is chlorine to treat the water					
		A22e	Testing the chlorine residual levels					
		A22g	Shutting off the filtration system when necessary					
		A23	Who assigns and ensures that the above responsibilities are completed?					
		A27	What is your (director's) role in to the water treatment system?					
		H24	What is your (maintenance staff) role in the provision of safe water in hospital?					
		H40	Is it one of your (maintenance staff) responsibilities to repair the water treatment system? Why or why not?					
		H42	Who do you call (maintenance) when there is a problem with the water treatment system?					
		A24a-b	When the treatment system is shut off or bypassed, is the director informed? Before or after? Who informs the director?					
		H14	(Maintenance) Who is responsible for the GE water system?					

	Is there effective and structured communication between the hospital director, the maintenance staff, and the laboratory staff?	A39a-A39b, A24, H25-a-c	**Maintenance and Director:** How frequently do you (the director) talk to the maintenance staff about the water system? Are these meetings scheduled? What did you discuss last time you spoke? Does the maintenance staff inform you (the director) when the system is shut down?.....How often do you (the maintenance staff) meet with the director about the water system? Are the meeting scheduled? What did you discuss the last time you met? Did you inform the director when you shut off the filtration system?	There is very little to no communication between the director, maintenance staff, and laboratory staff about the water system.	There is some communication between the director, maintenance and laboratory staff but it is unscheduled and there is evidence of a lack of communication regarding key issues.	There is a loose schedule for communication between the three parties but communication happens intermittently and some key issues are not communicated.	There is regular and scheduled communication between all three parties; however, a few key issues are not communicated OR there are not scheduled meetings; however, all key issues are communicated.	There is regular and scheduled communication between all three parties about the water system. All key issues are communicated. The maintenance staff informs the director and the laboratory staff before shutting down the water system.
		A41a-b, K15-a	**Lab and Director:** How frequently do you (the director) talk to the laboratory staff about the water system? Are these meetings scheduled? What did you (the director and laboratory staff) talk about the last time you spoke about the water system?....When was the last time that you (the laboratory technician) spoke to the director about the chlorine levels?					
		A42a-b, J22-b	**Administrator and Director:** How often do you (the director) talk to the administrator about the water system? Are these meetings scheduled? What did you (the director and the administrator) talk about the last time you spoke about the water system? (and opposite questions for admin)					
		H26-a-d, K17, K14-a, K17a-b	**Maintenance and Lab:** How frequently do you (the maintenance) meet with the laboratory staff about the water system? Are these meetings scheduled? Did you inform the lab when you shut off the filtration system? Do you inform the lab when you change to a new chlorine concentration? .....What did you (the maintenance staff and laboratory staff) talk about the last time you spoke about the water system? .....How often do you give advice or feedback to the maintenance staff to adjust the					

			chlorine levels? How do they react? ..... How many times have the maintenance staff responded to the lab staff advice? .....How many times did the lab staff re-measure the chlorine after the maintenance staff adjusted the levels? Do you (the maintenance staff) inform the laboratory when the water system is shut down?					
		K16-a-b, K15-a	**Lab and Administrator:** How often do you (lab) meet with the admin about the water system? Are these meetings regularly scheduled? What did you discuss last time you talked?.....How often do you (the laboratory staff) talk to the administrator about the chlorine residual levels in the water system?					
		H27-a-b, J23-24	**Maintenance and Administrator:** How often do you (the maintenance staff) talk to the administrator about the water system? Are these meetings scheduled? What did you discuss the last time you talked? (and opposite for admin re: maintenance)					
		A61-62, H6b	Has there been a time when chlorine was not bought for the system? How frequently is chlorine not bought for the system? Why? Who is responsible for turning on the generator?					
Training and Capacity Strengthening	Are there sufficient trained personnel to manage, maintain, and operate the water system?	A1	How long have you been working here as the director?	There are not enough trained personnel to maintain the water system and there have not been any efforts made to increase the number of trained personnel. The hospital is not currently self-reliant.	Some basic management and operations are accomplished. However, additional capacity building is needed in at least two of the following areas: lab, management, maintenance. The hospital is self-reliant for some operation and	Essential management and operations are accomplished. However, additional capacity building is needed in one of the following areas: lab, management, maintenance. The hospital is self-reliant for many operation and maintenance	There are a sufficient number of trained personnel to manage, maintain, and operate the water system. However, additional capacity building would be beneficial to sustainably manage and operate the system. The	There are a sufficient number of trained personnel to manage, maintain, and operate the water system. The hospital is capable of holding their own follow-up trainings. The hospital can operate and maintain the water system
		H16	Has any staff member been trained to maintain the filtration system by another staff member?					
		A45	Who was trained within the hospital in maintaining the filtration system?					
		A25	Do you believe your hospital staff have the capacity/knowledge to maintain the system? Why or why not?					
		A26	Do you believe that your hospital staff have the knowledge/capacity to train new staff on the management, maintenance and operation of the system? Why or why not?					
		H5	How long have you (maintenance staff member) been working in this hospital?					

		H4	What is your (the maintenance staff member's) highest level of education?		maintenance; however, they depend on GE for the majority of it.	issues; however, they do not have any plans to be self-reliant in the next 5 years.	hospital is on the road to being able to maintain and operate the water system without support from GE within the next 5 years	without support from GE.
		A45, H9	Who was trained by GE in the operation and maintenance of the water treatment system? Do they all still work here?					
		K12	How many lab staff have been trained to perform the chlorine residual testing by another staff member?					
		H15	Normally, how many people do maintenance work on the water system?					
		H17	How many days a week is there someone present who knows how to manage the water system?					
		K19, K18	Does the hospital have the lab capacity to perform microbiological testing of water samples on-site? If not, are there other local options?					
		K11	Who was trained in water sample collection and testing? (lab)					
Maintenance	Are daily, weekly, and monthly recommended maintenance procedures followed?	H33	How often is a backwash performed? (if manual)	The daily, weekly, and monthly recommended tasks are often not completed and some have never been completed.	The daily, weekly, and monthly recommended tasks are completed irregularly. Daily tasks are generally completed at least once a week, and weekly tasks at least once a month.	The daily, weekly, and monthly recommended tasks are generally completed but not as frequently as is recommended. Daily tasks often may not be completed during non-peak times (like on the weekends).	All daily, weekly, and monthly recommended tasks are usually completed, but are occasionally forgotten.	All daily, weekly, and monthly recommended tasks are completed as recommended, if not more frequently.
		H34	How often are the filters checked to make sure the backwash is functioning?					
		G1	How many liters of chlorine are in the chlorine tank?					
		G3	Is there a significant drop in pressure at the entry and exit of the filter banks?					
		H37	How often do you check the pressure at the entry and exit to see if there is a significant pressure drop between the filters?					
		N (info graphic)	How often do you scrub and backwash the Amiad filters?					
		tap observations	How often do you add more chlorine to the system?					
		H36	Does the hospital always have enough chlorine for the system?					
		G4	**Observation:** Is the outside of the equipment clean?					
		G5	**Observation:** Is the area around the filter system clean and clear of non-filter related items?					

		G6	**Observation:** Are there any leaks in the system that have not been repaired?					
		NH8	Are the elevated tanks and cistern cleaned? If yes, how often? Are the polytanks cleaned? If yes, how often?					
		K13-c	How often do you measure chlorine residual levels? Do you document this information? Where do you measure them?					
		H38	Have you ever removed the tops of the filters and washed the filters in a chlorine bath? If yes, how often?					
	Is there limited downtime in the operation of the water system?	H19-a-b	How many days in the last month have you not used the water filtration system? If the system was not working, when was the last time it was used? Why are the filters not being used? Have there been any attempts to fix the filters, if no, why not? (other WHY considerations: funds, leaks, pressure, communication failure, lack of demand for safe water, etc.	The water system has been bypassed or not used for at least 30 days within the past 2 months.	The water system has been bypassed or not used for at least a few hours multiple times a week OR maintenance or power issues make the system unreliable.	The water system is bypassed or not used at least every month but for no more than a couple hours at a time.	The only bypassing or disuse of the water system in the past 6 months has been due to repairs being made to the system and these have been minimal.	The water system has not been bypassed or not used within the past 6 months.
Repairs	Does the hospital maintain the capability to repair the water system when needed?	H42	Who do you call when there is a problem with the system?	The maintenance staff are not knowledgeable as to how to repair the water system or who to contact for help OR the water system is currently broken and there has been no effort made to repair it. External help is not called when needed.	The maintenance staff have demonstrated the capacity to make minor repairs; however, there are currently broken parts and their capacity for major repairs is low or unknown.	The maintenance staff have demonstrated the capacity to make repairs of various complexity; however, broken parts remain and they do not feel comfortable that they can resolve most problems.	The maintenance staff have demonstrated the capacity to make repairs of various complexity; however, the staff do not feel comfortable that they can solve all issues that arise. However, no unresolved repairs exist. The maintenance staff do not feel like they understand the	The maintenance staff knows how to repair the water system and feels capable that they could resolve any issues that arise. Any parts that have broken within the past year have been repaired or replaced successfully. When necessary, external help is brought in so
		H43	Has there been a time when you have sought external help for repairs? Explain.					
		A58, H42-a	How often are repairs to the water system completed?					
		H44 a-d (see maintenance supply sheet)	Have there been parts of the water system that have been successfully repaired or replaced?					
		H46	In your opinion, what specific aspects would you (maintenance) like more training on?					
		H39	What do you do if there is a drop in pressure?					
		H41	Give the following scenarios, do you have the capacity to repair the water treatment system? Why or why not?					

		H45a	Which parts of the filtration system cannot be fixed without help from an external support structure?				inner workings of the filtration system.	that issues don't go unresolved.
		H39	What do you do when there is a pressure drop?					
		H45	Which parts of the filtration system could you (or your team) be capable of repairing without external help?					

Domain - Technical Feasibility

Sub-Domain	Broad Question	Code	Survey Questions and Metrics	0	1	2	3	4
Water Source and Availability	Is there a reliable water source that provides the quantity and availability of water needed to meet demand? Is the water managed in a way that provides the quantity and availability needed to meet demand?	A10	What water sources are available in this hospital?	The principle source of water is intermittent and it is necessary for water to be rationed every day. Water is not available in more than two departments. The hospital frequently runs out of water and has to bring in water from another source (tanker truck) in at least one season. The hospital is not able to store sufficient water or manage their water supply in a way that meets demand.	The principle source of water is intermittent and it is necessary for water to be rationed. Stored water is relied upon during most weeks in at least one season. However, the hospital has sufficient stored water or manages their water in a way that most months, the hospital does not run out of water. Water is not available in more than two departments.	The principle source of water is intermittent. However, most days of the week, water is not rationed. The hospital rarely runs out of water. Water is not available in fewer than two departments.	The principle source of water is intermittent but for most of the month, it does not need to be rationed. Water is available in all departments. There is sufficient stored water available or water is managed in such a way that the intermittent water supply very rarely results in the hospital running out of water.	The principle source of water is dependable and while water may be stored, it is sufficient to meet demand. The hospital does not experience days without water supply (any interruptions are planned in advance and an alternative supply is pre-arranged). Water is available in every department within the hospital.
		A11	Are there any wards that do not have running water today [If not, why not?]					
		H6-a	In the last week, how many times has the electricity gone out? On average, how often does the electricity stay out when it goes out?					
		A12	Are there any wards that are not connected to the water purification system (exclusively)? Why not, which ones?					
		A16	What are other sources of drinking water in this hospital?					
		A13a-b	Typically how much unfiltered/untreated water do you store? Typically, how much filtered/treated water do you store?					
		N (Info graphic)	If the water source shut down, how long would the stored water last the hospital?					
		A15	Have you ever had to bring in water from a tanker truck due to lack of water? If yes, how often in the past year? Where is the water from the tanker truck usually stored (before or after filtration system).					
		A14a-d	How often is unfiltered/untreated water pumped into the elevated tank/cistern (Ghana only) How often is filtered water pumped to the clean side of the elevated tank? When the elevated tank/cistern is full of treated water, how long does it take to empty? When the polytanks are full of treated water, on average, how long do they take to empty?					

		A8	How often does water not flow from the taps in the hospital in the average week? (A9: What causes the water to stop flowing)					
Local Access to Replacement Parts	Are replacement parts for foreseeable issues during the life of the filtration system available locally?	H42-d (see maintenance supply sheet)	Where have you been able to find replacement parts for the system when they break down?	All replacement parts for the water system are produced and sold in the US exclusively.	Replacement parts for minor repairs can be purchased locally (tubes, glue, valves) but no parts for major repairs (chlorine doser, homespring filters) cannot be purchased within country.	All replacement parts for minor repairs can be purchased locally (tubes, glue, valves) and some parts for major repairs can be purchased within country (replacement parts for, pumps, chlorine doser.	All replacement parts for minor repairs can be purchased locally (tubes, glue, valves) and many parts for major repairs can be purchased locally (replacement parts for pumps, chlorine doser.	All replacement parts for the water system can be purchased within the country, most of them locally.
		H42-c (see maintenance supply sheet)	How far do you need to travel to find replacement parts?					
		H42-b (see maintenance supply sheet)	How accessible are replacement parts (tubing, etc.) for water treatment system?					
Current Infrastructure	Is the hospital committed to maintenance and management of infrastructure and resources for water, sanitation, and hygiene?	E, F, G	Tap Observations	Hospital infrastructure relating to water, sanitation, and hygiene is not maintained. The majority of the sinks observed were non-functional. Water storage containers are never cleaned and most polytanks (if applicable and commonly used) do not have lids.	Hospital infrastructure is not consistently maintained. At least 50% of sinks observed were functional. Fewer than 75% of all polytanks (if applicable and commonly used) have lids. Most storage containers are never cleaned but some may be.	Hospital infrastructure relating to water, sanitation, and hygiene is moderately maintained. At least 75% of all sinks observed were functional. At least 75% of all polytanks (if applicable and commonly used) have lids. Most storage containers are occasionally cleaned.	Hospital infrastructure relating to water, sanitation, and hygiene is mostly maintained. At least 85% of all sinks observed were functional. At least 90% of all polytanks (if applicable and commonly used) have lids. Most storage containers are cleaned on a semi-regular basis.	Hospital infrastructure relating to water, sanitation, and hygiene is well maintained. At least 95% of all sinks observed were functional. Water storage containers are cleaned according to a schedule and all polytanks (if applicable) have lids.
		NH1-N4K (P1A-P14A..etc)	TBD (Cistern and Polytanks) Number of polytanks without lids, cleaning schedule for polytanks and cisterns					
		H7	What types of toilets are available?					
		H8	What are the common maintenance problems associated with the toilets? (not part of metric)					
Water Quality Testing	Does the tap water throughout the hospital meet WHO guidelines for microbial water quality?	M		Fewer than 40% of all samples met WHO guidelines for microbial water quality.	Between 40-59% of all samples met WHO guidelines for microbial water quality.	Between 60-79% of all samples met WHO guidelines for microbial water quality.	Between 80-99% of all samples met WHO guidelines for microbial water quality.	100% of all samples met WHO guidelines for microbial water quality.

	Does the tap water throughout the hospital meet guidelines for chlorine residual?	M		Fewer than 20% of samples met guidelines for chlorine residual.	Between 20-39% of samples met guidelines for chlorine residual.	Between 40-59% of samples met guidelines for chlorine residual.	Between 60-79% of samples met guidelines for chlorine residual.	More than 80% of samples met guidelines for chlorine residual.

Domain - Accountability

Sub-Domain	Broad Questions	Code	Survey Questions and Metrics	0	1	2	3	4
Monitoring Performance	Does the hospital perform monitoring activities?	A33	Does this hospital have a record for any of the following activities? Who is responsible?	The hospital has no written records of activities regarding water infrastructure.	The hospital has some records but they are not well maintained and are out of date.	The hospital maintains some records of activities regarding water infrastructure but does not do so consistently or are missing key items.	The hospital maintains records of important activities regarding water infrastructure, but there is room for improvement in maintaining them or including additional items.	The hospital keeps well maintained, up to date records of activities regarding water infrastructure.
		A33a, J16a	Availability of water					
		A33b, J16b	Water treatment					
		A33g, H31a, J16g	By-passing the system					
		A33f, H31b, J16f	Measuring chlorine levels					
		A33c, H31c, J16c	Cleaning of water containers					
		A31d	Cleaning water cisterns					
		A33d, H31d, J16d	Repairing taps and broken sinks					
		A33e, J16e	backwashing					
Oversight by another entity	Is there oversight by another entity?	A55a-d, A85 a-d	Do you communicate with MoH, GHS, about the water treatment system? How often? What do you discuss? Are these meetings schedule? When you bring up issues, are they addressed?	There are no outside organizations that monitor water quality in the hospital. The hospital does not have a biosafety committee/QA OR the biosafety/QA committee.	There is an outside organization that could monitor water quality and may have done so in the past but there is no formal relationship established. The biosafety/QA committee (if there is one) does not discuss water issues.	There are outside organizations that occasionally monitor water quality. The biosafety/QA committee has discussed water quality.	There are outside organizations that monitor water quality on a regular basis, but they may not share results or have a collaborative relationship. The biosafety committee regularly discusses water quality and has made efforts to improve or monitor water quality.	An outside organization regularly monitors water quality within the hospital. The hospital and the outside organization have a collaborative relationship. The biosafety committee in the hospital is devoted to keeping the hospital water clean. The hospital communicates to the
		A86 a-b	(Director)How frequently do you talk to the bottling company about the water treatment system? Are the meetings regularly scheduled? What did you talk about last time you spoke?					
		A56-A56a	Who reviews expense reports? Where are they sent? How often?					
		A34-35, J25-26	Are there any organizations or institutions that are monitoring water quality within the hospital? How often do you have contact when them? If yes, how frequently do they take samples? Do they share their findings with the hospital?					
		A36, J19-a	What is the closest city where water samples could be taken for analysis?					
		H22-b	Do you (maintenance) communicate with the MoH/GHS about the filtration system? How often? What do you					

			discuss?					
		A44a-b, J18a-b	Does the hospital have a biosafety committee/quality assurance (QA) committee?If yes, is water one of the themes they discuss? Have they taken any action with regard to improving the provision of safe water? What actions?					
	Do the hospital and GE (or GE representatives through ambassadors, Assist, technicans) successfully communicate with each other?	H12-13	How many visits have GE, Assist, and Kwame made in the past year? What are the issues you discuss during these visits?	The hospital does not communicate with GE representatives. GE representatives have made very few or no follow up visits. The hospital is not aware of GE's long-term level of involvement.	The director and the GE representatives communicate occasionally regarding the water system. The communication mostly involves planning the next visit by GE representatives. The hospital may have some sense of GE's long-term involvement but has many unanswered questions.	The director and GE representatives communicate regarding the water filtration system semi-regularly, but key issues are not brought to the attention of GE representatives. If key issues are brought up, they may not be adequately addressed. The hospital has some sense of GE's long-term involvement but has questions .	The director and the GE representatives discuss the filtration system regularly; however, key issues may not adequately be addressed. The hospital is generally aware of GE's long-term involvement.	The hospital and GE representatives regularly communicate specifically about the water filtration system. The hospital feels that their concerns and issues are adequately addressed. The hospital is aware of and understands GE's long-term level of involvement.
		A38a-c, J21-c; H11-a-c, H21 a-d,	How often do you(director) talk to Assist International? What do you talk to them about? How often do you specifically talk to them about the water system? When you bring up issues are they addressed? (and same questions for maintenance)					
		A37a-c, J20-c; H10 a-c, H20a-d	How often do you (director) communicate with GE Ambassadors / Kwame Akorsa about the water system? How often? Are these meetings regularly scheduled? What do you discuss? When you bring up issues, are they addressed? (and same questions for maintenance)					
		A46	Did hospital staff receive a training session regarding the water treatment system?					
		A47-a	Has GE communicated with the hospital regarding their long-term level of involvement regarding the water treatment system (see A47a) For how long to you expect GE to continue to offer their assistance? In what capacity? Why? If GE were to stop providing assistance, would you continue to be able to buy safe water?					
Financial Ownership	Does the hospital have the potential to fund the water system without GE support?	A37	Does GE or the MOH provide:	If GE stopped providing funding, the hospital could not maintain the fixed costs associated with	The hospital is able to cover some of the costs associated with the system but relies on GE for the majority.	The hospital has allocated funding toward the recurring costs but maybe not fixed costs. If GE stopped providing	The hospital has allocated funding for recurring and fixed costs; however, the funding may not be sufficient and	The hospital has allocated funding to both the recurring costs and fixed costs associated with the provision of
		A48b	fund for water treatment (reoccurring costs)					
		A48c	funds for infrastructure (piping and sinks) (fixed costs)					
		A48d	Staff training					

		A48a	Water bill	the provision of safe water. There is no evidence that the hospital has invested in the provision of safe water.		funding, the hospital would struggle to maintain the provision of safe water. There may be an outside organization/ foundation that can support fixed costs.	is uncertain.	safe water. There is evidence that the hospital has invested in the provision of safe water.
		A37e	Other					
		A49	If yes, how much?					
		A51	Does the hospital set aside funds for:					
		A51a	water treatment (reoccurring costs)					
		A51b	infrastructure (piping and sinks) (fixed costs)					
		A51c	Other					
		A52	Is there any part of the water system that was donated by a business, organization, or foreign government?					
		A52	Are there any outside organizations or institutions that finance infrastructure for the provision of water and sanitation in the hospital?					
		A53	What are other sources of external funding for the hospital?					
Finances	Is the hospital able to pay reoccurring costs for the system and does it maintain a record of their finances regarding the water system?	A57, H29f, J27	How much do chlorine (bleach) cost on a monthly or quarterly basis for the water system? (maintenance and director)	The hospital is consistently unable to pay recurring costs associated with the system and there are no records maintained for expenditures.	The hospital is sometimes able to pay the recurring costs but most of the time they are unable to. There may be records of expenditures but they are not easily traced to the water system.	The hospital is able to pay the recurring costs associated with the system most of the time but sometimes does not due to water quality being of low priority compared to other demands on hospital resources. There are records of expenditures but not easily traced specifically to the water system.	The hospital is able to pay recurring costs associated with the system the majority of the time. They maintain some records of expenditures easily traced to the water system.	The hospital is able to pay all recurring costs associated with the system and maintains a record of expenditures easily traced to the water system.
		A60, H23, J17	What process does the hospital have in place to track the expenses required for the water treatment system operation? (ask to see expense tracking system)					
		J15	Is there a specific budget for the water system? (if not, please explain the system used to obtain consumables and parts)					
		A59	Who funds the costs of repairs associated with the system?					
		J13	Approximately how much do you spend monthly to obtain consumables and parts needed to make repairs to the water system?					
		J12, J14	What influences your (the administrator's) decision to buy (or not buy) chlorine for the water system? To maintain infrastructure?					
		A63	Is the hospital able to cover the recurring cost associated with the					

			water purification system (i.e. chlorine, staff time, small repairs)					
		A61-62, J28-a	Has there been a time when chlorine was not bought for the system? How frequently is chlorine not bought for the system? Why?					

Domain – Institutional Engagement

Sub-Domain	Broad Question	Code	Survey Questions and Metrics	0	1	2	3	4
Demand	Is treated water accessible and utilized by the population within the hospital for drinking, hygiene and medical purposes?	A17a, B8a, C8a, J9a, K8a	Does the staff drink water from the tap?	No one (with the exception of those who have no other option) drinks water filtered in the hospital, everyone brings their own drinking water or purchases water. In patient care, treated water is not used any differently than untreated water.	Few people drink water from the treatment plant. Bottled water is purchased or provided but is not always available. Treated water is sometimes but rarely used hygiene and medical purposes when it is appropriate.	While some people drink water filtered in the plant, they are not the majority. Bottled water is purchased. Treated water is used for the majority of hygiene and medical purposes when it is appropriate.	While staff has access to filtered water from the plant and they know it is safe, patients and visitors have more limited access or are not generally aware that the tap water is safe. The hospital does not purchase bottled water. Treated water is used for the vast majority of hygiene and medical purposes when it is appropriate.	Staff, patients, and visitors alike drink filtered water from the plant (either from the tap or bottles of water filled from the treatment plant). Treated water is used when appropriate for all hygiene and medical purposes.
		A17b, B8b, C8b, J9b, K8b	Do patients drink water from the tap?					
		A17c, B8c, C8c, J9c, K8c	Do visitors/caretakers drink water from the tap?					
		A17d, B8d, C8d, J9d, K8d	Do others drink water from the tap?					
		A10f	Does the hospital buy bottled water for staff? For patients? (look at water use surveys)					
		water use survey	Is treated water used for critical hygiene purposes? Is treated water used for critical medical purposes?					
Satisfaction and Perceived Value	Is the director of the hospital satisfied with the water system?	A67	How is the water quality in this hospital when compared to the water you (the director) use in your house?	The hospital director is completely unsatisfied with water filtration system and would not recommend to another hospital.(1)	The hospital director is mostly unsatisfied with the water filtration system. S/He would probably not recommend the system to other hospitals. (2)	The hospital director is somewhat satisfied with the water filtration system. S/He knows it has its problems but he would probably recommend the system to other hospitals. (3)	The hospital director is mostly satisfied with the water filtration system. S/He would recommend the system to other hospitals. (4)	The hospital director is completely satisfied with water filtration system and would definitely recommend the system to other hospitals. (5)
		A70	How would you rate your satisfaction with the taste of the water?					
		A71	How would you rate your satisfaction with the color of the water?					
		A72	How would you rate your satisfaction with the water pressure of the system?					
		A73	How would you rate your satisfaction with the maintenance cost of the system?					
		A74	How would you rate your satisfaction with the ability of the filtration system satisfy your hospital's needs?					

		A68	In your opinion (director) is the water from the tap safe to drink?					
		A69	Do you (the director) drink from the tap?					
		A75	Would you recommend this water system to other hospitals? Why or why not?					
	Is the maintenance staff satisfied with the water system? Is the maintenance staff committed to the water treatment system?	H48	Would you recommend this water system to other hospitals? Why or why not?	The maintenance staff is completely unsatisfied with water filtration system and would not recommend to another hospital. The maintenance staff does not understand the importance of safe water, does not have goals for the system and is not committed. (1)	The maintenance staff is mostly unsatisfied with the water filtration system. They would probably not recommend the system to other hospitals. They are marginally committed to maintaining the system. (2)	The maintenance staff is somewhat satisfied with the water filtration system. They know it has its problems but they would probably recommend the system to other hospitals. They are committed to maintaining the water system, as long as it is not too much work above and beyond their normal duties. (3)	The maintenance staff is mostly satisfied with the water filtration system. They would recommend the system to other hospitals. They are committed to the water system and will go above and beyond their responsibilities to ensure it's success. However, there are also examples of the maintenance man not being fully committed.(4)	The maintenance staff is completely satisfied with water filtration system and would definitely recommend the system to other hospitals. The maintenance staff understands the importance of safe water and has set goals for the water treatment system. He is committed to maintaining the system, even when there are challenges. (5)
		H50	Do you have other questions for GE about the water filtration system?					
		H30	Do you (maintenance staff) talk to other maintenance teams with GE water filtration systems?					
		H32-a	For long do you expect GE to continue to offer their assistance? In what capacity and why? If GE were to stop providing assistance, would you be able to continue to provide safe water? How?					
		H49	What advice would you give others who operate the same water filtration system?					
		H57	Do you drink from the tap?					
		H56	In your opinion (maintenance) is the water from the tap safe to drink?					
		H55	Why is it important to treat the water?					
		H58	What are you (maintenance) goals for the water filtration system? Do you feel like you are achieving them? Why?					
			Maintenance commitment scores					
		H47	What can GE do to improve the filtration system?					

	Is the hospital director committed to the sustainability of the water system?	A28	What are your (director's) goals for the water treatment system? Do you feel like you are achieving them? Why?	The hospital director does not see a future for the water filtration system in his hospital. If GE were to stop providing support, water filtration would not continue.	The hospital director is unsure of the future of the water filtration system in the hospital. He has goals but has not taken steps to achieve them. It is likely that water filtration would not continue if GE stopped providing support.	The hospital director has goals for the water filtration system and has set plans in motion for some of them. If GE stopped providing support, the hospital may be able to sustain water filtration for a time.	The hospital director has both short-term and long-term goals for the water filtration system and has set plans in motion for some of them. The hospital is preparing for the day when they can manage the system on their own. If GE stopped providing support they would do their best to continue to provide filtered water. However, it is likely that large challenges would not be surmountable.	The hospital director is committed to maximizing the water filtration system's full potential. They are preparing for the day when GE will no longer provide support and by that point, should be able to withstand challenges to continued provision of filtered water.
		A47-a	For how long do you expect GE to continue to offer their assistance? In what capacity and why? If GE were to stop providing assistance, would be able to continue to provide safe water? How?					
Engagement of Hospital Director and Staff	Are the hospital director and staff committed to the provision of clean water?	A57, B17, C17, H59	On a scale of 1-5 where 5=very committed and 1=not committed:	Neither the hospital director nor the hospital staff are engaged or committed to the provision of safe water. (1)	There are a few hospital staff engaged or committed to safe water; however, they are the minority. (2)	The director and some staff are engaged and committed to the provision of safe water in the hospital, but they are not the majority. (3)	The director and most hospital staff are engaged and committed to the provision of safe water in the hospital. (4)	Both the hospital director and the staff are devoted to improving the provision of safe water within their hospital. (5)
		A57a, B17a, C17a, H59a	How committed was the participant to respond to questions asked?					
		A57b, B17b, C17b, H59b	What was the participant's level of knowledge about the practices at this hospital?					
		A57c, B17c, C17c, H59c	How willing was the participant to give examples and additional information?					
		A57d, B17d, C17d, H59d	What was the participant's level of commitment to the provision of clean water?					

		A66	What actions does the hospital take to promote the availability and awareness of safe water for staff patients and visitors?					
		A29	What do you do to promote safe water use in the hospital?					
		A64	In your opinion (director) what are the benefits of having a safe water source here in the hospital?					
Educational Messaging and Awareness	Does the hospital provide educational materials/trainings/PSAs regarding safe water, sanitation, and hygiene practices? What does the hospital do to promote safe water use in the hospital?	G7	Did you observe any messages regarding safe water?	No educational messaging regarding safe water, sanitation, or hygiene practices were visible during the hospital visit. There are not hospital workshops regarding safe water and the director and maintenance staff do not educate the staff about the water system.	Educational messaging regarding safe water, sanitation, or hygiene practices were observed infrequently and not in both staff and patient areas. There may be some hospital workshops that involve topics surrounding safe water and the director and maintenance staff have educated the staff about the water system at some point but it was not consistent.	Educational messaging regarding safe water, sanitation, or hygiene practices were observed in several locations and were visible to both patients and staff. However, the messages were not catchy or engaging. There may be hospital workshops regarding safe water and the director and maintenance staff have educated the staff about the water system on several occasion s but it was informal and only to specific staff.	Educational messaging regarding safe water, sanitation, or hygiene practices were observed in several locations and were visible to both patients and staff. Some messages were engaging/catchy but most were not. There may be hospital workshops regarding safe water and the director and maintenance staff do educate the staff about the water system; however, more consistent and widespread education would be an improvement.	Compelling educational messaging regarding safe water, sanitation, and hygiene practices were very visible in places where both patients and staff can see them. There may be hospital workshops regarding safe water and the director and maintenance staff educate the staff about the water system in a manner that reaches all staff on a consistent basis.
		G8-10	Are the messages visible to staff? Are the messages visible to patients/ visitors? Are the messages engaging/catchy?					
		G11	Did you observe any messages regarding hand washing?					
		G12-14	Are the messages visible to staff? Are the messages visible to patients/ visitors? Are the messages engaging/ catchy?					
		G15	Did you observe any messages regarding bathroom usage?					
		G16-18	Are the messages visible to staff? Are the messages visible to patients/ visitors? Are the messages engaging/ catchy?					
		A43a , H28-a	Have you even spoken with the staff about the filtration system? What have you talked about? (Director and Maintenance Staff)					
		G19	Messages observed/organizations:					

	Are staff and patients aware of the water system and the water quality?	B6-a, C6-a, D12, J8-a, K7-b	Prior to being informed today, were you aware of the water treatment system at the hospital? How did you learn this information?	Staff and patients are not aware of the water treatment plant and are generally incorrect in their understanding of the hospital water quality.	There is a limited amount of awareness regarding the water system. Some people drink/use water from the plant, though not necessarily because they know it is safe.	There is some awareness of the water system among staff, though the knowledge is limited or vague. Some participants drink/use water from the system because they believe it to be safe.	The majority of staff are aware of the water system and some are knowledgeable about the process. Over half the participants believe the water from the system is safe to drink/use.	Staff are knowledgeable about the water treatment plant. Everyone knows water from the system is safe to drink/use.
		C7	What do you know about the water treatment system at the hospital?					
		D7, D9, D10	Have you (the patient) drunk from the tap in the hospital? If not, why not? Did your children drink from the hospital tap?					
		B4, C4, D11, J5, K4	Do you believe that the tap water is safe to drink? Why or why not?					
		B11	Do you recommend that your patients drink the tap water?					
		BW, C9, J6, K5	Do you drink from the tap?					
		A 17a-d, B8	Who drinks the water?					
		B10, C10, J10, K9	What are the benefits of having safe water for your job?					

Appendix 4: IRB Exemption Letter

EMORY UNIVERSITY

Institutional Review Board

May 25, 2012

Christine Moe, PhD
Principal Investigator
Global Health

RE: **Exemption of Human Subjects Research**
IRB00057332
Impact Evaluation of Hospital Water Purification Systems in Honduras & Assessment of Global Field Sites for Water Purification Systems

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 **05/25/2012** 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, the project aims to improve strategies for increasing access to small-scale, safe drinking water systems around the world and ensure their sustainability. The project will evaluate safe water practices in hospitals in Honduras where water purification systems have been implemented by the General Electric Foundation (GEF); compare these hospitals to matched control hospitals without purification systems. Evaluation will address water distribution patterns and uses, and knowledge and attitudes about treatment and use of safe water. This evaluation will engage hospital staff, patients, and other water users.
Other project activities that do not include human subjects research involve water quality data collection, facility inspections, and in-depth evaluations at each hospital in Honduras. The data collected throughout this project will be analyzed and then used to make recommendations to the stakeholders regarding improvements to sustainability of these water filtration systems in Honduras and in other areas of the world where these safe drinking water systems have been implemented.

Documents reviewed with this application:

- Protocol_v2_Version Date: 05/18/2012

- Consent_GE Honduras_v2_Version Date: 03/28/2012

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,

Carol Corkran, MPH, CIP
Senior Research Protocol Analyst
This letter has been digitally signed

	Huttinger	Alexandra	Global Health
CC:	Robb	Katharine	Financial Aid - Cdc
	Roguski	Katherine	Public Health

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Study Identification Information

1.0 * **Enter the Full title of the study (include any version dates from the sponsor)**

Impact Evaluation of Hospital Water Purification Systems in Honduras, Ghana, Kenya, and Rwanda & Assessment of Global Field Sites for Water Purification Systems

2.0 * **Enter a SHORT identifying title for tracking purposes:**

Impact Evaluation of Hospital Water Purification Systems in Honduras, Ghana, Kenya and Rwanda

3.0 **What is the estimated start date of this study:**

01-Apr-12

4.0 **What is the estimated completion date of this study:**

01-Jan-13

5.0 * **Name of Principal Investigator. Limit is one person; Emory affiliation is required. If name does not appear in menu, the person probably does not yet have an eIRB account. For more information about obtaining an eIRB account, click here.**

Christine Moe **Dept**:Global Health

6.0 **Names of Emory Co-Investigators. May include Emory personnel and non-Emory persons with sponsored eIRB accounts. If name does not appear in menu, the person probably does not yet have an eIRB account. For more information about obtaining an eIRB account, click here.**

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7.0 **Names of Emory Study Coordinators. May include Emory personnel and non-Emory persons with sponsored eIRB accounts. If name does not appear in menu, the person probably does not yet have an eIRB account. For more information about obtaining an eIRB account, click here.**

Last	First	Dept
Gallegos	Marisa	Global Health
Huttinger	Alexandra	Global Health
Robb	Katharine	Financial Aid - Cdc
Roguski	Katherine	Public Health

8.0 **Names of other Emory Study Staff not listed above. If name does appear in menu, the person probably does not yet have an eIRB account. For more information about obtaining an eIRB account, click here.**

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View Lie-Tjauw	Samantha	Public Health	Research Fellow
View Swearing	Erin	Emory College - Main	Research Fellow

	Last	First	Dept	Type
View	Turner	Sarah	Public Health	Research Fellow

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