Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

_____

Signature

_____

Date

Ethiopia Household Water Treatment Evaluation Among Antiretroviral Treatment Clients and Matched Community Members in 2008

By

Anjelica N. Young

Master of Public Health

Hubert Department of Global Health

_____

Joanne A. McGriff, MD, MPH

Committee Chair

_____

Robert Quick, MD, MPH

Committee Member

Ethiopia Household Water Treatment Evaluation Among Antiretroviral Treatment Clients and Matched Community Members in 2008

By

Anjelica N. Young

B.A., University of Georgia, 2012

Thesis Committee Chair: Joanne A. McGriff, MD, MPH

Thesis Committee Member: Robert Quick, MD, MPH,

In fulfillment of the requirements for the degree of

Master of Public Health

in Global Health

2018

Abstract

Background: In Ethiopia, the prevalence rate of adult HIV is approximately 1.5%, and the burden of opportunistic infections are high. People living with HIV experience higher levels of morbidity and mortality from opportunistic infections related to enteric disease. One major intervention to prevent opportunistic enteric infections in people living with HIV is the use of safe water systems that include chlorination of water. The international community, through PEPFAR, is also combatting these enteric infections by providing HIV basic care packages that include a water treatment system. However, it is not clear how HIV patients use water treatment systems provided in these basic care packages.

Project Goals: The four research questions of this analysis center on whether people formally enrolled in antiretroviral therapy (ART) or pre-ART groups 1) have higher rates of self-reported water treatment, 2) have higher rates of Wuha Agar (a chlorine-based water treatment system found in Ethiopia) in their household, and 3) have higher rates of detectable free chlorine residual in their household drinking water compared to matched community members?

Methods: 795 formally enrolled ART clients and 795 age-matched community members were recruited from twenty healthcare facilities in Ethiopia. Original data was collected in December 2008 by the Centers for Disease Control and Prevention (CDC). In this secondary analysis, survey data assessed population demographics, water sources and treatment, latrine coverage, diarrhea rates, and water treatment knowledge. Bivariate analysis and logistic regression modeling were implemented to determine treatment of water, presence of Wuha Agar (chlorinated water treatment solution) and chlorine detection within household drinking water.

Results: Overall, the ART clients were more likely to self-report treatment of water than matched community members (aOR 3.391, 95% CI 2.637, 4.363, p<.0001). They were also more likely to have Wuha Agar in their household (aOR 8.147, 95% CI 4.996, 13.283, p<.0001), and had higher frequency of chlorine detection in the household drinking water (aOR 10.735, 95% CI 4.560, 25.270, p<.0001). ART clients were also more likely to have no reported income (p<.0001) and less education (p=0.0031).

Conclusions: The provision of a basic care package for people living with HIV, which includes a water treatment system, lowers the barriers to access and may increase the quality of life of those affected by HIV/AIDS and their family members. ART clients with access to water treatment systems were more likely to self-report treatment of water, have the chlorine solution present at their household, and have their drinking water test positive for chlorine residual.

Ethiopia Household Water Treatment Evaluation Among Antiretroviral Treatment Clients and Matched Community Members in 2008

By

Anjelica N. Young

B.A., University of Georgia, 2012

Thesis Committee Chair: Joanne A. McGriff, MD, MPH

Thesis Committee Members: Robert Quick, MD, MPH,

In fulfillment of the requirements for the degree of

Master of Public Health

in Global Health

2018

Acknowledgements

A huge thank you to my thesis advisor, Dr. McGriff, for your hours of support and encouragement throughout this process. Also, a big thank you to Dr. Quick for his guidance and coaching. This was a wonderful learning experience because of the education and assistance that each of you provided. To Dr. Lyles, thank you for your hours of advice and mentoring on SAS. I am grateful to the division of Foodborne, Waterborne, and Environmental Diseases at CDC, and especially to Eric Mintz for allowing me to be part of the team and learn from the network of colleagues in the division. And finally, thank you to my family and friends who have listened to me discuss this project for months and have offered kindness and love throughout the process.

Table of Contents

INTRODUCTION

Background

In Sub-Saharan Africa, it is estimated that 25.6 million people are living with HIV, making it the most affected region in the world in 2015 (Luba et al., 2017). In Ethiopia alone, an estimated 793,700 people were living with HIV in 2014, with an adult prevalence rate of 1.5% (Luba et al., 2017). To combat the HIV pandemic, the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) was established in 2008 to develop a package of interventions to reduce HIV-associated morbidity, mortality and HIV transmission (USAID, 2017). Since its inception, PEPFAR has transformed the global HIV/AIDS response, which now supports over 13.3 million people with lifesaving antiretroviral treatment in more than 50 countries hardest hit by HIV/AIDS (PEPFAR, 2018). PEPFAR, along with other government and non-government organizations, is working to reduce HIV morbidity and mortality on a global scale.

One technique PEPFAR has taken to respond to the HIV/AIDS epidemic is through the provision of basic care packages. While the package may differ depending on the country and prevalence of other opportunistic infections, most basic care packages include: cotrimoxizole (a powerful antibiotic used to treat and prevent opportunistic infections in HIV positive persons), insecticide-treated bed net, water treatment system, condoms and family counselling and HIV testing advice. The preventative measures in the package that align with the topic of this thesis include improved screening and treatment of opportunistic infections; increased access to safe drinking water and promotion of basic hygiene and sanitation (USAID, 2017).

Safe water access in Ethiopia is estimated around 76% in urban areas and as low as 20% in rural areas (CDC, 2009). The country also has a high infectious disease

prevalence, with diarrhea being one of the most common illnesses affecting infants and children with HIV (CDC, 2009). One of the major causes of enteric infections is a lack of access to proper water, sanitation and hygiene. These infections are a major cause of morbidity and mortality among persons living with HIV (O'Reilly et al., 2014). One major intervention to prevent opportunistic enteric infections in people living with HIV is the use of safe water systems which include chlorination of water and narrow mouthed containers for storage. Research has shown safe water storage systems decrease the risk of diarrhea by 25-85%.

In low-resource settings with a lack of access to proper water, sanitation and hygiene, it is crucial to support interventions to combat the coinfection of enteric infections, among those living with HIV. In 2006, the US President's Emergency Plan for AIDS Relief in Ethiopia (PEPFAR-Ethiopia) implement a palliative care program with a major component focused on increasing the knowledge, attitude and practices regarding water, sanitation and hygiene. Although global funding for HIV/AIDS care has stagnated, PEPFAR aims to work at the country level to expand coverage and access to basic care packages for people living with HIV (Barnhart; Voelker, 2010). In Ethiopia, these would include cotrimoxazole, insecticide-treated bed net, household water treatment products, water storage containers, soap, oral rehydration salts (ORS), condoms, family counselling and HIV testing advice. Commonly, the provision of water treatment interventions and other preventative care interventions are less widely available, although they have proven efficacy and are cost-effective (USAID, 2009). The basic care package intervention is cost-effective, simple, and has the ability to improve the quality of life, prevent transmission of HIV, and even delay the HIV disease and prevent mortality (CDC, 2009).

Purpose Statement

This secondary analysis intends to provide additional evidence regarding how HIV/AIDS patients taking antiretroviral therapy (ART) use water treatment systems provided in basic care packages. Specifically, the analyses will determine if ART clients with free access to water purification solutions engage in water treatment differently than their community members. This thesis aims to add to the evidence base regarding the inclusion of water treatment products as an essential component of the HIV/AIDS basic care package.

The four *research questions that drive this analysis include:*

1. Do people formally enrolled in ART/pre-ART groups with free access to water purification solutions engage in water treatment differently than community members who do not have this access?

2. Do people formally enrolled in ART/pre-ART groups have higher rates of self-reported water treatment vs the reports of the matched community members?

3. Do people formally enrolled in ART/pre-ART groups have higher rates of WuhaAgar (a chlorine-based water treatment system found in Ethiopia) in the household, as observed by study enumerators compared to matched community members?

4. Do people formally enrolled in ART/pre-ART groups have higher rates of detectable free chlorine residual in their household water than their matched community members?

The null hypothesis for this analysis is that ART/pre-ART enrolled clients have the same rate as the matched community members of 1) self-reported water-treatment, 2) Wuha Agar in the household, and 3) levels of free chlorine residual in their household drinking water. Apriori hypotheses that differ from the null hypothesis include: ART

clients will have a higher rate of chloride residual detected in their household water than matched community members, and 2) community members have a higher rate of self-reported treatment of water than the matched ART clients.

LITERATURE REVIEW

Enteric Disease in HIV Patients (or PLWHA)

Diarrhea and other opportunistic enteric infections are a significant cause of morbidity and mortality among people living with HIV/AIDS (O'Reilly et al., 2014). A study by Brink et al., found that within a community-based cohort of HIV-infected adults in Uganda, CD4 counts were significantly lower in individuals with diarrhea than those without (Brink et al., 2002). In a later study by Lule et al., HIV-infected persons in rural Uganda were six times more likely to have episodes of diarrhea and a three times increased risk of diarrhea was associated with lower CD4 cell count. (J. R. Lule et al., 2009).

Compared to immunocompetent populations, those living with HIV/AIDS experience not only more cases of diarrhea but more hospitalizations and mortality due to waterborne pathogens, even when on antiretroviral therapy (ART) (USAID, 2015) (Brink et al., 2002). A randomized control trial in Zambia which assessed safe water storage in HIV-positive mothers showed diarrheal disease may lead to the malabsorption of essential nutrients, putting people living with HIV/AIDS at risk of not attaining their essential nutrients and necessary dosages of medications, especially antiretroviral drugs (Peletz et al., 2012). In immunocompromised persons with HIV/AIDS already at risk for lower CD4 counts, opportunistic infections can hasten the progress of HIV to AIDS (Seremet, 2010).

Impact of Improved WASH on People Living with HIV/AIDS

In Ethiopia, where 1.5% of the population are living with HIV/AIDS, access to clean water and sanitation services are limited. The World Health Organization (WHO)

estimates that 85 to 90 percent of diarrheal infections in developing countries are due to unsafe water and inadequate sanitation (Seremet, 2010). In order to prevent opportunistic enteric infections, clean water is critical for maintaining the quality of life of people living with HIV (Seremet, 2010).

A study by Yates et al., which analyzed the impacts of water, sanitation and hygiene interventions in people living with HIV, found that lack of proper sanitation, contaminated drinking water, and poor hygienic practices in homes of people living with HIV/AIDS in Zambia increased the risk of diarrhea, which can result in a decreased CD4 count, increased viral load, and a reduction in the absorption of necessary nutrients and antiretroviral medication. (Yates, Lantagne, Mintz, & Quick, 2015). In fact, household water treatment was shown to have a significant impact in the reduction of diarrhea in infants with HIV positive mothers (P= 0.001) and also reduced diarrhea in other household members ($p<0.001$) (Yates et al., 2015).

WASH in Basic Care Packages

WASH programming for people living with HIV/AIDS has the ability to significantly improve quality of life as well as prevent opportunistic infections which can have life threatening effects on this population. While the implementation may vary depending on the population, the interventions generally include distribution of a safe water system along with counseling on safe water and hygiene and promotion of safe water storage (CDC, 2009). There is conclusive evidence that simple, household, low-cost strategies for safely treating and storing water greatly improve the bacteriological quality of water and reduce diarrheal disease morbidity analogous to those achieved through hand washing and safe feces disposal (USAID, 2009).

A policy brief on integrating hygiene improvement into HIV/AIDS programming to reduce diarrhea found that diarrhea affects 90 percent of people living with HIV/AIDS and is a significant cause of morbidity and mortality (USAID, 2009*)*. Home based safe water treatment systems that consist of a chlorine to disinfect water along with a narrow mouth container with a lid and spigot reduced the frequency of diarrhea by over 25 percent and reduced the severity of diarrhea cases in people living with HIV/AIDS (J. R Lule, 2005).

A study by Colindres et al., which assessed the utilization of a basic care package and prevention package by HIV-infected persons in Uganda found that the basic care package water storage vessel had a high degree of reported and observed use (Colindres et al., 2008). This report demonstrated successful distribution of a basic care package by an AIDS organization in Uganda. It is appropriate to expect that similar results if healthcare facilities with PEPFAR funding successfully provide basic care packages to the ART clients.

In 2009, the CDC conducted an evaluation of safe water programs serving people living with HIV/AIDS in Ethiopia. The study captured utilization of the basic care package provided at intervention sites to people living with HIV/AIDS and found that participants of the study appeared to have improved reported health outcomes and higher utilization of water purification tools (CDC, 2009). The study also found that safe water storage systems reduce the risk of diarrhea by 25-85%, (depending on factors such as country and population) and demonstrated a 33% reduction in the total number of days ill from diarrhea in PLWHA (CDC, 2009). *This research* by the Waterborne Disease and Prevention Branch at CDC, Atlanta showed that the inclusion of WASH programming in the PEPFAR basic care package led intervention clients to be significantly more likely

than comparison clients to have detectable chlorine in stored water ($p<.001$) (O'Reilly et al., 2014). The intervention clients showed a staggeringly high uptake of water treatment with 40% testing positive for free chlorine residual in their household drinking water versus the comparison group at 1%(O'Reilly et al., 2014). In the same study, CDC researchers found that other factors associated with the inclusion of WASH in the basic care package such as the observation of soap at the household and a basic care package water container at each home visit, were also statistically significant for the intervention clients (O'Reilly et al., 2014). Intervention clients were also significantly less likely than comparison clients to report visiting a health care facility for illness ($p<.001$) or to report feeling ill ($p<.001$) (O'Reilly et al., 2014). In fact, 71-82% of intervention clients reported using water purification solution provided through the basic care package. Intervention clients had between 71-82%, with between 67-78% of household drinking water which tested positive for free chlorine residual. The comparison group reported water purification treatment and free chlorine residual less than 10% (O'Reilly et al., 2014).

The CDC study was the first to attempt to ascertain the health impacts of providing basic care packages to people living with HIV/AIDS. Results of the study suggests that recipients of basic care packages are more likely to have less visits to the health facility, fewer hospitalizations than comparable people living with HIV who did not receive the package. Those HIV positive clients also experienced lower illness scores derived from self-reported illness than the comparison group (O'Reilly et al., 2014).

In order to meet the needs of people living with HIV for whom clean water is crucial, an evidence-based intervention of a safe water system (SWS) which includes

water treatment and safe storage is included within the recommendations for the basic care package for people living with HIV.

HIV and Poverty

A study by Taraphdar et el., assessed the consequences of HIV/AIDS on socioeconomic status and identified that for a prolonged duration of the disease, there was a higher proportion of patients reporting for loss of employment, decrease in family income, higher expenditures for car and that the economic consequences caused families to sell assets to offset the economic effects of the illness (Taraphdar et al., 2011). Loss of employment was most highly reported due to illness and disclosure of sero-status and the stigma related to the disease. One of the most devastating aspects of HIV infection is not only the high mortality, but that deaths occur mainly in adults 25 and 45 years old, the very people who work to support their family and are typically during the most productive, income-generating years (Drimie, 2002). This has massive impacts on the economy of a country as well as at the household level. Taraphdar argues that to make redress for the economic strains associated with HIV/AIDS, the provision of care and support are required to curb stigma and maintain the social wellbeing of people living with HIV/AIDS. In the above mentioned study by Reilly et at., which assessed utilization of the basic care package, the author notably asserts that without free distribution, utilization of the basic care package, including water purification components, would have been lower because two-thirds of this population earned no income (O'Reilly et al., 2014). Providing free safe water systems to those affected by HIV/AIDS is one intervention which has the ability to reduce vulnerabilities in the population.

MATERIALS AND METHODS

In 2008, the Centers for Disease Control and Prevention (CDC) Atlanta and CDC-Ethiopia set out to evaluate the safe water programs serving people living with HIV in Ethiopia. The original goals of the study were to determine Safe Water System (SWS) utilization, observe hygiene behaviors and sanitation practices among this population and to measure the difference in SWS utilization following the distribution of basic care packages for people living with HIV. The data that was collected primarily captured knowledge, attitudes and practices of participants around the importance of WASH, including treatment of water, and included household observations of WASH practices. The original study's protocol for data collection was approved by the Ethiopian Ministry of Health.

Study Population

The original data collection methods described in the study protocol are as follows: Research staff enrolled 2,560 study participants in three categories: 1) patients over 18 or children with parental consent currently receiving antiretroviral treatment, 2) pre-antiretroviral treatment patients from the registers maintained at health facilities participating in the care and treatment programs, and 3) matched community members. The matched community members (comparison group) included adults and children not recruited from ART/pre-ART program treatment roster and living in the catchment area of the health facility of the selected ART and pre-ART clients. Community members were also age-matched to the ART and pre-ART clients and selected from the same administrative regions as the clients. Two persons in the ART group and two in the comparison group were excluded due to age matching issues. There were no

refusals. Study participants under the age of 18 (less than 5% of the study population) had a parent or adult caretaker respond to questions.

Community members selected for the evaluation who were not participants in the care and treatment program were age-matched to the ART and pre-ART clients and selected from the same administrative regions as the clients (CDC, 2009). It is important to note that due to the stigma of HIV in Ethiopia, matched community members were not asked about their HIV status. Therefore, the research findings of this study cannot be generalized to represent HIV positive versus HIV negative populations.

Geographical Distribution of Sample

All participants were selected from three administrative regions where Population Services International (PSI) strongly markets the WuhaAgar water disinfectant solution. The three regions include Amhara (population size 20,136,000), Oromia (population size 28,067,000) and the Southern Nations, Nationalities, and Peoples Region (SNNPR; population size 15,745,000)(CDC, 2009). While these three regions will not be representative of the country population, they do represent about 80 percent of the total country population.

Sample Size Calculations for Original Study

The original study protocol recommended a sample size of 640 ART and pre-ART clients and 640 matched community members based on a confidence level of 95%, power of 80%, and design effect of 4.0. The sample size calculations assumed that the confirmed WuhaAgar water purification solution utilization rate would be at 15% for ART clients in the treatment program, and 5% for the general population (CDC, 2009).

The sample size accounts for a retention rate of 50%, therefore a total of 1,280 individuals in the ART and pre-ART client group, and 1,280 matched community members was proposed in order to meet the target of 640 individuals per group (CDC, 2009).

Sample Recruitment and Data Collection

Participants who agreed to participate signed an informed-consent form and all participants were provided a bar of soap as thanks for their participation.

Study participants answered a survey of 122 items including questions about their demographic background, their behaviors around water purification, hygiene and access to sanitation. They were also asked about access to water purification resources, namely knowledge, attitude and practices around safe water. The full evaluation survey and household demographics worksheets may be found in the Appendix.

Data Storage and Analysis

The original research team at CDC shared the de-identified, stored data with the author of this thesis for the purpose of performing secondary data analysis (in October 2017). Quantitative survey data were stored in Stata. SAS 9.4 was used to perform statistical analysis through frequency and distribution calculations, tests of bivariate association (Pearson's χ^2, or Fisher's exact p-value when 20% or more cells have an expected count less than 5), and multivariate logistic regression at the 95% confidence level. Multivariate modeling was used to determine exposures that are independently associated with the outcome of free chlorine residual and to control for variables that cause confounding.

Outcome Variables

The primary outcomes are the detection of free chlorine residual, self-reported household water treatment, and observation of the water purification solution WuhaAgar in the household. Free chlorine residual was not measured according to chlorine test results only. Due to resource constraints and data collection methods, chlorine residual testing was performed only when a study participant reported treating their water. In order to avoid inflation of the percentage of positive chlorine residual, it was important to adjust the denominator to include those who did not report testing. The denominator included households where the participants self-reported treatment of water plus those that reported no treatment of water, (excluding participants that said they reported treatment of water but had no water available for testing).

The self-reported household water treatment variable included a question where participants were asked if they treat their water in any way to make it safer to drink. The response set included yes, no and I don't know. The respondents who answered I don't know were removed from the analysis.

For the observation of Wuha Agar, participants were initially asked if they have a bottle of WuhaAgar in their home at the moment. If respondents answered yes, the enumerator followed up with the question, "May I see it, please?" For those that had Wuha Agar present in their household, a bottle of the solution had to be observed by the enumerator at this time.

Ethics

For the original study, participants gave their free and informed consent to

participate in this study, and numeric study identifiers were used to ensure confidentiality of data. The study was approved by the institutional review boards of the Ethiopian Ministry of Health.

All collected data were de-identified and stored securely by research staff of the CDC Waterborne Disease and Prevention Branch prior to the analyses performed for this thesis. This study is a secondary data analysis of a de-identified database, rather than primary research involving human subjects.

RESULTS

Demographics

Survey data from 1590 households were collected in 20 catchment areas. The sample included 795 anti-retroviral treatment (ART) or pre-ART enrolled clients and 795 matched community members from the same healthcare facility area. Overall, the study population included 72.8% female, and 27.2% male. Since matching for ART and community members was based on age, the mean age was very similar for ART clients median age at 34.2 and community members at 33.4. The majority of the population was 18 years or older (96%). Nearly all participants surveyed (98%) reside in an urban setting. Table 1 below summarizes the demographic frequencies for this population.

Socioeconomic Indicators

Noticeable variance emerged on poverty characteristics between the two groups. Education and a dichotomous self-report variable of income were used to assess poverty and socioeconomic standing. A total of 38% of the total study population had a primary education or less, while 27.8% had no formal schooling. The ART clients accounted for 53% of those with no schooling, while 36.7% of the community members had no schooling. Within the study group, ART clients, 350 (44.0) had primary or less education while 292 (36.7) of the community members had primary or less (p=0.0031).

Further, of the 52% of the study population that reported no income, 63% are from the ART client group. In fact, 289 (36.7%) of the ART clients reported having an income compared to 439 (56.6%) of the community members (OR 2.247, 95% CI 1.834, 2.753, p<.0001; Table I). These data show a trend towards ART clients having lower levels of education and reported income. As a measure of poverty, household amenities

were also recorded. Of the 480 people that reported mobile phone ownership, 34% came from the ART group versus 65.8% community members, (OR 0.394, 95% CI 0.315, 0.492, p<.0001; Table I). As a measure of household assets, earth floor was considered as an indicator for socioeconomic status. The ART clients reported having an earth floor in their house, 78.1% (621) versus 32.0% (509) of community members (OR 2.005, 95% CI 1.606, 2.504, p<.0001; Table I). Overall, ART clients reported lower poverty levels in each of the education and socio-economic variables.

TABLE I. POPULATION DEMOGRAPHICS, N(%)

Variable		ART/Pre-ART Clients N=795	Community Control N=795	OR (95% CI)	p-value
Urban/Rural+					
Rural		9 (1.13)	15 (1.89)		
Urban		785 (98.8)	778 (98.1)		
Gender+					
Male		216 (27.1)	216 (27.1)		
Female		579 (72.8)	579 (72.8)		
Age+					
Child (less than 5 years old)*		11 (1.38)	11 (1.38)		
Child (5 years to less than 18 years old)*		16 (2.01)	18 (2.26)		
Adult (18 years old or older)		768 (96.6)	766 (96.3)		
Education					
Primary or less		350 (44.0)	292 (36.7)	1.355 (1.108, 1.656)	0.0031
Completed primary or higher		445 (55.9)	503 (63.2)		
Income					
No		497 (63.2)	336 (43.3)		
Yes		289 (36.7)	439 (56.6)	2.247 (1.834, 2.753)	<.0001
Household Assets					
Electricity		740 (93.0)	762 (95.8)	0.583 (0.374, 0.908)	0.0169
Mobile phone		164 (20.6)	316 (39.7)	0.394 (0.315, 0.492)	<.0001
Earth Floor		621 (78.1)	509 (64.0)	2.005 (1.606, 2.504)	<.0001

**Interviewed mothers in place of those 18 years or younger*

+Matching variables

++ Missing data for urban/rural: 3Missing data for Education: 3, Missing data for income: 29,

Bivariate Analysis

Water Sources and Latrine Coverage

Access to water, sanitation and hygiene infrastructure was similar between the two groups. Within the ART clients and matched community members, both receive their water piped into the yard (44% and 58% respectively). However, slightly more of the ART clients used a neighborhood pipe for water (26% versus 18%). Similarly, the majority of each group reports that there is water inside their compound for ART (45%) and community members (51%). The most common distance to retrieve water was fifteen minutes or less for the ART (40%) and community members (31%).

Of all study participants, 93.7% pay for their water, with 92% of ART clients paying for water and 95% of community members. Water storage was nearly identical between the two groups, with both reporting the use of narrow mouth, jerry cans (73% versus 74%).

To understand latrines access, study participants were asked what type of latrine was used by their family members at their house. This was to avoid reporting bias and the Hawthorne effect. The most prevalent latrine type between the two groups was a pit latrine without a slab which accounts for 39.5% of the study population, 41% from ART clients and 37% from community members. Important to note, significantly more ART clients reported their family members used no facility, bush or field, implying open defecation practices among 14% of the ART group, compared to 6% of the community members. This further supports the trend towards ART clients having lower socio-economic standing than their matched community members, most likely due to their HIV status.

TABLE II. WATER SOURCES AND LATRINE COVERAGE AMONG ANTIRETROVIRAL TREATMENT CLIENTS AND MATCHED COMMUNITY MEMBERS IN ETHIOPIA IN 2008

Variable	ART Client N (%)	Community Control N (%)	OR (95% CI)	p-value
Drinking Water Source:				
Improved Source	785 (98.75)	781 (98.24)	1.407 (0.621, 3.187)	0.4129
Unimproved Source	10 (1.26)	14 (1.76)		
Time to water:				
Less than 15 minutes	319 (40.13)	247 (31.07)	N/A	N/A
15-29 minutes	73 (9.18)	88 (11.07)		
30-59 minutes	27 (3.40)	44 (11.07)		
1-3 hours	15 (1.89)	7 (.88)		
Greater than 3 hours	1 (.13)	3 (.38)		
Water is inside my compound	360 (45.28)	406 (51.07)		
Pay for water: *				
No	63 (7.93)	36 (4.53)		
Yes	731 (92.07)	759 (95.47)	0.550 (0.361, 0.839)	0.0055
Latrine type by family members: *+				
Improved	343 (43.14)	357 (44.91)	N/A	N/A
Unimproved	452 (56.86)	438 (55.09)		
Water Storage: *				
Improved	597 (75.09)	603 (75.85)	0.960 (0.764, 1.207)	0.7266
Unimproved	198 (24.91)	192 (24.15)		

*Pay for water missing 1; Latrine type missing 96; Water storage missing 209
+Insufficient data to classify

As expressed in Table III, the self-reported treatment of water was significantly higher in the ART group (40.5%) versus the community members (16.5%) (OR 3.443, 95% CI, 2.721, 4.356, p<.0001; Table III) . Similarly, the observation of Wuha Agar was 20% among the ART group versus 2.4% among community members (OR 7.519, 95% CI 4.939, 11.445, p<.0001; Table III). Oral Rehydration Salts (ORS), a commonly used supplement for rehydration was significantly more likely to be observed at the ART clients' houses (28%) when compared to community members (7.7%) (OR 4.707, 95% CI

2.750, 8.057, p<.0001; Table III). The observation of soap showed that 77% of ART clients had soap in the house compared to 89% of community members, making community members significantly more likely to have soap in their household (OR 0.412, 95% CI 0.311, 0.547, p<.0001; Table III).

TABLE III. WATER, SANITATION AND HYGIENE CHARACTERISTS WITHIN HOUSEHOLDS IN ETHIOPIA, 2008

Variable	ART Client N (%)	Community Control N (%)	cOR (95% CI)	*p-value*
Treat water				
No	469 (59.44)	661 (83.46)		
Yes	320 (40.56)	131 (16.54)	3.443 (2.721, 4.356)	<.0001
Received healthy living kit?				
No	747 (94.08)	771 (97.59)		
Yes	47 (5.92)	19 (2.41)	2.553 (1.484, 4.391)	.0007
Wuha present at Household				
Absent	628 (79.09)	768 (96.60)		
Present	166 (20.91)	27 (3.40)	7.519 (4.939, 11.445)	<.0001
Oral Rehydration Salts (ORS)				
Absent	236 (71.73)	215 (92.27)		
Present	93 (28.27)	18 (7.73)	4.707 (2.750, 8.057)	<.0001
Soap present at Household				
Absent	175 (22.32)	83 (10.59)		
Present	609 (77.68)	701 (89.41)	0.412 (0.311, 0.547)	<.0001

*Treat water missing 9, Chlorine residual missing 1419, Received health kit missing 6, Wuha present: 1 missing, ORS missing 1028, soap missing 22.

Overall, the ART enrolled clients trended towards having more knowledge around water, sanitation and hygiene indicators. As presented in Table IV, 49% of clients reported hearing messages about preventing diarrhea in the past six months compared to 39% of community members (OR = 0.6681, 95% CI 0.5476, 0.8150). A total of 490 (61.7%) of ART clients reported receiving information about how to treat water in the past six-months, compared to 395 (49.6%) of the community members (p=<.0001; Table IV). Forty percent of ART enrolled clients reported that they treat their water to make it safer to drink. This is markedly higher than the sixteen percent of the community members (p=<.0001; Table IV).

Nearly twenty-eight percent of the ART clients reported receiving Wuha Agar for water purification from a hospital, clinic or NGO for free (p=<.0001; Table IV). This is compared to only two percent of the matched community members

TABLE IV. DIARRHEA AND WATER TREATMENT KNOWLEDGE AMONG STUDY PARTICIPANTS (N=1590) BY ANTIRETROVIRAL TREATMENT CLIENTS (N=795) AND MATCHED COMMUNITY MEMBERS (N=795) IN ETHIOPIA IN 2008, N(%)

Variable	ART/Pre-ART Client	Community Control	OR (95% CI)	*p*-value
Heard messages about preventing diarrhea in the past six months?	395 (49.69)	316 (39.75)	1.497 (1.227, 1.826)	<.0001
Received information about how to treat drinking water in the past six months? *	490 (61.71)	395 (49.69)	1.632 (1.337, 1.993)	<.0001
Treat your water in any way to make it safer to drink?	320 (40.56)	131 (16.54)	3.443 (2.721, 4.356)	<.0001
Heard of Wuha Agar?	636 (80.00)	599 (75.54)	1.295 (1.022, 1.643)	0.0327
Received Wuha Agar for free from a hospital, clinic or from an NGO?	213 (26.79)	19 (2.41)	14.832 (9.164, 24.004)	<.0001
Received a Healthy Living Kit for free from a hospital, clinic or from an NGO?	47 (5.92)	19 (2.41)	2.553 (1.484, 4.391)	0.0007
Where to buy Wuha Agar?	208 (26.16)	214 (26.95)	0.960 (0.769, 1.200)	0.7219

*Received information missing 1; Treat water missing: 9; Heard of Wuha Agar missing: 2; Received Wuha Agar free missing: 6; Received healthy living kit missing: 6; Where to buy Wuha Agar missing:1

STRATIFICATION BY RECRUITMENT HEALTHCARE FACILITY

Demonstrated in Table V, notable disparities in water treatment outcomes were present between the ART clients and community members when stratified by the healthcare facility they were recruited from.

Four of the healthcare facilities (20%) have over 50% of ART clients reporting treatment of water, while seven have less than 20% reporting treatment. This signifies a

lack in programming for WASH and likely points towards a gap in counseling on water treatment for people living with HIV.

Of the seven health facilities that had less than 20% of ART clients reporting treatment of water, five (71%) had Wuha Agar present in their households. As expected, chlorine residual was drastically lower in those facilities that had fewer reported clients who treated their water, since chlorine residual was only tested among those who reported treatment.

The observation of soap and more specifically cotrimoxazole in the household was used as a proxy to determine how many of the community members were also enrolled in ART programs (since this was not assessed in the recruitment process). By every healthcare facility, soap was found at a higher frequency in the homes of community members than ART clients, which further supports the trend towards ART clients having lower socio-economic standing and not able to purchase monthly household items. Cotrimoxazole is a strong predictor for ART enrollment since it is an antibiotic used to prevent opportunistic infections and is oftentimes provided in the most basic care packages for those living with HIV (usually more common than water treatment systems)(Penfold et al., 2014). Between 48% and 89% of all ART clients at health facilities had (observed) cotrimoxizole at their household. This is compared to between 2% and 30% of community members with observable cotrimoxazole in their home.

Since the dataset does not include which health facilities formally implemented a basic care package to ART clients, this analysis cannot extrapolate basic care utilization directly correlated to participants receiving ART care.

TABLE V. BASIC CARE PACKAGE COMPONENTS STRATIFIED BY RECRUITMENT HEALTHCARE FACILITY

Health Facility	N	Self-Report Water Treatment		Presence of WuhaAgar at HH		Chlorine Residual Detected at HH		Soap Present		Co-trimoxazole Present in HH	
		ART/Pre-ART client	Community Members	ART/Pre-ART client	Community Members	ART/Pre-ART client	Community Members	ART/Pre-ART client	Community Members	ART/Pre-ART client	Community Members
HCF A (1001)	282	79 (56.83)	17 (12.06)	66 (46.81)	3 (2.13)	24 (48.98)	2 (100)	115 (81.56)	133 (95.00)	122 (86.52)	21 (14.89)
HCF B (1003)	72	14 (41.18)	9 (25.71)	2 (5.56)	1 (2.78)	1 (50.00)	1 (100)	26 (72.22)	29 (80.56)	18 (50.00)	1 (2.78)
HCF C (1005)	66	11 (33.33)	2 (6.06)	8 (24.24)	1 (3.03)	4 (66.67)	0	26 (78.79)	30 (90.91)	16 (48.48)	1 (3.03)
HCF E (1011)	54	4 (14.81)	2 (7.41)	0	1 (3.70)	0	0	21 (77.78)	24 (88.89)	24 (88.89)	2 (7.41)
HCF F (1017)	36	2 (11.11)	4 (22.22)	0	0			13 (72.22)	18 (100)	14 (77.78)	2 (11.11)
HCF G (1024)	72	23 (63.89)	7 (19.44)	11 (30.56)	3 (8.33)	8 (80.00)	2 (66.67)	25 (69.44)	31 (86.11)	32 (88.89)	1 (2.78)
HCF H (1027)	24	3 (25.00)	1 (8.33)	2 (16.67)	1 (8.33)	0	0	10 (83.33)	12 (100)	7 (58.33)	1 (8.33)
HCF I (1065)	28	7 (50.00)	2 (14.29)	6 (42.86)	1 (7.14)	1 (33.33)	0	9 (64.29)	11 (78.57)	8 (57.14)	2 (14.29)
HCF J (2001)	58	2 (6.90)	4 (13.79)	1 (3.45)	1 (3.45)			23 (82.14)	26 (92.86)	24 (82.76)	0
HCF K (2002)	28	0	1 (7.69)	0	0			11 (78.57)	12 (85.71)	8 (57.14)	2 (14.29)
HCF L (2007)	32	5 (31.25)	8 (50.00)	2 (12.50)	4 (25.00)	1 (50.00)	1 (25.00)	12 (75.00)	15 (93.75)	9 (56.25)	1 (6.25)
HCF M (3005)	46	9 (40.91)	6 (26.09)	8 (34.78)	0 out of 23	2 (25.00)	0	23 (100)	23 (100)	15 (65.22)	0
HCF N (3006)	88	4 (9.09)	3 (6.98)	2 (4.65)	1 (2.27)	0	0	26 (72.22)	27 (75.00)	30 (69.77)	0
HCF O (3010)	36	1 (5.56)	3 (16.67)	0	0			9 (50.00)	12 (66.67)	12 (66.67)	1 (6.25)
HCF P (3017)	122	13 (21.31)	6 (9.84)	3 (4.92)	1 (1.64)	1 (33.33)	0	48 (78.69)	55 (90.16)	30 (49.18)	4 (6.56)
HCF Q (3027)	26	0	1 (7.69)	2 (15.38)	1 (7.69)			7 (58.33)	7 (58.33)	11 (84.62)	0
HCF R (3037)	254	89 (70.63)	17 (13.39)	44 (34.65)	6 (4.72)	7 (46.67)	0	111 (88.10)	118 (92.91)	103 (81.10)	5 (3.94)
HCF S (3040)	154	36 (46.75)	21 (27.27)	5 (6.49)	1 (1.30)	3 (60.00)	0	56 (72.73)	72 (93.51)	47 (61.04)	7 (9.09)
HCF T (3046)	80	12 (30.00)	13 (32.50)	4 (10.00)	1 (2.50)	3 (75.00)	0	26 (65.00)	32 (80.00)	26 (65.00)	6 (15.00)
HCF U (3050)	32	6 (37.50)	4 (25.00)	0	0			12 (75.00)	14 (87.50)	12 (75.00)	6 (31.25)

Logistic Regression

Three logistic regression models were created to understand if people formally enrolled in ART programs with free access to water purification solutions engage in water treatment differently than community members who do not have this access. The models are presented step-by-step with each model including a different outcome of interest. The first model outcome is self-reported treatment of water, the second is presence of Wuha Agar in the household and the third is chlorine residual detected in the household drinking water.

Self-Reported Treatment of Water

Of the ART clients, 289 of 755 (37.8%) reported treatment of water compared to 126 of 785 (15.8%) community members. Multivariate analyses reveal that ART clients formally enrolled in an ART program were significantly more likely to self-report treatment of water than community members (cOR 3.251, 95% CI 2.553, 4.139, p<.0001; Table VI). Controlling for education, income and sex, the direction of the association did not change (aOR 3.391, 95% CI 2.637, 4.364, p<.0001; Table VI).

TABLE VI. MODELING SELF-REPORTED TREATMENT OF WATER AMONG ART CLIENTS AND COMMUNITY MEMBERS IN ETHIOPIA, 2008

		Unadjusted (Bivariate)			Adjusted (Multivariate)		
Factors	N	OR	95% CI	*p*	OR	95% CI	*p-value*
CACO	1540	3.251	(2.553, 4.139)	<.0001*	3.391	2.637, 4.364	<.0001*

*significant
ϕ Model controls for education, income, and sex

$$\textit{Self-Reported Treatment of Water} = \beta_1 + \beta_2 \textit{ART Clients} + \beta_3 \textit{Education level} + \beta_4 \textit{Income} + \beta_5 \textit{Sex} + \varepsilon_{it}$$

To better account for possible social desirability bias, the data was stratified by those who reported treatment of water and also had chlorine residual detected in their drinking water. Of the 289 ART clients that reported treatment of water, 55 (19%) tested positive for chlorine residual. Of the community members, 126 reported treatment and 6 (4.7%) tested positive for chlorine residual (OR 10.196, 95% CI (4.364, 23.823), p<.0001; Table VII). Therefore, significantly more ART clients reported treating their drinking water and had chlorine residual detected.

TABLE VII: SELF-REPORTED TREATMENT OF WATER AND FREE CHLORINE RESIDUAL IN DRINKING WATER AMONG ART CLIENTS AND COMMUNITY MEMBERS IN ETHIOPIA, 2008; N(%)

Variable	ART Clients	Community Members	OR (95% CI)	p-value
Self-Reported Treatment and Free Chlorine Residual Detected	55 (7.28)	6 (0.76)	10.196 (4.364, 23.823)	<.0001

Observation of Wuha Agar in the Household

The variance between the observation of Wuha Agar between the ART clients and matched community members denotes a significant difference in water treatment practices. Of the 794 ART clients, 166 (20.9%) had Wuha Agar observed in their house compared to (27) 3.4% of the community members (cOR 7.519, 95% CI 4.939, 11.445, p<.0001; Table VIII). After controlling for education, income and sex, the association continues in the same direction with little deviation (aOR 7.395, 95% CI 4.827, 11.328, p<.0001; Table VIII).

TABLE VIII. PRESENCE OF WUHA AGAR IN HOUSEHOLDS AMONG ART CLIENTS AND COMMUNITY MEMBERS

		Unadjusted (Bivariate)			Adjusted (Multivariate)		
Factors	N	OR	95% CI	*p*	OR	95% CI	*p-value*
CACO	1548	7.519	(4.939, 11.445)	<.0001*	7.395	4.827, 11.328	<.0001*

*significant
ϕ Model controls for education, income, and sex

$$Wuha\ Agar\ Present\ at\ Household = \beta_1 + \beta_2 ART\ Clients + \beta_3 Education\ level + \beta_4 Income + \beta_5 Sex + \varepsilon_{it}$$

Free Chlorine Residual Detection

The crude study observations for chlorine residual detection among ART clients 55 (37.16%) and community members 6 (26.09%) were not significant at a .005 level. This variable could potentially skew the data so a new variable was created with the intention of more accurately depicting the presence of chlorine residual (Table X). This was explained in the methods section of this paper. The new chlorine residual variable has significantly fewer study participants with only 61 meeting the criteria for inclusion. The new chlorine residual data shows a significant difference between ART clients and matched community members detection of free chlorine residual (OR 10.149, 95% CI 4.344, 23.711, p<.0001; Table XI). Controlling for education, income and sex, the association does not change (aOR 10.735, 95% CI 4.560, 25.270; p<.0001; Table XI), indicating that utilization of water treatment programs is more likely among ART clients, when accounting for income, education level and sex. However, this data is extremely small with only 61 study participants, so it is unable to determine significance beyond this study.

TABLE X: ORIGINAL CHLORINE RESIDUAL VARIABLE AND NEW CHLORINE RESIDUAL VARIABLE

Variable	ART Clients N (%)	Community Members N (%)	p-value
Original Free Chlorine Residual Detected	55 (37.16)	6 (26.09)	0.5836
Adjusted Free Chlorine Residual Detected	55 (7.23)	6 (.76)	<.0001

TABLE XI. FREE CHLORINE RESIDUAL DETECTED AMONG ART CLIENTS VS. COMMUNITY MEMBERS IN ETHIOPIA, 2008

		Unadjusted (Bivariate)			Adjusted (Multivariate)		
Factors	N	OR	95% CI	*p*	OR	95% CI	*p-value*
CACO	1549	10.149	(4.344, 23.711)	<.0001*	10.735	(4.560, 25.270)	<.0001*

*significant

ϕ Model controls for education, income, and sex

Model 3

$$Free\ Chlorine\ Residual_t = \beta_1 + \beta_2 ART\ Clients + \beta_3 Education\ level + \beta_4 Income + \beta_5 Sex + \varepsilon_{it}$$

DISCUSSION AND RECOMMENDATIONS

Discussion

Results of this study suggest people living with HIV/AIDS and enrolled in a formal ART/pre-ART treatment program are more likely to self-report treatment of their water; have Wuha Agar present in their household; and have a positive test for free chlorine residual in their drinking water, controlling for education, income and sex. Despite this population being more likely to be unemployed, less educated with a lower socio-economic status, the ART clients had significantly better outcomes of water treatment then their matched community members. Several possible reasons for this outcome include the effective provision of a basic care package with WASH programming from a healthcare facility or NGO and effective counseling on the importance of clean water for persons living with HIV/AIDS.

Self-Reported Treatment of Water

Self-reported treatment of drinking water appeared to be significantly higher among ART clients than community members. This finding could be explained by the nature of the PEPFAR HIV support provided to most clients. Counseling on the role of safe water in the lives of people living with HIV/AIDS is part of the package of interventions patients receive and is considered important in bolstering the quality of life and reducing morbidity and mortality from opportunistic enteric infections among this population. Counseling on the impact of safe water creates awareness of enteric infections in unsafe water and potentially encourages behavior change among this population. Of note, although these results suggest that knowledge and understanding of safe water were significantly higher in ART clients than community members, the effect

was not seen in the majority of the ART clients, considering that only 40.5% reported treatment of water.

While these finding were statistically significant and show evidence of ART clients reporting treatment of their water source, the results could be skewed by response bias or the tendency for respondents to provide survey answers that are socially acceptable or possibly misleading. Given that this data was collected through in-person interviews, it is important to account for this type of social desirability bias (and possible other biases related to survey interviews). Since the discrepancy between self-report and chlorine detection is oftentimes significant, this understanding of potential bias is crucial for programs that hope to survey HIV populations on their knowledge and practices around water treatment. Rather than simply asking study participants about their water treatment behaviors, it may be more accurate for investigators to test for free chlorine residual.

Wuha Agar Present in Household and Chlorine Residual

In Ethiopia, where access to safe water is around 76% in urban areas and as low as 20% in rural areas, procurement of a water treatment solution is paramount to preventing enteric infections (CDC, 2009). Given that 40.56% of ART clients self-reported treatment of water, this may indicate that many know and understand benefits of water treatment. Unfortunately, only 20.9% of them had Wuha Agar present in their household, which was an important prerequisite for water purification. This finding could be due to barriers, financial or otherwise, that prevent households from obtaining the solution. While this study does not have data to support the question of why some people

report treatment but do not have the treatment solution to do so within their home, it is critical to understand the barriers to access that may exist.

Conversely, by lowering potential barriers of accessing Wuha Agar and other water purification treatments, we would expect an increase in chlorine residual found among the population. For example, because 37.16% of the ART clients had chlorine residual detected in their households, it is possible to hypothesize that higher rates of chlorine residual detection would be found if more people had access to Wuha Agar. Lowering barriers to water treatment solution access is a consistent theme in the study by O'Reilly et al., 2014. In this study, the free provision of a basic care package with a WASH component in Ethiopia had high levels of utilization and the ability to significantly prevent diarrhea (O'Reilly et al., 2014).

By providing free safe water systems to people living with HIV, it is also possible to mitigate other health and economic impacts that affect this population. In terms of economic impacts, as HIV progresses, this oftentimes leads to the population falling out of the workforce and no longer having sustainable income. In this present study, 62.3% of ART clients were unemployed with low economic status. This financial situation can have detrimental effects on access to safe water and a person's ability to pay for water. The financial burden of paying for water may become more difficult the longer a person is unemployed and without the provision of a free water purification solution.

In terms of health outcomes, diarrhea among this population can lead to malabsorption of key nutrients and have detrimental effects on the health status of people living with HIV. In a study by Peletz et al., research shows that diarrheal disease may lead to intestinal malabsorption and cause people living with HIV on ART to not acquire the essential nutrients and proper dosages of medications, therefore putting them at risk

of progressing into AIDS more quickly (Peletz et al., 2012). By providing free water treatment programs to people living with HIV/AIDS, it is possible to lower the financial, physical and health burdens associated with the infection.

Healthcare Facility Recruitment

The gap between theoretical HIV/AIDS programming and the realities on the local level must be addressed. Although the safe water system is included in the recommended basic care package for people living with HIV, this water treatment tool is oftentimes not available at the health facility level for this population. A study by Penfold et al., showed that in a mixed methods evaluation of 120 PEPFAR-funded health facilities in Kenya and Uganda, the full care package was offered 14% of the time. While there is evidence of the cost-effective benefits of water treatment solutions within the PEPFAR program, these solutions are rarely fully implemented, often due to coordination and logistical issues (Mermin et al., 2005).

The findings from the present study suggest that ART clients did not receive uniform access to the basic care package across the twenty recruitment healthcare facilities. The discrepancies between the healthcare facilities in regard to the basic care package components echo the Penfold et al. findings which indicate that not all ART clients are receiving a *full* basic care package within the HIV care. This is most likely the product of some health facilities having support from PEPFAR. The second reason could be due to some health care facilities having outside funding sources from NGOs. Therefore, it is expected that healthcare facilities that had external support to provide a basic care package to their ART clients would have higher levels reports of water treatment, presence of Wuha Agar in the household, and positive chlorine residual in the

household. Unfortunately, this study data does not inform which health facilities had PEFAR or external basic care packages programing and which did not. More research must be done to identify the gaps and better understand the availability of the full contents of the basic care package for those enrolled in an ART program. In order to better serve those with HIV, it is crucial that PEPFAR programs address the logistical necessities that the adequate provision requires. It is not enough to say that water treatment is included in the basic care package, if the full package is rarely implemented.

Improved water source

An improved water source was observed among 98% of all study participants. This was likely due to the fact that the data was collected almost exclusively among urban populations. While it is notable to have such high coverage for water, not all improved water sources are safe and without the need for purification. Although it was beyond the scope of this research, it would have been interesting to have tested for E. coli in the improved water source to understand the water safety of the population.

Recommendations

The dynamics of providing holistic care for people living with HIV span from the provision of antiretroviral drugs, insecticide treated bed nets, to safe water systems. In order to effectively provide water treatment solutions to people living with HIV/AIDS, they must be provided for free within a care package. The availability of water solutions within the community is not enough to combat the major financial barriers that could inhibit utilization. Although the international aid community is moving away from the provision of free distribution of goods, the community of people living with HIV are a

unique population that arguably are significantly impacted by poverty and an inability to pay for water treatment.

In health facilities that can provide the basic care package, it is important to evaluate the logistics and supply chain to ensure water treatment can be provided on a regular basis to those who utilize it. As addressed earlier, basic care packages are too often the ideal, and do not reach the people they intend to serve because proper evaluation of logistics and supply chains is lacking.

LIMITATIONS AND CONCLUSIONS

Limitations

This evaluation had several important limitations. First, community members were not asked their HIV status or enrollment status in an ART program, so it is likely that some of the community members are also enrolled in the ART program. The data attempts to ascertain the percentage of community members enrolled in ART programs by stratifying study participants by recruitment healthcare facilities to determine the prevalence of basic care package components at community members' households. Using this measure, about two percent of the community members were enrolled in ART programs. Therefore, this data cannot conclusively speak to whether or not HIV positive populations in Ethiopia are more likely to treat their water.

Second, data collection did not specify which healthcare facilities received assistance from PEPFAR or outside NGO's for HIV programming, therefore programming sites are postulated using proxy variables such as presence of co-trimoxazole and ORS.

Third, the survey was designed with a binary positive or negative variable for the chlorine data. This coding could potentially skew data or highlight a misunderstanding of how to properly treat water. For example, it is possible that some people reported treating their water but when the water was tested the chlorine residual was not detected at a level high enough to be classified as treated. When testing for chlorine residual, it is important to record actual levels of chlorine (vs. binary positive or negative detection) in order to adjust for this issue.

The detection of free chlorine residual is the most accurate test to understand utilization of water treatment systems. However, this was difficult to ascertain due to several factors. First, only study participants that reported treatment of water were eligible to have their water tested. This resulted in 410 participants eligible for water testing. Of those, only 130 actually had their water tested, potentially due to time constraints of the enumerators. None of the study participants refused to have their water tested and 44 did not have water available in the household for testing. Given these constraints, treatment of water could not be fully determined from the data.

Fourth, the data was collected from primarily urban health care facilities which makes this information not generalizable for the wider Ethiopia population. Also, data was not collection to determine which health facilities were already implementing the basic care package. This data would have lent itself to provide information on utilization of free basic care packages and better inform programing on the subject.

Conclusion

Water, sanitation and hygiene interventions are effective in reducing the burden of opportunistic enteric infections in people living with HIV/AIDS. Lowering the barriers to access and providing water treatment solutions for free in a basic care package to those enrolled in an ART program is one way to increase the quality of life of those affected by HIV/AIDS and their family members. Within this study, ART clients with access to water treatment systems were significantly more likely to self-report treatment, have the solution present at their house, and to have their drinking water test positive for free chlorine residual. Research on the utilization of WASH interventions for people living

with HIV/AIDS in necessary to advocate for the inclusion of water treatment systems in basic care packages (Yates et al., 2015).

Currently more research is needed on the uptake of basic care package components, to identify the role free distribution plays in the usage of such tools. Moreover, further research focusing on the availability of basic care package components at PEPFAR-funded healthcare facilities. In order to strengthen systems, health facilities should be evaluated on their ability to provide full basic care packages in order to understand the impact on the livelihood of those living with HIV/AIDS.

Water treatment has the ability to significant reduce morbidity and mortality among people living with HIV and the cost-effective solution can help to lower the barriers of access to these tools.

References

Barnhart, S. PEPFAR: is 90-90-90 magical thinking? *The Lancet, 387*(10022), 943-944. doi:10.1016/S0140-6736(16)00570-5

Brink, A. K., Mahé, C., Watera, C., Lugada, E., Gilks, C., Whitworth, J., & French, N. (2002). Diarrhoea, CD4 Counts and Enteric Infections in a Community-Based Cohort of HIV-Infected Adults in Uganda. *Journal of Infection, 45*(2), 99-106. doi:https://doi.org/10.1053/jinf.2002.1002

CDC. (2009). *Evaluation of Safe Water Programs Serving People Living with HIV/AIDS in Ethiopia*

. Ethiopian Science and Technology Agency Protocol # IERC 0030. Unpublished. Centers for Disease Control and Prevention.

Colindres, R., Mermin, J., Ezati, E., Kambabazi, S., Buyungo, P., Sekabembe, L., . . . Quick, R. (2008). Utilization of a basic care and prevention package by HIV-infected persons in Uganda. *AIDS Care, 20*(2), 139-145. doi:10.1080/09540120701506804

Drimie, S. (2002). The Impact of HIV/AIDS on Rural Households and Land Issues in Southern and Eastern Africa. *Food and Agriculture Organization of the UN*.

Luba, T. R., Feng, Z., Gebremedhin, S. A., Erena, A. N., Nasser, A. M., Bishwajit, G., & Tang, S. (2017). Knowledge about mother-to-child transmission of HIV, its prevention and associated factors among Ethiopian women. *J Glob Health, 7*(2), 020414. doi:10.7189/jogh.07.020414

Lule, J. R. (2005). Effect of Home-Based Water Chlorination and Safe Water Storage on Diarrhea Among Persons Living with Human Immunodeficiency Virus in Uganda. *American Journal of Tropical Medicine and Hygiene*.

Lule, J. R., MERMIN, J., AWOR, A., HUGHES, P., KIGOZI, A., WAFULA, W., . . . QUICK, R. (2009). Aetiology of Diarrhea Among Persons With HIV and Their Family Members in Rural Uganda: A Community-Based Study. *EAST AFRICAN MEDICAL JOURNAL, Volume 86*.

Mermin, J., Bunnell, R., Lule, J., Opio, A., Gibbons, A., Dybul, M., & Kaplan, J. (2005). Developing an evidence-based, preventive care package for persons with HIV in Africa. *Tropical Medicine & International Health, 10*(10), 961-970. doi:doi:10.1111/j.1365-3156.2005.01488.x

O'Reilly, C. E., Taylor, E. V., Ayers, T., Fantu, R., Abayneh, S. A., Marston, B., . . . Quick, R. (2014). Improved Health among People Living with HIV/AIDS Who Received Packages of Proven Preventive Health Interventions, Amhara, Ethiopia. *PLoS One, Volume 9 |*.

Peletz, R., Simunyama, M., Sarenje, K., Baisley, K., Filteau, S., Kelly, P., & Clasen, T. (2012). Assessing Water Filtration and Safe Storage in Households with Young Children of HIV-Positive Mothers: A Randomized, Controlled Trial in Zambia. *PLoS One, Volume 7*.

Penfold, S., Simms, V., Downing, J., Powell, R. A., Mwangi-Powell, F., Namisango, E., . . . Harding, R. (2014). The HIV basic care package: where is it available and who receives it? Findings from a mixed methods evaluation in Kenya and Uganda. *AIDS Care, 26*(9), 1155-1163. doi:10.1080/09540121.2014.882489

PEPFAR. (2018). About Us: PEPFAR.
Seremet, C. (2010). Water, Sanitation and Hygiene Considerations in Home-Based Care for People Living with HIV. *Catholic Relief Services*.
Taraphdar, P., Guha, R. T., Haldar, D., Chatterjee, A., Dasgupta, A., Saha, B., & Mallik, S. (2011). Socioeconomic consequences of HIV/AIDS in the family system. *Nigerian Medical Journal : Journal of the Nigeria Medical Association, 52*(4), 250-253. doi:10.4103/0300-1652.93798
USAID. (2009). Integrating Hygiene Improvement into HIV/AIDS Programming to Reduce Diarrhea.
USAID. (2015). The impact of water, sanitation, and hygiene interventions on the health and well-being of people living with HIV: a systematic review. *PEPFAR*.
USAID. (2017). Five-Year Strategy: The U.S. President's Emergency Plan for AIDS Relief. *PEPFAR*.
Voelker, R. (2010). One casualty of global economic crisis: Uncertain finances for hiv/aids programs. *JAMA, 304*(3), 259-261. doi:10.1001/jama.2010.962
Yates, T., Lantagne, D., Mintz, E., & Quick, R. (2015). The Impact of Water, Sanitation, and Hygiene Interventions on the Health and Well-Being of People Living With HIV: A Systematic Review. *Wolters Kluwer Health, Inc, Volume 68*.

Appendix: Data collection instruments from original study

Part A: Household Identification Worksheet for Pre-ART and ART Clients

Part B: Household Identification Worksheet for Community Members

Part C: Full survey

APPENDIX Part A

Household Identification Worksheet for Pre-ART and ART Clients

TODAY'S DATE	☐☐/☐☐☐/☐☐☐☐ *(Day / Month / Year)*
REGION	Amhara……1 Oromia ……2 SNNPR……3
HEALTH FACILITY NAME	
HEALTH FACILITY NUMBER	☐☐☐☐☐
TYPE OF FACILITY	Hospital ……1 Health Center ……2 Other (specify)_____ ..…9
CLIENT NAME	
IS THE CLIENT CURRENTLY A PRE-ART OR ART CLIENT?	Pre-ART Client……..1 ART Client ……2
CLIENTS STUDY NUMBER	☐☐☐☐☐☐
If on ART, UNIQUE ART NUMBER	
AGE GROUP	Child (less than 5 years old)……1 Child (5 years to less than 18 years old)…....2 Adult (18 years old or older)……...3

Kebele number: _____

Name of city, town, village: _____

Name of Head of Household:

_____

Directions to household:

_____

_____

_____

_____

Date of 1st visit: __ __/__ __ __ /__ __ __ __ Time of 1st visit: __ __:__ __
Day Month Year *24 hour clock*

Date of 2nd visit: __ __/__ __ __ /__ __ __ __ Time of 2nd visit: __ __:__ __
Day Month Year *24 hour clock*

Date of 3rd visit: __ __/__ __ __/__ __ __ __ Time of 3rd visit: __ __:__ __
Day Month Year *24 hour clock*

Outcome of the household visits: *(Circle one)*
Questionnaire completed..... 1
Refused 2
Died..... 3
Respondent not present after three visits..... 4
House not occupied..... 5
Could not locate the house 6
Other (specify) _____ 7

Interviewer's Name _____ | | | | *Staff code*

*Supervisor's Name*_____ | | | | *Staff code* | | *Day* | | | | *Month* | 2 | 0 | | | *Year*

APPENDIX Part B

Household Identification Worksheet for Community Members

TODAY'S DATE	☐☐/☐☐☐/☐☐☐☐ *(Day / Month / Year)*
REGION	Amhara……1 Oromia……2 SNNPR……3
HEALTH FACILITY NAME	
HEALTH FACILITY NUMBER	☐☐☐☐☐
TYPE OF FACILITY	Hospital ……1 Health Center ……2 Other (specify)_____ ..…9
COMMUNITY MEMBERS NAME	
COMMUNITY MEMBERS STUDY NUMBER	☐☐☐☐☐☐
AGE GROUP	Child (less than 5 years old)……1 Child (5 years to less than 18 years old)…....2 Adult (18 years old or older)……...3

Kebele number: _____

Name of city, town, village: _____

Name of Head of Household:
_____

Directions to household:
_____
_____
_____
_____

Date of 1st visit: __ __/__ __ __ /__ __ __ __ Time of 1st visit: __ __:__ __
Day Month Year *24 hour clock*

Date of 2nd visit: __ __/__ __ __ /__ __ __ __ Time of 2nd visit: __ __:__ __
Day Month Year *24 hour clock*

Date of 3rd visit: __ __/__ __ __/__ __ __ __ Time of 3rd visit: __ __:__ __
Day Month Year *24 hour clock*

Outcome of the household visits: *(Circle one)*
Questionnaire completed..... 1
Refused 2
Died..... 3
Respondent not present after three visits..... 4
House not occupied..... 5
Could not locate the house 6
Other (specify) _____ 7

Interviewer's Name _____ | | | |
Staff code

*Supervisor's Name*_____ | | | | | | | | | | | | | |
Staff code *Day* *Month* *Year*

APPENDIX Part C

Evaluation Questionnaire

Who is being interviewed? *(Circle one only)*

Pre-ART or ART client……...…1 *(proceed to section A1.)*
Member of the community…….2 *(proceed to section A2.)*

A1. EVALUATION TRACKING INFORMATION

Please fill this section if the person to be interviewed is enrolled in the pre-ART or ART Care and Treatment Program at the Health Facility, otherwise leave blank.

Q1	**TODAY'S DATE**	☐☐/☐☐☐/☐☐☐☐ *(Day / Month / Year)*
Q2	**REGION**	Amhara……1 Oromia ……2 SNNPR……3
Q3a	**HEALTH FACILITY NAME**	
Q3b	**HEALTH FACILITY NUMBER**	☐☐☐☐☐
Q3c	**TYPE OF FACILITY**	Hospital ……1 Health Center ……2 Other (specify)_____ ..…9
Q4a	**CLIENT NAME**	
Q4b	**IS THE CLIENT CURRENTLY A PRE-ART OR ART CLIENT?**	Pre-ART Client……..1 ART Client ……2
Q4c	**CLIENTS STUDY NUMBER**	☐☐☐☐☐☐
Q4d	**PRE-ART REGISTER NUMBER**	
Q4e	**If on ART, UNIQUE ART NUMBER**	
Q4f	**AGE GROUP**	Child (less than 5 years old)……1 Child (5 years to less than 18 years old)…....2 Adult (18 years old or older)……...3
Q4g	**PARTICIPANTS KEBELE NUMBER**	

A2. EVALUATION TRACKING INFORMATION

Please fill this section if the person to be interviewed is a member of the community otherwise leave blank.

Q1	**TODAY'S DATE**	☐☐/☐☐☐/☐☐☐☐ *(Day / Month / Year)*
Q2	**REGION**	Amhara……1 Oromia……2 SNNPR……3
Q3a	**HEALTH FACILITY NAME**	
Q3b	**HEALTH FACILITY NUMBER**	☐☐☐☐☐
Q3c	**Q3c TYPE OF FACILITY**	Hospital ……1 Health Center ……2 Other (specify)……...…9
Q4a	**COMMUNITY MEMBERS NAME**	
Q4b	**COMMUNITY MEMBERS STUDY NUMBER**	☐☐☐☐☐☐
Q4e	A**GE GROUP**	Child (less than 5 years old)……1 Child (5 years to less than 18 years old)…....2 Adult (18 years old or older)……...3
Q4f	**PARTICIPANTS KEBELE NUMBER**	

B. GENERAL HOUSEHOLD INFORMATION

Q5	Is the selected person in the household answering the questions? **ADULT ART AND PRE-ART CLIENTS: [THE FIRST CHOICE IS TO INTERVIEW THE PERSON WITH HIV IF THIS PERSON IS WILLING AND ABLE. ONLY INTERVIEW ANOTHER MEMBER OF THE HOUSEHOLD ON BEHALF OF THE PERSON WITH HIV IF THE PERSON WITH HIV IS UNWILLING OR UNABLE TO ANSWER THE QUESTIONS]** **CHILDREN: [IF THE SELECTED PERSON IS LESS THAN 18 YEARS OLD INTERVIEW THE CHILDS CARETAKER OR GUARDIAN]**	Yes……1 *(if yes skip to Q8)* No…….0 *(if no go to Q6)*
Q6	Who is answering the questions on behalf of the selected adult or child?	Male head of household……..… 1 Female head of household……2 Other male member of household……3 Other female member of household….4 Childs female caretaker/guardian ……5 Childs male caretaker/guardian……6
Q7	Are you familiar with [*Selected Participant's Name*] daily activities and willing to answer questions on his/her behalf?	Yes……1 No……..0 *(if no, ask if there is another family member who is familiar with selected participants daily activities)*
Q8	Sex of selected participant	Male ……1 Female……...2
Q9a	Age of selected participant	☐☐ years
Q9b	Is the kebele where you live and urban or rural kebele?	Urban……1 Rural…….0
Q10	Do you earn an income?	Yes……1 No……..0
Q11	What is your ethnicity? **[Read responses and choose only one response]**	Oromo…….....1 Amhara…….....2 Gurage…….....3 Sidama …….....4 Hadiya…….....….....5 Kembata…….....….....6 Tigray.....7 Somali.....8 Afar.....9 Other (specify)_____.....10

Q12	How far did you go in school? **[Read responses and choose only one response]**	No formal schooling ..... 1 Completed primary ..... 2 Completed secondary ..... 3 Less than primary ..... 4 Post-secondary ..... 5 Religious education only 6
Q13	How many people have been living regularly in your household for the past 6 months?	☐☐☐ people
Q14	How many rooms in your household are used for sleeping?	☐☐ rooms
Q15	Are you tenants in this house or is it owned by the family?	Owned…….. 1 Rented……2 Don't know……..99
Q16	Does your household have any of the following? **[Must be functioning; read answers and circle yes or no for all that apply]**	Electricity……Yes…1 No…0 Radio……...Yes…1 No…0 Television……Yes…1 No…0 Kerosene lamp /pressure lamp…Yes…1 No…0 Refrigerator……Yes…1 No…0 Land line phone……..……Yes…1 No…0 Mobile phone…….....Yes…1 No…0 Bicycle……Yes…1 No…0 Horse/mule for transport…….Yes…1 No…0 Animal drawn cart……..….Yes…1 No…0 Motorcycle/scooter……..….Yes…1 No…0 Car/truck……..….Yes…1 No…0 Boat with a motor……...….Yes…1 No…0 None of the above…….……...Yes…1 No…0

C. DRINKING WATER SOURCES

Q18	What is your main source of drinking water? **[Read responses and choose only one response]**	Bottled Water ..... 1 Piped water into dwelling ..... 2 Piped into yard/plot ..... 3 Public tap/standpipe ..... 4 Protected dug well ..... 5 Unprotected dug well ..... 6 Tube well/borehole ..... 7 Protected spring ..... 8 Unprotected spring ..... 9 Rainwater collection/burka ..... 10 Tanker-truck ..... 11 Cart with small tank ..... 12 Surface water (river, dam, lake, pond, stream, canal, irrigation channels) ..... …..13 Other (specify)_____ 14

Q19	What is the main source of water used by your household for other purposes such as cooking and handwashing? **[Read responses and choose <u>only one</u> response]**	Bottled Water.....1 Piped water into dwelling.....2 Piped into yard/plot .....3 Public tap/standpipe .....4 Protected dug well .....5 Unprotected dug well .....6 Tube well/borehole..... 7 Protected spring .....8 Unprotected spring .....9 Rainwater collection/burka.....10 Tanker-truck .....11 Cart with small tank .....12 Surface water (river, dam, lake, pond, stream, canal, irrigation channels) .....…..13 Other (specify)_____.....14
Q20	How long does it take to go there, get water, and come back? **[Read responses and choose only one response]**	< 15 minutes……...1 15 minutes to 29 minutes……...2 30 minutes to 59 minutes……3 1 to 3 hours……4 More than 3 hours……..5 Water is on premises……..6 Don't know……..99
Q21	Who usually goes to this source to fetch water for your household? **[Check if the person under age 15 and what sex]**	Adult women .....1 Adult man .....2 Female child (under 15).....3 Male child (under 15) .....4 Don't know.....99
Q22	Did you have to pay to obtain water?	Yes..... 1 No……...0 *(If no go to Q24)*
Q23	How much do you pay for 20 L (one ensera/jerican) of water? **[Read responses and choose only one response]**	<50 Cents……..1 10 Cents-1 Birr……..2 1 Birr-2 Birr……...3 2 Birr-3 Birr……...4 3 Birr-4 Birr……...5 4 Birr-5 Birr……...6 >5 Birr……7 Receive it for free……..8
Q24	Have members of this household ever been prevented from collecting water or felt discrimination when collecting water?	Yes..... 1 *(if yes, go to question Q25)* No ..... 0 *(if no, go to question Q26)*
Q25	If yes, do you have to walk farther than your nearest source to obtain drinking water because of this?	Yes..... 1 No 0

Q26	Do you think your main source of drinking water is safe to drink?	Yes..... 1 No 0

C. HYGIENE INFORMATION

Q27	Do you currently have soap in your house?	Yes..... 1 No……...0
Q28	When do you wash your hands? **DO NOT READ ANSWERS** **[CIRCLE EACH ANSWER MENTIONED BY THE RESPONDENT. MULTIPLE RESPONSES POSSIBLE]** **(PROBE ONCE: "Any other times?")**	When you prepared food……Yes…1 No…0 After going to the toilet……...Yes…1 No…0 Before eating food……...Yes…1 No…0 After eating food ……Yes…1 No…0 Before feeding a child……Yes…1 No…0 Other (specify) _____……Yes…1 No…0
Q29	When do you wash your hands <u>with soap</u>? **DO NOT READ ANSWERS** **[CIRCLE 1 EACH TIME AN ANSWER IS MENTIONED BY THE RESPONDENT. MULTIPLE RESPONSES POSSIBLE]** **(PROBE ONCE: "Any other times?")**	When you prepared food……Yes…1 No…0 After going to the toilet……...Yes…1 No…0 Before eating food……...Yes…1 No…0 After eating food ……Yes…1 No…0 Before feeding a child……Yes…1 No…0 Other (specify) _____……Yes…1 No…0
Q30	Do you have any type of cleaning material such as ash or herbs for cleaning purposes in your house?	Yes..... 1 No……...0
Q31	What kind of toilet facility do members of your household usually use? **DO NOT READ ANSWERS IF LATRINE IS GIVEN AS A RESPONSE, PROBE FOR FURTHER INFORMATION.** **(ONLY ONE ANSWER POSSIBLE)** <u>*Refer to pictures & verify with visual inspection*</u>	Flush/pour toilet to: Piped sewer system……..1 Septic tank……2 Pit latrine……..3 Elsewhere……4 Unknown place/not sure/ don't know where……5 Ventilation improve pit latrine (VIP).....6 Pit latrine with slab ……7 Pit latrine without slab/open pit……..8 Composting toilet……..……..9 Bucket……10 Hanging toilet/hanging latrine…….. …… 11 No facilities or bush or field……...12 Other (specify) _____……...13

Q32	What kind of toilet facility do you use? **DO NOT READ ANSWERS IF LATRINE IS GIVEN AS A RESPONSE, PROBE FOR FURTHER INFORMATION.** **(ONLY ONE ANSWER POSSIBLE)** *Refer to pictures & verify with visual inspection*	Flush/pour toilet to: Piped sewer system……..1 Septic tank……2 Pit latrine……..3 Elsewhere……4 Unknown place/not sure/ don't know where……5 Ventilation improve pit latrine (VIP).....6 Pit latrine with slab ……7 Pit latrine without slab/open pit……..8 Composting toilet……..……..9 Bucket……10 Hanging toilet/hanging latrine…….. …… 11 No facilities or bush or field……...12 Other (specify) _____……...13
Q33	Is this facility on your compound/property?	Yes……1 No..... 0
Q34	Have you or anyone in your household ever been prevented from using this facility?	Yes……1 No…….. ……. 0
Q35	Do you share this toilet facility with other households?	Yes……1 *(if yes go to Q36)* No……..0 *(if no go to Q37)*
Q36	How many households use this toilet facility?	Number of households (if less than 10) ☐☐ 10 or more households ……Yes…1 No…0 Don't know……99
Q37	How do people in your area dispose of feces, if they do not have a toilet/sanitary facility? **[ONLY ONE ANSWER POSSIBLE]**	Throw in toilet/latrine…….1 Use potty/popo…….2 Throw in field……..3 Bury in yard…….4 Rinse away ……..5 Not disposed of/nothing……..6 Other (specify)_____..…..……..7 Don't know……99
Q38	How does a very sick person who is unable to go to toilet/latrine collect his stool? **(ONLY ONE ANSWER POSSIBLE)**	Throw in toilet/latrine…….1 Use potty/popo…….2 Throw in field……..3 Bury in yard…….4 Rinse away ……..5 Not disposed of/nothing……..6 Other (specify)_____..…..……..7 Don't know…….99
Q39	How do members of this household avoid soiling the mattress when sick with diarrhea?	Use nothing……1 Use plastic sheeting……2 Use cloth sheeting……..3 Other (specify) _____…4

Q40	What do you do if the bed gets soiled with feces?	Wash bed…….. 1 Destroy bed (grass beds/ burned)…….. 2 Use protective sheeting/then wash…….3 Use protective pads (for menstruation) then wash/discard ……..4

D. EXPOSURE TO DIARRHEA AND WATER TREATMENT INTERVENTIONS

Q41	Have you heard any messages about preventing diarrhea in the past six months?	Yes .....1 No…..0 *(If Yes, go to next question)* *(If No, go to question Q44)*
Q42	Where have you heard messages about preventing diarrhea diseases in the past six months? **DO NOT READ ANSWERS** **[CIRCLE EACH ANSWER MENTIONED BY THE RESPONDENT. MULTIPLE RESPONSES POSSIBLE]** **(PROBE ONCE: "Anywhere else?")**	Community worker/distributor…Yes…1 No…0 Home-based care worker…….Yes…1 No…0 Treatment centre doctor/nurse/counselor ……..Yes…1 No…0 Hospital/Health Center/Post…….Yes…1 No…0 Friends/relatives……Yes…1 No…0 Brochure/Leaflet ……Yes…1 No…0 Billboard ……..Yes…1 No…0 Radio……Yes…1 No…0 TV……Yes…1 No…0 Other (Specify) _____…Yes…1 No…0
Q43	Have you received any information about how to treat your drinking water in the past six months?	Yes .....1 No 0
Q44	Do you treat your water in any way to make it safer to drink?	Yes……1 No…….. …… 0 Don't know…….99 *(If Yes, go to next question)* *(If No, go to question Q46)*
Q45	What do you usually do to the water to make it safer to drink? **[MULTIPLE RESPONSES POSSIBLE]** **(PROBE ONCE: "Anything else?")**	Boil ……Yes…1 No…0 Use WuhaAgar ……...Yes…1 No…0 Use PuR ……..Yes…1 No…0 Use chlorine tablet……...Yes…1 No…0 Add bleach/chlorine……Yes…1 No…0 Strain through a cloth ……..Yes…1 No…0 Use water filter (ceramic, sand, composite, etc) ……...Yes…1 No…0 Solar disinfection ……Yes…1 No…0 Let it stand and settle ……..Yes…1 No…0 Other (Specify) _____…Yes…1 No…0 Do nothing……Yes…1 No…0 Don't know ……..Yes…1 No…0
Q46	Have you ever heard of WuhaAgar?	Yes .....1 No .....0 *(If Yes, go to next question)* *(If No, skip to question Q49)*

Q47	What messages have you heard about treating drinking water with WuhaAgar? **DO NOT READ ANSWERS** **[CIRCLE 1 EACH TIME AN ANSWER IS MENTIONED BY THE RESPONDENT. MULTIPLE RESPONSES POSSIBLE]**	a. *WuhaAgar* kills germs that cause diarrhea, typhoid and other water borne diseases. Yes……..….1 No……...……0 b. Add one capful of *WuhaAgar* to 20 liters of water, shake well to mix it with the water, wait for 30 minutes and drink. Yes……...…1 No…….0 c. Treat your water everyday using *WuhaAgar*. Yes……1 No……..0 d. Other (Specify) _____ _____
Q48	Where have you heard these messages about treating your water with WuhaAgar in the past six months? **DO NOT READ ANSWERS** **[CIRCLE EACH ANSWER MENTIONED BY THE RESPONDENT. MULTIPLE RESPONSE POSSIBLE]** **(PROBE ONCE: "Anywhere else?")**	Community worker/distributor…Yes…1 No…0 Home-based care worker…….Yes…1 No…0 Treatment centre doctor/nurse/counselor …….....Yes…1 No…0 Hospital/Health Center/Post…….Yes…1 No…0 Friends/relatives……Yes…1 No…0 Brochure/Leaflet ……Yes…1 No…0 Billboard ……..Yes…1 No…0 Radio……Yes…1 No…0 TV……Yes…1 No…0 Other (Specify) _____…Yes…1 No…0
Q49	Have you ever seen community counseling cards?	Yes ..... 1 No ..... 0 *(If Yes, go to next question)* *(If No, skip to question Q52)*
Q50	Where did you see them?	Hospital……..…..1 Health Centre……..…..2 NGO brought to my home… ……3 Other (specify)_____….4
Q51	Who was using them?	Health professionals ……..……1 HIV counselors……..……2 Home based care volunteers …….....3 Community Agents……..4 Community Development workers (NGOs)…5 Others (specify) _____…….6

E. WuhaAgar USE, AVAILABILITY, AND WILLINGNESS TO PAY

Q52	Have you treated your current drinking water using WuhuAgar (liquid)?	Yes.....1 No.....0
Q53	Have you treated your current drinking water using a PuR (sachet)?	Yes.....1 No.....0
Q54	Have you treated your current drinking water using a chlorine tablets or bleach?	Yes.....1 No.....0

Q55	How often do you use WuhuAgar?	Daily 1 2-3 times per week 2 Once a week 3 Every 2 weeks 4 Once a month 5 Only during certain season 6 Other (specify) _____ 7
Q56	Did you use this product the last time you fetched water?	Yes…….1 No……..0 Don't know……99
Q57	Did you or your family drink water treated with this product every day in the past week?	Yes…….1 No……..0 Don't know ……99
Q58	If no, when did you last use WuhuAgar?	Within the last 24 hours……..1 A couple of days ago……..2 Last week……...3 Two weeks ago…….…..4 Last month……..5 Last season……..6 Other (specify) _____…..7 Don't know ……..99
Q59	If you do not use WuhuAgar, why not?	Cannot find 1 Place where I buy from is out of stock 2 Do not need it 3 I cannot afford 4 Do not like smell/taste 5 Not the right season 6 Other (specify) _____ 7
Q60	Have you ever received WuhaAgar for free from a hospital, clinic or from an NGO?	Yes.....1 No.....0
	Have you ever received a Healthy Living Kit for free from a hospital, clinic or from an NGO?	Yes.....1 No.....0
Q61	Have you ever received counseling on how to use WuhaAgar?	Yes.....1 No.....0 *(If yes go to next question)* *(If no skip to Q63)*
Q62	From whom did you received counseling on how to use WuhaAgar?	Treatment Center 1 Community worker 2 Community distributor 3 Home-care worker 4 Health center nurse 5 Other (specify) _____ 6
Q63	Did a home-based care agent ever show you how to use WuhaAgar?	Yes.....1 No.....0

Q64	After you received counseling, did you feel confident about how to use WuhaAgar?	Yes.....1 No.....0
Q65	Do you ever tell your friends or relatives about WuhaAgar and advise them to use it?	Yes.....1 No.....0
Q66	Do you think this product is effective at preventing diarrhea?	Yes.....1 No.....0 Don't know…….99
Q67	How many capfuls of WuhaAgar do you use to treat 20L of your water? _____capful(s) How long do you wait to drink the water after adding WuhuAgar? ____minutes	Correct 1 Incorrect 0
Q68	Do you know where to buy WuhaAgar?	Yes.....1 *No.....0* *(If yes go to next question)* *(If no, skip to 71)*
Q69	If yes, where can you buy?	Pharmacy at health center..Yes…1 No…0 Shop……...Yes…1 No…0 Market……...Yes…1 No…0 Local pharmacy……..Yes…1 No…0 Community distributor…...Yes…1 No…0 From a women's group…...Yes…1 No…0 NGO……Yes…1 No…0 Other (specify)_____..Yes…1 No…0
Q70	When you buy WuhaAgar at the location nearest your home, how long does it take to go there, purchase WuhaAgar, and come back? **[Read responses and choose only one response]**	< 15 minutes……...1 15 minutes to 29 minutes……...2 30 minutes to 59 minutes……3 1 to 3 hours……4 More than 3 hours……..5 Don't know……..99
Q71	The last time you obtained WuhaAgar, did you purchase it?	Yes….....1 No….....0 *(If yes go to next question)* *(If no go to Q74)*
Q72	If yes, from what source? **[Choose only one response]**	Pharmacy at hospital or health center……..1 Shop……..…2 Market……..……3 Local pharmacy……..……...4 Community distributor……..……5 From a women's group……6 NGO……7 Other (specify)_____.....8

Q73	If yes, how much did you pay? **[Read responses and choose only one response]** ***(price should currently be 1.50 Birr, do not prompt)***	<1.40 Birr……1 1.40-1.49 Birr……...2 1.50 Birr……3 1.51-1.60 Birr……...4 1.61-1.80 Birr……...5 1.81-2 Birr…….. 6 >2 Birr……..7 Received it for free……..8
Q74	If the price increased to 2 Birr would you continue or be willing to buy WuhaAgar?	Yes.....1 No.....0 *(if yes, go to next question)* *(if no, go to question Q77)*
Q75	If the price increased to 3 Birr would you continue or be willing to buy WuhaAgar?	Yes.....1 No.....0 *(if yes, go to next question)* *(if no, go to question Q77)*
Q76	If the price increased to 5 Birr would you continue or be willing to buy WuhaAgar?	Yes.....1 No.....0
Q77	What would you do if the price of WuhaAgar was higher than what you are willing to pay? **[READ POSSIBLE ANSWERS AND CHOOSE ONLY ONE RESPONSE]**	Look for a cheaper product at the same place?.....1 Look for a cheaper product at a different location?.....2 Look for a different way to treat your water? …….3 Look for a free way to treat your water? ……4 Not to treat my water……..…5

F. PERCEPTIONS OF HIV, DIARRHEA, and WATER QUALITY

Q78	If water looks clear, do you think its safe to drink?	Yes.....1 No.....0
Q79	Do you know what can cause diarrhea? **[DO NOT READ ANSWERS]** **[CIRCLE EACH ANSWER MENTIONED BY THE RESPONDENT. MULTIPLE RESPONSES POSSIBLE]**	Contaminated water……...Yes…1 No…0 Contaminated food……Yes…1 No…0 Eating raw food…….……Yes…1 No…0 Dirty/unwashed hands……Yes…1 No…0 Leaving stored water uncovered……..…Yes…1 No…0 Defecating around house/compound……Yes…1 No…0 Sharing water sources with animals…..…Yes…1 No…0 Sharing water sources with bathing/cleaning areas…….……Yes…1 No…0 Other (specify)_____Yes…1 No…0
Q80	Do you think diarrhea can be prevented?	Yes.....1 No.....0
Q81	Do you think people can die from diarrhea?	Yes.....1 No.....0
Q82	Do you think that diarrhea is a serious problem for everyone in your community?	Yes.....1 No.....0

Q83	How much of a problem is diarrhea for your/your household?	Big problem 1 Somewhat 2 Not much 3 Not at all 4
Q84	Has [selected adult/child's name] had diarrhea (3 or more loose stools in 24 hours) in the past two weeks?	Yes.....1 No.....0
Q85	Have anyone else in your household had diarrhea (3 or more loose stools in 24 hours) in the past two weeks?	Yes.....1 No.....0
Q86	The last time you or your family member had diarrhea, what types of fluid did you take/give? **DO NOT READ ANSWERS]** **[CIRCLE EACH ANSWER MENTIONED BY THE RESPONDENT. MULTIPLE RESPONSES POSSIBLE]**	Oral Rehydration Salt .....1 Lem Lem.....2 Home made sugar and salt solution….3 Milk.....4 Other fluids (soup etc) ..... 5 Nothing .....6 Other (specify)_____ 7
Q87	Who should be drinking treated water?	All household members.....1 Only children under five.....2 Only adults.....3 Only PLWHA.....4 Other (specify) _____.....7
Q88	How do you know if water is fit and safe for drinking?	Clear.....1 Treated.....0 Other (specify) _____...7 Don't know…….99

G. BREASTFEEDING (QUESTIONS FOR SELECTED PARTICIPANTS LESS THAN 5 YEARS OLD)

Q89	Was [selected child less than 5 years old name] ever breast feed?	Yes.....1 No.....0 Don't know…….99 *(If Yes, go to next question)* *(If No, go to question Q91)*
Q90	Is he/she still breastfeeding?	Yes.....1 No.....0 Don't know…….99
Q91	Is [selected child less than 5 years old name] given formula?	Yes.....1 No.....0 Don't know…….99 *(If Yes, go to next question)* *(If No, go to question Q93)*
Q92	Is the water for the formula treated?	Yes, boiled.....1 Yes, treated with chlorine……2 Yes, filtered……..3 No treatment.....4 Don't know…….99

H. HOUSEHOLD OBSERVATIONS [INTERVIEWER ASKES PERMISSION TO CARRY OUT SOME OBSERVATIONS AROUND THE HOME]

Q93	Does your household have any mosquito nets that can be used while sleeping?	Yes.....1 No.....0 *(If Yes, go to next question)* *(If No, go to question Q9)*
Q94	How many mosquito nets does your household have? **[IF 7 OR MORE NETS RECORD '7']**	NUMBER OF NETS _____
Q95	Did [you/selected child's name] sleep under a mosquito net last night?	Yes.....1 No.....0
Q96	Can I see [your/selected child's name] mosquito nets?	Bednet present……1 Bednet absent…….0
Q97	Please record or ask the general condition of the net.	GOOD (NO HOLES)……..1 FAIR (no holes that fit a torch battery)…….2 POOR (1-4 holes that fit a torch battery)…….3 UNSAFE (>5 holes that fit a torch battery……4 UNUSED (still in package….5 UNKNOWN……6
Q98	Observe or ask the brand of mosquito net.	'PERMANENT' NET1 Permanet ……1 Olyset…….2 Safenite……..…3 Other/Don't Know……4 (SKIP TO) 'PRETREATED' NET2 Salam Enkilfe….5 KO Nets……..6 Other/Don't Know…..7 (SKIP TO) OTHER …….8 DON'T KNOW BRAND ……..9
Q99	Where did you obtain the mosquito net?	Government clinic/hospital……1 Neighborhood health committee……2 Health Extension worker…….3 Community health worker/agent…….4 Retail shop……...5 Pharmacy……..6 Workplace…….7 Other (Specify)_____.....8 Don't know……....9

Q100	Did you receive your mosquito net for free or did you pay for it?	Free.....1 Paid for the net.....2
Q101	Did you ever receive soap from a clinic or an NGO?	Yes.....1 No.....0
Q102	Do you have soap in your home at the moment? May I see it?	Soap present……..1 Soap absent…….…..0
Q103	Did you ever receive packets of ORS packets from a clinic or an NGO?	Yes.....1 No.....0
Q104	Do you have ORS packets in your home at the moment? May I see it?	ORS present……..1 ORS absent……..…..0
Q105	Did you ever receive co-trimoxazole tablets from a clinic or an NGO?	Yes.....1 No.....0
Q106	Do you have co-trimoxazole tablets in your home at the moment? May I see it?	Co-trimoxazole present……..1 Co-trimoxazole absent……..…..0
Q107	Did you ever receive blankets from a clinic or an NGO?	Yes.....1 No.....0
Q108	May I see the blankets you received from the clinic or NGO?	Blankets present……..1 Blankets absent……...0
Q109	Did you ever receive nutritional products from a clinic or an NGO?	Yes.....1 No.....0
Q110	May I see the nutritional products you received from the clinic or NGO?	Nutritional products present……..1 Nutritional products absent……...0
Q111	Do you have a bottle of WuhaAgar in your home at the moment? May I see it please?	Bottle present……..1 Bottle absent…….…..0
Q112	**IF THE RESPONDENT HAS TREATED THEIR CURRENT WATER WITH WUHAAGAR, PUR, CHLORINE TABLETS OF BLEACH (i.e. YES TO Q52, Q53 or Q54) PERFORM CHLORINE TEST ON WATER FROM HOUSEHOLD DRINKING WATER CONTAINER]** Did you detect chlorine in the household drinking water?	Yes (pink)……1 No (clear)……2 Refused ……...3 No water in household……4
Q113	Ask the respondent when they did you treat this water?	Today (less than 24 hours ago)…1 More than 24 hours ago……2 2 days ago……...3 More than 2 days ago……4
Q114	**OBSERVE:** How do you store your drinking water in the household? Would you please show me? **Interviewer to observe and record**	Open container/ bucket……1 Container with cover/closed bucket….2 Closed bucket……...3 Covered bucket with tap……...4 Narrow mouth container/jerrycan…….5

<table>
<tr><td></td><td>What types of containers are these? Observe and check all that apply. (Narrow mouth opening is 3 cms. or less.)</td><td>Traditional clay pot…….. 6
Other (specify) _____ ……..……7</td></tr>
<tr><td>Q115</td><td>Interviewer to observe and record
OBSERVE: Count how many containers are used and write down thetype, number of litres of water and whether the containers have a lid or not?</td><td><table><tr><th>Type of container</th><th># liters</th><th>Lid?</th></tr><tr><td></td><td></td><td>Yes No</td></tr><tr><td></td><td></td><td>Yes No</td></tr><tr><td></td><td></td><td>Yes No</td></tr><tr><td></td><td></td><td>Yes No</td></tr></table></td></tr>
<tr><td>Q116</td><td>OBSERVE: What is the estimated total amount of stored water in liters?</td><td>Estimated total amount of water _____</td></tr>
<tr><td>Q117</td><td>OBSERVE and write down the number of containers with a lid.</td><td>Number of containers with lid _____</td></tr>
<tr><td>Q118</td><td>Who in the household drinks the stored water in these containers?</td><td>All household members……1
Only children under five……..2
Only adults……...3
Only PLWHA……..4
Other (specify) _____ …….5</td></tr>
<tr><td>Q119</td><td>Did you ever receive condoms from a clinic or an NGO?</td><td>Yes.....1
No.....0</td></tr>
<tr><td>Q120</td><td>May I see the condoms you received from the clinic or NGO?</td><td>Condoms present……..1
Condoms absent……...0</td></tr>
<tr><td>Q121</td><td>Interviewer: Observe and note:
Presence of plastic sheeting on bed
Presence of bedding on bed (removable cloth)
Presence of feces (visible) in compound</td><td>Presence of plastic sheeting on bed
Yes ……1 No……..0
Presence of bedding on bed (removable cloth)
Yes ……1 No……..0
Presence of feces (visible) in compound
Yes ……1 No……..0</td></tr>
<tr><td>Q122</td><td>What is the predominant floor inside the house?

[Observe which material covers the largest surface and choose only one response]</td><td>Natural Floor
Earth/Sand……1
Dung…….2
Rudimentary Floor
Wood planks……3
Palm/bamboo……...4
Finished Floor
Parquet or polished wood……5
Carpet……..6
Cement…….7
Vinyl or asphalt strips……..8
Ceramic Tile……9
Other, specify_____10</td></tr>
</table>

THANK THE RESPONDENT(S) FOR THEIR COOPERATION

Notes or comments

Interviewer's Name ______________________ | | | |

Staff code

Supervisor's Name ______________________ | | | | | | | | | | | | 2 | 0 | | |

Staff co