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When a Vaccine Alone is not Enough:

An Assessment of Effective Point-of-Use Water Treatment and Hand Washing Among Cholera-Vaccinated and Unvaccinated Inhabitants in Mirpur Slum, Dhaka, Bangladesh

By

Danielle McFall Schaeffner
Master of Public Health

Epidemiology

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Committee Chair

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B.A., Lewis and Clark College, 2005

Thesis Committee Chair: Christine L. Moe, PhD.

An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Epidemiology
2012

Abstract

When a Vaccine Alone is not Enough:
An Assessment of Effective Point-of-Use Water Treatment and Hand Washing Among Cholera-Vaccinated and Unvaccinated Inhabitants in Mirpur Slum, Dhaka, Bangladesh

By Danielle McFall Schaeffner

Background: Cholera prevention and control includes vaccines and improved water, sanitation and hygiene (WASH). In endemic regions, vaccination may provide time to improve WASH infrastructure and behaviors in high-risk populations. While there is debate about the role of cholera vaccination because of the modest efficacy and limited duration of protection, it will not be a cost-effective intervention without proper messaging and good WASH practices.

Objective: To examine the impact of cholera vaccination on WASH-related behavior by comparing vaccinated and unvaccinated populations.

Methods: 728 households (HHs) were recruited from cholera-vaccinated and unvaccinated groups in Mirpur slum, Dhaka, Bangladesh. Approximately 100 HHs were surveyed every month for 4 key WASH outcomes: household water contamination, self-reported household water treatment, and self-reported and observed hand washing, with and without soap. The first four months of data were examined for an association between WASH outcomes and vaccination.

Results: There were no significant differences in the 4 WASH outcomes between the vaccinated and unvaccinated groups. The adjusted odds ratios ranged from 1.10 to 1.57, and included the null value in the 95% CI. In the vaccinated group, 53% reported that they felt protected by the cholera vaccine. There were no significant differences in WASH outcomes for vaccine recipients who felt protected versus those who did not. No consistent time trends in WASH practices were observed over the 4-month study period.

Discussion: Cholera vaccination alone did not change WASH-related behavior. Because vaccination was implemented without providing information on efficacy and duration of protection, it is not possible to determine the impact an effective message may have had on WASH practices. Future studies should examine whether a clear, culturally-appropriate message provided with the cholera vaccine could influence WASH-practices in endemic areas.

Acknowledgements:

I would like to thank Dr. Christine L. Moe and Dr. Matthew Strickland for advising me through this process, the wonderful Water and Sanitation Team at the International Center for Diarrheal Disease Research, Bangladesh and my friends and family for their unconditional support.

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BACKGROUND

HISTORY OF CHOLERA

Cholera can kill an individual in a few hours [1]. One *Vibrio cholerae* case can contaminate a whole village or coastal area's water supply [2]. This acute diarrheal disease is an intestinal infection that produces watery stools in large quantities and consequently leads to severe dehydration [3]. Over 50% of untreated cholera cases result in death. Annually, there are an estimated 3-5 million cases of cholera worldwide, with approximately 100,000 to 120,000 deaths [1]. Oral rehydration solution (ORS) is proven effective in treating nearly 80% of cholera cases. Cholera has been documented by name since the nineteenth century, with references as early as Sanskrit writings.

History records the epidemiology of the seven major cholera pandemics over the last three centuries [1]. The first cholera pandemic occurred from 1817-1823 [2]. This initial pandemic started in the delta of the Ganges River in India, transported southwards by trade and colonization into Southeast Asia, eastern Africa, the Middle East and parts of the Mediterranean coastline [4]. After hundreds of thousands of deaths, cholera was again isolated to the surrounding area of the Bay of Bengal by 1823 [4].

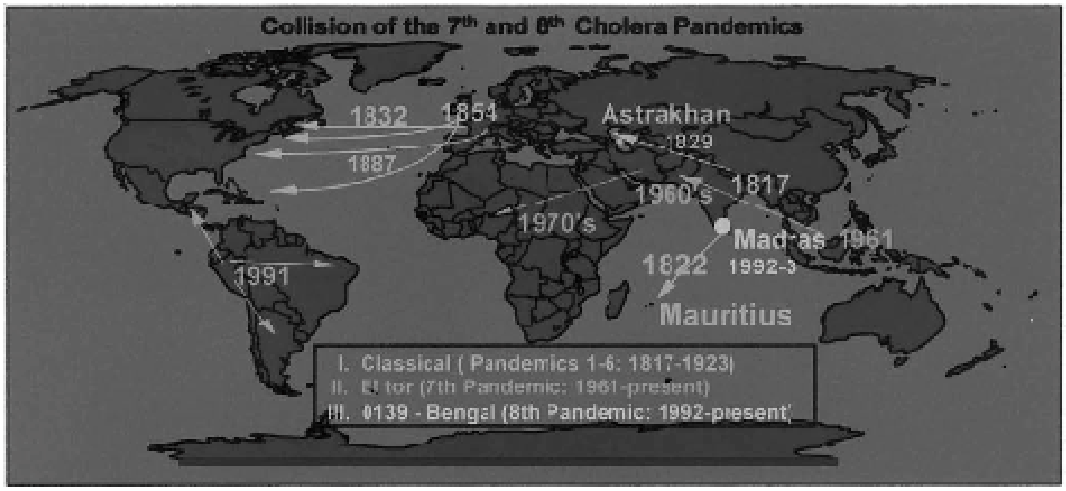
Cholera pandemics have affected the world six additional times since the first documented pandemic [5] [6]. The second pandemic started in 1829, travelled from India to Russia and then to Finland and Poland, and included a two-year outbreak in England from 1831-1833 with a death toll of over 20,000 persons [4]. This pandemic brought cholera to North America for the first time, killing greater than 2,000 Canadians and causing an epidemic in New York City in 1832 [7] before moving into Central

America [4]. The third pandemic of cholera included John Snow's historic water pump discovery in 1854 [8] and his recognition of cholera transmission through contaminated water [9].

The fourth pandemic (1863-1879) covered the region between Bengal and Europe [10] impacting Africa through Meccan pilgrimage [11] and killing nearly 100,000 Russians [12]. The fifth pandemic spanned from 1881-1896, during which quarantine measures helped save thousands of British and American lives thanks to Snow's previous findings in England [9]. It was during the fifth cholera pandemic, in 1892, that Ukrainian bacteriologist Waldemar Haffkine developed the first human vaccine for cholera [4].

By the end of the sixth pandemic (1899-1923), cholera had again disappeared from most of the world, except for India. The seventh pandemic started in 1961, in Indonesia, travelling across Asia and the Middle East, into Africa circa 1971 and Italy in 1973. In 1994, there was an outbreak in Rwanda and another in Zimbabwe in 2008 [4]. Most recently cholera appeared in Haiti, where the case count is currently over 500,000 and the death toll is over 7,000 [13].

FIGURE I. SPREAD OF CHOLERA
[14]



A new strain of cholera was discovered in Bangladesh in 1992, termed O139 [15]. This particular strain has led some to believe that an eighth pandemic could occur, as it has since been found in eleven additional countries in South-east Asia [4].

It is the unexpected and unrestrained movement of cholera between continents and populations, both historically and more recently [Figure I.], that raises concern for cholera naïve and underprepared regions of the world. This disease's devastating impact necessitates a more comprehensive understanding of cholera transmission routes and potential prevention and control measures. It is important to determine the best ways to treat and prevent cholera in both endemic and epidemic settings. Cholera is a considerable burden in places like Haiti that do not have the experience or logistical knowledge to deal with a new outbreak. Cholera is also devastating for areas of the world that do not have the infrastructural capacity to protect their waterways or promote sufficient sanitary measures to fight seasonal outbreaks such as Dhaka, Bangladesh. It is important to find cost-effective and sustainable solutions for both scenarios.

BIOLOGICAL ASPECTS

The bacterium responsible for these international outbreaks is *Vibrio cholera (V. cholera)*. This gram-negative bacteria was first discovered and characterized by Robert Koch in 1883 in Germany, a key contributor to germ theory [3]. There are 16 known strains of *V. cholerae [16]*, with O1 and O139 being the most deadly. *V. cholerae* produces a toxin that stimulates adenylate cyclase, causing the intestine to produce large amounts of watery fluids highly concentrated in sodium, bicarbonate, and potassium [5]. These fluids are produced in volumes far exceeding the intestine's capacity to absorb the integrated nutrients [5]. While two-thirds of *V. cholerae* infections are asymptomatic, the bacteria are present and can be transmitted by the stools of asymptomatic individuals for up to two weeks [5]. Because such a small percentage of those infected show symptoms, it is often difficult to assess an outbreak early on. Approximately 80% of symptomatic individuals will only demonstrate mild to moderate symptoms, while the remaining 20% will present with diarrheal illness [5].

There are two serogroups of *Vibrio cholerae* (*V. cholerae*), O1 and O139, [3]. The O139 serogroup has only been recognized and documented in South-East Asia. Serogroup O1 consists of two different bio-types, El Tor and classical, with newer strains of the El Tor bio-type associated with greater severity [17]. While these organisms can be found both in the small intestines of humans and in the natural environment, these microbes prefer natural environs [3]. Their ecological niche was discovered in the mid to late 21st century and characterized as an ecotone, or a narrow ecological region more commonly known as an estuary [18].

BANGLADESH

As a delta region with intense rainy seasons, Bangladesh provides a perfect breeding ground for *Vibrio cholerae*. The long durations of warm precipitation alters the salinity and temperatures of the nearby estuaries, creating optimum growth opportunities for the bacteria. It is the large quantities of precipitating freshwater that results in the inversion of nutrients and sediment in these estuary bodies and promotes cholera bacterial growth [18]. Warmer temperatures, nutrient increase from runoff and decreased salinity result in areal algal blooms and the presence of necessary copepod species. These copepods serve as vectors for cholera bacteria, picking up and storing the *V. cholerae* through their lifecycle [18]. The cholera bacteria replicate until they cover the copepod's egg sack and then await full maturation of the copepod eggs, following them into the water source once they detach from the copepod. Filter-feeding benthic organisms, such as clams and oysters, act to concentrate the bacteria, storing them in the lining of their gut as they process large quantities of water. The minimum bacterial concentration necessary for a human infectious dose of *V. cholerae* is around 103 cells per milliliter of water [18].

Over one million annual cases of diarrheal disease are estimated to occur in Bangladesh by the International Center for Diarrheal Disease Research [19], of which 300,000 are deemed severe. Environments like Dhaka, the capital city of Bangladesh, are particularly vulnerable to cholera transmission due to the lack of sufficient water and sewage infrastructure [3].

CHOLERA PREVENTION AND TREATMENT

Prevention and control measures against cholera infection include behavioral and medical approaches. Prior to the 1970's, most of the world had no access to effective cholera treatment [20]. Oral rehydration solution was created and first tested in Dhaka in 1968 and has been in worldwide circulation and use since the early 1970's [20]. Oral rehydration solution was developed through research conducted at the International Center for Diarrheal Disease, Bangladesh. Made up of sugar, salts and water in specific amounts, oral rehydration solution is not a complicated mixture and therefore easy to access and make. Studies demonstrated that the use of oral rehydration solution resulted in a 70-80 % reduction in the need for intravenous fluids [21] [22] [23] [24]. This treatment signified a turning point in the history of cholera, lessening the global burden of mortality from dehydration.

Two primary behavioral approaches to decreasing cholera risk are hand washing and point-of-use water treatment, both of which have been proven to significantly reduce cholera infection [25] [26]. Studies have shown that using household-level water chlorination and a variety of filtration devices, including household resources such as a sari cloth, reduces the spread of *V. cholerae* among households by 58 to 75% [25] [27]. Extensive cost-benefit analyses of household water treatment have been conducted in various regions of Africa and Southeast Asia. The results from these analyses support the use of point-of-use water treatment methods to reduce predicted rates of diarrheal illness, including cholera [28].

The practice of hand washing with soap is proven to decrease transmission of cholera, and may possibly be more effective than a vaccine or other hygiene behavior

[29]. A study conducted in urban Dhaka Bangladesh by ICDDR, B found that when hand washing interventions were employed there was a 2.6 fold reduction in diarrheal disease as well as substantial reduction in bacterial pathogens. The decrease in diarrheal incidence was observed across age groups [30]. A study in rural Bangladesh in 2007 concluded that washing two hands with water alone or at least one hand with soap was associated with a significant decrease in diarrheal morbidity [31]. This study concluded that those who washed one hand with water only were 0.78 times as likely to have diarrhea as those who did not wash hands, those that washed both hands with water and no soap were 0.67 times as likely to exhibit diarrheal illness, and those that washed at least one hand with soap were 0.30 times as likely to develop diarrhea [31] . Hand contamination has been verified through microbiological assessments as a major component of fecal transmission. Fecal contamination on hands can subsequently be transferred to food and water during handling [32].

According to the World Health Organization, a combination of approaches, including appropriate levels of preparedness, adequate response and prevention, and vaccine use is needed to control the growing number of reported cholera cases worldwide over the last four to seven years [33]. Whether this increase is indicative of true trends or due to an increase in reporting remains to be determined. Improved case follow-up and management have reduced deaths from diarrheal diseases, including cholera, by an estimated 3 million per year compared with 20 years ago [34]. While vaccination has been advocated, it has not been considered feasible logistically or economically in the global fight against cholera.

VACCINES

There are two oral cholera vaccines currently being produced: Dukoral and Shanchol. Both of these vaccines are proven safe and effective and are available on the international market [17]. Dukoral and Shanchol are oral, whole-cell, killed vaccines and require two doses each approximately two weeks apart [17]. In studies using human volunteers, these vaccines have demonstrated protection against the major strains of cholera for a maximum of three years [35] [36] [37]. In cholera endemic settings, both vaccines have greater than 50% efficacy for at least the first two years post-vaccination [38]. Thorough analyses have been conducted to determine the efficacy of these vaccines in terms of individual and herd immunity. These assessments have confirmed that both of the vaccines result in more than 90 % short-term protection and reduction in disease 4-6 months post-vaccination when administered at 50 to 60% coverage [39]. This was demonstrated through the reanalysis of Dukoral studies conducted in Matlab, Bangladesh in the 1980's [40].

The World Health Organization has advocated for the use of the cholera vaccine in combination with other control measures since as early as 1999 [41]. However, the question remains, as to whether these vaccines are effective in the prevention of unforeseen outbreaks, even with promising oral whole-cell killed vaccine results in emergency situations such as Darfur and Aceh, Indonesia [42].

Dukoral is licensed in more than sixty countries, including Bangladesh [43]. Several mass vaccinations, covering over 500,000 persons, have been conducted in Beira, Mozambique, Indonesia post-tsunami, Madagascar, Sudan, and Zanzibar [19]. While Dukoral was the only World Health Organization qualified cholera vaccine until recently,

it is expensive and not always feasible. Dukoral costs approximately 18 United States dollars (USD) per dose and because it includes a recombinant B-subunit needs to be administered with 150 ml of safe water to provide optimum protection [38]. Because Dukoral requires this buffer of safe water, it is difficult to administer in large-scale settings, especially those in which safe water is already a scarcity [44] such as the ongoing emergency in Haiti.

Shanchol, the newer, reformulated vaccine, is comprised of various strains of the original Dukoral vaccine but is manufactured by different production techniques [1]. Shanchol has a lower cost of 1.85 United States dollars per dose [19]. Additionally, Shanchol does not require administration with a buffer of safe water, making it more easily administered to large populations in resource-poor settings [19]. This vaccine is manufactured by Shantha Biotechnics in India and is approved by the World Health Organization [19].

A double-blind, placebo-controlled phase III clinical trial was conducted in Kolkata [45] with 70,000 participants to ascertain the efficacy of this new vaccine and concluded that the vaccine was approximately 70% efficacious [46] [47]. The Shanchol vaccine was licensed in India in February 2009 and officially introduced to Bangladesh in 2010.

Vaccines are scrutinized as preventative measures, both in terms of efficacy and unintended consequences such as adverse health outcomes or development of alternate pathogen strains. A newer concern regarding vaccine use is that inoculation may create a sense of false security. A false sense of security occurs when a vaccine is perceived as

preventing a broader range of illnesses or having a longer-lasting efficacy than it actually has. This effect has been assessed for a number of vaccines, including Human Papilloma Virus (HPV) [48] [49], Lyme disease [50], and Influenza [51]. However, there has not been extensive exploration of this effect with regard to the sense of protection perceived for cholera vaccination.

BEHAVIORAL INFLUENCE

The Health Belief model, developed in the 1950's, describes how environmental variables influence an individual's perception of susceptibility to illness. This assessment of self-risk impacts whether an individual alters cautious behaviors [52]. Components that affect a person's behavioral choices, according to this model, include ascertaining the costs and benefits of changing one's behavior, perception of illness severity and what additional cues to action are present in the individual's daily surroundings [52]. According to the Health Belief Model, it is a combination of these factors that dictates the transformation of, or alternately solidifies, existing behavior [52]. This behavioral change hinges on whether the recognized benefits of changing one's behavior outweigh the identified costs of change and barriers to change [52]. While the Health Belief Model is based on an individual's decision-making process, individual behavior impacts community decision-making and actions [53], especially in densely populated areas and family-driven cultural settings.

This behavioral concept could greatly impact the cost-effectiveness of a vaccine and subsequent policy-making if individual behavior does not improve during a period of vaccination. This is particularly important with the cholera vaccine as it provides protection at approximately 60% efficacy for a maximum of three years. Because

immunity is limited in duration, vaccinees need to utilize the protected span of time to learn and adopt safe behavioral precautions against cholera.

The Risk Compensation Hypothesis, also referred to as *risk homeostasis* [54], suggests that by reducing the risk posed in one area of daily life a surplus of risk is allotted for elsewhere [55]. An example of this would be if an individual receives a vaccine and considers it more efficacious than it actually is, then this perception may impact the use of other measures of protection employed by that individual [54] such as hand washing or water treatment practices. There have been a number of risk compensation and vaccination studies designed to assess whether receiving a vaccine may increase one's likelihood of engaging in risky behaviors [50, 55]. One study considered two specific outcomes to test this theory [55]. The first potential outcome is termed "*regression"* when an individual who has received a vaccine may increase their risky behaviors and do less to protect themselves, thus moving their 'risk profile' closer to that of an unvaccinated individual [50]. The second possible outcome, termed "*disinhibition*" is when those who receive the vaccine become riskier in their activities and less protected by their behavioral choices than those in the unvaccinated cohort [55]. In relation to cholera, the relevant protective behaviors include hand-washing frequency and technique and point-of-use water treatment by chlorine disinfection, filtration, or boiling [19] [56].

Risk compensation has not been assessed for the cholera vaccine, although effects associated with flu-vaccine protection have been reported [55] [53]. After receiving the vaccine, participants self-reported a reduced perception of current risk ($p< 0.001$) and perceived risk of infection in the future to be less than those who remained unvaccinated

($p < 0.05$), leading recipients of the vaccine to behave in less preventative behaviors [50]. In actuality, the vaccine protects only against the strain of the flu expected to dominate in the upcoming year, leaving the individual susceptible to a host of other respiratory infections. Unclear messages about vaccine protection and risks of respiratory illness in general can reduce the impact of the intervention [57].

A study conducted at the University of North Carolina focused on behavior aspects associated with the Lyme disease vaccination [55]. The investigators assessed 'Lyme-disease-protective behaviors' at time of vaccination as well as at 18-months post-vaccination. This study found that those who received the vaccine for Lyme disease perceived their overall risk to be less [55]. In this study, those who chose to be vaccinated practiced safe behaviors such as wearing longer, lighter colored clothing, staying away from heavily forested areas and tucking in their pants [55]. However, nearly all of these behaviors significantly diminished over time, $p < 0.05$ [55] in the vaccinated group. A critical finding of this study was that the group of vaccinated persons behaved less safely in two out of five assessed behaviors than those who had chosen not to be vaccinated [55]. For other designated activities, there was no change in behavior and therefore no difference in risk between the two groups based on behavior alone [55]. These findings support the "regression" component of the risk compensation theory but not "disinhibition" [55]. It is important to note that Lyme disease vaccination has an efficacy of 79-92% [58], which is appreciably higher than that of the cholera vaccine. This study raises the question of how behavior may be influenced by misguided and uninformed perception of vaccine efficacy.

Previous studies [50] indicate the need to carefully consider the messaging that is employed when implementing a mass vaccination in a seasonally endemic cholera region such as Dhaka, Bangladesh. It is critical to effectively communicate the benefits of a vaccine both to the targeted population as well as to the government that is responsible for supporting long-term health. If not messaged properly, these well-substantiated interventions could have contradictory results. Vaccinees could revert to using less safe water, sanitation and hygiene practices, resulting in greater risk of exposure to cholera and other enteric pathogens and a reduced health benefit. In both endemic and epidemic regions, this vaccine is necessary to procure additional time to develop sustainable WASH behavior change as well as improve WASH infrastructures. In summary, there is still major debate about the cholera vaccine's place in disease prevention in both endemic and epidemic areas and the most cost-effective utility of the newest vaccine is still uncertain.

In January 2010 in Dhaka, Bangladesh, the "Introduction of Cholera Vaccine in Bangladesh" study was initiated. This project's aim was to examine and assess the effectiveness of a whole cell, oral cholera vaccine in the reduction of cholera in urban Dhaka and the impact of hand washing and household water treatment behaviors on the reduction of diarrheal illness due to cholera. This study is intended to determine the feasibility of the cholera vaccine and specified behavioral interventions in reducing diarrheal disease and to analyze the cost efficiency and cost benefit of these interventions[19] .

This thesis is a sub-study of the "Introduction of Cholera Vaccine in Bangladesh". This thesis examines WASH behaviors between vaccinated and unvaccinated groups,

assessing whether those that are administered the cholera vaccine behave differently in respect to household water treatment and hand washing practices than those who are not vaccinated against cholera.

STUDY OBJECTIVES

Study Goal: To examine the impact of cholera vaccination on WASH-related behavior by comparing WASH behaviors in populations that received the cholera vaccine to WASH behavior in analogous, unvaccinated populations.

I. Compare hand washing behaviors in vaccinated and unvaccinated groups in Mirpur study site, Dhaka, Bangladesh.

II. Compare household water treatment behaviors in vaccinated and unvaccinated groups in Mirpur study site, Dhaka, Bangladesh.

III. Examine the effect of time since vaccination on the observed patterns of household water treatment and hand washing behavior for the two groups.

MANUSCRIPT

TITLE

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AUTHOR

Danielle McFall Schaeffner

ABSTRACT

Background: Cholera prevention and control includes vaccines and improved water, sanitation and hygiene (WASH). In endemic regions, vaccination may provide time to improve WASH infrastructure and behaviors in high-risk populations. While there is debate about the role of cholera vaccination because of the modest efficacy and limited duration of protection, it will not be a cost-effective intervention without proper messaging and good WASH practices.

Objective: To examine the impact of cholera vaccination on WASH-related behavior by comparing vaccinated and unvaccinated populations.

Methods: 728 households (HHs) were recruited from cholera-vaccinated and unvaccinated groups in Mirpur slum, Dhaka, Bangladesh. Approximately 100 HHs were surveyed every month for 4 key WASH outcomes: household water contamination, self-reported household water treatment, and self-reported and observed hand washing, with and without soap. The first four months of data were examined for an association between WASH outcomes and vaccination.

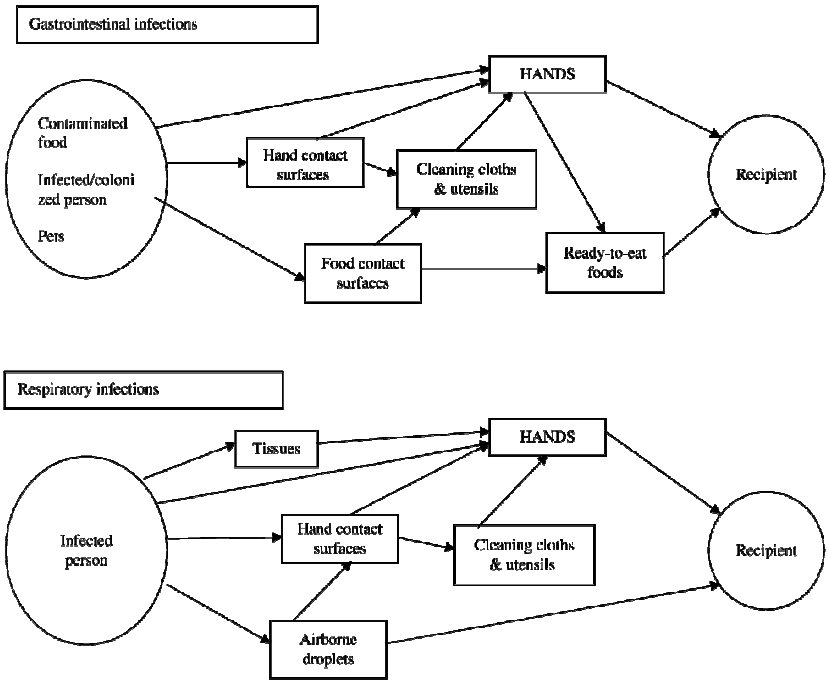
Results: There were no significant differences in the 4 WASH outcomes between the vaccinated and unvaccinated groups. The adjusted odds ratios ranged from 1.10 to 1.57, and included the null value in the 95% CI. In the vaccinated group, 53% reported that they felt protected by the cholera vaccine. There were no significant differences in WASH outcomes for vaccine recipients who felt protected versus those who did not. No consistent time trends in WASH practices were observed over the 4-month study period.

Discussion: Cholera vaccination alone did not change WASH-related behavior. Because vaccination was implemented without providing information on efficacy and duration of protection, it is not possible to determine the impact an effective message may have had on WASH practices. Future studies should examine whether a clear, culturally-appropriate message provided with the cholera vaccine could influence WASH-practices in endemic areas.

INTRODUCTION

The most effective way to limit the spread of fecally-transmitted illnesses is to improve sanitation infrastructure. However, this is a massive undertaking for most low-income countries, and requires time and material resources. The Bangladeshi government hopes to implement a less costly and short-term solution that can benefit the most people for the least expense. The two most frequently promoted behavioral interventions for diarrheal disease prevention, acknowledged by both the Bangladeshi government and the International Center for Diarrheal Disease Research, Bangladesh, are household water treatment and hand washing. Both behaviors have proven effective in the reduction of diarrheal and respiratory illness prevalence in past trials in low-income settings [59] [19]. The World Health Organization has concluded that point-of-use water treatment is one effective approach to reach the Millennium Development Goal of halving the proportion of persons without access to an improved water supply [28]. While findings on the efficacy of hand washing often differ from one geographic region to another [56], it is well recognized that hand washing greatly reduces both diarrheal and respiratory diseases [56]. Figure II illustrates the role of hands in the spread of diarrheal and respiratory illness. The chart conveys the practical role in prevention of washing hands before and after specified behaviors, highlighting the most effective stages to discontinue pathogen transmission.

FIGURE II. PATHOGEN TRANSMISSION PATHWAYS [56]



Despite the body of evidence on the health benefits of both of these activities, early efforts to achieve sustained behavior change in large, at-scale, interventions have resulted in limited uptake [60] [61]. The use of a vaccine intervention can provide additional time to promote uptake of risk-reduction behaviors and to better communicate messages about the benefits of both of these behaviors, including the benefit of the cholera vaccine itself. In order to communicate the vaccine's purpose and benefit effectively, there needs to be transparency and accuracy in the health messages that are included in the vaccine implementation campaign.

The Shanchol vaccine was chosen for this study, based on a randomized placebo trial in a smaller section of the study site in Mirpur. The trial consisted of 330 participants including adults, toddlers and infants. All participants were randomized to

one of two treatments, either receiving the vaccine or a placebo. Vibriocidal antibodies are produced by the human body in response to cholera infection or vaccination [62]. These antibodies were monitored in all study participants as indicators of vaccine-induced immunity. Additionally, the trial demonstrated that the vaccine did not cause adverse health effects. Seventy-two percent of vaccinees developed a humeral immune response compared to only 4.7% of the placebo group. The difference between the two groups was statistically significant in all age groups [19]. This trial concluded that the Shanchol vaccine is safe and immunogenic in all age groups, necessitating its evaluation in a larger vaccine study.

The Government of Bangladesh only expends approximately twenty-six United States dollars (USD) annually per person on health-related costs [63]. Thus there is a significant economic challenge to implementation of a large-scale cholera vaccination campaign. It is not feasible to vaccinate a population as large as that of Bangladesh, or its main city of Dhaka, at nearly 4 USD (not including transportation or administration costs) per person every two to three years. One possible strategy is to target vaccination towards higher risk portions of the population. However, even this strategy will cost the government more than what is already budgeted per individual. A longer-term, self-sustaining solution is needed to ensure that the vaccine is coupled with appropriate messaging about hygiene behaviors that should accompany the vaccine, such as appropriate hand washing frequency and methods and various point-of-use water treatment options. The purpose of implementing this particular vaccine in an endemic setting such as Dhaka, Bangladesh, is to determine the most cost-effective solution for controlling cholera in endemic areas. A vaccine administered on its own to those at

highest risk in the area may achieve this goal. However, the most sustainable option will likely be to ensure that there is enough time allotted by vaccine protection in this population to implement safe, sustainable water, sanitation and hygiene practices. This would enable the government of Bangladesh to administer the vaccine while improvements are made to the country's water treatment and sewage infrastructure.

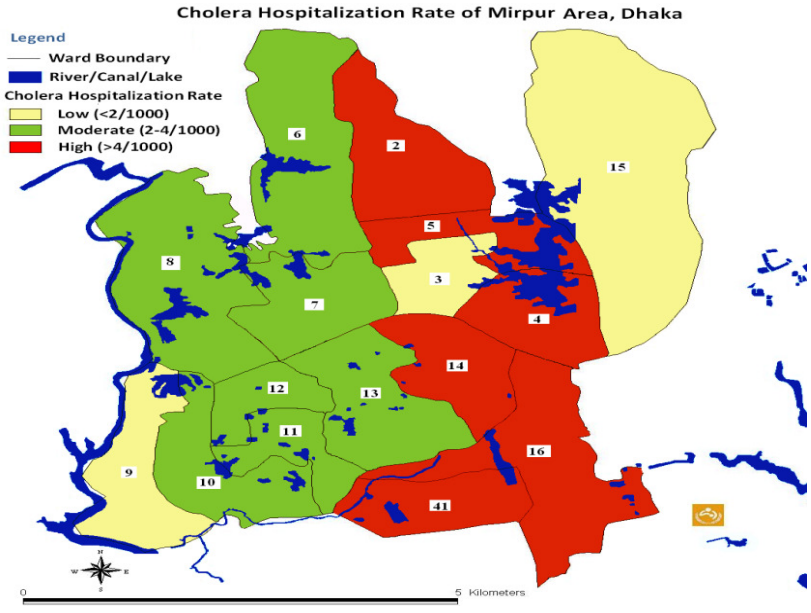
The study's main goal is to examine whether without proper messaging attached to the vaccine there will be maintenance of improved WASH behavior in the vaccinated group in comparison to the unvaccinated group. The objectives of this study are to determine whether there are differences in hand washing and household water treatment practices between vaccinated and unvaccinated populations and to discern whether time since vaccination is important. We hypothesize that without adequate and appropriate education about the way the cholera vaccine works, and the reasons for healthy hygiene practices, people in high-risk settings will consider the vaccine sufficiently protective and fail to be as diligent about point-of-use water treatment and hand washing. We further predict that as time since vaccination increases, those in the vaccinated group will demonstrate a decrease in safe WASH behaviors, ultimately acting no differently or worse than the unvaccinated group.

METHODS

STUDY SITE

The Mirpur section of Dhaka, Bangladesh, is a densely populated, metropolitan area that includes approximately 2.5 million people [19]. This slum area is partitioned into 16 different sections referred to as wards. Based on the data collected through the International Center for Diarrheal Disease Research, Bangladesh's hospital and clinic records, ward sections 2, 4, 5, 6, 14 and 16 have the highest incidence of cholera in the 2-3 years preceding the start of the study in January, 2010 [Figure III.] [19]. These cholera rates were used to ensure that there was uniform dispersal of infection throughout the clusters, ensuring true randomization of the study [19]. It is in this slum area of Dhaka, Bangladesh that the Introduction of the Cholera Vaccine, Bangladesh (ICVB) study is taking place.

FIGURE III. MIRPUR, DHAKA: STUDY SITE [19]



STUDY DESIGN

The study design for the introduction of the cholera vaccine in Bangladesh is a randomized cluster trial. Ninety clusters within this area were randomly selected and divided into three study arms. Each of these 90 clusters had approximately 2,667 individuals enrolled in the study. Pregnant women and children less than one year of age were excluded from the intervention because the vaccine is not recommended for these groups. The clusters were defined within the study area, and each cluster was randomly assigned to one of the three arms: 1) vaccine-only; 2) vaccine-plus-behavior change intervention, or 3) control [19].

Once these clusters were formed, community census workers collected pre-intervention information from all households on household births, deaths, migratory history and diarrheal events occurring within the last two days [19]. This data was collected every six months throughout the course of the study. The non-governmental organization, Dushtha Shasthya Kendra (DSK), managed the delivery of promotional hardware and the rollout of the implementation. This organization has extensive experience within the study area and had established good rapport with the residents of the area.

Households in the slum areas of Dhaka, including Mirpur, are most commonly structured into units, referred to as compounds, that include approximately ten households. Each compound often shares a kitchen space, toilet structure and indoor or outdoor water source [19]. Community hygiene workers visited all the households in the second study arm, vaccine-plus-behavioral intervention, and demonstrated how to make soapy water, explained that each household is responsible for keeping the soapy water

container filled and accessible, as well as maintaining the soap or detergent used to do so [19]. Health messages accompanying the hand-washing portion of the intervention included the various health benefits of hand washing with soap, including hand washing as a way to avoid missing work due to illness, improving the development of children's health, and religious reasons for maintaining cleanliness [19].

Two to four months into the hand washing promotion, community hygiene workers returned to the households to promote the household water treatment portion of the behavioral intervention [19]. This staged approach was found to be more effective in pilot studies than implementing both interventions at the same time. The community hygiene workers demonstrated chlorination and filling of the chlorine dispenser, explained that treated water had a distinctly different taste due to the chlorine and that it should be considered an indicator of safety [19]. Messages similar to those accompanying the hand washing station implementation included various health benefits of water treatment. These conveyed benefits included preventing cholera infection, avoiding missed work due to diarrheal illness, providing treated water to children to further nurture and ensure healthy development, and treating drinking water to avoid consuming other people's germs [19]. Community hygiene workers visited each compound a minimum of three times during the first two months after installation of the chlorine dispenser to troubleshoot difficulties and to encourage regular use of treated water [19].

SAMPLE SIZE

Because each of the arms in the study contains 30 clusters, the sample size figures were calculated to the nearest multiple of 30 prior to further adjustments. To determine

an appropriate sample size, we used an incidence rate of cholera of 2.2 per 1,000 persons per year [19]. There is very little reliable information available about the prevalence of hand washing and household water treatment practices in this area. Therefore, the sample size calculations were based on our best estimates of expected proportions of water treatment and hand washing activity in the vaccinated and unvaccinated study arms. The expected proportions of each activity were 25% and 40% in the unvaccinated and vaccinated groups respectively. The null hypothesis was represented by the equation H_0: $P_1 = P_2$ with the anticipated detectable difference between vaccinated and unvaccinated groups at 12%. The Type 1 error rate was a one-tailed alpha (α) with a level of .05, and power is $1 - \beta$, which was 0.80. P_1 and P_2 were the estimated proportions for the two groups. Using these parameters, the calculations indicated that we needed approximately 350 people in each group (total of 700) to detect a 12% difference or greater in behavior rates with a statistical power of at least 80%.

HOUSEHOLD DATA COLLECTION

Approximately 400 household surveys were implemented on a monthly basis, and included 100 households from the control arm, 100 households from the vaccine-only arm, and 200 households from the vaccine-plus-behavior arm. We used the first four months of data collection, both collectively as well chronologically, using each month as a timeline point. These analyses were used to assess for an association between various water-related behaviors and vaccination status. For some of our descriptive analyses the vaccine-plus-behavioral arm was included to validate differences across study arms. However, most of the analysis ascertained differences between the vaccinated and unvaccinated groups only, without behavioral messaging and hardware implementation.

The survey tool [Appendix C] consisted of questions on demographic information, current and past household water treatment practices, perceived protection of both vaccine and point-of-use water treatment, and hand washing. Additionally, the questionnaire included observational sections to assess current water treatment and hand washing behaviors. Community health workers collected water samples from household storage containers and tested them for fecal contamination. Data was entered into personal display assistants (PDAs) during interviews and then transferred to and analyzed with SAS 9.3.

WATER QUALITY ASSESSMENT

Determination of household water contamination was measured by H_2S tests in each interviewed household [64]. H_2S tests measure the amount of hydrogen sulfide-producing bacteria that are present in water, as an indication of fecal contamination. The reaction of H_2S with iron results in the formation of an insoluble precipitate of iron sulfide [64]. Due to iron sulfide's very low solubility this test can detect even trace amounts of sulfide production. There are many bacteria that release sulfide from proteins through reduction reactions and therefore there are multiple sources possible for a positive H_2S result [64]. Although the test is not specific for fecal contamination solely from human origin, it is simple, low-cost and a useful indicator of microbiological water quality [65]. For the purpose of this analysis, 48-hour H_2S test results, as well as self-reported water treatment, were assessed. The result of the H_2S test can serve as a proxy for water treatment.

HAND WASHING ASSESSMENT

The hand washing assessment in this study was conducted through self-reported questions and direct, prompted, observations. Community health workers (CHWs) asked participants about the frequency and duration of hand washing before and after activities such as defecation, food handing and cleaning infants post-defecation. CHWs also asked participants if they used soap each time they washed their hands and if the respondent could show proof of the soap in the household. During each assessment the CHWs asked an adult and a child under the age of five to demonstrate hand washing behavior. CHWs recorded whether soap was used each time, duration of the individual's hand washing and noted hand cleanliness of a household member.

DATA ANALYSES

The distribution of potential confounding risk factors for cholera was examined to check that they were evenly distributed across the study arms. Descriptive statistics were determined through univariate procedures, chi-square tests and frequency tables. Characteristics of the study population included hand washing prevalence, household water contamination, self-reported water treatments, and beliefs about the protective value of water treatment and cholera vaccination.

Four binary outcomes were assessed, including; H_2S test results after 48 hours, self-reported hand washing behavior, observed hand washing behavior and reported current use of water treatment by any available means. We tested the association between these outcomes and vaccination status. For each of these outcomes, two

different models were analyzed: one including the possible effect modification of time since vaccination, and one crude analysis without elapsed time.

The main SAS analysis consisted of eight logistic regression models, two for each predetermined measurement outcome. These models compared vaccinated households to unvaccinated households to determine the odds of water contamination, hand washing behaviors and current reported water treatment, both controlling for the number of months since vaccination and combined over time. Odds ratios between the two groups were assessed to determine trends of likelihood over time.

RESULTS

Households in all three arms were compared and deemed analogous in terms of size, duration of residence; mean monthly rent, proportion of residents in each that share a toilet, kitchen and water source. Households were also compared and found similar in average household expenditure, number of persons in each household, proportion of each household that reported diarrhea in past two days, and distance of the clusters from the ICDDR, B's hospital in the Mirpur study site [19].

There were no significant differences between the vaccinated and unvaccinated groups with respect to behaviors and perceptions [Table I. and Table II.]. Because there was a lack of data on what perceptions individuals had previous to vaccination we did not assess the effect of perceived protection on behaviors. Instead, the differences between the two groups at each month since vaccination were analyzed.

In the vaccinated group, 19% of the household representatives that were interviewed were male and 81% were female. Thirty-six percent had no education and 70% had five years of education or less. Water sources for households in the vaccinated group were divided as follows: 1% used buckets, 18% accessed a municipal water source, 50% used outside water taps, and 30% used tubewells. Everyone in this group considered boiling their water to be protective against diarrheal disease. Fourteen percent of the respondents reported no history of using water treatment, and only 57% were currently treating their household water, by any means. Almost the entire vaccinated group, 98%, considered water treatment by any method other than boiling to be protective against diarrheal illness, while 54% considered the vaccine itself to be at least slightly protective on a four-step scale from very protective to not at all [Table I.].

TABLE I. BEHAVIORS AND PERCEPTIONS BY VACCINATION STATUS, COMBINED OVER FOUR MONTHS SINCE VACCINATION

Behavior/Perception	Vaccinated		Unvaccinated		Chi-Square
	N	%	N	%	P
Vaccine Protects	191	54	184	49	0.26
Self-reported Water Treatment	200	57	199	54	0.50
Boiling Protects	356	100	369	99	0.09
Treatment Protects	348	98	359	96	0.31
Contaminated Household Water	303	90	312	88	0.45
Self-Reported Hand Washing(HW)	169	47	166	45	0.44
Observed HW with Soap	327	92	327	88	0.07

In the unvaccinated group, 17% of the household representatives were male. Thirty-seven percent had no education, and 72% of them had five years of education or less. Water sources for households in the vaccinated group were divided as follows: one percent used community buckets, 12% accessed a municipal water source, 54% used outside taps or pumps, and 35% used tubewells. Nearly everyone in the unvaccinated group (99% positive response) considered boiling their water to be protective against diarrheal disease. Thirteen percent reported no history of water treatment, and only 55% were currently treating their water, by any means. Of the unvaccinated group, 97% considered water treatment of any method other than boiling to be protective against diarrheal illness, while 50% considered the vaccine itself to be at least slightly protective.

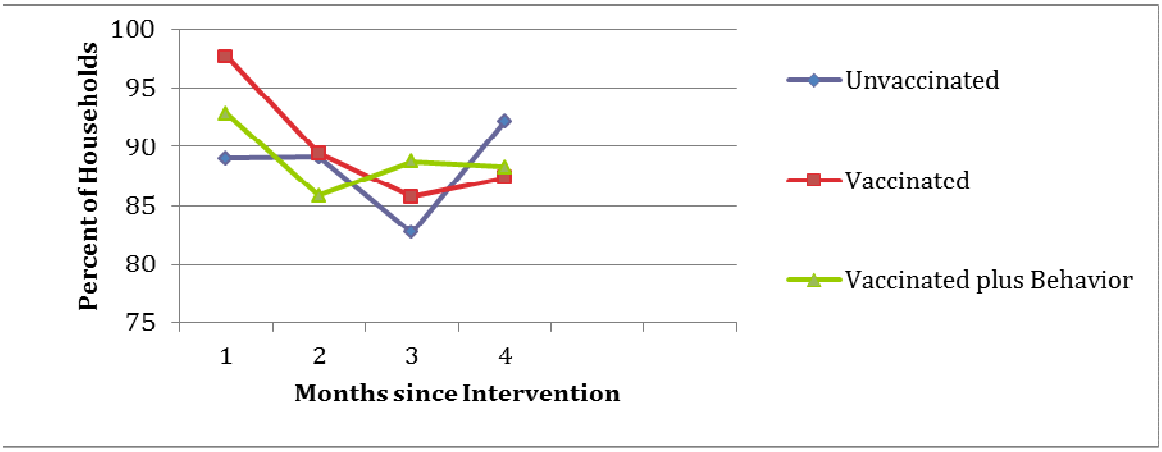
Sixty-one percent of this group had contaminated household water after forty-eight hours, measured by H_2S testing [Figure V.].

TABLE II. BEHAVIORS ACROSS PERCEPTIONS OF VACCINE PROTECTION WITHIN VACCINATED STUDY ARM

Behavior	**Protected**		**Unprotected**		**Chi-Square**
	N	%	N	%	P
Self-reported Water Treatment	113	60	87	54	0.27
Contaminated Household Water	161	89	142	91	0.63
Self-Reported Hand Washing (HW)	92	48	77	47	0.78
Observed HW with Soap	176	92	151	92	0.98

Within the vaccine-only study arm 60% of those that felt protected by the vaccine reported household water treatment, 89% had contaminated household water, 48% self-reported hand washing and 92% were observed using soap when hand washing (Table II.). In the subgroup of the vaccine-only study arm that did not feel protected by the vaccine 54% reported household water treatment, 91% had contaminated household water, 47% self-reported washing their hands and 92% were observed washing hands with soap (Table II.).

FIGURE V. HOUSEHOLD WATER CONTAMINATION



Overall, there was little change in the proportion of households with contaminated water during the four-month follow-up period [Figure V. and Table III.]. One month after the intervention, 89% of the unvaccinated group had contaminated household water, 98% of the vaccinated group's household water was contaminated and 93% of the vaccine-plus-behavior group had contaminated household water. Between one and four months after vaccination there was an increase in household water contamination in the unvaccinated group while the other two groups' household water contamination decreased [Figure V.].

In regards to hand washing behaviors, there was a trend of decreasing hand washing behavior across all study arms. Sixty-one percent of the unvaccinated arm was observed to wash their hands at one month follow-up and 90% of those households demonstrated the use of soap during hand washing [Figure VI. and Table III.]. In the vaccinated group without behavioral intervention, 56% of the households demonstrated hand washing and 96% of these households used soap. The vaccine-plus-behavior arm

had 65% of the households that washed hands at the first month post-vaccination and 91% used soap. In the unvaccinated group, hand washing dropped to 39% by the fourth month of the follow-up period and 85% of these respondents washed with soap [Figure VI.]. Hand washing behavior in the vaccinated group decreased to 37% of the surveyed households, and 92% of those households were observed using soap. In the vaccinated-plus-behavioral intervention group, the overall hand washing decreased from 65% to 38% by four months post vaccination and 92% of these households demonstrated the use of soap [Figure VI.].

FIGURE VI. HOUSEHOLD HAND WASHING: WITH OR WITHOUT SOAP

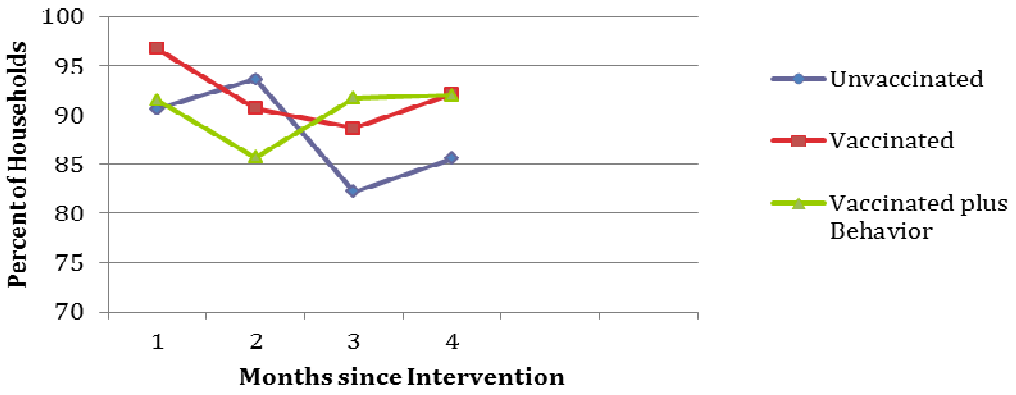


TABLE III. BEHAVIORS ACROSS STUDY ARMS OVER TIME

Behavior	Unvaccinated N (%)	Vaccinated N (%)	Vaccinated + N (%)	Chi-Square P
Household Water Contamination				
After 1 month	81 (89)	85 (97)	167 (92)	0.07
After 2 months	82 (89)	76 (89)	151 (85)	0.61
After 3 months	67 (82)	66 (85)	134 (88)	0.43
After 4 months	82 (92)	76 (87)	150 (88)	0.54
Reported Water Treatment				
After 1 month	58 (62)	52 (58)	101 (53)	0.42
After 2 months	48 (51)	55 (64)	121 (65)	0.07
After 3 months	50 (55)	45 (51)	97 (54)	0.87
After 4 months	43 (49)	48 (53)	106 (62)	0.09
Any Hand Washing				
After 1 month	59 (61)	52 (57)	124 (65)	0.36
After 2 months	40 (42)	44 (51)	89 (47)	0.47
After 3 months	32 (35)	39 (44)	57 (31)	0.11
After 4 months	35 (39)	34 (38)	67 (38)	0.98
Washing with Soap				
After 1 month	87 (91)	89 (97)	173 (92)	0.21
After 2 months	89 (94)	78 (91)	162 (86)	0.11
After 3 months	74 (82)	78 (89)	167 (92)	0.07
After 4 months	77 (86)	82 (92)	161 (92)	0.20

The odds ratios for each behavior outcome in the vaccinated group compared to the unvaccinated group, not taking months since vaccination into consideration, showed minimal differences between each of the groups [Tables IV.-VII.] and all of the 95% confidence intervals for the odds ratios included the null value. The likelihood of water contamination in the vaccinated group in comparison to the unvaccinated group was 1.2, with a 95% confidence interval of 0.74 to 1.96. This indicates a slightly higher likelihood of the vaccinated group not treating their household water as contamination is being used as a proxy for water treatment in this analysis [Table IV.]. The vaccinated group was 1.1 (CI 95%: 0.84, 1.5) times more likely to wash their hands at all [Table V.], 1.6 (CI 95%:

0.96, 2.59) times more likely to wash their hands with soap [Table VI.], and 1.1 (CI 95%: 0.82, 1.48) times more likely to report current water treatment [Table VII.], than the unvaccinated population. The odds ratio of hand washing with soap amongst the vaccinated and unvaccinated groups is notable, with a 60% increased likelihood of soap being used in the vaccinated population [Table VI.].

Assessment for effect measure modification of elapsed time since vaccination on the relationship between vaccination status and the four designated outcomes indicated there was no evidence of significant interaction [Tables IV.–VII.]. However, the significance of the effect measure modification between vaccine status and time in relation to the outcome of household water contamination was marginal (p=0.05) [Table IV.].

TABLE IV. THE ODDS OF CONTAMINATED HOUSEHOLD WATER BY VACCINATION STATUS: COMBINED OVER TIME AND CONTROLLING FOR TIME

Odds Ratio: 1.21 (0.74, 1.96)				
Parameter	**Estimate**	**Standard Error**	**Wald**	**Pr > ChiSq**
Vaccination Status	0.19	0.25	0.58	0.45
Assessing for Time since Vaccination as Potential Effect Modifier				
Vaccination Status	1.35	0.66	4.21	0.04
Months since Vaccination	0.03	0.15	0.05	0.83
Interaction: Elapsed Time and Vaccination Status	-0.44	0.23	3.73	**0.05**

TABLE V. THE ODDS OF HANDWASHING BEHAVIOR BY VACCINATION STATUS: COMBINED OVER TIME AND CONTROLLING FOR TIME

Odds Ratio: 1.12 (0.84, 1.5)				
Parameter	**Estimate**	**Standard Error**	**Wald**	**Pr > ChiSq**
Vaccination Status	0.11	0.15	0.59	0.44
Assessing for Time since Vaccination as Potential Effect Modifier				
Vaccination Status	-0.01	0.36	0.00	0.98
Months Since Vaccination	-0.31	0.09	10.55	0.00
Interaction: Elapsed Time and Vaccination Status	0.06	0.14	0.17	**0.68**

TABLE VI. THE ODDS OF HAND WASHING WITH SOAP BY VACCINATION STATUS: COMBINED OVER TIME AND CONTROLLING FOR TIME

Odds Ratio: 1.57 (0.96, 2.59)				
Parameter	**Estimate**	**Standard Error**	**Wald**	**Pr > ChiSq**
Vaccination Status	0.45	0.25	3.16	0.08
Assessing for Time since Vaccination as Potential Effect Modifier				
Vaccination Status	0.37	0.68	0.30	0.58
Months since Vaccination	-0.26	0.15	3.10	0.08
Interaction: Elapsed Time and Vaccination Status	0.03	0.23	0.02	**0.89**

TABLE VII. THE ODDS OF SELF-REPORTED WATER TREATMENT BY VACCINATION STATUS: COMBINED OVER TIME AND CONTROLLING FOR TIME

Odds Ratio: 1.10 (0.82, 1.48)				
Parameter	**Estimate**	**Standard Error**	**Wald**	**Pr > ChiSq**
Vaccination Status	0.10	0.15	0.43	0.51
Assessing for Time since Vaccination as Potential Effect Measure Modifier				
Vaccination Status	0.04	0.37	0.01	0.92
Months since vaccination	-0.14	0.09	2.28	0.13
Interaction: Elapsed Time and Vaccination Status	0.03	0.13	0.04	**0.85**

The odds ratios for these behaviors [Tables IV.-VII.] range from 1.104 to 1.571 and all of these include the null value in the 95% confidence interval. The results indicate that, without considering passed time since vaccination, those who are vaccinated are 1.5 more times likely to wash their hands with soap. However, the analyses of the data combined over the four-month follow-up period do not allow examination of changes in behavior over time.

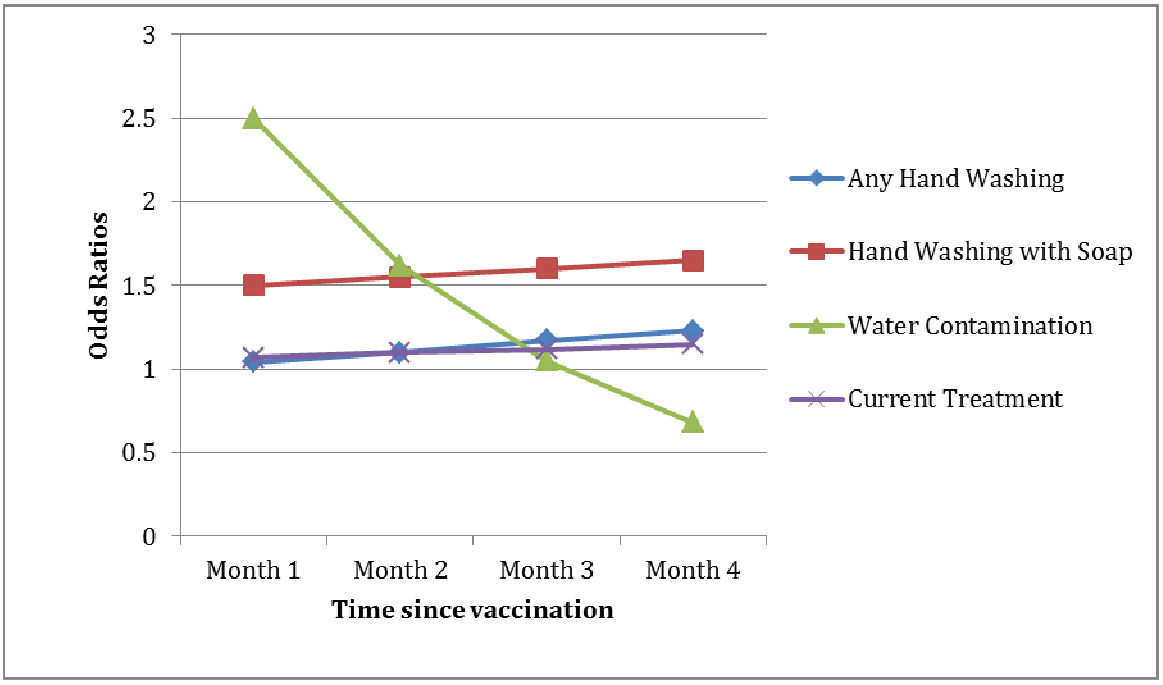
TABLE VIII. ODDS RATIOS BY MONTHS SINCE VACCINATION: CONSIDERING INTERACTION BETWEEN TIME AND VACCINATION

Behavior	Month 1	Month 2	Month 3	Month 4
Household Water Contamination	**2.50**	**1.62**	**1.05**	**0.68**
Any Hand Washing	**1.04**	**1.10**	**1.17**	**1.23**
Hand Washing with Soap	**1.50**	**1.55**	**1.60**	**1.65**
Current Water Treatment	**1.07**	**1.10**	**1.12**	**1.15**

When interaction between time since vaccination and vaccination is considered in the model, there is a modest change over time in the odds ratios for three of the outcome behaviors and a more than three-fold change in the odds ratio for household water contamination [Table VIII]. For three of the four outcomes, the odds ratios increase slightly as time since vaccination increases [Table VIII. and Figure VI.]. The odds ratio for household water contamination greatly decreased over time, suggesting that water quality may have improved due to household water treatment by the vaccinated group [Table VIII. and Figure VI.]. The high odds ratio is likely due to the amount of people in the vaccinated arm that had contaminated water. The low number of people with uncontaminated water skewed the odds ratio away from the null and must be take into

account when assessing these findings. It is unlikely, considering the numbers depicted in Table II. that the odds ratio is truly 2.50 to begin with and that by month four the vaccinated group was less than three fourths as likely to have contaminated household water as the unvaccinated group [Table VIII. and Figure VI.], crossing over the null.

FIGURE VI. ODDS RATIOS OF BEHAVIORS SINCE VACCINATION: CONSIDERING INTERACTION BETWEEN TIME AND VACCINATION



DISCUSSION

The objective of the main 'Introduction of the cholera vaccine in Bangladesh (ICVB) study is twofold: 1) to assess whether there is a role for the cholera vaccine to prevent cholera in endemic areas, and 2) to determine the most effective way to implement the cholera vaccination in endemic areas given the modest efficacy of the vaccine, the relatively short duration of protection, and the limited health budget of the Bangladesh government. The study design of the main ICVB study is a randomized cluster trial made up of three study arms: 1) vaccine-only; 2) vaccine-plus-behavior change intervention, or 3) control. Each study arm consisted of 30 clusters of neighborhoods, each with approximately 2,500 to 3,000 residents. The main ICVB study will continue through December 2014.

This thesis is a sub-study that focuses on comparing WASH behaviors in two groups in the study site of Mirpur Dhaka, the vaccinated-only group and the unvaccinated group. The main hypothesis of this study is that those who receive the cholera vaccine may consider themselves more protected than they really are and may be less likely to practice safe and effective WASH behaviors than the unvaccinated arm. If this, 'disinhibited' trend exists in the vaccinated population of the cholera study it would further substantiate the pattern observed by Brewer et al. in a study of the impact of Lyme disease vaccine on behaviors to reduce risk of Lyme disease [55]. There are few studies of disinhibited behaviors among individuals who receive specific vaccinations, and this issue has not been previously explored in regards to the effect of cholera

vaccination on WASH preventative behaviors. The question of vaccination impact on risk prevention behaviors is particularly relevant to cholera vaccination in endemic areas like Bangladesh because the cholera vaccine does not provide long protection and has a lower efficacy than most other vaccines.

We hypothesize that if appropriate messaging were incorporated into the cholera vaccine campaign, then vaccine recipients would be aware that the vaccine's protection is incomplete and not long term and they would maintain, or establish, safe WASH behaviors. Furthermore, we hypothesized that any adoption of improved WASH behavior is not likely to be sustained without ongoing intervention and support, and therefore we would expect that, in the absence of ongoing support, any differences in WASH behavior between the vaccinated and unvaccinated groups will likely diminish over the 4-month follow-up period.

MAIN FINDINGS

We studied behaviors of the cholera-vaccinated and unvaccinated groups for four months and did not see any difference in two key WASH practices, household water treatment (HWT) and hand washing, between the two groups.

SELF-REPORTED WATER TREATMENT AND HOUSEHOLD WATER QUALITY

Most study households had contaminated household water (88-90%) according to the H_2S test results. Just over half of the study population reported treating their household water (54-57%) over the combined four-month follow-up period. Because the

data on self-reported HWT was not consistent with the high proportion of households with contaminated water indicated by the H_2S test, both outcomes were analyzed separately. The objective H_2S measurements were considered more reliable due to potential over-reporting of HWT. There were no significant differences between the vaccinated group and unvaccinated group in household water contamination (90% vs. 88%) or self-reported water treatment (57% vs. 54%). Based on these results, we concluded that that vaccination did not affect household water treatment practices.

Previous studies of household water treatment have concluded that it is difficult to get populations who receive messages about HWT to actually adopt this practice [66]. Even if households adopt HWT, it is usually not sustained for a variety of reasons and has not been monitored and evaluated for periods much longer than a year [67]. HWT options for developing countries consists of five main approaches: chlorination, biosand and ceramic filtration, solar disinfection, a combination of filtration and chlorination, and boiling [27]. Boiling is typically the most common HWT practiced in low-income settings because of accessibility and convenience. However, costs and time associated with fuel, and hazards from burning may discourage this practice. Other methods continue to pose challenges to long-term implementation. Chlorine disinfection often leads to complaints of bad smell and taste, and the necessary waiting period for disinfection to occur despite a longer disinfected duration. Filtration is difficult to sustain as clay filters are difficult to transport and the initial cost of ceramic candle filters may be high. Another issue with filtration is the need for education on how to maintain and clean the filters [27] [68]. Solar disinfection has not been very successful long-term due to the relatively small amount of water that can be treated at one time, the time it takes to

decontaminate the water, and the need for good solar exposure. This method also requires the supply and use of clean, appropriately sized plastic containers [27] which poses additional challenges in developing settings. The combined method of chlorination and filtration requires the replacement of parts and technical expertise. These requirements, in addition to the need for ongoing education, make this option difficult to sustain.

It is important to acknowledge these barriers to adopting and sustaining HWT because they may independently affect one of the key outcomes in this study – regardless of vaccination status.

SELF-REPORTED HAND WASHING AND OBSERVED HAND WASHING BEHAVIOR

Less than half of all the study respondents reported hand washing (45-47%). However, a high proportion of the study respondents used soap when they were observed washing their hands (88-92%). There were no significant differences between the vaccinated group and unvaccinated group in self-reported hand washing (47% vs. 45%) or observed hand washing behavior (92% vs. 88%). Based on these results, we conclude that vaccination status did not affect hand washing behavior.

Previous studies have found that hand washing is a difficult component of WASH behavior to measure. Researchers question whether it is possible to accurately observe and record hand washing by study participants without impacting their behavior [69]. Recent studies have found that, during observation periods, soap is used and moved 35% more often than when participants are unobserved [69]. It is also important to ascertain

the most effective length of observation time during hand washing studies and what factors may contribute to hand contamination and recontamination [70].

Because of potential over-reporting of hand washing behavior by study participants and altered behavior during observation, the hand washing data in this study must be interpreted with caution. It is unlikely that vaccine status would bias hand washing reporting or behavior differently for the two study groups.

Previous hand washing studies have been conducted in Bangladesh in settings similar to the Mirpur study site, Dhaka, Bangladesh and have documented the difficulty in measuring this behavior [31, 71]. The participants in this study were asked to demonstrate hand washing behavior for the community health worker. This may have resulted in participants demonstrating increased behavioral compliance due to observation, known as the Hawthorne effect [72]. This effect has been documented in hand hygiene studies in the United Sates, resulting in an 8% decrease in behavior compared to when participants were unaware of ongoing observation [73]. A related study limitation is that the community health workers only observed the respondents for a short time period, possibly missing behavior that would have been observed during longer periods of surveillance. The respondents were also prompted to wash their hands for the community health workers. This may have impacted how the respondent hand washed and whether the individual used soap. Respondents may be aware of proper techniques but may be less likely to take the time to practice them when they are not being observed [73].

DIFFERENCES IN WASH BEHAVIOR OVER FOLLOW-UP: WAS THERE A CHANGE OVER TIME?

There was little change in the four key outcomes over the 4-month follow up period (Figure V., Figure VI. and Table II). There was little change in the difference in behavior between the vaccinated and unvaccinated groups over time (Figure VI) except for household water contamination. At 1-month follow up, the adjusted odds ratio for household water contamination was 2.5, and by four months of follow-up, the adjusted odds ratio was 0.68. It is important to note that all of these odds ratios considered possible interaction between elapsed time and vaccination. The observed decrease in the odds ratio of water contamination across vaccination status over the follow-up period may not be an accurate reflection of the true trend. There were a high percentage of households in the vaccinated and unvaccinated study arms that had contaminated household water, and few households with uncontaminated water. These numbers were so low for this particular outcome that the odds ratio in this example is likely skewed away from the null.

Despite the body of evidence on the health benefits of both HWT and hand washing, early efforts to achieve and sustain behavior change in large, at-scale, interventions have not been successful as evidenced by point-of-use water treatment studies conducted in Guatemala by Luby et al. [60] and household water disinfection by chlorine in Zambia, conducted by Olembo et al. [61].

PERCEPTIONS OF VACCINE PROTECTION

Only 50% of the vaccinated population believed that the cholera vaccine provided protection (Table I.). We then looked at whether the vaccinated people who felt protected behaved differently than the vaccinated people who did not feel protected and did not see any differences in water treatment or hand washing (Table II.). The lack of differences in behavior between these two groups suggests that belief in vaccine protection or lack of protection is not sufficient to drive change in WASH behavior.

There are very few studies that have looked at perceptions of vaccine protection and resulting behavior. The only studies we found are in industrialized countries with vaccines that are known to be more efficacious and provide longer-term protection, such as the Lyme disease vaccine and Human Papillomavirus vaccine (HPV) [48] [74]. However, these studies support 'disinhibited' trends in behavior post vaccination.

Like the cholera vaccine, the HPV vaccine is not as efficacious as many recipients believe and nearly one in four girls (24%) believe the vaccine is protective against Sexually Transmitted Infections (STIs) other than HPV [74]. In assessing perceived risk of HPV and other STIs after the initial HPV vaccination, a recent study found that adolescent girls between 13 and 21 perceived themselves to be at less risk after the vaccine, but continued reporting the need for safer sex behaviors [74]. Even though most of the participants in this study reported a continued need for and use of safer sex practices, the perception of reduced need for safer behaviors was measured and recognized through separate analysis of HPV knowledge, concern about infection and knowledge of the mother [74]. This study did not attempt to measure post-vaccination sexual behavior.

The findings of our perception-based analysis differentiates this research study from that of Brewer et al. on Lyme disease vaccination. Brewer et al. found that those who believed the Lyme disease vaccine to be protective acted less safely over time than those who did not believe the vaccine to be protective, often wearing less protective clothing in heavily forested areas, not wearing clothing that was as lightly colored, and more frequently venturing into areas where a heavier infestation of ticks was likely [55].

STRENGTHS AND LIMITATIONS OF THIS STUDY

RANDOMIZED DESIGN

A specific strength of this study is the randomized trial design. Due to this randomization, many of the confounding factors should be controlled. Although the study areas were chosen because of their higher rates of cholera, within the study areas, clusters of households were randomly assigned to the different study arms.

There are limitations to this study that should also be acknowledged.

SHORT FOLLOW-UP PERIOD

This research study was four months in length. Ideally, the relationship between vaccination status and WASH behavior would have been assessed over a longer time period. This abbreviated time frame was due to delays in certain intervention segments and in survey development. Due to this shortened data collection time frame, the results are less decisive. The time trends in WASH outcomes were not consistent and are

difficult to interpret. Our findings may be more conclusive, if further months of data were available for analysis. After more time has elapsed since vaccination intervention, additional analyses may be warranted.

DIFFERENT SUBSETS OF HOUSEHOLDS

One design limitation is that the monthly assessment surveys were of different subsets of households in each study arm each month. Due to this design, it is more difficult to determine whether the associations between vaccine status and the outcome variables change over time. However, because the study has a randomized design, the households that are surveyed each month should be representative of the entire study arm and the observed trends in behaviors should be generalizable to the whole study population.

NO BASELINE DATA ON WASH BEHAVIOR

We were unable to compare behavior before vaccination to behavior after vaccination in the same study populations. Therefore, we cannot determine what changes in WASH behaviors may have been specifically associated with the cholera vaccine intervention and what changes may be due to other factors – such as seasonal changes in WASH behavior.

DIFFICULT TO MEASURE WASH BEHAVIORS

There is often measurement error in self-reported behaviors. For example, study respondents may provide the answer that they thought the data collector wanted to hear by over-reporting "good WASH behavior". This can result in recall bias and social desirability bias. Recall bias occurs when a participant incorrectly remembers an action or motive in response to a question, often due to how the question is formatted and asked. Social desirability bias occurs when a respondent wants to answer an interviewer favorably, resulting in over-reporting of positive behavior and under-reporting of negative behaviors [75]. These biases may have affected the results of the study, dependent upon respondents' knowledge base of WASH behaviors. However, it is unlikely that the bias would have had a different effect in the vaccinated group compared to the unvaccinated group.

H_2S TEST INACCURACIES

The H_2S test of household water quality may be a poor proxy for HWT because: a) the water may have been re-contaminated after treatment; b) H_2S can be produced by non-fecal organisms and may not indicate fecal contamination or health risk, however these organisms are also likely to be inactivated by household treatment; c) the household may have access to clean source water so a negative H_2S test may not be due to water treatment, however this is unlikely based other information about the study area source water [19]. Another limitation of the H_2S test is that it is only a presence/absence test and did not provide information on the magnitude of water contamination.

LACK OF DATA ON HEALTH MESSAGES

Finally, we had no information on the actual health messages provided by the community health workers who interacted with the vaccinated-only arm of the study population. We had no data on whether the households in our study actually received any health messages with the vaccine, if they remember any messages, and if these messages made them change their behavior. There was also no information on whether any messaging had reached these two study groups through verbal communication with participants in a separate vaccine-plus-behavioral intervention study group.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS:

- There was no evidence of an association between cholera vaccination status and WASH behaviors, based on the findings of this study.

- Because there was no proven association between cholera vaccination status and WASH behaviors, additional vaccine messaging and behavior change interventions are necessary to ensure that long-term cholera protection does not depend only on cholera vaccination but also on risk prevention behavior.

- Within the vaccinated-only study group, half of the households felt protected by the vaccine while the other half did not. These perceptions did not impact WASH behaviors. These findings indicate deficient vaccine messaging and a knowledge gap that needs to be assessed and remedied in this high-risk population.

- The findings of this sub-study analysis will contribute to the findings of the larger ICVB study and consequently impact public health endeavors and decision-making about cholera vaccination in endemic, high-risk settings like Mirpur slum of Dhaka, Bangladesh.

RECOMMENDATIONS:

- It is critical to establish whether the time of protection provided by the cholera vaccine can stimulate and/or sustain WASH behaviors in a vaccinated population. Therefore, the analyses and assessments carried out in this research study need to continue for the duration of the larger "Introduction of the cholera vaccine in Bangladesh" (ICVB) study.

- Because no information was provided with the cholera vaccine in this study, we were unable to assess if clear, culturally-appropriate messaging with the cholera vaccine would have an impact on WASH behavior. An important next step will be to test the implementation of vaccine messages in this study population and follow up to determine whether the messages are received, understood, and have an effect on WASH behavior.

- It would be advantageous to add an additional study arm to this study. This additional group would receive behavioral messaging, point-of-use water treatment equipment and hand washing hardware, but not the cholera vaccine. This added group would allow us to measure the protective effect of the behavioral intervention without the cholera vaccine. The households in this study arm could also be compared to households in the behavior-plus-vaccine arm to examining the impact of the vaccine with WASH behavior change, as the counterfactual difference between the two groups.

- A baseline assessment of participants' perceptions of vaccine protection, before the vaccine implementation, would support future analyses. Because we did not have information on perceptions of cholera risk and vaccine efficacy of the study population in the Mirpur area prior to the vaccine administration, it was not possible to determine if the vaccine intervention played a part in altering those perceptions or knowledge base.

- A baseline assessment of WASH behaviors, prior to vaccine implementation would also be beneficial to future research. Because we did not have information on the baseline WASH behaviors in the vaccine-only and unvaccinated groups prior to the vaccine implementation, it was not possible to determine if the vaccine intervention had an impact on those behaviors.

- Due to the complexity of implementing a vaccine program and delivering information on vaccine efficacy and duration of protection, it is critical that the community health workers (CHWs) receive sufficient training. Health messages should be designed for the appropriate education level of the community and the CHWs.

- Better measures of household water quality and use of HWT should be considered for future studies of WASH behavior. Simple, reliable water quality tests that indicate the magnitude of fecal contamination would be more useful than just a presence/absence test for H_2S. Possible measurement of chlorine residual would provide information on whether chlorine disinfection had been used.

- It would be helpful to increase the number of households surveyed each month in the vaccine-only and unvaccinated study arms. This would allow more robust data analyses and decrease the risk of having below 80% power when analyzing the data by month after vaccination. There are often missing households and pieces of data in this type of data collection due to various errors. Larger sample sizes in each study group this would provide more robust study results.

- It would be beneficial to assess the same households in each study arm every month to examine changes in WASH behavior in the same families over time.

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APPENDICES

APPENDIX A: IRB LETTER OF EXEMPTION

EMORY UNIVERSITY | Institutional Review Board

March 12, 2012

Danielle Schaeffner, MPH Candidate
Rollins School of Public Health
Emory University
Atlanta, GA 30322

RE: Determination: No IRB Review Required
eIRB #IRB00054953 - Title: ***Introduction of Cholera Vaccine in Bangladesh: "Impact Evaluation of cholera vaccine and behaviour change interventions in urban Dhaka"***
(Faculty Advisor: ***Christine Moe)***

Dear Ms. Schaeffner:

Thank you for requesting a determination from our office about the above-referenced project. Based on our review of the materials you provided, we have determined that it does not require IRB review because it does not meet the definition of research with "human subjects" or the definition of "clinical investigation" as set forth in Emory policies and procedures and federal rules, if applicable. Specifically, in this project, you will be doing a secondary data analysis on data obtained from the International Center for Diarrheal Disease Research, Bangladesh, to assess whether the cholera vaccine impacts hand washing and water treatment behaviors in Dhaka, Bangladesh. The ICDDR,B has provided this data to you with no HIPAA identifiers, and has agreed never to provide you with identifiers.

This determination could be affected by substantive changes in the study design. If the project changes in any substantive way, please contact our office for clarification.

Thank you for consulting the IRB.

Sincerely,

Rebecca Rousselle, CIP
Assistant Director
This letter has been digitally signed

APPENDIX B: INTERNATIONAL CENTER FOR DIARRHEAL DISEASE RESEARCH, BANGLADESH: LETTER OF PERMISSION

icddr,b

July 27, 2011

Emory University
Institutional Review Board
1599 Clifton Road
5th Floor East
Atlanta, GA 30322

Re: Introduction of the Cholera Vaccine in Bangladesh Study Dataset

This letter is written in regards to the dataset collected for the Introduction of Cholera Vaccine in Bangladesh project at the International Centre for Diarrheal Disease Research, Bangladesh (ICDDR, B). Danielle Schaeffner, a student at the Rollins School of Public Health will be using this data in a secondary data analysis for the master's thesis requirement. As owners of this data we confirm that the data used for the analysis is completely de-indentified and that the student Danielle Schaeffner will not have access to this information at any given time now or in the future.

If you have any questions regarding this information, please contact me at +880-01715130314.

Sincerely,

Leanne Unicomb

Dr Leanne Unicomb
Scientist
Programme on Infectious Diseases and Vaccines

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APPENDIX C: ICVB STUDY QUESTIONNAIRE

Introduction of Cholera Vaccine in Bangladesh (ICVB), 2011-13
Assessment of uptake of handwashing and Point of use water treatment intervention
International Centre for Diarrhoeal Diseases Research, Bangladesh

Table of contents

Section-A: Identification		
ID001a	(Arm ID) Instruction for the PDA programmers: If arm 1, 3 and 4 then show the spillover assessment questionnaire otherwise will not/if arm 2 skip all spillover assessment questionnaire	Vaccine only arm Vaccine plus behavior change arm Control arm Buffer zones
(Instruction for the FRA: First try to identify if this is our enlisted household or not. Ask the respondent the following question :) Can you show me the card given to you/to any of your family member by Cholera hospital people? 1. (Yes) 2. (No) (Please record information in ID 001b, 002a and 003a from the card. If the person is unable to show a card, write '999' in ID 001b, 002a and ID 003a.)(If migrated then ID 003 would be 333)		
ID001b	(Cluster ID- as shown in the respondent's ID card/members ID card)	
ID001	Cluster ID (as shown in the PDA)	
ID002a	(Household ID- as shown in the respondent's ID card /members ID card)	
ID002	Household ID (as shown in the PDA)	
ID003a	Individual ID-as shown in the respondent's ID card)	
ID003	Individual ID-as shown in the PDA	
ID004	(Name of household head)	
ID005	[Household address (detailed)]	

ID006	(Interviewer name)	
ID007	(Interviewer Number)	
ID008	(Date)	

Instruction to the FRA's:
101a. If the person unable to show the id card, please ask him/her: What are the reasons of not being able to show the card?
a) Never have the card
b) Has lost the card.
Has the card, but unable to show.
d) Other_____.
101a If the response is either b, c or d, then ask:
101b. Have you got the Cholera vaccine? Instruction to FRAs: please make them understand what is meant by the cholera vaccine according to their local understanding)
Yes
No
Not sure/Don't know

Section-B: Demographic information
FRA: I would like to begin by collecting a bit of information on you and the people that live in this household.

101		(Name of the respondent)	
102		(Primary language spoken in the home)	1. (Bengali only) 2. (Urdu and Bengali) 3. (Urdu only) 7. [Other (specify)]: _____
103		Sex of the respondent (record by observation)	1. Male 2. Female
104		Your age in years?	Full Years
105		Marital status	1. Married 2. Divorced / Separated 3. Widow(er) 4. Never married
106		At present which of these is the principal source of drinking water for your household? (<u>Instruction for the FRA: Circle only one option; if the options are either 3 or 4, investigate further to ensure the correct response</u>)	1. Municipal supply for individual household level use 2. Hand pump (Municipal supply) outside the house. 3. (Shallow tube well water) 4. (deep tubewell/Boring water) 5. [Supplied by water bearer (in buckets/barrels)] 6. (Well) 7. (Bottled water) 8. Municipal water storage in reservoir 77. Other (specify) _____
107		(For how long have you been living in this compound?)	_____ (weeks) _____(Months) _____ (Years)

108SA		Have you been living in this compound since the first week of June 2011?	1. Yes 2. No with card 3. No without card

Section C: (Observation of Hand cleanliness)

501. (Cleanliness of the palms/fingerpads?) May I please look at your hands?
(Codes):
(Visible dirt) 1
(No visible dirt but unclean appearance) 2
(Clean)..... 3
(Observation was not possible/refused). 4

a. (Fingernails) .....
b. (Palms).....
c. (Fingerpads).....

502. (If there is a child <5 at home, inspect and record the cleanliness of the palms/finger pads of that child. If there are more than one child, inspect the hands of the younger child.)

(Codes:)
(Visible dirt) 1
(No visible dirt but unclean appearance) 2
(Clean)..... 3
(Observation was not possible/refused). 4

Not applicable) (specify)_____
..... 8

a. (Fingernails) .....
b. (Palms).....
c. (Fingerpads).....

Section D: Diarrhea, respiratory disease and acute hepatitis in the household

[Now I would like to ask you about the health of the people that live in this household. Could you please show me the cards that have been given to each of your household members from Mohakhali Cholera Hospital? (Check and note the unique card IDs (a2). If someone cannot show the card, write '999' instead of the unique card ID)(a2)][If migrated then a1 would be 333]

a1. Unique ID in the PDA	a2. Unique ID in the respondent's ID card	b. Name	c. Age Days Months Years	d. Diarrhea in the last 2 days	e. Fever in the last 2 days	f. Cough in the last 2 days	g. Nasal congestion or a runny nose in the last two days	h. Breath-ing difficulties in the last two days

Section E: Treatment, storage and handling of drinking water; treated water testing; reported drinking water practice

503.Can you please show me how you store your drinking water? Ask & observe how drinking water is stored? (>1 response allowed)

a. (Bucket) 1
b. (Drum) 2
c. (Kalashi) 3
d. (Hari) 4
e. (Matka) 5
f. (Bottle) 6
g. (Jerry can) 7
h. (Jug) 8
i. (Mini water tank) 9
j. (Reservoir with chlorine dispenser) 10
k. (Other wide-mouthed container) 11
l. (Other narrow-mouthed container) 12
m. (Double chambered filter).....13
n. (No water stored) ..... .14
o. (Refused to say & show) ..... .98 } Skip to 508

(If 503 is 14 or 98, skip to 508)

504. Observe stored water's covering status (if >1 storage containers, then document the status of the largest one)

1. (Completely uncovered)
2. **(**Partially covered)
3. (Completely covered)

504a. Observe if there is any measuring mark on the storage container?

1. (Yes)(Skips to 505)
2. (No)
8. (Not applicable) (specify)_____

504b. Is there any other container with measuring mark given by CHP?

1. Yes
2. No (Skips to 505)
8. Not applicable) (specify)_____(skip to 505)

504c. Ask to show the container:

1. Has shown the container
2. (Skips to 505) Could not show the container
3. (Skips to 505) Did not agree to show the container

504d. What do you do with the container?

1. To store chlorinated water
2. To store boiled water
3. Use for other work
4. Does not use

505. (Do you have boiled or treated drinking water at home today?)
   1. (Yes)
   2. (No) [Skips to 508]
   8. (Refused to say) [Skips to 508]
   9. (Don't know) [Skips to 508]

506. (How did you treat this water?) (Multiple answers allowed)
   1. (Used halo-tab)
   2. (Used waterguard)
   3. (Used Chlorine dispenser)
   4. (Used filter)
   5. (Boiled water)
   6. (Used fitkiri)
   7. (Do not treat water)
   77. (Other)

507. (If the person reports about boiling, ask: How many times within last 2 days you boiled your water? _____times)

508. Ask to give a glass of water like they give their child to drink. (Can you please give me a glass of water like you would give to your child to drink?)(Observe water handling behavior from your asking to getting water and check following questions. (Yes = 1, No = 2)
a **.** Glass/container washed before water obtained?
If the answer is yes then ask whether

   a1. Washed with only water
   a2. Washed with soap
   a3. Washed with other materials
   b. Hands washed with water (no soap) before water obtained?
   c. Hands washed with soap before water obtained?
   d. Hands/fingers came into contact with water?
   e. Glass dipped into water?
   f. Ladle used to obtain water?
   g. Water poured from container?
   i. Collected water from source directly
   h. Other (Specify)

509. (FRA collected stored water sample for H_2S test?)

1. Yes
2. No (reason of not collecting water)_____

510. FRA collected stored water sample to check residual chlorine?) (Applicable for self reported chlorine product users)

1. Yes
2. No
8. (Refused to provide water sample)

Assessment of practice of drinking treated water by chlorine dispenser/chlorine product:
Who drink treated/untreated water with frequency and when? (Only treated data will be obtained (col:j)and untreated (k) will be obtained automatically by the above instruction.) (Serial number and a1, a2, b and c columns information will be obtained automatically from section 2.

When select treated	Always=1	Most times=1	Sometimes=3	Never=4
Auto untreated	Never=4	Sometimes=3	Most times=2	Always=1

Section F: Chlorine Dispenser recognition and reported usage

(FRA will carry a flip chart with all the intervention products)
(The FRA will show the respondent the picture of chlorine dispenser and will ask:

401	(Do you know what this is?)	1. (Yes) 2. (No)
401a	Did you or your compound receive any of these products (Chlorine dispenser) from ICDDR,B?	1. (Yes) 2. (No)
401b	[Where did you receive this chlorine dispenser?]	1. (Current compound) 2. (Previous compound) 3. (Both) 4. (Neither)
402	[Is there one (or was there one) in the compound you are currently living or in the compound you were living previously?]	1. (Current compound) 2. (Previous compound) 3. (Both) 4. (Neither)
403	(Have you seen this in another compound?)	1. (Yes) 2. (No)
404	(Can you tell me what you would use this for?)	1. (Mentions to treat drinking water) 7. Other **-> Skip to 801** 9. (Don't know **Skip to 801**
405.	(Did you yourself or anybody of your household use it at least once to treat drinking water?)	1. (Yes) 2. (No)**->Skip to 407** 9. (Don't know)**->Skip to 407**

406	(When was the last time you or anybody of your household used it to treat drinking water?)(Read the answers to the participant)	1. (Today) 2. (Yesterday) 3. (Within one week) 4. (Within one month) 5. (1 – 6 months) 6. (More than six months ago) 99. (Don't remember)
407	(In general, how often does your household treat your drinking water with the chlorine dispenser?)(Read the answers to the participant)	[Every time we collect water/always] 2. (Most of the time when we collect water) 3. (Occasionally/sometimes) 4. (Only during dry season/summer) 5. (Only during rainy season) 6. (Only when there is increase in diarrhoeal patients in the community) [OTHER (SPECIFY__] 9. (DON'T KNOW) 8. (Not applicable) (specify)_____
412	(Who is responsible for refilling the chlorine in your Chlorine dispenser most of the time?)	1. (The compound manager) 2. Every family (who use this water source) by rotation 3. (A family volunteers all the time) 4. (My family does it all the time) 5. CHP of ICDDR,B/DSK 7. (Other) 8. Not applicable) (specify)_____ 9. (Don't know)

Section G: (Spot check for chlorine dispensers; source water testing):

801.Can you please show me where the CD is located? (If there are >1 CDs within the compound, record the status of the CD that is near the water source that the respondent use. If there are >1 CDs near the same water source, collect the status of the CD that is fully functional. If both are functional, then collect the status of the CD that has been refilled most recently)

1. (Near the water source from where people collect drinking water)
2. (Near the cooking area)
3. (In the alley/corridor of the compound)
4. (Inside a room)
5. (There is no CD)[Skip to 818]
7. Other (specify):_____

802. (How far is the CD from the water source from where people usually get water? _____ steps away.)

803. (How many people Use this CD that you just showed me?)

1. (Everyone who usually collects water from this nearby source)
2. (Most of the people who usually collect water from this nearby source)
3. (Only a few among those who usually collect water from this nearby source)
4. (Anyone who even do not usually collect water from this nearby source)
5. Now nobody use it
7. others (specify):_____
9. Don't know

804. [Is there lid on the CD holder? (Observe and record)]
1. (Yes)
2. (No)

805. [Is there chlorine tank present? (Observe and record)]
1. (Yes)
2. (No)

806. [Is there a cap on the chlorine tank? (Observe and record)]
1. (Yes)
2. (No)
3. (Not possible to check it)

807. [Is there chlorine in the tank? (Observe and record)]
1. (Yes)
2. (No)

808. [Is the spigot in place? (Observe and record)]
1. (Yes)
2. (No)

809. (When was the CD refilled last time? ___weeks, ____Days, ____Hour ago)

809a. (Is the cue card currently present on/by the CD?)
1. (Yes)
2. (No)

811. [Is there a reservoir available near the chlorine dispenser/to the designated place?]
1. (Yes)
2. (No)->Skip to 816
8. (Not applicable)(specify):_____-> Skip to 816

812. [Is there water in the reservoir (FRA will check and record)]
1. (Yes)
2. (No)-> Skip to 816
8. Not applicable)(specify):_____-> Skip to 816

813. (Is the water in the reservoir (Any type of vessel) treated?
1. (Yes)
2. (No)-> Skip to 816
8. (Not applicable)(specify):_____-> Skip to 816

814. Approximately how long ago was chlorine used to purify water in the reservoir?
_____:_____hh:mm ago)

815. Level of residual chlorine in the water stored in the reservoir _____ (mg/L) [Range: 0.01 to 3.5]

816. (Level of residual chlorine in the household stored water ____)(mg/L) [Range:0.01 to 3.5]
(Applicable if 506=2/3)

817. (Approximately how long ago was chlorine used to purify water? _____:_____hh:mm ago) (Applicable if 506=2/3) (get help from others in hhd if participant doesn't know)

818. (Did the FRA collect water from the source to do H_2S tests?)
1. (Yes)
2. (No) (reason for not collecting the sample)_____
8. (Not applicable)(specify):_____

819. (Did the FRA collect stored water to do membrane filtration tests?)
1. (Yes)
2. No (reason for not collecting the sample)_____
8. (Not applicable)(specify):_____

Section H: (Spot checks for hand washing stations and uptake of hand washing behavior):

Ask the respondent: "Can you please show me where you most often wash your hands?"

1101. Observation/ask if needed: primary handwashing station is shared between multiple households?
1. Yes
2. No
9. Don't know

1102b. (Observation: Record the location where the primary handwashing station is located)

1. Indoors
2. Outdoors in a specific place
3. No specific place (skips to1109)
4. No permission to see (skips to 1109)
7. Other, specify)_____

1103. Observation:
1. ≤ 10 steps of cooking area (stove)
2. > 10 steps from cooking area (stove)

1104. Observation:
1. (≤ 10 steps of the latrine)
2. (> 10 steps from the latrine)

1105. Observation: Is water present at the specific place for handwashing? (Record code in box) (You must actually see water to record "yes"):
1. (Yes)
2. (No)

1106. Observation: Which of the following are present at the handwashing station? (If you observe the listed item, write "1" for "yes" in the box below. If you do not observe the listed item, write "0" for "no" in the box below)

Yes = 1
No = 2

|_____| 1. (Body/hand soap)
|_____| 2. (laundry bar)
|_____| 3. Detergent (powder))
|_____| 4. (Liquid soap)
|_____| 5. (Dishwashing soap)
|_____| 6. (Ash)
|_____| 7. (Mud/Sand)
|_____| 8. (Bucket)
|_____| 9. (Basin)
|_____| 10. (Tubewell)
|_____| 11. Red bucket with tap (provided by ICDDR,B)
|_____| 12. (Soapy water in bottle provided by icddrb.

a. ..... Bottle full
b. ..... Bottle partly full
c..... Only small amount of soapy water at the bottom
d. ..... Empty

|_____|13. Kolshior other containers
|_____|14. (Nothing is there)
|_____|15. (Soap pasted on the wall)
|_____|16. (Cuecard)
|_____|177. Basin provided by ICDDRB
|_____|18. Stool provided by ICDDRB
|_____|19. Soapy water in some other container, not the one provided by ICDDRB. Mark level as above
|_____| 77. Other, specify_____

1107. Whatever is present in the hand washing station, ask the respondent if that is for communal use or for personal use. If the observed item is for personal use, write 0, if for communal use write 1.

|_____| 1. (Body/hand soap)
|_____| 2. (laundry bar)
|_____| 3. Detergent (powder))
|_____| 4. (Liquid soap)
|_____| 5. **(**Dishwashing soap)
|_____| 6. (Ash)
|_____| 7. (Mud/Sand)
|_____| 8. **(**Bucket)
|_____| 9. **(**Basin)
|_____| 10. **(**Tubewell)
|_____| 11. Red bucket with tap (provided by ICDDR,B)
|_____| 12. (Soapy water in bottle provided by ICDDR,B)
|_____|13. Kolshi or other containers
|_____|14. (Nothing is there)
|_____|15. (Soap pasted on the wall)
|_____|16. (Cuecard)
|_____|17. Basin provided by ICDDRB
|_____|18. Stool provided by ICDDRB
|_____|19. Soapy water in some other container, not the one provided by ICDDRB
|_____|77. Other, specify_____

1108. Can you please bring your own soap that you use for washing hands to this handwashing station?

How long did it take to bring the soap to the handwashing station? _____seconds (Not applicable=888) (Do not agree to bring soap=666)

1109. If the Red bucket is there, does it have water in it?

1. Yes
2. No (skip to 1111)
8. Not applicable (specify):_____ (skip to 1111)

1110. How much water is in there?

1. The container is full
2. The container is partly full
3. Only small amount of water at the bottom
4. Empty

1110a. If the red bucket with tap provided by ICDDRB is not there (where it was installed), and if the compound was given it, ask the respondent where the red bucket is?

1. ..... It was returned to the CHP to fix it
2. It is kept in the compound manager's/landowner's house
3. It is kept at my/some other person's home
4. It is kept in kitchen
5. It is kept in other place of the compound
6. It has been sold
7. Other_____ specify_____
8. Not applicable (It is there where it was installed)
9. Don't know

1110b. If red bucket is there, what is the status of it?

1. ..... The bucket is functional
2. The bucket is damaged
    a.Tap broken
    b. tap missing
    c. leaking
    d. Others specify:_____
8. Not applicable

1110c. What is the status of the lid of the red bucket with tap?

1. Is functional
2. Is cracked -broken
3. Is there but not covering the bucket
4. It covers the bucket completely-partially
5. Is missing

1110d. (Who refills the water in the red bucket?)
1. The compound caretaker/manager
2. There are volunteers within the compound to do that
3. Every household does it in shift
4. No specific person
5. No one refills it
6. Only my family do it
7. Other

1111. If there are other kinds of containers, is there water in any of those?
1. Yes
2. No (skip to 1115)
8. Not applicable (specify):_____ (skip to 1115)

1112. How much water is in there? [If there are >1 container with water, record the status of the largest container]
1. The container is full
2. The container is partly full
3. Only small amount of water at the bottom
4. Empty

1113. Is any of these containers (other than the red bucket given by ICDDR,B) for communal use?
1. (Yes)
2. (No) (1115)
8. (Not applicable)(specify):_____ (skip to 1115)

1114. (Who refills the water in it/them?) (Other than the red bucket given by ICDDR, B)
1. (the compound caretaker/manager)
2. (There are volunteers within the compound to do that)
3. (Every household does it in shift)
4. No specific person
5. No one refills it
6. Only my family do it
7. (Other)

1115. (If soapy water bottle is there, who refills the soapy water bottle?)
1. (the compound caretaker/manager)
2. (There are volunteers within the compound to do that)
3. (Every household contributes for it)
4. (This bottle is for personal use)
5. No specific person
6. No one refills the bottle
7. (Other)
8. Not applicable(specify):_____
9. Don't know
10. Only my family do it

1116. "Is there anywhere else you wash your hands?")
1. (Yes)
2. (No) (<u>skip to question 1130)</u>

1117. Observation/ask if needed: secondary handwashing station is shared between multiple households?

1. (Yes)
2. (No)
9. (Don't know)

1118. (Observation: Record the location of the secondary handwashing station.)

1. Indoors
2. Outdoors in a specific place
3. No specific place (skips to 1130)
4. No permission to see (skips to 1130)
7. Other, specify

1119. Observation: is it...

1. (≤ 10 steps of cooking area (stove))
2. (> 10 steps from cooking area (stove)

1120. Observation: is it....

1. (≤ 10 steps of the latrine)
2. (> 10 steps from the latrine)

1121. Observation: Record if water is present at the specific place for handwashing? (Record code in box) (You must actually see water to record "yes"):

1. Yes
2. No

1122**.** Observation: Which of the following are present at the handwashing station? (If you observe the listed item, write "1" for "yes" in the box below. If you do not observe the listed item, write "0" for "no" in the box below.) [Yes = 1, No = 0]

|_____| 1. Body/hand soap
|_____| 2. laundry bar
|_____| 3. Detergent (powder)
|_____| 4. Liquid soap
|_____| 5. Dishwashing soap
|_____| 6. Ash
|_____| 7. Mud/Sand
|_____| 8. Bucket
|_____| 9. Basin
|_____| 10. Tubewell
|_____| 11. Red bucket with tap (provided by ICDDR,B)
|_____| 12. Soapy water in bottle provided by ICDDRB bottle provided by ICDDRB

a. ..... Bottle full
b. ..... Bottle partly full
c. ..... Only small amount of soapy water at the bottom
d. ..... Empty

|_____|13. Kolshi or other container (s)
|_____|14. nothing is there
|_____|15.(Soap pasted on the wall)
|_____|16. (Cuecard)
|_____17. Basin provided by ICDDRB
|_____18. Stool provided by ICDDRB
|_____19. Soapy water in some other container, not the one provided by ICDDRB

|_____| 77. other, specify

1123. Whatever is present in the handwashing station, ask the respondent if that is for communal use or for personal use. If the observed item is for personal use, write 0, if for communal use write 1.

|_____| 1. (Body/hand soap)
|_____| 2. (laundry bar)
|_____| 3. Detergent (powder)
|_____| 4. (Liquid soap)
|_____| 5. **(**Dishwashing soap)
|_____| 6. (Ash)
|_____| 7. (Mud/Sand)
|_____| 8. Bucket
|_____| 9. Basin
|_____| 10. Tubewell
|_____| 11. Red bucket with tap (provided by ICDDR,B)
|_____| 12. (Soapy water bottle provided by ICDDRB)
|_____|13. Kolshi or other containers
|_____|14. (Nothing is there)
|_____|15. (Soap pasted on the wall)
|_____|16. (Cuecard)
|_____17. Basin provided by ICDDRB
|_____18. Stool provided by ICDDRB
|_____19. Soapy water in some other container, not the one provided by ICDDRB
|_____| 77. other, specify

1124. Can you please bring your own soap that you use for washing hands to this handwashing station if not already here? How long did it take to bring the soap to the handwashing station?
_____seconds (Not applicable=888) (Do not agree to bring soap=666)

1125. If the Red bucket with tap is there, does it have water in it?

1. Yes
2. No
8. Not applicable (specify):_____

1125a. Who refills the water in it?

1. The compound caretaker/manager
2. There are volunteers within the compound to do that
3. Every household does it in shift
4. No specific person
5. No one refills it
6. Only my family do it
7. Other

1126. If there are other kinds of containers, is there water in any of those?

1. (Yes)
2. (No)
8. (Not applicable)(specify):_____

1127. Is any of these containers (other than Red bucket with tap given by ICDDR,B) for communal use?

1. Yes
2. No (skip to 1129)
8. (Not applicable)(specify):_____

1128. Who refills the water in it? (Other than the Red bucket with tap given by ICDDR, B)
1. The compound caretaker/manager
2. There are volunteers within the compound to do that
3. Every household does it in shift
4. No specific person
5. No one refills it
6. Only my family do it
7. Other

1129. (If soapy water bottle is there, who refills the soapy water bottle?)
1. The compound caretaker/manager
2. There are volunteers within the compound to do that
3. Every household does it in shift)
4. This bottle is for personal use)
5. No specific person
6. No one refills the bottle
7. Other)
8. Not applicable (specify):_____
10. Only my family do it

Field workers will now ask one child (≥5 years to ≤13 years) of the household to demonstrate where and how he/she usually washes his or her hands after defecation. They will first ask where he/she usually washes hands after defecation. Then they will ask the child to go to that place and handwash as usual after defecation. The field worker will note

1130. Is there any child aged (≥5 years to ≤13 years) present now at home?
1. Yes
2. No, there is no such child in this home (skip to 1139)
3. No, the child is not present at this moment (skip to 1139)

1131. What was the age of the child? _____ Years

1132. What was the sex of the child?
1. Male
2. Female

1133. Did the child wash his/her hand?
1. Yes
2. No, child refuse to demonstrate (Skip to 1139)

1134. (Did he/she wash both the hands?)
1. Yes
2. No

1134a. Where (the place) did the child demonstrate washing his/her hands?
1. At the primary handwashing station spot checked earlier
2. At the secondary handwashing station spot checked earlier
3. At another handwashing station not spot checked earlier
4. In the latrine
5. In the kitchen
6. inside his/her room
7. Other (specify)

1135. What did he/she use to wash his/her hands (Check all that apply)

1. Soap
2. Soapy water (in bottle provided by ICDDR,B)(skip to 1137)
3. (Material other than soap or ash; specify __
4. Only water (skip to 1137)
5. (Pasted soap on the wall)
6. (Mud/Sand) (skip to 1137)
7. Bucket) (skip to 1137)
8. Basin) (skip to 1137)
9. Tubewell) (skip to 1137)
10. Red bucket with tap (provided by ICDDR,B) (skip to 1137)
11. Kolshi or other containers (skip to 1137)

1136. To what extent lather was formed?

1. A lot of lather
2. A little lather
3. No visible lather
8. Not applicable (Those who did not use soap for washing hands)

1137. The total time to spend for washing hands? (Timed with a stop watch) _____sec

1137a. From where did he/she use water to wash her hands?

1. Directly from the municipal tap/hand pump/tubewell (skip to 1135f)
2. Water stored in Red Bucket provided by ICDDR,B
3. Water stored in another container within household (skip to 1137f)
4. Water stored from municipal line(skip to 1137f)
7. Other (specify)_____(skip to 1137f)

1137b. Did he/she use pour it through the red ICDDR,B bucket's tap water?

1. Yes
2. No

1137c. Did he/she take it from the top?

1. Yes
2. No

1137d.Did he/she wash hand(s) under running water?

1. Yes
2. No

1137e. Did he/she wash hand(s) by dipping in washbasin?

1. Yes
2. No

1137f. Where are the materials that the child used for HW?

1. At the primary handwashing station spot checked earlier
2. At the secondary handwashing station spot checked earlier
3. At another handwashing station not spot checked earlier

4. In the latrine
5. In the kitchen
6. inside his/her room
7. Other (specify)

1137g. Was a parent/adult helping child with providing handwashing materials to him/her during the demonstration?

1. ..... Yes
2. ..... No (Skip to 1138)

1137. Where are the materials that the parent/caregiver/adult bring to the child for HW?

1. At the primary handwashing station spot checked earlier
2. At the secondary handwashing station spot checked earlier
3. At another handwashing station not spot checked earlier
4. In the latrine
5. In the kitchen
6. inside his/her room
7. Other (specify)

1138. How were hands dried?

1. Cloth other than own clothing
2. Own clothing
3. Air dry (reflects intentional drying before moving on to other activities /touching anything else)
4. ..... Did not dry hands before moving on to other activities or touching anything else

If there is a child <5years at home, the field worker will ask the mother of the child to go to the usual place where they wash hands after defecation and demonstrate how they usually wash their hands after defecation. If there is no such child at home, then the field worker will ask an adult female (≥17years) to go to the usual place where they wash hands after defecation and demonstrate washing hands. In absence of both such persons, the FRA will ask an adult male (≥17years) to go to the usual place where they wash hands after defecation and demonstrate washing hands. The field worker will note

1139. The person who will demonstrate washing hands was. ...

1. Care giver of <5years
2. Another adult female
3. An adult male

1140. What is the sex of that person (who agreed to demonstrate to wash hands in front of the interviewer?)

1. (Male)
2. (Female)

1141. Did the respondent wash his/her hand?

1. Yes
2. No (Skips to1147a)
3. (Someone else other than the respondent demonstrated washing hands)

1142. **(**Did he/she wash both the hands?)

1. Yes
2. No

1142a. Where (the place) did the person demonstrate washing his/her hands?

1. In the primary handwashing station
2. In the secondary handwashing station

3. In the latrine
4. In the kitchen
5. inside his/her room
7. Other (specify)

1143. **(**What did he/she use to wash his/her hands)
1. (Bar Soap)
2. (Soapy water)
3. Ash (skip to 1145)
4. (Material other than soap or ash; specify (skip to1145) _____
5. (Only water (skip to 1145)
6. (Pasted soap on the wall)
7. (Mud/Sand) (skip to 1145)
8. (Bucket) (skip to 1145)
9. (Basin) (skip to1145)
10. (Tubewell) (skip to1145)
11. Red bucket with tap (provided by ICDDR,B) (skip to1145)
12. Kolshi or other containers (skip to1145)

1144. To what extent lather was formed?
1. A lot of lather
2. A little lather
3. No visible lather

1145. The total time to spend for washing hands (timed with a stop watch) _____sec

1145a. From where did he/she use water to wash her hands?
1. Directly from the municipal tap/hand (skip to 1146)
2. Water stored in Red Bucket
3. Water stored within household(skip to 1146)
4. Water stored from municipal line(skip to 1146)
7. Other (specify)_____(skip to 1146)

1145b. Did he/she use pour it through the red ICDDR,B bucket's tap water?
1.Yes
2. No

1145c. Did he/she take it from the top?
1. ..... Yes
2. ..... No

1145d. Did he/she wash hand(s) under running water?
1. Yes
2. No

1145e. Did he/she wash hand(s) by dipping in washbasin?
1. ..... Yes
2. ..... No

1146. How were hands dried?

1. Cloth other than respondent's/his/her own clothing
2. Respondent's/his/her own clothing

3. Air dry (reflects intentional drying before moving on to other activities or touching anything else)
4. ..... Did not dry hands before moving on to other activities or touching anything else

Instruction for the FRA: At the end of handwashing behavior uptake, if soapy water is present in the household/compound, the FRA will ask for soapy water to wash his/her hands. If soapy water is present at both respondents' household and at compound level, the FRA will use the soapy water prepared for the communal use. The FRA will note the following information:

1147a. Is soapy water present in the compound/household?

1. Yes
2. No (skip to 1004)

1147. To what extent lather was formed?

1. A lot of lather
2. A little lather
3. No visible lather

1148. Ask the responendent or the person who prepared the soapy water how many packet/packets of detergent was added? _____caps (Don't know=999)

1149. Ask the responendent or the person who prepared the soapy water to what amount water the detergent was added? _____ (Don't know=999)

1150. Which brand of detergent was used to prepare this soapy water?
1. Wheel
2. Keya
3. Surf excel
4. Jet
5. No specific brand
6. Other_____
9. Don't know

1151. FRA, please give your personal assessment here as to whether the soapy water had the correct consistency, was too diluted, or was too soapy. On a scale from 0 to 4, with 0 = too diluted, 1 = mild diluted, 2=perfect mix, 3 = mild soapy and 4 = too soapy, what is your score of this soapy water preparation? 0 1 2 3 4 (circle the best score)

4/4	_____
3/3	_____
2/2	_____
1/1	_____
0	_____

Section I: Hand washing Station recognition and reported usage(FRA will carry a flip chart with all the intervention products.) FRA will show the respondent the picture of soapy water bottle and red bucket with tap and stool and basin and will ask the following question, pointing to the bottle:

1004. [Do you know what this is? (Bottle with soapy water)
1 . (Yes)
2. (No)
1004a. Did you/r compound receive BOTTLE for making soapy water from ICDDR, B/DSK?

1. Yes
2. No

1004b. [Where did you receive this chlorine dispenser?]	1. (Current compound) 2. (Previous compound) 3. (Both) 4. (Neither)
1004c. [Is there one (or was there one) in the compound you are currently living or in the compound you were living previously?]	1. (Current compound) 2. (Previous compound) 3. (Both) 4. (Neither)

1005a. Can you tell me what would you use soapy water for?
1. for hand washing
2. Other (skip to 1012)
9. Don't know (skip to 1012)

1005b. When did you or your household use soapy water for hand washing last?
1. (Today)
2. (Yesterday)
3. (Within one week)
4. (Within one month)
5. (1 – 6 months)
6. (More than six months ago)
99. (Don't remember)

If yesterday then ask 1005c otherwise skip to 1005

1005c. How many times did you, yourself use soapy water for handwashing yesterday? _____

1005. Within last 2 weeks did you or any of your family members ever make soapy water at home for your family?
1. Yes
2. No(skip to 1007)
9. Don't know (skip to 1007)

1006. Within last 2 weeks how many times did you/your family members make soapy water at home for your family? _____times [Put 999 if 'cannot remember'; put 888 if 'not applicable'(specify):_____]

1007. (Do you have a soapy water bottle at home today?)
1. (Yes)
2. (No)

1008. Can you show me the soapy water?
1. (Yes)= bottle plus soapy water
2. (No, bottle was empty) [(skips to1010)
3. (No) [(skips to 1010)] =no bottle

[How many seconds did it take to show the soapy water? _____ (sec)]

1009a. (Did you purchase detergent in the last two weeks?)
1. (Yes)
2. [No (Skips to 1010)]

8. [Not applicable (specify):_____ (Skips to 1010)]
9. [Don't know (Skips to 1010)]

1009b. [How much money did you spend on detergent in the last two weeks? _____ (taka)
(don't know=999)

1010.Is there any other household within this compound who prepared soapy water by themselves for their use within last 2 weeks?

1. Yes
2. No
9. Don't know

1011. Did you or anyone from the neighbourhood/compound prepare soapy water for communal use within last 2 weeks? (>1 answers allowed)

1. I/my family did it
2. The compound manager did it
3. Several families within the compound did it by rotation
4. A family volunteered to do that
5. Other
6. No one did it
9. Don't know

1011a. How many days does a full bottle of soapy water last in your compound? ___Days ___weeks [write 888 if 'not applicable' & '999' if 'don't know']

1012. Do you know what this is? (Red bucket with tap and stool and basin supplied by ICDDR,B)]

1. Yes
2. No

1013a. Did you/your compound receive Red bucket with tap, stool and basin from ICDDR,B?

1. Yes
2. No

1013b. [Where did you receive the red bucket with tap, stool and basin from ICDDR,B?]	1. Current compound 2. Previous compound 3. Both 4. Neither
1013c. [Is there in the compound you are currently living or in the compound you were living previously?]	1. Current compound 2. Previous compound 3. Both 4. Neither

1013. Did you ever use it?

1. Yes
2. No (skip to 1014)

1013b. For what?

1. To wash hands
2. To store water

3. To wash cloths
4. Others specify_____

1014a. When did you or your household use red bucket with tap for handwashing last?

1. (Today)
2. (Yesterday)
3. (Within one week)
4. (Within one month)
5. (1 – 6 months)
6. (More than six months ago)
99. (Don't remember)

If yesterday then ask 1014b otherwise skip to 1014

1014b. How many times did you, yourself use red bucket with tap for handwashing yesterday?
_____ times

1014c. In the last 2 weeks, how often have you used the red bucket for handwashing?

1. several times a day
2. once a day
3. once a week
4. never

1014c. How long does the water in the bucket last you?

1014. Right now, do you have any soap (other than soapy water) in the house that you use for handwashing?

1. (Yes)
2. [No (Skips to 1018)]
9. Don't know (Skips to 1018)

1015. Can you show me the soap? (Observe)

1. Yes
2. No, soap unobservable (in use elsewhere, none in the house, etc.) (Skips to1018)

1016. (How long did it take to show the soap? _____second)

1017. What kind of soap is it? (Fill in based on observation. Put 1= Yes and 0=No)

|_____|1. (laundry soap)
|_____|2. (Powdered detergent)
|_____|3. (dish soap)
|_____|4. (body/hand soap)
|_____|5. (Liquid soap)
|_____|7. (Other _____)

1018. Do you have any spare unused soap in the house? (a second bar/package that is unopened)

1. (Yes)
2. [No (Skips to 1024)]
9. [Don't know (Skips to 1024)]

1019. Can you show me the soap? (observe)

1. Yes

2. No (Skips to 1024)

1020. (How long did it take to show the soap? _____seconds)

1021. What kind of soap is it? (Fill in based on observation. Put 1= Yes and 0=No)

|_____|1. (Laundry bar soap)
|_____|2. (Powdered detergent)
|_____|3. (Dish soap)
|_____|4. (body/hand soap)
|_____|5. (Liquid soap)
|_____|7. [Other _____]

1022. If the respondent showed bar soap(s), how many bars of each size hand/ body soap did he/she show you?

1. _____ (small)
2. _____ (medium)
3. _____ (large)

1023. If the respondent showed detergent packet(s), how many of each size detergent packet(s) did he/she show you?

1. _____ (small)
2. _____ (medium)
3. _____ (large)

1024. (Did you purchase laundry soap in the last two weeks?)

1. (Yes)
2. [No]
8. Not applicable (specify):_____
9. Don't know (skip to 1026)

1025. How much money did you spend on laundry soap in the last two weeks? _____ (taka)(don't know=999)

1026. Did you purchase hand/ body soap in the last two weeks?)

1. Yes
2. No
8. Not applicable (specify):_____
9. Don't know

1027. (How much money did you spend on hand/ body soap in the last 2 weeks? _____ (taka) (don't know=999)

1028**.** (How many bars of each size hand/ body soap did you buy in the last one month? ____)

1. _____ (small)
2. _____ (medium)
3. _____ (large)

1029. (Is there any place within this compound where soap has been attached to the wall?)

1. Yes

2. No (skip to 1001)
9. Don't know (skip to1001)

1031. Can you show me the soap/soaps attached to the wall? (observation) (>1 response allowed)

1. It is in the latrine
2. It is in the kitchen
3. In the handwashing station
4. No soap could be observed
7. Other place (specify)_____

Section J: (Respondent's reported hand washing practice:

1001. How frequently do you wash your hands with the materials that I am going to mention to you now? [Ask about each of the options and ask them if they practice this 'always', 'most of the time', 'sometimes' and 'never'; if not applicable, write '888']

Name of the handwashing agents	1. Always	2. Most of the time	3. sometimes	4. Never
a. body/hand soap				
b. dish soap				
c. laundry soap				
d. ash				
e. Soapy water				
f. only water				
g. mud				
h. powdered detergent				
Soap pasted on the wall				

1002. How frequently do you wash your hands with water alone at each of the times I am going to mention now? [Ask about each of the options and ask them if they practice this 'always', 'most of the time', 'sometimes' and 'never'; if not applicable, write '888']

Time to wash hands	1. Always	2. Most of the time	3. Sometimes	4. Never	8. Not applicable (specify)
a. Before eating					
b. After eating					
c. Before feeding a child					
d. After cleaning the child's anus					
e. After cutting fish or meat					
f. After defecation					

g. Before cutting vegetables, fruit, salad, mashing any food					
h. Before touching cooked food					
i. After touching cooked food					

1003. How frequently do you wash your hands with soap/soapy water at each of the times I am going to mention now? [Ask about each of the options and ask them if they practice this 'always', 'most of the time', 'sometimes' and 'Never'; if not applicable, write '888']

Time to wash hands	1. Always	2. Most of the time	3. sometimes	4. Never	8. not applicable (specify):_____
a. Before eating					
b. After eating					
c. Before feeding a child					
d. After cleaning the child's anus					
e. After cutting fish or meat					
f. After defecation					
g. Before cutting vegetables, fruit, salad, mashing any food					
h. Before touching cooked food					
i. After touching cooked food					

Section K: Knowledge about water and hand hygiene

(Now I am going to read you a variety of statements. For each statement, I would like to know how much you agree or disagree with the statement. There are no right or wrong answers – I only ask that you tell me your honest opinion on these statements. Because this may not be like previous questions you have answered, I would like to do an example:) (Cooking rice is easy. Do you agree or disagree with this statement?)

(If Agree: Okay – you agree that cooking rice is easy. Now, I would like to know how strong you agree with the statement. Would you say that you slightly agree with the statement that cooking rice is easy or would you say that you that you strongly agree with the statement that cooking rice is easy?).
(If Disagree: Okay – you disagree with the statement that cooking rice is easy. Now I would like to know how strong you disagree with the statement. Do you slightly disagree with the statement or do you strongly disagree with the statement?)

Ok – Would you like to do one more practice session?
Rickshaws are the best way to travel.

301A	Boiling drinking water is the best way to protect against diarrhea	1. (Strongly disagree) 2. (Slightly disagree) 3. (Slightly agree) 4. (Strongly agree)
301B	Water that looks clear is safe to drink	1. (Strongly disagree) 2. (Slightly disagree) 3. (Slightly agree) 4. (Strongly agree)
301C	Treating drinking water will protect against diarrhea	1. (Strongly disagree) 2. (Slightly disagree) 3. (Slightly agree) 4. (Strongly agree)
301D	After using the toilet, it is okay to just rinse hand with water	1. (Strongly disagree) 2. (Slightly disagree) 3. (Slightly agree) 4. (Strongly agree)
301E	Washing hands with soap after eating food is an important way to protect against diarrhea	1. (Strongly disagree) 2. (Slightly disagree) 3. (Slightly agree) 4. (Strongly agree)
301F	After cleaning a child's bottom, it is only important to wash hands if you can see feces on your hands	1. (Strongly disagree) 2. (Slightly disagree) 3. (Slightly agree) 4. (Strongly agree)
301G	Eating spoiled foods will cause diarrhea	1. (Strongly disagree) 2. (Slightly disagree) 3. (Slightly agree) 4. (Strongly agree)
301H	It is not important to wash hands before touching fruits and vegetables	1. (Strongly disagree) 2. (Slightly disagree) 3. (Slightly agree) 4. (Strongly agree)

301I	Taking cholera vaccine will not protect against severe diseases like cholera and diarrhea	1. (Strongly disagree) 2. (Slightly disagree) 3. (Slightly agree) 4. (Strongly agree)
301J	It is important to wash hands before touching food that is to be served	1. (Strongly disagree) 2. (Slightly disagree) 3. (Slightly agree) 4. (Strongly agree)
301K	Rinsing hands with water will protect against diarrhea	1. (Strongly disagree) 2. (Slightly disagree) 3. (Slightly agree) 4. (Strongly agree)

(Now I am going to ask you about specific methods of treating drinking water – for each of these, I would like to know if you have heard of this method, if you have ever used it, and how effective you think it is at purifying water.)

	(Have you heard of people…to make water safe for drinking?)	(Have you ever used this to make your drinking water safe?)	(How effective do you think this is for purifying drinking water: not effective, somewhat effective, or very effective)
A. Boiling	302A1 1. (Yes) 2. (No) -> 302B1 9. (Don't know) -> 302B1	302A2 (PLEASE NOTE – NO SKIP CODES ON THESE) 1. (Yes) 2. (No) 9. (Don't know)	302A3 1. (Not effective) 2. (Somewhat effective) 3. (Very effective)
B. Filtering with a cloth	302B1 1. (Yes) 2. (No) -> 302C1 9. (Don't know) -> 302C1	302B2 1. (Yes) 2. (No) 9. (Don't know)	302B3 1. (Not effective) 2. (Somewhat effective) 3. (Very effective)
C. Sedimentation	302C1 1. (Yes) 2. (No) -> 302D1 9. (Don't know) -> 302D1	302C2 1. (Yes) 2. (No) 9. (Don't know)	302C3 1. (Not effective) 2. (Somewhat effective) 3. (Very effective)
D. Aluminum sulphate	302D1 1. (Yes) 2. (No) -> 302E1 9. (Don't know) -> 302E1	302D2 1. (Yes) 2. (No) 9. (Don't know)	302D3 1. (Not effective) 2. (Somewhat effective) 3. (Very effective)

E. Chlorine tablets	302E1 1. Yes 2. No -> 302F1 9. Don't know -> 302F1	302E2 1. Yes 2. No 9. Don't know	302E3 1. Not effective 2. Somewhat effective 3. Very effective
F. Chlorine powder	302F1 1. Yes 2. No -> 302G1 9. Don't know -> 302G1	302F2 1. Yes 2. No 9. Don't know	302F3 1. Not effective 2. Somewhat effective 3. Very effective
G. Filter	302G1 1. Yes 2. No -> 302H1 9. Don't know-> 302H1	302G2 1. Yes 2. No 9. Don't know	302G3 1. Not effective 2. Somewhat effective 3. Very effective
H. Chlorine dispenser	302H1 1. Yes 2. No (skip to 303) 9. Don't know (skip to 303)	302H2 1. Yes 2. No 9. Don't know	302H3 1. Not effective 2. Somewhat effective 3. Very effective

303	Do you have access to gas to boil your water?	1. Yes 2. No
304	What do you do if you do not have treated water at home?	1. (Drink directly from source water) 2. (Drink untreated stored water) 3. (Buy bottled water) 4. (Take water from the neighbours who are known to treat their water) 5. (Never drink untreated water) 7. Other (specify)_____ 8. (Not applicable) (specify)_____
304a	what else have you do if you do not have treated water at home- I will read a list (and collect any further options)	1. (Drink directly from source water) 2. (Drink untreated stored water) 3. (Buy bottled water) 4. (Take water from the neighbours who are known to treat their water) 5. (Never drink untreated water) 6. Nothing else 7. Other (specify)_____ 8. (Not applicable) (specify)_____

Section L: Exposure to the ICVB Behavior Change Intervention by icddrb/dsk CHPs

1032a. Have you had a discussion or received information about treating your drinking water with chlorine, in the last month?

1. Yes
2. No

1032b. Who have you discussed with or received information from?

1. Friend
2. Family member
3. Icddr,b/DSK CHPs
4. Other NGO CHPs
5. Medical practitioner
6. School based interaction
7. Mosque based interaction
8. Neighbor
9. Other (Specify):----------

1032c.Have you had a discussion or received information about handwashing with soap/soapy water, in the last month?

1. Yes
2. No

1032d. Who have you discussed with or received information from?

1. Friend
2. Family member
3. Icddr,b/DSK CHPs
4. Other NGO CHPs
5. Medical practitioner
6. School based interaction
7. Mosque based interaction
8. Neighbor
9. Other (Specify):----------

1032e.There are community health promoters sponsored by an organization known as DSK and by icddrb – they carry those logos on their IDs, who do promotion in some neighborhoods and not in others. Have you seen them in your neighbourhood?

1. Yes
2. No

1033. How many courtyard sessions by an icddrb/dsk CHP have you or a member of your household attended within last 1 month? _____times (If not applicable, put 888)

1032. How many times did an icddrb/dsk CHP visit your compound within last 1 month? _____ [put 999 if don't remember] (Not applicable=888)

1034. How many time did theicddrb/dsk CHP visited you at home until today? _____

1034a. How many times have you or members of your household attended a tea stall session?_____times (Not applicable=888)

1034b. How many times did your children attend a children's meeting by icddrb/dsk CHP? _____times (Not applicable=888)

1034c. What is the name of the icddrb/dsk CHP who comes to your home/compound? _____ (Not applicable=888)

1034d. Did the icddrb/dsk CHP negotiate with you and your compound before installing any technologies/hardware

1. Very well
2. Somewhat
3. did not negotiate
8. Not applicable

1034e. Regarding the flipcharts/books, do you remember learning from looking at the pictures,

1. A lot
2. Some
3. None
8. Not applicable

1034f. Regarding drinking water treatment, would you say that you learned

1. Many new things
2. Some new things
3. Nothing new from the icddrb/dsk CHP
8. Not applicable

1034g. Regarding the watertreatment machine and medicine, do you find it

1. Very useful
2. Somewhat useful
3. Not useful
9. Not applicable

1034h. Regarding handwashing practice, would you say that you learned

1. Many new things
2. Some new things
3. Nothing new from the icddrb/dsk CHP
1. Not applicable

1034i. Regarding the handwashing technologies/hardware, do you find them

1. Very useful
2. Somewhat useful
3. Not useful
8. Not applicable

1034j. Do you still consult the water treatment cue card?

1. Yes
2. No
8. Not applicable

1035.Did you share any of your concerns related to drinking water treatment with the CHP?

1. Yes
2. No

1036. Did the CHP help you find a solution?

1. Yes, partly
2. Yes, complete solution
3. No

1037. Do you still have problem now?

1. Yes
2. No

1038. Did you share any of your concerns related to handwashing with the CHP?

1. Yes
2. No (skip to sec M)
3. Don't know (skip to sec M)

1039. Did the CHP help you find a solution?

1. Yes, partly
2. Yes, complete solution
3. No

1040. Do you still have problems now?

1. Yes
2. No

Section M: Exposure to other water and hygiene interventions by other NGOs- ask all arms

413. Do you know if this householdwas visited by a community health promoter who was not from ICDDR.B/DSK?

1. Yes
2. No (Skip to 601)
9. Don't know (Skip to 601)

414. Did the person carry any of these logos that I am going to show you now? (Multiple responses allowed)

1. Care
2. Plan International
3. Water Aid
4. ICDDR,B
5. DSK
6. Don't know
7. Other

415. Instructions for the FRAs: Based on the response at 414, try to determine if the CHP was from any of the following NGOs other than ICDDR,B

1. Care
2. Plan International
3. Water Aid
4. Other: Specify _____
9. Could not determine

416. tell me if the health promoters talked about the following: (ask the respondent about each of the options) (Multiple answare allowed)(If 1 and 2 both answers have come then avoid skip)

1. Handwashing
2. Water treatment(skip to 416b)
3. None of these(skip to 601)
4. Nutrition

5. Sanitation

416a. Do they provide any hand washing agent (soap/detergent)?(If in Q416,1 and 2 both answers have come then avoid skips)

1. Yes
2. No(skip to 417)

416b. Water treatment Provisions?

1. Boiling?(skip to 601)
2. Did they provide free Chlorine tablets ?
3. Did they provide free Liquid chlorine?
4. Did they provide free chlorine powder
5. Did they provide free filter?
7. Others:_____

416c. Check the product for the name/logo of the NGO and record if it is from….

1. Care
2. Plan International
3. Water Aid
4. Other: Specify _____
8. Not applicable (Could not show)
9. Could not determine

417. Did the CHPs leave any leaflets/posters/brochures behind?

1. Yes
2. No (Skip to 601)
9. Don't know(Skip to601)

418. Could I take a look at them? Note the name of the NGO:

1. CARE
2. Wateraid
3. Plan International
4. Name of the NGO could not be determined
8. Not applicable (Could not show any leaflets/posters/brochures) (skip to 601)

419. What information do the leaflets/posters/brochures have?

1. Promoting water treatment
2. Promoting hand washing hygiene
7. Others:

Section N: (Socio economic status and sanitation facilities)

601**. (**Can the respondent read newspaper and/or write?)

1. (Cannot read or write)
2. (Can read but cannot write)
3. (Can read and write)

602. (What is the highest level of education of the respondent? _____years of education)

603. [How many rooms do you have in your house? (Excluding kitchen and bathroom)_____]

604. (What is the ownership status of the house where your household is currently living?)
1. (Self owned)
2. (Rental)
3. (Government land)
4. (Living in someone's house without giving rent)
7. (Other (specify)_____)

605. (Does your household own any homestead land?)
1. (Yes)
2. (No)
8. (Refused to say)
9. (Don't know)

606. (Does your household own any land other than homestead land?)
1. (Yes)
2. (No)
8. (Refused to say)
9. (Don't know)

607. [Does your household/family own any of the followings? (WRITE 1=yes and 2=No)]
|____| (A) Bicycle
|____| (B) Motor cycle
|____| (C) Baby taxi/CNG
|____| (D) Rickshaw/van
|____| (E) Working radio/Cassette Player/CD player
|____| (F) Working television/VCD
|___ | (G) Working computer
|____| (H) Working mobile Phone
|____| (I) Working refrigerator
|____| (J) Bed/chouki
|____| (K) Sofa set
|____| (L) Working sewing machine
|____| (M) locally made holder for clothings
|____| (N) Blanket
|____| (O) Almira/wardrobe (wooden/steel)
|____| (P) Electricity connection

608. (For the purpose of our research, would you please tell us your total monthly household income? (Please sum up your income from all sources like wage, rent, agriculture etc.) _____taka)

609. (What kind of fuel do you use for cooking?)
1. (Wood/ charcoal)
2. (Kerosene)
3. (Natural gas)
4. [Electricity (Electric heater)]
5. (Husk/ Dust ofWood)
7. (Other_____)

610. (What kind of toilet facility do the children less than three years old in your household use?) (ask and observe) (>1 answers allowed)

1. (Water sealed latrine in the home) (skip to 611)
2. (Water sealed latrine outside the home shared by multiple households)(skip to 611)
3. (Pit latrine in the home) (skip to 611)
4. (Pit latrine outside of the home shared by multiple households)(skip to 611)
5. (Potties)
6. (Hanging latrine) (skip to 611)
7. (No fixed place) (skip to 611)

77. (Other__) (skip to 611)

8. [Not applicable (if there is no such children at home)] (skip to 611)
10. (Latrine Without Water seal in the home) (skip to 611)
11. (Latrine Without Water seal shared by multiple households) (skip to 611)

610a. Where are potties emptied?

1. (Water sealed latrine in the home)
2. (Water sealed latrine outside the home shared by multiple households)
3. (Pit latrine in the home)
4. (Pit latrine outside of the home shared by multiple households)
5. (Hanging latrine)
6. (No fixed place)
7. (Latrine Without Water seal in the home)
8. (Latrine Without Water seal outside the home)

77. (Other__)

10. (Latrine Without Water seal in the home) (skip to 611)
11. (Latrine Without Water seal shared by multiple households) (skip to 611)

611. [What kind of toilet facility do the adults in your household use? (ask and Observe)]

1. (Water sealed latrine in the home)
2. (Water sealed latrine shared by multiple households)
3. (Pit latrine in the home)
4. (Pit latrine outside of the home)
5. (Hanging latrine)
6. (No fixed place)
7. Other _____

10. (Latrine Without Water seal in the home)
11. (Latrine Without Water seal shared by multiple households)

FRAs will not ask this question (to the respondents). They will just observe it and check the options

611a. What kind of toilet facility do members of your household usually use?

<u>Improved sanitation facilities</u>

[Flush or pour flush toilet flushed to:]

01 (Piped sewer system)
02 (Septic tank)
03 (Flush to pit latrine (Off set)]
04 [Pit latrine with slab & water seal]
05 [Pit latrine with slab & no water seal but with a lid]

06 [Ventilated Improved Pit Latrine (VIP)]
07 [Pit Latrine with slab but without ventilation and no water seal]
08 [Composting toilet, *(Composting toilet ensure separation of urine, water and excreta)]*
09 (Dual Pit Latrine)

Unimproved sanitation facilities

10 [Flush or pour flush toilet connected to somewhere else (canal, ditch, river, etc.)]
11 [Pit latrine without slab /Open pit]
12 (Bucket)
13 (Hanging toilet)

Open defecation

14 (No facility / bush / field)

612. Does more than one household share the same toilet?)

1. Yes
2. No (Skips to next section)

613. [How many households (including the respondent's household) are there within this compound?__

614. (How many toilets are there within this compound? _____

701. (Observethe condition of the clothing carefully (without asking anything) and record)

1. (No holes/tears)
2. (A few holes/tears)
3. (Many holes/tears)

702. (Are there child faeces visible in the compound (other than in a designated pile)?

1. (Yes)
2. (No)

703. [Are there animal feces visible in the compound (other than in a designated pile)?]

1. (Yes)
2. (No)

704. (MAIN EXTERIOR Construction materials of the walls)

1. (Mud/sticks/reeds/branches)
2. (Corrugated iron/tin)
3. (Fired bricks)
4. (Wood)
5. (Cement/concrete)
7. (OTHER (SPECIFY):)_____

705. Construction material of the floor)

1. (Earth/mud/dung/sand)
2. (Cement/concrete)
3. (Wood)
7. (Other (specify):)_____

706. Construction material of the roof)

1. (Mud, branches)

2. (Wood)
3. (Corrugated iron/tin)
4. (Cement/concrete)
7. Other (specify):_____

707. (How does your household dispose of most of its wastes? (ask and Observe))
1. (THROW IN A SPECIFIED PLACE)
a. Designated pile in the compound
b. Designated Garbage dump
c. Collection service
d. others (specify)
2. (THROW IN DRAINS/ LAKES/ STREAMS)
3. (No specific place to dispose the wastes)
7. OTHER (SPECIFY)_____

708. [In which category the socioeconomic status of this household fit? (Interviewer will circle an option based on his/her own observation and assessment)]
1. (Very poor)
2. (Somewhat poor)
3. (Neither poor nor rich)
4. (Somewhat rich)
5. (Very rich)

Section O: Spillover Assessment:

POU Hardware recognition assessment

422aSA. Do you recognize the chlorine dispenser because you saw it or because you heard about it?
1. I saw it (stop after 422bSA and go to next section)
2. I heard about it (go to 422cSA)
3. Both

422bSA.]Where did you see the chlorine dispenser? (This is not free response. FRA asks about each possible option. Put 1 for each positive response, else 0. [>1 response allowed]
1. Compound of friend/neighbor __
2. Compound of relative __
3. Tea stall __
4. Poster __
7. Other __
9. Cannot remember

422cSA. From whom did you hear about the chlorine dispenser? (This is not free response. FRA asks about each possible option. Put 1 for a positive response, else 0.) [>1 response allowed.]
1.Medical practitioner __
2. Someone at school __
3. Friend/Neighbor __
4. Relative/Spouse __
5. Mosque attendee __
6. Tea stall patron __
77. Other(Specify) _____

POU Motivational Assessment		
511SA.	Why do you treat your water with chlorine? (This is a free response question. FRA will prompt respondent no more than*twice*. FRA will put a1for yes next to each response, else0.>1 Response allowed.)	1. Saves time__ 2. Reduces sickness/exposure__ 3. Saves money__ 4. Keeps you tension free__ 5. Child will not be sick as often__ 6. Destroys all germs__ 7. Remains safe longer than boiling__
512SA.	How long do you wait after treating your water with chlorine to drink it? (This is a free response.	1. Any time between 30 and 45 minutes__ 2. Other time frame__
513SA.	How many turns of the chlorine dispenser would be appropriatefor a 15-liter container? (Free response)	1. Three__ 2. Other value or Don't Know__

514SA.	Have you had a discussion about treating your water with chlorine with anyone in the last month?	1. Yes 2. No 3. Cannot recall	If 2 or 3, skip to next section.
515SA.	Who have you discussed this with? (This is nota free response. FRA asks specifically if any of these people have been sources of discussion).	1. Friend 2. Family Member 3. CHP Socially 4. CHP professionally 5. Medical Practitioner 6. School-based Interaction 7. Mosque-based Interaction 8. Neighbor 9. Other	

III) Hand Washing hardware recognition assessment

1004aSA. Do you recognize the soapy water because you saw it or because you heard about it?

1. I saw it (stop after 1004bSA and go to1012aSA)
2. I heard about it (go to 1004dSA)
3. Both

1004bSA. Where did you see the soapy water bottle? (This is not free response. FRA asks about each possible option. Put 1 for a positive response, else 0.) [>1 response allowed]

1. Compound of friend/neighbor __
2. Compound of relative __
3. Tea stall __
4. Poster __
7. Other (Specify) _____
9. Cannot remember

1004dSA. From whom did you hear about the soapy water?(This is not a free response. FRA asks about each possible option. Put 1 for a positive response, else 0.)[>1 response allowed]

1. Medical practitioner
2. Someone at school
3. Friend/Neighbor
4. Relative/Spouse
5. Mosque attendee
6. Tea stall patron
77. Other

1012aSA. Do you recognize the red bucket with tap because you saw it or because you heard about it?

1. I saw it (Stop after 1012bSA and go to 1146bSA)
2. I heard about it (go to 1012dSA)
3. Both

1012bSA. Where did you see the red bucket with tap? (This is not free response. FRA **GdAviG** asks about each possible option. Put 1 for a positive response, else 0.) [>1 response allowed]

1. Compound of friend/neighbor
2. Compound of relative
3. Tea stall
4. Poster
9. Other _____

1012dSA.From whom did you hear about the red bucket with tap?(This is not free response. FRA asks about each possible option. Put 1 for a positive response, else 0.) [>1 response allowed.]

1. Medical practitioner
2. Someone at school
3. Friend/Neighbor
4. Relative/Spouse
5. Mosque attendee
6. Tea stall patron
77. Other

IV) Hand Washing motivational assessment		
1146a1SA.		
1146bSA.	Why do you wash your hands? (This is a free response. FRA will prompt respondent no more than *twice*. Put 1 next to positive response, else 0.)[>1 response allowed.]	1. To stay healthy __ 2. Cost of doctor/medicine _ 3. Child cannot attend school 4. Cannot go to work __ 5. Worry about the health of my family __ 6. Feel better if children are healthy 7. Will not lose income due to illness 8. To make/keep my hands clean.

1146cSA.	Have you had a discussion about the things that you just demonstrated for me with anyone in the last month?	1. Yes 2. No 3. Can't recall

Section P: H2S and E. coli water test results

820. What was the H_2S test result of household stored water after 24 hours?)
1. (Water was found to be contaminated)
2. **(**water was uncontaminated)
8. (Not applicable)(specify):_____

821. What was the H2S test result of household stored water after 48 hours?)
1. (Water was found to be contaminated)
2. (Water was uncontaminated)
8. (Not applicable)(specify):_____

822. What was the H_2S test result of source water after 24 hours?)
1. (Water was found to be contaminated)
2. **(**water was uncontaminated)
8. (Not applicable)(specify):_____

823. What was the H2S test result of source water after 48 hours?)
1. (Water was found to be contaminated)
2. (Water was uncontaminated)
8. (Not applicable)(specify):_____

824. E.Coli count in the stored drinking water ___/100ml) [Put '888' if not applicable.
825. E.Coli count in the source water ___/100ml) [Put '888' if not applicable.