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The impact of regular soap provision to primary schools on hand washing with soap

and *E. coli* hand contamination among pupils in Nyanza Province, Kenya:

A cluster-randomized trial

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By

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B.S.
The Georgia Institute of Technology
2004

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

**Abstract**

The impact of regular soap provision to primary schools on hand washing with soap and *E. coli* hand contamination among pupils in Nyanza Province, Kenya:
A cluster-randomized trial
By Shadi Saboori

*Objectives:* This cluster-randomized trial, conducted in Nyanza Province, Kenya from May to November 2010, assessed whether supplying soap to primary schools on a regular basis increased pupil hand washing and decreased *E. coli* contamination on pupils' hands.

*Methods:* Sixty public schools, in two geographic strata, were randomly assigned to one of three study arms—a hand washing intervention including soap provision and teacher training on hygiene promotion (HW), the same HW intervention plus a latrine cleaning component (LC+HW), or control. Multiple rounds of structured observations of pupil hand washing after latrine use were conducted over a 6-month period. A subset of 457 children from 24 schools (8 schools per study arm) was randomly selected for one round of hand rinse collection to measure *E. coli* contamination on hands.

*Results:* The odds of observing at least 50% and 75% of pupils practicing hand washing with soap (HWWS) after latrine use was significantly greater in both intervention arms compared to controls. The overall proportion of pupils observed practicing HWWS was 31.5% and 38.2% in the HW and LC+HW arms, respectively, compared to 2.9% in the controls. Girls and boys had similar hand washing rates. There were no significant differences in *E. coli* contamination of hands between intervention schools and controls.

*Conclusion:* Removing the barrier of soap procurement can significantly increase availability of soap and hand washing among pupils, but other limitations in the enabling policy and institutional environment may still prevent reaching desired levels of HWWS. A single measurement of *E. coli* contamination on hands may not be sufficient to indicate differences in hand washing behavior between intervention and control schools. Instead of relying on biased self-reported behavior, future hand washing studies should consider using multiple observations in order to more accurately capture variability in hand washing behavior.

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To my mother, Zoha Yazdani, for always bringing laughter and positive energy into the room, no matter who is there or what is happening.

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## Introduction

*Literature review*

Acute respiratory infections and diarrheal diseases are leading causes of morbidity and mortality for all ages worldwide (Matthers, Boerma et al. 2004). Of the approximately 8.8 million deaths in children under five years globally in 2008, 18% were attributable to pneumonia and 15% to diarrhea (Black, Cousens et al. 2010). In the African region, 2008 estimates of pneumonia and diarrhea account for 16% and 17% of deaths in children under five years, respectively (WHO 2011) and in Kenya, 16% and 20%, respectively (Black, Cousens et al. 2010).

Hand washing with soap (HWWS) has been shown to reduce fecal contamination on hands (Burton, Cobb et al. 2011) and can decrease the risk of diarrheal diseases by 42-48% (Cairncross, Hunt et al. 2010) and respiratory infections by 16% (Rabie and Curtis 2006). HWWS is one of the most low-cost and cost effective hygiene improvements (Borghi, Guinness et al. 2002). Yet, HWWS on a regular basis at critical times, such as after defecation, remains a challenge among various communities worldwide (Pittet and Mourouga 1999; Curtis, Biran et al. 2003; Lankford, Zembower et al. 2003; Scott, Lawson et al. 2007). In a review of hand washing observation studies in 12 countries, child caretakers practiced HWWS after defecation 17% of the time on average (Curtis, Schmidt et al. 2011). A 2007 large-scale observational study, conducted in all but one province of Kenya, concluded HWWS practice at the household level occurred 24% of the time during critical times (Schmidt, Aunger et al. 2009). Available data from hand washing observational studies tend to focus on adult caregivers and little is currently known about children's hand washing practices.

Children of all ages have a higher risk than adults of acquiring and transmitting communicable diseases, such as respiratory illnesses, both within the household and at school (Arnold S 2002). At the school level, children are touching shared objects such as bathroom doors, desks, and chairs, as well as coming into contact with one another on a daily basis. One study conducted in German schools among children six to 13 years old found student-to-student and student-to-teacher contact, defined as speaking or playing with another person, to occur an average of 32 times per day (Mikolajczyk, Akmatov et al. 2007). Another study found that individuals within a household that has members less than 18 years of age are twice as likely to become infected with respiratory illness as households without members under 18 (Longini, Koopman et al. 1982). Because children have frequent contact with each other at school and are more susceptible to communicable illnesses within a community, regular HWWS practice by children at both the household and school level must take place in order to effectively reduce transmission to younger children and adults in the wider community.

There is evidence linking school hand washing programs to various educational and health benefits. A 90-school, cluster-randomized, hand washing intervention program targeted to first graders in China found 54% fewer days of absence in the intervention group that received soap, a student hand washing champion, and hand washing promotion materials compared to the control group that received annual government hygiene educational programming that included a statement about hand washing before eating and after using the latrine. (Bowen, Ma et al. 2007). In the United States, a study in five schools that provided elementary students with hand sanitizer and hand washing education reported that the intervention group had 51% fewer episodes of absenteeism compared to the control group that did not receive any components of the intervention (Guinan, McGuckin et al. 2002). A two-school pilot study among 5 to 15 year old pupils in Denmark estimated the odds ratio for absence related to infectious illnesses to be

0.69 in the intervention school that required pupils to practice HWWS before the first class, lunch, and leaving for home compared to the control school where pupils were not required to undertake any particular HWWS regiment (Nandrup-Bus 2009). In Kenya, a 185-school cluster-randomized water, sanitation, and hygiene (WASH) intervention trial found a 58% reduction in the odds of absence for primary school-aged girls in schools that received a hygiene promotion and water treatment intervention compared to control schools that did not receive any type of intervention (Freeman, Greene et al. 2012). Despite these encouraging outcomes from various school WASH interventions, few studies have observed HWWS practice or measured pupil hand contamination to determine whether the HWWS component of WASH programming is actually increasing HWWS practice and decreasing fecal hand contamination.

There are several methods for assessing hand washing practice. Self-reported hand washing behavior, a common method for measuring hand hygiene practice, uses structured or informal interviews to assess an individual's hand washing behavior. Interviews typically aim to measure an individual's knowledge of critical hand washing times, common occasions for personal hand washing, barriers to hand washing practice, or prioritization of hand washing compared to other hygiene practices such as washing dishes or clothing (Wilson and Chandler 1993; Pinfold 1999; Metwallya, Saad et al. 2007; Scott, Schmidt et al. 2007; Rhee, Mullany et al. 2008).

Direct observation of hand washing practices is another method for assessing hand hygiene practice and consists of an observer directly observing an individual's hand washing method. Observers typically observe and document hand washing practices during critical times, such as prior to preparing food and after latrine use (Haggerty, Muladi et al. 1994; Curtis, Kanki et al. 2001; Jagals, Nala et al. 2004; Luby, Agboatwalla et al. 2009).

One proxy measure of hand washing practice is measurement of hand contamination. Hand contamination is often assessed through collection and microbiological analyses of hand rinse samples (Sobel, Mahon et al. 1998; Luby, Agboatwalla et al. 2001; Hoque 2003; Pickering, Boehm et al. 2010; Pickering, Davis et al. 2010; Pickering, Julian et al. 2010). Microbiological analyses are used to determine the presence and concentration of a microbial indicator of fecal contamination, such as *E. coli*. Presence of such indicators helps to assess whether an individual has fecal contamination on their hands and is at risk of exposure to various enteric pathogens. Since regular HWWS practice has been shown to effectively reduce microbial contamination on hands (Burton, Cobb et al. 2011), the absence of an indicator, such as *E. coli*, on an individual's hand would be associated with a likelihood of proper hand hygiene behavior.

At the school level, there are only a handful of studies that have assessed pupils' HWWS practice in low- or medium-income countries, and, of those studies, most use the self-reported method to assess HWWS practice. In Colombia, a study conducted in 25 schools, using anonymous questionnaires, found students who reported having regular access to soap and water were almost three times more likely to report consistently washing their hands after defecation and prior to eating than children without regular access to soap and water; however, less than 7% of the students surveyed reported having regular availability of hand washing materials at their schools (Lopez-Quintero 2009). In Kenya, a nine-school study testing a school-based safe water and hygiene intervention found a substantial increase between baseline and final evaluation of pupils that reported washing their hands both before eating and after using the latrine (61% versus 83%, respectively), and over half of the pupils surveyed correctly demonstrated at least three of the six key steps of hand washing that had been promoted by the intervention (O'Reilly, Freeman et al. 2008). A UNICEF-funded, six-country evaluation of school sanitation and hygiene education programs revealed that, although over 80% of the schoolchildren surveyed in all six countries correctly reported knowing when to wash hands, less than one-third were observed practicing HWWS (Bolt, Shordt et al. 2006). This highlights the challenge that self-reported hand washing knowledge and observed hand washing practice are not always in agreement in school-based studies.

Household-based studies also show differential rates between self-reported and observed hand washing practice. A study conducted in Burkina Faso, using structured observations and interviews, among households assessing child defecation and fecal disposal practices showed poor agreement between the two methods and concluded that there was over reporting of good hygiene practices compared to actual observed practices (Curtis, Cousens et al. 1993). Additionally, self-reported hand washing knowledge and practice may not necessarily correlate to having clean hands. A study that examined the effectiveness of different communication channels for improving hygiene behavior in targeted communities in northeastern Thailand concluded that higher reported knowledge scores of improved hygiene behavior did not translate into having clean hands (Pinfold 1999). Therefore, although self-reported hand washing assessments may reveal the general knowledge of a study population around hand washing practice, it does not necessarily equate to actual practice. Hand washing observations and hand contamination measurements are likely more accurate measures of assessing hand washing practice.

*Study background*

This study was conducted as part of a research program in Nyanza Province, Kenya called Sustaining and Scaling School Water, Sanitation, and Hygiene Plus Community Impact (SWASH+) that was designed to identify effective, sustainable, and scalable strategies for improving WASH behaviors and educational outcomes for primary school children. Several sub-studies conducted through the program identified various challenges related to hygiene in schools. A sustainability assessment conducted through the program found one school out of 55 providing soap for hand washing three years after a hygiene intervention, with 61 percent of school officials citing cost as one of the barriers to soap provision (Saboori, Mwaki et al. 2011). A hand rinse study measuring *E. coli* contamination on pupil hands in a subset of intervention schools—one arm receiving hygiene promotion and the other arm receiving hygiene promotion with the addition of newly constructed latrines—found that the intervention consisting of hygiene promotion did not reduce rates of *E. coli* hand contamination. Surprisingly, the risk of detecting *E. coli* on girl pupils' hands was 2.6 times higher in schools that had received sanitation improvements in addition to hygiene promotion compared to control schools that did not receive any intervention ($p<0.01$) (Greene, Freeman et al. 2012). Exploration of potential reasons for these results revealed that girls in particular claimed to use latrines more often in schools that received new latrines, self-reported hand washing behavior did not improve much compared to controls, several schools did not provide hand washing materials, and there was no evidence that schools provided anal cleansing materials to pupils. The authors suggested that, by providing new latrines without regular provision of soap and anal cleansing materials and without sufficient hygiene behavior change, increased use of school latrines may have resulted in increased fecal contamination on hands. One limitation is that it was not possible to assess with certainty the degree to which girl and boy pupils may or may not have washed their hands after latrine use in the various study groups, as no observations were conducted. Additionally, baseline results that included this study population showed that latrine cleanliness, rather than the ratio of pupils per latrine, had a significant association with recent absence (Dreibelbis, Greene et al. 2012). Although the reasons for a link with absence are not clear from this cross-sectional study, it raises the possibility that increased exposure inside soiled latrines may be a risk factor for hand contamination and illness.

*Study objectives*

These findings reflected a need to further understand the role of latrine and soap provision on pupil behaviors and fecal exposure in schools. As a result, in May 2010, a cluster-randomized trial was implemented in 60 primary schools in Nyanza Province, Kenya to supply and monitor the provision of latrine maintenance cleaning materials and powdered soap to make soapy water for hand washing. The primary objective of this trial was to determine whether improving conditions of school latrines would reduce absenteeism in schools; these findings are described elsewhere (Caruso 2012, unpublished work). This paper describes the results of the soap supply component of the intervention including pupil hand washing after latrine use and pupil hand contamination. This study aims to assess whether eliminating the challenge of school soap provision, by supplying soap to schools on a regular basis, increases hand washing and decreases presence of *E. coli* on pupils' hands in primary schools in Nyanza Province, Kenya. Additionally, this study investigates gender-specific effects and pupil-reported perception of soapy water use and hand washing conditions.

## Methods

*Study context*

Between 2007 and 2009, a cluster-randomized trial assessing the health and educational impacts of various school-based WASH interventions was carried out by the SWASH+ program in 185 schools in three geographic strata in Nyanza Province, Kenya (Freeman, Greene et al. 2012). The various school-based WASH interventions included: (1) a hygiene promotion "package" consisting of provision of water treatment products, drinking water and hand washing containers with lids and taps, hygiene promotion, and teacher training; (2) a sanitation "package" consisting of the hygiene promotion component plus newly constructed latrines; (3) a water "package" consisting of the latter two packages plus the addition of either a borehole or a large-scale rainwater harvesting system; and (4) control schools that received all interventions after the conclusion of the trial. The schools selected for this study in 2010 were all part of the former SWASH+ study.

*Study setting*

The study took place in two geographic strata—Kisumu/Nyando and Rachuonyo—in Nyanza Province, Kenya. The Kisumu/Nyando geographic stratum is generally less rural than the Rachuonyo geographic stratum. The population of Nyanza Province is approximately 6.3 million, and 29% are primary school-age children (Kenya National Bureau of Statistics (KNBS) & ICF MACRO 2010). In 2003, the Government of Kenya enacted the Free Primary Education program, which made attendance of primary school free for all Kenyans. One of the direct results of this initiative was the immediate overcrowding of classrooms and other school facilities, such as latrines, and there was insufficient funding to upgrade facilities to meet the rapid expansion of the school population (Mathooko 2009).

*School selection and intervention assignment*

The study comprised 60 public primary schools. Inclusion criteria for the 60 schools included: schools were previously enrolled in the SWASH+ impact study, at least 25% of latrines in each school were rated "dirty" by previous SWASH+ analysis, the distance to dry season water source was not more than 1000 meters, and schools were located in the geographic strata of Kisumu/Nyando or Rachuonyo.

The trial consisted of three arms including a hand washing (HW) intervention arm (n=20), a latrine cleaning plus hand washing (LC+HW) intervention arm (n=20), and a control arm (n=20) that received no intervention. All interventions were administered at the school level.

The selected schools were assigned to the study arms using stratified random sampling. Schools were stratified by geographic stratum and the intervention the school had previously received as part of the previous SWASH+ study and were then randomly allocated to intervention and control arms based on a random number generated by Microsoft Excel. A subset of 24 schools was randomly selected for hand rinse samples and included eight schools in each study arm. It was not possible to blind the intervention status of schools from project field staff since the intervention status of a school was obvious based on the intervention supplies present or absent from schools during field monitoring visits.

The HW group received one 3.5kg bag of powdered soap and 10 slender 500ml plastic bottles. Powdered soap to make soapy water was chosen as the method to supply soap for hand washing due to a previous pilot study conducted in Nyanza Province, Kenya in 2008 which found schools preferred powdered soap over bar or liquid soap because it was easier to use, lasted longer, and prevented soap theft (Saboori, Mwaki et al. 2010). From laboratory tests conducted, 10g of powdered soap mixed with 1L of water was determined to be effective in removing fecal contamination from hands and creating lather during hand washing (Akoko 2010, unpublished work). Prior to receiving the intervention supplies, the head teacher and two designated teachers called “health patrons” were trained once by the SWASH+ field staff on how to make soapy water solution from the materials given (2 capfuls—2.5g per cap—per 500 ml bottle filled with water). The teachers were also asked to review the hand washing component of the teacher's training manual that had been provided to them during the previous SWASH+ program which outlines proper hand washing practice and key times to wash hands. They were in turn encouraged to review the hand washing concepts and teach the soapy water preparation method to the school health club members, a pupil-run organization that all schools had formed as one of the activities of the previous SWASH+ project, as well as to the rest of the pupils in the school. Soap was replenished two-three weeks after the start of the second school term.

The LC+HW arm also received the HW intervention supplies and training described above. Additionally, they received a latrine cleaning supply package that included two buckets, bleach, powdered soap, a measurement cup for soap use, a broom, and a hand brush for every four latrine doors, one half of a roll of toilet paper per pupil per term (three months in a term), and a binder with forms to monitor latrine conditions. The head teacher and health patrons received training on latrine cleaning methods and how to use the monitoring forms. They were encouraged to teach pupils the latrine cleaning methods learned and reviewed. Consumables (e.g. soap and bleach) were replenished and broken supplies were replaced two-three weeks after the start of the second term.

The intervention supplies were provided and trainings took place in June 2010 after the baseline data collection period. The control group received the same intervention as the LC+HW group except for the latrine monitoring forms four months following the conclusion of the trial in November 2010.

*Outcome*

The primary goal for this study was comparing the effect of the HW and LC+HW interventions to the control group on observed pupil HWWS practice after latrine use.

The secondary goal was comparing the effect of the two interventions to the control group for the presence of *E. coli* on pupils' hands in a subset of schools.

*Sample size*

The sample size was calculated to detect changes in pupil absenteeism—the primary purpose of the overall trial—rather than for assessing the hand washing component of the trial—the primary objective of this paper. The sample size was based on absenteeism data determined in a previous cluster-randomized trial (Freeman, Greene et al. 2012). Data from this previous trial were used to determine the median number of "acceptable" (latrines without excess flies, smell, or presence of feces) latrines. The difference in pupil absenteeism between schools with latrines below and above the median number of "acceptable" latrines resulted in a risk difference of 0.86 or a 14% reduction in absence. A Kappa coefficient of 0.877 was used– taken from the data - to calculate the sample size (Hayes and Moulton 2009). The sample size required 300 roll call absence measurement observations per school and 20 schools per intervention group. Therefore, 60 total schools (clusters) were selected for the overall trial, with 20 schools per study arm. The hand washing observations took place in all 60 schools. For the hand contamination outcome, the subset of 24 schools and 20 pupils per school was chosen as a convenience sample determined by available funds, staff time, and laboratory capacity.

*Pupil and facility data collection*

At baseline and final data collection rounds, an average 28 pupils between grades four and seven were randomly selected using school rosters and administered structured interviews in the Dholuo language to assess pupil perception of school hand washing conditions. School facility data were collected at baseline and every fortnight for seven subsequent rounds (excluding the school break in August). In each school, structured interviews were conducted in English with head teachers and structured observations of school WASH facilities were performed during unannounced visits by field enumerators between May and November 2010. All pupil and facility data were collected using Syware Visual CE v10 software (Cambridge, MA) on Dell Axim x51 (Round Rock, TX) personal digital assistants.

*Hand washing observations data collection*

Between May and November 2010, hand washing observations took place at all 60 schools at baseline and during four subsequent unannounced monthly visits (excluding the school break of August) during 30-minute school-allotted break times, typically from 11:00 to 11:30 am. Two trained enumerators conducted observations of the latrine banks. Involving two enumerators helped to avoid overwhelming one enumerator during peak latrine use times. They used observation sheets to record the number of pupils entering latrines and washing their hands with water only or with soap and water after latrine use.

*Hand rinse data collection*

A subset of 24 schools (8 schools per trial group) was randomly selected for inclusion in one round of hand rinse data collection in October and November 2010, and the schools were visited in random order. Ten schools had hand rinse samples collected from 10:30 am to noon and the remainder in the afternoon prior to 3pm. Twenty pupils per school, between grades four through seven, were randomly selected using school rosters. Enumerators asked each selected pupil to place one hand in a 500mL Whirl-Pak (Nasco, Fort Atkinson, WI) bag containing 250ml of sterile phosphate-buffered saline solution and wiggle fingers around while counting to ten slowly and then repeated the procedure with the other hand. Samples were sealed, placed in a cooler, and transported at 4$^{o}$C to the Great Lakes University of Kisumu (GLUK) laboratory and stored overnight at 4$^{o}$C.

*Laboratory analysis*

Hand rinse samples were analyzed the morning following sample collection for *E. coli* by the membrane filtration method using m-ColiBlue24 broth (Hach, Loveland, CO) (Hoque, Mahalanabis et al. 1995; USEPA 2003). Two volumes, 1mL and 10mL, were filtered per sample, and the plates were incubated at 44.5°C ± 0.5°C for 24 hr. *E. coli* concentrations were assessed as colony forming units (CFU) per two hands. Plates exceeding 200 CFU were considered "too numerous to count" (TNTC). When a plate was determined to be TNTC or had zero colonies, the other plate of the same sample was used to determine the concentration. Samples containing atypical colonies, heavy background growth, and/or processed when control plates displayed contamination were not included in the analysis.

*Statistical methods*

Frequencies of key indicators from the structured interviews with pupils were used to determine reported changes of hand washing conditions over time, and student's *t-test* comparisons were used to test the school-aggregated difference in these indicators between baseline and final data collection rounds for the intervention arms compared to the control arm. Two school facility-level water accessibility indicators, current water source and distance to the source, were used to determine potential changes in water access over the course of seven follow-up data collection rounds. The follow-up data collection rounds were aggregated in order to have a representation of the entire trial period. Linear regression models were conducted using SAS 9.2 (Cary, NC) to test the mean proportions of the water accessibility indicators in each intervention arm versus controls. The baseline facility-level data, while presented, was not statistically compared to the follow-up facility-level data because the baseline data represents one point in time while the aggregated follow-up rounds represent seven points in time.

Comparing the baseline round to the aggregated follow-up facility-level data rounds would have given too much weight to the baseline time point.

For the primary outcome measure of pupils practicing HWWS after latrine use, two indicators—hand washing with water only and HWWS for girls, boys, and pupils—were aggregated to the school level, and the PROC MEANS procedure was used to compare baseline and aggregated follow-up data by study arm. Since the data for these indicators were not normally distributed, the school-aggregated values were categorized into four binary variables—at least 50% and at least 75% of pupils practicing hand washing with water only and HWWS—and the logistic regression procedure PROC SURVEYLOGISTIC was used to conduct bivariate analyses to test the effect of the HW and LC+HW arms versus the controls. Models accounted for correlated observations within the school due to cluster sampling as well as stratified sampling by geographical strata. Observed hand washing water availability and soap availability at the school were also assessed. Since the hand washing observation visits were conducted at four separate time points throughout the duration of the trial, and the baseline visit only at one time point, the baseline observation visit was not statistically compared to the aggregated follow-up observation visits. The potential differences between the HW and LC+HW study arms were assessed using the aforementioned method. Hand washing conditions and practice after latrine use were graphed in Microsoft Excel 2011 at baseline and the four subsequent follow-up observation visits in order to show the variability observed between visits and overall trends over time in each study arm.

For the secondary impact analysis of *E. coli* detection on hands, individual pupil hand rinse data and multivariable logistic regression using the SURVEYLOGISTIC procedure was used to test the effect of the intervention on the odds of *E. coli* contamination. Models accounted for correlated observations within the school due to cluster sampling and pupil sampling weights as well as stratification by geographical strata. Model 1 contained the primary predictor of interest, intervention group, and the following covariates: gender, grade, socio-economic status (SES), and geographic strata; the first three were determined *a priori* to model fitting due to their importance in a previous study (Freeman, Greene et al. 2012). Household SES data from households within the school catchment area were collected and calculated in a previous cluster-randomized trial (Freeman, Greene et al. 2012). Additionally, Model 2 was fitted separately for gender due to *a priori* determination. Gender differences in WASH provision is of sectoral interest and was found to be present in a previous school-based hand contamination study conducted in this region (Greene, et al 2012). *E. coli* presence was analyzed initially to get a sense of the degree of difference among the study arms. Because no significant differences between study arms were found, and a boxplot of *E. coli* concentrations did not reveal any noticeable differences, it was decided there was no need to analyze the *E. coli* concentrations in a separate analysis. The $\log_{10}$ of the *E. coli* concentrations were categorized into four levels—0, 1-2, 2-3, and greater than 3-4—and displayed graphically to show the variability in concentration within each study arm as well as between the study arms.

*Ethics*

Approval from the Institutional Review Board at Emory University and the Great Lakes University of Kisumu's Ethical Review Committee were received prior to carrying out this trial. The head teacher provided consent for a school's inclusion in the trial. Before conducting a structured pupil interview or collecting a hand rinse sample, oral assent was collected from each pupil.

## Results

*Pupil and facility characteristics at baseline*

Baseline levels of key indicators from the pupil structured interview (school-aggregated) and the school facility assessment are presented in Table 1. There were 1,715 pupils interviewed during the baseline data collection period in May 2010. In all study arms, the mean age of pupils interviewed was between 12 and 13 years, the mean grade was five, and approximately half of pupils interviewed were girls. The current drinking water source was improved in 65% of schools in the HW and control arms and 85% in the LC+HW arm. An improved water source in this context may have been a borehole, rainwater harvesting tank, protected spring or protected well. Between 20 to 25% of schools had their current water source greater than one kilometer away. The pupil-reported school hygiene conditions—whether there is a designated place to wash hands and whether water and soap are always or never enough or available for hand washing—were similar in all study arms.

*Pupil and facility characteristics at follow-up*

There were 1,731 pupils interviewed during the final data collection period in October-November 2010. There was a significant 12.6% increase in the number of pupils that reported that there was always enough water for hand washing at their schools in the HW arm compared to the controls, which had a 4.8% decrease ($p=0.03$) (Table 2) between the baseline assessment and the final assessment. Both the HW and LC+HW arms had significant increases (51.0% and 60.8%, respectively) in pupils reporting that soap was always available for hand washing at their schools compared to the controls, which had a 2.6% decrease ($p<0.0001$ for each intervention arm). There was no significant difference between schools in each intervention arm compared to the controls in the number of pupils who reported having a designated place to wash hands in schools and water never being enough for hand washing. Water accessibility—whether the current water source was improved and distance to the current water source was greater than one kilometer—did not significantly change in either intervention arm compared to the controls throughout the duration of the trial (data not shown).

The majority of pupils surveyed during final data collection in both the HW and LC+HW arms reported having used soapy water in their schools (93% and 98%, respectively). Among those pupils, 72% and 81% reported the scent of soapy water was “better” compared to bar soap and 67% and 78% reported soapy water made hands feel “better” compared to bar soap in the HW and LC+HW study groups, respectively (data not shown).

*Observed hand washing after latrine use*

There were 294 separate observation rounds of hand washing behavior after latrine use conducted during baseline and follow-up visits in the 60 schools. In the majority of the schools, four follow-up visits were conducted; however, two schools in the control arm, one school in the HW arm, and three schools in the LC+HW arm had three follow-up visits per school due to school activities that did not allow observations to take place, such as sports days where pupils were visiting neighboring schools. Of the 294 observation visits, there were 77 visits in which enumerators indicated that they were not able to see the hand washing stations from their observation viewpoints; therefore, no hand washing observations took place. Of the remaining 217 observation visits, seven were not completed because the enumerators did not observe water in the hand washing containers at the beginning of the observation session. Of the remaining 210 observation visits, 100 visits documented that there was no soap near the hand washing containers at the beginning of the observation; however, hand washing with water was still documented. A total of 110 observation visits at 60 schools (eight visits in seven schools in the control arm, 45 visits in 19 schools in the HW arm, and 57 visits in 18 schools in the LC+HW arm) were completed where pupils practiced HWWS after latrine use.

At least 50% of schools in all three study arms had hand washing containers with water at baseline, and at least 65% of the schools had them in the aggregated follow-up visits (Table 3). Soap was not present near the hand washing containers in the majority of the schools at baseline in all three study arms, and the presence of soap increased in the HW and LC+HW arms in the aggregated follow-up observation visits (54.4% and 72.73%, respectively) compared to the controls (5.1%). Washing hands only with water—no soap—after latrine use at baseline was observed among less than 13% of pupils in all study arms and increased in the control arm in the aggregated follow-up visits (32.2%) compared to the HW and LC+HW arms, which remained similar to baseline levels (17.9% and 13.6%, respectively). The proportion of observed girls compared to boys practicing hand washing with water only after latrine use at baseline and aggregated follow-up observation visits were similar in all three study arms. Washing hands with soap and water after latrine use at baseline was observed among less than 7% of pupils in all three study arms and increased in the HW and LC+HW arms in the aggregated follow-up visits (31.5% and 38.2%, respectively) compared to the controls (2.9%). The proportion of observed girls compared to boys practicing HWWS after latrine use at baseline and aggregated follow-up observation visits were similar in all three study arms.

Figures 1-3 display the hand washing conditions and practice after latrine use at baseline and the four subsequent follow-up observation visits in the HW, LC+HW, and the control arms, respectively. The proportion of pupils observed practicing HWWS was consistently higher at every follow-up observation visit compared to the proportion of pupils observed practicing hand washing with only water in both the HW and LC+HW arms. In both the HW and HW+LC study arms, the percent of schools observed providing soap for hand washing and the proportion of pupils observed practicing HWWS peaked at the second follow-up observation visit. In the two intervention arms, soap was provided in 40 to 84% of the schools during the follow-up observation visits. In the control arm, observed soap availability and the proportion of pupils observed practicing HWWS remained low throughout the duration of the trial while the proportion of pupils observed practicing hand washing with only water was greater in all of the follow-up observation visits compared to the baseline with a peak during the third follow-up observation visit.

The odds of observing at least 50% and 75% of pupils practicing hand washing with only water after latrine use was significantly less in both intervention arms compared to the controls while the odds of observing at least 50% and 75% of pupils practicing HWWS after latrine use was significantly greater in both intervention arms compared to the controls (Table 4). The odds of having hand washing water available at the schools in the aggregated follow-up observation visits did not differ significantly between the intervention arms and controls. The odds of having soap present nearby the hand washing containers was significantly greater in both intervention arms compared to the controls. The odds of having soap present nearby the hand washing containers was significantly greater in the LC+HW arm compared to the HW arm (data not shown).

*Pupil hand contamination results*

Between 60 to 70% of the pupils' hands that were sampled had no detectable *E. coli* contamination on both hands, about 20% had 10-100 units, and about 10% of students had greater than 100-1000 units (Figure 4). The distribution of *E. coli* concentration on pupils' hands was similar in all three study arms.

Being in a school in either intervention group did not affect whether a pupil was likely to have *E. coli* contamination present on her or his hands (Table 5). Pupils in schools in the Rachuonyo geographic stratum were significantly more likely to have *E. coli* contamination on their hands compared to pupils in the Kisumu/Nyando geographic stratum, irrespective of intervention status. There were no significant differences found in the odds of *E. coli* in the remaining three covariates—gender, grade, and SES—among the study arms.

## Discussion

This study found that an intervention that regularly supplied soap to primary schools in Nyanza Province, Kenya significantly increased the proportion of pupils observed practicing HWWS in the intervention arms compared to the controls. However, there was no significant difference in *E. coli* contamination on pupils' hands between the intervention and control arms. A school-based six-country final evaluation of a UNICEF hygiene program observed that less than one third of pupils practiced HWWS (Bolt, Shordt et al. 2006). The aggregation of the multiple observation visits after baseline found that the proportion of pupils observed practicing HWWS was 31.5% and 38.2% in the HW and LC+HW arms, respectively, which is consistent with the UNICEF study. The aggregated proportion of pupils observed practicing hand washing with only water after latrine use remained similar to baseline levels in both intervention arms. The addition of soap increased the overall proportion of pupils observed practicing hand washing after latrine use—with only water or with soap and water—from a total of 14.1% and 19.0% at baseline to a total of 49.4% and 51.8% in the HW and LC+HW arms, respectively. Therefore, supplying soap to the schools with a limited degree of hygiene promotion improved hand washing practice overall.

A previous trial within the SWASH+ project in which hygiene promotion, but not soap, was provided to schools found that 36% of schools provided soap during the first year of implementation, followed by 21% and 8% during the second and third year follow-up visits, respectively (Rheingans 2011). A 2.5-year follow-up sustainability study of a hygiene promotion intervention in primary schools in Nyanza Province, Kenya, which did not supply soap, found 2% (one school) out of 55 provided soap. Cost was reported by 61% of school officials interviewed as a barrier to providing soap. Inability to prevent the theft of bar soap and lack of prioritization of soap by school administrators were also cited as barriers (Saboori, Mwaki et al. 2011). This study addressed two of those barriers by supplying powdered soap, which has been reported to reduce soap theft compared to bar soap in a previous study (Saboori, Mwaki et al. 2010), to schools at no cost. The resulting aggregated soap provision in the four follow-up observation visits in this trial was 54.4% and 72.73% in the HW and LC+HW arms, respectively. This suggests that cost and theft of bar soap were indeed likely barriers to soap provision.

Barriers to soap provision still remain. In this study, although all intervention schools were supplied soap, some schools did not provide soap for hand washing during observation visits. Potential reasons for lack of provision by school administrations may include prevailing social norms among teachers themselves (Schmidt, Aunger et al. 2009) and lack of institutional incentives and accountability (Saboori, Mwaki et al. 2011). Within the schools that provided soap, not all pupils observed using the latrine practiced HWWS. Potential reasons may include insufficient or ineffective hygiene promotion or prevailing social norms in the household (Schmidt, Aunger et al. 2009).

Two previous SWASH+ studies found differential effects of educational and health benefits among girls and boys after the implementation of a WASH intervention in schools. One study found a significant reduction in the odds of girls missing school in intervention arms that received hygiene promotion and hygiene promotion with the addition of sanitation improvements (Freeman, Greene et al. 2012). The other study found a significant increase in *E. coli* hand contamination among girls in the intervention arm that received hygiene promotion with the addition of sanitation improvements (Greene, Freeman et al. 2012). One reason postulated by both studies for these gender differences was potential disparate hand washing behavior between girls and boys, and both studies recommended further research on gender differences in sanitation and hygiene behavior in order to implement WASH interventions more effectively. This study found that hand washing rates were similar for both girls and boys at baseline and at the aggregated follow-up observation visits. Therefore, differential hand washing rates among girls and boys may not have been the mechanism that explains the differences found between girls and boys in the previous studies.

The only difference found between the HW and LC+HW intervention arms for this study was soap availability. The HW+LC arm schools provided soap for hand washing in significantly more schools over the duration of the trial. This difference may have been due to the LC+HW arm receiving additional powdered soap as part of the latrine cleaning supplies. Alternatively, attention to the latrine cleaning component may have had positive added effects for soap provision.

The majority of school-based studies to date have used pupil self-reported structured interviews, scoring of demonstrated hand washing acumen of selected pupils, or absenteeism and illness measurements to assess the effectiveness of a hand washing intervention (Onyango-Ouma, Aagaard-Hansen et al. 2005; Bowen, Ma et al. 2007; Dongre, Deshmukh et al. 2007; O'Reilly, Freeman et al. 2008). To our knowledge, this is the first school-based, cluster-randomized study to conduct multiple observations of pupils practicing HWWS after latrine use. Conducting multiple observation visits allowed for variability over a six-month time period to be measured. The variability may reflect lack of consistent hand washing habits within the study population, insufficient provision of soap by schools, or the lack of periodic reinforcement of hygiene messaging. By conducting multiple observation visits, the trends over the six-month follow-up period and the overall picture were captured more accurately.

No significant differences were found in *E. coli* contamination between intervention arms and the controls. The majority of pupils sampled in all three arms had no detectable *E. coli* on their hands. One potential reason for not seeing a difference between the intervention and control arms may be a result of the significantly increased hand washing with only water observed in the control arm compared to the intervention arms. Studies have shown that even hand washing with only water can have a protective effect on diarrhea and hand contamination (Ejemot, Ehiri et al. 2008; Burton, Cobb et al. 2011). Additionally, hand washing observations confirmed that soap was not always available for hand washing in all the intervention schools during any of the visits; therefore, lack of compliance in some schools may have decreased the likelihood that all pupils sampled from the intervention schools had the opportunity to wash hands with soap.

The significant differences found in *E.coli* presence between geographic strata may be due to differences in overall socio-economic status and rural versus less rural differences between Kisumu/Nyando and Rachuonyo. Rachuonyo is more rural and resource-poor compared to Kisumu/Nyando. However, the exact reason for the differences found cannot be explained within the scope of this study.

## Limitations

Structured observational hand washing studies can introduce bias by prompting individuals under observation to carry out "good" hygienic behavior (Ram, Halder et al. 2010); however, bias may be reduced by conducting multiple observational visits in a set period of time to normalize the presence of the observer and the behavior of the observed (Curtis, Cousens et al. 1993). The proportion of pupils observed hand washing with water only after latrine use significantly increased in the control arm even though there was no direct hand washing intervention implemented in those schools. This increase may have occurred as a direct consequence of being under observation. However, by conducting multiple observation rounds, the proportion of pupils observed hand washing—with soap in the intervention arms and with only water in the control arm—after latrine use decreased after reaching a peak, which may be an indication that conducting multiple observation visits reduced bias overall.

Hand contamination was only measured during one time point. Therefore, potential variations in hand contamination across the six-month duration of the trial were not captured. A hand contamination measurement study conducted in Bangladesh reported variability in hand contamination levels on the same individual's hand within several hours and concluded that single hand rinse measurements are not valid proxy measures for hand washing practice (Ram, Jahid et al. 2011). Other hand washing studies have found that fecal streptococci, *Clostridium perfringens*, or enterococci may be better indicators of fecal contamination on skin compared to *E.coli* due to longer survival times (Kaltenthaler E.C. and Pinfold 1995; Luby, Kadir et al. 2010; Pickering, Boehm et al. 2010; Pickering, Julian et al. 2010). Additionally, the number of schools sampled was a convenience sample, and there may have been an insufficient sample size to see a significant reduction in the odds of hand contamination as a result of the intervention—

large, non-significant reductions in the odds of hand contamination were observed in both intervention arms.

A great majority of pupils in both intervention arms reported preferring soapy water use over bar soap in terms of feel and scent. However, given that the intervention only provided soapy water materials, it is uncertain whether the positive feedback was truly a reflection of pupils' preferences or a result of courtesy bias.

Finally, although hand washing training was conducted with head masters and health patrons of the two intervention arms prior to implementation, it is uncertain whether the trained teachers conducted hygiene promotion and education at the schools after training. Varying levels of hygiene promotion within the intervention schools may have influenced the proportion of proper hand washing practice observed among pupils. A more rigorous hygiene promotion strategy may achieve even greater HWWS behavior.

## Conclusions, Public Health Implications, & Future Directions

*Conclusions and Public Health Implications*

Removing the barriers of soap procurement can greatly increase both provision of soap by schools and hand washing among pupils. The non-significant decrease in *E. coli* hand contamination among pupils in the intervention arms may suggest that compliance by approximately one third of pupils to practice HWWS in a resource-challenged environment is insufficient to provide health benefits. However, the study design for *E. coli* contamination may not have been robust enough to detect decreases. In contrast to some studies that observed differential health outcomes from school WASH interventions, and hypothesized that there were differential behaviors of hand washing among boys and girls, this study found essentially identical rates of hand washing across gender.

*Future Directions*

Multiple observations of hand washing practice can be useful for describing variability and time trends. Future studies should consider this method when assessing hand washing interventions versus the more popular, but unreliable, measure of self-reported behavior (Vindigni, Riley et al. 2011).

In this study, a system of regular soap provision to schools was associated with a significant increase in hand washing rates in approximately one third of the school population, but barriers to hand washing in school remain. Future research should assess the additional benefit of institutional incentives and accountability for school administrations as front-line service providers. The interface of school hygiene improvements with wider prevailing social norms on hygiene also needs further examination. Researchers and program implementers working in resource-challenged settings will need to get beyond direct delivery of hygiene services and should use learning to address relevant concerns in the enabling environment. Greater attention to the following factors are needed: increased budgets for soap and hand washing stations, improved accountability systems, and more regular promotion of hygiene behaviors to foster sustained improvements in pupil hygiene.

## Tables and Figures

**Table 1.** Aggregated pupil and school characteristics and pupil-reported school hygiene conditions at baseline between primary schools (n=60) in the hand washing (HW), hand washing with the addition of a latrine cleaning (LC+HW) component, and controls, Nyanza Province, Kenya, May 2010.

| Variable | HW (n=20 schools & 583 pupils) | LC + HW (n=20 schools & 555 pupils) | Control (n=20 schools & 577 pupils) |
|---|---|---|---|
| ***Pupil demographics*†** | | | |
| Age, years | 12.7 (0.3) | 12.5 (0.4) | 12.4 (0.4) |
| Grade | 5.5 (0.3) | 5.5 (0.2) | 5.4 (0.3) |
| Proportion of girls interviewed | 48.5 (6.5) | 50.7 (9.6) | 53.1 (8.7) |
| ***School conditions*§** | | | |
| % current water source is improved[1] | 65.0 (48.9) | 85.0 (36.6) | 65.0 (48.9) |
| % distance to current water source >1 km | 25.0 (44.4) | 20.0 (41.0) | 25.0 (44.4) |
| ***Pupil-reported school hand washing conditions*†** | | | |
| % designated place to wash hands | 90.7 (20.4) | 96.2 (17.1) | 89.0 (21.5) |
| % water always enough for hand washing | 70.2 (29.1) | 75.2 (21.4) | 73.3 (26.9) |
| % water never enough for hand washing | 5.2 (9.4) | 4.3 (16.3) | 4.4 (15.1) |
| % soap always available to wash hands | 13.7 (10.6) | 16.8 (15.9) | 18.0 (15.7) |
| % soap never available to wash hands | 23.4 (18.4) | 20.9 (18.1) | 23.7 (21.0) |

†Pupil results are mean (standard deviation) or mean % (standard deviation) of school-aggregated values by study arm.
§School conditions are mean proportions % (standard deviation) calculated from school-level means by study arm.
[1]Improved source includes boreholes, rainwater harvesting tanks, protected springs and protected wells.

**Table 2.** Changes from baseline to follow-up of pupil-reported school hand washing conditions between primary schools that received a hand washing (HW) intervention or an intervention with the addition of a latrine cleaning (LC+HW) component versus controls, Nyanza Province, Kenya, May-November 2010.

| Variable | HW§ | | LC+HW§ | | Control§ |
|---|---|---|---|---|---|
| ***% change in pupil-reported school hand washing conditions†*** | | ***P**** | | ***P**** | |
| Designated place to wash hands | 8.8 | 0.64 | 3.0 | 0.56 | 6.1 |
| Water always enough for hand washing | 12.6 | **0.03** | 3.1 | 0.32 | -4.8 |
| Water never enough for hand washing | -4.3 | 0.55 | -4.0 | 0.71 | -2.1 |
| Soap always available to wash hands | 51.0 | **<0.0001** | 60.8 | **<0.0001** | -2.6 |
| Soap never available to wash hands | -18.2 | **<0.01** | -18.6 | **<0.01** | 0.9 |

§HW study arm had 20 schools with 583 and 580 pupils interviewed at baseline and final, respectively; LC+HW study arm had 20 schools with 555 and 571 pupils interviewed at baseline and final, respectively; and control study arm had 20 schools with 577 and 580 pupils interviewed at baseline and final, respectively
†Data are percentage point change in school-aggregated values, adjusting for cluster sampling and unequal probability of pupil selection
*P value of t-test comparing difference from baseline to follow-up between intervention and control study arms

**Table 3.** Observed hand washing conditions and practice after latrine use at baseline and at four [aggregated] follow-up visits in 60 primary schools that received a hand washing intervention (HW), a hand washing plus a latrine cleaning (LC+HW) component, and controls, Nyanza Province, Kenya, May-November, 2010

| **Variable** | **HW** | | **LC+HW** | | **CONTROL** | |
|---|---|---|---|---|---|---|
| | **Baseline (n=20)*** | **Follow-up (n=79)*** | **Baseline (n=20)*** | **Follow-up (n=77)*** | **Baseline (n=20)*** | **Follow-up (n=78)*** |
| ***Hand washing conditions†*** | | | | | | |
| % hand washing water present | 50.0 (10) | 76.0 (60) | 90.0 (18) | 81.8 (63) | 60.0 (12) | 65.4 (51) |
| % soap present | 10.0 (2) | 54.4 (43) | 25.0 (5) | 72.73 (56) | 20.0 (4) | 5.1 (4) |
| ***Hand washing with water only§*** | | | | | | |
| % of girls | 9.0 (23.1) | 9.7 (12.9) | 5.8 (10.1) | 7.0 (10.2) | 3.9 (7.5) | 14.3 (16.0) |
| % of boys | 3.6 (7.8) | 7.7 (10.5) | 5.8 (10.4) | 6.3 (12.3) | 4.1 (8.4) | 16.1 (17.2) |
| % of pupils | 12.8 (23.6) | 17.9 (21.6) | 12.7 (13.9) | 13.6 (18.5) | 8.0 (11.9) | 32.2 (30.9) |
| ***Hand washing with soap & water§*** | | | | | | |
| % of girls | 3.3 (11.0) | 33.6 (36.0) | 9.1 (23.9) | 40.7 (36.6) | 1.0 (3.1) | 3.3 (15.1) |
| % of boys | 0.0 (0.0) | 29.8 (33.4) | 4.3 (17.9) | 40.6 (57.0) | 8.3 (26.2) | 2.3 (12.6) |
| % of pupils | 1.3 (4.4) | 31.5 (33.2) | 6.3 (20.7) | 38.2 (34.6) | 3.6 (10.1) | 2.9 (13.0) |

*N indicates the number of observation visits conducted in each study arm during baseline and aggregated follow-up
†Data are mean % (number)
§Date are mean % (standard deviation) in school-aggregated values by intervention arm

**Table 4.** Odds of observed hand washing conditions and practice after latrine use at four [aggregated} follow-up visits in primary schools that received a hand washing intervention (HW), or a hand washing plus a latrine cleaning component (LC+HW), versus controls, Nyanza Province, Kenya, June-November 2010.

| **Variable** | **HW (n=79)** | | | **LC+HW (n=78)** | | |
|---|---|---|---|---|---|---|
| | **OR†** | **95% CI** | **P*** | **OR†** | **95% CI** | **P*** |
| ***Hand washing conditions*** | | | | | | |
| Hand washing water present | 1.62 | 0.62-4.53 | 0.31 | 2.38 | 0.94-6.07 | 0.07 |
| Soap present | 22.10 | 7.78-62.80 | **<0.001** | 49.33 | 15.95-152.56 | **<0.001** |
| ***Hand washing with water only*** | | | | | | |
| At least 50% of pupils | 0.27 | 0.13-0.59 | **<0.001** | 0.09 | 0.03-0.30 | **<0.001** |
| At least 75% of pupils | 0.18 | 0.04-0.85 | **0.03** | 0.09 | 0.01-0.75 | **0.03** |
| ***Hand washing with soap and water*** | | | | | | |
| At least 50% of pupils | 35.65 | 4.65-273.54 | **<0.001** | 44.00 | 5.76-336.00 | **<0.001** |
| At least 75% of pupils | 11.16 | 1.31-95.26 | **0.03** | 18.63 | 2.30-150.62 | **<0.01** |

†Unadjusted odds ratio
*P value of logistic regression coefficient on the difference between the HW and LC + HW study arms compared to controls

**Table 5.** Odds of having any *E.coli* hand contamination for pupils who attended primary schools that received a hand washing intervention (HW) or hand washing plus a latrine cleaning component (LC+HW), versus controls, Nyanza Province, Kenya, October-November 2010.

| | **Model 1 (n = 457 pupils)** | | | **Model 2: Girls only (n = 232 pupils)** | | | **Model 2: Boys only (n = 225 pupils)** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **OR†** | **95% CI** | **P*** | **OR†** | **95% CI** | **P*** | **OR†** | **95% CI** | **P*** |
| HW | 0.58 | 0.24-1.42 | 0.23 | 0.43 | 0.14-1.33 | 0.14 | 0.69 | 0.26-1.84 | 0.46 |
| LC + HW | 0.64 | 0.26-1.58 | 0.33 | 0.57 | 0.23-1.45 | 0.24 | 0.69 | 0.23-2.12 | 0.52 |
| Gender[1] | 0.77 | 0.50-1.21 | 0.26 | - | - | - | - | - | - |
| Grade | 0.94 | 0.75-1.18 | 0.60 | 0.80 | 0.57-1.12 | 0.20 | 1.08 | 0.86-1.35 | 0.50 |
| SES | 1.86 | 0.69-4.99 | 0.22 | 2.83 | 0.82-9.78 | 0.10 | 1.05 | 0.26-4.28 | 0.95 |
| District[2] | 3.37 | 1.61-7.03 | **<0.01** | 2.45 | 0.99-6.07 | **0.05** | 4.42 | 1.98-9.88 | **<0.001** |

†Adjusted odds ratio
*P value of logistic regression coefficient on the difference between the HW and LC + HW study arms compared to controls
[1]Female versus male pupils
[2]Rachuonyo versus Kisumu/Nyando

**Figure 1.** Baseline (May) and four follow-up observation visits (F1=June 7-July 2; F2=July 5-July 30; F3=September 13-October 8; and F4=October 12-November 3) of hand washing conditions and pupil hand washing after latrine use conducted in primary schools (n=20) that received a hand washing (HW) intervention in Nyanza Province, Kenya, May-November, 2010

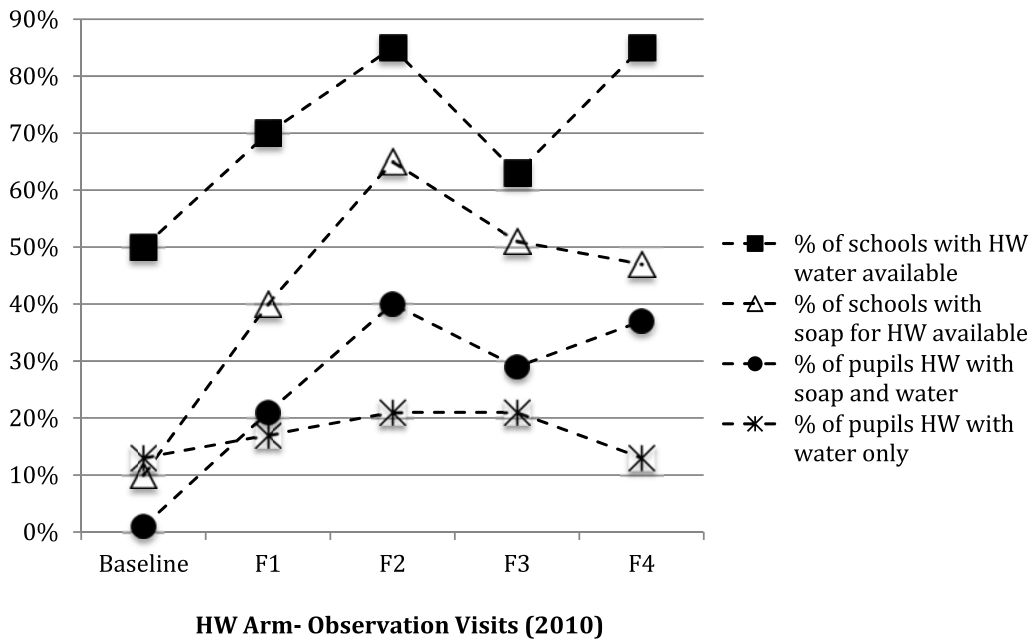


**Figure 2.** Baseline (May) and four follow-up observation visits (F1=June 7-July 2; F2=July 5-July 30; F3=September 13-October 8; and F4=October 12-November 3) of pupil hand washing after latrine use conducted in primary schools (n=20) that received a latrine cleaning and hand washing (LC+HW) intervention in Nyanza Province, Kenya, May-November, 2010

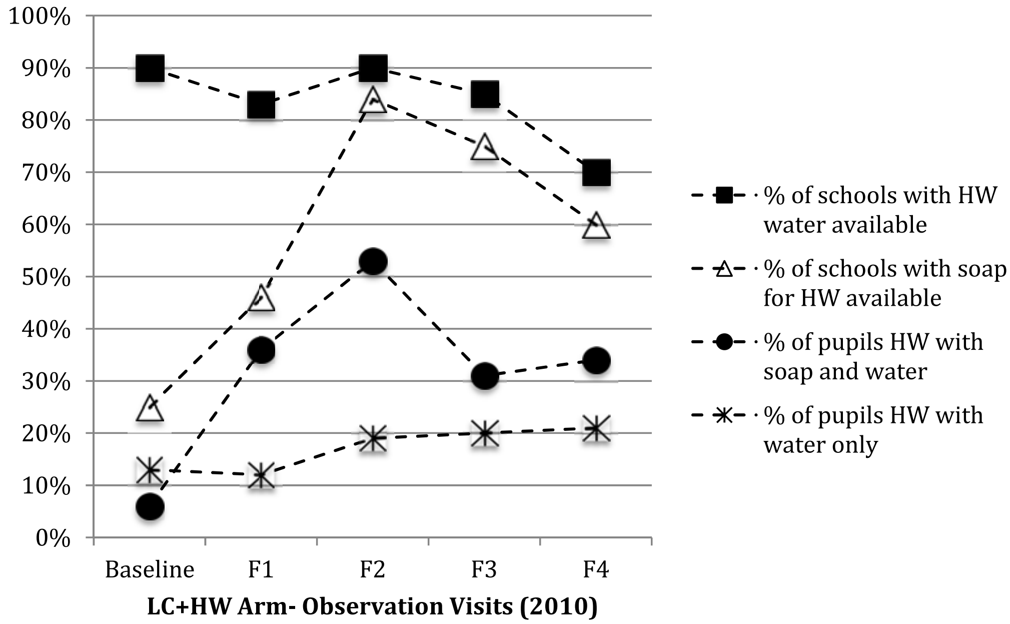



**Figure 3.** Baseline (May) and four follow-up observation visits (F1=June 7-July 2; F2=July 5-July 30; F3=September 13-October 8; and F4=October 12-November 3) of pupil hand washing after latrine use conducted in primary schools (n=20) that did not receive any intervention (controls) in Nyanza Province, Kenya, May-November, 2010

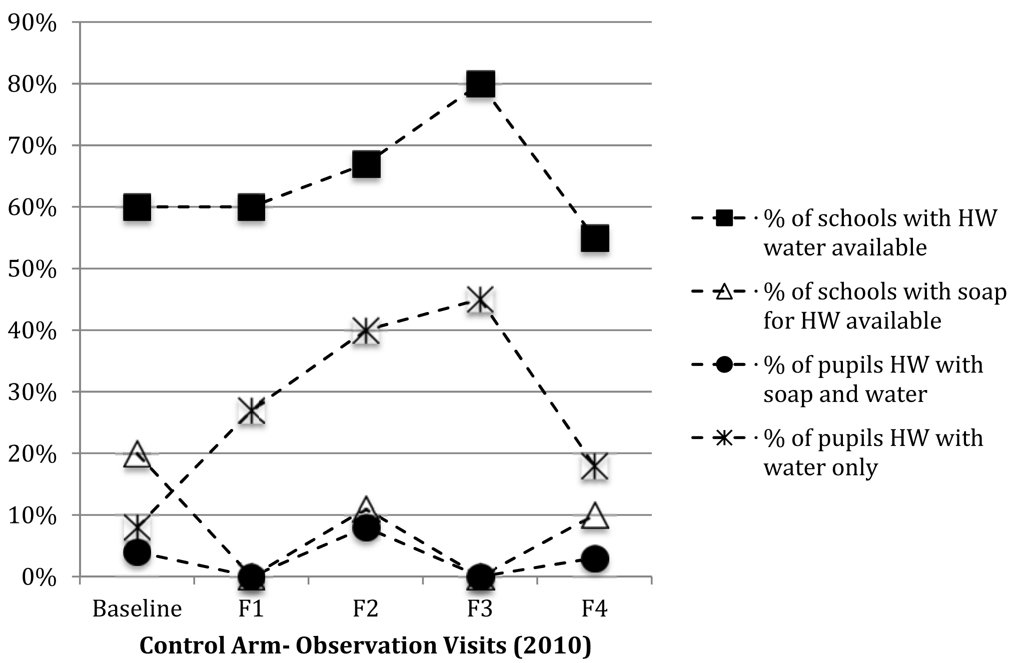
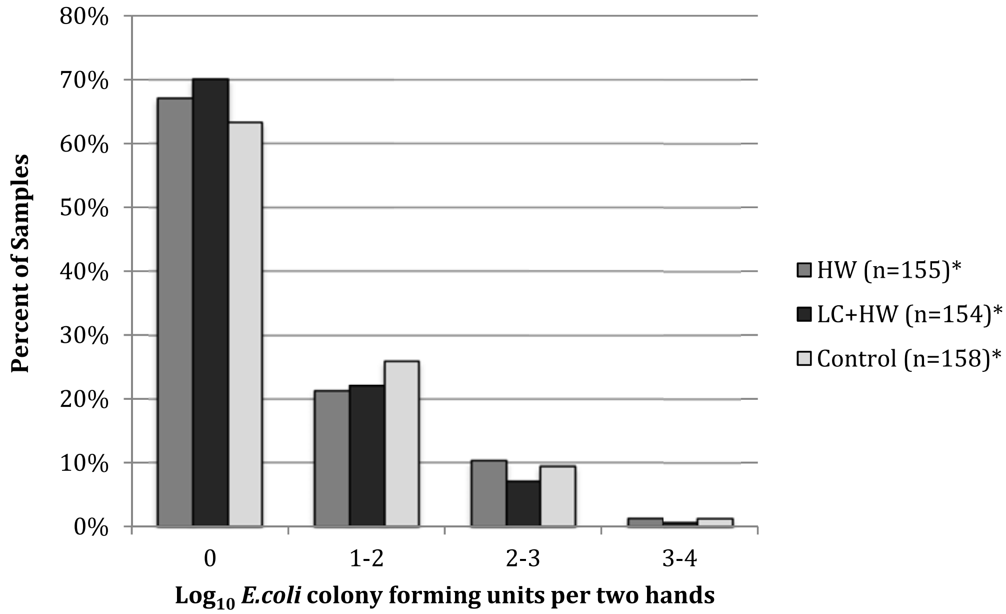


**Figure 4.** Distribution of $\log_{10}$ *E. coli* contamination on pupils' hands in schools (n=60) that received a hand washing (HW) intervention, a hand washing plus a latrine cleaning (LC+HW) component, and controls, Nyanza Province, Kenya, October-November, 2010




*n = the total number of pupils sampled

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# Appendices

## Appendix A.

### 2010 Latrine Use Observation Monitoring Tool

<table>
<tr><td>School name:</td><td>School code:</td><td>Date:</td></tr>
<tr><td colspan="2">Enumerator name:</td><td>Sheet ___ of ___</td></tr>
<tr><td>Time observations began:</td><td colspan="2">Time observations ended:</td></tr>
</table>

**1.** Were you able to observe latrine use during a designated break period? 1. Yes 0. No
**2.** If Yes to (1) above: For which classes was the break period designated? *Circle all that apply:*
1 2 3 4 5 6 7 8 Don't Know
**3.** Is toilet tissue available during this observation? 1. Yes 0. No
**4.** Are you able to see the hand washing stations from where you are observing? 1. Yes 0. No
***If No, skip 5 & 6 and only conduct latrine use observations. (Do not conduct hand washing observations.)***
**5.** Is there water in the hand washing containers at the beginning of this observation? 1. Yes 0. No
**6.** Is there soap at the hand washing containers at the beginning of this observation? 1. Yes 0. No

<table>
<tr><td rowspan="2">Block<br>B=Boy<br>G=Girl<br>D=Disabled<br>T=Teacher<br>E=ECD<br>(Circle all that apply)</td><td rowspan="2">Able to view clearly from your observation point?<br><br>1. Yes<br>2. No</td><td rowspan="2">LATRINE OBSERVATIONS<br>Put a 'l' in the appropriate block below to indicate when a person was observed entering one of the latrines. If there is a block that NO students visit, please put a '0.' If '0' please indicate any barriers to use (lock, structural issues, etc)</td><td colspan="2">HAND WASHING OBSERVATIONS<br>Put a 'l' if a person is observed washing their hands after using the latrine using:</td></tr>
<tr><td>WATER ONLY</td><td>WATER AND SOAP</td></tr>
<tr><td>Block A Designate: B, G, D, T, E</td><td>A_1</td><td>A_2</td><td rowspan="8">W_1</td><td rowspan="8">WS_1</td></tr>
<tr><td>Block B Designate: B, G, D, T, E</td><td>B_1</td><td>B_2</td></tr>
<tr><td>Block C Designate: B, G, D, T, E</td><td>C_1</td><td>C_2</td></tr>
<tr><td>Block D Designate: B, G, D, T, E</td><td>D_1</td><td>D_2</td></tr>
<tr><td>Block E Designate: B, G, D, T, E</td><td>E_1</td><td>E_2</td></tr>
<tr><td>Block F Designate: B, G, D, T, E</td><td>F_1</td><td>F_2</td></tr>
<tr><td>Block G Designate: B, G, D, T, E</td><td>G_1</td><td>G_2</td></tr>
<tr><td>Block H Designate: B, G, D, T, E</td><td>H_1</td><td>H_2</td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| **Block I Designate: B, G, D, T, E** | ***I_1*** | ***I_2*** | | |
| **Total (Blocks A-I Only)** *(add the total number of hash marks from above)* | | ***T_1*** | ***T_2*** | ***T_3*** |

| **Block** *B=Boy G=Girl D=Disabled T=Teacher E=ECD (Circle all that apply)* | Able to view clearly from your observation point? 1. Yes 2. No | **LATRINE OBSERVATIONS** Put a 'l' in the appropriate block below to indicate when a person was observed entering one of the latrines. If there is a block that NO students visit, please put a '0.' If '0' please indicate any barriers to use (lock, structural issues, etc) | **HAND WASHING OBSERVATIONS** Put a 'l' if a person is observed washing their hands after using the latrine using: | |
|---|---|---|---|---|
| | | | **WATER ONLY** | **WATER AND SOAP** |
| **Block J Designate: B, G, D, T, E** | ***J_1*** | ***J_2*** | ***W_2*** | ***WS_2*** |
| **Block K Designate: B, G, D, T, E** | ***K_1*** | ***K_2*** | | |
| **Block L Designate: B, G, D, T, E** | ***L_1*** | ***L_2*** | | |
| **Block M Designate: B, G, D, T, E** | ***M_1*** | ***M_2*** | | |
| **Block N Designate: B, G, D, T, E** | ***N_1*** | ***N_2*** | | |
| **Block O Designate: B, G, D, T, E** | ***O_1*** | ***O_2*** | | |
| **Block P Designate: B, G, D, T, E** | ***P_1*** | ***P_2*** | | |
| **Total (Blocks J-P Only)** *(add the total number of hash marks from above)* | | ***T_4*** | ***T_5*** | ***T_6*** |

**6.** Please note any potential irregularities observed which may have effect latrine use at this school today (i.e. rain, sporting events, visitors, etc.):

________________________________________

________________________________________

________________________________________

**Appendix B.**

**2010 Hand Rinse Protocol**

***Purpose:***
Collect a hand rinse sample that will allow us to measure how much contamination is on the hands of the school children in our study. We will use this information to see if the provision of soapy water in some of the schools results in cleaner hands.

*Twenty (20) assenting randomly selected students will rinse both their hands in a bag containing 250mL of sterile saline solution for 10 seconds (per hand).* This saline solution with the dirt from the pupils' hands sample will then be taken to the GLUK laboratory in Kisumu for analysis of hand contamination. Enumerators trained on hand rinse sampling collection will be responsible for setting up and collecting the samples at a subset of randomly selected Latrine Maintenance Trial schools (24 schools total).

**ROLES AND RESPONSIBILITIES**
After random selection of the students has taken place (using school registers and random number generator sheets), the field enumerators should gather all selected students and explain the purpose for the day's activities. He/she should read the Pupil Hand Rinse Assent and answer any questions from the pupils. The hand rinse enumerators should then demonstrate the hand rinse procedure to the whole group of student volunteers. Use a demonstration bag. Explain that the liquid being poured into the bag is salt water and is completely harmless. One of the enumerators should put their hands in the bag (one at a time) and show how the person should agitate their hands in the bag. Ask if the students have any questions or concerns about the procedure.

***Materials Required for EACH School:***
21 (1 extra in case of errors) Sterile Plastic whirl pack bags
1 demonstration whirl pack bag
Special markers for writing on whirl packs
12 (2 extra for demonstration and potential errors) 500 ml bottles of sterile PBS (salt water solution)
Cooler with frozen ice packs
Hand Rinse Sample (chain of custody) forms
Pupil Hand Rinse Assent form

***Procedure:***
1. The field enumerator should bring the pupil to the hand rinse station, where the enumerator will review how the student will perform the hand rinse sample and read the Pupil Hand Rinse Assent. **Emphasize that participation is completely voluntary.** NEVER FORCE A PUPIL TO PROVIDE A HAND RINSE SAMPLE.

2. If the pupil consents to the sampling, FIRST label the empty sterile whirl pack bag with the following information: Sample #-SCODE-GENDER –DATE-TIME OF DAY
**For example, if the hand rinse enumerator went to Kandaria Primary School (with SCODE = 11009) and took the hand rinse sample of the first pupil who happened to be a female pupil on October 2, 2010 at 11:30 am, then the whirl pack should be labeled the following:**

**1_11009_F_2/10/10_11:30AM**

If it was the THIRD pupil being sampled at 11:40AM in that school and the pupil happened to be male, then the label should say:

**3_11009_M_2/10/10_11:40AM**

PLEASE ENSURE THAT EACH SAMPLE CONTAINS ALL OF THE INFORMATION ABOVE.

3. Unscrew the top of the plastic bottle that contains the sterile PBS. Tear the perforated seal on the top of the whirl pack bag and carefully open. Carefully pour 250 ml of PBS (half the contents of the bottle) into the open whirl pack bag. Immediately close the PBS bottle in order to ensure that the PBS remains sterile.

4. Ask the student to put his/her hand in the bag with the PBS and wiggle their fingers around in the PBS while counting slowly to ten. **Make sure that the student's hand is immersed in the PBS as much as possible**. For older students with large hands, it will be necessary to hold the bag in a way so that their fingers will be immersed in the PBS. Ask the student to repeat the procedure with the other hand.

5. Close the whirl pack bag by carefully rotating the bag and then fastening the wire tabs. **MAKE SURE that the bag is completely closed and not leaking (Turn it upside down to check).**

6. Put the bag in the cooler.

7. Thank the student for participating and let them know they can resume their regular scheduled school activity.

8. Repeat steps 1-7 with the next student volunteer.

**MAKE SURE THAT YOU:**

- **Do not contaminate the PBS in the sterile bottles with your fingers or any other objects. If you do, PLEASE use another PBS bottle. If there are no more PBS bottles available, end the hand rinse sampling activity.**
- **Do not contaminate the inside of the sterile whirl pack bag with your fingers or any other objects. If contaminated, you must use another whirl pack.**
- **Do not contaminate the hand rinse sample with your fingers or any other objects.**
- **Have the correct information labeled on the bag before you put it in the cooler.**
- **Keep the hand rinse samples COLD. Do NOT expose to sunlight or heat. Do NOT freeze.**

IF A SAMPLE IS LOST:
If a child changes his/her mind about giving a sample after you have already labeled the whirl pack bag – mark "REFUSED" on the bag and chain of custody form.

If a sample spills during the collection process, try to get a sample from the other hand if it has not yet been rinsed. Otherwise, mark the sample as "SPILLED" on the chain of custody form.

At the end of the day, the hand rinse enumerators should ensure that all the samples listed on the Handrinse Sample Form are present in the cooler and are labeled correctly.

They should tick the boxes for each sample present and sign in the appropriate line of the chain of custody section of the form. Samples should be stored in the cooler and brought to the lab in Kisumu that same day. Each person who receives the samples should sign the chain of custody until it reaches the TICH laboratory.

**Appendix C.**

**HAND RINSE SAMPLING FIELD FORM / CHAIN OF CUSTODY**

School name: ______________________ SCODE: ________________ Date: ______________

Enumerator name: _______________________________
Enumerator name: _______________________________

Time of collection: From: _________ To: __________

| UniqueID<br>(Sample#_SCODE_GENDER _DATE_TIME OF DAY)<br>For example: 15-11009-F-02/10/10-11:30AM | Hand Rinse Enumerator | Lab Personnel |
|---|---|---|
| 1. | ☐ | ☐ |
| 2. | ☐ | ☐ |
| 3. | ☐ | ☐ |
| 4. | ☐ | ☐ |
| 5. | ☐ | ☐ |
| 6. | ☐ | ☐ |
| 7. | ☐ | ☐ |
| 8. | ☐ | ☐ |
| 9. | ☐ | ☐ |
| 10. | ☐ | ☐ |
| 11. | ☐ | ☐ |
| 12. | ☐ | ☐ |
| 13. | ☐ | ☐ |
| 14. | ☐ | ☐ |
| 15. | ☐ | ☐ |
| 16. | ☐ | ☐ |
| 17. | ☐ | ☐ |
| 18. | ☐ | ☐ |
| 19. | ☐ | ☐ |
| 20. | ☐ | ☐ |

<u>Chain of custody</u>

Received by

Print name: _______________________Signature: ___________________Date:__________Time:________

Print name: _______________________Signature: ___________________Date:__________Time:________

Laboratory tech: _____________________Signature: ____________________Date:_______Time:________

Comments:

______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

**Appendix D.**

**Laboratory Quality Control Checklist**

**Week beginning (date): ______________**
**Name of supervisor performing quality control checks: __________________**

**MORNING tasks:**

| | Mon | Tues | Weds | Thurs | Fri | Sat | Sun |
|---|---|---|---|---|---|---|---|
| Record temperature of refrigerators (should be ~4 º C) | º C | º C | º C | º C | º C | º C | º C |
| Record temperature of autoclave (should be 121 º C) | º C | º C | º C | º C | º C | º C | º C |
| Record temperature of incubator | *Record temperatures on attached temperature log* | | | | | | |
| Confirm benchtops were decontaminated with 10% bleach (JIK) solution | | | | | | | |
| Confirm 1 morning sterility check was run on distilled water used as diluent *and results recorded on lab data form* | | | | | | | |
| Confirm morning sterility check was run on mColiBlue broth *and results recorded on lab data form* | | | | | | | |

**AFTERNOON/ EVENING tasks:**

| | Mon | Tues | Weds | Thurs | Fri | Sat | Sun |
|---|---|---|---|---|---|---|---|
| Confirm 2 afternoon sterility checks were run on distilled water *and results recorded on lab data form* | | | | | | | |
| Confirm afternoon sterility check was run on mColiBlue broth *and results recorded on lab data form* | | | | | | | |
| | *Record temperatures temperature log form* | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Record temperature of incubator | | | | | | | |
| Confirm benchtops were decontaminated with 10% bleach (JIK) solution | | | | | | | |
| Confirm laboratory floor was wet-mopped with disinfectant solution (do not use dry mop) | | | | | | | |
| Confirm all glassware is washed with soapy water (Teepol), rinsed 3x with tap water, and rinsed with distilled water. | | | | | | | |
| Confirm all critical glassware and filtration funnels are sterilized. | | | | | | | |
| Confirm that all reagents, chemicals, and test kits are stored in a cool place out of sunlight | | | | | | | |

**WEEKLY tasks (confirm which day each task was completed):**

| | **Mon** | **Tues** | **Weds** | **Thurs** | **Fri** | **Sat** | **Sun** |
|---|---|---|---|---|---|---|---|
| Wash inside of incubator with soapy water, rinse with distilled water, then wipe with 70% ethanol (should be done every Monday) | | | | | | | |
| Wipe lab windows down with a damp cloth | | | | | | | |
| Incinerate biohazard waste (used filters, pads) | | | | | | | |
| Calibrate pH meter using pH 7 and 10 standard buffers | *Record results calibration log form* | | | | | | |
| Run sterility checks on PBS from field workers distilled water used as diluent and on the mColiBlue broth | | | | | | | |
| Check with person responsible for the generator**.** Report lack of fuel to the GLUK administration. | | | | | | | |

**MONTHLY/ QUARTERLY tasks:**
Record date when the water still and reservoir was drained and cleaned:

________________

**GENERAL COMMENTS:**

*(Describe any equipment malfunctions/problems, supplies that must be ordered, or other comments):*

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

*(Please return completed form to PERSON RESPONSIBLE at the end of each week)*

**Appendix E.**

**SUMMARY: *E. COLI ANALYSES OF HANDRINSE AND WATER SAMPLES***

- A minimum of two volumes of each water or handrinse sample should be filtered.
- Three distilled water negative controls should be filtered daily – one at the start of the day, one in the middle of the day, and one at the end of the day.
- Two broth controls should be tested daily (filter on a pad with broth).
- A sample of PBS from a field worker should be tested for sterility at least once a week.
- During employee training period, duplicate filters should be run for each sample volume to compare replicability and consistency.
- During employee training period, two analysts should count all plates and the results compared.
- After employee training period, two analysts should count 10% of all plates and the results compared to ensure continued accuracy.
- Lab data should be entered into duplicate databases and compared to detect data entry errors.

**FULL LAB PROTOCOL: IDENTIFICATION OF *E. COLI***

**Preparation of 1X Phosphate Buffered Saline (PBS)**

**Method 1:**

Add one packet of 10X PBS powder to about 800 ml of distilled water in a sterile 2 liter beaker. Stir with a sterile pipette until dissolved and then bring up the volume to 1 liter with distilled water to make 1 liter of 10X PBS stock solution. Mix by stirring with a sterile 10 ml pipette. Using a sterile 10 ml pipet, collect a 20 ml sample and add to a small beaker. Calibrate the pH meter with the pH 7 and pH 10 standards, then check the pH of the PBS sample. The pH should be 7.2 ±0.5. If necessary, adjust the pH to 7.2 with 1N NaOH.

Take 10 ml of the adjusted 10X PBS stock solution and dilute with 90 ml of distilled water in a sterile 100 ml beaker to make 100 ml of 1X PBS. Check the pH again.

If the pH is still 7.2, then make 1X PBS by adding 50 ml of 10X PBS and 450 ml of distilled water to 20 sterile 500 ml sample bottles that have been marked for 250 ml and 500 ml volumes. Close each bottle immediately after filling, tighten lids and shake bottles to mix.

Label each bottle "1X PBS" and with the date of preparation. Record the preparation of PBS in the laboratory log book with the date, amount prepared and name of the person who prepared it.

**Method 2:**

Add two packets of 10X Phosphate Buffered Saline (PBS) powder into one 20 liter container of distilled (DI) water. Mix by shaking container until PBS is dissolved.

Using a sterile 10 ml pipet, collect a 10 ml sample and add to a small beaker. Calibrate the pH meter, then check the pH of the PBS sample. pH should be 7.2 $\pm$0.5. If the pH is off, adjust the pH with 1N NaOH. Keep track of how much NaOH you added in order to adjust the pH to 7.2. Calculate how much 1N NaOH needs to be added to the 20 liter container in order to adjust the pH. For example, if 0.2 ml of 1N NaOH was added to adjust 10 ml of 1X PBS, then 400 ml [(20,000 ml x 0.2 ml) divided by 10 ml] of 1N NaOH would be necessary to adjust the pH of 20 liters of 1X PBS to 7.2.

After adding the 1N NaOH to the 20 liter container, mix by shaking the container. Using a sterile 10 ml pipet, collect another 10 ml sample and add to a small beaker. Check the pH of the PBS sample again to confirm that the pH is 7.2 $\pm$0.5.

Pour 500mL into each of 40 sterile 500 ml sample bottles that have been marked for 250 ml and 500 ml volumes. Close each bottle immediately after filling and tighten the lid.
Label each bottle "1X PBS" and with the date of preparation.

Record the preparation of PBS in the laboratory log book with the date, amount prepared and name of the person who prepared it.

## 1.0 Scope and Application

**1.1** This method determines the presence or absence of fecal coliforms and *E. coli* in finished potable water using a selective and differential membrane filtration (MF) medium, m-ColiBlue24 Broth.

**1.2** This method can detect the presence or absence of both fecal coliforms and *E. coli* simultaneously within 24 hours and without the need for a confirmation step.

**1.3** The detection limit of the method is one colony forming unit (CFU) of fecal coliform bacteria per 100 mL of sample. See Attachment 1.3.

## 2.0 Summary of Method

**2.1** Coliform bacteria are identified in water either as fecal coliforms or *E. coli*. Fecal coliforms can be present in water without *E. coli* being present; *E. coli* cannot be present in water without total coliforms also being present.

**2.2** An appropriate volume (please see recommended volume table) of sample is filtered through a 47-mm membrane filter using standard techniques. The filter is then transferred to a 50-mm petri plate containing a sterile absorbent pad saturated with m-ColiBlue24 Broth. The filter is then incubated at 44.5°C ± 0.5°C for 24 hours. This higher incubation temperature selects for fecal coliform bacteria instead of the total coliform bacteria. If fecal coliform bacteria are present in the sample, both red and blue colonies may appear; the blue colonies are specific to the presence of *E. coli*. Two volumes of each sample should be tested.

**2.3** M-ColiBlue24 Broth is a nutritive, lactose-based medium, containing inhibitors to selectively eliminate growth of non-coliforms. It is analogous to an improved version of m-Endo. Total coliform colonies growing on the medium are highlighted by a non-selective dye, 2,3,5-Triphenoltetrazolium Chloride (TTC), which produces red colored colonies. Among the fecal coliform colonies, which grow up on the medium, any *E. coli* colonies are distinguishable by a selective blue color, resulting from the action of b-glucuronidase enzyme on 5-Bromo-4-Chloro-3-Indolyl-Beta-D-glucuronide (BCIG).

## 3.0 Definitions

**3.1** M-ColiBlue24Broth contains a nutritive medium and colorimetric indicators.

**3.2** Total Coliform Bacteria - Bacteria belonging to the genera *Klebsiella* sp., *Enterobacter* sp.,*Citrobacter* sp., or *Escherichia* sp. Fecal coliform bacteria are a sub-group of total coliforms that are thermotolerant (able to grow at 44.5$^{o}$C)

**3.3** Fecal coliform Positive Colony - A red or blue colony.

**3.4** Fecal coliform Negative Colony - A clear or white colony. (Background growth)

**3.5** *Escherichia coli* or *E. coli* Bacteria - A genus within the total coliform group typified by possession of the enzyme b-Glucuronidase, ability to grow at 44.5°C, and form indole from tryptophan.

**3.6** *E. coli* Positive Colony - A blue colony.

**3.7** *E. coli* Negative Colony - A non-blue colony.

## 4.0 Interferences

**4.1** No interferences to the colony color development have been found in finished potable water samples. Similarly, particulates in water samples do not alter the efficacy of the medium, although excess particulates may cause colonies to grow together on crowded filters or slow the sample filtration process.

## 5.0 Quality Control

**5.1** m-ColiBlue24 Broth undergoes quality control (QC) testing at the time of manufacture. A Certificate of Analysis is included with every m-ColiBlue24 product, stating that the m-ColiBlue24 Broth, as received by the analyst, is ready for use in analyzing water samples by the membrane filtration procedure. The laboratory should test quality control by running a broth negative control.

**5.2** To run a broth negative control, add 2 ml of m-ColiBlue 24 broth to the pads in two MF petri dishes, then add a sterile membrane filter on top of the pad. Label as "start-of-day broth control" and "end-of-day broth control". Incubate the broth negative control for 24 hours at 44.5°C ± 0.5°C. The broth negative control should have no growth. Record the results of the broth negative controls on a Water Sample Results Form.

**5.3** To run a distilled water negative control, add m-ColiBlue 24 broth to the pads in three MF petri dishes. Filter 10 mL of the distilled water (DI) used for dilutions and in the wash bottle and place filter on the first pad. Filter one distilled water negative control at the start of the day, a second negative control in the middle of the day (see daily schedule) and a third negative control at the end of the day. Label as “start-of-day DI water control”, “mid-day DI water control” and “end-of-day DI water control”. Incubate the DI negative controls for 24 hours at 44.5°C ± 0.5°C. The DI negative controls should have no growth. Record the results of the DI negative controls on a Water Sample Results Form.

**5.4** If possible, it would also be useful to test samples of the PBS solution that the enumerators (field workers) have been using to see if it is maintaining its sterility under field storage conditions. Try to test 10 – 100 ml aliquots from a couple different enumerators once a week using the procedures described above in section 5.3

**5.5** Colonies may be picked from membrane filters and inoculated into Lauryl Tryptose Broth (LTB), Brilliant Green Lactose Bile (BGLB), EC+MUG, or other media for further QC testing if desired.

## 6.0 Procedure

**Necessary Equipment and Supplies**

- 47-mm sterile 0.45 micrometer membrane filters
- Filtration manifold connected to a vacuum pump
- Sterile filtration funnels
- Sterile forceps
- Two beakers with methylated spirits to store the forceps during filtration
- Bunsen burner to sterilize forceps during filtration
- Sterile distilled water for making dilutions (for 1 ml and 0.1 ml sample volumes)
- Sterile 50-mm petri plates with sterile pads
- m-ColiBlue24 Broth
- Sterile 2 ml and 10 ml pipets
- Pipet aids
- Sterile 100 ml graduated cylinders
- Incubator set at 44.5°C
- Permanent marker
- Wash bottle with sterile distilled water
- Gas lighter

Recommended Sample Test Volumes

| **Type of Sample** | **Test Volume 1** | **Test Volume 2** |
|---|---|---|
| Handrinse | 1 ml (diluted in 9 ml distilled water) | 10 ml |

| | | |
|---|---|---|
| Drinking water (clear) | 10 ml | 100 ml |
| Drinking water (turbid) | 1 ml (diluted in 9 ml distilled water) | 10 ml |
| Source water (clear) | 10 ml | 100 ml |
| Source water (turbid) | 1 ml (diluted in 9 ml distilled water) | 10 ml |

Note: For highly contaminated water or handrinse samples, it may be necessary to make a 1:10 dilution (1 ml sample + 9 ml sterile distilled water) in a sterile test tube and then add 1 ml of this dilution to 9 ml of sterile distilled water in the filter funnel.

**6.1** Test Procedure

**6.1.1** Aseptically open m-ColiBlue24 Broth bottle and pipette 2mL of broth onto the pad in a 50-mm MF petri plate. Label Petri dishes for 18 samples (36 petri dishes + 2 neg controls) at a time. Label should include sample number and volume filtered. Add broth to 38 petri dishes at a time.

**6.1.2** Using sterile forceps**,** place a sterile membrane filter onto a sterile filter holder.

Shake the whirl-pack bag or sample bottle to mix the sample. Using sterile pipettes or graduated cylinders, measure an appropriate volume of a **well-mixed** sample. **Filter the smallest volume first. For example, start by filtering a 1 ml volume of sample, change the filter, then filter a 10 ml volume. The 1 ml volume should be diluted in 9 ml of sterile distilled water before filtering.**

Pour water sample into the funnel on filter holder and draw the water through the filter using a vacuum pump.

Rinse the inside of the funnel with sterile distilled water in a wash bottle. In order to maintain sterility, do not allow the wash bottle to touch the funnel. Turn off vacuum pump.

With **sterile** forceps, transfer the filter to a petri plate containing the pad saturated with m-ColiBlue24. "Roll" the filter onto the plate in order to avoid trapping air bubbles between the membrane filter and the saturated pad.

Invert plate and incubate at 44.5°C ± 0.5°C for 24 hours. Record the time that each set of plates is placed in the incubator.

**6.2** Interpretation

**6.2.1** Examine filters for colony growth. Colonies are typically readily visible, but a magnifying glass may prove useful.

**6.2.2** A red or blue colony is a fecal coliform Positive result. A clear or white colony is a fecal Coliform Negative result and should be recorded as background growth. A blue colony is specifically an *E. coli* Positive result. A non-blue colony is an *E. coli* Negative result:

**6.2.3** The incubation time is 24 hours. If no colonies are visible after 24 hours, the sample is free of fecal coliforms and *E. coli*.

## 7.0 Data Analysis, Calculations, Interpretation and Reporting

**7.1** Presence/Absence

**7.1.1** The presence of at least one red or blue colony indicates the sample is fecal coliform positive. The presence of at least one blue colony also indicates the sample contains *E. coli*. Absence of red or blue colonies indicates the sample contains no fecal coliforms or *E. coli*. No further analysis or calculation is required.

**7.2** Quantification

**7.2.1** If enumeration of fecal coliform and/or *E. coli* populations is desired, refer to the table of recommended sample volumes in this protocol or to Standard Methods section 9222B page 9-56 for appropriate volumes of the sample to filter so that 10-100 (ideally 20–80) colonies are present after incubation. For analysis of drinking water samples, a standard sample of 100 mL is usually advisable. Enter the results for each sample on the Water Sample Data sheet (Appendix A).

**Fecal coliforms**: For each sample volume, count the number of red colonies that are easily visible and record the number on the Water Sample Data sheet. Count in a methodical way, using the grid on the membrane as a guide (ie. count row-by-row) and use the counter.

***E. coli***: For each sample volume, count the number of blue colonies that are easily visible and record the number on the Water Sample Data sheet.

If there are no colonies on the filter membrane, report the results as “no growth” (NG)

If the total number of bacterial colonies exceeds 200, report the results as “too numerous to count” (TNTC).

Record the amount of background growth (colonies that are not red or blue) as “none”, “light”, “moderate” or “heavy”.

“None” = all visible colonies are either red or blue.

“Light growth” = a few colonies are not red or blue

"Moderate growth" = a number of colonies but still able to count red and blue colonies accurately

"Heavy growth" = many small colonies or confluent growth covering the plate, unable to see or accurately count red and blue colonies

In the comments section of the Water Sample Results form, report any problems in sample storage time and conditions, problems with sample processing or incubation (such as a prolonged power outage), colonies that do not appear to be typical, problems with sample turbidity, etc. Also report if the PBS negative controls or broth negative controls processed on this date had growth.

**7.2.3** We will calculate the number of microorganisms per 100-mL sample as described in Standard Methods 9222B pages 9-56 through 9-58. This will be done in the electronic database and does not need to be done manually and recorded on the Water Sample Form.

**Appendix E.**

## Latrine Maintenance PUPIL QUESTIONNAIRE

## GENERAL INFORMATION

**EXIT SURVEY OPTION BOX.**
**READ CONSENT**
**ADD CONSENT SCRIPT HERE**

**PS000** Consent
Yes = 1
No = 0

**AUTOMATED ENTRIES**

PS001 PDA Serial Number:

PS002 PDA Autonumber _ _

PS003 PDA Device Name PDA _ _

PS004 Unique ID ________

PS005 Date of interview (dd/mm/yyyy) ____/_____/_____

**PS006** Time survey begins __________

**PS007** School name: _____________________

PS009 School code: _____________________

**BEGIN INTERVIEW**

PS010 Respondent sex
1) Male

2) Female

PS011 Enumerator Number: ________________

PS012 How old are you? **In ja higni adi?** _______ years

PS014 What class are you in? **In e class adi?** Standard_____ (range 4-8)

PS016 Were you in this school last year?
**Bende ne isome eskundni higa mokalo?**
1) Yes 0) No

## SCHOOL ABSENTEEISM

*I am now going to ask you a few questions about missing school.*
**Koro adwaro penji matin kuom kama iyude pi gi kaka irito pigno**

PS140 Have you missed school in the past two weeks? **Isebari skul e jumbe ariyo mokalo?**
1) Yes 0) No ► **GO TO PS158**

PS142 How many days of school have you missed in the last two weeks?
**Iselewo ne dhi skul kuom ndalo adi e jumbe ariyo mosekalo?**
_____ days

**PS144** What was the primary reason that you missed school?
**En ang'o mane ochuni ni nyaka ibari ne skul chieng' mogik mani leo dhi skul?**
________ *(use codelist)*

PS150 Did you miss school because you were ill? **Ne ilewo ne skul nikech nituo?**
1) Yes 0) No ► **GO TO PS154 (Frame 12750)**

What type of illness did you have? **Ne in gi tuo mane?** *(probe. Multiple responses possible)*

| | | |
|---|---|---|
| PS152_1 | Diarrhea | **idiewo** |
| PS152_2 | Cough | **ifuolo** |
| PS152_3 | Malaria | **midusi** |
| PS152_4 | Headache | **wich bar** |
| PS152_6 | Stomach problem | **ich kach / mur** |
| PS152_5 | Other illness:____________ | **Tuoche mamoko** |

**PS154** What were the other reasons that you missed school in the past 2 weeks?
**En ang'o momoko momiyo ni bari gi skul e jumbe ariyo mokalo?**
PS154a _______ PS154b ________ PS154c ________ PS154d ________ *(use codelist)*

PS158 Have you had diarrhea in the past week? **Be isebedo gi tuo diep e juma mokalo?**
1) Yes 0) No ► **GO TO PS170**

PS160 How many days did you have diarrhea? **Ne idiewo kuom ndalo adi?**
_______days

## SANITATION PRACTICES

*I am now going to ask you a few questions about your sanitation practices*
**Koro adwaro penji matin kuom yor rito ler.**

PS 170 How often are latrines cleaned at the school?
**Ithoro luok chope marom nade e skul ka?**
1) Daily **pile**
2) 2-4 times per week **di 2-4 e juma**
3) Weekly **di chiel e juma**
4) Less than once per week **matin ne dichiel e juma**
99) I don't know **Akia**

PS172 Are you ever involved in cleaning the latrines at school?
**Bende ijaluoko chope e skul ka?**
1) Yes 2) No ► **GO TO PS185**

PS173 Do you clean the latrines alone or in a group?
**Iluokoga choo kendi kose gi jowadu?**
1) Alone **kenda**
2) With others **gi jowadwa**

PS174 What do you do? *(probe. Multiple responses possible)*
**Itimo nang'o**
1) Sweep **yweyo**
2) Mop **goyo dasta**
3) Scrub **rudho**
4) Pour Water **ole pii**
5) Use Ash **tiyo gi buru**
6) Use Detergent **tiyo gi sabun**
7) Monitor cleaning **ng'iyo ler mare**
8) Other ________________(specify)

PS176 How often are cleaning materials available?
**Gigo ma uluoko godo choo thoro yudore marom nade?**
1) Never **ok yudre**
2) Sometimes **seche moko**
**3)** Every time we clean the latrines **seche duto ma waluoko chope**
**99)** I don't know **Akia**

Are the following materials available? (ASK EACH)
**Bende gik ma adhi kwanogi yudore ?**

PS177 1) Boots **Gambut** 1) Yes 0) No 99) I don't know
PS178 2) Bucket **Ndoo** 1) Yes 0) No 99) I don't know
PS179 3) Bleach/ Chlorine Powder **Jik** 1) Yes 0) No 99) I don't know
PS180 4) Hand Broom(Local, natural materials) **Ywech ma olosi gi oboke**
1) Yes 0) No 99) I don't know
PS181 5) Mop **Dasta** 1) Yes 0) No 99) I don't know
PS182 6) Gloves **Glove** 1) Yes 0) No 99) I don't know
PS183 7) Ash **Buru** 1) Yes 0) No 99) I don't know
PS184 8) Cleaning solution (soap based) **Sabund pii mar luoko choo**
1) Yes 0) No 99) I don't know

PS180 9) Shop Broom (Plastic or metal) **Ywech ma onyiew (plastic kata chuma)**

1) Yes 0) No 99) I don't know

PS180 10) Duster **Dasta** 1) Yes 0) No 99) I don't know

PS180 11) Any other materials available? ________________(specify) **Gimoro kendo ma utiyogo ma opogore gi ma wasewacho?**

1) Yes 0) No 99) I don't know

PS185 Last time you had to defecate while you were at school, did you use the latrine, go to the field, wait until you got to another place, or something else?
**Chieng ma ogik mane idwaro dhi pielo e skul ka,bende ne idhie choo, idhie pap, ne irito ma idhi kama opogore, kose nitie gimopogore maneidhie kata itimo?**

1) Use the latrine **Dhie choo**
2) Go to the field **Dhie pap**
3) Wait until another place **Rito dhi kamoro**
4) Other ________________(specify)

PS186 Did you use the latrine at the school the last day that you were in school for urination, defecation, both, or neither?
**Chieng' mane in e skul mogik bende ne idhi ee choo mar skul layo, pielo ,kata layo kod pielo koso ne ok itimo mago ee choo mar skul ni?**

1) Urination only **layo kende ► GO TO PS188**
2) Defecation only **pielo kende ► GO TO PS188**
3) Urination and defecation **Layo gi pielo ► GO TO PS188**
4) Neither urination nor defecation **ok layo kata pielo**

PS187 When was the last time you used the latrine at school?
**Ne en chieng' mane mogik mane idhie choo e skul ka?**

1) Never use the latrine **ok adhie ga choo**
2) Within the past week **kind juma ma okadho**
3) Within the past month **kind dwe mokadho**

PS188 Was toilet paper or another anal personal cleansing material available when you used the latrine?
**Bende tishu kata gimoro ma inyalo ywego sienda ne nitiere e choo seche ma ne idhi no?**

1) Yes 0)No ► **GO TO PS190**

PS189 How often is toilet paper or another personal cleansing material available when you want to use the latrine?
**Tishu kata gima iyweyogo sienda thoro yudore marom nade sama idwa dhie choo?**

1) Always **seche duto**
2) Sometimes **seche moko**
3) Never **ok yudre**

PS192 How often do you use pages from your schoolbooks when you take a long call at school?
**Ithoro yweri gi otas mar buk skul marom nade?**

0) Always **seche duto**
1) Sometimes **seche moko**
2) Never **ok yudre**

PS193 Are there pupils at this school who use their hands to clean themselves after taking a long call?
**Bende nitiere nyithindo e skul ka ma joywerega gi lwetgi ka gisepielo?**
1)Yes 0) No

PS196 How often do you use your hands to clean yourself after taking a long call?
**Ithoro yweri gi lweti marom nade sama isepielo?**

1) Always **seche duto**
2) Sometimes **seche moko**
3) Never **ok yudre**

PS200 How do you consider the usual smell in the latrines at school: no smell, slightly bad smell, very bad smell? **Gi pachi dun'g/tik mar choo eskul chal nade: onge tik, nitie matin kata dum ahinya?**
1) No smell
2) Slightly bad smell
3) Very bad smell

PS202 How do you consider the usual cleanliness of the latrines: clean, slightly dirty, or very dirty?
**Gi pachi ler mar choche chal nade: ler, olil moromo kata olil ahinya?**
1) Clean
2) Slightly dirty
3) Very dirty

PS204 How comfortable do you feel using the latrine at school: feel comfortable, prefer not to use the latrine, don't like using the latrine?
**Be iwinjo ka yotni tiyo gi choo mar skul: yot ni tiyogo, ok diher, ok ihero tiyo gicho?**
1) Feel comfortable using the latrine ► GO TO **PS206**
2) Prefer not to use
3) Dislike using the latrine

PS206 When you have to go for a long call (defecate) at school, do you use the latrine at school: always, sometimes, never? **Ka idwaro dhi oko/losori be itiyoga gi choo mar skul kinde duto, kinde moko koso ok iti go?**
1) Always ► GO TO **PS210**
2) Sometimes
3) Never
4)

*If sometimes or never* ► If you don't use the latrine, where do you go for a long call (defecate) while you are at school? **Kaponi ok idhi e choo mar skul seche duto kata ka ok idhi, to kare idhi oko kanye ka in e skul?** *(probe. Multiple responses possible)*

PS208_1 Bush/field
PS208_2 Friend's/neighbor's latrine
PS208_3 Public latrine
PS208_4 Home latrine

PS208_5 Behind the Latrine
PS208_6 Behind the Classrooms
PS208_7 By the Fence
PS208_8 School Urinal
PS208_9 Other location on compound grounds
PS208_88 Other

PS210 When you have to make a short call (urinate) at school do you use the latrine: always, sometimes, or never?
**Ka idwaro layo e skul, be itiogi choo kinde duto, kinde moko, koso ok iti gi choo?**
1) Always ► GO TO **PS214**
2) Sometimes
3) Never

*If sometimes or never* ► If you don't use the latrine, then where do you urinate while you are at school? **Kanye ma ilaye ka in e skul?** *(probe. Multiple responses possible)*

PS212_1 Bush/field
PS212_2 Friend's/neighbor's latrine
PS212_3 Public latrine
PS212_4 Home latrine
PS212_5 Behind the Latrine
PS212_6 Behind the Classrooms
PS212_7 By the Fence
PS212_8 School Urinal
PS212_9 Other location on compound grounds
PS212_88 Other

PS214 Do you have a latrine at your home? **Bende un gi choo e dalau?**
1) Yes 0) No ► GO TO **PS224**

PS216 When you have to make a long call (defecate), do you always use the latrine, sometimes use the latrine, or never use the latrine at home?
**Ka idwaro losori / dhi oko, be itiyoga gi choo kinde duto, kinde moko, koso ok iti gi choo?**
1) Always ► GO TO **PS220**
2) Sometimes
3) Never

PS220 When you have to make a short call (urinate), how often do you use the latrine at home: sometimes, always never? **Ka idwa layo ka in dala, itiyo ga gi choo marom nade, kinde duto, kinde moko, kata ok iti go?**
1) Always ► GO TO **PS306**
2) Sometimes
3) Never

PS224 Where do you go to make a long call (defecate) if you do not use the latrine at home?
**Idhi oko kanye ka uonge choo dala?**
PS224_2 Bush/field / behind the latrine
PS224_3 Friend's/neighbor's latrine
PS224_4 Public latrine
PS334_5 Behind the house
PS334_6 Other location on compound grounds

PS224_88 Other ______________________(specify)

PS226 Where do you go to make a short call (urinate) if you don't have a latrine at home?
**Ilayo ga kanye ka uonge choo dala?**
PS226_1 On compound grounds somewhere
PS226_2 Bush/field / behind the latrine
PS226_3 Friend's/neighbor's latrine
PS226_4 Public latrine
PS226_5 Behind the house
PS226_6 Other location on compound grounds
PS226_88 Other ______________________(specify)

## HAND HYGIENE PRACTICES

Now I am going to ask you a few questions about handwashing, both at home and school.
**Koro adwaro penji penjo moko kuom luoko luedo e dala kod skul.**

PS306 Is there a designated place at school for you to wash your hands?
**Bende nitiere kama oketi mar luoko luedo eskul ka?**
1) Yes 0) No ► GO TO **PS312**

PS308 How often is there soap available for you at the place to wash your hands? **Be sabun ohinyo bedo e kar luoko luedo manie skul, kinde duto, kinde moko, koso onge ga?**
1) Always ► GO TO **PS312 (Frame 2000)**
2) Sometimes
3) Never

PS312 Is there enough water at school for you to wash your hands?
**Be nitie pii moromo minyalo luokgo luedo eskul secheduto, sechemoko koso onge chuth?**
1) Always
2) Sometimes
3) Never

**<u>Only ask the next 3 questions if this is an intervention school (do NOT ask in control schools).</u>**

PS316 Have you used soapy water to wash your hands in this school?
**Bende isetiyo gi sabun mar pii ee logo ee skul ka?**
a. Yes b. No *(Skip to the next section)*

PS320 Compared to bar soap, is the scent from soapy water better, worse, or the same?
**Kipime gi sabund miti, bende tik mar sabund pii ber, rach kose gichalre?**
a. Better -ber
b. Worse-rach
c. Same -chalre

PS324 Compared to bar soap, does soapy water make your hands feel better, worse, or the same?

**Kipime gi sabund miti, bende sabund pii miyo iwinjo maber e lweti, marach kose chalre?**

b. Better **-**ber
c. Worse -rach
d. Same -chalre

## COMFORT QUESTIONS

41 How comfortable do you feel using the latrine at school to defecate?
**Iwinjo maber marom nade tiyo gi choo mar skul e pielo?**
- **a.** Feel very comfortable –**winjo maber ahinya**
- **b.** Feel somehow comfortable **–winjo mabet maber**
- **c.** Feel uncomfortable –**winjo marach**

43 How comfortable do you feel with the bushyness of the area around the latrine?
**Iwinjo maber marom nade gi yugno aluora mar choo mar skul?**
- **a)** Feel very comfortable –**winjo maber ahinya**
- **b)** Feel somehow comfortable **–winjo mabet maber**
- **c)** Feel uncomfortable **–winjo marach**

44 How comfortable do you feel with the bushyness of the path to the latrine?
**Iwinjo maber marom nade gi yugno mar yoo madhii e choo mar skul?**
- **a)** Feel very comfortable –**winjo maber ahinya**
- **b)** Feel somehow comfortable **–winjo mabet maber**
- **c)** Feel uncomfortable **–winjo marach**

49 How comfortable do you feel with the latrine structure from the inside?
**Iwinjo maber marom nade gi kaka ichoo skul chalo?**
- **a)** Feel very comfortable –**winjo maber ahinya**
- **b)** Feel somehow comfortable **–winjo mabet maber**
- **c)** Feel uncomfortable **–winjo marach**

50 How comfortable do you feel with the size of the inside of the latrine?
**Iwinjo maber marom nade gi kaka ichoo skul rom?**
- **a)** Feel very comfortable –**winjo maber ahinya**
- **b)** Feel somehow comfortable **–winjo mabet maber**
- **c)** Feel uncomfortable **–winjo marach**

53 How comfortable do you feel with the stability of the school latrines?
**Iwinjo maber marom nade gi tegno mar choo skul**
- **a)** Feel very comfortable –**winjo maber ahinya**
- **b)** Feel somehow comfortable **–winjo mabet maber**
- **c)** Feel uncomfortable **–winjo marach**

54 How comfortable do you feel with the smell of the school latrines?
**Iwinjo maber marom nade gi dung' choche skul**
- **a)** Feel very comfortable –**winjo maber ahinya**
- **b)** Feel somehow comfortable **–winjo mabet maber**
- **c)** Feel uncomfortable **–winjo marach**

55 How comfortable do you feel with the cleanliness of the school latrines?
**Iwinjo maber marom nade gi ler choche skul**
- **a)** Feel very comfortable –**winjo maber ahinya**

- **b)** Feel somehow comfortable **–winjo mabet maber**
- **c)** Feel uncomfortable **–winjo marach**

56 How comfortable do you feel with the number of flies of the school latrines?
**Iwinjo maber marom nade gi luang'ni mane choche skul**

- **a)** Feel very comfortable –**winjo maber ahinya**
- **b)** Feel somehow comfortable **–winjo mabet maber**
- **c)** Feel uncomfortable **–winjo marach**

57 How comfortable do you feel with the number of maggots of the school latrines?
**Iwinjo maber marom nade gi kute mane choo che skul**

- **a)** Feel very comfortable –**winjo maber ahinya**
- **b)** Feel somehow comfortable **–winjo mabet maber**
- **c)** Feel uncomfortable **–winjo marach**

58 How comfortable do you feel with the number of holes or cracks of the school latrines?
**Iwinjo maber marom nade gi buche kata baruok mar choche skul**

- **a)** Feel very comfortable –**winjo maber ahinya**
- **b)** Feel somehow comfortable **–winjo mabet maber**
- **c)** Feel uncomfortable **–winjo marach**

59 How comfortable do you feel with the materials available for anal cleansing?
**Iwinjo maber marom nade gi gige yueruok mantie e skul**

- **a)** Feel very comfortable –**winjo maber ahinya**
- **b)** Feel somehow comfortable **–winjo mabet maber**
- **c)** Feel uncomfortable **–winjo marach**

60 How comfortable do you feel with what is available for handwashing?
**Iwinjo maber marom nade gi gige logo mantie e skul**

- **a)** Feel very comfortable –**winjo maber ahinya**
- **b)** Feel somehow comfortable **–winjo mabet maber**
- **c)** Feel uncomfortable **–winjo marach**

61 How comfortable do you feel with the number of mosquitoes of the school latrines?
**Iwinjo maber marom nade gi suna mantie e choche skul**

- **a)** Feel very comfortable –**winjo maber ahinya**
- **b)** Feel somehow comfortable **–winjo mabet maber**
- **c)** Feel uncomfortable **–winjo marach**

62 How comfortable do you feel with the privacy of the school latrine?
**Iwinjo maber marom nade gi geng'ruok ma choo skul chiwo?**

- **a)** Feel very comfortable **–winjo maber ahinya**
- **b)** Feel somehow comfortable **–winjo mabet maber**
- **c)** Feel uncomfortable **–winjo marach**

PS640 Comments?

----------- That is the last question. Thank you for answering our questions. -------------
**----------------- (Mano epenjo mogik. Erokamano kuom duoko penjo gi.) -------------**

**Appendix F.**

**School Facilities Observation Tool for the Latrine Maintenance 2010 Trial**

**Time of survey start**
**Date of survey start**
**ENUMERATOR NAME**
**ENUMERATOR NUMBER**
**SCODE**
**SCHOOL NAME**

**9.00 Initial Observations Upon Arrival at the School**

**9.01** When you **first** arrived at the school, was there hand washing water available?
1. Yes
2. No

**9.05** When you **first** arrived at the school, was there soap available near the hand washing containers?
1. Yes
2. No

**1.00 Base Package / Safe Water System**
*Observe the school's drinking water and hand washing water stations that are in use at time of visit.*
*Please complete the first column and then proceed to the second column.*

| ***"Containers in use"= Container is currently operational and accessible to pupils*** | **DRINKING WATER CONTAINERS** | **HAND WASHING CONTAINERS** |
|---|---|---|
| Total number of containers currently being used: | ***1.01*** (SF810)<br>________ no. of containers<br>If ZERO, → **1.40** | ***1.40*** (SF850)<br>________ no. of containers<br>If ZERO, **→ 2.00** |
| Number of containers with a lid or narrow mouth: | ***1.02***<br>________ no. lid or narrow | ***1.42***<br>________ no. lid or narrow |
| Number of containers currently being used with stands: | ***1.03***<br>________ no. with stands<br>If ZERO, → **1.05** | ***1.43***<br>________ no. with stands<br>If ZERO, **→ 1.45** |
| Number of containers that contain water: | ***1.05*** (SF814)<br>________ no. of containers<br>If ZERO, → **1.40** | ***1.45*** (SF854)<br>________ no. of containers<br>If ZERO, **→ 1.75** |
| Number of containers that visibly leak: | ***1.10*** (SF816)<br>________ no. leaking | ***1.55*** (SF856)<br>________ no. leaking |
| Number of containers with tap: | ***1.20*** (SF826)<br>________ no. with tap<br>If ZERO, → **1.30** | ***1.60*** (SF866)<br>________ no. with tap<br>If ZERO, **→ 1.70** |

| | | |
|---|---|---|
| Number of containers with functioning tap:<br>*Note: test to see if the tap is functioning.* | ***1.25*** (SF828)<br>________ no. functioning tap | ***1.65*** (SF868)<br>________ no. functioning tap |
| Number of containers with detectable residual chlorine:<br>*Note: use the chlorine kit to test.* | ***1.30*** (SF830)<br>________ no. detectable chlorine residual → **1.40** | ***1.70*** (SF870)<br>________ no. detectable chlorine residual |
| How many containers had soap nearby at the time of the site visit? | | ***1.75*** (SF871)<br>______No. of containers |

**2.00 Latrines**

*Please fill out one entire column before moving to the next column. You are to assess each LATRINE DOOR in each block.*

| | Lat. 1 | Lat. 2 | Lat. 3 | Lat. 4 | Lat. 5 | Lat. 6 | Lat. 7 |
|---|---|---|---|---|---|---|---|
| Latrine Block: *(write the letter)* | ***2.01*** | ***2.21*** | ***2.41*** | ***2.61*** | ***2.81*** | ***3.01*** | ***3.21*** |
| Latrine Number: | ***2.01_1*** | ***2.21_1*** | ***2.41_1*** | ***2.61_1*** | ***2.81_1*** | ***3.01_1*** | ***3.21_1*** |
| Is the latrine in use?<br>1-Yes 3-No, pit full<br>2-No, new 4-No, structure dilapidated | ***2.03_1*** | ***2.23_1*** | ***2.43_1*** | ***2.63_1*** | ***2.83_1*** | ***3.03_1*** | ***3.23_1*** |
| **IF VIP:** Are the pipes in good condition with a screen?<br>1 – Yes<br>0 – No<br>88- Not Applicable | ***2.03_2*** | ***2.23_2*** | ***2.43_2*** | ***2.63_2*** | ***2.83_2*** | ***3.03_2*** | ***3.23_2*** |
| Who uses the latrine?<br>1 – Teachers<br>2 – Boys<br>3 – Girls<br>4 – Not assigned<br>5- ECD boys<br>6- ECD Girls<br>7- ECD Boys and Girls<br>8- Disabled students only | ***2.04*** | ***2.24*** | ***2.44*** | ***2.64*** | ***2.84*** | ***3.04*** | ***3.24*** |
| Does the latrine have a shutter?<br>1 – Yes<br>0 – No | ***2.05*** | ***2.25*** | ***2.45*** | ***2.65*** | ***2.85*** | ***3.05*** | ***3.25*** |
| IF LATRINE HAS A SHUTTER: Does shutter close completely?<br>1 – Yes<br>0 – No | ***2.07*** | ***2.27*** | ***2.47*** | ***2.67*** | ***2.87*** | ***3.07*** | ***3.27*** |
| IF LATRINE HAS A SHUTTER: Does shutter have a working latch inside the latrine? | ***2.08*** | ***2.28*** | ***2.48*** | ***2.68*** | ***2.88*** | ***3.08*** | ***3.28*** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 – Yes<br>0 – No | | | | | | | |
| IF LATRINE HAS A SHUTTER: Does shutter have a working latch outside the latrine?<br>1 – Yes<br>0 – No | ***2.08_1*** | ***2.28_1*** | ***2.48_1*** | ***2.68_1*** | ***2.88_1*** | ***3.08_1*** | ***3.28_1*** |
| Smell:<br>1 – Minimal Smell<br>2 – Strong Smell Inside only<br>3 – Strong Smell inside and outside | ***2.09*** | ***2.29*** | ***2.49*** | ***2.69*** | ***2.89*** | ***3.09*** | ***3.29*** |
| Feces<br>1 – No visible feces<br>2 – Small amounts of visible feces<br>3 – Feces very visible | ***2.10*** | ***2.30*** | ***2.50*** | ***2.70*** | ***2.90*** | ***3.10*** | ***3.30*** |
| Urine<br>1 – No visible urine<br>2 – Small amounts of visible urine<br>3 – Puddles of urine | ***2.10_1*** | ***2.30_1*** | ***2.50_1*** | ***2.70_1*** | ***2.90_1*** | ***3.10_1*** | ***3.30_1*** |
| Cleanliness:<br>1 – Clean<br>2 – Slightly dirty<br>3– Very dirty | ***2.11*** | ***2.31*** | ***2.51*** | ***2.71*** | ***2.91*** | ***3.11*** | ***3.31*** |
| Flies:<br>1 – None<br>2 – Some inside<br>3 – Many inside | ***2.13*** | ***2.33*** | ***2.53*** | ***2.73*** | ***2.93*** | ***3.13*** | ***3.33*** |
| Mud:<br>1- There is no mud in or around the latrines<br>2- There is some mud around the latrines<br>3- There is a lot of mud in and around the latrines | ***2.15*** | ***2.35*** | ***2.55*** | ***2.75*** | ***2.95*** | ***3.15*** | ***3.35*** |
| Drainage inside the latrine:<br>1- There is no pooling of water in the latrine<br>2- There is some pooling of water in the latrine<br>3- There is a lot of pooling of water in the latrine | ***2.17*** | ***2.37*** | ***2.57*** | ***2.77*** | ***2.97*** | ***3.17*** | ***3.37*** |
| Drainage outside the latrine:<br>1- There is no pooling of water outside the latrine | ***2.18*** | ***2.38*** | ***2.58*** | ***2.78*** | ***2.98*** | ***3.18*** | ***3.38*** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2- There is some pooling of water outside the latrine<br>3- There is a lot of pooling of water outside the latrine | | | | | | | |
| Comments about latrine? | ***2.20*** | ***2.40*** | ***2.60*** | ***2.80*** | ***3.00*** | ***3.20*** | ***3.40*** |

**5.00 Duty Rosters & Health Messaging**
*Observe the school's walls, classrooms, and head teacher's office to see whether there are any duty rosters, schedules and/or health messaging on display. Complete the following questions based on your observations.*

**5.01** Do you observe any duty rosters or schedules that assign specific students or classes to WASH related tasks? (ie cleaning, fetching water, treating water, etc).
1. Yes
2. No **→ 5.011**

**5.03** Do the duty rosters or schedules designate specific students or classes?
1. Students
2. Classes
3. Both

**5.05** Where are these rosters or schedules displayed? *(multiple responses possible)*
1. Classrooms
2. In offices
3. On a central notice board
4. On latrines
5. Other____________________________________ (specify)

**5.06** What are the tasks assigned? *(multiple responses possible)*
1 – Water fetching
2 – Setting out drinking water containers
3 – Setting out hand washing containers
4 – Treating Water
5 – Cleaning Latrines
6 – Cleaning drinking water containers
7 – Cleaning hand Washing Containers
8 – Cleaning RWH Tanks
10 – Monitoring latrine cleanliness
11 – Monitoring cleaning supplies
12 – Monitoring other WASH tasks
13 – Other (specify)

**5.11** Did you observe any safe drinking water message(s) displayed that children can see?
1. Yes
2. No

**5.15** Did you observe any hand washing message(s) displayed that children can see?
1. Yes
2. No

**5.19** Did you observe any latrine use message(s) displayed that children can see?
1. Yes
2. No

**7.00 Head teacher questions:**
*Please ask the Head Teacher the following questions:*

**7.01** What is the school's current water source?
01 Bring water from home
11 Piped to school
12 Piped to household
13 Other pubic tap
21 Open well-compound
22 Open public well
31 Covered well/Borehole-compound
32 Covered well/Borehole-public
33 Spring – protected
41 Spring - unprotected
42 River/Stream
43 Lake
44 Pond/Dam/Earthpan
51 Rainwater/roof catchment
61 Water Vendor
98 No water available
99 Don't know

**7.02** How far away is the school's current water source?
0. The current water source is on school grounds.
1. The current water source is __________ metres away.
2. Water brought from home.

**7.03** Is water currently available from that source?
1. Yes
0. No
99. Don't Know

**7.05** Is water available today for latrine cleaning?
1. Yes
0. No
99. Don't Know

**7.10** Does the school currently have any supplies for cleaning the latrines?
1. Yes
0. No **→ 7.25**

**7.10**_1 **IF YES,** Please ask to see the supplies that the school currently has. Are you able to see the supplies or are they locked away?
1. Yes, I am able to see the supplies
0. No, I am not able to see the supplies **→ 7.18**

*If you are able to see the supplies, please answer the following questions:*

**7.12** How many long-handled commercial brooms does the school have?
_____________Long-handled commercial brooms

**7.13** How many hand brushes does the school have?
_____________ Hand brushes

**7.14** How many cleaning buckets does the school have?
_____________ Cleaning buckets

**7.15** How many litres of JIK/other disinfectant does the school have?
*(if less than 1litre indicate how much is approximately left)*
_____________ Litres

**7.16** How many Kilograms of Omo/soap does the school have? *(if less than 1 kg indicate how much is approximately left)*
_____________ Kilograms

**7.18** Have any commercial cleaning supplies broken since the last visit?
1. Yes
0. No
99. Not Applicable (baseline)

**7.18**_1 IF YES, Please specify which supplies have broken
1. Long-handled commercial broom
2. Hand brush
3. Cleaning bucket
4. Other, specify_____________________________

**7.19** Has the school purchased any cleaning supplies since the last visit?
1. Yes *(Specify)* _____________________________
0. No
99. Not Applicable (baseline)

**7.19_1** IF YES, Please specify which supplies have been purchased.
1. Long-handled commercial broom
2. Hand brush
3. Cleaning bucket
4. Cleaning Soap (Omo or other brand)
5. Disinfectant (Vim, Jik, or other disinfectant)
6. Other, specify_____________________________

**7.25** Does the school currently use monitoring sheets to monitor cleaning supply quantities and/or the conditions of the latrines?
1. Yes
0. No **→ END SURVEY**
99. Don't Know **→ END SURVEY**

**7.27 IF YES**, Ask the Head Teacher to show you the monitoring sheets. Were you able to view the sheets during your visit?
1. Yes
0. No **→ END SURVEY**

**7. 29** If you were able to see the monitoring sheets, how much of the pupil monitoring sheets were completed since your last visit?
1. The sheets were not used at all since the last visit.
2. The sheets were partly completed since the last visit.
3. Both sheets were fully completed since the last

**7. 31** If you were able to see the monitoring sheets, how much of the Head Teacher/Patron/SMC monitoring sheets were completed since your last visit?
1. The sheets were not used at all since the last visit.
2. The sheets were partly completed since the last visit.
3. Both sheets were fully completed since the last visit.

That is the last question. Thank you for answering our questions.