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National Hygiene Baseline Survey

Preliminary Report

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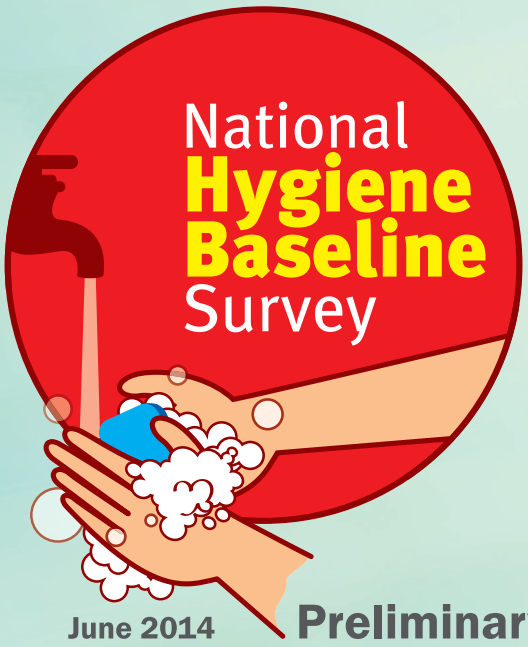

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National Hygiene Baseline Survey

Preliminary Report

International Centre for Diarrheal Diseases Research, Bangladesh (icddr,b)

WaterAid Bangladesh

Policy Support Unit (PSU)
Local Government Division
Ministry of Local Government, Rural Development and Cooperatives
Dhaka, Bangladesh

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FOREWORD

The government of Bangladesh has a commitment to ensure safe environment through promoting personal hygiene practices as mentioned in the strategy document. However, there is a lack of baseline information on hygiene practices among different segment of the population and regions. The overall objective of this national hygiene survey was to establish a nationally representative baseline status of hygiene situations related to knowledge, facilities and practices in the area of Water, Sanitation and Hygiene (WASH). The data to be generated from the survey would further help the WASH sector in Bangladesh to use as a document for advocacy, planning and implementation initiatives.

The survey was conducted in 2013 by icddr,b and supported by WaterAid, Bangladesh and Policy Support Unit of Local Government Division. It was conducted for Water and Sanitation Sector in Bangladesh using an extensive and methodologically sound approach. The exercises under the survey covered a wide range of population groups including households, schools, especially the girls and women for menstrual hygiene management at households and schools. It also focused on hospitals, food handlers at restaurants and food vending locations and, traditional birth attendants. Most importantly, the survey included representative number of survey populations in both rural and urban areas in Bangladesh.

Local Government Division of the Government of Bangladesh has the mission objective of "*Improving the standard of living of the people by strengthening local government systems and institutions and implementing activities for social, economic and infrastructure development*." This broad mission objective has driven the division to distribute its functions into different spheres of its operation where hygiene and sanitation issues are inbuilt. For the proper implementation of the National Hygiene Promotion Strategy, the Local Government Division takes a major role of collaborating with the related departments and agencies involving Ministry of Education, Ministry of Health, Local Government Institutions (LGIs) and non- government organizations working in WASH sector.

I cordially appreciate the tremendous efforts from icddr,b, WaterAid and PSU for the establishment of the benchmark hygiene situation at different population groups such as households, schools, hospitals, and commercial food handlers in Bangladesh. This would, in fact, go a long way towards our journey to ensure a safe environment for the people of Bangladesh. I look forward to the proper use of the survey findings for the effective monitoring of sector performance in the arena of hygiene practices as depicted in the Sector Development Plan.

Monzur Hossain

Secretary
Ministry of Education
Government of the People's Republic of Bangladesh

MESSAGE

One of the main objectives of the Ministry of Education (MoE) of the Government of Bangladesh is to provide value based education. In this regard MoE believes that promoting and maintaining of hygiene knowledge, making availability of facilities related to sanitation, handwashing, environmental hygiene and ensuring hygiene practices is very important for f all of us, especially teachers, school children and school compounds as well. We are thankful that the National Hygiene Survey presents a very useful set of information related to hygiene knowledge and awareness, skills of hygiene behaviours by school children, facilities available for sanitation and hand washing, water availability and hygiene behaviours at schools. I am glad that the survey particularly focuses on the menstrual hygiene management and presents a very valuable set of information in this arena. It would be critically important for us to to promote and ensure the gender parity in education management system in Bangladesh, which is one of the objectives of MoE as well.

I greatly appreciate the tremendous efforts from icddr,b, WaterAid and PSU of Local Government Division for the establishment of the benchmark hygiene situations at primary and secondary schools in Bangladesh. I believe this integrated efforts will certainly help us to track the further improvement of hygiene practices in education sector in Bangladesh. I look forward observing the successful implementation of the National Hygiene Strategy through proper monitoring using this benchmark set by the survey.

Dr. Muhammed Sadique

Secretary
Ministry of Health and Family Welfare
Government of the People's Republic of Bangladesh

MESSAGE

Ministry of Health and Family Welfare has a clear vision that "*we seek to create conditions whereby the people of Bangladesh have the opportunity to reach and maintain the highest attainable level of people health. It is a vision that recognizes health as a fundamental human right and therefore, the need to promote health and reduce suffering in the spirit of social justice.*"

Ministry of Health and Family Welfare has 47 specific objectives to implement the quality of health promotion activities across the country. Therefore, promoting and maintaining the hygiene and sanitary environment and practices of hygiene behaviour for the hospital staff, patients, caregivers and guardians visiting the hospitals are widely linked with the vision and with a number of specific objectives as mentioned in its policy. It is praiseworthy that the National, Hygiene Survey included the hygiene and sanitation situation at hospitals and also the traditional birth attendants. As conducting the hygiene survey at hospital is probably the first of its kind, the data related to the true practices of hospital level hand-washing behaviours, knowledge, availability of sanitation facilities and hygiene practices would, I believe, establish an important milestone and benchmark to monitor the further improvement in this area.

Practicing of hygiene behaviours of course is a difficult area to monitor because it is mostly related to personal wish and desire shaped by knowledge, attitude and above all the overall environment the individuals live in. However, the user-friendly environment can greatly contribute to maintaining personal hygiene practices.

The data presented in this report indicates how poor we are in both the area of hospital hygiene and personal hygiene. I am thankful to icddr,b, WaterAid and Policy Support Unit of the Local Government Division for their excellent efforts in conducting the study and presenting its findings for the wider audience. We would be happy to use the findings of this study as a benchmark for us and would monitor further progress in this sector.

M.M. Neazuddin

ACKNOWLEDGEMENT

The National Hygiene Strategy is a planning document included in the Sector Development Plan (FY 2011-25). Implementation of the strategy demands a certain starting point and accordingly we are trying our best to establish a benchmark in collaborations with WaterAid and icddr,b. Although it took a bit time for the methodology designing, gathering a good volume of data, synthesizing, analyzing and preparing for results to present to the mass audiences in Bangladesh and beyond, finally, despite some limitations, but at least we could gather some level of valid data that covered major population groups including hygiene at household level, school level, menstrual hygiene management, hospital level hygiene and, commercial food handlers.

While it would be difficult to mention the contributions of all by name, yet, it would be generous to recognize some who truly contributed a lot. Starting with icddr,b Water, Sanitation and Hygiene Research team headed by Dr. Leanne Unicomb putting her tireless efforts in the preparation of protocol, methodology, data collection, data analysis, report preparation and incorporation of and finalization of the report incorporating the feedback from the national level dissemination workshop. ln doing this assignment the contributions of Prof. Stephen P Luby (currently based at Stamford University), Dr. Amal K Halder, Mr. Mahbub Ul Alam and Md. Fosiul A Nizame were indeed very helpful.

I am very glad to note that the person who has assumed a central role and taken all the troubles in designing the concept, generating funds and above all has taken a lead role in ensuring the quality issues is Dr. Khairul lslam, the Country Representative of WaterAid Bangladesh. I am grateful to him. Besides this, a considerable support right from the starting till to-date from Mr. Aftab Opel (Research Manager of WaterAid Bangladesh) deserves a special mentioning.

I greatly appreciate and acknowledge the expert review team including Ms. Zuena Aziz, Director General (Additional Secretary), LGD, Dr. Sue Cavill (WASH Consultant-UK), Prof. Shuaib Muhammad, Dhaka University, and Mr. Hrachya Sargsya, Chief of WASH Section, unicef Bangladesh. Their feedback and suggestions greatly enriched the report.

I also, acknowledge the comments and feedback from those who attended different consultation meetings including representatives from Plan lnternational, Dutch WASH Alliance, VERC, NGO Forum, CARE, icddr,b, Save the Children, FHl360, lPA, DSK and UNICEF.

I must acknowledge the endless efforts from my colleagues of the PSU, including Md. Mohsin, Assistant Project Director (Deputy Secretary) and Mr. Md. Abdur Rauf, Assistant Project Director (Deputy Secretary). These are the people who were always with me, providing useful support for coordinating up to union parishad and ward level.

Finally, I must keep on records with gratitude that the whole hearted support I received from Mr. Monzur Hossain, Senior Secretary of Local Government Division, were, indeed, very tremendous without which we could not accomplish the task with success.

Kazi Abdul Noor
Project Director (Joint Secretary)
Policy Support Unit (PSU)
Local Government Division
Ministry of Local Government, Rural Development
and Cooperatives

ACKNOWLEDGEMENT

Bangladesh has made enormous strides in tackling open defecation and increasing access to safe water. However, the accomplishments of increased access to improved water sources and latrine may not lead to proportionate health and nutritional gains in absence of appalling condition of hygiene practices especially handwashing with soap. There is little knowledge of progress in the field of promoting hygiene at national level. Small scale project-specific studies indicate that despite widespread knowledge of hygienic behavior, practice remains abysmally low. The critical knowledge gap on the state of the nation's hygienic practices is holding up further interventions in this area. When the Government of Bangladesh formulated the National Hygiene Promotion Strategy for Water Supply and Sanitation in 2012, it emphasised the needs for reliable national level baseline data in order to design appropriate programs and allocate resources optimally. The urgency of conducting such a baseline prompted the Policy Support Unit of the Local Government Division to take the initiative to conduct a National Hygiene Baseline, with research support from icddr,b and financial and technical supports from WaterAid.

It is indeed a great pleasure that the preliminary report is now ready for dissemination and dialogue. It is expected that the report will contribute immensely to the understanding of the current state hygiene practices in Bangladesh across households, schools, hospitals and other institutions; and in population groups like food handlers, health service providers including TBAs. Most importantly, it has laid a platform to talk about menstrual hygiene management by eliciting the current situation. The report will serve as a baseline dataset to help the government, development partners, NGOs and private sector to set priorities; design and monitor WASH, health, education and other development programs. To the best of our knowledge this is the first of its kind in any country. The national baseline has been designed in modular ways so that it can be used and implemented periodically in future by the relevant stakeholders especially by the sector actors in WASH, health, maternal and reproductive health, education and information dissemination. We also hope that this work will be cited as a model and example and be replicated elsewhere. All the efforts will be successful only when the findings will be acknowledged and used for programming and resourcing hygiene initiatives in the country; and people, in particular, children will be healthy, wealthy and wise.

I would like thank the officials of the Local Government Division, especially Mr Kazi Abdul Noor, Project Director and Joint Secretary of PSU along with his colleagues for spearheading the initiative. I thank our colleagues in the sector who relentlessly provided support by participating in different review meetings and consultation over the past two years. The team work between icddr,b, PSU and WaterAid was phenomenal. I acknowledge contribution of Dr Leanne, Dr Amal and research team members of icddr,b. I am grateful to my colleagues who were instrumental in the process especially Mr Aftab Opel and Ms. Therese Mahon for their support.

WaterAid is proud to have been a partner in the country's first ever National Hygiene Baseline, and we hope this valuable resource can guide and inspire new directions in water, sanitation and hygiene in Bangladesh.

Md Khairul Islam
Country Representative
WaterAid Bangladesh

Abbreviations

95% CI	95% Confidence intervals
CDC	Centers for Disease Control and Prevention
DHS	Demographic and Health Survey
GEE	Generalized Estimating Equations
Govt.	Government
IQR	Interquartile range
JMP	WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation
MICS	Multiple Indicator Cluster Survey
NGO	Non-government Organization
Non-govt.	Non-government
PPS	Probability Proportion to Size
PD	Prevalence difference
PSU	Policy Support Unit
TBA	Traditional Birth Attendant
UHS	Urban Health Survey
UNICEF	United Nations International Children's Emergency Fund
WASH	Water, Sanitation and Hygiene
HO	World Health Organization of the United Nations

Executive Summary

This report includes findings on a range of handwashing indicators from a nationally representative population along with water, sanitation and hygiene (WASH) indicators to provide baseline information for use in advocacy, planning and program monitoring. Field workers conducted face-to-face surveys, spot checks and structured observations to determine handwashing practices and facilities and collected data on other WASH practices, facilities and knowledge. We used two-stage stratified cluster sampling to select households. The nearest schools, restaurants, street food vendors, hospitals and Traditional Birth Attendants were enrolled.

Among households, a location near the toilet for post-defecation handwashing was detected for more than two-thirds of the households; however, only 40% had water and soap available. During handwashing demonstration, 13% of children 3 to 5 years of age and 57% of mothers/female caregivers washed both hands with soap. However, these figures are likely to be an over-estimate of usual practice. Among other WASH facilities approximately half of the households had an improved toilet, 34% had clean improved toilets, 99% had an improved water sources and <25% of the water points were clean. Only 2% had no access to a toilet.

Preventing disease transmission in schools can have an impact on school attendance, school grades, and child cognitive development, with longer term consequences. In 35% of schools a handwashing location with both water and soap was found, around one-third of students' hands appeared to be clean and 28% washed both hands with soap during handwashing demonstration. A critical issue for schools was limited toilet access for students. Overall there were 187 students per toilet; the majority of schools (84%) had a functional improved toilet for students however, in only 45% of schools were these unlocked. Approximately one-third of all schools had water and soap available inside or near (<30 feet) the improved toilet accessed by students and a quarter of toilets were clean. An improved functional drinking water source was found in 80% of schools, and 41% appeared clean.

Menstrual hygiene management remains a challenge, especially in schools. Among menstruating girls and women, old cloth was the predominant menstruation management material (82-86%) among which 12% of school girls, 23% of girls at home and 27% of women washed cloth appropriately. Forty percent of surveyed girls reported that they miss school during menstruation for a median of 3 days a month. School facilities may contribute to absence during menstruation.

About a third (34%) of restaurants had soap and water present at a handwashing location for staff and soap was used in only a few instances during structured observations; ≤ 14% of handwashing events among restaurant cooks and ≤20% of events among food vendors included the use of soap. Low soap and water availability in street food vending stalls impacts on practices, evident from handwashing demonstrations, where only 16% washed hands with soap. Less than 25% of food sold by restaurants and <42% sold by vendors was kept in covered and clean pots or containers. Fifty-six percent of restaurants and 51% of food vendors stored water for cleaning utensils; 40% of restaurants and 44% of food vendors dipped utensils into the stored water for cleaning.

Among hospitals, there were differences between handwashing agents available for hospital staff versus for patients/caregivers; 93% of hospitals had available handwashing agents for doctors, 97% for nurses, and 87% for ward boys/ayas compared to just 23% for patients and caregivers. Most daily patient care in Bangladeshi hospitals is performed by family caregivers rather than hospital staff. The most common handwashing agent for hospital staff was bar soap, followed by alcohol hand sanitizer for doctors and nurses (33-52%). During structured observations, among all possible handwashing opportunities, only 46% resulted in any handwashing and only 2% resulted in recommended handwashing practice (use of soap or sanitizer). Nineteen percent of hospitals had no toilets designated for doctors, 27% had no toilets for nurses/other hospital staff, and 1% had no toilets for patient/attendant. Nearly all hospitals had at least one water source for general use, but many drinking water sources were not improved or protected. Most hospitals have adequate general water infrastructure, but need to improve drinking water supply, sanitation, environmental hygiene, and waste disposal, to provide a clean, well maintained environment.

Traditional Birth Attendants reported suboptimal handwashing, delivery preparation, cord care and neonatal care practices. For example 58% reported that they checked labor progress using bare hands, almost half (44%) did not clean the delivery surface and around 20% reported using a non-sterile blade to cut the cord. This supports the government strategy to direct pregnant women and families to seek care at facilities that have emergency obstetric and neonatal care, and to increase connections between pregnant women and local skilled birth attendants.

A hygiene campaign to address handwashing, menstrual hygiene management and food safety could promote sensible convenient practices to reduce disease transmission, increase comfort and enhance educational attainment. Handwashing knowledge levels are very high; therefore, a campaign should promote behavior change to facilitate improved practices, low cost soap alternatives and suggestions for improving facilities essential for handwashing with soap. In hospital settings, where knowledge and soap availability is high but practices low, addressing convenience may be the key along with supervision. Knowledge on menstrual hygiene management is low.

A campaign that informs school girls of what to expect during menstruation, methods to use and maintain menstrual management materials and that they should continue everyday activities at this time could have far reaching impact on school attendance and related long term benefits. This could be complemented with an intervention that aims to improve existing school facilities to ensure that they are unlocked, clean and have a disposal bin. A campaign would need to include measures to address inequities and should be supported by policy and regulation from relevant government sectors.

Introduction

There is a considerable disease burden attributed to inadequate water, sanitation and hygiene facilities and practices, particularly in low income countries (Cairncross et al., 2010). Improved handwashing has been shown to reduce diarrheal disease and respiratory disease when conducted in research settings and on a scale including up to a few thousand households (Rabie et al., 2006), (Luby et al., 2011a), (Luby et al., 2005).

In 2012 the National Hygiene Promotion Strategy for Water Supply and Sanitation in Bangladesh was launched, which incorporates five behavioral domains including sanitation hygiene, water hygiene, personal hygiene, food hygiene and environmental hygiene promotion. The Government of Bangladesh has committed to the national strategy but there is a paucity of information on the practices and facilities for washing hands with soap for a nationally representative population, which is important to assist in planning appropriately targeted interventions. Representative data can in turn be used as a baseline by the government to aid priority setting, and to monitor program progress.

Demographic and Health Surveys (DHS) and UNICEF/WHO Multiple Indicator Cluster Surveys (MICS) are useful sources of data on water, sanitation and hygiene facilities and practices. DHS and MICS recently incorporated spot check indicators for handwashing (presence of handwashing location and handwashing agent) and previously only collect a single indicator (reported handwashing agents used after a head of household or child defecation event) as a proxy for handwashing with soap in households. It is not known whether this indicator reflects practices in households and whether it is appropriate for other settings. Moreover, the frequency of DHS and MICS surveys may not be sufficiently useful for program assessment, where rapid feedback on uptake of interventions can guide programmatic adjustments.

Measuring handwashing practices is difficult. Self-reported information, while easy to collect, over-estimates actual practices by several fold (Halder et al., 2010) Observing practices is intrusive, results in reactive behaviors (Ram et al., 2010), is expensive and only practical on a small scale. Using health outcomes as indicators of program progress (e.g. frequency of self-reported diarrhea or respiratory disease) is unlikely to adequately capture early changes in handwashing practice; diarrhea prevalence is highly variable (Luby et al., 2011b). Currently, there is no clear understanding of the extent of behavior change required to affect health outcomes (Huda et al., 2012).

Lack of good sanitation and handwashing infrastructure in schools and hospital facilities hampers improvement of handwashing and sanitation behaviors in these institutional settings. The hands of health care workers and hospital visitors may become contaminated with potentially pathogenic bacteria or viruses through exposure to infected patients or from contaminated hospital surfaces and instruments (Wang et. al., 2010). One recent study showed that inadequate infrastructure and poor hygiene created numerous opportunities for infectious disease transmission in the hospital (Rimi et al., 2012). A study conducted in Bangladesh recommended that if hospitals improve access to

handwashing locations and promote proper disposal of waste in combination with behavior change communication the risk for disease transmission could be reduced (Rimi et al., 2012). Schools and hospitals are two settings in our study, in addition to households, where handwashing has been demonstrated to markedly reduce hand contamination and disease (Bowen et al., 2007; Kirkland et al., 2012; Greene et al., 2012; WHO, 2009; CDC, 2002; Gurley et al., 2010).

Food is a likely vehicle of diarrheal disease in low income countries; handwashing and food handling are likely important risk factors for disease transmission. In Bangladesh, serving and eating foods with bare hands is common (Faruque et al., 2010). Outbreaks of food borne disease have involved poor hygiene in restaurants (Todd et al., 2008) and eating food from street vendors as risk factors (Vollaard et al., 2004).

In 2011 almost three-quarters of births occurred at home and of those around two-thirds were assisted by a birth attendant; 52% were untrained and 11% were trained (DHS, 2011). However, there is an increasing trend of having persons that are medically trained (qualified doctors, nurses/midwives/paramedics, field welfare assistants and community skilled birth attendants) attend deliveries; among 16% in 2004 increasing to 32% in 2011 (DHS, 2011). Good infection control practices among Traditional Birth Attendants (TBAs) who are assisting deliveries are critical to prevent maternal and neonatal infection.

Assessing handwashing facilities and practices in households, schools, hospitals, settings where food is prepared and sold and among Traditional Birth Attendants would provide data for advocacy and intervention planning. Handwashing data that is sufficient to be disaggregated by area, socioeconomic status and other factors can provide policy makers with information that aids in targeting programs.

We have collected data on several self-reported and spot check indicators of handwashing that are simple to collect, may reflect actual hygiene behavior. For two population groups, restaurants/food vendors and hospitals, we have conducted structured observations. The questions and spot checks included in this study may be candidates for incorporation into future DHS and MICS survey rounds in Bangladesh and other low income countries. This report includes data intended to form a baseline and to describe the current state of handwashing practices and facilities, and water, sanitation and hygiene practices and facilities among five population groups across Bangladesh, collected between January and October 2013. To obtain data from a representative population, the study included sufficient numbers of randomly selected households. We also surveyed schools, hospitals restaurants, street food vendors and Traditional Birth Attendants that were serving the same communities.

Methods

Sample size calculation

We determined sample size based on anticipated differences between the frequency of practices, facilities and knowledge at baseline (this study) and subsequent follow-up surveys. To determine the sample size between a nationally representative urban and rural household sample, we used the STATA sampsi command for two samples and assumed a design effect of 12.0, power of 0.8, and α of 0.05. We based our calculations for sample size on the indicator 'soap or ash and water present at a convenient handwashing location after defecation from a recent rural (47%) and urban (44%) survey (Huda et al., 2012, Bulbul et al., unpublished), assumed a minimum detectable difference of 6% between rural and urban, estimated that 2,400 households was required and sampled 2,500 households. For schools, we based our calculations on the indicator 'schools having soap and water at handwashing location' (detected among 68% of schools, from a recent rural survey), assumed that behavior change would be more rapid than for households, assumed a 10% difference in between rural and urban schools with an estimated 672 required therefore we sampled 700. We did not have indicator data from restaurants so used data from street food vendors (Faruque et al., 2010) where 43% were found to serve food with their bare hands, assumed a minimum detectable difference of 10% between rural and urban areas and estimated that 864 were required, therefore we aimed to sample 875, where approximately one third would be restaurants. For hospitals, we assumed hygiene behavior change would be more rapid than households, assumed a 10% difference in the indicator 'hospitals with soap and water at handwashing location', estimated 864 hospitals/clinics would be needed and sampled 875 hospitals. For traditional birth attendants we based our calculations on the number who were trained vs. untrained in a study conducted in Bangladesh (45% vs. 19%; Goodburn et al., 2000) and determined that we required at least 200 TBAs.

Sampling method

We selected a nationally representative population including rural and urban settings for five population groups (households, schools, restaurants/street food vendors, hospitals, Traditional Birth Attendants). We used a two-stage stratified cluster sampling methodology for selecting households, then selected schools, hospitals, restaurants, food vendors and TBAs serving those communities. To select households, we divided Bangladesh into two strata: rural and urban. In detail, the Government of Bangladesh has the 'Union' as the lowest political boundary in rural Bangladesh, consisting of 9 wards each. Each ward comprises multiple villages. In urban Bangladesh, the lowest political boundary is the Pourashava, consisting of 9 wards each and a ward has multiple *mahallas*. Thus we detected 86,925 rural villages and 10,000 urban *mahallahs* that represented population clusters. We selected 50 clusters each from rural and urban areas using the probability proportional to size (PPS) population sampling technique. For the urban sampling frame we used the technique employed in the 2006 Urban Health Survey (2006 UHS), in which the country's urban population was subdivided into eight statistical domains including 1) Dhaka Metro Area large slum areas, 2) Dhaka Metro Area small and medium slum areas, 3) Dhaka Metro non-slum areas, 4) Chittagong City Corporation slum

areas, 5) Chittagong City Corporation non-slum areas, 6) Slum areas of the remaining city corporations, 7) Non-slum areas in the remaining city corporations and 8) District municipalities. For the 50 urban clusters, we randomly sampled 50 *mahallas* from the eight statistical domains using PPS sampling. Based on the national level rural population available in the Bangladesh Census 2011 report, we randomly selected 50 rural villages using PPS sampling.

Once clusters were selected, we selected 25 households within each cluster with children aged <5 years old as the eligible sampling unit skipping every two households between the sampled households. We selected the 7 nearest schools, 3 restaurants, 6 food vendors, 9 hospitals and 2 TBAs from each selected cluster.

Respondent selection

Summary information on participants, eligibility criteria and data collection methods are provided in Table 1. Households were the starting point for most components. Once the cluster villages and *mahallas* were selected, we asked the residents to assist in determining center points of each village/*mahalla,* and commenced with the eligible household nearest to the center point. We skipped the nearest two households and determined the next nearest eligible household. Among the 100 cluster communities, we obtained a list of the 7 nearest government/ registered primary and high schools. If any of the authorities from these selected school refused to participate in the study, we replaced it with the next closest school. In the community where the household survey was conducted, the field team asked household respondents and guardians of children/ households to describe the nearest or most popular restaurants. The field team listed up to 6 of these and sampled 3 in each cluster. The field team identified street food vendors in the same locale. The TBAs were similarly identified from participant households. We collected data from 875 hospitals from the randomly selected clusters, therefore 9 hospitals each from the initial 75 clusters and 8 hospitals from each of the remaining 25 clusters. Our field team visited the Upazila Health Officer of each cluster community from which we sampled households, obtained the list of the nearest government hospitals or private/NGO hospitals or clinics that provide overnight inpatient healthcare facilities inside the hospital or clinics. If the respective *upazila* failed to provide the required number of health facility centers, the field team traveled to the next nearest *upazila* and collected the remaining required numbers nearest to the community.

Table 1: Population group eligibility, participants and data collection summary

Population group (number/cluster)	**Eligibility**	**Participants**	**Data collection methods**
Households (25)	• Child <5 years living in the household • Child caregiver gave informed consent	• Child caregiver • For menstrual hygiene management 10-49 year old females with menstruation experience	• Face to face survey • Spot check • Handwashing demonstration
Schools (7)	• Government or registered primary or high school • Headmaster gave informed consent, class teacher gave consent and students gave assent	• 50% of schools; Headmaster, 50% teacher • 4 students/school (grades II-X) • For menstrual hygiene: 4 randomly selected girls with menstruation experience	• Face to face survey • Spot check • Handwashing demonstration
Restaurants (3)/ street food vendors (6)*	• Reported as source of readymade food by during household members of the restaurant/vendor available to give informed consent • Vendors; sell at least one food item involving hand contact and were not mobile all the time	• Restaurants; one each - manager/owner - cook - service boy • Street food vendor	• Face to face survey • Spot check • Handwashing demonstration • Structured observation (90 mins, all restaurants and vendors

Population group (number/cluster)	Eligibility	Participants	Data collection methods
Hospitals (8-9)	• Government or private/NGO hospitals or clinic that provided overnight inpatient healthcare service facilities inside the hospitals or clinics • Head of the facility was available to give informed consent	• One each - administrator/ doctor - nurse - ward boy/aya - patient/ caregiver	• Face to face survey • Spot check • Handwashing demonstration • Structured observation (5h, N=100, prioritised pediatric ward, else female/general ward)
Traditional birth attendants (2)	• Mentioned by community members as providing birthing service • Gave informed consent • Were not working as a birth attendant/ assistant for an NGO/clinic or similar program (=independent TBAs)	• Traditional Birth Attendant	• Face to face survey • Spot check • Handwashing demonstration

*Qualitative studies were conducted with 32 restaurant staff members and 32 street food vendors

Instrument design

These were designed by the icddr,b team, reviewed by a Stanford University consultant and by stakeholders.

Data quality control

We recruited a team of 65 field research assistants, 13 field research officers, 2 senior field research officers, 2 senior research officers, a programmer, a statistician, and a research investigator. The field team attended two weeks of in-house training and two days field practice in Dhaka prior to data collection. We used multiple levels of supervision, developed standard operating procedures for data collectors and supervisors, and monitored the field work by assessing the number of visits completed each week, checked for completeness and consistency, included passwords and unique usernames for each data collector and securely stored data in a central repository system.

Data analysis

We selected 50 villages from among the 86,925 villages from rural areas and 50 *mahallas* from among the 10,000 *mahallas* from urban areas using the probability proportional to size (PPS) population sampling technique. Thus each cluster in rural areas represents 1738 clusters (86,925/50) and each cluster in urban areas represents 211 clusters (10,552/50). For determining national estimates standardized to a population difference among rural and urban areas, we used inverse probability weighting adjustment; we used a weight factor of 1,738 for rural and 211 for urban clusters. We made the following comparisons: rural versus urban areas, across wealth quintiles, government versus non-government hospitals, and primary versus secondary schools. To estimate the adjusted prevalence difference (PD) for clustering effect and to estimate sandwich standard errors, we used generalized estimating equations (GEE) (Rabe-Hesketh & Skrondal 2006). We report medians and inter-quartile ranges (IQR) for continuous variables that were skewed and used the Wilcoxon rank sum test for comparisons between groups. For hospitals we summarize continuous variables that were normally distributed as mean and range. We analyzed data using STATA version 12.0.

Definitions: we used the following definitions in this report-

Appropriate menstrual cloth cleansing	Cloth was washed with soap, using an improved water source, dried in the sunlight and stored normally with other cloth
Appropriate waste disposal	Visible waste is within the specified waste container
Clean hands (on inspection)	Clean hands were defined as those with no visible dirt over palms, finger pads and over/ under finger nails
Clinical wastes	Cotton, cloth, bandages, gloves, sanitary pads, syringes, bottles, medicine foils, plastic saline packets, blood/ urine/ stool/collection tubes used in clinical settings, and placentas
Good menstrual hygiene practice	JMP* definition: women and adolescent girls using a clean menstrual management material to absorb or collect menstrual blood, that can be changed in privacy as often as necessary for the duration of a menstrual period, using soap and water for washing the body as required, and having access to facilities to dispose of used menstrual management materials
Handwashing agent	Soap, detergent, hand sanitizer
Handwashing location	A tube well, basin, tap, drum with tap, bucket/ piped/tank/container and mug together.
Handwashing location for use after defecation	Location within 30 feet of a latrine
Improved toilet	JMP* categories: Flush or pour-flush to - piped sewer system, septic tank, pit toilet, Ventilated improved pit (VIP) toilet, Pit toilet with slab, composting toilet. Shared toilets were defined as those use by >1 household in a single building or plot/ compound.
Improved water source	According to JMP* categories: piped water into dwelling or yard/plot, public tap or standpipe, tube well or borehole, protected dug well, protected spring, rainwater
Restaurant	A fixed structure where people can buy and eat a meal
Shallow tube well	Tube well less than 250 feet deep
Street food vendor	Those who prepare or cook and subsequently sell food in a street or other public location for immediate consumption, no permanently built structure but a temporary static structure or mobile stall. They could be stationary and occupy space on the pavement or other public or private areas, or mobile, and move from place to place carrying their wares on push carts or baskets on their heads.
Traditional Birth Attendant	A person who assists the mother during childbirth and who initially acquired her skills by delivering babies herself or through an apprenticeship to other TBAs
Water logging	Water (remains) present on the platform

*WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation

Ethical considerations: the protocol for this study was reviewed and approved by the icddr,b Institutional Review Board.

Results

Part A: Households

Household characteristics

Ninety-five percent of the main respondents were mother of the youngest child with significantly fewer caregivers among our urban population (rural: 97%, urban: 94%, p<0.05).

About 18% of mothers and 30% of fathers of the youngest children had no formal education; which was more common in rural areas. Mothers were more likely than fathers to have completed more than 5 years of education. Nationally, the average household size was 5 (Table 2).

Table 2: Household characteristics

Indicators	Rural (N=1,250)		Urban (N=1,250)		p-value*	National (N=2,500)		
	n	%	n	%		n	%†	95% CI
Status of main respondent								
Mother of youngest child	1,209	97	1,177	94	**0.011**	2,386	95	(94, 96)§
Male caregiver	9	1	18	1	0.130	27	1	(0, 2)
Female caregiver	32	3	55	4	**0.023**	87	4	(3, 4)§
Female headed households	28	2	53	4	**0.011**	81	3	(2, 4)§
Education of mother of the youngest child								
No formal education	237	19	151	12	**0.005**	388	18	(15, 22)§
Completed 1 to 5 years formal education	389	31	299	24	**0.004**	688	30	(27, 33)§
Completed > 5 years	624	50	798	64	**0.000**	1,422	51	(46, 56)§
Education of father of the youngest child								
No formal education	393	31	201	16	**0.000**	594	30	(26, 33)§
Completed 1 to 5 years formal education	343	27	267	21	**0.007**	610	27	(24, 29)§
Completed > 5 years	504	40	767	61	**0.000**	1,271	43	(38, 47)§
Household size (median, IQR)	5‡		5‡		**0.004**	5‡ (4, 6)		

* Clustering effect adjusted by using Generalized Estimating Equation (GEE) model; † Weighted; ‡ Not weighted; § Differences between urban and rural was significant

When compared to characteristics of respondents of other national surveys, which had somewhat different eligibility criteria, some significant differences were detected. Our survey participants were better educated compared to other surveys. However, our respondents generally had a larger average number of household members and more commonly lived in a single room house (Table 3).

Table 3: Comparison of household characteristics with other nationally representative Bangladeshi surveys

Indicators for comparison	National Hygiene Survey*			Other Surveys		
	Rural	Urban	National (95% CI)	Rural	Urban	National
Education of mother of the youngest child						
No formal education	19%	12%	18% (15, 22)			28% ever married (10-49 years), DHS 2011
Completed > 5 years	50%	64%	51% (46, 56)			12% ever married (10-49 years), DHS 2011
Education of father of the youngest child						
No formal education	31%	16%	30% (26, 33)			26% ever married (15-54 years), DHS 2011
Completed > 5 years	40%	61%	43% (38, 47)			9% ever married (15-54 years), DHS 2011
Household size (median)	5	5	5 (4, 6)	5.4 , SHEWAB 2012†	4.4, ICVB 2013‡	4.4, Population and Housing Census, 2011
Household had electricity connection	58%	95%	62% (54, 69)			57% used source of light, Socio-economic and Demographic report, 2011
Households with one living room	41%	38%	39% (35, 43)			27%, Socio-economic and Demographic report, 2011
Households with improved toilet	48%	45%	47% (41, 53)	54%	54%	MICS 2009
Households with improved drinking water source	99.7%	99.9%	99.8% (99, 100)	97%	99.5%	MICS 2009
Households with improved water point tested for arsenic contamination	37%	30%	36% (26, 46)	38% (Tested & safe)	23% (Tested & safe)	MICS 2009

* Figures from this study; † Figures from the SHEWA-B impact assessment study that surveyed households with at least one child <5 years of age; ‡ The Introduction of Cholera Vaccine Study survey for the handwashing and water treatment intervention monitoring that surveyed households enrolled in the study for which there was not age restriction

Household handwashing facilities and practices

Around two-thirds (67%) of the households had a handwashing location detected within 30 feet of the toilet for post-defecation handwashing. Forty percent of all households were observed to have a handwashing location for post-defecation use with water and soap available. Half of the mothers' (52%) and one third of the youngest children's (3 to 5 years of age) hands appeared to be clean (35%) during spot check observation. Only 13% of the youngest children, just over half of the mothers/female caregivers (57%) and 51% of the male caregivers washed both hands with soap during handwashing demonstration. On average, households estimated that they spent 15.5 taka (US $. 0.20) to purchase bar or liquid soap in the last 30 days (roughly equivalent to half a bar of soap per month).

Urban households were more likely to have a handwashing location for post-defecation use with water and soap available (urban: 70%, rural: 36%, p<0.001), and urban mothers and youngest

children more likely had clean hands (mothers: 62%, p<0.001 and youngest children 44%, p<0.001). Urban households were more likely to use soap and water to wash their hand during demonstration.

Poorer households were less likely to have a handwashing location with water and soap available than wealthier households increasing from 16% in the poorest to 88% in the wealthiest quintile (Table 4).

Table 4: Household handwashing facilities; hand cleanliness; handwashing skills; availability of handwashing soap and soap purchase

Indicators	n/N	%*	95% CI
Handwashing location† after defecation			
Handwashing location within 30 feet from the toilet structure (improved and unimproved toilet)	1,898/2,500	67	(63, 72)‡
Handwashing location with water available within 30 feet from the toilet structure (improved and unimproved toilet)	1,637/2,500	52	(47, 58)‡
Handwashing location with water and soap available within 30 feet from the toilet structure (improved and unimproved toilet)	1,321/2,500	40	(34, 45)‡
Poorest quintile	91/500	16	(11, 22)‡
2nd	165/500	27	(20, 34)‡
3rd	260/500	49	(41, 56)‡
4th	340/500	60	(51, 69)‡
Wealthiest quintile	465/500	88	(82, 94)‡
Hand cleanliness			
Mother's hands appeared clean§	1282/2,500	52	(49, 56)‡
Youngest child's (< 5 years age group) in household's hands appeared clean	838/2,500	35	(31, 38)‡
Handwashing demonstration			
3-5 year old children washed both hands with soap	144/1,123	13	(11, 15)
Mothers/female caregivers washed both hands with soap	1,171/2,082	57	(53, 60)‡
Male caregivers washed both hands with soap	195/390	51	(45, 57)‡
Households were able to show a soap that was used for handwashing	1,004/2,500	41	(37, 45)‡
Average amount of Taka spent per household in last 30 days for bar or liquid soap purchase	15.5		(11, 22)‡

* Weighted; † Household members use that specific place for handwashing after defecation such as: tube well, basin, tap, drum with tap, bucket/ piped/tank/container and mug together; ‡Differences between urban and rural was significant;

§ No visible dirt over palms, finger pads and over/ under finger nails

Household sanitation facilities, drinking water source, and environmental hygiene

Almost half of households had access to an improved toilet and 2% had no access to a toilet (rural: 4%, urban: 0%, p<0.05). Household access to an improved toilet showed a trend for wealth, increasing from 23% in the poorest to 90% in the wealthiest quintile; no access to a toilet was had an inverse relationship with wealth. Improved toilets were most commonly sanitary pit toilets (rural: 73%, urban: 33%, p<0.001) followed by a septic tank toilet (18%, rural: 9%, urban: 24%, p<0.001) and piped sewer system toilets (17%, rural: 0%, urban). About a third of the improved toilets had clean slabs and floors. The presence of improved toilets with a clean slab and floor showed a trend across wealth quintiles, increasing from 8% in the poorest quintile to 82% in the wealthiest. Almost 90% of the respondents reported that they disposed child feces into a pit or toilet.

More than two-thirds of the households used some form of tube well/Tara pump as a source of improved drinking water. In the rural areas, the majority of the households used either a shallow tube well/Tara pump (72%, p<0.001) or a deep tube well/Tara pump (24%, p<0.05) as their source of improved drinking water. However, only 7% of the households collected drinking water from a tube

well that had been tested in the year prior to the survey. Tap water inside the dwelling (29%) was the major source of improved drinking water in urban households. A little more than one third of all households (38%) owned their source of improved drinking water and another 39% of households had a shared/public source. Households in the urban areas were more likely than the rural households to own their source of improved drinking water (rural: 32%, urban: 44%, p<0.05). There was a relationship between wealth and those who owned their improved drinking water source, increasing from 17% in the lowest to 79% in the highest quintile. More than twenty percent of household-owned (22%) improved water points appeared to be clean. Sixty percent of households stored drinking water in containers while 45% stored drinking water in a covered container.

Most of the households (86%) stored their prepared/cooked food and 73% used a covered container. Wealthier households were more likely to store prepared or cooked food in a covered container than the poorer households. More than half of the households disposed of their household waste into a pit or drum which was more common among households from the wealthiest quintile (Table 5).

Table 5: Household toilets, water sources, water management, food and environmental hygiene

Indicators	n (N=2,500)	%*	95% CI
Access to Toilet			
Access to improved† toilet	1,165	47	(42, 51)
Poorest quintile	119/500	23	(18, 29)
2nd	178/500	35	(29, 40)‡
3rd	166/500	32	(26, 38)‡
4th	253/500	50	(43, 57)‡
Wealthiest quintile	449/500	90	(85, 94)‡
Access to improved toilet (including shared toilet)	2,150	86	(83, 90)
No access to a toilet	55	2	(0, 4)‡
Access to toilet by category			
Piped sewer system	392	17	(10, 24)‡
Septic tank	424	18	(14, 22)‡
Pit - sanitary	1,334	51	(44, 58)‡
Flash to open sources	190	8	(4, 11)
Open pit	93	3	(2, 5)‡
Hanging toilet	12	0	(0.1, 0.8)
No toilet	55	2	(1, 4)‡
Improved toilet slab and floor appeared clean	830	34	(30, 38)‡
Household disposed of child feces into a pit or toilet (reported)	565/652	87	(84, 91)‡
Poorest quintile	13/25	52	(29, 74)
2nd	44/66	67	(53, 80)
3rd	107/134	80	(72, 89)
4th	192/206	93	(89, 97)
Wealthiest quintile	209/221	95	(92, 98)‡
Source of drinking water by category			
Shallow tube well/Tara pump	1,468	57	(49, 66)‡
Deep tube well/Tara pump	452	17	(11, 24)‡
Protected sources: dug well/spring	1	0	(0.0, 0.1)
Tap water inside dwelling	377	16	(11, 22)‡
Tap water outside dwelling/public	185	8	(5, 11)‡
Direct channel/Unprotected§ sources	17	1	(0, 1)
Ownership of improved water sources			
Household owned‖	942	38	(34, 43)
Shared/public	959	39	(34, 43)

Indicators	n (N=2,500)	%*	95% CI
Ownership of improved water sources by wealth quintiles¶			
Poorest quintile	87/500	17	(12, 22)
2nd	127/500	25	(20, 30)
3rd	140/500	27	(22, 33)‡
4th	196/500	39	(32, 46)
Wealthiest quintile	392/500	79	(72, 85)
Household owned improved water points appeared clean**	535	22	(18, 26)‡
Households with tube wells††	1,920	75	(67, 83)‡
Individual households tube wells	644	25	(21, 30)‡
Shared/public tube wells	1,276	50	(44, 56)‡
Arsenic testing in year prior to survey	129	7	(5, 9)
Individual tube well tested	33	6	(3, 9)
Shared tube well tested	96	8	(5, 11)
Households stored drinking water in containers	1,489	60	(54, 66)‡
Households stored drinking water in covered containers	1,098	45	(39, 51)‡
Households treated source water after collecting	457	7	(4, 9)‡
Households stored ready/cooked food (spot check)	2,141	86	(84, 88)
Households stored ready/cooked food that have been covered (spot check)	1,822	73	(70, 76)
Household had waste disposal facilities (spot check)			
Pit or drum	1,396	57	(52, 62)‡
River/dam/lake/ponds/stream/canal	299	12	(9, 14)
Road side	114	5	(3, 6)
Drain	15	1	(0, 1)‡
Besides homestead/kitchen	278	11	(9, 13)‡
In Jungle	216	8	(6, 10)‡
Households had a pit or drum to dispose household waste (spot check)			
Poorest quintile	204/500	41	(33, 48)
2nd	225/500	45	(39, 51)
3rd	262/500	53	(47, 59)
4th	318/500	64	(58, 71)‡
Wealthiest quintile	387/500	78	(72, 85) ‡
Households disposed waste appropriately into a pit or drum (spot check)	833	35	(29, 41)‡
Poorest quintile	52/500	10	(6, 14)
2nd	90/500	18	(14, 23)
3rd	147/500	31	(24, 37)‡
4th	220/500	45	(37, 54)‡
Wealthiest quintile	324/500	66	(58, 74)‡

* Weighted; † Improved toilet according to JMP: Flush or pour-flush to - piped sewer system, septic tank, pit toilet, Ventilated improved pit (VIP) toilet, Pit toilet with slab, Composting toilet and no shared toilet; ‡Differences between urban and rural was significant; § Direct channel/unprotected sources (Arsenic filter, Arsenic free treatment plant, Pathogen treatment plant-pond sand filter, Distilled bottled water, Boiled water, Unprotected dug well, Spring water, Tanker truck, Cart with small tank, Directly from river/ dam /lake /ponds /stream /canal /irrigation channel); ‖ Owned by household and no shared ownership; ¶ Denominator has been changed here due to break down into wealth quintiles; **No water logging, no feces, and no visible dirt immediately adjacent to the water point or platform, observed during spot check; †† Tap water not included.

Part B: Schools

School characteristics

Around three-quarters of the schools included were primary schools. More than half (52%) of the teachers selected were female. Female teachers were more common in urban than rural (68% versus 50%, p<0.001). Only 22% of teachers were female in secondary school whereas 61% were female in primary schools. Around half of the students in primary and secondary schools were female. The median number of students per school was 332 (Table 6).

Table 6: School and respondent characteristics

Indicators	n/N	%*	95% CI
Type of School			
Primary	511/700	76	(73, 80)†
Co-ed primary	507/511	99	(98, 100)
Secondary	189/700	24	(20, 27)†
Co-ed secondary	140/189	87	(81, 93)†
Female teachers at school	3,875/7,050	52	(48, 56)†
Primary	2,419/3,297	61	(57, 65)†
Secondary	1,456/3,753	22	(19, 25)†
Female students in school			
Primary	10,2997/19,7522	51	(50, 52)†
Secondary	8,3327/14,4768	56	(53, 59)†
Median (IQR) number of students per school (N=700)	332		(224, 584)†
Primary (N=511)	289		(203, 439)†
Secondary (N=189)	600		(350, 937)†
Respondents from school			
Head master	375/700	53	(51, 55)
Teacher	325/700	47	(45, 49)
Female students	1,646/2,800	57	(54, 59)
Age group of interviewed students			
≤10 years	1,563/2,800	59	(56, 62)†
≤10 years (female)	885/2,800	33	(30, 35)
> 10 years (female)	761/2,800	24	(21, 27)†

* Weighted; † Differences between urban and rural was significant

School handwashing facilities and practices among students

Almost one-third of the schools had a handwashing location with water and soap available and around one-third (32%) of students' hands appeared to be clean during observation (rural: 31%, urban: 45%, p<0.001). Secondary school student's hands were more commonly clean than primary school students (49% versus 27%, p<0.000). Less than one-third of students (28%) washed both hands with soap during handwashing demonstration (Table 7).

Table 7: School handwashing facilities, student hand cleanliness and handwashing demonstration

Indicators	n/N	%*	95% CI
Handwashing locations† available (within the school compound)	641/700	88	(84, 92)‡
Primary	455/511	85	(80, 90)‡
Secondary	186/189	98	(94, 100)
Handwashing locations with water available	626/700	85	(81, 89)‡
Primary	441/511	81	(77, 86)‡
Secondary	184/189	97	(92, 100)
Handwashing locations with both soap and water available	308/700	35	(30, 41)‡
Primary	198/511	30	(24, 36)‡
Secondary	110/189	53	(43, 64)‡
Students' hands appeared clean	1,061/2,800	32	(29, 36)‡
Primary	634/2,044	27	(24, 31)‡
Secondary	427/756	49	(44, 55)‡
Handwashing demonstration: Students washed both hands with soap	807/2,800	28	(24, 32)
Primary	595/2,044	27	(22, 32)
Secondary	212/756	29	(20, 37)

* Weighted; † Designated place at school for students to wash hands; ‡ Differences between urban and rural was significant

School sanitation facilities, drinking water source, and environmental hygiene

There was a median of 187 students per toilet. The vast majority of all schools (84%) had an improved toilet for students and among these, the most common was a sanitary pit toilet (59%) followed by a toilet with a septic tank (30%). Urban schools were more likely to have access to a septic tank toilet (45%, p<0.005) than the rural schools which had sanitary pit toilets (62%, p<0.001). Four percent of all schools had unimproved toilets (flush anywhere/open pit). Less than half of schools had improved functional toilets that were unlocked (rural: 43%, urban: 63%, p<0.001). Secondary school students had greater access to improved toilets compared to primary schools (57% versus 42%, p<0.005).

Approximately one-third of all schools had water and soap available inside or near (<30 feet) the improved functional and un-locked toilet accessed by students (rural: 31%, urban: 47%, p<0.001). Secondary school students were more likely to have water and soap available inside or nearby (<30 feet) the improved toilet than primary schools (42% versus 30%, p<0.005). Around one-quarter of the schools had improved, functional and accessible toilets for students, that were clean (no visible stool over the slab/ pan/ floor).

The majority of schools had an improved functional drinking water source (80%). In urban areas, schools were more likely to use an improved water source than rural (91%, p<0.001). In rural areas, the majority of the schools used a shallow tube well/Tara pump as their source of improved drinking water. Only 6% of schools used tap water as a source of improved drinking water. Urban schools were more likely to use tap water (33%, p<0.001) as a source of improved drinking water. Only 20% of school reported that their tube wells were tested for arsenic contamination in last year. A small proportion of school students (13%) carried drinking water from home rather than use the school source, significantly more commonly among urban school students (rural: 10%, urban: 37%, p<0.001)

Forty-four percent of the schools disposed their solid waste into a pit or drum but only 7% were observed to dispose their solid waste properly (spot check). Less than half of the improved water points in schools appeared clean; significantly more likely among urban schools (rural: 40%, urban: 54%, p<0.001; Table 8).

Table 8: Student school sanitation facilities and access, water sources and environmental hygiene

Indicators	n/N	%*	95% CI
Functional† improved‡ toilet facilities available at schools for students (spot check)	613/700	84	(81, 88)§
Primary	429/511	80	(76, 85)§
Secondary	184/189	98	(96, 100)
No toilet at school for students	19/700	4	(2, 6)§
Primary	19/511	6	(3, 8)§
Secondary	0/189	0	-
Median (IQR) number of students per toilet (N=700)	187		(123, 289)§
Primary (N=511)	182		(116, 288)
Secondary (N=189)	200		(142, 294)§
Functional Improved unlocked toilets for student use‖ (spot check)	363/700	45	(39, 50)§
Primary	237/511	41	(35, 47)§
Secondary	126/189	57	(47, 66)§
Schools toilets for students by category (spot check)			
Piped sewer system- improved	58/700	2	(1, 3)§
Septic tank- improved	256/700	30	(23, 37)§
Pit- Sanitary- improved	344/700	59	(52, 67)§
Flush anywhere- unimproved	9/700	1	(0, 2)
Open pit- unimproved	14/700	3	(1, 5)§
No facilities	19/700	4	(2, 6)§
Water available inside or near toilet (<30 feet from the toilet; spot check)	359/700	45	(39, 50)§
Primary	234/511	41	(34, 47)§
Secondary	125/189	57	(47, 66)§
Soap available inside or near toilet (<30 feet from the toilet; spot check)	272/700	33	(28, 38)§
Primary	184/511	30	(24, 36)§
Secondary	88/189	42	(33, 51)
Water and soap available inside or near toilet (<30 feet from the toilet; spot check)	269/700	32	(27, 38)§
Primary	182/511	30	(24, 36)§
Secondary	87/189	42	(33, 51)
Functional improved unlocked toilet for students that appeared clean (floor, slab and pan; spot check)	171/700	24	(19, 29)
Primary	123/511	24	(18, 30)
Secondary	48/189	23	(16, 30)
Improved‡ functional§ water source at schools (spot check)	593/700	80	(75, 85)§
Primary	415/511	76	(70, 81)§
Secondary	178/189	94	(89, 99)
Drinking water sources by types at schools (spot check)			
Shallow tube well	306/700	50	(41, 58)
Deep tube well	150/700	23	(17, 30)
Protected dug well/spring	4/700	1	(0, 2)
Tap water into school compound	128/700	6	(3, 9)§
Tap water outside compound/public	6/700	0	(0, 1)
Direct / unprotected channel‡	4/700	1	(0, 1)
No functional water sources at school	102/700	19	(14, 24)§
Reported arsenic contamination tested in last year¶	121/466	26	(20, 29)
Primary	101/343	29	(24, 34)
Secondary	20/123	16	(8, 25)§
Improved water points appeared clean (spot check)**	328/700	41	(37, 46)§
Improved water points with platform (spot check)	548/700	74	(69, 80)§
Improved water points with platform with no water logging (spot check)	446/700	59	(54, 65)§

Indicators	n/N	%*	95% CI
Students carried drinking water from home††	657/2,800	13	(10, 16)§
Primary	451/2,044	14	(11, 16)§
Secondary	206/756	12	(7, 17)§
Schools have drum/pit for solid waste disposal (spot check)	341/700	44	(38, 49)§
Disposed solid wastes properly (no waste lying outside the pit/drum (spot check)	42/350	7	(4, 9)§

* Weighted; † Toilets were useable year the round; ‡ Improved toilet according to JMP: Flush or pour-flush to - piped sewer system, septic tank, pit toilet, Ventilated improved pit (VIP) toilet, Pit toilet with slab, Composting toilet; ‖ Toilet always open for students during school hours; § Differences between urban and rural was significant; ¶ Information given by headmaster/ teacher (reported), tested for tube well/Tara pump; ** No water logging, no feces, and no visible dirt immediately adjacent to the water point or platform, observed during spot check; †† Students were asked what they usually do

Part C: Menstrual hygiene management

Household menstrual hygiene management

Most of the participants who were eligible for discussion on menstrual hygiene were adults (85%) and approximately three-quarters were less than 35 years of age. Significantly fewer adult women than adolescent females menstruated regularly. Older adult women (35-49 years) were more likely to have regular menstruation than their younger counterparts (19-35 years). Just over a third of the adolescent females and adult women knew about menstruation before menarche; mostly told by their female relatives.

Disposable pads were used by about one-tenth of adolescents (rural: 10%, urban: 21%, p<0.006) and one quarter of adult women (rural: 10%, urban: 33%, p<0.001). The majority used old cloth for menstruation management which was significantly more common among rural adolescents and women. Good practices were observed among only 12% to 27% of respondents. About a third of adolescent females and half of adult women reported that they were forbidden from religious activities; and a further quarter to third were forbidden from non-religious activities during menstruation (Table 9).

School menstrual hygiene management

The average (median) age at first menstruation was 12 years. Among the students, only 36% knew about menstruation before menarche, more commonly known among students from secondary schools (45% versus 32%, p<001). Female relatives were the most common source of information.

Ten percent of students used disposable pads during menstruation (rural: 9%, urban: 21%, p<001). Whereas 86% of students used old cloth, more common among rural students (rural: 87%, urban: 76%, p<0.001). Eighty-nine percent of students stored their menstrual cloth in a hidden place for repeated use (rural: 90%, urban: 78%, p<0.001).

Around a quarter of the female students did not go to school during menstruation and almost one-third thought that menstrual problems interfered with school performance. Just over half of students reported that they were forbidden from religious activities; while 74% of them were forbidden from non-religious activities during menstruation (Table 9).

Table 9: Menstrual hygiene management knowledge, facilities and practices among respondents from households and schools

Indicators	n/N	%*	95% CI
Median (IQR) age at first menstruation			
Adolescent school girls (N=2,326)	12		(11.8, 12)
Adolescent girls at household (N=377)	12.5		(12, 13)
Adult women (N=2,100)	13		(12, 14)
Knew/ heard about menstruation at menarche			
Adolescent school girls	862/2,332	36	(33, 39)
Adolescent girls at household	157/377	42	(37, 46)
Adult women	755/2,107	36	(33, 39)
Materials used during menstruation			
Adolescent school girls			
Cloth	1,904/2,332	86	(83, 88)
Pad	355/2,332	10	(9, 12)
Adolescent girls at household			
Cloth	283/352	85	(80, 91)†
Pad	55/352	11	(6, 15)†
Adult women			
Cloth	1,273/1,740	82	(79, 85)†
Pad	370/1,740	12	(8, 15)†
Median (IQR) number of menstrual cloths changed per day			
Adolescent school girls (N=1,898)	3		(2, 3)
Adolescent girls at household (N=283)	3		(2, 3)
Adult women (N=1,267)	2		(2, 3)
Washed cloth with soap and improved water for repeated use			
Adolescent school girls	1,228/1,904	56	(50, 63)
Adolescent girls at household	206/283	64	(55, 73)
Adult women	932/1,273	65	(57, 73)
Dried cloth for repeated use in sunlight			
Adolescent school girls	309/1,904	17	(12, 21)
Adolescent girls at household	100/283	36	(28, 44)
Adult women	495/1,273	40	(34, 46)
Washed cloth with soap and improved water and dried in sunlight for repeated use			
Adolescent school girls	240/1,940	12	(9, 14)
Adolescent girls at household	73/283	23	(16, 29)
Adult women	363/1,273	27	(21, 32)
Stored menstrual cloth for repeated use			
Adolescent school girls			
Normally like other cloth	131/1,904	6	(4, 8)
In hiding	1,670/1,904	89	(87, 92)†
Adolescent girls at household			
Normally like other cloth	42/ 278	15	(10, 21)
In hiding	216/278	77	(71, 83)†
Adult women			
Normally like other cloth	211/1,240	17	(14, 20)
In hiding	948/1,240	76	(73, 79)†
Schools with separate improved latrine for girls/household with improved latrine			
Adolescent school girls	1,177/2,332	43	(38, 49)
Adolescent girls at household	210/377	55	(49, 62)
Adult women	951/2,107	45	(41, 50)
Schools with un-locked and clean separate improved latrine for girls	451/2,332	22	(18, 26)

Indicators	n/N	%*	95% CI
Schools with improved latrine with soap and water available/household with improved latrine with soap and water available			
Adolescent school girls	291/2,332	12	(9, 16)†
Adolescent girls at household	210/377	57	(50, 64)
Adult women	951/2,107	45	(41, 50)
Disposed menstrual cloth at school:			
In the open	71/2,217	4	(2, 5)
Inside latrine pan	85/2,217	5	(3, 77)
Hid inside classroom	73/2,217	3	(1, 5)
Don't change at school	1,935/2,217	86	(81, 90)
Menstrual hygiene education sessions are provided at school	213/2,332	6	(4, 8)
Adolescent school girls think menstrual problems interfere with school performance	756/2,332	31	(27, 36)
Adolescent school girls reported missing school during menstruation	931/2,332	40	(36, 45)
Median (IQR) number of days per menstrual cycle that adolescent school girls reported missing school (N=931)	3		(1, 4)
Using disposable pad (N=136)	2		(1, 3)
Using cloths (N=768)	3		(1, 4)
Forbidden activities during menstruation			
Adolescent girls at school			
Religious activities	1,185/2,332	55	(49, 60)
Non-religious	1,653/2,332	74	(72, 77)†
Adolescent girls at household			
Religious activities	142/377	38	(32, 44)
Non-religious‡	133/377	35	(30, 41)
Adult women			
Religious activities	1,023/2,107	48	(44, 52)
Non-religious‡	658/2,107	31	(28, 34)

* Weighted; † Differences between urban and rural was significant; ‡ Non-religious includes: not go to certain places, touch certain things and eat certain foods; not allowed to cook and to go out

Part D: Restaurant and street food vendors

Restaurant and food vendor characteristics

Three-quarters of the restaurant managers were also the restaurant owners. Almost all of the food vendors and restaurant owners/managers were male and 19% of the restaurant cooks were female. Half of the restaurant owners/managers were less than 40 years of age whereas food vendors were usually younger (median: 35 years). About 13% of the restaurant owners/managers and 52% of food vendors had no formal education. The majority (81%) of restaurants was operated in a rented building; more than half of the food vendors (58%) had a fixed location for their business, and most operated throughout the year. Restaurants operated for a median of 16 hours per day compared to 8 hours for street food vendors. Each restaurant served on average 150 customers per day (Table 10).

Table 10: Restaurants and food vendor demographic information and business characteristics

Indicators	Restaurant (N=300)		Food vendor (N=600)	
	n (%*)	95% CI	n (%*)	95% CI
Male respondents				
Owner/Manager	298 (99)	(98, 100)	581 (97)	(95, 98)†
Customer service staff	295 (98)	(97, 100)	-	-
Cook	242 (81)	(76, 86)†	-	-
Median‡ (IQR) age of respondents				
Owner/Manager	40	(31, 50)	35	(27, 48)†
Customer service staff	28	(21, 38)	-	-
Cook	35	(28, 46)	-	-
Education of respondents - Managers				
No formal education	41 (13)	(8.6, 18)	311 (52)	(48, 56)
Median‡ (IQR) years of formal education	5	(3, 9)†		
Nature of area/location§				
Bazaar	164 (53)	(46, 61)†	180 (29)	(23, 34)†
Street gathering	85 (30)	(23, 37)†	161 (28)	(23, 33)†
Bus station	51 (17)	(11, 23)	80 (13)	(9, 18)
Near school	-	-	166 (28)	(23, 33)
Business season (Food vendors)				
Seasonal	-	-	91 (15)	(12, 18)
Year round	-	-	509 (85)	(82, 88)
Business mobility (Food vendors)				
Semi-ambulant/mobile locations	-	-	255 (42)	(38, 47)
Fixed location	-	-	345 (58)	(53, 62)
Years business in operation (median‡, IQR)	5	(1.5, 12)	5	(2, 11)
Hours open each day (median‡, IQR)	16	(14, 17)†	8	(6, 10)†
Days open each week (median‡, IQR)	7	(7, 7)	7	(7, 7)
Median‡ (IQR) number of staff including owner	5	(3, 8)†	-	-
Median‡ (IQR) number of female staff including owner	1	(0, 1)	-	-
Median‡ (IQR) number of customers per day	150	(100, 250)†	-	-
Median‡ (IQR) customer number that could be accommodated at one time	22	(16, 30)	-	-
Ownership of restaurant building				
Self-owned	59 (19)	(14, 25)	-	-
Rented	241 (81)	(75, 86)	-	-
Materials of restaurant building				
Roof- tin	243 (80)	(74, 86)†	-	-
Roof- concrete	51 (18)	(12, 23)†	-	-
Floor- concrete	236 (80)	(74, 85)†	-	-
Floor- *katcha* (not concrete)	64 (20)	(15, 26)†	-	-
Wall-tin	103 (33)	(27, 40)†	-	-
Wall-cement	181 (61)	(55, 68)†	-	-

* Weighted; † Differences between urban and rural was significant; ‡ Not weighted; § Nature of area/location was single answer and spot-checked for close proximity

Restaurant and food vendor handwashing facilities and practices

Less than half of the restaurants had a handwashing location for staff inside the restaurants with available water (spot check) and one-third were observed to have soap at the handwashing location. A little less than one-third of food vendors had a handwashing location with available water for customers (spot check). Only 11% of food vendors had a handwashing location with available water and soap.

Approximately half of the restaurant service staff's hands appeared to be clean during observation. Fewer staff directly handling food had clean hands; 35% of the restaurant cooks' and 34% of the food vendors' hands appeared to be clean during observation. Most (90%) of the service staff and restaurant cooks (86%) washed both hands with soap during handwashing demonstration, while only 16% of food vendors washed both hands with soap during demonstration (Table 11).

Table 11: Restaurant and food vendor handwashing: cleanliness, skills and availability of soap

Indicators	Restaurant (N=300)		Food vendor (N=600)	
	n (%*)	95% CI	n (%*)	95% CI
Handwashing location† available for restaurant staff (different from customers' handwashing location; spot check)				
Available water	124 (42)	(36, 48)	-	-
Available water and soap	100 (34)	(28, 40)	-	-
Handwashing location† for customers (spot check)				
Available water	298 (99)	(98, 100)	190 (32)	(27, 36)
Available water and soap	273 (91)	(88, 95)	68 (11)	(8, 14)
Respondents' hands appeared clean‡ (spot check)				
Service staff/Food vendors	156 (52)	(46, 59)	205 (34)	(30, 39)
Cooks	106 (35)	(29, 41)	-	-
Respondents washed both hands with soap during hand washing demonstration (observed)				
Service staff/Food vendors	270 (90)	(87, 94)	98 (16)	(13, 20)
Cooks	259 (86)	(82, 91)	-	-

* Weighted; † Specific place for handwashing such as: tube well, basin, tap, drum with tap, bucket/ piped/tank/container and mug together; ‡No visible dirt over palms, finger pads and over/ under finger nails

Handwashing during 90 minute structured observation

The frequency of observed events that included washing hands with soap among restaurant service staff, restaurant cooks and food vendors was low. Among restaurant service staff, the most common event observed when soap was used was after cleaning human/animal feces (25%). They washed their hands with soap on only 1% of occasions before serving food. Among restaurant cooks, the field team observed that they washed their hands with soap before food preparation on 3% of occasions, 8% of the times after cutting fish/meat/raw vegetables. We observed food vendors washing their hands with soap on 7% of occasions after cleaning/removing wastage/left-overs. Most of the other handwashing opportunities did not include the use of soap (Table 12).

Table 12: Restaurant and food vendor handwashing: observed handwashing behavior of staff, vendors and customers from 90-minute structured observation

Indicators	Restaurant		Food vendor	
	n/N (%*)	95% CI	n/N (%*)	95% CI
Washed hands with soap				
Service staff /Food vendors				
1. After cleaning bench, table, chair, floor	38/855 (4)	(3, 6)	3/264 (1)	(0, 3)
2. After cleaning utensils	78/1,309 (6)	(4, 75)	4/574 (1)	(0, 2)
3. After cleaning/ removing wastage/left-overs	17/82 (20)	(11, 30)	2/27 (7)	(1, 24)
4. Before food preparation	6/151 (4)	(2, 8)	1/3,691 (0)	(0, 0.2)
5. Before mashing food/salad preparation	2/142 (1)	(0, 5)	0/1,096 (0)	(0, 0.3)
6. Before eating	51/243 (21)	(14, 29)	1/241 (0)	(0, 2)
7. Before serving food	25/2,335 (1)	(0, 2)	4/3,678 (0)	(0, 0.2)
8. After cutting fish/meat/raw vegetables	2/28 (7)	(1, 24)	0/26 (0)	(0, 13)
9. After defecation/cleaning a child after defecation	-	-	1/5 (20)	(1, 72)

Indicators	Restaurant		Food vendor	
	n/N (%*)	95% CI	n/N (%*)	95% CI
10. After cleaning human/animal feces	1/4 (25)	(1, 81)	0/29 (0)	(0, 12)
11. After cleaning cough/sneeze/nose/eyes/inside mouth	0/64 (0)	-	0/104 (0)	(0, 4)
Cooks				
1. After cleaning bench, table, chair, floor	1/38 (3)	(0, 14)	-	-
2. After cleaning utensils	9/63 (14)	(5, 24)	-	-
3. After cleaning/removing wastage/left-overs	4/36 (12)	(0, 23)	-	-
4. Before food preparation	14/514 (3)	(1, 4)	-	-
5. Before mashing food/salad preparation	0/49 (0)	(0, 0)	-	-
6. Before eating	8/55 (14)	(5, 24)	-	-
7. Before serving food	3/71 (4)	(1, 12)†	-	-
8. After cutting fish/meat/raw vegetables	6/82 (8)	(2, 14)	-	-
9. After defecation/cleaning a child after defecation	1/1 (100)	(2, 100)	-	-
10. After cleaning human/animal feces	-	-	-	-
11. After cleaning cough/sneeze/nose/eyes/inside mouth	1/32 (3)	(0, 16)		
Observed customers washing hands with soap -				
1. Before eating	770/3,755 (21)	(17, 24)†	1/7,647 (0)	(0.0, 0.1)
2. Before serving food	5/32 (16)	(5.3, 33)	0/28 (0)	(0, 12)
3. After defecation/ cleaning a defecated child	3/4 (75)	(19, 99)†	-	-
4. Before water handling	3/174 (2)	(0, 5)	0/732 (0)	(0, 1)
5. After cleaning cough/sneeze/nose/eyes/inside mouth	1/29 (3)	(0, 18)	0/28 (0)	(0, 12)
6. Before contacting /touching food with hand	9/232 (4)	(1, 8)	0/745 (0)	(0.0, 0.5)
7. Before feeding a child	1/36 (3)	(0, 15)	0/100 (0)	(0, 4)

* Weighted; † Differences between urban and rural was significant

Restaurant and food vendor sanitation facilities, drinking water source, food and environmental hygiene

Very few of the restaurants had an improved toilet on the premise. Only 2% of restaurants had a functional, improved toilet with floors and slabs that appeared clean (spot check). Food vendors most commonly used nearby market's or a mosque's toilet for defecation (45%) and 1% openly defecated. Thirty-four percent of the restaurants had handwashing location inside the restaurants with soap and water available for use after defecation.

More than two-thirds of the restaurants (69%) and 60% of food vendors used tube wells as a source of drinking water. In the rural areas, the majority of the restaurants used tube wells (rural: 61%, urban: 33%, $p<0.001$) and in urban areas tap water inside restaurants (37%) was the major source. Twenty-four percent of the food vendors had no water source for drinking or didn't keep drinking water for business. Approximately half of the restaurants and food vendors stored drinking water and ~10% used covered containers which appeared to be clean. When asked for a glass of water, almost all respondents from restaurants and 42% of food vendors washed the glass with only water before pouring water into the glass.

Fifty-six percent of restaurants stored water for cleaning utensils and 40% dipped utensils into the stored water, while 51% of food vendor stored water for cleaning utensils and 44% dipped utensils into the stored water. Approximately 30% of restaurants and 11% of food vendors disposed waste appropriately (no waste outside) into a pit/drum/dustbin. Nineteen percent of restaurants and 13% of food vendors disposed of waste on or in road side/drain/bush/jungle or no specific place (Table 13).

Table 13: Restaurant and food vendor staff access to toilets during business hours, staff access to and management of water, environmental hygiene

Indicators	Restaurant (N=300)		Food vendor (N=600)	
	n (%*)	95% CI	n (%*)	95% CI
Access to toilet during business hours				
Improved† toilet for staff	35 (12)	(8, 16)	-	-
Unimproved toilets	18 (6)	(3, 8)	-	-
No facilities	247 (82)	(77, 87)	-	-
Handwashing location inside the restaurant for use after defecation (spot check)				
Water available	112 (37)	(31, 44)	-	-
Soap and water available	103 (34)	(28, 41)	-	-
Defecation locations for food vendors during business hours, if needed				
Nearby market/mosque	-	-	272 (45)	(40, 49)††
Nearby residential houses	-	-	180 (30)	(26, 35)
Nearby school/collage/hospital	-	-	88 (15)	(12, 18)
No facility/bush/field--open defecation	-	-	4 (1)	(0.0, 1)
Functional improved toilets' floor and slab appeared clean‡ (spot check)	7 (2)	(1, 4)	-	-
Median distance of toilet from kitchen in feet (N=43)	5	(2, 20)	-	-
Median distance of toilet from water source in feet (N=43)	5	(2, 25)	-	-
Source of drinking water by category				
Shallow§ tube well	141 (46)	(37, 54)††	244 (40)	(33, 47)
Deep tube well/Tara pump	69 (23)	(16, 30)	128 (20)	(16, 26)††
Tap water inside restaurant/food vending structure	70 (25)	(18, 32)††	40 (7)	(4.0, 10)††
Tap water outside restaurant/food vending structure	1 (0)	(0.0, 2)	31 (5)	(2.5, 8.4)††
Filter (ceramic/other filter; considered as "not improved" according to JMP definition)	19 (7)	(3, 11)††	11 (2)	(0, 4)††
No water source/not applicable	-	-	145 (24)	(20, 30)††
Source of water for cleaning utensils by category				
Shallow§ tube well	148 (48)	(39, 57)††	211 (35)	(28, 41)
Deep tube well/Tara pump	57 (19)	(13, 25)	92 (15)	(11, 19)
Tap water inside restaurant/food vending structure	85 (30)	(22, 38)††	48(9)	(5, 12)††
Tap water outside restaurant/food vending structure	3 (1)	(0, 3)	33 (6)	(3, 9)
Direct channel/unprotected sources (river, pond, lake)	7 (2)	(1, 5)	3 (1)	(0, 2)
No water source/not applicable	-	-	206 (34)	(29, 39)
Drinking water source appeared clean‖ (spot check)	122 (41)	(35, 47)††	-	-
Stored drinking water in a container	150 (50)	(43, 57)	332 (56)	(51, 60)
Stored drinking water in a covered and clean¶ container	22 (7)	(4, 11)	83 (14)	(11, 17)
Drinking water offered to interviewer, when asked (multiple behaviors recorded)				
Washed the glass with water before pouring water	290 (97)	(94, 99)	250 (42)	(37, 46)
Washed hands with water only	130 (43)	(37, 50)	72 (12)	(9, 15)
Washed hands with soap	51 (17)	(12, 22)	5 (1)	(0, 2)
Hands came into contact with the water inside the glass	-	-	5 (1)	(0, 2)
Glass dipped into the water container	-	-	23 (4)	(2, 6)
Water poured from container	126 (42)	(35, 49)	269 (45)	(40, 50)
Brought directly from tube well/water source	147 (49)	(42, 56)	38 (6)	(4, 8)
No water available	1 (0)	(0, 2)	224 (37)	(33, 42)
Stored water for cleaning utensils	169 (56)	(49, 63)	304 (51)	(47, 56)††

Indicators	Restaurant (N=300)		Food vendor (N=600)	
	n (%*)	95% CI	n (%*)	95% CI
Used stored water for cleaning utensils				
Poured water on the utensils	44 (15)	(11, 19)	46 (8)	(5, 10)
Dipped utensils inside the stored water	122 (40)	(33, 48)	258 (44)	(39, 48)††
Restaurant disposed of waste into (spot check)				
Pit/drum/dustbin	176 (60)	(53, 66)††	106 (18)	(14, 23)††
River/dam/lake/ponds/stream/canal	63 (21)	(15, 26)	34 (6)	(3, 7)
Road side/drain/bush/jungle/no specific place	59 (19)	(14, 24)	78 (13)	(10, 16)
Disposed waste appropriately‡‡ into a pit/drum or dustbin (spot check)	88 (30)	(24, 36)††	64 (11)	(8, 14)
Restaurant interior (including kitchen) appeared clean§ (spot check)	109 (36)	(30, 42)	63 (11)	(8, 13)
Area surrounding the restaurant (within 10 feet) appeared clean‡ (spot check)	108 (36)	(30, 41)	-	-
Personal clothes worn by the food vendor (observed)				
No shirts worn	-	-	13 (2)	(1, 3)††
Wearing plastic gloves	-	-	2 (0)	(0, 1)
Head covered	-	-	11 (2)	(1, 3)

* Weighted; † Improved toilet according to JMP ‡ No human or animal feces , stale food, dead animal body, waste from fish/meat/raw vegetables/fruits; § Less than 250 feet deep; ‖ No water logging, no human or animal feces , stale food, dead animal body, waste from fish/meat/raw vegetables/ fruits on the water source platform; ¶ No black, green or yellow spots appeared inside the container; ††Differences between urban and rural was significant; ‡‡ No waste outside pit/drum

Food hygiene

A few restaurants and some food vendors were observed to display their cooked food items in a covered and clean pot/container for sale. Respondents reported that most of the unsold foods in the restaurants were stored in a covered pot/container inside a meat safe or inside a refrigerator at closing. Food vendors reported that they stored most of the unsold foods in a covered pot/container at the end of the day (Table 14).

Table 14: Restaurant and food vendor food hygiene

Indicators	Restaurant		Food vendor	
	n/N (%*)	95% CI	n/N (%*)	95% CI
Food items kept in a covered and clean† pot/container for sale (spot check)				
Rice/ rice, lentils and vegetable mix	68/285 (23)	(18, 29)	6/14 (42)	(18, 66)
Fish	36/246 (14)	(10, 19)	-	-
Meat/egg	38/248 (15)	(10, 20)	-	-
Lentil soup	27/243 (11)	(7, 15)	-	-
Vegetables	25/198 (12)	(8, 17)	-	-
Curry (fish, lentil, meat, egg, vegetable etc.)	-	-	10/27 (38)	(19, 56)
Sweets/curd/milk	17/69 (25)	(13, 36)	1/3 (33)	(1, 91)
Tea, biscuits, dry cake	-	-	16/45 (36)	(22, 50)
Fushka/chotpati/golgoppa (boiled diced potatoes, onions, chilies, chickpeas with grated eggs, roasted spice powder)	-	-	30/118 (26)	(17, 34)
Variety of juice	0/1 (0)	(0, 0)	24/76 (32)	(21, 43)
Variety of dried fruits kept in oil (called pickles)	-	-	8/67 (12)	(4, 20)
Puffed rice with chilies and oils/nuts	-	-	24/191 (13)	(8, 18)

Indicators	Restaurant		Food vendor	
	n/N (%*)	95% CI	n/N (%*)	95% CI
Kept unsold food items in a covered pot/container after end of day at closing				
Rice/ rice, lentils and vegetable mix	16/22 (72)	(52, 91)	-	-
Fish	69/76 (91)	(85, 97)	-	-
Meat/egg	76/82 (93)	(87, 99)	-	-
Lentil soup	6/8 (75)	(35, 97)	-	-
Vegetables	8/13 (62)	(31, 93)	-	-
Curry (fish, lentil, meat, egg, vegetable etc.)	-	-	2/2 (100)	(16, 100)
Sweets/curd/milk	58/66 (89)	(81, 96)	-	-
Tea, biscuits, dry cake	-	-	17/19 (89)	(67, 99)
Fushka/chotpati/golgoppa (boiled diced potatoes, onions, chilies, chickpeas with grated eggs, roasted spice powder)	-	-	20/23 (87)	(66, 97)
Variety of juice	-	-	4/8 (46)	(2, 91)
Variety of dried fruits kept in oil (called pickles)	-	-	28/32 (87)	(74, 100)
Variety of cake-rice cake, steamed rice cake, rice cake fried in oil	-	-	-	-
Puffed rice with chilies and oils/nuts	-	-	48/53 (90)	(82, 99)

** Weighted; † No visible dirt inside or outside the containers that contained food for sale

Part E: Hospitals

Hospital characteristics

Of the total 875 hospitals included in the survey, the majority were small non-government private hospitals, with an average of 25 beds per hospital and 12 admissions per day. Government upazila hospitals constituted 11% and have an average of 41 beds per hospital and 31 admissions per day. Non-government medical college/specialized hospitals were the largest hospitals, with an average of 325 beds per hospital, and had the highest number of admissions (159 per day). Our survey included only 2 government union hospitals and 13 government maternal child welfare centers and no government medical college/specialized hospital. Hospitals had an estimated 50% bed occupancy, higher among government hospitals (80%) compared to non-government hospitals (50%). In the calculation we include full-time doctors reported by hospital administrators, and therefore likely overestimate the number of doctors. While the mean bed to doctor ratio of 8.8 may not be accurate, the overall trend shows that government hospitals had fewer doctors and nurses per patient bed compared to non-government hospitals (Table 15).

Table 15: Hospital characteristics

Indicators	Rural (N = 432)		Urban (N = 443)		National (N = 875)	
	n	%	n	%	n	%
Hospital Type						
Govt maternal child welfare center	7	2	6	1	13	2
Govt district	14	3	11	3	25	3
Govt upazila	67	16	26	6	93	11
Govt union	1	0	1	0	2	0
Non-govt medical college/specialized	2	1	5	1	7	1
Non-govt private	330	76	368	83	698	80
Non-govt organization	11	3	26	6	37	4
Hospital beds	Rural (average)		Urban (average)		Average (range)	
Govt maternal child welfare center	15		63		37 (8-173)	
Govt district	129		130		129 (56-275)	
Govt upazila	42		39		41 (10-100)	
Govt union	19		10		15 (10-19)	
Non-govt medical college/specialized	65		429		325 (11-617)	
Non-govt private	21		28		25 (3-266)	
Non-govt organization	23		31		29 (4-163)	
	Rural n (%)		Urban n (%)		Total n (%)	
Number of hospital beds*	28		36		32 (3-617)	
% male beds	21		18		19	
% female beds	35		32		33	
% pediatric beds	2		2		2	
% private cabins	32		42		37	
Admissions on site visit day	Rural (average)		Urban (average)		Average (range)	
All hospitals	17		20		19 (1-494)	
Govt maternal child welfare center	6		32		18 (1-146)	
Govt district	149		123		137 (33-279)	
Govt upazila	31		30		31 (1-117)	
Govt union	5		1		3 (1-5)	
Non-govt medical college/specialized	34		209		159 (2-494)	
Non-govt private	9		14		12 (1-176)	
Non-govt organization	15		12		13 (1-109)	
Patient to bed ratio	0.5		0.5		0.5 (0-2)	
Govt	0.8		0.7		0.8 (0-2)	
Non-govt	0.5		0.5		0.5 (0-2)	
Bed to full time doctor ratio†	10.4		7.3		8.8 (1-129)	
Govt	6.9		7.4		7.1 (2-31)	
Non-govt	11.5		7.3		9.2 (1-129)	
Bed to nurse ratio	4.1		3.2		3.6 (0-31)	
Govt	5.9		4.4		5.4 (0-31)	
Non-govt	3.7		3.0		3.3 (0-25)	
Survey respondents						
% Female of Head medical officer/ administrator	10%		12%		11%	
% Female of Nurse	96%		97%		97%	
% Female of Ward boy/Aya	65%		61%		63%	
% Female of Patient	78%		73%		73%	
% Female of caregiver	68%		65%		66%	

* Number of hospital beds = male + female + pediatric + private + remaining common/general beds; † Total doctors = full-time doctors

Hospital handwashing agents and practice

Handwashing agents

There were differences between the type and availability of handwashing agents for hospital staff versus patients/caregivers; 93% of hospitals had handwashing agents available for doctors, 97% for nurses, and 87% for ward boys/ayas compared to just 25% for patients and only 21% for caregivers. The most common handwashing agent for hospital staff was bar soap, followed by alcohol hand sanitizer for doctors and nurses (33-52%). For ward boys/ayas, powder detergent was the second most common handwashing agent (30%); bar soap was available for 15-30% of patients and caregivers.

In government hospitals, handwashing agents were less frequently available compared to non-government hospitals especially for patients, and caregivers. Bar soap was the most common handwashing agent across all categories. Any handwashing agents availability for patients was 4% in government hospitals versus 31% in non-government (p=0.003). Handwashing agents for caregivers was 5% in government hospitals versus 26% in non-government (p=0.005; Table 16).

Table 16: Hospital handwashing agents on spot check

Indicators	n (N=875)	%*	95% CI*
Handwashing agent provided for doctors	828	93	(91, 95)†
Any bar soap	758	85	(82, 87)†
Any liquid soap	267	30	(26, 34)
Any powder/detergent	111	12	(9, 15)
Any hand sanitizer	330	38	(33, 42)
Handwashing agent provided for nurses	838	97	(96, 98)†
Any bar soap	789	91	(88, 93)
Any liquid soap	198	23	(20, 27)
Any powder/detergent	144	17	(13, 22)
Any hand sanitizer	422	47	(43, 52)
Handwashing agent provided for ward boys/ayas	751	87	(83, 90)
Any bar soap	719	84	(80, 88)
Any liquid soap	99	12	(8, 14)
Any powder/detergent	264	30	(25, 35)
Any hand sanitizer	183	23	(19, 26)
Handwashing agent provided for patients or caregivers	218	23	(19, 27)
Any bar soap	213	22	(18, 26)
Any liquid soap	11	1	(0, 2)
Any powder/detergent	15	2	(0, 3)
Any hand sanitizer	9	1	(0, 2)

* Weighted; † Differences between urban and rural was significant

Handwashing during 5 hour structured observations

Out of a possible 4,676 handwashing opportunities, 36% were before eating or giving food/medicine to patients, 18% were after eating or feeding others, and 13% were before preparing/serving food or water. “World Health Organization 'Five Moments'” represented 30% of all possible handwashing opportunities, with 14% occurring after body fluid exposure. Handwashing with water only was the most common (41%), especially after toileting and eating events (Table 17).

Table 17: Summary table of handwashing behavior by specific indications

Indicators	Handwashing with water only		Handwashing with soap		Recommended handwashing[†]	
	n/N	%	n/N	%	n/N	%
Total	1921/4,676	41	174/4,676	4	100/4,676	2
WHO Five Moments for hand hygiene						
1. Before touching patients	0/132	0	3/132	2[*]	14/132	11[*]
2. Before clean/aseptic procedures	4/383	1[*]	9/383	2	30/383	8[*]
3. After body fluid exposure or toileting (urine; vomit; feces; lab samples)	290/636	46[*]	85/636	13[*]	18/636	3
After (self) toileting	108/209	52[*]	9/209	4	2/209	1
After (self) defecation	59/71	83[*]	10/71	14[*]	1/71	1
After (others) feces exposure	91/251	36	58/251	23[*]	7/251	3
4. After touching patients or wounds	5/105	5[*]	18/105	17[*]	26/105	25[*]
5. After touching patient surroundings (clothes, bed, or floors)	27/127	21*	11/127	9[*]	2/127	2
Other key handwashing moments						
6. Before preparing/serving food or water	189/596	32[*]	4/596	1[*]	0/596	0
7. Before giving food or medicine (self & others)	629/1,673	38[*]	10/1,673	1[*]	5/1,673	0[*]
8. After eating (self) or feeding others	707/827	85[*]	14/827	2[*]	4/827	0[*]
9. After sneezing/coughing (self & others)	1/64	2[*]	2/64	3	0/64	0
10. After general cleaning (dishes, drums, pots, bins)	69/133	52[*]	18/133	14[*]	1/133	1

[*] Differences between government and non-government hospitals were significant; [†] Recommended handwashing is defined as 1) washing both hands with soap and air drying or 2) washing both hands with soap and drying with clean cloth or 3) using alcohol hand sanitizer.

Among handwashing where there were greater than 10 events for the 'Five Moments', handwashing with soap was infrequent (<20%). The most common event when soap was used was after touching a patient's wound (17%). The most common handwashing event where soap was used by staff was after body fluid exposure or toileting (urine; vomit; feces; lab samples; 19%) followed by touching a patient's wound (18%). For patients the most common event was after touching another's feces (10%) and caregivers was also after touching another's feces (24%). The frequency of 'recommended handwashing' for all hand washing events was low, and the highest frequency was detected for staff after touching patients or wounds (26%; Table 18).

Table 18: Hospital handwashing behavior by specific indications during directly observed handwashing

Indicators	Handwashing with only water		Handwashing with soap		Recommended handwashing[*]	
	n/N	%	n/N	%	n/N	%
WHO Five Moments for HH						
1. Before touching patients	0/132	0	3/132	2	14/132	11
Staff	0	0	3/129	2	14/129	11
Patient	0	0	0	0	0	0
Caregiver	0	0	0	0	0/3	0
2. Before clean/aseptic procedures	4/383	1	9/383	2	30/383	8
Staff	4/378	1	8/378	2	30/378	8
Patient	0/3	0	1/3	33	0/3	0
Caregiver	0/2	0	0/2	0	0/2	0
3. After body fluid exposure or toileting (urine; vomit; feces; lab samples)	290/636	46	85/636	13	18/636	3
Staff	16/53	30	10/53	19	7/53	13
Patient	90/159	57	7/159	4	2/159	1
Caregiver	184/424	43	68/424	16	9/424	2

Indicators	Handwashing with only water		Handwashing with soap		Recommended handwashing*	
	n/N	%	n/N	%	n/N	%
After (self) toileting	108/209	52	9/209	4	2/209	1
Staff	6/13	46	1/13	8	0/13	0
Patient	48/97	49	3/97	3	1/97	1
Caregiver	54/99	55	5/99	5	1/99	1
After (self) defecation	59/71	83	10/71	14	1/71	1
Staff	0/1	0	1/1	100	0/1	0
Patient	34/39	87	3/39	8	1/39	3
Caregiver	25/31	81	6/31	19	0/31	0
After (others) feces exposure	91/251	36	58/251	23	7/251	3
Staff	4/7	57	2/7	29	0/7	0
Patient	3/10	30	1/10	10	0/10	0
Caregiver	84/234	36	55/234	24	7/234	3
4. After touching patients or wounds	5/105	5	18/105	17	26/105	25
Staff	4/101	4	18/101	18	26/101	26
Patient	0	0	0	0	0	0
Caregiver	1/4	25	0/4	0	0/4	0
5. After touching patient surroundings (clothes, bed, or floors)	27/127	21	11/127	9	2/127	2
Staff	24/98	24	11/98	11	2/98	2
Patient	0/5	0	0/5	0	0/5	0
Caregiver	3/24	13	0/24	0	0/24	0

* Recommended handwashing is defined as 1) washing both hands with soap and air drying or 2) washing both hands with soap and drying with clean cloth or 3) using alcohol hand sanitizer.

Hospital sanitation facilities, drinking water source, and environmental hygiene

Toilets and handwashing facilities

The median patient bed to toilet ratio was 2:3 and toilet to handwashing location ratio was 1 across hospitals. Doctors had more toilets designated for their exclusive use than other staff. There were 19% of hospitals with no toilets designated for doctors, 27% had no toilets for nurses/other hospital staff, and 1% had no toilets for patient/caregiver. All toilets were improved and almost all were inside the hospital compound. Patient/caregiver toilets were dirtier than staff toilets, with feces visible on spot check near 36% of patient/caregiver toilets versus 7% of staff toilets versus 4% of doctor toilets.

Handwashing locations for use after toileting were all located less than 10 feet from the toilet. Soap availability on spot check at handwashing locations was variable: among 42% for any patient/caregiver handwashing locations compared to 52% for nurses/hospital staff and 76% for doctors.

Non-government hospitals had fewer toilets for doctors and hospital staff and the opposite was true for toilets available to patient/caregivers. Among non-government hospitals, 17% had no toilets designated for doctors compared to 1% of government hospitals ($p<0.001$). Similarly, among non-government hospitals 27% had no toilets designated for nurses/staff compared to 2% of government hospitals ($p<0.001$). However, for toilets for patient/caregiver, all non-government hospitals had toilets compared to 1% for government hospitals. Government hospital toilets were objectively dirtier than non-government hospital toilets: with feces visible on spot check for government doctors' toilets 12% versus non-government 3% ($p<0.001$); government nurses/staff toilets 22% versus non-government 4% ($p<0.001$); and government patient/caregiver toilets 75% versus non-government 24% (PR 3.08, $p<0.001$; Table 19).

Table 19: Hospital toilet and handwashing facilities on spot check

Indicators	n (N=875)	%	95% CI
Facilities available (Median, IQR)			
Bed: toilet ratio	2.3		(1.7, 3.7)
Doctors: doctor toilet ratio	2		(1, 4)*
Other hospital staff: staff toilet ratio	9		(5, 15)*
Patient/caregivers: patient toilet ratio	1.3		(0.6, 3)*
Toilet: hand washing station ratio	1		(1, 1)
For doctors/officers:			
Toilets			
None per hospital reporting	63	8	(6, 11)
None or nonfunctional toilets on spot check	125	19	(13, 25)*†
Type of toilet			
Piped sewer	142	7	(4, 10)*
Septic tank	583	72	(66, 78)*
Ventilated improved pit	20	2	(0, 3)
Feces visible near toilet on spot check	41	4	(2, 6)†
Hand washing stations after toileting			
Location of hand washing station			
No location	76	12	(7, 16)*†
Basin	718	77	(71, 82)*†
Tap	72	10	(7, 14)*
Water available	786	86	(82, 91)*
Soap available	697	76	(71, 81)*
For nurses/other hospital staff:			
Toilets			
None per hospital reporting	153	20	(16, 24)*†
None or nonfunctional toilets on spot check	200	27	(21, 32)*†
Type of toilet			
Piped sewer	130	6	(4, 9)*
Septic tank	521	65	(60, 71)*
Ventilated improved pit	19	2	(0, 3)
Feces visible near toilet on spot check	58	7	(4, 9)†
Hand washing stations after toileting			
Location of hand washing station			
No location	178	24	(19, 28)*
Basin	568	59	(54, 64)*†
Tap	121	16	(12, 20)*†
Water available	681	75	(70, 79)*
Soap available	489	52	(48, 56)*
For patient use:			
Toilets			
None per hospital reporting	28	4	(2, 5)
None or nonfunctional toilets on spot check	7	1	(0, 2)†
Male toilets	554	63	(57, 68)
Female toilets	645	73	(67, 78)
Private cabin toilets	698	74	(68, 80)*
Type of patient toilets on spot check			
Piped sewer	147	7	(4, 10)*
Septic tank	686	88	(85, 92)*
Ventilated improved pit	21	2	(0, 3)
Feces visible near toilet on spot check	280	36	(31, 40)*†
Hand washing stations after toileting			
Location of hand washing station			
No location	16	3	(1, 4)
Basin	630	67	(62, 73)*
Tap	355	46	(40, 52)*
Water available at any station	853	97	(95, 98)
Soap available at any station	381	42	(37, 46)

* Differences between govt. and non-govt. hospitals were significant; † Differences between rural and urban hospitals were significant

Water sources

For general water use, 30% of hospitals had more than one water source, and 97% of all water sources were improved. For drinking water, 3% of hospitals had no water source for staff and 4% had no water source for patients/caregivers. Ninety-one percent of government hospitals that had improved sources for staff drinking water compared to 66% for non-government hospitals (p=0.05). Most hospital administrators thought the hospital water supply was sufficient for general use as defined by enough water for general hospital cleaning, washing, and toilets, but 8% of government hospital administrators reported insufficient water supply versus 2% of non-government hospital administrators (p=0.001; Table 20).

Table 20: Hospital water sources (spot check)

Indicators	n (N=875)	%[†]	95% CI[†]
General use water			
No water source	2	0	(0, 1)
Improved water source	854	97	(96, 99)
Type of water source			
Shallow tube well/tara pump	242	33	(25, 40) [*]
Deep tube well	418	53	(46, 60) [*†]
Piped water inside hospital	345	30	(23, 36) [*]
Direct channel/unprotected	19	2	(1, 4)
Located inside hospital	721	79	(74, 83) [*†]
Condition on spot check			
Functional and no water logging	583	75	(71, 80) [*†]
No drain, broken drain, or soak pit	241	30	(23, 36) [†]
Drinking water for staff			
No drinking water source	22	3	(1, 5)
Improved drinking water source	613	78	(71, 84) [*†]
Type of drinking water source			
Shallow tube well/Tara pump	249	34	(25, 42) [*†]
Deep tube well	300	40	(32, 47) [*]
Piped water inside hospital	144	13	(9, 17) [*†]
Direct channel/unprotected[§]	262	22	(16, 29) [*†]
Located inside hospital	592	59	(53, 65) [*†]
Condition on spot check			
Functional and no water logging	434	56	(50, 63) [*]
No drain, broken drain, or soak pit	356	38	(32, 44) [†]
Drinking water for patients/caregivers			
No drinking water source	29	4	(2, 6)
Improved drinking water source	605	76	(70, 83) [*†]
Type of drinking water source			
Shallow tube well/Tara pump	246	33	(25, 42) [*†]
Deep tube well	301	39	(32, 46) [*†]
Piped water inside hospital	159	15	(11, 19) [†]
Direct channel/unprotected	241	20	(14, 26) [*†]
Located inside hospital	592	59	(52, 65) [*†]
Condition on spot check			
Functional and no water logging	442	57	(51, 64) [*]
No drain, broken drain, or soak pit	342	37	(31, 42) [†]
Water supply insufficient[‡]	23	1	(1, 3) [†]

[*] Differences between govt. and non-govt. significant; [†]Differences between rural and urban significant; [‡] Opinion of doctor in-charge

Environmental hygiene and waste disposal

Rural hospitals had objectively dirtier environments than urban hospitals – as defined by visible paper or food waste; sputum or betel-nut waste; human or animal feces; animals or insects – across all hospital locations including at water sources and in kitchens. 49% of rural hospitals had visible paper/food waste visible in hospital wards and 4% animals/insects compared to urban hospitals with 37% visible paper/food waste (p=0.001) on wards and 2% animals/insects (p=0.041). Most hospitals, 84%, disposed of general waste in drums/dust bins, and 94% of urban hospitals disposed in drums/dust bins versus rural hospital, 83% (p<0.001).

Three percent of hospitals even disposed general and clinical waste in open areas e.g. rivers, lakes, drains, jungles. 43% of clinical waste had no specific disposal method, with 59% of urban hospitals having no specific clinical waste disposal method compared to 41% of rural hospitals (p=0.001). The most common disposal method was burning clinical waste in 35% of hospitals, although disposal through incineration was only 4%. Burying clinical waste was the second most common method, seen in 17% of rural hospitals versus 8% of urban hospitals (p<0.001).

Government hospitals had objectively dirtier environments than non-government hospitals; feces – human or animal – were visible in 11% of government verandas versus 1% non-government (p<0.001), 57% of government toilets versus 16% in non-government (p<0.001), 5% of government water sources versus 2% non-government (p=0.440), and 31% of government hospital grounds versus 4% non-government (p<0.001; Table 21)

Table 21: Hospital environmental cleanliness and waste disposal on spot check

Indicators	n (N=875)	%	95% CI
Hospital environment spot check			
Visible in hospital wards and rooms:			
Paper or food waste	376	48	(43, 53) *
Sputum or betel-nut waste	152	21	(16, 25) *
Human or animal feces	6	1	(0, 1)
Animals or insects, live or dead	26	4	(2, 6) *
Visible in toilets:			
Paper or food waste	264	34	(30, 38) *
Sputum or betel-nut waste	146	20	(16, 25) *
Human or animal feces	196	25	(20, 30)
Animals or insects, live or dead	24	3	(1, 4)
Visible in hand washing locations:			
Paper or food waste	257	34	(29, 38) *
Sputum or betel-nut waste	131	17	(13, 21)
Human or animal feces	1	0	(0, 1)
Animals or insects, live or dead	6	1	(0, 1)
Visible at water sources			
Paper or food waste	339	44	(40, 49) *
Sputum or betel-nut waste	54	7	(5, 10)
Human or animal feces	24	4	(2, 6) *
Animals or insects, live or dead	10	1	(0, 2)
Visible outside on hospital grounds:			
Paper or food waste	596	73	(68, 78) *
Sputum or betel-nut waste	204	27	(23, 31) *
Human or animal feces	68	10	(6, 13) *
Animals or insects, live or dead	30	4	(2, 6)
Visible in kitchen:			
Rotten food	20	15	(7, 23)
Human or animal feces	3	3	(0, 6)
Animals or insects, live or dead	14	13	(6, 21)

Indicators	n (N=875)	%	95% CI
Waste disposal (spot check)			
General waste disposal location			
Drum/dust bin	772	84	(80, 88) *
Pit	77	12	(9, 16) *
Other (river, lake, drain, jungle)‡	22	3	(2, 5) *
No designated area	4	1	(0, 1)
Clinical waste disposal location§			
Drum/dust bin	741	80	(75, 84) *
Pit	103	16	(12, 19) *
Other (river, lake, drain, jungle)‡	18	3	(2, 5) *
No designated area	13	1	(0, 2)
Clinical waste disposal method			
Bury	105/862	16	(13, 19) *
Burn	268/862	35	(29, 40) *
Incinerate	38/862	4	(2, 6)
Dismantle or provide/sell to reuse	17/862	2	(0, 3)
Nothing	434/862	43	(37, 50) *

* Differences between government and non-government hospitals were significant

Part F: Traditional birth attendants

Traditional Birth Attendant (TBA) target practices

HYGIENE:*

- Nails must be short as well as clean and hands must be carefully washed with soap and water prior to delivery
- Maintain cleanliness of the environment and all materials used during birth
- Ensure the three cleans – hands, perineal area, and umbilical area
- Ensure that there is clean water at hand
- Ensure careful handwashing, clean delivery surface, clean cord cutting and care
- Avoid direct contact with blood and other body fluids by the use of gloves during vaginal examination, during delivery of the infant and handling the placenta

APPROPRIATE CORD CARE**

- Hand-washing by birth attendant / neonatal caregiver before cutting the cord
- Tying the cord in at least 3 places using a clean/sterile thread
- Cutting instrument must be a sterile surgical blade or a new razor blade
- Cutting technique: Cut in the space between the last two ties, one finger width away from the second one
- Applications to the cord: The cord should be kept clean and dry after cutting. Nothing should be applied. Cord that is very soiled may be gently cleansed with clean, preferably boiled water.

PREVENT AND MANAGE HYPOTHERMIA**

- Quickly wipe the baby dry from head to toe to stimulate the baby. Remove wet cloth and wrap the baby with another dry and warm cloth (within 0-4 minutes of birth).
- Delay the first bath for at least 3 days (bathe the newborn 72+ hours after delivery)
- Early initiation of breastfeeding (not later than 1 hour) and frequent breastfeeding to reduce possibility of hypoglycemia, risks of hypothermia and improves immunity
- Clothe the baby and encourage sharing bed with the mother: cover the neonate from head to toe with warm cloth, and kept the babies with their mothers as much as possible throughout the day.

* Y Buowari. *Training Workshop for Traditional Birth Attendants at Aliero, Kebbi State, Nigeria; A Community Development Service at Aliero, Kebbi State, Nigeria*. The Internet Journal of Tropical Medicine. 2010 Volume 7 Number 2; **2009 National Neonatal Health Strategy and Guidelines for Bangladesh; Ministry of Health and Family Welfare. National Neonatal Health Strategy and Guidelines [Internet]. Government of the People's Republic of Bangladesh; 2009 Oct p. 96. Available from: https://extranet.who.int/nutrition/gina/sites/default/files/ BGD%202009%20National%20Neonatal%20Health%20Strategy.pdf

TBA characteristics

Most selected TBAs were in their mid-50s to mid-60s, have no or low education, are commonly involved in occupations other than attending births (most commonly as homemakers), and have been attending births for approximately 20 years. They performed deliveries rather infrequently (the median number is 5 deliveries per year in rural areas, and 6 per year in urban areas). One-third of TBAs had received training on attending birth/delivery (Table 22).

Table 22: Demographic characteristics of TBAs

Indicators	Rural (N=127)		Urban (N=127)		p-value	National (N=254)		
	n	%	n	%		N	%	95% CI
Age of the TBA (years; median, (IQR))	59 (50, 65)		55 (49.5, 60)		**0.019**	56 (50, 61.5)		
Level of education								
No formal education	96	76	93	73	0.902	189	74	(69, 80)
Primary education (1-5 years)	27	21	30	24		57	22	(18, 28)
Junior secondary education (6-8 years)	4	3	4	3		8	3	(1, 5)
Attending birth as main occupation	14	11	15	12		29	11	(7.4, 15)
Received training						85	34	(28, 40)
Number of training received	1 (1,3)		2 (1, 3)		0.052	2 (1, 3)		
Years since the last training (median, IQR)	10.5 (5,15)		10 (5, 15)		0.828	10 (5, 15)		
Duration of the last training (days)	7 (3,11)		7 (4, 7)		0.94	7 (3, 9)		
Involvement in other occupations								
Homemaker	119	94	112	88	0.108	231	91	(87, 94)
Non-agri labor	1	1	3	2		4	2	(1, 4)
Salaried job (Govt./Private/NGO)	1	1	4	3		5	2	(1, 5)
Spiritual healer/*kabiraj/ Ojha*	0	0	1	1		1	1	(0, 3)
Domestic maid / servant	0	0	4	3		4	2	(1, 4)
Years in the profession (median, (IQR))	20 (15,26)		20 (15,29.5)		0.921	20 (15,28)		
Number of births attended to in the:								
Previous week (median, (IQR))	0 (0,0)		0 (0,0)		0.205	0 (0,0)		
Delivered one or more babies in the previous week	21	17	30	24	0.210	51	20	(15, 26)
Previous two weeks (median, (IQR))	0 (0, 0.5)		0 (0, 1)		0.141	0 (0, 1)		
Previous month (median, (IQR))	0 (0, 1)		1 (0, 1)		0.409	0 (0, 1)		
Previous year (median, (IQR))	5 (3, 10)		6 (4, 12)		0.351	5 (3, 10)		

TBA handwashing

It was more common for rural TBAs to show that they used both soap and water to wash both hands; the median time for handwashing was 25 seconds. More concerning was the method that TBAs used to dry their hands: the most common method was to dry hands on the clothing that the TBA was wearing. Fewer than 10% of the TBAs used clean cloth to dry their hands (Table 23).

Table 23: TBA handwashing demonstration

Indicators	n	%	95% CI
TBA participated in handwashing demonstration	240	95*	(90, 97)
washed both hands with water only	52	22*	(17, 28)
washed one hand with soap and water	3	1	(0, 4)
washed both hands with soap and water	185	77	(71, 82)
How long did the TBA rub hands with soap? (in seconds; median, (IQR))	25 (18, 30)		

Indicators	n	%	95% CI
TBA dried her hands			
On clothing that she was wearing	179	75	(68, 80)
On dirty cloth	4	2	(1, 4)
On clean cloth	19	8	(5, 12)
Air dried	7	3	(1, 6)
Not dried	31	13	(9, 18)

* Differences between urban and rural were significant

TBA hygiene practices at the last delivery

During the most recent delivery they had performed, almost all TBAs (89%) reported washing both hands with soap (unprompted response, multiple answers allowed) prior to attending the delivery. The most common locations of handwashing were in proximity to water sources; at the tube well and near a bucket/*bodna*/bowl from which they poured water. Use of water from the tap/basin was significantly more common in urban than in rural areas.

The most common method for checking the condition of labor was to insert bare hands into the vagina (58%). About half of all TBAs reported that they did not clean the surface before delivery commonly reporting that the surface was perceived to be clean. Nearly all TBAs (97%) reported that they used a blade, thread and knife during delivery. The blade was the most common equipment for cutting the umbilical cord and almost all stated that they used a new blade, and approximately 81% boiled the blade/scissor/knife before use during delivery. Roughly half of all TBAs reported that they used boiled thread to tie the umbilical cord, while others used any kind of thread for tying. After cutting the cord, the most common agent applied to the cord was Dettol™/Savlon™/chlorhexidine, followed by mustard oil. Two-thirds of all TBAs did not apply anything to the cord.

TBAs reported that after delivery the baby was most commonly placed on persons other than the mother, and only around 6% placed the baby on the mother's abdomen/chest. About 80% of TBAs reported that they would then dry the baby, 65% using dry and clean cloth, and 96% wrap the baby with a different clean cloth after the baby was bathed or dried. The median reported time for the procedure was 15 minutes after birth, and the median time to bathing was 3 days (Table 24).

Table 24: Hygiene practice reported by TBAs for their last delivery

Indicators	n (N=254)	%	95% CI
Number of days since last delivery (median, (IQR))		36.5 *(13, 90)	
TBA was family members of the pregnant woman	81	32	(26, 38)
Reported practice after reaching the woman's home (Multiple answers allowed)			
Washed both hands with water only			
Washed at least one hand with soap	228	90*	(85, 93)
Washed both hands with soap	225	89*	(86, 94)
Washed both hands and feet with soap	16	6	(3, 9)
Checked the condition of labor	210	83	(78, 87)
Cleaned the place of delivery	49	19	(14, 24)
Cleaned mat/cloth/plastic sheet for delivery	41	16	(12, 21)
Washed hands before attending delivery	242	95	(93, 98)
Handwashing location			
Tube well	114	47*	(39, 51)
Tap/basin	19	8	(4, 11)
Dipped hand into water container (e.g. bucket, mug, bowl)	17	7	(4, 10)
Poured water from bucket, *bodna*, bowl	83	34	(27, 38)
Pond	9	4	(1, 6)
How did the TBA check the condition of labor?			
Inserted bare hands into vagina	147	58	(52, 64)
Inserted hands into vagina with gloves	43	17	(12, 22)

Indicators	n (N=254)	%	95% CI
Applied pressure on lower abdomen	64	25	(20, 31)
Delivery practice (Multiple answers)			
Used oil in vagina	131	52	(45, 58)
Applied pressure on lower abdomen of the pregnant women	129	51	(45, 57)
Inserted bare hands into vagina	151	59	(53, 66)
Inserted hand with gloves into vagina	57	22	(17, 28)
Delivery Surface			
On mat	5	2	(0, 4)
On cloth	110	43	(37, 49)
On bed	10	4	(1, 6)
On plastic sheet	103	41	(34, 47)
On floor	3	1	(0, 2)
Jute bag	23	9	(5, 13)
Did the TBA clean the surface before delivery?	141	56	(49, 62)
If yes, how did the TBA clean the surface?			
Washed with only water	19	14	(8, 20)
Washed with soap/ detergent	76	54	(43, 57)
Wiped with a cloth	30	21	(14, 28)
With Savlon™/Dettol™	5	4	(2, 6)
Equipment used during delivery			
Blade	246	97	(95, 99)
Scissors	9	4	(1, 6)
Knife	2	0.8	(0, 2)
Thread	242	95	(93, 98)
Dettol™/Savlon™/Chlorhexidine liquid	70	28	(22, 33)
Soap	113	45	(38, 51)
Oil	125	49*	(43, 55)
Cloth	147	58	(52, 64)
Plastic sheet/polythene paper	50	20	(15, 25)
Piece of bamboo	1	0.4	(0, 1)
Needle	2	0.8	(0, 2)
Gloves	43	17*	(12, 22)
Hexisol	2	1	(0, 2)
Spirit/iodine solution	3	1	(0, 2)
What equipment did the TBA use for cutting the cord?			
Blade	247	97	(95, 99)
Scissors	4	2	(0, 3)
Knife	2	1	(0, 2)
Piece of bamboo	1	0	-
Used new blade/scissor/knife	252	99	(98, 100)
Was blade/scissor/knife boiled before use during delivery?	206	81	
If yes, how long was the blade/scissor/knife boiled? (minutes) (median (IQR), n=185)		10 (5, 25)	
What was used to tie the umbilical cord after birth?			
Any kind of thread	116	46	(40, 52)
Boiled thread	34	53	(47, 59)
Umbilical clamp	4	2	(0, 3)
What did you apply to the cord after cutting cord? (Multiple answers allowed here)			
Anti-septic cream	1	0	(0, 2)
Dettol™ /Savlon™/Chlorhexidine	52	21	(15, 25)
Hexisol	2	1	(0, 2)
Spirit/iodine solution	4	2	(0, 2)
Mustard oil	21	8	(5, 12)
Nothing	168	66	(60, 72)
Where did you place the baby immediately after delivery?			
On the floor	33	13	(9, 17)
Next to mother	39	15	(11, 20)
In a cot	13	5	(2, 8)
On mother's abdomen/chest	14	6	(3, 8)
In another room	1	0	-
On anyone other than mother	154	61	(55, 67)

Indicators	n (N=254)	%	95% CI
What did you do for cleaning the baby after delivery?			
Dried	205	81	(76, 86)
Bathed	49	19	(14, 24)
If you dried the baby, how did you clean the baby after delivery?			
Dry the baby with a dry and clean cloth	165	65	(59, 71)
Dry the baby with a wet and clean cloth	38	15	(11, 20)
Dry the baby with a dry and unclean cloth	13	5	(2, 8)
How did you wrap the baby after delivery?			
Dried, then wrapped with same cloth	6	2	(0, 4)
Dried, then wrapped with different clean cloth	243	96	(93, 98)
If the baby was dried, wrapped, or bathed, how soon after birth was the procedure performed? (minutes; median, (IQR))		15 (30, 6)	
How soon after birth was the baby bathed (days)? (n=197) (median, (IQR))		3 (4, 1)	
How long did you wait before bathing?			
>=72h	107	54	(46, 61)
<72h	90	46	(38, 53)

*Differences between rural and urban were significant

Delivery kits

More than 70 percent of TBAs reported that they had never used a clean delivery kit. Among those who had used clean delivery kits, only half had their own kit; most of the others borrowed the kit from the pregnant women's home or from other persons. However, most of those who reported having their own kit could not show the delivery kit at the time of the interview (Table 25).

Table 25: Availability and use of delivery kits, reported by TBAs

Indicators	n/N	%	95% CI
Ever used any clean delivery kits for delivery?	66/254	26	(21, 32)
If yes, from where did you get the kit? (Multiple answers allowed)			
From pregnant women's home	26/66	39	(28, 52)
From training provider	29/66	44	(32, 57)
Purchased by oneself	8/66	12	(6, 23)
From another person	3/66	5	(1, 14)
Items in the kit (spot check)			
Used/old blade	1/37	3	(0, 16)
New blade	5/37	14	(5, 30)
Scissor	2/37	5	(1, 20)
Piece of thread	2/37	5	(1, 20)
Thread ball	4/37	11	(4, 26)
Alcohol	0/37	0	(0, 12)
Hexisol	0/37	0	(0, 12)
Gauze	6/37	16	(7, 33)
Medicine (specify)	0/37	0	(0, 12)
Liquid anti-septic	1/37	3	(0, 16)
Gloves	2/37	5	(1, 20)
Can't show delivery kit box	29/37	78	(61, 90)
Source of supplies for own delivery kit?			
Market	7/37	19	(9, 36)
Govt.	6/37	19	(7, 33)
Other NGOs	27/37	73	(56, 86)
Other sources	0/37	0	(0, 12)
Re-used blade for delivery	1/254	0	(0, 16)
Sterilized blade for re-use by boiling	1/254	0	(5, 100)

Discussion

Households

Socio-demographic characteristics of households: representativeness of the National Hygiene Survey study population

Demographic characteristics of the sampled households suggested that our survey population is similar to those sampled from other larger national surveys, at earlier time points with some differences. Our survey population had a median household size of 5 (IQR: 4, 6), greater than for households comprising the Population and Housing Census, 2011 (average household size of 4.4). Our survey enrolled households with a child <5 years of age and compared to surveys with similar eligibility, household size was comparable.

Among our respondents 18% of mothers and 30% of fathers of the youngest children had no formal education compared to 28% of ever married women age 15-49 years and 26% of ever married men aged 15-49 years that had no formal education (DHS, 2011). A greater difference was observed for those having completed primary education; 51% of women and 43% of men had 5 or more years of education in our survey compared to 12% of ever married women aged 15-49 years and 9% of ever married men aged 15-49 years in the 2011 DHS survey. However there were some indicators among our population suggesting lower wealth; 39% (CI: 35, 43) of sampled households were living in a one room house, in comparison to the reported 27% in the Socio-economic and Demographic Report, 2011. Based on the handful of differences with other national surveys, collected 2 or more years prior, and the study design used, this survey likely represents national practices, facilities and knowledge across socioeconomic and geographic categories.

Household handwashing

A handwashing location near the toilet for post-defecation handwashing was detected for more than two-thirds of the households. However, only 13% of children 3 to 5 years of age and more than half of mothers/female caregivers washed both hands with soap during demonstrations. There was a significant positive correlation between wealth and all handwashing indicators for example 42% of the mothers/female caregivers washed both hands with soap from the poorest and 71% from the wealthiest households and those from the poorest households were more likely to have unclean hands. Urban households had significantly better handwashing indicators. For example, urban households were more likely to have a handwashing location with soap and water available than rural. Similar trends were detected for handwashing demonstrations, also reflected in hand cleanliness of mothers and children.

Rural activities that involve agricultural work and animal husbandry may also have contributed to lower levels of hand cleanliness in this setting; something that should be considered for hygiene

intervention messaging. These data clearly show the importance of facilities with the strong link to handwashing behavior, as has been reported previously (Luby et al., 2011a; Luby et al., 2009). They suggest that a handwashing intervention for households needs to concentrate more effort on the underserved, particularly rural and poor households where poorer practices were detected, as reported previously (Luby et al., 2008).

The degree to which the proxy handwashing measures reflect actual handwashing with soap is not known. Comparing previously collected data from 1000 households, we detected that reported handwashing with soap was between 2 and 41 times more frequent than observed practices (unpublished data; SHEWA-B Impact Evaluation Report). Comparisons of structured observation findings with other proxy indicators have not been undertaken but observed practices are likely less common than reflected by proxy measures. Finding 40% of households with soap present at the handwashing location does not reasonably suggest that this many handwashing events include soap use. When structured observations have been undertaken in Bangladesh, the soap use was found among 1% to 36% of events (Huda et al., 2012).

Household WASH facilities

Access to an improved toilet was detected among approximately half (47%) of the households, compared to 54% detected in the MICS 2009 survey. Access to an improved toilet showed a significant positive correlation with wealth and having no access to a toilet a significant negative correlation. Toilet cleanliness continues to be a challenge with only a third of the improved household toilets having clean slabs and floors, which was significantly better in urban compared to rural households (rural: 25%, urban: 41%, $p<0.001$) and among wealthier households.

The vast majority of households reported using an improved drinking water source (99%), verified through spot checks; similar to findings from the MICS 2011 survey. Around one-third of households (38%) owned their improved drinking water source which was more common among urban areas (rural: 32%, urban: 44%, $p=0.05$) with a positive correlation with wealth. The cleanliness of water points likely impacts on water microbiological quality. However, water point cleanliness was poor with ~20% of water points found clean. In urban areas, both household-owned improved drinking water sources (rural: 12%, urban: 30%, $p=0.001$) and shared/public improved drinking water sources (rural: 27%, urban: 29%, $p=0.620$) more commonly appeared clean than in rural areas. Moreover, the definition of an improved drinking water source does not account for arsenic, manganese or microbiological contamination; these are common water contaminants across Bangladesh and have an impact on health.

Schools

School characteristics

In this survey we detected a greater number of primary schools adjacent to sampled households with 24% secondary schools enrolled. Households from urban areas were more likely to be near secondary schools compared to rural areas (secondary schools: rural: 23%, urban: 31%, $p<0.05$). In urban areas selected secondary schools were significantly less likely to be co-educational and there were more female teachers and more female students >10 years of age selected as respondents compared to rural schools.

School handwashing

Preventing disease transmission in schools can impact school attendance, school grades, child cognitive development, with longer term consequences (Talaat et al., 2011; Roby, 2004; Bowen et al., 2012; Hanushek et al., 2007). Moreover, reducing disease transmission in schools can reduce transmission to household members. Schools are therefore important settings for disease prevention initiatives. Hygiene behaviors learnt early in life can lead to habit adoption. Therefore we synthesized the findings on handwashing practices and facilities to determine the current situation and opportunities for interventions to inform the education sector on where improvements can be made to impact on student and household member health.

Thirty-five percent of schools had a handwashing location inside or near (<30 feet) the toilet with water and soap. Few students (28%) washed both hands with soap during handwashing demonstrations and around one-third of students' hands appeared to be clean during observation. Limited soap presence likely accounted for these poor findings. Low average spending on soap means limited availability; monthly spending suggests about two bars of soap per month were available for an average of 332 students.

There were some differences for urban versus rural schools; soap availability was higher in urban schools (rural: 29%, urban: 37%), and urban schools reported spending more money to purchase soap 102 Taka (US $. 1.32) versus 56 Taka (US $. 0.72; p<0.001). Of note, students in urban areas were significantly more likely to have clean hands than those from rural areas (rural: 31%, urban: 45%; p<0.001), possibly reflecting cleanliness of their environment. As highlighted for households, agricultural and animal tending in rural areas is more common which can have an impact on hand cleanliness.

School WASH facilities

The Government of Bangladesh Standards for Schools state that there should be "one toilet for 50 children (For boys 60% of the toilets can be replaced by urinals). When possible, girls and boys toilets must be completely separated". The schools surveyed fell short of the government recommendations with around 3-fold more students per latrine suggesting that numbers in addition to quality were inadequate. The vast majority of schools had an improved toilet for students (84%), however, in only 45% were these unlocked. Approximately one-third of all schools had water and soap available inside or near (<30 feet) the improved toilet accessed by students and a quarter of toilets were clean (no visible stool over the slab/ pan/ floor). More than three-quarters of schools had an improved, functional water source, however, fewer than half (41%) appeared clean. The importance of WASH facilities in addition to hygiene practices on school attendance has been demonstrated by intervention studies. A Kenyan study of a school-based water treatment, hygiene and sanitation program (Freeman et al., 2012) found a significant reduction in absence among girls for a subset of schools. Toilet and water facilities can impact on hygiene practices, including menstrual management, and disease transmission.

Menstrual hygiene management

From households, around one-tenth (rural: 10%, urban: 21%, p<0.05) of adolescents and one-tenth of adult women (rural: 10%, urban: 33%, p<0.001) used a disposable pad during menstruation. Reusable cloth is more the norm. Among students a small proportion (10%) used a disposable pad, more common among urban students (rural: 9%, urban: 21%, p=0.000). Most used old cloth (86%), some of whom do not use soap or an improved water source for washing and rinsing and many dry cloth in hiding.

Moreover, there are beliefs about menstruating women participating in usual activities. Women and adolescents exclude themselves from activities for religious and non-religious reasons.

Only 6% of school provided menstrual hygiene education session for girls at school and they were mostly urban schools and secondary schools (secondary: 13%, primary: 3%). As many as 40% of surveyed girls reported that they miss school during menstruation and many thought that menstrual problems interfere with school performance This is considerably higher than a study conducted in India which detected 14% of absences among girls due to menstruation (Dambhare et al., 2012).
Poor facilities may contribute to absence during menstruation; only 45% of schools had toilets accessible for students, a quarter were clean and <5% of schools had separate facilities for girls that offered optimal menstrual management. Studies have suggested that poor facilities, practices and beliefs around menstruation can have an impact on health, especially on reproductive tract infection, although there is no robust evidence of this association (Sumpter et al., 2013).

Most studies have failed to establish a link between reproductive tract infection and menstrual hygiene (Sumpter et al., 2013). Studies also suggested that poor facilities, practices and beliefs around menstruation can have an impact on school absenteeism among girls (Khanna et al., 2005; McMahon et al., 2011; Dambhare et al., 2012), although there is very little high quality evidence associating school attendance or drop-out with menstrual management (Sumpter et al., 2013). Further research should explore how school girls could better manage their menstruation, what is required by way of a supportive environment at school and how to reduce absence due to social restriction.

Restaurants and food vendors

Restaurant and food vendor characteristics

Almost all of the restaurant owners/managers, restaurant cooks and street food vendors (97%) were male, similar to the study conducted by Faruque et al. (2010) among Dhaka city street food vendors. Each restaurant served an average of around 221 customers per day, thus for each restaurant in Bangladesh we estimate that approximately 76,000 persons per year are served and the majority of restaurants have suboptimal hygiene and food safety practices, putting many persons at risk for foodborne disease. Street food vendors likely serve a greater population than restaurants, especially in urban area (WHO, 1996). They operate their business for on average 8 hours a day, 7 days per week, thereby serving a large population groups and similarly putting many at risk from disease. Fifty-two percent of food vendors and 13% of restaurant managers had no formal education, which should be considered when designing behavior change communication materials.

Restaurant and food vendor handwashing

Almost all of the restaurants had a handwashing location with soap and water available for customers, and about one-third had soap and water in the food preparation area. Food vendors rarely had a handwashing location with soap and water available. Low availability of handwashing locations with soap and water in food vending shops should be addressed in hygiene interventions, as soap and water present at a convenient location increases handwashing with soap (Luby et al., 2011a). A very high proportion of restaurant service staff washed both hands with soap during handwashing demonstration, however, during 90 minutes structured observation there were less than 25% of events when they washed hands with soap. This was similarly observed for those involved in cooking.

Very few food vendors washed both hands with soap during handwashing demonstrations or during structured observation. Our study findings support the results from developed countries for example

randomly selected food workers from 321 restaurants in US washed their hands properly in only 27% of activities in which they should have compare to less than 25% of activities in this study. However, appropriate handwashing could be improved by providing multiple hand sinks, a hand sink in the workers' sight and food safety training (Green et al., 2007). Restaurant staff reported that they couldn't wash their hands with soap due to workload.

Restaurant and food vendor WASH facilities and food hygiene

An improved toilet was found among <10% of restaurants and almost 50% of the food vendors used nearby markets or a mosque's toilet for defecation. Most water served for customers to drink was from improved sources. When examining restaurant environmental cleanliness, less than one third disposed their waste appropriately and fewer food vendors disposed their solid waste into a pit or drum. Cleanliness inside the restaurants and at food vendor locations was poor. Improper food handling and waste disposal could result in contamination of the food preparation area, by encouraging flies to congregate, multiply (Sharmila., 2011); these may harbor foodborne pathogens that can be transferred to food and food preparation surfaces. Our findings suggest opportunities to improve the cleanliness of restaurants' and food vendors' environment to reduce disease transmission.

Around half of restaurants and food vendors stored water for cleaning utensils, however, 40% of restaurants and 44% of food vendors dipped utensils into the stored water for cleaning. A qualitative study found that this water was used repeatedly over long periods of time without changing (National Hygiene Survey Qualitative Report, 2014). We found considerably fewer food vendors used stored water for cleaning utensils than that reported in a recent urban study where they reported 94% storing water for this purpose (Faruque et al., 2010). However, Faruque et al. showed that, since water is a scarce resource for food vendors, they wash their utensils by dipping them only once into the stored water. This practices likely results in utensils remaining contaminated. A street food vendor study conducted in a Burkina Faso found that 100% of dish washing water was contaminated with an average of 1.9×10^5 cfu/ml of total coliforms (Nicolas et al., 2006). When we spot checked for food items, we found that < 25% of food sold by restaurants and < 42% of food sold by vendors were kept in a covered and clean pot or container. Uncovered food could be exposed to hands, pests and flies, some of which can carry pathogens (Muinde et al., 2005).

Hospitals

Hospital characteristics

Hospital hygiene, especially handwashing, is critical for hospital infection control and prevention of healthcare associated infections. The majority of surveyed hospitals were small non-government private hospitals and about 10% were Government upazila hospitals. Our survey included only 2 government union hospitals and 13 government maternal child welfare centers and no government medical college/specialized hospital. Bed occupancy was higher among government than non-government hospitals.

Hospital handwashing

Directly observed handwashing behavior was overall quite low with hospital staff practicing recommended handwashing only 9% of possible opportunities and patients/caregivers 0-1%. Directly observed handwashing rates were consistently lower than handwashing knowledge or self-reported handwashing practices. Out of all possible handwashing opportunities, only 46% resulted in any handwashing action and only 2% resulted in recommended handwashing practice. Contributing

factors to such low handwashing rates are lack of handwashing supplies. Handwashing locations had available water and were often located within 10 feet of toilets, but usually lacked soap. Most handwashing events, however, often did not occur at fixed handwashing locations and instead occurred at open portable containers. Mobility and convenience are probably key factors influencing use of handwashing locations. Building more handwashing locations in hospital wards and using portable alcohol hand sanitizer are potential solutions. (Kaplan et al., 1986; Graham, 1990).

Overall handwashing agents were quite limited especially for patients and caregivers. For instance, bar soap availability was only 15-30% for patients and caregivers compared to 80-95% for staff. Government hospitals had even less soap availability than non-government hospitals. Handwashing with water alone was therefore the most common handwashing behavior, with only 4% of handwashing opportunities using soap. Handwashing promotion efforts, especially in government hospitals, need to first provide enough soap supplies for regular use. Alcohol hand sanitizer is the World Health Organization recommended handwashing agent for hospitals even in low-income countries.(WHO, 2009) Our survey found up to half of hospitals had alcohol hand sanitizer available for hospital staff, but was used in only 1% of handwashing opportunities and only by hospital staff.

Most daily patient care in Bangladesh is performed by family caregivers and not hospital staff (Islam et al. 2014; Hadley et al., 2007) similarly found in our survey. We observed distinct patterns in staff versus non-staff handwashing practices; Patients and caregivers were more likely to practice handwashing after eating, self-toileting and defecation, and general cleaning. Caregivers did not practice handwashing as often after exposure to others' feces as they did after self-defecation. Caregivers were less likely than staff members to practice handwashing after being exposed to patient body fluids, thus enabling transmission of blood or fluid-borne diseases between patients and family members. Hospital staff handwashing compliance in low-mid income countries is quite low, 1-46% in a six-country study, and improving hospital handwashing has been shown to decrease healthcare associated infections (Jefferson et al., 2008; Raka, 2009; Allegranzi et al., 2013). Our survey observed only 9% recommended handwashing rates among Bangladeshi hospital staff.

Hospital WASH facilities

Nearly all hospitals had at least one water source and sufficient water for general use, but many drinking water sources were not improved or protected. Government and urban hospitals had better water and sanitation infrastructure, but overall poorer maintenance. The higher volume of patients in government and urban hospitals also likely contributes to overall poorer facilities maintenance and cleanliness.

Many hospitals had no toilet facilities available for staff or patients. Non-government hospitals had fewer toilets dedicated for staff perhaps because of the smaller size of non-government private and non-government organization hospitals. Toilet cleanliness was highly variable, with staff toilets being much cleaner than non-staff toilets and non-government hospital toilets being much cleaner than government hospital toilets.

Environmental hygiene was notably worse in rural and government hospitals. Poor environmental hygiene is an infection control risk for both patients and healthcare workers and needs to be a higher priority for hospital administrators. Interventions should include staff handwashing training, information for caregivers to increase good handwashing practices at key times, maintenance initiatives to improve environmental hygiene and should focus resources on staff sanitation training, proper waste disposal, and cleaning hospital environs.

Traditional birth attendants

The majority of births in Bangladesh occur in the home. In the 2011 Bangladesh DHS 71% occurred at home and of those 63% were assisted by a birth attendant; 52% were untrained and 11% were trained. However, there is an increasing trend of having persons that are medically trained (qualified doctors, nurses/midwives/paramedics, field welfare assistants and community skilled birth attendants) attend deliveries; among 16% in 2004 increasing to 32% in 2011 (DHS, 2011). The Government of Bangladesh aims to increase the number of deliveries performed by Skilled Birth Attendants (Bhuiyan et al., 2005), who assisted less than 1% of deliveries in 2011 (DHS, 2011). We detected that among TBAs interviewed, each performed deliveries rather infrequently (median of 5 deliveries per year in rural areas, and 6 per year in urban areas), however we did not ascertain the number of TBAs serving the study area.

TBAs in Bangladesh had low or no formal education and most had received little to no training, similar to other low-income settings (Garces et al., 2112). A study in India similarly reported increased knowledge of handwashing and using a clean blade, among other promoted behaviors post training (Saravanan et al., 2011).

When asked about their most recent delivery, 77% reported that they washed both hands with soap and detected 77% that washed both hands with soap when asked to demonstrate usual pre- and post-delivery handwashing practices. It is likely that these figures represent overestimates of usual practice. We found that 59% of TBAs reported that they used bared hands during delivery, and 22% used gloves. This is similar to the prevalence of vaginal examination with bare hands, that included multiple manual vaginal examinations as part of an earlier study in Bangladesh, where these behaviors were significantly associated with postpartum morbidity (Fronczak et al., 2007).

Roughly half of all TBAs reported the need to tie the cord and half reported using boiled thread to tie the umbilical cord, the remainder reported using some type of thread for tying the cord during their last delivery. Thus tying the cord seems like a common practice and there is some recognition of the need for clean/sterile materials. Slightly less than half of the TBAs recognized that they should use sterile or boiled instruments for delivery or cord care and nearly all reported that they used a blade, thread and knife during the last delivery with more than three-quarters reporting that they boiled the blade/scissor/knife before use during delivery, for a median of 10 minutes. These findings contrast with a study of practices among TBAs in Dhaka slums in the 90s, assessed by TBA service recipients, who reported that the umbilical cord was cut with a boiled razor blade on 13% of occasions (Iyengar et al., 2008).

Nothing was applied to the cord after it was cut, as recommended at the time of data collection, based on reported practices during the last delivery among 66% of births; in a Nepali study nothing was applied to the cord among 74% of deliveries (Hoque et al., 1996). These figures compare with a study of practices among TBAs in Dhaka slums in the 90s 71% of service recipients reported that nothing was applied to the umbilical cord (Iyengar et al., 2008). However figures from the 2011 BDHS (58.6%) were slightly lower than the current and other studies. It is important to note that in 2013, applying chlorhexidine to the cord was integrated into national policy.

Conclusions

Measuring handwashing practice is difficult. Self-reported behaviors are the most commonly used and are easy to collect, but mostly reflect knowledge. Self-reported behaviors are therefore not useful indicators with which to measure handwashing behavior change. This, and other, studies found that self-reported practices over-estimate actual handwashing with soap by between 2 and 40 times in households, 2 and 4 times in hospitals and 2 and 300 times in restaurants and among food vendors. There are some indicators that are candidates as proxy handwashing measures. Among the self-reported indicators those associated with reduced disease burden include mothers reporting washing hands with soap before feeding a child and reported number of times hands were washed in the previous 24 hours (Luby et al., 2011a), (Health and Science Bulletin, 2012). Among handwashing demonstration indicators, observations of mothers or students using soap when asked how they usually wash their hands after defecation and allowing their hands to air dry has been associated with decrease diarrhea or respiratory disease (Luby et al., 2011b). There are spot check indicators including observations of children's hands for evidence of visibly clean finger pads associated with disease reduction (Luby et al., 2011b) Structured observation, capturing practices in the presence of a study observer, are subjected to reactivity among those under observation (Ram et al., 2010). However, this technique gives the closest estimate of true practice. It is an expensive method and not applicable to broad national surveys, however, it could be considered for a small subset of the population.

Handwashing with soap is impossible without adequate resources. Facilities stocked with water and soap remain an area for further improvement among all of the settings comprising this survey, to encourage more regular handwashing with soap to reduce disease burden. To address low soap availability, an important primary barrier to good handwashing practice, promoting the use of low cost bar soap alternatives such as soapy water among various settings should be considered.

Poor quality and maintenance of water and sanitation facilities can contribute to disease transmission. Cleanliness of toilets and water points, appropriate waste disposal practices were suboptimal in most settings. Encouraging better practices can help to reduce fecal contamination of the environment and in turn reduce hand contamination. Thus promoting improvements in facility and environmental cleanliness and maintenance in conjunction with handwashing promotion can impact disease burden.

Schools are venues for rapid dissemination of infectious diseases and places of learning where good habits can be inculcated. Handwashing with soap has proven effective in reducing diarrhea and respiratory disease in these settings (Talaat et al., 2011; Freeman et al., 2011). To encourage good practice supervised group handwashing sessions could be promoted at school, which could reduce school absenteeism (Bowen et al., 2007). Reasons for locking toilets and for poor toilet cleanliness are unclear and warrant investigation, since optimum defecation practices are important to reduce environmental fecal contamination.

Menstrual hygiene management at home and in schools and beliefs that menstruation limits regular activities can impact on girls' school attendance and education attainment. The data from this survey demonstrate that limited school latrine access and options for changing menstrual management materials are likely barriers to school attendance. Among adolescents and women, disposable pad use is low. Providing information on optimal menstrual cloth cleansing and encouraging the use of disposable pads could contribute to increased comfort and fewer menstrual-related infections.

Street food vendors face specific difficulties in maintaining personal and food hygiene, especially with limited access to water. Interventions aimed at improving hygienic practices will need to provide alternatives to water use. Moreover, good water and sanitation infrastructure to facilitate improved practices in restaurants or publicly available for food vendors could reduce overall environmental contamination thereby reducing opportunities for transmission of pathogens to the hundreds of customers they serve each day. Promoting greater restaurant and food vending location cleanliness to enhance customer appeal and comfort would be feasible. Kaferstein (2003) has stated that there is a need to integrate food safety, along with water and sanitation programs, as an essential strategy to prevent diarrhea in developing country.

Hospitals are places where water, sanitation, handwashing, and infection control are crucial to the health of patients, healthcare workers, and the general community (Raka, 2009; Rimi et al., 2012). Hospital staff training should be a focus of hygiene intervention efforts. In addition to making low cost handwashing agents available, handwashing promotion efforts need to include both hospital staff and non-staff caregivers. Addressing inadequate general water infrastructure, sanitation, environmental hygiene, and waste disposal can reduce disease transmission.

Among the TBAs surveyed in this study, practices were mostly suboptimal. These findings emphasize the need to direct pregnant women and families to seek care at facilities that have emergency obstetric and neonatal care, to work on strengthening those service, and to increase connections between pregnant women and their local skilled birth attendants, as encourage by the Government of Bangladesh.

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