



## Research Paper

## Sustaining an elementary school-based hygiene intervention in Bangladesh by forming 'hygiene committees': a pilot study

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### ABSTRACT

School-based water, sanitation and hygiene (WASH) promotion often lacks strategies to sustain behaviors beyond the promotion period. This paper describes school community engagement, in the form of a hygiene committee to institutionalize a school-based hygiene intervention and its role in implementation and sustainability. With formative data on existing hygiene practices from four urban and rural elementary schools, we arranged a workshop to design a low cost, acceptable, and feasible hygiene intervention. We formed hygiene committees including student representatives in each of four additional schools, and piloted and assessed the hygiene intervention. The hygiene committee members' active role supported intervention facilities, materials and maintenance, and promoted targeted behaviors. They encouraged continued use of hygiene materials and provided funds to cover the cost of consumables. The teachers' commitment, student motivation, and financial cost recovery facilitated continued intervention activities. During the 14-months follow-up assessment, the hygiene committee activities were still in place in all schools. The dual involvement of teachers and students in hardware maintenance ensured hygiene intervention consumables availability, functionality, and retention in the pilot schools. The hygiene committee facilitated intervention implementation and sustained functionality. Future school interventions should consider this approach in the implementation processes and cost-recovery strategies.

**Key words:** financial support, hygiene, motivation, ownership, school

### HIGHLIGHTS

- Bangladeshi schools often lack low-cost interventions, funds, and maintenance strategies for sustained WASH behavior change adoption.
- We formed hygiene committees that created school ownership to institutionalize and sustain the intervention even after the project ended.
- Committee members encouraged continued use of hygiene materials and provided funds to cover the cost of consumables even after the project ended.

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## GRAPHICAL ABSTRACT

The formation of hygiene committees in Bangladeshi schools created school ownership to institutionalize and sustain hygiene interventions



Safe drinking water



Handwashing with soapy water



Teacher-led weekly hygiene sessions



Coughing and sneezing into upper sleeves



Toilet cleaning by the student members of the hygiene committee

## BACKGROUND

Schools gather many students in a specified site for a prolonged period. This provides an ideal setting for infectious disease transmission and outbreaks (Bartram *et al.* 2009; Stebbins *et al.* 2009; Xue *et al.* 2012), with opportunity for onward transmission to family members (UNICEF 2010). Previous studies have identified the high burden of a range of infectious diseases including diarrhea, respiratory, and helminth infections among school-aged children (Rabie & Curtis 2006; Waddington *et al.* 2009; United Nations Children's Fund and Regional Office for South Asia (UNICEF ROSA) 2012). In a systematic review focused on children in educational settings, illness was reported as a major cause of school absenteeism (Joshi & Amadi 2013). Student attendance can ultimately affect academic performance (Gottfried 2010).

School-based promotion of water, sanitation and hygiene (WASH) is an effective strategy to reduce disease burden in low- and middle-income countries, including Bangladesh (Ejemot *et al.* 2008; Catalina *et al.* 2009; Freeman *et al.* 2012; Thanh Xuan *et al.* 2013; Bowen *et al.* 2018; McMichael 2019). Previous studies have documented the outcome of water treatment, hygiene and sanitary practices on improving attendance, academic performance, and health of school-age children (Ejemot *et al.* 2008; Catalina *et al.* 2009; Freeman *et al.* 2012). Furthermore, school-based hygiene interventions markedly improve short-term outcomes, for instance, washing hands at critical times, drinking safe water, and using upper sleeve during coughing (Dreibelbis *et al.* 2016; Sultana *et al.* 2017; McMichael 2019; Yeasmin *et al.* 2019; Sultana *et al.* 2021). However, a recent systematic review on sustained adoption of WASH interventions identified that most articles focused on 'initial WASH behavior adoption' whereas only two studies addressed sustained adoption (Martin *et al.* 2018). Poor maintenance of sanitary toilets and unavailability of handwashing materials (e.g. soap) during post-intervention months or years were reported previously in school settings (Catalina *et al.* 2009; Mathew *et al.* 2009; Saboori *et al.* 2011). For instance, combining water storage for handwashing, point-of-use drinking water treatment, and hygiene education, a 1-year Safe Water System promotion program was piloted in 60 Kenyan elementary schools. In a sustainability evaluation, that is, 2.5 years after implementation, only one out of 55 pilot schools had handwashing soap near the handwashing containers and this school did not have drinking or handwashing water (Saboori *et al.* 2011). A study on the sustainability and impact of WASH interventions conducted among 300 Indian upper elementary schools revealed that more than 94% of students from intervention schools washed their hands before eating with water only, as soap near handwashing stations was rarely available (Mathew *et al.* 2009).

Schools play an important role in promoting health literacy among students (St Leger 2001). There are limited data on strategies to institutionalize hygiene interventions in schools. In Bangladeshi schools, a water treatment, handwashing, and

coughing etiquette intervention was successful in changing these behaviors, up to 14 months after a 1-month intervention (Sultana *et al.* 2017; Yeasmin *et al.* 2019; Sultana *et al.* 2021). In this paper, we described how forming a 'hygiene committee' within the school community helped to institutionalize this school-based hygiene intervention, its role in intervention implementation and sustainability beyond the implementation period.

### Study context: school hygiene intervention

The findings presented in this paper were generated from a multi-component project, which was conducted between May 2011 and September 2013 among elementary school students in urban and rural Bangladesh to generate evidence on hardware designs and social and behavior change communication materials for an elementary school-based hygiene intervention in Bangladesh. This research purposively included four urban (located in Dhaka) and four rural (located in Mymensingh, in north-central Bangladesh) co-education elementary schools, to capture variability in socio-demographic, cultural and geographic profile; half were government schools and half were non-government schools. The physical environment of the selected schools has been described in a separate paper (Sultana *et al.* 2017). A summary of the research project phases is provided in Supplementary material, Figure S1. Formative research methods, data collection process and results have been reported in separate papers (Sultana *et al.* 2017; Yeasmin *et al.* 2019; Sultana *et al.* 2021). Overall, the hygiene intervention contributed to 100% adoption of safe drinking water (from observation of 141 students), as documented in the 1-month assessment (Yeasmin *et al.* 2019). During the 1-month pilot intervention period, field workers observed that 46% of students washed their hands with soap before eating (Sultana *et al.* 2021). We found handwashing with soap and water after toileting increased from 0.7% (2/269) to 82% (154/187) in the follow-up visit after the start of piloting. Since there is limited research on mechanisms for adopting, sustaining, and institutionalizing hygiene interventions in schools, we aimed to address this knowledge gap and describe this tipping point from adoption of hygiene behaviors to maintenance of intervention activities. We qualitatively explored the perception of students, school principals, and school management committees regarding the elements of 'hygiene committee' engagement in elementary schools in Bangladesh.

## METHODS

### Intervention

Based on findings from formative research, teachers, representatives from school management committee and parent-teachers association members and the research team participated in a one-day workshop to design an acceptable and feasible hygiene intervention in January 2012. The systematic intervention development process has been detailed elsewhere (Sultana *et al.* 2017; Yeasmin *et al.* 2019). The intervention included hardware for each school as follows: (1) Handwashing facilities: plastic buckets as handwashing stations and soapy water bottles with a pump dispenser, (2) 100-L water storage tank with a tap, and a liquid chlorine dispenser for ensuring safe drinking water, and (3) Materials (cleaning brush, aprons and footwear) for cleaning sanitary latrine (Table 1) (Yeasmin *et al.* 2019; Sultana *et al.* 2021). US\$ 54.10 for each of three schools with inconsistent water supply and US\$ 44.10 for one school with consistent water supply (total US\$ 206.40) was expended for the pilot hygiene intervention for 6 months (Table 1).

### Conceptualization and formation of the 'hygiene committee'

During the intervention development workshop, most of the teachers, school management and parent-teacher association members recommended forming a hygiene committee, with the school principal as the lead, to institutionalize the hygiene intervention in schools and maintain the activities beyond the research period. According to workshop participants, engaging a hygiene committee was important to coordinate hardware maintenance, including collecting the necessary funds. A full description of the hygiene committee of 18 members (in each school) is available in Table 2.

### Piloting and post-intervention follow-up

We piloted the hygiene intervention in four schools (additional to those included in the formative study) in June 2012, by installing WASH hardware, training teachers to lead and conduct social and behavior change communication sessions and forming a hygiene committee. Four weeks after the pilot intervention commenced, fieldworkers conducted a qualitative assessment in July 2012 to explore perceptions, perceived benefits, motivations and barriers regarding appointing a hygiene committee for intervention hardware maintenance and cost recovery in schools. Qualitative assessment included 12 focus group discussions: four with Grade 4 students, four with Grade 5 students and four focus group discussions with teachers,

**Table 1** | Pilot hygiene intervention hardware and consumable components in the elementary schools in urban Dhaka and rural Mymensingh, Bangladesh

Promoted behaviors/activities	Hardware, number per school and capacity	Description	Cost per hardware	Total cost per hardware in four schools
<b>Handwashing station and soapy water:</b> For three schools with inconsistent supply of water	Two sets of 40-L buckets, two plastic stools, and a 16-L bucket	Handwashing station consisted of a plastic bucket with a lid, a plastic turn-handle spout and a plastic stool for the bucket to stand on. A small plastic bucket was provided for used handwashing water.	US\$ 5	US\$ 74.8
	Two soapy water bottles with holder to attach on walls	A translucent 1.5-L plastic bottle with a plastic pump topped the bottle. The steel bar holder held the soapy water bottle and attached it to the walls.	US\$ 5.6	
<b>Handwashing station:</b> For one school with consistent supply of water	Two soapy water bottles with holder to attach on walls	A translucent 1.5-L plastic bottle with a plastic pump topped the bottle. The steel bar holder holds the soapy water bottle and attached it to the walls.	US\$ 5.6	
<b>Point-of-use water treatment:</b> For ensuring safe drinking water	60-L storage tank with metal stools, and chlorine dispenser with a lock	A plastic barrel, with turn-handle water-dispensing spout and child friendly tap and chlorine dispenser	US\$ 11.25	US\$ 45
<b>Ensuring clean sanitary latrines</b>	Four aprons	Cotton aprons	US\$ 2.5 each (US \$ 10)	US\$ 40
	Four pairs of footwear	Plastic footwear	US\$ 2.5 each (US \$ 10)	US\$ 40
	One toilet cleaning brush	Cleaning toilet brushes with long handle	US\$ 1.65 each	US\$ 6.60
<b>Total cost in four schools</b>				US\$206.40

school management committee and parent-teachers association members (Table 3). Participants were selected based on availability and willingness to participate in focus group discussions. However, we included seven students of grade III in one school. We took additional open-ended field notes during formal interviews and informal observations.

### Follow-up assessment at 14 months

Fourteen months after the pilot intervention commenced, the research team revisited the four pilot schools in August 2013 to explore frequency of target intervention behaviors and functionality of the hygiene committee in hardware maintenance and cost recovery. Field staff conducted 12 focus group discussions with students, teachers, school management committee and parent-teachers association members to explore the functionality of the hygiene committee in hardware maintenance and persistency in cost recovery for intervention consumables (Table 3). They also interviewed two janitors, one from each urban school. Each focus group had eight to fourteen participants who were purposively sampled in accordance with the maximum variation sampling procedure in order to facilitate the understanding of the diversified issues related to the hygiene committee activities.

### Spot checks of facilities and structured observations

Detailed approaches and findings have been described and presented previously (Sultana *et al.* 2017; Yeasmin *et al.* 2019; Sultana *et al.* 2021). Briefly, fieldworkers conducted spot checks of WASH facilities before and after intervention rollout to explore the improvement in the physical environment. They also conducted 4-h long structured observations at baseline, at 1 month and 14 months follow-up assessments to identify hygiene behavior change and habit adoption.

**Table 2** | Roles and responsibilities of hygiene committee members formed in elementary schools in urban Dhaka and rural Mymensingh, Bangladesh

Designation/class of the member	Position	Gender	No. of representatives	Roles and responsibilities
Local Government Education Officer (Sub-district)	Advisor	Female	1	Overall supervision and contribution to creating a supportive environment
Local Government Assistant Education Officer (Sub-district)	Co-advisor	Female	1	
School Management Committee (SMC)	Chair	Male	1	Management and expenditure of funds
Parent teacher association (PTA)	Co-chair	Male/Female	1	
Head teacher	Secretary	Male/Female	1	Overall supervision of intervention activity, promoting hygiene rules and fund collection
Science teacher/physical education teacher	Assistant Secretary	Male/Female	2	Assist promoting intervention activities and monitoring hygiene practices
Student of Grades IV and V	Member	Male, Female	10	Monitoring hygiene practices, supporting cleaning and hardware maintenance activity
Janitor	Member	Female	1	Storing water, cleaning and maintenance activities
Total members			18	

### Using conceptual framework as data collection guide

We used the Integrated Behavioral Model for Water, Sanitation and Hygiene (IBM-WASH) adapted for school WASH interventions as a guide for data collection and analysis (Dreibelbis *et al.* 2013). We explored three major dimensions: (a) contextual (i.e. school policies, existing hygiene and sanitation facilities, interest in taking responsibilities, motivational factors, regular school timing), (b) psychosocial (i.e. leadership and ownership of school community, support and commitment of teachers and students, promoting targeted practices), and (c) technological (i.e. ease to maintain, low-cost facilities, demonstration of use) (Table 4). Detailed analysis using different factors of this model in this study has been described previously (Sultana *et al.* 2017). Briefly, the contextual dimension is the social and physical environment in which the WASH behaviors and technologies are implemented; a psychosocial or software dimension relates to the social and psychological factors that affect WASH practices; and finally, a technological or hardware dimension relates to the factors affecting adoption of WASH technologies. Table 4 represents the formative study findings in contextual dimension that we used to develop the intervention package, and the psychosocial and technological dimensions represent the behavior change communication strategies and WASH hardware-related findings after the intervention was implemented.

### Data analysis

Experienced and well-trained researchers conducted focus group discussions and in-depth interviews in the native language, Bengali. From audio recordings, field researchers transcribed the qualitative data verbatim in Bengali. We cross-checked the transcripts with audio recordings to avoid discrepancy and misinterpretation. We drew from the IBM-WASH model, adapted for school WASH interventions, to develop an *a priori* codebook and completed thematic analysis as shown in Table 4. This framework distinguishes between factors affecting WASH behaviors along contextual, psychosocial and technological dimensions (Dreibelbis *et al.* 2013). We included new codes as they emerged. Notably, *a priori* codes based on both the IBM-WASH model and the emerging codes were used in a previous study (Rothstein *et al.* 2015). Before coding, we read the transcripts thrice to gain familiarity with them. Then we clustered and compared the coded data to identify patterns. We analyzed the qualitative data from in-depth interviews and focus group discussions separately for ensuring triangulation and drew inferences collectively from both data sources. We reported findings based on the 'Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist' (Supplementary material, Table S1) (Tong *et al.* 2007).

**Table 3** | Socio-demographic characteristics of study participants for qualitative data collections in urban Dhaka and rural Mymensingh, Bangladesh

Indicators	Pilot (n = 187)	14 months follow-up assessment (n = 132)
<b>Participant type 1: Student</b>		
Age (7–13 years)	163	107
<b>Sex</b>		
Female	85	54
<b>Education</b>		
Grade III	7	3
Grade IV	60	51
Grade V	96	53
<b>Occupation of student guardian</b>		
Farmer	19	14
Salaried job/government job	46	25
Small business	59	18
Non-agricultural labor	18	–
Bus/Van operator	14	15
Others <sup>a</sup>	7	25
<b>Participant type 2: Teachers, janitors, school management committee members and Parent–teacher association members, and local government officials</b>		
Age (23–65 years)	24	25
<b>Sex</b>		
Female	17	17
<b>Education</b>		
No formal education	1	3
Secondary not completed	7	4
Secondary completed	–	3
Higher secondary completed	8	5
Graduation and above	8	10

<sup>a</sup>Rickshaw puller, shopkeeper, daily wage laborer, mechanic, retired person, and political representative.

## RESULTS

### Key roles of hygiene committee in hygiene intervention

#### Maintenance of hygiene intervention hardware

During piloting, the handwashing station maintenance responsibility (i.e. refilling water in buckets, preparing soapy water and emptying wastewater from the bucket) was assigned to student members of the hygiene committee under the teachers' supervision in both in urban and rural schools.

*We start cleaning, refilling water and preparing soapy water just after arriving at school otherwise all other students have to suffer.* (Male student, grade V, rural school)

Actions to ensure access to safe drinking water (cleaning and storing water in a 100-L vessel, dosing chlorine, and ensuring a 30-min waiting time before drinking) were performed by students in rural schools and janitors in urban schools. As urban schoolteachers perceived the dosage of chlorine as a critical concern for water purification, they engaged the janitor. However, one janitor perceived this additional involvement as an extra burden in absence of financial incentives:

**Table 4** | Details of operationalizing and conceptualizing of IBM-WASH framework in piloting a hygiene intervention in elementary schools in urban Dhaka and Rural Mymensingh

Levels	Contextual	Psychosocial Dimension	Technology dimension
School system/ Structural	Large number of students and a shortage of teachers.	The school system supported the formation of hygiene committee, promotion of hygienic behaviors and implementation of piloted hygiene intervention.	The school community in installing, use and regular maintenance of WASH technologies and recurring-related costs. The WASH intervention materials were child friendly.
School/School Principal/School Management Committee	School community and hygiene committee members took the responsibility to maintain WASH facilities in schools.	Hygiene committee members supported the intervention and committed to continue the activities beyond the research period.	Hygiene committee members agreed to develop and raise a fund for WASH facilities maintenance.
Interpersonal/ Classmates and teachers	Each classroom consisted of an average of 50 students provided little opportunity for one-on-one interaction during the school day.	Teachers motivated the students to promote hygienic behavior and maintain WASH facilities accordingly. Students from Grade V inspired the younger to do the same. Student members of the hygiene committee acted as role model for other students and provided reminders for maintain cleanliness and hygiene. They also promoted intervention activities and encouraged other students to use WASH hardware carefully.	Hygiene committee members, teachers and janitors were trained practically with demonstration on how to use and maintain installed WASH hardware.
Individual	Elementary schools included both male and female students, who usually represent from low socio-economic backgrounds.	Hygiene committee members and other students had the self-efficacy to use and maintain WASH intervention hardware appropriately and understood the importance of practicing hygienic behavior.	Piloted WASH hardware in schools was low cost, child friendly, easy to use and maintain.
Behavioral/Habitual	School hours were varied in urban and rural areas.	Overall, change in existing hygiene and WASH-related behaviors among students Perception of disease prevention and other health benefits	Easy adoption of piloted WASH hardware in schools

*I am involved in so much work here and overloaded. Basically, three persons are required to finish the work, and I don't have any assistant or cleaner. If I got some extra money, I could do these duties happily because I am working here for money.* (Janitor, female, urban school)

Janitors at urban schools and student members at rural schools were assigned to clean school latrines during the school week. The janitors mentioned that the latrine cleaning materials such as aprons, brushes and regular supply of disinfectant toilet cleaners made cleaning work easier. The hygiene committees' student members from four schools opined that three motivators encouraged them to clean latrines: weekly social and behavior change communication classes, interest to protect the school students from water and air borne diseases, and enthusiastic parents at home. Students engaged in maintenance activities and acted as role models for the younger students. Motivation from peers encouraged students to practice hygiene behaviors during school hours, as echoed in an interview with a teacher from a rural school:

*Now younger children are watching their seniors doing these jobs for the good health of all students; after certain period these children will also become interested in being a member of the hygiene committee.*

The findings correspond to the School/School Principal/School Management Committee and interpersonal rows and technology dimension in the IBM-WASH framework (Table 4) (Dreibelbis *et al.* 2013).

### Promotion of target hygiene behavior and motivation for continued practice

The school community members (teachers, school management committee, and parent–teacher association) and students at all schools appreciated having a hygiene committee to encourage positive behavioral practices among students and to promote continued hygiene intervention activity at their schools.

*Every work needs to be done through a system, and the hygiene committee is like a very good system to conduct the promoted activities in the school compound.* (Head teacher, rural school)

Student hygiene committee members reminded fellow students to practice recommended hygiene behaviors including handwashing with soapy water at the three recommended times, drinking safe water, pouring water after toileting. They also advised on methods to prevent misuse of sanitation materials (e.g. wasting treated drinking water, playing with soapy water). Thus, engagement of students facilitated a sense of ownership through participation in a leadership role, maintenance support and positive attitudes.

*We motivate [the other students] by telling that the bad smell [in treated water] means the medicine is [present and] working to kill germs.* (Student member of hygiene committee, male, rural school)

The findings correspond to the interpersonal and individual rows and psychosocial dimension in the IBM-WASH framework (Table 4) (Dreibelbis *et al.* 2013).

### Hygiene behavior change

The spot checks water revealed that the provision of hardware improved schools' physical environment favoring handwashing with soapy before eating, and after toileting and after cleaning toilet and safe drinking water practices (Sultana *et al.* 2017; Yeasmin *et al.* 2019; Sultana *et al.* 2021).

At baseline, among 63 observed students, 58 (92%) coughed/sneezed into open air, five (8%) covered coughs/sneezes with their hands, which were not subsequently washed with soap and water as they judged this infeasible. After 4 weeks, among 70 observed students, 27 (39%) coughed/sneezed into upper sleeves, 33 (47%) into open air, and 10 (12%) covered with hands. After 14 months, among 230 observed students, 13 (6%) used upper sleeves, 154 (67%) coughed/sneezed into open air, and 59 (26%) covered with hands (Sultana *et al.* 2017).

At baseline, of 300 before eating events, no one washed hands with soap, and 99.7% (299) did not wash hands at all as soap was unavailable. Out of 269 after toileting events, 0.7% (2) washed hands with soap, and 88% (237) did not wash hands. After 4 weeks of the intervention, 45% (87/195 before eating events), 83% (155/186 after toileting events), and 100% (15/15 after cleaning toilet events) washed both hands with soapy water as children found it accessible, low cost, and child friendly. After 14 months, 9.4% (55/586 before eating events) and 37% (172/465 after toileting events) washed both hands with soapy water for health benefits (Sultana *et al.* 2021).

During 1-month follow-up, among 141 drinking events observed, 141 students (100%) drank chlorinated water. In 93 or 66% of events, students used their own bottles, and in 43 (30%) of the events, they used common cups or hands washed before drinking. During the 14-month follow-up, we observed 732 drinking events. In 653 of 732 events (89%), students drank chlorinated water; in 78 events (11%), they consumed water from untreated drinking water sources. Among those who consumed chlorinated water, 20% (131/653) used their own bottles to drink water, 72% (467/653) used common cups, and 8% (55/653) used both hands to drink water (Yeasmin *et al.* 2019).

### Recurrent cost of hygiene intervention consumables

The research team motivated the school community (teachers, school management and parents–teachers association committee members) to develop a system for recovering maintenance and consumable product costs. The aim of encouraging fund raising was to explore the potential for schools to cover the maintenance and repair expenditures beyond the project implementation period.



Since the maintenance cost was considered low, all the teachers, school management and parents–teachers association committee members of the hygiene committee contributed small amounts and developed a fund which was utilized to cover full cost of cleaning materials i.e. liquid chlorine, detergent sachet, disinfectant toilet cleaner. In total US\$ 0.25–1.25 was disbursed from this fund to purchase a detergent sachet for daily use or a 1-kilogram packet for longer use (~6 months). All school hygiene committees agreed to set up a fund and bought one bottle of 2-L liquid chlorine costing US\$6, which lasted for 6 months.

At the time of piloting, the project supplied a 1-L disinfectant toilet cleaner (US\$1.75) in each school for maintenance of sanitary toilets, which lasted for 2 months. At the end of piloting, hygiene committee members agreed to continue the recurrent cost of cleaning materials, considering cost effectiveness and health benefits of students. The student members were not included in fund raising, as the policy of the Government of Bangladesh states that elementary schooling is free of cost.

*Basically, the school management and parents-teachers association committee members who are economically solvent are contributing to such a fund. We use that fund to purchase detergent powders and disinfectant toilet cleaners. Other elementary schools may not have similar situation to recurrent the cost. Besides, the matter is crucial for us because we cannot collect money from the students. However, if the solvent parents agree or show interest, they may contribute.* (Head teacher, urban school)

The findings correspond to the School system/Structural, School/School Principal/School Management Committee and individual rows and technology dimension in the IBM-WASH framework (Table 4) (Dreibelbis *et al.* 2013).

### Hygiene committee's role in sustaining the pilot hygiene intervention

During the 14th month follow-up assessment, the presence of a functioning hygiene committee differed between urban and rural schools. Continuation of treating drinking water with chlorine and maintenance of the handwashing stations with stored soapy water was confirmed in one urban school. In another urban school, there were transfers of teachers who had been committee members to other schools, death of a janitor, trained students were promoted to Grade 6, and the hygiene committee became less engaged. Some school management committee and parent–teacher association members became inactive. In the absence of school management committee members, janitors and trained students, maintenance and monitoring no longer occurred and intervention hardware went missing. The absence of briefing and instructions on hardware use and maintenance among new janitors was also noted.

*The president of the school management committees is sick, vice president is outside of Bangladesh, and one teacher has resigned from this school. Our janitor, who was proactive, also died last month and students of grade five have finished their studies and left for high schools. Therefore, the hygiene committee became inactive in the school.* (Head teacher, urban school)

A similar situation was noted by a female janitor at an urban school,

*When I started my job here, I found two soapy water bottles. One teacher was responsible to prepare the soapy water regularly. None took the responsibility after she left the school. Then, we lost one of the soapy water bottles during the junior school certificate exam [central public examination for class 8] since many children with parents from other schools came to sit for the exam.*

In rural schools, maintenance activities were mainly carried out by student members of hygiene committees and teachers and school management committee members covered the recurrent cost for hardware maintenance. Rural schoolteachers ensured the availability and functionality of intervention materials in the school compound and distributed overall maintenance responsibilities to student members and janitors. The rural students were motivated to carry out their responsibilities as they came to the school earlier to perform maintenance work and ensure equal participation of all members.

*As students are supervising [and] monitoring the hygiene intervention activities, so hygiene committee made our students responsible. Besides, school management and parents–teachers association committee members have the right to know*

*about every single penny that we are expending. So, involving them in the hygiene committee for running activities in the school is a [part of] institutionalization process.* (Head teacher, rural school)

*We are five friends and come to the school half an hour earlier. One pumps the tube-well, two refill the [water storage] vessel, one moves all the hardware (60-L vessel, stool, 10-L bucket to collect rinse water) onto the veranda and one doses water with liquid chlorine. Two of us clean the hardware every seven to 15 days.*- Student member of hygiene committee, grade V, rural school

In urban schools, due to the disagreement among parents in engaging students for these tasks, the teachers assigned janitors. In absence of incentives, the janitors perceived intervention material maintenance as an additional burden and threatened the school principal saying, *'If the principal does not increase my salary, I will leave my job.'* As urban students were less engaged, they played with intervention hardware, making it difficult for janitors to retain and sustain it.

*Sometimes I prepare soapy water and sometimes I ignore it because male students mostly play with the soapy water. They make bubbles with soapy water, pour it all over the toilet and throw the bottle at other students. This way they finish it. So, I don't want to refill it though teachers told me to, but how many times should I refill the bucket and the bottle? It becomes difficult for me to clean the toilet and hardware.* (Female janitor, urban school)

The findings correspond to the School system/Structural and interpersonal rows with technology dimension, and individual rows with both psychosocial and technology dimension in the IBM-WASH framework (Table 4) (Dreibelbis *et al.* 2013).

## DISCUSSION

We observed that leadership and decisions made by the hygiene committee in three of the four schools (two rural and one urban) created a supportive environment to monitor hygiene intervention materials, maintain hygiene facility functionality and cover consumable recurrent costs. Nevertheless, lack of hygiene facility maintenance (i.e. missing soapy water bottle) in one urban school at the 14 months follow-up suggests some limitations of the hygiene committee over longer term: agreement, decision-making, and communication within committee and member roles, specifically among students, teachers and school management committee representatives. Our findings illustrate the motivation, accountability and a 'sense of ownership' among hygiene committee members from rural schools. In contrast there was less engagement of urban school hygiene committees evident in infrequent maintenance and monitoring, which impacted intervention sustainability.

Inadequate financial planning and unavailability of a recurrent fund for interventions to cover the cost of soap, other consumables, operation and maintenance, are major barriers to a sustainable and mainstreamed WASH intervention in schools (Mooijman & Water 2012). Financial assistance from the community or government proved to facilitate well-managed sanitation services in Bangladesh's elementary schools. Active, motivated and independent teachers, who were dedicatedly responsible for sanitation facilities, could reverse the negative outcome of limited or no government support (Chatterley *et al.* 2014). The Government of Bangladesh provides government elementary schools with a contingency fund (approximately US\$ 9 per month per school) for photocopying and managerial work. Regardless of student number, the government provides a School-Level Improvement Plan fund (approximately US\$ 240–370 per school) on a yearly basis which can be used according to school needs (Chatterley *et al.* 2014). Specific amounts drawn from these funds can be allocated to maintain hygiene and sanitation facilities in elementary schools. In this project, the capital cost for intervention technologies per school was US\$ 28.5 (Table 1), and had been anticipated to last at least five years, and the hygiene consumables and cleaning supplements cost was US\$ 26 for three schools with inconsistent water supply and US\$ 16.10 for one school with consistent water supply for the 6-month hygiene intervention. This could possibly be covered under the annual School-Level Improvement Plan fund. A recent systematic review identified three major financing models to support WASH programs in schools or community settings: government and public financing, private and donor's financial assistance and service user fees (McGinnis *et al.* 2017). We recommend testing these financing models in Bangladeshi school WASH programs in the future.

Along with regular government support and school management committee involvement, including a local sanitation champion, an accountable teacher and a maintenance plan acted as motivators for ensuring well-managed sanitation in Bangladeshi elementary schools (Chatterley *et al.* 2014). However, a team of school management committee representatives and

teachers need to plan for and manage potential teacher transfer (Chatterley *et al.* 2014). Engagement of diverse community stakeholders can influence community ownership, trust of target population and understanding of local vulnerabilities, which are crucial factors for intervention implementation success (Sandison 2018), or as stated in one study 'Involvement can take the shape of school management committees, parent-teacher associations or committees specifically set up for WASH in Schools' (Mooijman & Water 2012). In our study, parents and the school community involvement were specifically coupled with collecting funds for hygiene consumable cost recovery. Outside of schools, community engagement has also supported WASH intervention uptake in other contexts (Waterkeyn & Cairncross 2005; Sinharoy *et al.* 2017).

Our findings highlight the advantages of student engagement and fostering their leadership. Students have the ability to maintain an effective WASH intervention if they obtain clear education and guidance (Bresee *et al.* 2016). In our case, the teachers guided the students. This complements the experience of a school-based participatory education and social entrepreneurship model 'Project SHINE' (Sanitation & Hygiene Innovation in Education) in Tanzania where the SHINE club's student members replicated lessons from classroom learning to school and community members under guidance of teachers (Greene *et al.* 2012). Student members also hosted sanitation science fairs. Students can effectively disseminate hygiene information learnt in the classroom to their friend, family members, relatives and neighbors (Bresee *et al.* 2016; Hetherington *et al.* 2017). Additionally, they can explain to and teach one another (Rohrbeck *et al.* 2003; Greene *et al.* 2012).

In this study, hygiene committees played a role and made centralized decisions on cost recovery and shared maintenance responsibilities (i.e. drinking water treatment timing, monitoring) in a 'controlled' school environment, contrasting with individual decisions and behaviors in the community setting. In households, human and financial resource availability, engaging local leaders, affordability, and willingness to invest influenced the sustainability of household-water treatment and storage practices, as mapped by Ojomo *et al.* (2015). Low community interest in paying water-point users fee and repairing non-functional water system was observed in Sub-Saharan African countries (Foster 2013; Klug *et al.* 2017). In Bangladesh, a large scale 5-year (2007–2012) WASH program resulted in low health impacts and low uptake due to limited supervision, management and performance monitoring of hygiene promoters who were the frontline actors (Huda *et al.* 2012; Benjamin-Chung *et al.* 2017). In our case, the hygiene committee took the opportunity of schools' regulatory framework, internal accountability, and commitment to promote and sustain hygiene intervention.

The systematic analysis of our findings using the IBM-WASH model indicated that a number of contextual, psychosocial and technological factors are important to influence and sustain school-based hygiene interventions and habit adoption (Dreibelbis *et al.* 2013). School community's willingness and commitment to maintain and promote the intervention activities at contextual level; self-efficacy and leadership role to continue the activities beyond the research period at the psychosocial level; and consensus to raise funds and recurrent costs for WASH facilities at the technological dimension (Table 4) enhanced the institutionalization and potential for sustainability. In interventions that require maintenance and funds within the schools, formation of 'hygiene committees' could be the key to high feasibility and acceptability as schools can create a supportive context both the individual, community and societal level.

The study has some limitations. The research was conducted among only eight schools, so we may have missed potential insights, reflections and contextual factors such as differences in the regulatory environment and good will of schools, water scarcity, planning and construction of existing facilities, and engagement of the school community if a larger sample had been included. We observed that hygiene committee members from rural schools were more engaged and active than urban schools, which may or may not generalize to other schools. A second limitation is the possibility of recall and reporting bias (Baird & Özler 2012). Courtesy bias was likely whereby participants might have been supportive of the intervention and provided positive insights rather than difficulties. To minimize this, during unannounced visits, we conducted spot checks and structured observation for specific indicators (i.e. number of students washed hands at three recommended times after teacher's announcement, functionality and availability of intervention material, and cleanliness of latrine) to monitor intervention progress and published elsewhere (Sultana *et al.* 2017; Yeasmin *et al.* 2019; Sultana *et al.* 2021). We also drew inferences collectively from different categories of participants, to minimize the impact of potential biases. It was not possible to explore all concepts elaborately from all categories of respondents because of school timetable constraints. We collected data within mid-morning breaks and after school classes ended. During breaks, the students were in hurry to play with their friends and were distracted, therefore potentially provided limited feedback. Teachers were busy with other academic and administrative work, potentially providing fewer responses.

The most recent Bangladesh National Hygiene Survey indicated that per elementary school spent US\$ 2.6 (BDT 205) monthly for bar or liquid soap, 39% of the students had improved, unlocked, accessible toilets that have soap and water

available and per toilet was shared by 121 students, and 64% toilets appeared clean (Bangladesh Bureau of Statistics 2020). The 2022 Progress on drinking water, sanitation and hygiene in schools by UNICEF and WHO suggest that there was a 57% point gap in basic hygiene coverage between primary (85%) and secondary schools (28%) in Bangladesh (UNICEF and WHO 2022). This suggests the solutions identified in our 2011–2013 study have the potential for sustainability in Bangladeshi schools.

## CONCLUSIONS

In this pilot study, the school-based hygiene committee played an active role in monitoring hardware and consumable products and covering the recurrent cost of maintenance, suggesting their role in ownership development and intervention sustainability. Community participation, local capacity building with human and organizational resources, leadership, accountability, and decision-making are ‘interrelated dimensions’ in WASH sector empowerment (Dery *et al.* 2020). Future research should include community involvement strategies (i.e. introducing ‘school hygiene management’ as an agenda of the school management authority meetings, developing a ‘hygiene plan’ for managing maintenance and monitor and review the hygiene intervention materials’ functionality and using ‘school assembly speech’ delivered by teachers for hygiene behavior adoption among children). For ensuring intervention sustainability, integrating cost recovery and community engagement strategies in school WASH program can be pivotal to be potentially included in policy and implementation processes. However, strategies and determinants of long-term engagement of hygiene committee in school WASH program can be explored in future.

The 2020 Bangladesh Strategic Paper (DPHE, Bangladesh 2020) written in response to the WASH issues during and post COVID-19 outbreak situation planned establishing handwashing stations at primary and secondary schools with a monthly real-time monitoring system with US\$ 1 million budget to encourage and ensure students’ handwashing practices. The Government of Bangladesh and UNICEF worked closely to develop school reopening guidelines and installing handwashing facilities, however, systematic monitoring and reporting on water quality and handwashing practices remains a constraint (UNICEF 2022). The lessons learned from this study could benefit monitoring and sustainability of WASH interventions within the schools. The hygiene committee’s role in leadership, accountability and centralized decision-making within the school environment fostered student support, funding assistance and institutionalization in the present study, although teacher transfer, student up gradation and minimally engaged hygiene committee members potentially limited hygiene intervention sustainability in urban schools. Sustaining hygiene interventions can potentially reduce infectious disease transmission and outbreaks among students within school settings. The current study informs efforts to make a difference in the current school WASH landscape in Bangladesh; hygiene committee can monitor schools’ existing WASH infrastructure. Additionally, the potential approach to be explored may include developing effective partnerships with local partners under corporate social responsibility (CSR) for continuous and sustained supply of intervention materials according to need. The government can also incorporate research evidence on hygiene intervention sustainability, specifically cost-recovery strategies in practice and policy decisions as a part of promoting evidence-informed decision-making. This intervention could be complementary to government investments in capital improvements in school wash infrastructure.

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## AUTHOR CONTRIBUTIONS

F.S. led the overall study, collected, and analyzed the data, implemented the intervention, and drafted the full report. S.M.K. drafted the manuscript with F.S., P.J.W., S.P.L., and L.U. conceptualized the study design, and guided the intervention and study implementation. S.P.L. contributed to the fund raising. L.U. guided the manuscript writing and all the authors reviewed the manuscript.

## ETHICAL CONSIDERATION

The study was approved by the icddr,b Ethical Review Committee. We sought permission from the Government of Bangladesh Divisional Primary Education Office, Dhaka, Bangladesh to work in specific schools in Dhaka and Mymensingh districts for research purpose. Teachers provided written consent and students assented to participate before we started interviews and focus group discussions with them. Before starting interviews and focus group discussions, we explained study objectives, activities, anonymity, and confidentiality to the participants and assured them that they could withdraw at any time. Our study involved no notable physical or psychological harm to the participants.

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## DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

## CONFLICT OF INTEREST

The authors declare there is no conflict.

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