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Can behaviour change approaches improve the cleanliness and functionality of shared toilets? A randomised control trial in Dhaka, Bangladesh

Households living in densely populated urban slums often lack the space for their own toilet, making shared sanitation the only viable solution. This is the situation in Dhaka, where many of the city's low-income residents depend on one of the city's enormous number of shared compound toilets: a recent study by the International Centre for Diarrhoeal Disease Research Bangladesh (icddr,b) estimated that 4.3 million people in Dhaka use such facilities. While shared compound toilets can play a central role in urban sanitation provision, it is notoriously difficult to keep these facilities clean and well-maintained, leading to an unhygienic and unpleasant user experience and often to under-use or eventual abandonment.

As part of its 2012 – 2015 DFID-funded research programme, WSUP commissioned a research project in Dhaka to explore behaviour change strategies to help users keep their toilets clean and functional. The study aimed to design, pilot and rollout low-cost behaviour change messaging approaches and associated simple hardware provision. The research team used a randomised control trial (RCT) design to evaluate the impact of the intervention on toilet cleanliness and other metrics. The results indicate that this type of behaviour change approach can be strongly beneficial to shared toilet cleanliness and functionality.

This Discussion Paper presents the context, methodology, results and conclusions of the study. The paper is derived from the final report of researchers from icddr,b, Stanford University and Johns Hopkins University Bloomberg School of Public Health.









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Executive Summary

Background

Shared toilets in urban slums are often unclean and poorly maintained. This can lead to underutilised or abandoned sanitation facilities, with a corresponding rise in rates of open defecation. Poorly maintained toilet facilities contribute directly to environmental faecal contamination and often result in serious and widespread health issues.

Improving water, sanitation and hygiene (WASH) facilities and WASH-related behaviour in low-income urban communities is complex. The limited political power of residents, coupled with lack of legal title to land, means that government authorities have little incentive to prioritise service provision to these areas. In addition, conventional behaviour change messages can fail to address the real causes of unclean and poorly maintained facilities, which might include a lack of defined toilet maintenance guidelines for the different families in a compound, poor landlord-tenant relations and high turnover of renters.

Aware of these challenges, the research team adopted an iterative approach to developing the behaviour change strategy for this study. Extensive formative work was conducted to better understand the specific challenges of maintaining shared toilets in low-income communities in urban Dhaka. A focus on shared toilets within compounds meant that the team could work with an identifiable community of users who, to some extent, shared common ideas about using and maintaining a communal sanitation facility. The understanding generated from this formative work was then used to develop several pilot interventions, which were repeatedly tested and revised before finalisation and full-scale rollout. The intervention's impact on a variety of outcomes including toilet cleanliness was then evaluated.

Methodology

Formative work

In order to identify how best to introduce behaviour change messaging and hardware to low-income areas, the research team used qualitative techniques throughout the intervention's design, development and piloting stages. A stakeholder workshop for various NGOs with experience of implementing sanitation interventions was held in January 2014 to identify the critical issues surrounding shared toilet usage in Dhaka. Field investigators also interviewed mud pump and Vacutug operators, landlords, community-based organisation (CBO) staff, NGO representatives and members of the community, as well as conducting focus group discussions. The field team then identified and ranked the foremost inappropriate toilet use behaviours.

Pilot development

Separate focus group discussions were held with male and female participants in three low-income communities. Participants listed the problems with the shared sanitation facilities and what they perceived as the contributing factors to poor toilet use behaviour, then proposed potential solutions.

Pilot testing

Two rounds of pilot testing took place in two neighbourhoods of Dhaka's Mirpur district. After analysing the results of the first round, the team revised the behaviour change messages and conducted a second round of piloting in the same compounds. Focus groups and in-depth interviews with residents, waste bin emptiers and landlords were conducted to assess the draft intervention package's acceptability and feasibility and which informed development of the final package.

Evaluating the intervention

Twenty three urban slums from three areas of Dhaka were selected for a cluster randomised control trial. Those 23 slums were sub-divided into 38 distinct clusters, the lowest geographical area for randomisation in the study. The sampling unit for the intervention activities and surveys was a shared toilet within a compound that was used by two or more households and which drained into a common septic tank or the sewerage network: an overall sample of 1,226 shared toilets.

A baseline survey of the users of those 1,226 toilets took place from 15 November 2014 to 25 January 2015, and an endline survey of the users of 1,214 of those toilets took place from 8 August to 30 September 2015. The second nearest adult household user of each selected shared toilet was the chosen survey respondent. The field team also inspected all toilets to assess their structure and provision of water, distance to water source, presence of visible faeces, urine, or other liquid, dirt, or solid waste inside and on the way to the toilet.

Intervention delivery

The 38 clusters were designated as either intervention or control. Each intervention cluster was matched to a control arm, selected according to the number of toilet cubicles per cluster. Dustha Shastho Kendro (DSK), a non-government organisation, recruited 50 community health promoters (CHPs) to deliver the intervention and its associated materials. CHPs shared messages on toilet use and cleanliness, disseminated through compound meetings and personal communication. Hardware to support the intervention (including a plastic waste bin and a four-litre flushing bucket for each cubicle) was provided and those compounds that experienced frequent water scarcity received an additional 70-litre plastic water storage bucket.

Data analysis

The field team transcribed the collated audio-recorded qualitative data and developed coding guides based on the research objectives. After coding, the field team translated the coded data into English and manually analysed it.

The proportions for categorical variables, means for symmetric continuous variables and medians for skewed continuous variables were reported in order to assess the balance between intervention and control. The adjusted difference in difference was estimated in order to measure the impact of the behaviour change intervention messaging in terms of improving the cleanliness of shared toilets. The effect of clustering was offset by estimating confidence limits of 95% and p-values using a generalised estimating equation.

Results

Formative work

Faecal sludge removers reported that faecal sludge contained rags, bottles, bags, children's faeces in plastic bags, pads and cloths used for menstrual management, condoms, toys, soap cases, broken brushes and construction debris. Community members and faecal sludge removers claimed the shared toilets' users were largely unaware that items disposed of in the latrines caused blockages and increased both labour costs and the time taken to clear the sludge.

Respondents described several forms of inappropriate toilet use. Their three highest ranked concerns were: **1)** non-use of toilets in favour of open defecation, particularly by young children; **2)** inadequate flushing of faecal matter; and **3)** smoking in the toilets.

Respondents also recommended locations for written messages or signs promoting WASH-related behaviours. Interviewees identified water shortages as the most significant barrier to keeping toilets clean. Specific behaviour change materials were therefore developed for low-income communities experiencing severe water shortage.

Pilot development

Residents of the community gave their opinions about the available hardware options and a series of pictorial messages were designed for the three pilot sites. The field team identified two types of appropriate waste bins, and tested one model in each neighbourhood. Areas suffering from water shortages also received a 70-litre reservoir with a small jug attached in order to fill the smaller four-litre bucket. A mechanism for refilling the reservoir bucket was developed and a "two container approach" was promoted: a bodna for anal cleansing and small bucket for flushing.

Pilot testing

After the initial pilot, residents explained they had become accustomed to disposing of general waste in the bin provided and using water to flush the toilets. The field team then developed images with explanatory text to encourage users to carry two containers for flushing and to remind men to use the small bucket to flush the toilet pan after urination to remove the smell of urine.

Results of the randomised trial

The population sampled for the intervention and control groups were demographically similar in terms of age, education, gender balance and household size. The toilets sampled for the baseline survey were also broadly similar in both intervention and control compounds.

The presence of buckets or drums used as water reservoirs next to the toilets (difference in difference [DID]: 52%, 95% confidence interval [CI]: 43, 58) and water availability inside toilet cubicles (DID: 4.7%, 95% CI: 0.2, 9.2) increased in the intervention group. In addition, toilets in the intervention group were more likely to have cleaning materials such as brushes or brooms inside the cubicles (DID: 8.4%, 95% CI: 2, 15) and water for flushing adjacent to the facilities (DID: 17%, 95% CI: 11, 23) compared to the control group. The waste bins provided inside the toilet cubicles were still in place in 64% of the shared toilets during the endline survey (DID: 63%, 95% CI: 59, 66).

The intervention group was less likely to have visible faeces inside the toilet pan compared to the control group (DID: -13%, 95% CI: -19, -5). The smell of stool was also less prevalent in the intervention cluster compared to the control cluster (DID: -7.6%, 95% CI: -14, -1.3) as was household waste/waste wrapped by polythene (DID: -4, 95% CI:-7, -1). Respondents' hands, especially the finger pads, were cleaner if they used toilets in the intervention cluster (DID: 17, 95% CI: 10, 24). During the handwashing demonstration, the use of clean cloths for hand drying were more common in the intervention group than the control group (DID: 10, 95% CI: 5, 16).¹

Figure 1: Faecal sludge removers in Dhaka



Discussion

Improving sanitation in Dhaka's low-income communities is intrinsically difficult: residents and landlords typically lack legal ownership and the government does not accept responsibility for the delivery of sanitation infrastructure or other basic services. This project did not address the underlying political economy that can contribute to poor sanitation coverage. Rather, this project assessed what possible steps users of shared sanitation facilities might take in order to improve the quality of those facilities, given the physical, political, social and infrastructural constraints faced by low-income communities in urban Dhaka.

Within these parameters, the intervention enjoyed some significant success. The systematic formative work identified individual-level behaviours that were keeping latrines unclean. The low-cost hardware supported regular latrine maintenance and the behaviour change communication messages supported the facilities' regular use . A rigorous randomised controlled trial demonstrated that the compounds that received the intervention were significantly more likely to have cleaner latrines than their matching control compounds.

The project focused on latrine cleanliness, based on the assumption that people are more likely to use cleaner sanitation facilities and therefore open defecation and further contamination of the environment would be reduced. While this objective of improving the cleanliness of shared sanitation facilities was achieved, the broader impact of the intervention was constrained by the absence of government-level support for waste and faecal sludge disposal. Faecal sludge management is an integral element of a safe sanitation system, as well as a key factor in promoting the continued use of shared facilities. The absence of an effective faecal sludge management system means that toilets will not be emptied when they become full, leading to unclean facilities that communities will be much less likely to use. Individual-level intervention packages should therefore be incorporated into a system that ensures the rigorous management of faecal sludge, from toilet to treatment. Additionally, toilets built by NGOs and others in Dhaka often have designs that do not allow for the easy removal of faecal sludge. Manual removal of faecal sludge remains common.

Not only do low-income communities in Dhaka often suffer from a lack of infrastructure and connection to a faecal sludge management chain, but water supply and general waste collection are irregular at best and often completely non-existent. No consistent water supply means that residents are often unable to flush toilets adequately, and the lack of a regular solid waste collection means that sanitation facilities are often used as makeshift waste bins, causing blockages that are expensive and time-consuming to remove, affecting the facilities' usability. As this study demonstrates, undertaking formative studies that examine local constraints, attitudes and priorities can result in a more effective behaviour change messaging campaign that can achieve meaningful changes in individual-level behaviour, even when there are severe constraints such as water shortages and no faecal sludge management system. However, changing individual behaviour should be matched by improvements in governmental service provision.

Future research could build on this project's findings and explore: **1**) how compound managers and/or landlords can improve sanitation facilities without project-funded hardware; **2**) how different approaches to mass media could reduce the cost of behaviour change communication; **3**) how the effectiveness of specific behaviour change strategies varies by gender; and **4**) further evaluations to assess the sustainability of these efforts to improve toilet cleanliness.

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1 Introduction

Shared toilets in urban slums are often unclean and poorly maintained (Rahman et al 2014). This results in underutilised or abandoned sanitation facilities, which in turn encourages open defecation. Poor hygiene and facility upkeep can lead to negative health and environmental outcomes (Heijnen et al 2014), as poorly maintained sanitation facilities contribute directly to widespread faecal contamination of the environment.

Improving water, sanitation and hygiene (WASH) facilities and WASH-related behaviour in low-income urban areas is difficult. The lack of legal title to land, and the limited political power of slum residents means that providing improved WASH services is a low priority for government authorities (World Bank 2007). Politicians often wish to avoid formalising settlements, as that informality keeps residents in a constant state of dependency on local party associates, allowing local elites to extract a continuous stream of money (Anjaria 2006; Hossain 2011).

Conventional behaviour change messaging for shared toilets often promote the message that sanitary facilities should be kept clean in order to reduce the risk of disease transmission. Such messages are often ineffective. This is partly because they do not address the common barriers to keeping toilets clean that low-income communities often face, such as the lack of commonly-agreed upon guidelines for toilet maintenance among the numerous families sharing a compound, poor landlord-tenant relations, and high renter turnover (Noar 2006). On the other hand, carefully-designed behaviour change messages that address community context and concerns are much more likely to be effective. An iterative approach to developing, pilot testing and evaluating interventions is a promising approach to improving behaviour change interventions within constrained environments.

Shared toilet cleanliness is highly valued by users (Biran et al 2011; Tumwebaze et al 2014; Günther et al 2011) and smelly and dirty conditions of shared toilets are often the main reasons for residents' dissatisfaction with their facilities (Tumwebaze et al 2014). It was assumed that improving toilet cleanliness would result in shared toilets becoming more valued and utilised by residents, and therefore reduce the frequency of open defecation (Mazeau et al 2013; Günther et al 2011).

The research team conducted formative work in order to understand the context of maintaining and cleaning shared toilets in low-income communities in urban Dhaka. The primary focus was shared toilets within compounds, as this would allow access to an easily identifiable community of users who shared common norms about using and maintaining a shared facility. The information generated from this formative work was then used to develop pilot interventions, which were repeatedly tested and revised. In January 2015, a randomised controlled trial began, with 5,986 households in 612 compounds receiving the intervention and 5,627 households in 614 compounds used as controls. The impact of the intervention on a variety of outcomes including toilet cleanliness was then assessed.

The broader objectives of the project were:

1. To develop appropriate behaviour change messaging by conducting stakeholder meetings and background research to determine which key behaviours will influence the quality and cleanliness of shared sanitation facilities; and

2. To evaluate the effectiveness of the intervention in improving the quality and cleanliness of shared toilets available to the low-income residents of Dhaka.

2 Methodology

2.1 Formative work

In January 2014, a stakeholder workshop identified the critical issues surrounding the use of shared toilets. Those interviewed included program staff from local NGOs who had experience implementing sanitation interventions, such as Dushtha Shastha Kendra (DSK), the Population Services and Training Centre (PSTC), WaterAid Bangladesh and Plan Bangladesh. Vacutug and mud pump operators were also interviewed, as well as community members who lived in areas recently visited by a WSUP-supported mud pump emptying service. The field team conducted group discussions in WSUP field sites in order to collect feedback on the common issues affecting waste disposal. The field team also conducted a ranking exercise to identify common inappropriate toilet use behaviour. In order to better understand faecal sludge removal from septic tanks, field workers conducted 10 in-depth interviews and 12 focus group discussions with adult male and female residents, landlords, and NGO-recruited operators.

2.1.1 Pilot development

After identifying the most common inappropriate toilet use activities, the field team conducted further qualitative assessments to understand why the communities thought that these problems were occurring. The team conducted six group discussions separately with male and female participants. Further assessments were undertaken in three different low-income communities, two of which enjoyed fairly steady water availability and one which suffered from frequent water shortages. Community members identified issues with toilet cleanliness and maintenance, and field anthropologists elicited further details on the characteristics, contributing factors and potential solutions for each problem.

2.1.2 Pilot testing

Two neighbourhoods in the Mirpur area of Dhaka were selected as pilot testing sites for the waste disposal and toilet cleanliness aspect of the intervention. These pilots were then followed by two rounds of assessment. After analysing the results of the first piloting round, the messages were revised and then used in a second pilot round in the same compounds. To pilot the provision of waste bins, field researchers organised eight courtyard meetings in two sites, four of which were held with female respondents and four with male respondents. Field researchers implemented the toilet cleanliness pilot in three separate sites, which began with six male-only and six female-only courtyard meetings. The field team ensured that the landlord attended the courtyard meetings.

Field workers followed up these sessions by conducting 10 focus groups with female residents and in-depth interviews with 22 male and 10 female residents, six waste bin emptiers and six landlords. These discussions and interviews assessed the intervention's acceptability and feasibility. After inviting the residents' opinions on the hardware options, the team selected the final hardware for the waste disposal aspect of the intervention. Residents from the two pilot neighbourhoods then gave feedback on the two types of bins provided. Residents also gave feedback on draft signs, including signs indicating appropriate and inappropriate waste disposal behaviours. These signs were then revised for further piloting.

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Figure 2: Focus group with female residents of a Dhaka low-income community



Fieldworkers conducted four in-depth interviews with the caregivers of children who use potties and conducted two key informant interviews with the implementers of other rural and urban projects which provided potties to the community. The team then reviewed findings from both the waste disposal and toilet cleanliness pilot intervention assessments and developed the final package.

2.2 Evaluating the intervention

Twenty-three urban slums in three different areas of Dhaka (Mirpur, Mohammadpur, Mohakhali) were selected for a cluster randomised control trial. Those 23 slums were sub-divided into 38 distinct clusters, the lowest geographical area for randomisation in the study. Large slums were divided into two or more clusters according to a marker such as a road, canal, market or drain. A geographically distinct working area of an existing community health promoter was considered as one cluster. Each distinct slum was considered as a separate cluster.

Researchers defined a toilet as shared if two or more households used at least one cubicle and the toilet drained into a common septic tank or sewerage. Any shared toilet with some kind of pan and squatting area were included in the study. If a two-cubicle toilet had one cubicle used by the landlord alone and the other cubicle was used by more than two tenant households, only the cubicle designated for tenants was considered, and that structure was classified as a one-cubicle shared toilet. Toilets that were not shared (private toilets that were used by only one household), open toilets or open defecation sites, mobile toilets (on a truck or van), and public toilets were excluded from consideration in this study.

A maximum of 40 shared toilets were chosen from each cluster. Large slums with more than 40 shared toilets were subdivided into smaller clusters so that a single community health promoter could manage each cluster. In small clusters of fewer than 40 shared toilets, all shared toilets were included. In large clusters, every other shared toilet was selected. Following this pattern, a maximum of 40 toilets from each cluster was included: 1,226 shared toilets overall.

The baseline survey covered the users of all 1,226 toilets from 15 November 2014 to 25 January 2015 while the endline survey included the users of 1,214 of those toilets from 8 August to 30 September 2015. Trained field staff collected data using a tablet-based questionnaire.

2.2.1 Selection of respondents

The second-nearest household to each shared toilet was approached to be a survey respondent. If multiple households were the same distance from the toilet, the household to the right was selected. Any adult member of that household was eligible to be interviewed for the survey. If the selected respondent did not want to participate another household member could be interviewed instead. The field team also assessed the structure and cleanliness of all the toilets. This involved noting indicators such as the availability of water, distance to water source, and the presence of visible faeces, urine, other liquid, dirt, or solid waste inside or on the way to the toilet.

2.2.2 Intervention delivery

After defining clusters, a statistician from Stanford University, who was not from Bangladesh or a member of the study project, randomly assigned the clusters as either intervention or control. For each intervention cluster, a control cluster was enrolled, matched according to the number of toilet cubicles per cluster: less than 25 cubicles, 26-36 cubicles, 37-50 cubicles, 51-61 cubicles, 62-70 cubicles and more than 70 cubicles per cluster.

Dustha Shastho Kendro (DSK), an NGO with extensive experience implementing water, sanitation and hygiene interventions in Bangladesh, was selected to deliver the intervention. DSK then recruited 50 community health promoters (CHPs) to implement the intervention in the selected communities.

The CHPs disseminated messages on toilet use and cleanliness, focusing on flushing after using the toilet, how and where to dispose waste to prevent toilet blockage, and the importance of children under three years old using a potty. These messages were shared through weekly compound meetings during the first month of the intervention and bi-weekly meetings thereafter. Hardware to support the intervention was also distributed: a plastic waste bin, a four-litre flushing bucket for each cubicle, and a 70-litre plastic water storage bucket for compounds that experienced frequent water shortages (see Figure 3).



Figure 3: A 70-litre plastic reservoir and four-litre flushing bucket

2.3 Data analysis

The field team transcribed the audio-recorded qualitative data from the interviews and focus groups into Bengali. Data collection and coding guides were developed based on the project's research objectives. After coding, the field team translated the coded data into English, which was then manually analysed. Each interview and focus group discussion was assessed separately but this report draws collective lessons from both.

To assess the intervention and control arms' demographic balance, sanitation facilities and available WASH infrastructure, proportions for categorical variables, means for symmetric continuous variables and medians for skewed continuous variables were calculated.

The adjusted difference in difference (DID) was estimated in order to measure the impact of the behaviour change intervention on the quality and cleanliness of shared toilets. The effect of clustering was accounted for by estimating 95% confidence limits and p-values using generalised estimating equation (GEE). The factors which showed a significantly different result (p<0.05) for DID analysis were identified as associated factors for the impact on shared toilet cleanliness.

Figure 4: From project design and formation to implementation



3 Results

3.1 Formative work

The operators who empty faecal sludge reported that the sludge often contained rags, glass bottles, plastic bottles, plastic bags, packets of detergent and shampoo, children's faeces in plastic bags, children's washcloths, pads and pieces of cloth used for menstrual management, condoms, toys, soap cases, broken brushes and construction debris. The operators explained the difficulties that these waste materials cause: sometimes operators have to pull out the solid waste manually before emptying the liquid sludge, otherwise the machine's collection pipe can become clogged. Operators claimed that the community was largely unaware that disposing such items down the toilet caused blockages, and that they did not know that their removal increased both the time taken to empty the sludge and labour costs. Vacutug operators suggested communicating the consequences of inappropriate waste disposal to residents and restricting access to those who fail to change their behaviour.

Respondents reported several forms of inappropriate toilet behaviour. In the ranking exercise, the top three inappropriate toilet practices were: 1) non-use of toilets in favour of open defecation, particularly by young children; 2) inadequate flushing of faecal matter after use; and 3) smoking in the toilets.

Respondents suggested some possible locations for written messages or signs (see Figure 5). The community noted that water shortages were the most important barrier to maintaining toilet cleanliness. Draft messages and signs to address this issue were developed, and a pilot of this initial intervention began in June 2014. An initial behavioural target was to eliminate the practice of disposing of general household waste in toilets. Additional behaviour change messages were added to this evolving intervention throughout the rest of 2014, until all targeted activities (including flushing after toilet use and child potties/disposal of child faeces) were in place.





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Work on other important issues that were less clearly a matter of householdlevel behaviour change (for example, lighting) was undertaken alongside the main intervention. The study applied lessons from a previous icddr,b study (WASH Benefits) - which included a potty promotion aspect - to inform the design of a child potty usage promotion campaign. PLAN Bangladesh's experiences promoting potty use were also helpful. For the waste disposal aspect of the intervention, signs were drafted and then revised according to feedback from informal group discussions among the community (Figure 6). Three focus group discussions helped to identify appropriate waste bins: two types of waste bins were selected for two neighbourhoods.

Figure 6: Sample of behaviour change communication materials for waste disposal



Dispose waste into the waste bucket

Translation: 'Don't dispose of waste in the toilet pit' Translation: 'Dispose of waste in the waste basket' Community members identified that a shortage of water prevented adequate flushing of faecal material after toilet use, which quickly made toilets dirty and unusable. To encourage residents to flush, specific behaviour change materials were developed for communities experiencing severe water shortages. Community residents reported that, if water were available, they could carry two small water containers while going to the toilet. Therefore, communication material with images and text encouraged people to take two containers with them to the shared facilities; one small bucket for pouring water in the toilet pan after completing defecation to flush away the faecal material; and a bodna - a tea pot size plastic container used to clean after defecation (Figure 7). The communication materials also included images of refilling a water storage container for flushing. The hardware provided as part of the intervention included a water reservoir with a small jug for refilling a flushing bucket.

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Figure 7: Sample of behaviour change communication materials promoting taking water to the toilet for cleaning and flushing (translated from Bengali to English)



We will take a bucket of water from reservoir bucket for flushing



🕙 icddr,b

3.1.1 Developing the intervention package

The draft intervention package included both hardware (waste bins) and behaviour change communication (home visits by health promoters, and posters). An additional site with running water beside the toilet was included in the pilot.

Promoting adequate flushing required a series of images. Male and female figures were used in the images for each site (see Figure 8).

Figure 8: Sample of behaviour change communication materials promoting using water to flush the toilet (translated from Bengali to English)





We will clean latrine after defecation by pouring water into the latrine





3.1.2 Piloting hardware and behaviour change activities

For the waste disposal aspect of the intervention, pilot activities were initiated in two separate neighbourhoods of the WSUP programme implementation area: Bauniabad and Kolyanpur. Two models of waste bins were identified, and one bin was tested in each neighbourhood. Four field assistants were recruited and trained to deliver the intervention package. They visited each household twice a week and conducted one-on-one counselling and spot checks to assess the conditions of the new waste bins and the cleanliness of the toilets.

For the toilet cleanliness aspect of the intervention, pilot activities were initiated in three sites. Six male and six female courtyard meetings were conducted across the three areas. Through this process, a four-litre bucket was used as an additional container for flushing where running water was available beside the toilet. For areas experiencing water shortages, the intervention providers included a 70-litre reservoir with a small jug attached to fill the four-litre bucket. A mechanism for refilling the reservoir bucket was developed and the intervention team promoted the 'two container approach': a bodna for the users to clean themselves and a small bucket for flushing.

Figure 9: Piloting the waste disposal aspect of the intervention



A = 12-litre bin for waste disposal, B = signs indicating appropriate waste behaviour

3.1.3 Assessing acceptability and feasibility of hardware & behaviour change strategy

The pilot intervention was well-received and residents noted that they had become accustomed to flushing the toilets and using the bin for waste disposal. According to the waste disposal module's first round of piloting, household members found the bins easy to use and even children were interested in using them. Both male and female respondents reported that items like menstrual rags or condoms should be wrapped before their disposal. The toilet cleanliness module intervention was also well-received after the first round of piloting, and residents successfully developed a way to refill the bucket in areas impacted by water shortages. The landlord played an important role monitoring this activity.

It was discovered that male residents were more reluctant to flush during urination, resulting in bad odours, and that children needed help to flush. Specific behaviour change materials were therefore incorporated into the intervention, encouraging flushing after male urination and parental supervision of flushing following their child's defecation, as well as helping children carry the two containers to the toilets (Figures 10 and 11).

Figure 10: Sample of behaviour change communication materials encouraging men to flush after urination (translated from Bengali to English)



We will urinate on pan and will flush

Figure 11: Sample of behaviour change communication materials encouraging parents to help their children



We will pour water after defecation, I will develop my child's good habit





3.1.4 Further piloting on revised behaviour change strategy

The pilot intervention reduced toilet blockages considerably. The residents were wellmotivated and successfully developed mechanisms for emptying the bins, although maintenance was difficult to enforce in compounds that did not employ a cleaner. The research team targeted landlords to resolve this issue by encouraging tenants to contribute to compound cleanliness. Certain items, such as sanitary napkins and rags, needed to be wrapped before disposal. Both neighbourhoods had limited solid waste disposal options, resulting in unresolved problems such as waste being dumped in the lake or moved somewhere else in the neighbourhood.

The second round of piloting for the toilet use and cleanliness section of the intervention was completed successfully; two types of promoters (icddr,b field research assistants and NGO Forum community volunteers) delivered the intervention messages in the three sites. Three focus group discussions with female residents, six in-depth interviews with male residents and three in-depth interviews with landlords/caretakers served as qualitative assessments of the second pilot round. These assessments demonstrated that male residents were willing to carry containers to the toilet for flushing, and that parents were willing to help their children carry the two flushing containers.

Figure 12: Final behaviour change intervention package for toilet use



3.1.5 Forming the final intervention package

Interviews with key stakeholders from icddr,b and DSK, reviews of previous potty interventions and data collected from potty users were then assessed and findings incorporated in the final intervention package. Parents of children aged from six months to three years of age were encouraged to purchase a locally available, low-cost child's potty, and messages were included to encourage them to clean the potty and dispose of faeces in the toilet.

Figure 13: Final behaviour change intervention package for waste disposal and child potties



3.2 Results of the cluster randomised control trial

The demographic characteristics of the sampled populations in both the intervention and control groups were of similar age, sex, education and household size (Table 1). Most of the respondents from both groups were homemakers.

Table 1: Demographic characteristics of respondent households

Indicators	Baseline		Endline		
	Intervention (N=612)	Control (N=614)	Intervention (N=609)	Control (N=605)	
	n (%)	n (%)	n (%)	n (%)	
Sex of respondent: Female	452 (74)	461 (75)	501 (82)	472 (78)	
Age of respondent (mean, Standard Deviation (SD))	33 (11)	34 (13)	33 (12)	34 (12)	
Education of respondent (mean, SD): No formal education	3.5 (3.6) 256 (42)	3.2 (3.2) 243 (40)	3.7 (3.6) 225 (37)	3 (3.3) 261 (43)	
Household (HH) size (mean, SD)	4.4 (1.8)	4.5 (1.8)	4.4 (1.8)	4.5 (1.7)	
Main occupation of respondent: Housewife Small business Salaried job Day labourer Driver Garment worker Domestic maid/servant Unemployed/disabled	354 (58) 64 (10) 58 (9) 29 (4.7) 50 (8.2) 19 (3.1) 15 (2.5) 19 (3.1)	375 (61) 60 (9.8) 50 (8) 46 (7.5) 26 (4.2) 14 (2.3) 18 (2.9) 21 (3.4)	390 (64) 60 (9.9) 54 (8.9) 31 (5.1) 15 (2.5) 7 (1.2) 30 (4.9) 17 (2.8)	358 (59) 56 (9.3) 54 (8.9) 27 (4.5) 38 (6.3) 16 (2.6) 34 (5.7) 13 (2.2)	
Monthly reported income of household in Taka (mean, SD)	12,040 (6,754)	12,401 (6,523)	14,275 (8,500)	13,846 (8,594)	
Number of children under 5 in HH (mean, SD)	0.43 (0.49)	0.42 (0.49)	0.41 (0.49)	0.40 (0.49)	
Number of differently abled persons in HH (mean, SD)	0.02 (0.13)	0.01 (0.11)	0.01 (0.12)	0.02 (0.14)	
Number of pregnant women in HH (mean, SD)	0.05 (0.22)	0.04 (0.19)	0.05 (0.22)	0.33 (0.18)	

Toilet characteristics were also broadly similar at baseline in intervention and control compounds (Table 2). More than half of the shared toilets in both intervention and control groups were flush or pour flush toilets connected to a canal, ditch or open body of water. Around one fifth of the toilets had a functional water seal before the intervention, a figure that doubled in both the intervention and control groups by the endline survey.

As part of the intervention a water reservoir and waste bin were provided for the intervention group after the baseline survey. The presence of buckets or drums as water reservoirs beside the toilets increased in this group (DID: 52%, 95% CI: 43, 58). Water availability inside toilet cubicles also increased in the intervention group (DID: 4.7%, 95% CI: 0.2, 9.2) (Table 2). In addition, toilets from the intervention group were more likely to have access to cleaning materials such as a brush or broom for cleaning inside the cubicles (DID: 8.4%, 95% CI: 2, 15) and water for flushing adjacent to the toilet facilities (DID: 17%, 95% CI: 11, 23) compared to the control group (Table 2). The waste bins we provided inside the toilet cubicles were still in place for 64% of the shared toilets during the endline survey (DID: 63%, 95% CI: 59, 66) (Table 2).

Table 2: Toilet characteristics, water source and toilet access of the shared toilet users (spot-check)

Indicators	Intervention			Control			DID*
	Baseline (N=612)	Control (N=614)	Difference*	Baseline (N=614)	Endline (N=605)	Difference*	
	n (%)	n (%)	(%) CI	n (%)	n (%)	(%) CI	(%) CI
Type of toilet: Flush or pour flush toilet connected to somewhere else such as canal, ditch, river	339 (55)	354 (58)	2.6 (-2.4, 7.5)	357 (58)	382 (63)	5 (-0.1, 10)	-2.5 (-9.6, 4.6)
Piped sewer system Toilet with septic tank Off-set pit Pit toilet with slab (Non-flush toilet) Pit directly underneath Pit toilet without slab (Non-flush toilet) Hanging toilet (drains directly into pond)	121 (20) 91 (15) 21 (3.4) 21 (3.4) 7 (1.1) 1 (0.2) 11 (1.8)	76 (12) 117 (19) 30 (4.9) 3 (0.5) 16 (2.6) 0 13 (2.1)	-7.4 (-11, -4.1) 4.4 (0.5, 8.3) 1.6 (-0.6, 3.8) -2.9 (-4.4, -1.4) 1.5 (0, 3) -0.2 (-0.5, 0.20) 0.3 (-1.1, 1.9)	94 (15) 77 (13) 30 (4.9) 25 (4.1) 14 (2.3) 3 (0.5) 14 (2.3)	41 (6.8) 114 (19) 27 (4.5) 1 (0.2) 15 (2.5) 1 (0.2) 24 (3.8)	-8.8 (-12, -5.8) 6.4 (2.5, 10) -0.5 (-2.7, 1.8) -3.9 (-5.5, -2.4) 0.2 (-1.5, 1.9) -0.3 (-0.9, 0.3) 1.7 (-0.1, 3.6)	1.4 (-3.1, 5.8) -2 (7.5, 3.5) 2 (-1.1, 5.2) 1 (-1.2, 3.2) 1.3 (-0.9, 3.5) 0.2 (-0.6, 0.9) -1.4 (-3.8, 1)
Toilet with functional water seal	115 (19)	249 (41)	22 (18,26)	108 (18)	255 (42)	25 (20, 29)	-2.7 (-9, 3.6)
Faeces coming out from the septic tank, pit or connected line	27 (4.4)	26 (4.3)	-0.1 (-2.4, 2.1)	25 (4.1)	12 (1.9)	-2.1 (-3.9, -0.2)	1.9 (-1, 4.9)
Water source: Common tap/hand pump inside compound Municipal supply for toilet use Shallow/deep tube well Municipal water stored in reservoir Supplied by water bearer	456 (76) 0 31 (5.1) 102 (17) 11 (1.8)	294 (48) 62 (10) 37 (6.1) 215 (35) 1 (0.16)	-27 (-32, 22) 10 (7.8, 12) 1 (-1.5, 3.5) 18 (14, 22) -1.7 (-2.7, -0.6)	518 (86) 0 17 (2.8) 58 (10) 9 (1.5)	334 (55) 31 (5) 48 (7.9) 189 (31) 1 (0.17)	-31 (-35, 26) 5.1 (3.4, 6.9) 5.1 (2.7, 7.5) 22 (17, 26) -1.3 (-2.4, -0.3)	3.5 (-3.1, 10) 5 (2.1, 7.8) -4.1 (-7.5, -0.6) -3.6 (-9.3, 2.2) -0.3 (-1.8, 1.2)
Types of reservoir: Reservoir/tank beside toilet Concrete reservoir underground with hand pump Kept bucket/drum beside toilet Tank on the roof No arrangement	294 (48) 53 (8.7) 8 (1.3) 6 (0.9) 244 (40)	155 (26) 5 (0.8) 377 (62) 5 (0.8) 259 (43)	-22 (-27, -17) -7.8 (-10, -5.6) 60 (53, 66) -0.2 (-1.2, 0.9) 2.6 (-2.6, 7.8)	216 (35) 59 (9.6) 125 (20) 2 (0.3) 313 (51)	103 (17) 10 (1.7) 182 (30) 2 (0.3) 103 (17)	-18 (-22, -14) -7.9 (-10, -5.6) 9 (5, 16) 0 (-0.6, 0.6) -34 (-39, -29)	-4.5 (-11, 2.1) 0.1 (-3.2, 3.3) 52 (43, 58) -0.2 (-1.4, 1.1) -37 (30, 44)
Water source inside toilet cubicle: Only bodna Drum/bucket Water tap Nothing kept for storing water	N=907 525 (58) 45 (4.9) 40 (4.4) 297 (33)	N=912 603 (66) 121 (13) 37 (4.1) 151 (17)	8.2 (3.9, 12) 8.3 (5.8, 11) -0.4 (-2.2, 1.4) -16 (-20, -13)	N=876 555 (63) 28 (3.2) 36 (4.1) 257 (29)	N=883 586 (66) 47 (5.3) 41 (4.6) 209 (24)	3.2 (-1.2, 7.6) 2.3 (0.5, 4.2) 0.6 (-1.2, 2.5) -6.3 (-10, -2.4)	4.9 (-1.1, 11) 6 (2.9, 9.2) -1 (-3.6, 1.6) -9.9 (-15, -4.6)
Water available inside toilet cubicle	122/907 (13)	199/912 (22)	8.4 (4.9, 12)	91/876 (10)	120/883 (14)	3.7 (0.8, 6.6)	4.7 (0.2, 9.2)
Number of functional ² toilet cubicles (median, IQR)	1 (1, 2)	1 (1, 2)	-	1 (1, 2)	1 (1, 2)	-	-
Number of user household per toilet (mean, SD)	9.8 (9.6)	9.9 (11)	0.1 (-0.9, 1.2)	9.2 (7.8)	9.3 (9.7)	0.06 (-0.9, 1)	0.06 (-1, 11)
Number of user per toilet (mean, SD)	40 (43)	39 (50)	-1.3 (-6, 3.5)	35 (34)	35 (34)	-0.15 (-3.7, 3.4)	-1.2 (-7, 4.9)
Number of user per toilet cubicle (mean, SD)	26 (20)	22 (17)	-3.4 (-5.5, -1.4)	24 (16)	23 (14)	-1.2 (-2.8, 0.5)	-2.3 (-4.9, 0.3)
Toilet can be accessed 24 hours a day	612 (100)	608 (99.8)	-0.2 (-0.5, 0.2)	613 (99.8)	605 (100)	0.2 (-0.2, 0.5)	-0.3 (-0.8, 0.1)
Toilet has a peak time when users experience a long queue	256 (42)	308 (51)	8.7 (3.4, 14)	316 (51)	338 (56)	4.3 (-1.2, 9.8)	4.4 (-3.2, 12)
Peak times of the toilet having long queues: 5.01am to 8.00am	256 (42)	305 (50)	8.2 (2.9, 14)	315 (51)	336 (56)	4.1 (-1.3, 9.6)	4.1 (-3.5, 12)

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*Cluster adjusted difference shown and text in bold if the p-value was less than 0.05.

The intervention group was less likely to have a toilet with visible faeces inside the pan compared to the control group (DID: -13%, 95% CI: -19, -5). The smell of stool was also less common in the shared toilets from the intervention group compared to the control group (DID: -7.6%, 95% CI: -14, -1.3) as was household waste or waste wrapped by polythene (DID: -4, 95% CI: -7, -1) (Table 3). Notably, all of these parameters also decreased in control group from baseline to endline (inside pan- Dif: -9, 95% CI: -11, -7; smell of stool- Dif: -15, 95% CI: -20, -11; household waste/waste wrapped by polythene-Dif: -2, 95% CI: -4, -0.2), though the difference in difference analysis clarifies that the changes in the intervention group were larger.

able 3: Shared toilet	cubicle cleanliness	in urban slums in Dhaka	(spot-check)
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Indicators	Intervention	1		Control		DID*	
	Baseline	Endline	Difference*	Baseline	Endline	Difference*	
	(N=907)	(N=912)		(N=876)	(N=883)		
	n (%)	n (%)	(%) Cl	n (%)	n (%)	(%) CI	(%) CI
Visible faeces: Inside pan Outside pan On path leading up to the toilet Inside hole of the pan	281 (32) 68 (7.5) 34 (5.6) 433 (48)	83 (9.1) 21 (2.3) 32 (5.3) 297 (33)	-22 (-28, -17) -5.2 (-7.2, -3.3) -0.3 (-2.8, 2.3) -15 (-20, -11)	212 (23) 64 (7.3) 47 (7.7) 399 (46)	124 (14) 31 (3.5) 35 (5.8) 351 (40)	-9 (-11, -7) -3.9 (-5.9, -1.8) -1.9 (-4.5, 0.7) -6.7 (-11, -2.3)	-13 (-19, -5) -1.4 (-4.3, 1.9) 1.6 (-2.1, 5.2) -8.5 (-15, -2.3)
Functional ³ toilet cubicle	N=919 906 (99)	N=892 877 (98)	-1.2 (-0.6, 2.5)	N=935 916 (98)	N=909 877 (96)	-1.9 (-2.3, 4.6)	0.5 (-3.5, 1.8)
Visible inside the toilet cubicle: Spit, cough on walls/doors Cigarette butts Water logged Household waste/waste wrapped by polythene Rags/sanitary pad	199 (22) 95 (10) 90 (10) 91 (10) 43 (4.7)	153 (17) 50 (5.8) 35 (3.8) 36 (3.9) 12 (1.4)	-5.2 (-8.7, -1.8) -5 (-7.1, -2.6) -6 (-8, -4) -6 (-8, -4) -3.4 (-4.9, -1.9)	257 (29) 112 (13) 77 (8.8) 43 (4.9) 47 (5.6)	187 (21) 73 (8.7) 41 (4.7) 26 (2.9) 23 (2.6)	-7.9 (-12, -4.1) -4.5 (-7.4, -1.7) -4 (-6, -2) -2 (-4, -0.2) -2.8 (-4.5, -1)	2.8 (-2.5, 7.9) -0.5 (-4.1, 3.2) -2 (-5, 1) -4 (-7, -1) -0.6 (-2.9, 1.7)
Smell of: Stool Urine Cigarette	521 (57) 463 (51) 83 (9.2)	319 (35) 264 (29) 54 (5.9)	-23 (-27, -18) -22 (-26, -18) -3 (-5.6, -0.9)	504 (58) 516 (59) 111 (13)	382 (44) 333 (38) 65 (7.4)	-15 (-20, -11) -22 (-26, 18) -5.5 (-8.2, -2.7)	-7.6 (-14, -1.3) -0.01 (-0.6, 0.5) 2.2 (-1.3, 5.8)
Visible cracks on the pan	125 (14)	86 (9.4)	-4.4 (-7.3, -1.4)	84 (9.6)	80 (9.6)	-0.5 (-3.2, 2.2)	-3.8 (-7.8, 0.1)
Waste bin inside the toilet cubicle	6 (0.7)	590 (65)	64 (61, 67)	3 (0.3)	13 (1.5)	1.1 (0.2, 2)	63 (59, 66)

*Cluster adjusted difference shown and text in bold if the p-value was less than 0.05.

³Usable on the day of survey

Respondents from both the intervention and control groups reported that toilet maintenance and repair was mainly the landlords' responsibility and ensuring cleanliness was the tenants' responsibility (Table 4). Respondents from the intervention group were more likely to rotate the responsibility of emptying and cleaning the waste bin among tenants compared to the control group (DID: 59%, 95% CI: 55, 63).⁴ They also reported that the waste bin was last emptied one to three days previously (DID: 39%, 95% CI: 35, 43) and was emptied at least two or three times per week (DID: 25%, 95% CI: 22, 29) (Table 5).

⁴ See supplementary Table 4 of the final study report which is available for download from the research page of the WSUP website.

Table 4: Shared toilet construction, management and cleaning behaviours among urban slum residents in Dhaka (reported)

Indicators	Intervention		Control	DID*			
	Baseline (N=612)	Endline (N=609)	Difference*	Baseline (N=614)	Endline (N=605)	Difference*	
	n (%)	n (%)	(%) CI	n (%)	n (%)	(%) CI	(%) CI
Person/organisation responsible for construction of the toilet: Landlord or compound manager NGO or other outside group Respondent's household contributed Neighbours or other compound residents Community based organisation or other community group	404 (66) 118 (19) 100 (16) 11 (1.8) 4 (0.7)	499 (82) 93 (15) 23 (3.8) 11 (1.8) 34 (5.6)	16 (11, 20) -3.8 (-7.8, 0.1) -13 (-16, -9) 0 4.9 (3, 6.7)	393 (64) 101 (16) 149 (24) 19 (3.1) 0	496 (82) 89 (15) 27 (4.5) 6 (0.9) 7 (1.2)	18 (13, 23) -1.6 (-5.5, 2.3) -20 (-24, -16) -2 (-4, -0.5) 1 (0.3, 1.9)	-2.3 (-8.8, 4) -2.2 (-7.8, 3.3) 7 (2, 12) 2 (-0.01, 4) 3.8 (1.8, 5.8)
Responsible for ensuring regular cleanliness of toilet: Residents rotate responsibility Landlord or compound manager pays a caretaker Residents pay a caretaker No regular cleaning	473 (77) 80 (13) 30 (4.9) 35 (6)	524 (86) 75 (12) 34 (5.6) 8 (1.3)	8.8 (4.7, 13) -0.8 (-4.4, 2.8) 0.6 (-1.8, 3.1) -4.4 (-6.4, -2.4)	497 (81) 44 (7) 16 (2.6) 59 (10)	515 (85) 56 (9.3) 15 (2.5) 17 (2.8)	4.2 (0.1, 8.3) 2.1 (-0.9, 5) -0.1 (-1.9, 1.6) -6.8 (-9.4, -4.2)	4.6 (-1.2, 10) -2.9 (-7.6, 1.7) 0.8 (-2.2, 3.8) 2.4 (-0.9, 5.7)
Responsible for ensuring functionality and repair of toilet: Landlord or compound manager manages cost Residents manage cost Maintenance committee collects funds	549 (90) 54 (9) 13 (2.1)	578 (95) 30 (4.9) 18 (2.9)	5.2 (2.3, 8.1) - 3.9 (-6.7, -1.2) 0.8 (-0.9, 2.5)	556 (91) 55 (9) 8 (1.3)	571 (94) 34 (5.6) 1 (0.2)	3.8 (0.9, 6.7) -3.3 (-6.2, -0.5) -1 (-2, -0.1)	1.4 (-2.7, 5.5) -0.6 (-4.5, 3.4) 1.9 (-0.01, 3.8)
Responsible for managing upgrades/ improvements to the toilet structure: Landlord or compound manager manages cost Residents manage cost Maintenance committee collects funds	552 (90) 46 (8) 16 (2.6)	590 (97) 19 (3.1) 17 (2.8)	6.7 (4, 9) - 4.4 (-6.8, -1.9) 0.2 (-1.5, 1.9)	566 (92) 45 (7) 11 (1.8)	588 (97) 16 (2.6) 1 (0.2)	4.9 (2.5, 7.5) -4.7 (-7, -2.3) -1.5 (-2.6, -0.5)	1.7 (-1.9, 5.4) 0.3 (-3, 4) 1.7 (-0.3, 3.7)
Responsible for ensuring regular emptying of faecal sludge: Landlord or compound manager manages cost Residents manage cost Maintenance committee collects funds	121 (20) 11 (1.8) 10 (1.6)	131 (22) 4 (0.7) 1 (0.2)	1.9 (-2.4, 6.2) -1.1 (-2.3, 0.01) -1.5 (-2.5, -0.4)	119 (19) 10 (1.6) 7 (1.1)	142 (23) 4 (0.7) 0	4.1 (-0.2, 8.5) -1 (-2.2, 0.2) 1.1 (-1.9, -0.3)	2.2 (-8.3, 3.9) -0.2 (-1.9, 1.5) -0.4 (-1.7, 0.9)
Method of emptying of faecal sludge: Hired manual sweeper Hired Vacu-tug or mud pump Not yet required	N=145 35 (24) 6 (4.14) 72 (50)	N=170 38 (22) 6 (3.53) 103 (61)	-0.8 (-9.9, 8.1) -0.5 (-4.6, 3.7) 10 (-0.2, 21)	N=133 24 (18) 14 (11) 61 (46)	N=153 26 (17) 13 (8.50) 90 (59)	-1.6 (-10, 7) 0.2 (-5.3, 5.7) 8.2 (-3.3, 20)	0.7 (-12, 13) -0.5 (-7.5, 6.5) 2.3 (-13, 18)
Septic tank last emptied: Within three months Within six months Within one to two year	N=45 22 (49) 13 (29) 9 (19)	N=50 16 (32) 5 (10) 23 (22)	-17 (-36, 2.5) -19 (-34, -4.1) 26 (8.5, 43)	N=39 19 (49) 5 (13) 14 (32)	N=49 18 (37) 6 (12) 11 (22)	-12 (32, 9) 1 (-3, 5) -9.3 (-27, 8.2)	-4.9 (-33, 24) -20 (-41, 0.01) 34 (9.7, 60)

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NA

Place of faecal sludge disposal: Dumped in a lake/pond/canal/river/ stream Disposed outside of this compound Dumped in a ditch or roadside near the compound Dumped within the compound	N=45 24 (51) 5 (11) 4 (8.9) 2 (4.4)	N=50 23 (45) 3 (6) 6 (12) 1 (2)	-7 (-26, 11) -4.7 (16, 6) 4.4 (-7.8, 17) -0.3 (-8, 7.5)	N=39 9 (21) 8 (21) 5 (13) 2 (5.13)	N=49 13 (26) 2 (4.1) 2 (4.1) 1 (2.1)	-3.2 (-13, 20) -8.6 (-20, 2.3) -7.5 (-18, 2.5) -1.9 (-8.9, 5)	-9.7 (-35, 15) 5.2 (-10, 21) 12 (-4.2, 29) 2 (-8.5, 13)
Toilet last cleaned with cleaning materials: 1-3 days ago 4-6 days ago More than 1 week ago Today	280 (46) 159 (26) 92 (15) 53 (8.7)	352 (58) 140 (23) 44 (7.2) 52 (8.5)	12 (6.5, 17) -2.9 (-7.6, 1.8) -7.8 (-11, -4.3) -0.1 (-3.3, 2.9)	282 (46) 143 (23) 79 (13) 62 (10)	343 (57) 139 (23) 68 (11) 37 (6.1)	11 (5.3, 16) -0.3 (-4.9, 4.4) -1.6 (-5.3, 1.9) -4 (-7, -0.9)	1.2 (-6.5, 8.9) -2.6 (-9.3, 4) -6.1 (-11, -1.1) 3.8 (-0.5, 8.2)
Frequency of toilet cleaning with cleaning materials: Once per week At least 2-3 times per week Less than once per week Daily	277 (45) 134 (22) 97 (16) 81 (13)	266 (44) 217 (36) 33 (5.4) 79 (13)	-1.6 (-7, 3.9) 14 (9, 19) -10 (-14, -7) -0.3 (-4, 3.4)	294 (48) 144 (23) 80 (13) 55 (8.9)	310 (51) 168 (28) 57 (9.4) 61 (10)	3.3 (-2.1, 8.8) 4.3 (-0.5, 9.1) -3.6 (-7, -0.1) 1.1 (-2.1, 4.4)	-4.9 (-13, 2.9) 9.4 (2.5, 16) -6.8 (12, -1.9) 1.5 (-6.4, 3.5)
Access of cleaning materials available for the toilet: Must bring from home Stored adjacent to toilet facility Inside the toilet chamber Unavailable	322 (74) 57 (13) 37 (9) 20 (5)	139 (23) 287 (47) 168 (28) 15 (2.5)	-51 (-56, -46) 33 (28, 39) 19 (15, 24) -2.1 (-4.3, 0.01)	322 (72) 56 (12) 51 (11) 21 (5)	173 (29) 278 (46) 129 (21) 25 (4.1)	-44 (-49, -39) 34 (28, 38) 11 (6.6, 15) -0.6 (-3, 1.8)	-6.8 (-14, 0.5) -0.01 (-7, 7) 8.4 (2, 15) -1.5 (-4.8, 1.8)
Access of water for cleaning the toilet with cleaning material: Adjacent to toilet facility Must carry from home Inside the toilet chamber Dug well Must carry from distant community tap	377 (62) 44 (7.2) 29 (4.7) 10 (1.6) 5 (0.8)	459 (75) 9 (1.5) 44 (7.2) 19 (3.1) 12 (1.9)	14 (8.7, 19) -5.7 (-7.9, -3.6) 2.5 (-0.1, 5) 1.5 (-0.1, 3.1) 1.1 (-0.1, 2.4)	408 (66) 25 (4.07) 31 (5.05) 7 (1.1) 5 (0.8)	412 (68) 23 (3.8) 40 (6.6) 21 (3.5) 12 (1.9)	1.6 (-3.5, 6.8) -0.2 (-2.4, 1.9) 1.8 (-0.7, 4.3) 2.3 (0.6, 3.9) 1.2 (-0.1, 2.5)	12 (4.9, 19) -5.5 (-8.6, -2.4) 0.7 (-2.8, 4.1) -0.8 (-3.2, 1.5) -0.01 (-1.9, 1.8)
Access of water for flushing the toilet after use: Adjacent to toilet facility I don't flush Inside the toilet chamber Must carry from home	461 (75) 70 (11) 35 (5.7) 51 (8.3)	532 (87) 20 (3.3) 53 (8.7) 7 (1.2)	12 (8, 16) -8 (-10, -6) 2.9 (0.1, 5.8) -7.2 (-9, -5)	479 (78) 87 (14) 33 (5.4) 25 (4.1)	439 (73) 82 (14) 39 (6.5) 20 (3.3)	-5.5 (-10, -1) -0.7 (-4.2, 2.8) 1.3 (-1.3, 3.8) -0.7 (-2.8, 1.4)	17 (11, 23) -7.4 (-12, -3.2) 1.7 (-2.1, 5.5) -6.5 (-9.6, -3.4)

*Cluster adjusted difference shown and text in bold if the p-value was less than 0.05.

Table 5: Waste disposal practice of shared toilet users in urban slums in Dhaka (reported)

Indicators	Interventio	on		Control		DID*	
	Baseline	Endline	Difference*	Baseline	Endline	Difference*	
	(N=612)	(N=609)		(N=614)	(N=605)		
	n (%)	n (%)	(%) CI	n (%)	n (%)	(%) CI	(%) CI
Items of solid waste usually disposed in the pit of the toilet:							
Rags used for menstrual management	2 (0.3)	0	-0.3 (-0.8, 0.1)	0	6 (0.9)	0.9 (0.2, 1.8)	-1.3 (-2.2, -0.4)
Paper	6 (0.9)	0	-1 (-1.7, -0.2)	1(0.2)	4(0./)	0.5 (-0.2, 1.2)	-1.5 (-2.5, -0.4)
Plastic bags	0	0	0	0	2(0.3)	0.3 (-0.1, 0.8)	
Conderna	0	0	0	0	2(0.3)	0.3(-0.1, 0.8)	
Nothing is dispessed in the tailet		28 (6 2)	0	0	2(0.3)	0.3(-0.1, 0.8)	-0.3(-0.8, 0.1)
	0	30 (0.2)	0.2 (4.3, 0.1)	0	1(0.2)	0.2 (-0.2, 0.5)	0.1 (4.1, 0)
Responsible for emptying waste bin or contributes to the cost of removal service:							
Residents rotate responsibility	7 (1.2)	3/4 (61)	60 (56, 640)	2 (0.3)	12 (1.9)	1.7 (0.5, 2.8)	59 (55, 63)
Residents pay a caretaker	0	40 (6.6)	6.5 (4.6, 8.4)	0	0	0	6.5 (4.6, 8.4)
Landlord or compound manager pays a	0	44 (7.2)	7.2 (5.2, 9.2)	1(0.2)	0	-0.2 (-0.5, 0.2)	7.4 (5.3, 9.4)
Waste bin last emptied:							
1-3 days ago	2(0.3)	244 (40)	40 (36, 44)	1(0.2)	6 (0.9)	0.8 (-0.01, 1.7)	39 (35, 43)
4-6 days ago	1(0.2)	103 (17)	17 (14, 20)	1(0.2)	2(0.3)	0.2 (-0.4, 0.7)	17 (14, 20)
loday	1(0.2)	55 (9.1)	8.9 (6.6, 11)	0	3 (0.5)	0.5 (-0.01, 1)	8.4 (6, 11)
More than I week ago	4(0.7)	44 (7.2)	0.0 (4.5, 8.7)	0	0	0	0.0 (4.5, 8.7)
Frequency of waste bin being emptied:	2 (0 2)	1(1(2())	26 (22, 20)		4 (0 ()	07(00110)	25 (22, 20)
At least 2-3 times per week	2(0.3)	101 (20)	20 (23, 30)	1(0.2)	4(0.6)		25 (22, 29)
When the backet (bin full	3 (0.5)	143 (23)	23 (20, 20)	1(0.2)	4 (0.6)	0.5(-0.2, 1.2)	23 (19, 20)
	2(0.3)	00 (14)	14 (11, 17)	1(0.2)	2(0.3)	0.2(-0.4, 0.7)	14 (11, 10) 5 6 (2 6 7 5)
Loss than once per week	1(0.2)	22 (3.6)	35(10/0)	0	2 (0.5)	0.3 (-0.1, 0.8)	3.6 (3.0, 7.3)
	1(0.2)	22 (3.0)	3.3 (1.7, 4.7)	0	0	0	5.5 (1.7, 4.7)
bin waste usually disposed:	1(0.2)	175 (20)	20 (25 22)		E (0 0)	0.9 (0.1.1.5)	29 (24 21)
in municipal bin	1(0.2)	1/5 (29)	27 (23, 32)	1(0.2)	3 (0.8) 2 (0.5)		20 (24, 31)
III a lake or waterway	4(0.7)	02 (12)	12 (10, 25)	0	3(0.5)	0.3(-0.3, 0.9)	12 (19, 25)
Moved away from the community for	2 (0.3)	20 (5)	13(10,10)	1(0.2)	4 (0.6)		13(10,15)
further dumning		29 (3)	4.7 (3.1, 0.4)	1(0.2)	0	-0.2 (-0.5, 0.2)	4.7 (3.2, 0.0)

*Cluster adjusted difference shown and text in bold if the p-value was less than 0.05.

In addition to hardware, cleaning and maintenance of the toilets, hand cleanliness in each group was also assessed. Respondents' hands, especially the finger pads, were cleaner in the intervention group (DID: 17, 95% CI: 10, 24). During the handwashing demonstration, the use of clean cloths for hand drying was more common in intervention groups than control groups (DID: 10, 95% CI: 5, 16) (Table 6).

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Table 6: Access to handwashing facilities & hand cleanliness of urban slum residents in Dhaka

Indicators	Intervention		Control	DID*			
	Baseline	Endline	Difference*	Baseline	Endline	Difference*	
	(N=612)	(N=609)		(N=614)	(N=605)		
	n (%)	n (%)	(%) CI	n (%)	n (%)	(%) CI	(%) CI
Location of handwashing facilities							
used after defecation:	100 (00)	E22 (00)	70 (4 12)	400 (70)	E22 (96)	9 2 (4 2 12)	02(5952)
facility	400 (00)	555 (66)	7.9 (4,12)	400 (78)	525 (60)	0.2 (4.3, 12)	-0.3 (-5.6, 5.3)
Near (within 30 feet) of kitchen/	80 (13)	44 (7.2)	-5.9 (-9, -2.9)	89 (15)	51 (8.4)	-6.2 (-9.4, -2.9)	0.2 (-4.3, 4.7)
cooking place	21 (5 1)		10(10)	22 (12)	10 (21)	17(20.05)	
Inside toilet facility	31 (5.1)	20 (3.3)	-1.8 (-4, 0.4)	30 (4.9)	9(15)	-1.7 (-3.8, 0.5)	-0.1 (-3.2, 2.9)
Water available in handwashing	582 (95)	584 (96)	0.8 (-15, 31)	561 (91)	561 (93)	14(-16,44)	-0.6 (-1.1.3.2)
place after defecation	502 (757	504 (707	0.0 (1.3, 3.1)	501(51)	501(55)	1.4 (1.0, 4.4)	0.0 (4.4, 5.2)
Presence of handwashing agent in							
handwashing place after defecation:							
Soap	220 (36)	233 (38)	2.3 (-2.9, 7.6)	237 (39)	211 (35)	-3.7 (-9, 1.5)	6 (-1.4, 14)
Able to access bandwashing agent	34 (0)	29 (4.0)	24 (3.9)	24 (3.9)	34 (5.0)	1.7 (-0.0, 4.1)	-2.5 (-5.9, 0.9)
within one minute in handwashing							
place:							
Soap	372 (61)	390 (64)	3.3 (-1.9, 8.4)	341 (56)	395 (65)	9.7 (4.3, 15)	-6.4 (-14, 1)
Detergent	119 (19)	104 (17)	-2.5 (-6.4, 1.3)	68 (11)	93 (15)	4.2 (0.5, 7.9)	-6.8 (-12, -1.4)
Hand cleanliness status during							
Fingernails:							
Člean	446 (73)	480 (80)	6.2 (1.7, 11)	477 (78)	498 (82)	4.7 (0.3, 9)	1.5 (-4.8, 7.8)
Unclean appearance	122 (20)	87 (14)	-5.4 (-9.5, -1.3)	82 (13)	80 (13)	-0.2 (-3.9, 3.5)	-5.2 (-11, 0.4)
Visible dirt Palms:	42(7)	36 (5.9)	-0.9 (-3.6, 1.8)	53 (9)	25 (4.1)	-4.5 (-7.2, -1.8)	3.6 (-0.2, 7.5)
Clean	493 (81)	487 (80)	-0.2 (-4.4, 4.1)	535 (87)	491 (81)	-5.6 (-9.6, -1.7)	5.4 (-0.4, 11)
Unclean appearance	90 (15)	95 (16)	1 (-2.9, 5)	54 (9)	88 (15)	5.7 (2.2, 9.2)	-4.6 (-9.9, 0.6)
Visible dirt Finger pade:	27 (4.4)	21 (3.5)	-0.9 (-3.1, 1.2)	23 (3.8)	24 (3.9)	-0.1 (-2.2, 2)	-0.8 (-3.8, 2.2)
Clean	320 (52)	402 (66)	14 (9, 19)	391 (64)	366 (61)	-2.8 (-8, 2.4)	17 (10, 24)
Unclean appearance	154 (25)	92 (15)	-10 (-14, -5.7)	73 (12)	80 (13)	1.4 (-2.2, 5.1)	-11 (-17, -5.8)
Visible dirt	135 (22)	109 (18)	-3.9 (-8, 0.3)	148 (24)	157 (26)	1.4 (-3.3, 6.1)	-5.4 (-12, 1)
Handwashing demonstration after							
Used soap and water, washed both	221 (36)	307 (50)	14 (9, 20)	222 (36)	286 (47)	11 (6, 16)	3.3 (-4, 11)
hands							
Used soap and water, washed one	100 (16)	89 (15)	-1.8 (-5.7, 2.2)	66 (11)	54 (8.9)	-1.8 (-5, 1.5)	0.01 (-5, 5)
hand only Used only water and washed both	32 (5)	31 (5 1)	-02(-2623)	54 (9)	57 (94)	06(-2637)	-07(-4733)
hands	52 (5)	51 (5.1)	0.2 (2.0, 2.3)	54())	57 ().47	0.0 (2.0, 3.7)	0.7 (4.7, 5.5)
Used only water and washed one	29 (4.7)	8 (1.3)	-3.4 (-5, -1.5)	29 (4.7)	8 (1.3)	-3.4 (-5, -1.5)	0
hand Observation was not possible (220 (20)	174 (20)	-9.0(-14 -4)	242 (40)	200 (22)	-6 (-11 -1 4)	26(06 42)
refused	230 (36)	1/4 (29)	-0.7 (-14, -4)	243 (40)	200 (33)	-0 (-11, -1.4)	-2.0 (-9.0, 4.3)
Duration of hand rubbing during	12 (13)	12 (13)	0.3 (-1, 1.8)	11 (14)	11 (15)	0.01 (-1.5, 1.5)	0.3 (-1.7, 2.4)
handwashing with soap (mean, SD)							
Process of hand drying after							
handwashing:	251 (41)	220 (22)	10(725)	210 (27)	26464		00/17 0 0
Used clean cloth	251 (41) 55 (9)	238 (39)	-1.9 (-7, 3.5) 11 (7.4, 15)	218 (36) 86 (14)	264 (44)	0.8 (-3, 4 6)	-9.9 (-17, -2.4) 10 (5, 16)
Didn't dry	37 (6)	54 (8.87)	2.8 (-0.1, 5.7)	48 (8)	35 (5.79)	-2 (-5, 0.8)	4.8 (0.8, 8.8)
Used dirty cloth	25 (4.1)	16 (2.6)	-1.5 (-3.5, 0.5)	12 (1.9)	13 (2.5)	0.2 (-1.4, 1.8)	-1.7 (-4.2, 0.9)

*Cluster adjusted difference shown and text in bold if the p-value was less than 0.05.

3.3 Limitations identified by community hygiene promoters

The community hygiene promoters (CHPs) faced some major barriers during the intervention's implementation. At the beginning of the implementation, the informal nature of slum households was a significant impediment as the CHPs could not find some of the targeted households. The temporary nature of slum toilets was a barrier to accurately identifying the toilet that had been assessed during the baseline survey. These two problems were overcome with support from the baseline team. Absenteeism was a recurring concern throughout the implementation. As many slum-dwelling women work in garment factories, they remained busy throughout the day so the CHPs could not reach them during compound meetings or for household visits. After consulting with their supervisor, CHPs decided to visit the households of female garment workers over the weekend.

Larger compounds of 30 to 60+ households were another barrier to optimal implementation. With so many households and residents, the toilet quickly became dirty with frequent usage. Cooperation and overall implementation remained more difficult in these larger compounds.

Waste disposal became a critical issue in many compounds. The waste disposed of in the bins was thought to be extra waste by waste collectors, who requested additional payment, but residents did not want to pay that extra fee. In some compounds waste collectors refused to remove this waste. Consequently, that waste stayed inside the structure and caused a bad smell. As a result, residents did not use the facilities and the CHPs had to wait until the problem was resolved, usually after the landlord intervened.

4 Discussion

Improving sanitation conditions in Dhaka's urban slums is a complex undertaking. Slum dwellers and landlords typically lack legal ownership, with the result that the government does not accept responsibility for delivering sanitation infrastructure or other basic services. The government is not motivated to regularise the settlements because political elites profit by taking financial kickbacks from local power-brokers (mastans) who, in turn, profit from arranging expensive substandard services (Banks et al 2011; Hossain 2012). In addition, residents of low-income urban communities who share a housing compound and a sanitary facility are usually not related to each other. Indeed, with high levels of migration in and out of slums, they are often strangers. There is therefore less social capital in urban slums than in rural communities to support cooperative problem-solving.

This project did not address the underlying political economy dynamics which contribute to poor sanitary infrastructure. Rather, this project asked:

Given the physical, political, social and infrastructure constraints of low income communities in urban Dhaka, what steps might be taken among users of shared sanitation facilities to improve their quality?

Within these constraints, the intervention was quite successful. The systematic formative work identified individual-level behaviours that were keeping latrines unclean. Low-cost hardware designed to support cleaner latrines was piloted and the team developed behaviour change communication messages to support regular use of shared facilities. A rigorous randomised controlled trial demonstrated that compounds that received this intervention were still actively using it at the endline evaluation. Most still had a waste bin in place and they were more likely to have water available to flush

the toilet pan. Intervention compounds were significantly more likely to have cleaner toilets, with a lower prevalence of visible faeces in the toilet pan and smell of faeces within the toilet.

Most of the studies evaluating interventions to improve water and sanitation use a before and after study design (Sheth et al 2004; Elsanousi et al 2009; Kolesar et al 2004; Moll et al 2007). Our data demonstrates that in these dynamic urban communities there was considerable improvement in the non-intervention control group in the prevalence of toilets with a functional water seal (18% at baseline increasing to 42% at endline) and toilet cleanliness (23% with faeces visible in the pan at baseline compared with 14% at endline). This illustrates that these before and after evaluations are at high risk of overestimating the impact of interventions. This rigorous randomised controlled trial was able to account for the secular trend towards improvements in the non-intervention group and still demonstrate a greater improvement with the behaviour change intervention.

This project focused on toilet cleanliness because of the underlying assumption that people would be more likely to use a clean toilet and so reduce the risk of open defecation and environmental faecal contamination. The research team were able to achieve this objective, but the broader impact of the intervention was constrained by the absence of government-level systems for waste and faecal sludge disposal. 98% of Dhaka's sewerage is discharged untreated into the environment (Peal 2014). A system for faecal sludge management is an integral element of an overall strategy to keep toilets clean and usable. When toilets fill up and there is no faecal sludge management, no individual-level intervention package will be effective in the long-term. To reduce environmental faecal contamination, low-income areas need a system for faecal sludge management as well as cleaner toilets that people will use. New toilets continue to be constructed by NGOs and other organisations in Dhaka that do not allow for easy removal of faecal sludge, meaning that manual removal of faecal sludge remains common.

The absence of a consistent water supply and regular solid waste collection were other barriers preventing well-maintained toilets. As this study demonstrated, behaviour change designed around formative studies that clarify local constraints, attitudes and priorities can achieve meaningful changes in individual-level behaviour. These changes would accomplish even more if they were accompanied by government-level changes in service provision.

Other benefits of the intervention included improvements in hand cleanliness among residents targeted for the intervention, especially the cleanliness of finger pads. After the handwashing demonstration, the prevalence of hand drying with clean cloths also increased. No hand hygiene intervention was provided by the project team, however interpersonal communication and/or courtyard meetings during the intervention period could have stimulated improved hygiene behaviour.

Throughout the process of piloting and delivering the interventions, landlords or compound caretakers emerged as key facilitators for catalysing the adoption of the targeted behaviours within the compound. They motivated the tenants to keep the toilet clean by reminding them about recommended hygiene behaviour such as flushing after defecation and urination, refilling the water reservoir and using the waste bucket. Furthermore, landlords can liaise with the waste collector who disposes of the general waste. Landlords benefit if the compound facilities are clean and valued by the residents: better facilities make the rental property more attractive and allow them

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to retain better tenants. Future interventions working to improve conditions in slums should consider the important role of these landlords.

Figure 14: Post-intervention shared toilet with messaging and hardware



4.1 Limitations

This intervention was restricted to shared toilets where access was limited to those living within a compound. Although these types of compound-level shared toilets are the most common shared toilets in low-income communities in Dhaka (WSUP 2011), they are not open public toilets. The approaches used in this intervention, which relied on shared responsibility among a defined group of toilet users, are unlikely to be directly applicable to open access public toilets in low-income communities.

Experienced workers from NGOs delivered this intervention. The NGO was reluctant to implement the more diverse intervention that was preferred by the project team for budgeting and administrative reasons. While there is no reason to believe that these messages could not be deployed as part of a broader intervention, this project did not specifically test this. Moreover, interpersonal communication is expensive and this project did not test mass media methods that might be able to support some of the behavioural changes at a lower cost per capita.

Although the cluster randomised design provides confidence that the comparison group was appropriate, the intervention included clearly visible hardware components and communication materials, meaning that data collectors were not blinded to the intervention group. Thus, there is some risk that they may have been unconsciously biased in their evaluations. This risk was minimised by using standardised objective measures and thorough team training.

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Figure 15: Sampling process of monthly quantitative monitoring during intervention

5 Conclusions

This project demonstrated that a behaviour change communication intervention built upon in-depth qualitative understanding of the perspective and constraints of local residents could improve toilet cleanliness, even in the setting of severe constraints: notably water shortages and the absence of faecal sludge management systems.

The most important step towards improving environmental sanitation in Dhaka is to address the absence of any faecal sludge management system. To improve the quality and cleanliness of shared facilities, behaviour change strategies targeting the central role that landlords and community managers play can be particularly effective.

Future research might explore: 1) how compound managers and/or landlords can make improvements to toilet cleanliness without project-funded hardware; 2) how to leverage mass media approaches to reduce the cost of behaviour change communication; 3) how the effectiveness of specific behaviour change strategies varies by gender; and 4) further evaluations to assess the sustainability of these efforts to improve toilet cleanliness.

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