

Could Alcohol-Based Hand Sanitizer Be an Option for Hand Hygiene for Households in Rural Bangladesh?

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Abstract. In low- and middle-income countries (LMICs), hand sanitizer may be a convenient alternative to soap and water to increase hand hygiene practices. We explored perceptions, acceptability, and use of hand sanitizer in rural Bangladesh. We enrolled 120 households from three rural villages. Promoters distributed free alcohol-based hand sanitizer, installed handwashing stations (bucket with tap, stand, basin, and bottle for soapy water), and conducted household visits and community meetings. During Phase 1, promoters recommended handwashing with soap or soapy water, or hand sanitizer after defecation, after cleaning a child's anus/feces, and before food preparation. In Phase 2, they recommended separate key times for hand sanitizer: before touching a child ≤ 6 months and after returning home. Three to 4 months after each intervention phase, we conducted a survey, in-depth interviews, and group discussions with child caregivers and male household members. After Phase 1, 82/89 (92%) households reported handwashing with soap after defecation versus 38 (43%) reported hand sanitizer use. Participants thought soap and water removed dirt from their hands, whereas hand sanitizer killed germs. In Phase 2, 76/87 (87%) reported using hand sanitizer after returning home and 71/87 (82%) before touching a child ≤ 6 months. Qualitative study participants reported that Phase 2–recommended times for hand sanitizer use were acceptable, but handwashing with soap was preferred over hand sanitizer when there was uncertainty over choosing between the two. Hand sanitizer use was liked by household members and has potential for use in LMICs, including during the coronavirus pandemic.

INTRODUCTION

Diarrhea and pneumonia are major causes of mortality among children < 5 years globally and in low- and middle-income countries (LMICs).^{1,2} Moreover, the novel coronavirus outbreak is responsible for a high number of deaths globally, and preventative measures are urgently needed. Handwashing with soap can significantly decrease the concentration of organisms on hands³ and reduce the incidence of both diarrhea and acute respiratory illnesses in children < 5 years.^{4–6} The current COVID-19 pandemic has increased the awareness of the importance of handwashing to prevent disease transmission. During the swine flu (H1N1 virus) outbreak in 2015, promotion of alcohol-based hand sanitizer contributed to increased hand hygiene practices to reduce transmission.⁷

A study among households receiving an intensive intervention and handwashing supplies in Bangladesh demonstrated high observed uptake of handwashing with soap after toilet use (67–74%) and after cleaning a child's anus (61–72%) but low levels before food handling.^{4,8} In the absence of intensive promotion, handwashing rates are considerably lower; the global estimate of handwashing with soap after potential fecal contact in 2015 was approximately 26%.⁹ Household facilities for handwashing in LMICs are often suboptimal; globally, three billion people lack basic handwashing facilities at home (a handwashing facility with soap and water available on the premises), with 1.6 billion lacking soap or water and 1.4 billion having no facility at all.¹⁰ In South Asia, an estimated 30% of urban residents¹¹ and half of rural residents lack

access to basic handwashing facilities.^{12,13} Handwashing with soap is significantly more likely when water and soap are located together near convenient areas.^{14–17} In a national hygiene survey conducted in 2014 in Bangladesh, more than two-thirds of the households had a handwashing location near the toilet, but only 40% had water and soap available.¹⁸ Because handwashing with soap is not feasible in many cases, initiatives that improve hand cleansing by increasing convenience through hand sanitizer use may help address sub-optimal habitual handwashing with soap.⁸ At the community level, hand hygiene is considered a key element to prevent the spread of infectious diseases, and identifying optimal methods is essential to facilitate behavior change.¹⁹

Hand sanitizer (alcohol-based hand rub) is being promoted globally including in low-income settings as a convenient hand hygiene method to reduce respiratory and diarrheal diseases²⁰ in addition to reducing coronavirus transmission.²¹ A study found that hand sanitizer could be useful in public health for reducing influenza virus transmission.⁵ Hand sanitizer has limited efficacy on soiled hands^{21,22} and is considered ineffective at reducing contamination with nonbacterial organisms such as norovirus.^{23,24} In LMICs, hand hygiene is one of the most effective strategies to reduce healthcare-associated infections.²⁵ Promising trials of hand sanitizer as a convenient hand cleansing agent alternative to water and soap in institutional settings in low-income settings have been conducted to prevent neonatal infection in Uganda, among school children in Kenya,^{20,26} and in schools and in healthcare facilities in Bangladesh.^{5,27} The study of household hand sanitizer uptake in Bangladesh has been undertaken in recent years.^{5,28} However, in low-income settings, limited research has been conducted on the behavioral and health impact of hand sanitizer use.^{29,30} At current market prices, these products are likely prohibitively costly compared with soap for

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low-income community members. A locally manufactured, alcohol-based hand sanitizer usually costs ~USD2.50 for 200 mL or approximately three times the cost of a bar of soap for a similar number of hand washes. Compared with soapy water, a mixture of detergent (30 g packets) and water (1.5 L), sanitizer is approximately 30 times the cost per handwashing event. Currently, during the COVID-19 pandemic, soapy water is approved by the WHO and UNICEF as an alternative to soap and water for handwashing. However, after the coronavirus pandemic commenced, hand sanitizer is selling out in local stores. Although there are data on institutional hand sanitizer use and acceptability, little is known about household demand for hand sanitizer use and its acceptability for hand cleansing and appropriate key times that take into account efficacy limitations.^{26,28,31} As part of a broader pilot to determine an optimal handwashing intervention to minimize fecal hand contamination for a large community water, sanitation, hygiene, and nutrition trial,⁴ we analyzed our findings to explore 1) acceptable times for hand cleansing using a hand sanitizer and 2) related community and household perceptions to inform a behavior change communication package to promote hand sanitizers as a supplementary hand cleansing agent to soap in rural Bangladeshi households.

METHODS

Study site and population. We conducted the study in the Kishoreganj subdistrict in central Bangladesh, where at the time (2012) there were no known ongoing water, sanitation, and hygiene (WASH) interventions. We enrolled all households ($N = 120$) with children ≤ 3 years from three rural villages.

Small-scale pilot. Based on the premise that there may be resistance to use alcohol-based hand sanitizer in a Muslim-majority country, we sought insights from local religious leaders in the target communities before initiating this study. The team collected a list of local *mufti/imams* (Islamic religious leaders) in villages based in Kishoreganj district from the Islamic Foundation of Bangladesh. We conducted informal interviews with five *imams* from the list to discuss whether using alcohol-based hand sanitizer for hands would be viewed as prohibited in the rural Muslim-majority communities. *Mufti/imams* reported that although ingestion of alcohol was unacceptable, the use of alcohol-based hand sanitizers to prevent disease transmission was allowed on religious grounds. They expressed willingness to provide support to educate concerned community members. When we shared this in preliminary conversations with community members, they also expressed acceptance of alcohol-based hand sanitizers for the purpose of improved health.

In this pilot, each household was provided with handwashing stations including 1) a 40-L drum with a lid and fitted tap to be placed near the toilet (separate structure from residence); 2) a 16-L bucket with a lid and fitted tap to be placed near or inside the kitchen; each station also comprised a stool/stand with a basin to catch rinse water; 3) a reclaimed 1.5-L empty commercial mineral water bottle to make a bar soap alternative, soapy water³² using detergent powder (not provided) and water, with a hole in the cap to dispense soapy water,³³ and 4) a 200-mL bottle of commercially locally produced hand sanitizer, Sepnil® (Square Toiletries Limited, Dhaka, Bangladesh) marketed and distributed across Bangladesh and purchased for the project in Dhaka, the capital

city. This hand sanitizer solution consisted of ethanol, carbomer, demineralized water, glycerine, isopropyl myristate, propylene glycol, triethanolamine, and perfume and was sold for taka 200 (USD 2.35). We did not promote placing handwashing stations inside the home and did not explore this behavior. Trained local female promoters distributed handwashing stations, soapy water bottles, and hand sanitizer.

The pilot comprised two phases aimed to identify relevant key times when usage of hand sanitizers would be acceptable in these communities. During Phase 1, the study encouraged household members to wash hands with a promoted hand cleansing agent (soap or soapy water or hand sanitizer) at three key times: after defecation, after cleaning child anus/feces, and before food preparation. We did not specifically designate whether to use soap, soapy water, or hand sanitizer for these events, leaving participants free to decide for themselves. After assessing hand sanitizer preferences, uptake, and barriers at the end of Phase 1, we provided separate recommendations for key times for soap use and hand sanitizer use in Phase 2. During this phase, we encouraged household members to cleanse hands with hand sanitizer before touching a child ≤ 6 months and after returning home from outside. We reinforced the need to wash hands with soap/soapy water/hand sanitizer at the established key times: after defecation, after cleaning child anus/feces, before food preparation. Through mutual discussion, the research team and household members identified locations within the residents' rooms for locating hand sanitizers and handwashing stations near the toilet and kitchen, to maximize convenience.

During both phases, trained female promoters encouraged hand hygiene through four household visits per month and two community meeting per month. They used behavior change communication materials including a flip chart and cue cards on key handwashing times (Figure 1), providing instructions on how to make soapy water, how to stock handwashing stations, and how to use hand sanitizer at key times. Materials were adapted from previous pilot studies and guided by the integrated behavioral model for water, sanitation, and hygiene (IBM-WASH).^{34,35} The behavior change communication messages included both health and non-health benefits of washing hands. Promoters encouraged use of hand sanitizers (described as hand medicine) (Figure 2) by verbally explaining how to use it and showing the cue cards and/or flip chart and describing potential convenience of using it at key times. Promoters replenished hand sanitizer bottles usually about twice a month when households had exhausted the contents during the intervention period. Promoters ensured supply of hand sanitizer for the duration of the study and then follow-up. They conducted courtyard meetings twice a month and made follow-up visits twice in a 15-day period and observed the hand sanitizer bottle to get the estimation of remaining sanitizer considering the use by household members. During the promoters' visits, usually participants asked to refill the sanitizer bottle after finished the existing one. Sometimes, participants called promoters via their cell phone to obtain new sanitizer bottles as they finished. During both phases, promoters provided a new sanitizer bottle and collected the finished bottle. In addition, to promote correct sanitizer use and ensure sufficient supply for all of the promoted events, promoters calculated that a family of four members usually consumed two hand sanitizer bottles per month.

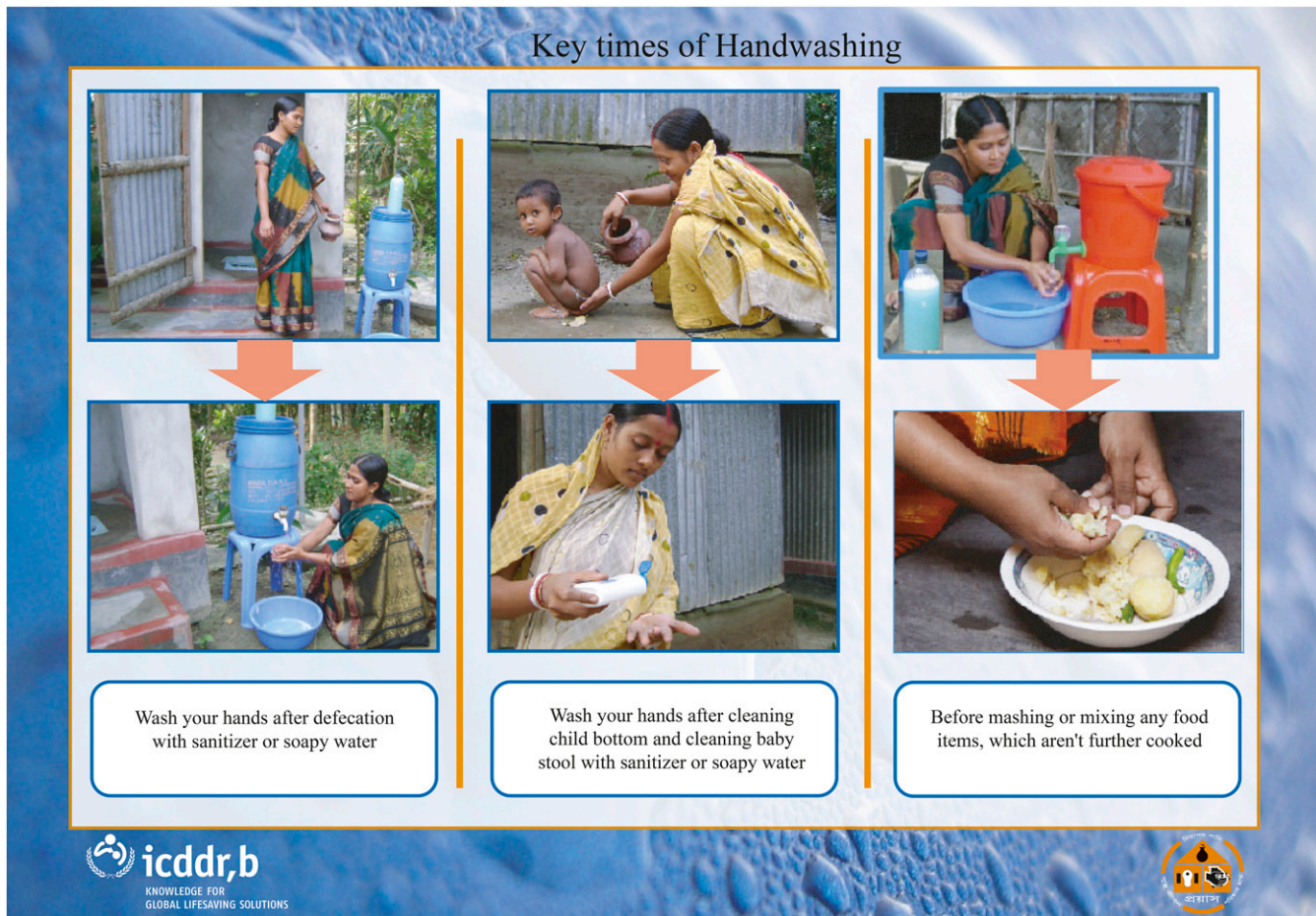


FIGURE 1. Materials used to promote key times of handwashing during Phase 1 (English translation).

The Phase 1 intervention ran for 8 months (February–October 2011), then data were analyzed, and the behavioral recommendations were revised. Phase 2 intervention ran for 4 months in the same households, from February to May 2012.

Data collection and analysis. For each phase, approximately 3–4 months after intervention delivery had commenced, we conducted a survey about hand hygiene behavior following key events with caregivers (mothers or grandmothers) from all households in the selected villages. To ascertain hand hygiene behavior, we asked respondents the following questions: do you wash or sanitize your hands, at which key times, how and how frequently. During qualitative interviews, all participants mentioned they used the hand sanitizer at recommended key times during the intervention period suggesting that its uptake was high. In surveys, we asked whether respondents used sanitizer and used self-reported use rates as an indicator of acceptability. We have inserted text in the data analysis section to this effect.

For the qualitative studies, 15 participants were enrolled across the two phases. Researchers interviewed three female participants in Phase 1, and 12 participants were included in Phase 2 in-depth interviews and focus group discussion. Participants comprised a convenience sample selected based on availability and willingness to participate in the interviews and group discussions.

The in-depth interviews and focus group discussions data were captured using audio recorders. We transcribed audio recordings in Bengali, coded the data based on thematic content, and analyzed manually. Summaries were translated into English. Deductive coding of qualitative data was based on levels and dimensions in the IBM-WASH framework focusing on context and psychosocial and technology factors, at the interpersonal/household level. We calculated percentages for categorical data, and means and SDs for continuous variables from survey responses.

Ethical consideration. The research team explained the research study objectives to the participants. Before taking part in the study, all participants provided written informed consent. The study received ethical clearance from the Ethical Review Committee of the International Centre for Diarrhoeal Disease Research, Bangladesh.

RESULTS

Participant characteristics. A total of 120 households with children < 3 years were enrolled in the study. The Phase 1 survey was completed for 89 of 120 enrolled households (74%). During the data collection period, because of respondent unavailability and out-migration, some did not participate in the surveys. The Phase 2

Using method of Handwashing medicine (Sanitizer)



Use hand medicine and hands keep germ free



Open the cap of the medicine



Put a coin size drop of your palm



Rub both hands including palms and fingers pads with the medicine



Rub hands with medicine and surface together until dry



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FIGURE 2. Materials used to promote hand sanitizer use (English translation).

survey was completed for 87 (73%) households, some of which were also included in the Phase 1 survey. The average household size was 5.4 persons in Phase 1 and 5.4 in Phase 2. The average respondent ages were 29 and 25 years in the Phases 1 and 2 surveys, respectively. More than one-third of the respondents had no formal education.

In Phase 1, 28% of the respondents were homemakers and 31% were agricultural laborers (Table 1). Only two respondents in the study were Hindu, and the rest were Muslims. For the qualitative studies, the mean age of respondents was 25 years among 15 participants. Nine respondents were identified as homemakers, and two

TABLE 1
Demographic characteristics of respondents

Characteristic of respondents	Survey respondents		Qualitative studies
	Phase 1 (N = 89), n (%)	Phase 2 (N = 87), n (%)	Phase 2* (N = 12), n (%)
Female primary caregivers	81 (91)	79 (69)	7 (59)
Age of respondents (years); mean [range]	29 [16–55]	25 [16–60]	25 [18–70]
Educational qualification			
No formal education	39 (44)	34 (30)	7 (58)
Primary	33 (37)	44 (38)	2 (17)
Higher	17 (19)	9 (8)	3 (25)
Mean household size	5.4	5.4	–
Profession			
Homemaker	31 (28)	53 (46)	9 (75)
Farmer	16 (18)	10 (9)	2 (17)
Agricultural laborer	28 (31)	18 (16)	2 (17)
Rickshaw puller	14 (16)	6 (5)	–
Gender			
Female	81 (72)	85 (74)	7 (58)
Religion			
Muslim	87 (98)	85 (98)	12 (100)
Hindu	2 (2)	2 (22)	–

* We did not include the information for Phase 1 qualitative study in Table 1 because only three participants were included and all were female. We have included this information in Results section under the participants' characteristics.

were farmers and two were agricultural laborers (Table 1).

Preferred hand cleansing times using hand sanitizer.

Among the 89 Phase 1 survey respondents, 38 (43%) reported using hand sanitizer after defecation, 26 (29%) after cleaning their child's anus, 23 (26%) before food preparation, and three (3%) after cleaning child feces. Soap was used more commonly than hand sanitizer; participants reported washing their hands with soap at the recommended times: 82 (92%) after defecation, 63 (69%) after cleaning a child's anus/feces, and 32 (36%) before food preparation.

During in-depth interviews and group discussions conducted after Phase 1, participants reported that they washed their hands with both soap and hand sanitizer before eating. After using hand sanitizer, specifically before eating foods, some participants immediately washed their hands again with water only to rinse away the residual product; this qualitative finding highlighted "a barrier that affected" sanitizer use which we consider to be based on psychosocial factors (perceived value), at the level that affects habit (habitual) in the IBM-WASH guiding framework (Table 2).

"Before having a meal it's not essential to wash hands with water again if I use hand sanitizer. But I wash my hands with water only after using hand sanitizer because I do not feel good and my hands feel slippery if hand sanitizer remains on my hands. I know hand sanitizer can kill germs. But for my own satisfaction, I wash my hands with water in addition to hand sanitizer before having meal, especially before having wet foods." (Female caregiver)

For the Phase 2 intervention, the research team revised the key times, based on the findings from Phase 1. A pilot study on hand sanitizer use among new mothers (unpublished) promoted its use before touching a child ≤ 6 months and after returning home from outside. These times were incorporated into the Phase 2 behavior change communication which continued to reinforce washing hands with soap/soapy water at the three established key times—after defecation, after cleaning a child's anus/feces, and before food preparation. Among 87 caregivers who were surveyed at the end of the

Phase 2 intervention (May 2012), 76 (87%) reported using hand sanitizer after returning home and 71 (82%) before touching a child ≤ 6 months. In addition, 14% reported using hand sanitizer after defecation, 6% after cleaning a child's anus, and 2% before food preparation.

In Phase 2, most qualitative study participants reported that it was more acceptable to use hand sanitizer after returning home and before touching a child than the previously recommended times (after defecation, after cleaning child's anus, and before food preparation) as these overlapped with the recommendation to use soap (IBM-WASH psychosocial factors, Table 2).

"After coming back from outside, frequently I and my family members pick up my child from other family members; it's not possible to wash hands with soap again and again. At that time I used hand sanitizer to cleanse my hands easily." (Female caregiver of young child)

Uncertainty over choosing between soap and hand sanitizer. Participants reported that they were not sure of when to use soap and when to use hand sanitizer during the recommended times promoted during Phase 1 (after defecation, after cleaning child's anus, and before food preparation). Given that they had a choice between soap, soapy water, and hand sanitizers, some respondents chose to use hand sanitizer in addition to soap at key times. Caregivers explained that after cutting fish, meat, or chicken, they first washed their hands with soap to remove dirt/oily material and then they used hand sanitizer because they perceived that it improved the smell of their hands (Table 2).

Facilitators to hand sanitizer use. *Keep the hand sanitizer at visible place.* Participants mentioned that placement of hand sanitizer in a visible place—"on an almirah (cabinet which was made from wood with wooden doors or a showcase made from steel with glass door)" inside their house prompted them to use it and acted as a cue for hand cleansing.

"I kept my hand sanitizer on my almirah (cabinet) which is most visible place in my room and easily any of my family members are seeing the sanitizer bottle which reminds us

TABLE 2

Integrated behavioral model for water, sanitation, and hygiene framework at the interpersonal/household level applied to hand-washing practices with alcohol-based hand sanitizer

Dimensions in the IBM-WASH model	
Contextual factors	<p>Access: Hand sanitizer was kept in a convenient place inside households, where the water source is usually located outside the house and soap is kept inside the house.</p> <p>Roles and responsibilities: Caregivers taught their children's to use hand sanitizer to cleanse their hands. They cleaned children hands after coming home from school with hand sanitizer.</p>
Psychosocial factors	<p>Existing habit: Soap was the better known and more commonly used handwashing material. Hand sanitizer was used after washing hands with soap, or they used hand sanitizer first and then washed hands with soap.</p> <p>Descriptive norms: Hand sanitizer use after returning home and before touching a child \leq 6 months was more acceptable than the previously recommended times (fecal- and food-related events).</p> <p>Perceived benefit: Caregivers first washed their hands with soap to remove visible dirt/oily material or after cutting fish, meat, or chicken and cleaning cow dung and then used the hand sanitizer to remove germs or improve hand smell.</p>
Technology factors	<p>Effectiveness of use of product: Participants considered hand sanitizer to be a medicine and effective at removing germs.</p> <p>Strength of the product: Participants believed that soap and water cleaned dirt from hands, whereas hand sanitizer killed germs. They used hand sanitizer after cutting fish/chicken/meat or after a meal, not to kill germs but to enhance the smell of hands. They also like the fragrance of the hand sanitizer which smelled like lemon.</p> <p>Weakness of the product: Participants found it difficult to use the hand sanitizer directly when hands were visibly dirt or after touching smelly substances/products, that is, cutting fish, meat or chicken and after cleaning cow dung.</p>

IBM-WASH = integrated behavioral model for water, sanitation, and hygiene.

as a reminder of hand cleansing, so I and my family members could easily clean our hands with hand sanitizer when needed.” (Female caregiver)

Cues to action through specific behavioral change communication messages and activities. Participants expressed that promoter visits worked as a reminder for them to clean hands with hand sanitizer. Promoters held courtyard meetings twice a month and made follow-up visits twice in a 15-day period. However, sometimes participants said they forgot to cleanse their hands at key times—before preparing foods and after cleaning child anus. Therefore, they found it helpful when these key times were clarified and emphasized by promoters along with the delivery of cue cards.

Perceived efficacy. In Phase 1, participants reported that they considered hand sanitizer to be a medical product. This perception was classified under technology factors (ease of use and convenience) which could influence their hand cleansing behavior in the IBM-WASH framework (Table 2).

“I know that by using hand sanitizer, germs will be removed from my hands. As this hand sanitizer is medicine, it will also remain on my hands. In that case, how can I eat with this [medicine] on my hands?” (Female caregiver)

In Phase 1, participants perceived that soap and water removed dirt from their hands, whereas hand sanitizer killed germs. They washed their hands with soap first to remove dirt after touching grimy substances like cow dung and soil. They also perceived that germs could remain on hands after washing with water and soap, and so they subsequently used hand sanitizer.

Convenience and ease of use. In Phase 2, participants explained that after coming back home, it was easy to use hand sanitizer when they did not feel motivated to go to the handwashing station to wash hands with water and soap. This was especially the case for children, as hand sanitizer was located inside their home (indicating contextual factors, Table 2).

“I cleansed my child's hands with hand sanitizer after coming from his school as the handwashing station is not installed inside the residence which required no need to go outside from there. Then I provided him a meal/snacks. Thus, my child took his meal with clean hands.” (Female caregiver)

Respondents explained that children wasted a lot of soap and soapy water while playing. They thought that children were less likely to waste hand sanitizer because it was dispensed as small droplets from pump pack bottles compared with larger volumes dispensed from soapy water bottles. Some households kept their bar soap indoors after hours to avoid theft; therefore, they did not keep it near the toilet or water source during the night. Caregivers cited that hand sanitizer, kept inside the home, could be an important substitute for handwashing after returning from the latrine at night.

Barriers. Participants mentioned that using hand sanitizer was a new concept in their area in rural Bangladesh. The novel experience of using a hand sanitizer was driven by the residual smell/odor on hands after use. This qualitative finding highlighted that this barrier affected use and falls under psychosocial factors (perceived value) at the habitual level in the IBM-WASH guiding framework (Table 2). Although our intervention did not recommend using hand sanitizer after cutting fish/meat/chicken or after a meal, participants indicated that they were using hand sanitizers in these instances, even after washing with soap to improve the smell of their hands. Some participants reported an alcohol odor when using hand sanitizer before meals which may limit its use at this key time. Two participants suggested that unscented hand sanitizer would be more acceptable to the community. Participants perceived that soap and water was better at removing mud, soil, or solid dirt from hands than hand sanitizer, indicative of important psychosocial and technology factors of the IBM-WASH theoretical framework (Table 2).

A barrier to sustained hand sanitizer uptake, which was not the focus of this study, though described in Phase 1, was the unavailability of hand sanitizer in the local market and its prohibitive cost. Participants stated that they would consider using hand sanitizer to keep them free from germs and disease, but continued hand sanitizer use was dependent on availability in the local markets. During qualitative interviews, participants mentioned that hand sanitizer was not available in their local shop and during the project, was only available when refilled by promoters.

"I could not use the hand sanitizer as my hand sanitizer bottle is empty from last three days, promoters did not come to my house as it was her vacation time." (Female caregiver of young child)

DISCUSSION

The study indicates that hand sanitizer was acceptable among household members for hand cleansing when times for the use of hand sanitizer were specified and promoted times did not overlap with the soap/soapy water use recommendations. This study identified that soap was generally preferred and used more commonly after defecation, after cleaning a child's anus/feces, and before food preparation. These key handwashing times are in line with long-standing behavioral recommendations by national and local non-government organizations. During Phase 1, the study encouraged household members to wash hands with a promoted hand cleansing agent (soap or soapy water or hand sanitizer) at three key times, two of which were fecal-related events (after defecation and after cleaning child anus/feces). When we assessed preferences, uptake and barriers at the end of Phase 1, most used soap. Hand sanitizer has limited efficacy on soiled hands^{21,22} and is considered ineffective at reducing contamination with nonbacterial organisms such as norovirus.^{23,24} As expected, when hand sanitizers were not promoted with specific recommended use times, despite liking hand sanitizer, respondents were uncertain about when to use it instead of soap and water.

Our study was conducted in households where respondents were provided with a handwashing station and soapy water bottle; thus, hand sanitizer was likely viewed as a secondary hand cleansing product. The decrease in hand sanitizer use in Phase 2 before food preparation, after defecation, and after child's anus cleansing likely occurred when these times were no longer promoted. The handwashing station enabled provision of flowing water and made handwashing with soap convenient. Future research should explore the uptake of hand sanitizer use in broader contexts for potential to improve hand hygiene practices where participants do not have such easy ready access to stored or flowing water and soap together. In resource-restricted communities, where availability of soap is difficult to maintain at handwashing station, promotion of hand sanitizer should be assessed as an alternative. Although purchasing hand sanitizers is expensive at this point, the technological feature of a hand sanitizer addresses several barriers that allow it to be used more frequently. Research studies that consider contextual restraints in LMICs should explore promoting sanitizer as a product that supplements, but not replaces, soap and water at handwashing

stations at Sustainable Development Goal 6 recommended key times. Participants predominantly cited convenience as a motivator for using hand sanitizer. Locating hand sanitizer inside the home, where there was no available running water and soap, made it appealing to use before touching a child \leq 6 months and after returning home. In high-income countries, the increased convenience of hand sanitizer has improved hand hygiene compliance and reduced incidence of infectious diseases, especially in healthcare facilities, households, and schools,^{15,20,36,37} but in low-income high-disease settings, there is little experience with this product.^{5,13,38}

Visible dirt is often a cue to wash hands.^{8,34} Participants reported that they used hand sanitizer on visibly dirty hands after first removing dirt with water and/or soap, whereby hand sanitizer was used to remove germs. This is in line with recommendations in the WHO guidelines and from the CDC that hand sanitizer does not reduce dirt or other substances from hands if visibly soiled. Clearly this was seen by participants as a disadvantage to hand sanitizer use where alternative handwashing agents were promoted in parallel. Hand sanitizer is an expensive product in Bangladesh compared with soap and soapy water. Therefore, clear direction on hand sanitizer use incorporated into promotional messages to increase hand hygiene to interrupt disease transmission, among low-income households, should include recommendations that avoid double cleansing. Participants used hand sanitizer after cutting fish/chicken/meat or after a meal, not to kill germs but to improve the smell of hands.

Respondents said that they could continue using hand sanitizer if it was available in their local shops, otherwise they would wash hands with soap. As noted in a survey on field trials of locally produced WHO-recommended alcohol-based hand rub formulations, particularly in LMICs, the product was much cheaper/provided a low-cost alternative to commercially produced alcohol-based hand rubs.³⁹ This is worthy of exploration in Bangladesh; however, very recently, the Carew and Co company produced affordable hand sanitizer and supplied it in the market at a low cost of 60 Bangladeshi taka (~USD 0.70) for 100 mL. Alcohol is restricted for some specific purposes, whereas a government permit is necessary for selling, storing, and transporting alcohol. Advocacy effort and market demands for the hand sanitizer, particularly for healthcare facility use or emergencies such as the continuing COVID-19 pandemic, could encourage the government to be flexible on tax on alcohol to improve affordability. In high-income community settings, there was an association between improvements in hand hygiene and reducing rates of infectious illnesses when using hand sanitizer, rather than soap.¹⁵

Reported reasons for hand sanitizer acceptability can be used to develop strategies to promote hand sanitizer use and so improve hand hygiene in low-resource settings.^{13,20,32} Hand sanitizers are an acceptable product in LMIC settings including households, hospitals, and schools.^{20,37,40} Promoting it as a product to protect from infection beyond the typical key times could increase its appeal across the community and make it attractive for producers to scale at local level. The current COVID-19 pandemic is increasing hand sanitizer uptake globally, and recently the WHO recommended using alcohol-based hand rub or soap and water to cleanse hands,²¹ for previous nonusers, including those in settings where water and soap are not readily available. Hand sanitizer will more commonly be

viewed as a way to prevent the spread of infections such as the novel coronavirus during this pandemic. During the swine flu (H1N1 virus) outbreak, alcohol-based hand sanitizer use increased hand hygiene practice as a preventative measure to reduce the spread of virus.⁷ In a previous study that promoted hand sanitizer in schools, more than 80% of respondents reported hand cleansing with hand sanitizer, suggesting the potential to establish hand sanitizer as a social norm among the students.⁴¹ In addition, this study identified that religious leaders could be considered as allies or intervention partners when introducing alcohol-based hand sanitizers in areas where it is novel in Muslim-majority communities.

There are some limitations to this study. First, we provided the hand sanitizer at no cost to study participants, so out of courtesy, they may have been less forthcoming about any dissatisfaction. Moreover, attitudes toward a product that is a gift may be quite different from interest in paying for a product. Nevertheless, households were willing to report aspects of the product they did not like, and their experience reflects use of a commercial product sold within the country. Because participants were unaware of the cost, they did not report cost as a barrier. Second, we did not perform observations for sanitizer use, for example, we did not record where households kept sanitizer bottles, but they reported that they kept this inside the home. We did not record whether sanitizer, soapy water bottles, or handwashing stations looked used or were filled. However, during both phases, promoters made follow-up visits twice in a 15-day period and held a courtyard meeting per month. For a family of four members, promoters provided approximately two hand sanitizer bottles per month. On occasion, participants called promoters to obtain new sanitizer bottles indicating that sanitizer was consumed, but we have no observations on key times, other than self-reports. This study was designed to assess sanitizer acceptability and feasibility as a hand cleansing option for a larger randomized controlled trial. Measuring the willingness to pay for sanitizer is a further question, but beyond the scope of this study. First, it was not our study objective. Second, at that time, sanitizer was not available in the market, and the context was different. We therefore provided the product free of cost. However, the point of assessing willingness to pay is a good suggestion for subsequent studies on hand sanitizer use in this setting and similar. Considering the COVID-19 pandemic, currently the product is in the market, allowing future evaluation of willingness to pay among consumers at the current price point. This assessment was conducted in a small region in Bangladesh, and therefore, findings may be limited in generalizability. We chose a small rural area broadly representing a typical setting in terms of WASH facilities, geographical locations, and socioeconomic status. Moreover, we anticipate this setting is similar to others in rural Bangladesh, but low-income communities in different countries, especially in contexts with less water availability, may have different attitudes and perspectives. Third, we collected data from in-depth interviews, focus group discussions, and surveys of reported handwashing behavior which may have overestimated practices. Nevertheless, reported data from Phase 1 were particularly useful in highlighting low hand sanitizer uptake and the need to explore underlying

reasons. Moreover, the formative nature of this pilot included promoting several hand cleansing agents alongside hand sanitizers. This led to some uncertainty about when hand sanitizer use is preferred or acceptable. If a focused hand sanitizer-based promotion was pursued, the uptake might have been greater.

When distributed at no cost, hand sanitizer was well accepted in rural communities in Bangladesh. Household members were familiar with soap and water for hand cleansing, and hand sanitizer was not common in rural markets. Also hand sanitizer is an expensive product in Bangladesh compared with soap and soapy water. For developing future interventions, it would be worth maintaining behavioral recommendations and additionally recommending sanitizer use when bad smells persist on hands (after cutting the fish, chicken, or meat and after cleaning cow dung), either sanitizer or soap and water can remove germs, and although sanitizer does not remove visible dirt from hands, it kills germs. If hand sanitizer becomes more affordable and is marketed to attract household members of more modest means, it has potential as a portable convenient product in LMICs including rural households. In the current climate of the COVID-19 pandemic, hand sanitizers have the potential to limit the spread of SARS-CoV2 infection through mass-level use in LMICs if they can be produced at low cost, marketed, and distributed broadly, especially in those settings where access to a fully equipped handwashing station is limited. Considering the COVID-19 pandemic, the product is now widely available in the market, allowing future evaluation of willingness to pay among consumers at the current price point. The intervention in its current format, with free provision of hand sanitizer and intensive promotion, is not amenable to scale up.

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