

Research methodology for developing efficient handwashing options: an example from Bangladesh

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SUMMARY

Handwashing has been universally promoted for health interventions, but it is essential that the factors related to behaviour are understood in order to develop appropriate handwashing messages. We found the study of behaviour complex and had to combine several methods: in-depth interviewing, questionnaire, observational and bacteriological. Here we present our experiences in developing efficient handwashing options for rural Bangladesh.

The components of handwashing practices after defecation of 90 rural women were studied (phase 1). During phase 1 an in-depth interview was used to design the observational and questionnaire surveys. Behaviour was observed using a semi-structured record form and the effectiveness of the acts was measured by means of bacteriological tests. A questionnaire survey was undertaken on socioeconomic and water sanitation-related variables since they influence behaviour. Then, to develop efficient handwashing options, an experimental phase (phase 2) tested the bacteriological efficacy of the components found appropriate in phase 1.

The effectiveness of the handwashing practices is believed to be poor since the bacteriological counts were found to be high (faecal coliform count of the left hand 1995, and of the right hand 1318 colony forming units/hand). The practice comprised several components: use of an agent, handedness, frequency of rubbing, source and volume of rinsing water, and drying of the hands. Seventy-five per cent of the women reported that they could not afford soap. The experimental trials showed that soap, ash and soil give similar results under similar conditions of handwashing (faecal coliform counts of left hands: 195 (soap), 98 (ash), 129 (soil) and of right: 112 (soap), 54 (ash) and 89 (soil) cfu/hand).

The use of multi-method techniques in the study helped to understand and develop efficient handwashing options.

Keywords: handwashing, multi-method, observational and experimental.

INTRODUCTION

Recent research has demonstrated that improvements in handwashing practices can lead to reduced (Black

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et al. 1981; Khan 1982; Stanton & Clemens 1988) diarrhoeal morbidity. This would indicate that handwashing practices reduce the bacterial concentration of hands. Consequently, intervention efforts have been focused on improvements in handwashing (UNICEF 1990).

In some instances, projects in Bangladesh have tried to promote the use of ashes for handwashing (Rahman 1983; Aziz *et al.* 1990). Other programmes have emphasized the use of soap (UNICEF 1990). But use of soap or ash is not common in the sub-continent (Aziz *et al.* 1983; Nath 1993), where most of the 1.2 billion people are very poor and cannot afford soap (Nath 1993; Hoque *et al.* 1994; Hoque & Briend 1991). Ash is not easily available in city slums where gas or kerosine is used for cooking (Haque & Briend 1994). Promoting a behaviour that conflicts with economic and other factors is unlikely to be effective. Moreover, it is inappropriate to design behavioural interventions without considering existing practices.

A careful study of the handwashing behaviour in any population can pose complex methodological issues. How can we learn enough concerning existing handwashing behaviours to fit hygiene education messages and other 'interventions' into the cultural, social, and economic context of people's daily lives? How can we learn whether existing handwashing techniques are actually effective in reducing contamination?

These issues suggest that systematic observations (qualitative methods) of current behaviour patterns and measurement of bacterial counts (quantitative methods) must be combined.

The cultural context of handwashing in rural Bangladesh

Handwashing, like every other human action, is strongly shaped by culturally learned patterns. Long-standing religious and secular patterns are involved in the ideas and behaviours of Bangladeshi people regarding cleanliness, handwashing and other hygiene actions. Cleanliness has a central place in Islamic religious beliefs and practices as well as in the other religions of South Asia. The *Quran* and the *Hadith Sharif* (teaching of the prophets) contain various references to the importance of cleanliness.

The relation of cleanliness to prayers is particularly important among Muslims, since the prayers rendered five times a day are regarded as mandatory, and one must be clean in mind and body to perform them. The *Quran* prescribes that before the five mandatory daily prayers the supplicant must do ablution (*ozu*): 'People must do *ozu* by washing both the hands, arms up to the elbow, the face, the legs up to the knees—all of this three times—using [clean] water'.

To be acceptable for prayer or other sacred acts the individual must be *pak*, or ritually clean. If one has not performed *ozu*, one is *napak* (unclean) for prayer. In many other activities, Muslims must be *pak*. There are clear directives concerning the things and conditions that are *napak*. However, the faces of a baby exclusively fed on breast-milk is not *napak*. In addition to the concept of *pak* people in Bangladesh generally feel that faecal material is *ghinna*; that it produces an unpleasant emotional reaction of 'dirtiness'. The concept of *ghinna* is much like the English word 'foul'.

The separation of left and right hands

Muslims of Bangladesh, as nearly all Hindus, Buddhists and other South Asian groups, share strong traditional concepts concerning the separation of the left hand from the right. This sharp separation of the hands seemingly runs counter to the two-hand washing model of behaviour set forth in the religious teachings. The left hand is associated with cleaning oneself after defecation, so it is ritually unclean in popular usage, though it is not *napak* in the religious sense. Before eating, many people wash only the right hand, just as after defecation they wash only the left (Aziz *et al.* 1983). The ritual uncleanness of *napak* does not arise from a 'germ theory' of disease. Commandments concerning the maintenance of cleanliness, performance of *ozu* before prayers, and avoidance of *napak* are generally expressed in the religious teachings as behaviours that please God.

People generally avoid allowing the two hands to come into contact with each other, at least in certain kinds of activities, including eating. These patterns of hygienic behaviour are well known and carry such strong symbolic force that it is somewhat surprising to find that some individuals nonetheless do rub the hands together in washing. However, this action is prescribed by religious teachings. This suggests that hygiene behaviours in Bangladesh, as in many other parts of the world, are affected by both religious and secular ideas.

Cleaning and handwashing after defecation: *shoucho haz* and *haat-mati*

Cleaning oneself after defecation, throughout South Asia, involves two distinct stages, and water is needed

at both. The water is brought to the latrine site in a pottery, metal, or plastic vessel, called a *bodna* in Bangla. The *bodna* usually has a spout, much like the spout of a teapot, and holds from 2 to 3 l of water. The use of this vessel is restricted to this one purpose.

The first stage of cleaning, of the anal region, occurs immediately after defecation. Water is poured from the *bodna* into the cupped left hand and then swiftly carried to the anal region. This process involves some skill and is explicitly taught to small children at an early age. The process of cleaning the anal region with the left hand is referred to as *shouchu haz*, or in more vernacular form, *shuchu*.

The second part of the cleaning act is referred to as *haat dhona* (if no soil is used). If soil is used, which is supposed to be the usual traditional practice, it is referred to as *haat mati*: a small amount of mud or soil is used as a rubbing agent. The rubbing may be single-handed or using both hands. Alternatively, persons may rub their left hand directly on the ground, on a patch of soil that has been moistened. After the rubbing with soil, the individual pours water from the *bodna* onto the left hand for rinsing. After the rinse, some persons dry their hand on a towel or other special cloth, some wipe the hand on their clothing, and others do not dry the hand.

These generalizations about the 'usual pattern of handwashing after defecation' should not give the impression of great uniformity (Hoque *et al.* 1994). Although the basic pattern of *haat mati* seems to be the cleaning of one hand only, some portion of the population evidently wash or rinse both hands.

RESEARCH METHODOLOGY

The study comprised two major phases: phase 1 (field phase), during which existing handwashing practices were studied under existing conditions, and phase 2 (experimental phase) during which existing practices were systematically studied under controlled conditions.

Field phase

In order to explore the cultural pattern of handwashing among rural women of Bangladesh, we carried out interviews, questionnaire surveys and observations of

handwashing practices and collected bacteriological samples from hands of women in a community some 16 km from Dhaka. The interviews and questionnaires served to gather information on socioeconomic, cultural, water use sanitation and handwashing variables. The women were observed washing their hands after defecation.

The first step consisted of two in-depth interviews with four women in a village close to our intended research community of Uttarkhan to find out where *haat dhona* or *haat mati* takes place. If the women wash their hands inside the latrine enclosure direct observation would be extremely difficult.

Most rural Bangladeshi homes have some kind of 'latrine' at the end of the courtyard or compound, at some distance away from the house. However rudimentary the structure, a main requirement is that the area is shielded from view, at least the sides most likely approached by other persons. In some cases the latrine is equipped with corrugated iron siding or other substantial material. Most have canvas or other flimsy materials.

The women reported that handwashing normally takes place outside the immediate latrine area, nearer the house, often right beside it. People may have a pond or other water source along the pathway from the latrine to the house, so hands are washed there.

Among rural women defecation generally occurs early in the morning, immediately before sunrise.

From the informal interviews we also learned that there is probably considerable variation in practices, including the use of soap. In fact, we expected the use of soap to be fairly high in the area, as all women claimed to use it.

The women wished the observer to be a local person not the principal investigator. They said that most of the people are aware that soap should be used in handwashing, and if the observer were an urban, educated person, the women would probably use soap to impress the visitor even though their usual practice might be not to use it. Soap is present in most households, as it is used for some clothes washing, washing one's face before going visiting and other special purposes. But, we found that soap is considered too expensive to be used in usual handwashing activities. It may be used as a beautifying agent.

We selected two local women as observers. Both had high school education (one had 9, the other 10 years). We advised that during their visits they should

not appear to be 'different' by wearing an expensive sari or the *shaltwar kamiz*.

During some of the observations, the principal investigator accompanied the local data-gatherers. On those occasions the women often stopped their usual activities to engage in conversation.

We prepared a detailed observation protocol incorporating the specific behavioural variations suggested by the women's groups. The protocol also set forth procedures for collection of post-defecation hand-washed samples for faecal coliform counts of the hands.

The observation phase was pretested for about a week in the same village where we had held the informal discussions. These pretest observations identified some problems in the protocol, which was then revised to its final form.

One hundred households had been selected as the sample, one each from 100 *baris* (family compounds) in the large village of Uttarkhan. Observations were made by our village-based female observers from 0530 to 0900 h. If observations in a household were completed quite early, the observers would go on to the next household on the list. They were able to average 1.7 observations per day. Ten women objected to our observation and so data is presented for 90 women.

We had instructed the observers to present themselves at the selected household, saying that they were observing people's behaviours in relation to children's diarrhoea. They were instructed to avoid mentioning handwashing. The observers, with visible data-recording protocol, were to engage the women in conversation and then accompany them in the direction of the latrine when the woman went to defecate. Having waited at some distance from the latrine, the observer could then resume the conversation with the woman as she went to the site where she washed her hands.

The bacteriological samples were collected according to the modified finger-tip method for faecal coliform count (Pinfold 1988). Before or after washing their hands in the usual ways, the women were asked to place their hands separately into two plastic containers, each of which contained 100 ml of Ringer and Tween solutions. The women were requested to make washing movements inside the containers by rubbing their fingers on the palm of the hands at least 12 times. As much of the hand as possible was immersed in the solution during this rubbing process. The containers were then immediately closed and placed in an ice-box. The faecal coliform counts from these samples were

determined at the Environmental Laboratory of the International Centre for Diarrhoeal Disease Research, Bangladesh, usually within 2-3 hours after collection.

Experimental phase

During the experimental phase, the effectiveness of the more common components of handwashing recorded in the observation phase was individually tested and compared by studying one component in a set of trials while keeping the other components constant. During each set of trials about 60 women were instructed to wash their hands in the same way and, following the handwashings, each hand was separately sampled for bacteriological count. For example: while testing for soil (an agent), about 60 women washed their hands rubbing both hands with soil (and a little water) 6 times and rinsing with 2 l of tubewell water. When testing for ash, about 60 women washed their hands rubbing both hands with ash (and a little water) 6 times and rinsing with 2 l of tubewell water. The difference in bacteriological counts after washing were compared between soil and ash (Stanton & Clemens 1988). The components showing acceptable results were combined to develop the efficient handwashing options.

Findings

The interviews clearly indicated significant positive association between better socioeconomic status and the use of soap for handwashing; the details are reported elsewhere (Hoque *et al.* 1994).

Fifteen women (17%) who reported that they use soap in handwashing were observed washing hands with soil (10 women) or water only (5 women). Seven per cent of the women who claimed to wash both hands were observed washing the left hand only. Three per cent of the women who reported that they wash hands using soil were observed washing hands with soap. Eighty-nine per cent of the women reported that they wash hands for '*ghinna*' or '*napak*' and only 11% for disease-causing agents.

Table 1 shows the format of the observational part of our data gathering protocol and illustrates two of the common patterns that we found in the data. All information in this part of the protocol was gathered directly

Table 1. Portion of observation protocol, with two cases

Protocol questions	Answers of woman 1	Answers of woman 2
Did she wash hands?	Yes	Yes
One hand or both?	Left hand	Both hands
What did she do?	Rubbed hand on ground	Rubbed both hands. Poured water on cupped left hand from <i>bodna</i> held in right hand. Put <i>bodna</i> down and rubbed both hands
How many times?	Twice	More than 6 times
Whole hand or just fingers?	Fingers only	Whole hands
What agent used (soil, ash, soap)?	Soil	Nothing
How was it used?	Rubbed on ground only	Not applicable
Where did she get the soil?	Near the house	Not applicable
How much water was used?	2 l	She filled the <i>bodna</i> in pond several times
Size of water container	2 l	Pond
Where did she get the water?	Container at house with tubewell water	Pond
Dried the hands?	No	Yes, wiped on her sari
Was there dirt under her nails?	No	No
Did the two hands come into contact?	No	Yes, while she was pouring water and then wiping hands
Did she wash her hands at the latrine?	No	No
Why did she not* wash her hands with soap?	Cannot buy soap for handwashing	Cannot buy soap for handwashing

*This was asked directly, and response recorded.

from observation, except the last item, which was asked directly. The observer was expected to estimate the container, and to make a careful estimate of the amount of water used during the *haat dhona* or *haat mati*.

In many instances (28%) the women had used only part of the water from the *bodna* inside the latrine (to do *succho kaaz*), and saved a portion of the water for the *haat dhona* or *haat mati* near the house. But most women (72%) refilled the container at the house to complete handwashing using at least twice as much water as the women who rinsed their hands using only the remainder of the water. Approximately half the women who refilled their containers used water from a tubewell as opposed to pond water. About 75% of the women said they cannot afford to buy soap. Two hands came into contact in 3% of cases, but both hands touched the same objects before handwashing occurred in 91% of cases while mainly changing hands in carrying the '*bodna*' and fitting cloths.

Overall, the observational survey indicates that handwashing consisted of use of an agent, handedness, volume of rinsing water, rubbing frequency and drying. These elements can be practised in different combi-

nations producing different bacteriological results depending upon frictional effects and rinsing which will wash away the loosened bacteria. The means of the faecal coliform counts of hands after defecation and usual washing were for the left hand: 1995; for the right hand: 1318 cfu. The counts of washed hands after cleaning of anus of children were 4326 and 8620 cfu, which means they were more contaminated than they were after washing following their own defecation.

Table 2 shows differences in faecal coliform counts from the contrasting aspects of observed handwashing in Uttarkhan village. Although the data are grouped against an element, they are really the effects of the combinations, or interactions, of handwashing elements: women who used soap also tended to use more water and rub both hands more than the others. It is possible that the 'extra' rubbing and water use was done to remove the 'soapy feeling' on their hands. Again, the faecal coliform data comparing 'left hand only' with 'both hands' washing show some surprisingly bad results for 'both hands'. These data contain a mixture of the 'soap-users' with 'soil-users' and 'water only'. Thus, it is not demonstrated conclusively that soap

Table 2. Results of bacteriological examination of women's hands

Type of handwashing	Left hand (Geometric mean)	Right hand (Geometric mean)
Water only	3801	3162
Soil and water	1820	1017
Soap and water	813	513
Left hand only	1122	1000
Washed both hands	4076	1906
Used more than 0.7 l of water	1122	1585
Used less than 0.7 l of water	2455	1230
Rubbed hands or fingers only 1 or 2 times	4266	2291
Rubbed hands more than 3 times	1412	1023

Table 3. Comparison of faecal coliform count of hands under various experimental conditions of agents

Experimental conditions	Left hand (geometric mean of c.f.u. of faecal coliform per hand) (<i>P</i> -values, 95% CI)	Right hand (geometric mean of c.f.u. of faecal coliform per hand) (<i>P</i> -values, 95% CI)
Ash+6 rubbings of both hands and rinsed with 2 l of tubewell water	98 (<i>P</i> =0.5; 0.33, 1.74)	54 (<i>P</i> =0.23; 0.26, 1.38)
Soap+6 rubbings of both hands and rinsed with 2 l of tubewell water	195 (<i>P</i> =0.25; 0.74, 3.02)	112 (<i>P</i> =0.52; 0.63, 2.45)
*Soil+6 rubbings of both hands and rinsed with 2 l of tubewell water	129	89

*Reference washing compared with soap and ash

causes a reduction of faecal counts or that it is the most appropriate way of washing hands.

To explain the methodological issues of the experimental phase, we present results from tests on agents only (Table 3). Soap, ash and soil produced similar acceptable results when other conditions were the same.

DISCUSSION

The purpose of this paper was to demonstrate both the complexities of research in hygiene behaviour and the possibilities of a multi-method approach. It is essential to actually interview and observe the behaviours under natural conditions and to record the steps involved. Through interviewing, we gathered general information about handwashing practices, but we did not have a clear idea about the practice and its elements.

Observation and attention to the variations in basic patterns allowed us to focus on the components of handwashing and to see that simply recording handwashing or no handwashing is much less informative than examination of how hands are washed. Interviewing was helpful to collect data on determinants of the practice, e.g. how socioeconomic and water sanitation factors influence the behaviour (Hoque *et al.* 1994). It also helped to know that the majority (89%) washed hands for 'ghinna' and 'napak', which means that culture and religion have a strong influence.

The microbiological techniques showed that there is a need to reevaluate the 'napak' perception related to breast-feeding and child faeces. Bacteriological sampling of hands caused interest and curiosity. We were requested by almost all women to inform them if bacteria were identified on their hands. Thus demonstration of bacteriological plates in handwashing intervention is likely to have an educational value.

This exploration suggests that many factors affect women's handwashing patterns. Any single-factor intervention runs the risk of failing to achieve substantial improvements in removal of faecal contamination of the hands. For example, the faecal coliform data of soap-users show much better results than others, but observation showed that the soap users washed both hands, used more water and rubbed more also. That means, overall, they practised a better method of handwashing and use of soap as a single indicator in that handwashing will be misleading, under-reporting the role of other elements in the handwashing. We would also question the advisability of emphasizing the use of soap when it did not show significantly better results than the use of soil and is considered unaffordable by the majority of local people.

A 'culturally appropriate intervention' can be obtained only through systematic gathering of data in the context of people's daily activities using a combination of techniques.

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REFERENCES

- Aziz K.M.A., Hasan K.Z., Patway M.Y. *et al.* (1983) A study of the interpersonal spread of human faeces in rural Teknaf Bangladesh Proceedings of an International Conference on Shigellosis, Bangladesh, ICDDR,B: Special Publication No. 20, pp. 238-249.
- Aziz K.M.A., Hoque B.A., Hasan K.Z. *et al.* (1990) Reduction in diarrhoeal diseases in children in rural Bangladesh by environmental and behavioural modifications. *Transactions of the Royal Society of Tropical Medicine and Hygiene* **84**, 433-438.
- Black R.E., Dykes A.C., Anderson K.E. *et al.* (1981) Handwashing to prevent diarrhoea in day-care centres. *American Journal of Epidemiology* **113**, 445-451.
- Hoque B.A. & Briend, A. (1991) A comparison of local handwashing agents in Bangladesh. *Journal of Tropical Medicine & Hygiene* **94**, 61-64.
- Hoque P.A., Mahalanabis D., Alama M.J. & Islam M.S. (1995) Post-defecation handwashing in Bangladesh: practice and efficiency perspectives. *Public Health* **109**, 15-24.
- Khan M.U. (1982) Interruption of shigellosis by handwashing. *Transactions of the Royal Society of Tropical Medicine and Hygiene* **76**, 161-168.
- Nath K.J. (1993) Personal Communication: Professor and Head, Department of Sanitary Engineering, Chief Coordinator, I.T.N. Centre, India.
- Pinfold J.V., Horan N.J. & Mara D.D. (1988) The faecal coliform fingertip count: a potential method for evaluating the effectiveness of low cost water supply and sanitation initiatives. *Journal of Tropical Medicine and Hygiene* **91**, 67-70.
- Rahman M.M. (1983) The Teknaf Health Impact Study: Methods and Results. Paper presented at the International Workshop on Measuring the Health Impacts of Water Supply and Sanitation Programmes, Cox's Bazaar, Bangladesh 21-25 November 1983.
- Rashid H. (1994) Guest Speech at the Third Annual Scientific Conference (ASCON III) of the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B).
- Stanton B & Clemens J.D. (1988) An education intervention for altering water sanitation behaviours for reducing childhood diarrhoea in urban Bangladesh. II A randomized trial to assess the impact of the intervention on hygiene behaviours and rates of diarrhoea. *American Journal of Epidemiology* **125**, 292-301.
- UNICEF (1990) *Facts for Life*. Oxford University Press, p. 60.