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Increasing awareness of arsenic in Bangladesh: lessons from a public education programme

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Experts are making a major effort to find technical solutions to the serious public health problems posed by arsenic in drinking water in Bangladesh, but public education strategies receive less systematic attention. This article presents the findings of a study evaluating the impact of a 1999 campaign by the 18 District Towns Project to educate the public about the arsenic problem in six Bangladesh towns, where half of the population was estimated to be using arsenic-contaminated domestic water: (1) Water users were advised not to consume arsenic-affected tube-well water; (2) A simple, temporary water treatment method was recommended for those using such water, if they had no safe alternative source; (3) Caretakers of tube-wells having arsenic-free water were advised to share their water sources with others. This evaluation study, utilizing a combination of quantitative and qualitative social research methods, found those influenced by the programme to have higher awareness levels and significantly lower levels of risk behaviour than others. Yet more than half of the at-risk, programme-influenced survey respondents were found still to be drinking (57%) or cooking with (54%) arsenic-affected water. Despite the fact that the campaign did not have a satisfactory public health impact, the experience can inform future efforts to educate the Bangladeshi public about arsenic. One finding is widespread confusion about trusted tube-well water being newly labelled as 'unsafe'. Some think the problem is in the hand pumps themselves. Awareness of life threatening danger from arsenic contamination was found to be low. Learning points from this experience are: the value of explaining together with water testing; giving people opportunities to ask questions; repeating messages; continuing to educate children about the serious risks of consuming surface water; conducting community-wide education programmes for people of all ages; and evaluating the impact of specific public education strategies. Respecting such principles in public information campaigns will greatly help the public to benefit from future technical developments.

Key words: arsenic, Bangladesh, public education programme, drinking water

Introduction

Ground water is the main domestic water source for people in Bangladesh. The vast majority get it from hand-pumped tube wells (HTWs), until recently much appreciated for their pathogen-free water. Since the early 1990s, however, a series of studies have proven that the water in numerous aquifers has an unacceptably high arsenic content. This public health emergency is of intense concern to officials, researchers and others. In recent years an ever-increasing effort has been devoted to assessing the causes and the extent of the problem, which is shared with neighbouring districts of West Bengal, India (Das 1996). The British Geological Survey (1999: 7–1) estimates that 26% of all the wells in the country may be contaminated with arsenic. Recent reports state that between 35 and 77 million Bangladeshis – 28–62% of the total population of 125 million – may be at risk because they consume arsenic-contaminated domestic water (Alam 2000: 84; Smith et al. 2000: 1093–4).

The arsenic danger is real, but the problem is complex, and solutions elusive. The underground distribution of arsenic is highly variable within small areas. While arsenic is mostly found in 'shallow' aquifers – those at depths of less than 150 metres – deep aquifers also are occasionally found to be contaminated by arsenic, probably because of leakage from shallow aquifers. Arsenic is invisible and does not affect the taste or smell of water. Skin discolouration and other recognizable symptoms tend to appear only after several years of water consumption.

Chemical treatments, filtration and other arsenic removal techniques command most of the attention of present-day Bangladesh 'arsenic mitigation' projects. Patient identification and mapping arsenic-affected wells were the main objectives of a World Bank/UNDP funded Dhaka Community Hospital survey of 500 villages in 1997–99 (Quamruzzaman et al. 2000: 29). Studies and action strategies, including public education programmes, are being developed by a number of agencies and organizations.[1] UNICEF and the Department of Public Health Engineering (DPHE) have developed radio and TV spots to inform the Bangladesh public about the arsenic problem; this pair of agencies has also produced a brochure and other educational items for use at the community level. And UNICEF has prepared a detailed communication manual (Galway 2001). Nongovernmental organizations (NGOs) with arsenic mitigation programmes, including this project, have used these materials together with others they themselves have produced. The agency responsible for coordinating arsenic-related activities, the Bangladesh Arsenic Mitigation Water Supply Project, has developed its own plan to disseminate messages about arsenic in 56 districts (BAMWSP 2001). Several other organizations and programmes such as CARE-SAFER, the NGO Forum for Drinking Water Supply and Sanitation, WaterAid and BRAC have developed flash-cards, games, posters and other techniques to help people grasp the seriousness of the arsenic problem and to explain ways of reducing risk. There is considerable sharing of materials and ideas among all concerned groups.

This report describes and evaluates one project's attempt to improve public awareness about arsenic in the domestic water supply of six Bangladesh towns. It is the first systematic evaluation of a large-scale community-level arsenic education programme.

Description of the 18 District Towns Project

The people covered by this study reside in six towns (*pourashavas*), all district headquarters, which are indicated on Figure 1. The towns – whose total population is approximately 300 000 – were among 18 covered by the 18 District Towns Project for Drinking Water, Sanitation, and Hygiene Education (18DTP), a recently completed project funded from 1989 to 1999 by the Netherlands Ministry of Foreign Affairs. The project was implemented by the Government of Bangladesh, Department of Public Health Engineering (DPHE), and a consortium of Dutch and Bangladeshi consulting firms. The project supported the municipal water departments, or Pourashava Water Supply Sections, and trained all-female NGO teams of community outreach workers in each town.

During the early 1990s, before the arsenic issue was recognized, public HTWs were installed as part of the project's water supply component. The tube wells were sold for Tk.300 (approximately US$6) to groups of some 10 households in 'fringe' areas of each town, areas to which piped water supply lines did not extend. Every tube well was provided in the name of a female caretaker, who received training in basic maintenance procedures. The all-female project teams in each town conducted household-level hygiene education and helped with distribution and installation of HTWs and low cost sanitary pit latrines provided by the project.

In 1995 project staff became aware that the ground water in the six towns had high arsenic content. Water treatment plants, constructed in several towns to remove iron from the project-installed piped supply, were found also to remove some 50–70% of arsenic. Thus the arsenic content of piped water could be kept below the Bangladesh standard of 50 µg/l. But only 10–15% of the population in each town uses piped water. All others remain dependent on HTWs, most of which tap 'shallow' aquifers. 18DTP has estimated that some 150 000 people in the six towns are at risk because the water in their tube wells is arsenic contaminated. More than one in five may have principal domestic water sources with arsenic content over 100 µg/l, or 0.1 mg/l (van Agthoven et al. 1999).

In mid-1998 the project launched a campaign in the six affected towns with a water-testing and public education programme. The project took responsibility to test, at its own cost, all of the 1384 HTWs it had installed in the towns. Each municipality also had installed HTWs (total number 3775) for use of the general public, and the municipalities wished to have these tested. As the project had a close working relationship with each municipality, the project agreed to share the costs of this additional testing with each municipality. Local women, who received special training from the project, were assigned the task of testing the HTW water and informing users about the arsenic problem.[2] Project resources were not sufficient to include privately owned HTWs under this testing programme, although there certainly was and is a need to test them. With variations among towns, some level of arsenic was found in the water of 55% of the 4621 project and public HTWs whose water was tested.

When the testing of HTWs started in 1998, the most readily available field test kit was that produced in Germany by the Merck Company. The project decided to use the Merck kit because (1) it was considered to be the most accurate field kit available (National Environmental Engineering Research Institute 1998), and the project's own laboratory checks confirmed this; and (2) it is easy for local people to use it. The Merck kit has the serious drawback, however, of measuring arsenic concentrations only at the level of 100 µg/l and above, i.e. concentrations above the Bangladesh maximum standard of 50 µg/l.

Field testers were instructed to paint a HTW spout red (Red/'unsafe') only if the Merck kit's test strip turned distinctively yellow, indicating an arsenic concentration of 100 µg/l or higher. If the strip turned pale yellow, indicating an arsenic concentration somewhere between 1 and 100 µg/l, the HTW spout was painted with a red question mark (Red-Q/'doubtful'). If the strip remained white, indicating that the water did not contain arsenic, the HTW spout was painted green (Green/'safe').

In order to further educate the HTW-using public about the arsenic problem, the project organized an 'Arsenic Week' in each town. Between January and June of 1999 local government officials and local project teams received training on arsenic topics.[3] Skilled caretakers received additional briefings on the arsenic issue. Primary school teachers, community leaders and residents of each town ward all had opportunities to learn about arsenic, ask questions and consider their options. Primary school children – those attending schools already using a project-developed hygiene education curriculum – received colourful stickers with cartoon figures warning each other not to drink Red HTW water. All HTW caretakers received copies of UNICEF/DPHE brochures demonstrating safe water practices in both pictures and words.

Basic messages to all HTW users were:

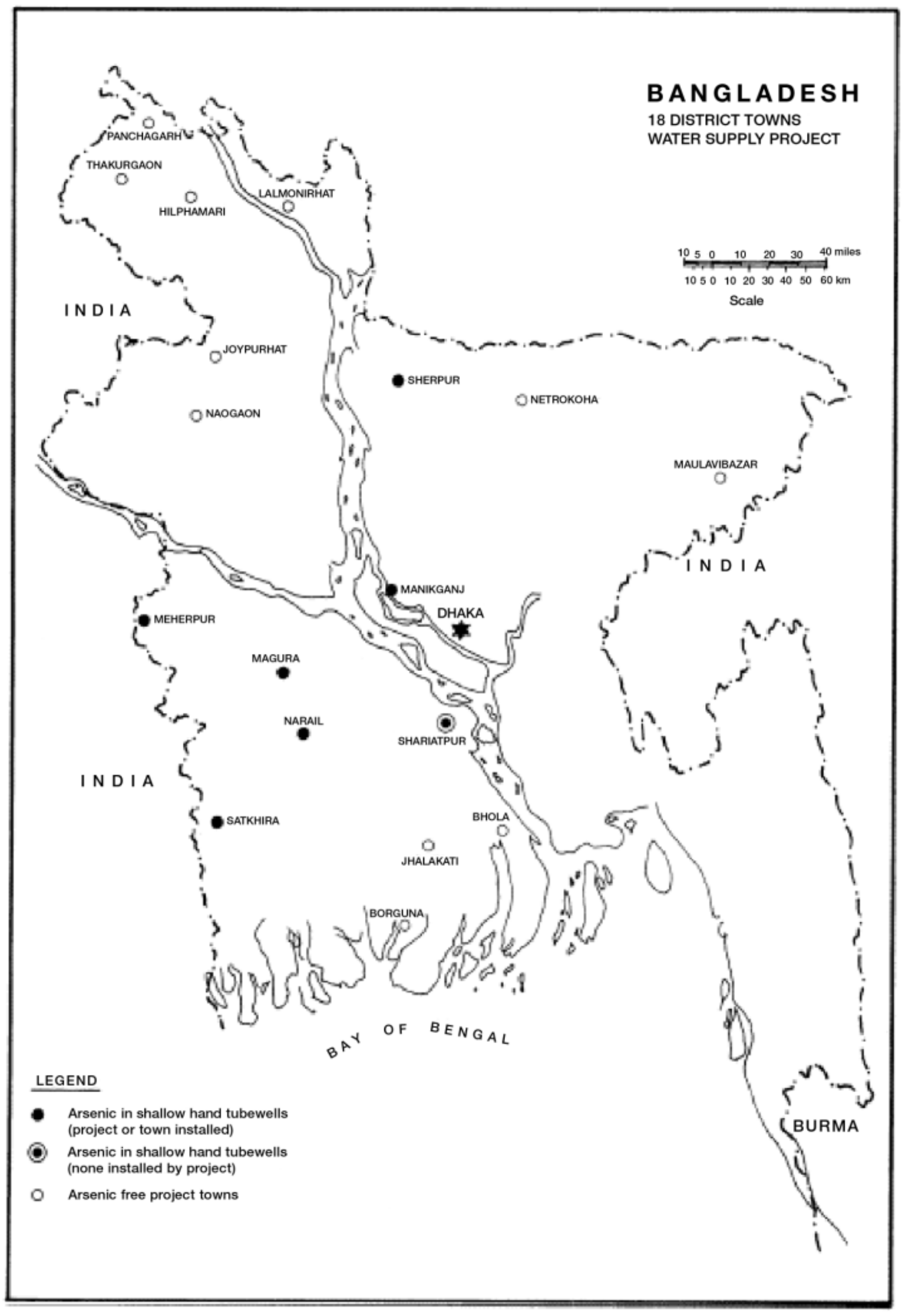

Figure 1. Arsenic affected project towns

(1) Water from Red or Red-Q HTWs is not to be consumed, although it can be used for washing and other domestic purposes. Red-Q HTW water was to be considered dangerous unless further laboratory tests proved otherwise.

(2) A simple domestic arsenic removal treatment was recommended as a short term, emergency measure until a better method could be made available. People were instructed to aerate the water, possibly adding some alum while doing so, and allow it to sit for 12–24 hours before using it for drinking or cooking. This measure, which would no longer be recommended by any project, was known to reduce the arsenic content of the upper portion of the stored water, but not to bring it down to a safe level if the original content was high (the method is discussed in UNICEF, n.d.).

(3) Families whose HTWs were painted red were advised to shift to safe water sources, especially Green HTWs, for drinking and cooking water. Caretakers of Green HTWs were urged to share them with anyone in need.

Evaluation study methodology

This evaluation study was conducted in September and October 1999, 3 months after the project's last Arsenic Week. A combination of qualitative and quantitative – or subjective and objective – data collection methods was used, in order to provide maximum insight into people's thinking *and* behaviour. Three standard social research methods were used:

(1) A questionnaire survey of 694 adult HTW users.[4] Survey interviewers visited a total of 306 HTWs in the six towns and interviewed users. Out of the total of 4621 previously tested public or project tube wells, 102 were randomly selected as interview locations. Approximately five users (one every 15 minutes, if possible) were interviewed at each HTW. Interviewers also visited two privately owned HTWs in the vicinity of each sampled public or project HTW. The questionnaire contained a number of open-ended questions, which were post-coded for computer analysis with the SPSS programme.

    Respondents were classified into two groups on the basis of information sources mentioned: those influenced in any way by the programme (PI, or 'programme influenced', n = 420) and those who had not had any contact with the programme (NPI, or 'not programme influenced', n = 274). A respondent was considered to be PI if he or she mentioned learning something about arsenic from a project source such as a community meeting, a project staff member, a HTW caretaker, a brochure or a sticker. In comparing PI and NPI responses, significance tests were used: χ^2, ANOVA, and t-tests.

(2) Focus group discussions, two in each town: one discussion was for Red/Red-Q HTW users, and one was for Green HTW users. A total of 138 women participated in the focus groups; 50% were project HTW caretakers. The semi-structured discussions, which took approximately 2 hours each, were guided by a set of six or seven questions, which provided similar information about each group's views and experiences.

(3) Short interviews of 48 primary school students in Class Four: 25 boys and 23 girls. These children were aged 10–12 years. Twenty-nine were students in project-affiliated schools, and 19 were in non-affiliated schools. Each child answered a set of 11 simple questions about the meanings of tube-well paint colours, 'arsenic', what is 'safe water', and information sources. Children also were invited to ask their own questions.

The full findings of this study have been published in book form by the Royal Netherlands Embassy in Dhaka (Hanchett et al. 2000).

Findings

In brief, the study found that people who have been influenced by the programme (PI respondents) are more likely than others (NPIs) to understand the health risks of drinking arsenic-contaminated water, which is often referred to as 'bad' water. The meanings of HTW spout colours are understood by some 80% of PI respondents, compared with only 25% of others. PI respondents also are significantly less likely to consume contaminated water than others, as Figure 2 indicates. If they do consume it, they are more likely to do so after trying some kind of domestic water treatment. Children familiar with the project's colourful stickers are more likely than others to know that water of red-painted HTWs is unsafe for drinking. The information campaign therefore can be said to have influenced people's understanding of the arsenic problem and their water use behaviour, at least to some extent. Such findings, however positive, are meaningful only relative to the very low knowledge levels and high-risk behaviour of people not yet informed about arsenic. More than half of the informed public (PIs) unfortunately still *does* consume arsenic-contaminated water. The achievements of this programme, as significant as they are, have not produced behaviour changes sufficient to prevent public health risk.

People's perceptions of the arsenic problem

The arsenic crisis is sorely testing the public's ability to understand and accept new water use messages. Not only are arsenic-related messages unfamiliar, but also they contradict what has been conventional wisdom about 'safe water' for

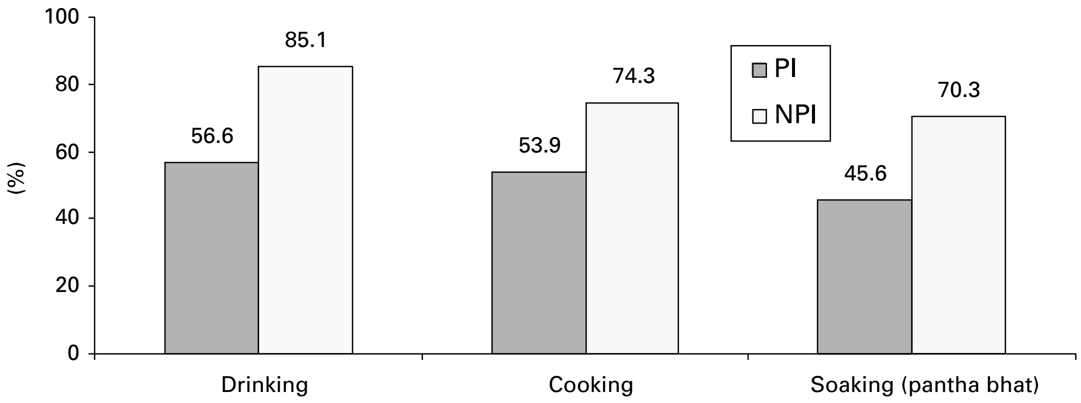

Figure 2. Programme effect on consumption of arsenic-contaminated water by Red HTW users
Pantha bhat is a popular breakfast food consisting of dinner rice soaked with water overnight and eaten the next morning without re-heating. PI = programme influenced; NPI = not programme influenced. Total n = 302; p < 0.01.

more than a decade. Numerous comments of focus group participants left no doubt that confusion persists in the six towns, despite this programme's attempts at clear communication.

While professionals tend to understand that arsenic has been in the ground all along but was not detected until recently, many of the affected people think that the earth has changed, or that some new kinds of diseases have come into existence. Some focus group participants think that the problem is in the hand pump: that the pumps have deteriorated somehow, causing arsenic to contaminate the water. This raises the unfortunate possibility that some people will purchase another hand pump as a replacement for their present Red HTW and install it on the same, arsenic-contaminated bore hole.

Like others, this study has found that some people are confusing arsenic, as indicated by a red HTW spout, with iron (Asiatic Social 1999). Until now the worst problem most HTW users have faced is high iron content of ground water. Many therefore know something about iron, whereas arsenic is a new and abstract idea. In almost all focus groups, however, at least one person mentioned that the arsenic disease or poison acted gradually on the body, eventually producing cancer and death, since there was no known medical treatment for the condition. A typical exchange on this topic occurred among a group of Red or Red-Q HTW users in the western Bangladesh town of Meherpur:

> (A): "Arsenic means that you can get wounds inside the body." (B): "Yes, but also spots on the palms." (C): "The palms become rough and you'll get black spots." (D): "The hands and legs become thick." (E): "Arsenic is a poison." (A): "Yes, it's true, it means that there are wounds inside the body. People can die if they take this poison." (D): [Agrees with these statements and adds] "People die because of lack of treatment." (F): "If people drink arsenic-contaminated water, then he or she gets wounds in the intestines and you will get cancer." (A): "These symptoms are with many people." (C): "There isn't any patient here now, but in the future there will be."

Focus group participants asked many of the same questions that experts are asking each other: Is it safe to water gardens with arsenic affected water? Is this water safe for cows and other farm animals? Can pregnant women pass arsenic poisoning along to their unborn children? Are older people and children more vulnerable than others to arsenic poisoning, or are they less vulnerable?

Of 97 focus group participants who made comments when asked 'What is arsenic?', 38% described it as a 'poison' (the project's message was that arsenic is 'a kind of poison') and 37% as a 'disease'. In some places the women were having difficulty distinguishing arsenic-related skin discolouration from other skin diseases or infections. Most participants who had received training as HTW caretakers, mentioned arsenic-related symptoms such as 'rough palms and soles of feet' or black spots on the skin.

People's views differ from place to place. In one town, Manikganj, some expressed suspicion that the arsenic danger might not be real at all; but focus group participants in the other five towns were more seriously concerned about the risk. All caretakers, and some others, had studied the pictures of arsenic patients in the UNICEF/DPHE brochure, and they most often mentioned symptoms of skin discolouration and 'thickening' of skin.

Survey respondents, when asked 'Do you know of any problems that result from drinking arsenic affected water?', mostly mentioned one or more named types of skin sores, blisters, boils, pimples, rashes or other 'wounds'; or they mentioned black spots, itching or rough palms or soles of feet (this vocabulary is described in Hanchett et al. 2000). One noteworthy difference was the greater likelihood of PI respondents' mentioning the possibility that arsenic can cause cancer (PIs 10% vs. NPIs 5%). Otherwise survey respondents, unlike focus group participants, did not mention the possibility that long-term arsenic consumption might be fatal. A far greater percentage of PIs (288, or 69%) responded to the question about arsenic-related symptoms than did NPIs (93, or 34%). Among those who did answer this question, 6% ($n = 16$) of PIs said they did not know of any physical problems that might result from arsenic, compared with 16% ($n = 15$) of NPIs.

Colour markings

Perceptions of the colour-marking system can be problematic. While most focus group participants were found to have grasped the idea that red paint on a HTW spout indicated 'bad' water and green paint indicated 'good', focus group discussions revealed flaws in the approach that might interfere with universal acceptance or understanding in the future. One thing to keep in mind is that such colour interpretation itself is a new idea to some people.

The programme's use of a red question mark to indicate doubtful arsenic HTW water content confused everyone except regular users of such HTWs. The symbol itself is not familiar to illiterate people, who mostly refer to it as a 'number one' or 'small mark'.

Fading of HTW paint colours

One key to the programme's effectiveness has been its combination of visual and verbal communication. At the HTW testing event testers checked the water, painted the HTW spouts *and* explained to users the meaning of these actions. Within 6 months, after the seasonal rains, however, HTW spout colours had faded or even disappeared. Survey findings showed that the fading of paint colour interferes with accurate identification of a tube well in use, even among those who use it more than once a week. It seems likely also, that even HTW caretakers may lessen their efforts to explain about arsenic to other users if vivid paint colours are not there to stimulate users' questions and remind them to explain.

Changes in water-use habits

Cooking vs. drinking

According to focus group participants, people are more likely to change their water drinking habits than their cooking habits. Among survey respondents, knowing the meaning of red paint on a HTW spout was found to significantly influence drinking behaviour and rice-soaking (*pantha bhat*) use, but not cooking behaviour. In terms of infectious disease risk, cooking practice is much less problematic than drinking water, since cooking involves boiling water and killing pathogens. In the case of arsenic-contaminated water, however, cooking may be more dangerous than drinking, because boiling arsenic-contaminated water increases the concentration of arsenic.

Combining domestic water sources

Use of multiple water sources for different purposes is normal in Bangladesh towns. The typical pattern in the less arid regions is to use HTW water for drinking, and river or pond water for cooking and bathing. Instructions to seek safer sources of drinking water were heeded by some, but not all, PI survey respondents. The study found people seeking various kinds of water alternatives to arsenic affected HTWs, as indicated in Table 1.

Green HTWs

Study findings demonstrate that advice to drink only Green HTW water has been followed by some, but not all, Red/Red-Q using PIs. The user survey found that 28% had shifted to Green HTWs as a supplementary source of drinking or cooking water.

Caretakers in focus groups made a number of statements to the effect that, difficult as it was to deal with increased numbers of people coming to use the (project-provided) HTWs, they had a social responsibility to share. They backed up their comments with Bengali sayings such as, 'Water is life', or 'You can refuse food or money, but you cannot refuse to give water'. Initial HTW sharing arrangements among fixed groups of households, however, have expanded to the point where some are out of control. Caretakers complain of excessive wear on equipment, new users not cleaning up after themselves and people coming at late hours. One participant used a Bengali expression to describe the situations that can develop: "Twelve people, thirteen minds".

Another problem with Green HTWs as the preferred alternative is that they are not available in all parts of a town. Certain neighbourhoods have all Green or all Red/Red-Q types. Some focus group participants said that in their areas there were simply not enough Green HTWs to meet the greatly increased demand.

Sharing water points

It is common to hear Red/Red-Q HTW users say that they have no other source, even if neighbours have Green HTWs. Some unpleasant realities of water source sharing are still fresh in people's minds. Tempers often flare up if users take too long to collect water or fail to clean up after themselves. For people plagued with such daily aggravation, having a water source of one's own has represented convenience, dignity and all-important peace of mind. Thus, when people say they have no other source, they may actually mean that they have no other *tolerable* source. Unless social conditions are favourable, a return to sharing will be perceived by many as a most unfortunate reduction in the quality of life.

Piped supply water

There is widespread interest in piped supply water, but many cannot afford it or do not live in areas reached by piped supply lines. Poor people were found to be significantly less likely than others to consider taking a piped supply connection, presumably because they do not want to pay water bills.

Surface water

Some officials are concerned that if people learn that their HTW water is arsenic contaminated, they may return to the earlier practice of drinking surface water. Focus group findings were very clear on this point: there is no panicky return to drinking pond or river water. Some have started cooking with surface water again since hearing about arsenic, but no adult mentioned drinking it.

Table 1. Alternative cooking or drinking water sources used by programme influenced (PI) and non-programme influenced (NPI) red/red-Q hand-pumped tubewell (HTW) users (multiple responses)

	PI (n = 228)		NPI (n = 74)		Total (n = 302)	
Alternative source mentioned	No.	%	No.	%	No.	%
Green HTW	64	28	7	9	71	24
Unmarked HTW	55	24	24	32	79	26
Piped supply	32	14	6	8	38	13
Pond	56	25	14	19	70	23
River or canal	23	10	14	19	37	12
Rain water	2	1	1	1	3	1
None: use this source only	64	28	27	36	91	30

Children's comments, however, do raise this possibility. Unlike the women of their mothers' generation, 6–8% of the 48 children interviewed think that untreated surface water from ponds or rivers might possibly be safe water. A few (8%) know that it is a good idea to boil surface water before consuming it; but at least an equal number of others do not. Most children have no opinion. These findings are cause for concern. Children now aged 10 to 12 years are starting to learn about 'safe – unsafe' water at a time when the public information focus is on arsenic, rather than on prevention of diarrhoeal diseases and other water-related infectious illnesses. The arsenic crisis, as serious as it is, must not be allowed to divert attention away from risks posed by water-borne diseases.

Domestic water treatment

The user survey found only 26% of PI respondents using Red/Red-Q HTWs to be doing any form of water treatment whatsoever. No more than 11% are using the recommended technique. A similar lack of enthusiasm for domestic water treatment was observed among some (but not all) focus group participants. It takes too much time, they said. Water becomes warm after standing for the recommended time, and cold water is preferred for drinking. Too many water storage containers are required. And people simply do not have the habit of doing it. Several commented that they felt safer collecting arsenic-free water from some other source instead of performing the suggested procedures.

While several women objected to domestic water treatment for the above reasons, other focus group participants expressed happiness that there was *something* they could do to fend off arsenic-related illnesses, or as one focus group participant put it, to 'rescue ourselves'.

Reliance on unmarked, untested HTWs

Focus group discussions and the user survey alike documented a turn to the unmarked, untested HTW as an alternative water source. As some women remarked, the arsenic content of such water is unknown, but the lack of a red mark leads some to assume (or hope) that it might be safe. More than one-quarter of all Red/Red-Q HTW users supplement their normal source with drinking or cooking water from unmarked HTWs. Almost all unmarked and untested HTWs in the six towns are privately owned. Assuming that the water of privately owned HTWs is as likely to be arsenic contaminated as that of nearby project or public HTWs, the tendency to rely on them is unwarranted and unwise. Full-scale HTW water testing is still non-existent, even in highly arsenic-affected areas. According to focus group participants and other information sources, many private HTW owners trying to arrange tests find public officials and agencies unable or unwilling to test their domestic water.

Social aspects of the arsenic crisis

This study has shown that people's social or economic circumstances must be taken into consideration when developing a communication programme.

Gender is one important consideration. Women are more likely than men to think that arsenic-related disease is hereditary or contagious, as Figure 3 indicates. This idea in itself, of course, has powerful implications for marriage arrangement and other social relationships, as whole families might be stigmatized by the arsenic-related illness of one or more members.

Another gender consideration is the social assignment of water management roles. In the majority of households, women have responsibility for water collection and storage; so they are the ones who need to understand about arsenic risks and household-level mitigation measures. Focus group participants pointed out a problem, however: that in some families, women's authority is too weak to command the attention of male household members. So there is a need to bolster that authority. Use of the UNICEF/DPHE brochure (referred to as a 'book') seems to have done this for many of the programme's female HTW caretakers.

Education is another factor influencing people's responses to the arsenic crisis. Women are generally less educated than men at all socioeconomic levels. Educational disadvantages, which also are directly associated with low economic status in Bangladesh society, were overcome to a large part by the programme's efforts to communicate with poor people.

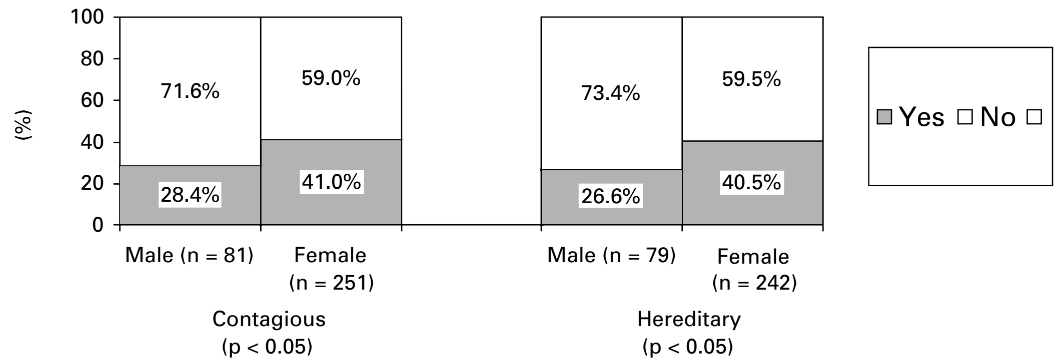

Figure 3. Men's and women's responses to questions about whether arsenic-related illness is contagious or hereditary[a] ([a] 'Don't know' responses excluded)

Better-educated people were found to be more likely to understand the mechanisms of arsenic poisoning. But people influenced by the programme (PI), even if not educated, *also* were found to be significantly more likely to understand about arsenic than others (NPI).

Economic status affects a family's ability take advantage of safe alternative water sources. It is middle or high income households who turn to the piped supply water alternative. Poorer families are more likely to depend on one Red/Red-Q HTW as a sole water source than are others. This may have something to do with the above-mentioned problems with *sharing* water sources.

Urban arsenic problems, especially those of the numerous 'secondary towns' (those other than the four large Bangladesh urban centres), deserve more attention than they presently receive. Urban populations such as those in the six towns supposedly have easier access to information and more water supply options than do rural populations. Piped supply connections, however, are found only in core areas. Everyone else drinks HTW water.

It must be kept in mind, furthermore, that access to urban options is influenced strongly by social perceptions and neighbourhood environments. The comment by one Narail focus group participant illustrates this point: she said that a HTW was 'far away' if it was more than three or four compounds (*baris*) distant.

Some *other social factors* relevant to the arsenic crisis have not been covered by this study. One, for instance, is nutritional and health status. People who are malnourished may be more vulnerable than others to chronic arsenic poisoning. Another social consideration is daily working conditions. People doing heavy labour – agricultural labourers or construction workers, for example – drink large quantities of water and so may be at higher risk than people with less physically demanding occupations.

Conclusions

In the absence of large numbers of recognized patients, people's only sources of information will be mass media, brochures and posters, and local campaigns of the type conducted by the project.

Considering the organizational resources dedicated to the effort and the personalized and detail-oriented communication approach, this programme may be considered a suitable *initial* public education effort. The awareness campaign's messages have reached almost two-thirds (61%) of the six towns' populations. That a high percentage of respondents (81% of all PI) mention the programme's community outreach staff as a source of information on arsenic shows the importance of a personalized approach. Study findings, however, generate as many new questions as answers. People's behaviour, of course, has not changed to a satisfactory extent. The findings of this study therefore demonstrate both the value *and* the challenges of communicating with the public about the arsenic crisis. As the evaluation study shows, if future arsenic mitigation projects are to reach acceptable public health results, it would be necessary to do these things *and more* in all arsenic-affected areas of the country. More public information, more campaigns and continual, vigorous, *personalized* follow-up services are urgently needed.

Although the 18DTP's public education programme did not *eliminate* risky water use behaviour among those (PI) people it reached, it did *reduce* risk. The differences between those who were and were not reached are dramatic enough to prove the value of combining all community-level interventions with carefully organized public education activities. As shown in Figure 2, among NPIs 85% were still drinking and 74% cooking with arsenic-contaminated water after area tubewells were tested and marked. If they do consume arsenic-affected water, only 2% of NPIs try to treat the water. As Table 1 demonstrates, NPIs are more likely to depend entirely on an arsenic-contaminated tube well than PIs. If they do seek out alternative sources, only 9% of NPIs using Red or Red-Q HTWs go to Green HTWs as alternative sources. And NPIs are more likely to go to unmarked HTWs as alternatives than PIs. These differences show that an expanded and improved public education programme is essential to ensure that the Bangladesh public, especially those with low education levels, will benefit fully from future technological improvements.

There is a serious need to figure out what makes public education programmes effective. This need is at least as great as the need to find technical solutions to the arsenic problem. The experiences of this project and others to date suggest a few principles of effective public communication about arsenic in Bangladesh:

- Use the water testing event as an opportunity to inform HTW users about arsenic. Communicate respectfully.
- Re-test and repaint HTWs regularly. Help people to stay informed about the quality of water in their HTWs.
- Offer opportunities for people, especially those who cannot read, to ask questions about arsenic.
- Explain that arsenic and iron are different problems, and that arsenic is not a 'germ' that can be killed by boiling the water.
- Take people's preferences into account when recommending drinking water treatment options: e.g. people like to drink cool, fresh, clear water.
- Repetition is important. Memory and motivation fade with time, even when staff are hired to remind people of what they have learned. Check to see if people are taking needed precautions.
- Continue to educate children about the serious health risks of consuming surface water.
- Children can be family or community change agents. However, a school programme without a related community information campaign is not likely to succeed, because of children's limited cognitive ability to organize complex information. Children *and* their parents should be educated at the same time.
- Rather than uncritically accepting claims that educational programmes are effective, carefully monitor them; and

periodically evaluate the larger programmes using proven research methods.

Endnotes

[1] The authors have conducted interviews with other organizations working on the arsenic problem. The following individuals kindly provided information on their organizations' arsenic mitigation activities: Shafiul Ahmed (UNDP-World Bank water and sanitation program, and BAMWSP), Mr J K Baral (Proshika, 2000), Adèle Beerling (DASCOH/Watsan Partnership Project, 1999 and 2000), Sirajul Hoque (CARE-SAFER, 2000 and 2001), Shirin Hussain (UNICEF, 1999 and 2000), Elizabeth Jones and Mr Adil (WaterAid, 1999 and 2001), Dr Wadud Khan (NIPSOM, 1999), Dr Milton (NGO Forum for Drinking Water Supply and Sanitation, 1999), Mr Mizan and Zahed Hossain (BRAC, 1999), Peter Ravenscroft (Mott MacDonald, 1999), and Jens Thøgersen (DPHE-Danida, 1999).

[2] Randomly sampled field test results were verified with laboratory tests often in combination with repeated field checks with other Merck kits, or repeated checks with another type of kit (NIPSOM). While 92% of the 49 laboratory tests confirmed the results of the Merck kit, in four cases (8%) laboratory tests produced different results (three cases recorded lower arsenic concentrations, one case higher) than the field findings from the Merck kit (van Agthoven et al. 1999: 11, 51–52).

[3] A seventh town, Shariatpur, also had an arsenic problem in shallow aquifers, but the project had not installed any shallow HTW there. Thus it was excluded from the first round of public information activities. An Arsenic Week programme was conducted in Shariatpur in December 1999.

[4] The survey was conducted by the Praxis organization under the direction of Mr Mohidul Hoque Khan.

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Biographies

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