Beyond medical treatment, arsenic poisoning in rural Bangladesh

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Abstract

Millions of drinking water supplies in Bangladesh are contaminated with potentially lethal levels of arsenic. This discovery in the late 1990s sparked widespread international concerns and generated a substantial amount of funds. Yet, after more than a decade, the provision of safe water supplies and accessible arsenicosis treatment schemes remains inadequate. A lack of understanding of the origin and health impacts of arsenic is one of the many obstacles at the community level. There is evidence that arsenic poisoning affects particularly the poor due to their malnutrition and low health status. Moreover, technologies and medicines for treatment are often unaffordable or unavailable to them. Interventions in the water and health sectors must not only address these inequalities, they must also be integrated. It has long been established that treatment is of no use unless people first have access to safe water. The reverse is also true; shifting to safe water is often not sufficient to detoxify the blood and organs affected by years of gradual poisoning. A safe water supply must go hand in hand with long-term medical support for existing patients. This raises serious doubts about the sustainability of many of today's efforts. Our paper describes the challenges by drawing from our experiences working with some of the poorer arsenic affected villages in rural Bangladesh.

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Introduction

Uncovering a major environmental health hazard

40 years ago, public health programmes revealed that unhygienic surface water was responsible for over half of the deaths of children under five. In the following decades families all over Bangladesh purchased and installed shallow tube-wells (Box 1). No one realised that this major shift to groundwater would expose people to a new contaminant. Arsenic, present in most of Bangladesh's shallow aquifers, is pumped up by two-thirds of all the tube-wells.

The figures are uncertain (AFP 2010), but studies have asserted that 18 to 35 million people have been drinking this 'slow poison' for many years, based on the Bangladesh Drinking Water Standard (BDWS) of 0.05 milligrams per litre (mg/l) (BGS and MMD 1999; BGS and DPHE 2001). Shifting from the BDWS to the World Health Organisation (WHO) guideline of 0.01 mg/l nearly doubles the population estimated to be at risk (Smith, Lingas et al. 2000). These figures could increase when taking into account the additional poisoning by arsenic-irrigated food (Huq and Naidu 2004; Huq, Joardar et al. 2006; Khan, Islam et al. 2010).

A crisis of governance

The 2004 National Policy for Arsenic Mitigation incorporates plans for both the provision of safe drinking water and the management of arsenicosis patients. On the ground, there is little actual integration of these policies; local government agencies in the water and health sectors still operate largely in isolation. Each sector is also facing its own challenges. Our views on some of the difficulties with current drinking water policies have been described in Rammelt (2009). Arsenic-related activities in the public health sector are undertaken under the Ministry of Health and Family Welfare (MHFW). The activities include the development of

education materials, treatment protocols, training of health professionals, and patients' identification (Kaufmann, Sorensen et al. 2001). A general weakness is the sector's limited capacity at the local level (MHFW 2004; Sengooba, Rahman et al. 2007). Besides its generally urban-biased policies, the administrative structure is hierarchical and bureaucratic, and down towards the village level, its executive capacity to act according to local priorities is largely dissolved. Even if the physical infrastructure is there, the public often reports on a lack of commitment from medical staff.

The arsenic crisis can therefore be seen as a crisis of governance. There is an urgent need to learn from local experiences and scale up potentially successful approaches for managing arsenicosis patients in conjunction with the provision of safe drinking water.

A pathway for implementation

Since 2005, the Arsenic Mitigation and Research Foundation (AMRF)[1] implemented projects in several severely arsenic-affected villages in the districts of Jessore and Munshiganj. Among the different technical solutions, we found an overwhelming popular preference for deep tube-wells. These serve as quick mitigation – in other words, an end in itself.[2] Deep tube-wells are also the means upon which people have started building their own community-based institutions. These not only look after operation and maintenance, but also encourage activities in other sectors of development, such as sanitation, education or village infrastructure. These initial steps have brought about a dialogue with local communities and created the necessary room to explore other dimensions of the arsenic problem, particularly its health aspects.

The process of implementation of the water supplies and their institutional arrangements at the village level has been described elsewhere (Rammelt 2002; Rammelt and Boes 2004; AMRF 2005; Rammelt and Boes 2005; AMRF 2006; Rammelt and Boes 2007; Rammelt and Boes 2008; Rammelt 2009). The focus of this article is on our experiences with the socio-economic dimensions of arsenic, the identification of potential arsenicosis patients, their diagnosis, their treatment and a potential course of action for the long-term.

Box 1:
A local perspective on the discovery of arsenic.

When were the first tube-wells installed in this village? *"When I came to live here 18 years ago, there were only two tube-wells. Most people relied on river water."*

If you had tube-wells in your village, why did you use river water? *"We knew that river water was unhealthy, but we also knew that boiling it made it safe. Also, the owners of the tube-wells were annoyed when we used them too often."*

How many tube-wells do you have in your village now? *"About thirty; every family has one. But we only have three tube-wells that are free of arsenic."*

So you know about arsenic. When did you first hear about it? *"Five years ago. People came here and tested the water. They painted the contaminated tube-wells with red paint, and the arsenic-free ones with green paint. They told us we could only drink from the green ones."*

Villager, 70 years old, Kumerbhog, 20-06-07

Socio-economic dimensions of arsenicosis

Poverty worsens arsenicosis

In the past, illnesses directly ensued from drinking unhygienic surface water. A complicating factor in this new situation is that arsenic occurs in such low doses that health impacts may take years to emerge (Box 2). It becomes very difficult to find ways to deal with this particular problem when the poor have so many other competing and urgent priorities.

The susceptibility to arsenic related illnesses is likely to be higher for the poor given their malnutrition and low health status[3] (Crow and Sultana 2002;

[1] See http://www.peopleandwater.org.

[2] We are aware of the long-term uncertainties around water supplies based on the deep aquifers and of the possible need to switch to other technologies. These risks are described in Bruining, Ahmed et al 2008.

[3] Malnutrition impedes and weakens the body's defense system. In 2004, 84% of children under the age of five were still considered malnourished (FAO 2004). The poorest households are food insecure for over 8 months a year and more than 50% reduce their meals to two a day in the lean season (CARE and DFID 2002). This is the result of a downward trend (FAO 2004).

Howard 2003; Hanchett 2006; Atkins, Hassan et al. 2007). Patient screening to date has been done without collecting socio-economic information on patients; the only reliable information on the relation between vulnerability to arsenic and poverty comes from limited local studies. In West Bengal, for example, Smith and Smith (2004) found approximately a doubling of the prevalence of skin lesions in households with the lowest intake of essential nutrients. Malnutrition is but one of the reasons the poor suffer most from this disaster. Other reasons are their inability to bear the costs of treatment and consultation with private medical practitioners, and their lack of connections to access and benefit from public medical services.

Arsenicosis worsens poverty

Alongside the health impacts, arsenicosis has serious socio-economic consequences. The poor rely almost entirely on their physical capacity or strength to make a living. For a Bangladeshi rickshaw driver, agricultural day-labourer or factory hand who does not own any other form of capital, his or her muscles and skills are the most basic productive assets for securing employment. In the absence of minimum wages, organised worker unions and social security, their livelihoods are already extremely vulnerable. The situation becomes worse when those affected by arsenic poisoning are suffering from sores, lesions and itching, and find themselves physically unable to conduct laborious work. This results in a reduction of income for the household. (Hassan, Atkins et al. 2005)

There are other indirect impacts as well. People are frightened into a tendency to ostracise arsenic-affected people. In the early stages of the discovery of arsenic, people developed their own views on the matter. They believed that symptoms on the bodies of arsenicosis patients were due to unhygienic habits or sin; they sometimes believed that the village was an evil place or that the air was polluted (Shafie 1999). Nowadays, people generally know about the presence of arsenic in the water and see it as a serious concern. On the downside, the understanding of external (scientific) knowledge regarding the exact causes and effects of arsenic contamination has not improved much.

Arsenicosis is often thought of as a contagious or hereditary disease (Hassan, Atkins et al. 2005). The resulting social stigma may take the form of

Box 2:
Characteristics of arsenicosis

In its inorganic form, arsenic is a cumulative substance that slowly passes through the body to lodge in urine, hair, nails, skin and some internal organs. It is chronically toxic after prolonged low-level exposure and can lead to, roughly in successive order, changes to the colour of the skin (hyper- or de-pigmentation, see Picture 1), a thickening of the skin particularly on the palms and soles (keratosis, see Picture 2), skin lesions, skin and internal cancers, peripheral vascular disorders and neurological disorders (WHO 2001). Research suggests 2-9 years as the minimum latency for hyperpigmentation and keratosis. Latency for cancers is unknown, but estimated to be of the order of 20 years (Howard 2003). Manifestation will depend on many factors besides dosage.

Arsenic is not a bacterium for which doctors can prescribe a cure, and the scope for detoxifying the body is still uncertain. After a patient has switched to arsenic-free water, there are indications that antioxidants (vitamins A, C and E) and compounds containing zinc and selenium may reverse the poisoning in early stages, but this requires further controlled clinical trials (Howard 2003; Ahsan, Chen et al. 2006). A variety of treatments can relieve the symptoms of chronic arsenic poisoning, such as burning and itching sensations, but this is unresolved as well.

Picture 1 – Depigmentation.

Picture 2 – Keratosis

Location of Kumerbhog and Kanokshar.

Adapted from Banglapedia (2006).

exclusion by friends and family, from social events, and can lead to significant mental trauma. Widespread fears of contagion have also resulted in a loss of access to job opportunities. In one particular study area, employers even check the palms of labourers and reject those who show arsenicosis symptoms (Ibid.). We have observed similar cases in Munshiganj. Women displaying arsenicosis lesions also have difficulty finding work as maids, tailors or other jobs where they are in close contact with their employers. For female-headed households that are already much poorer than male-headed households (FAO 2004), this can have catastrophic consequences. Arsenic-affected women also experience difficulties getting or staying married, which often results in humiliation and dire economic consequences, especially if they are already poor (Hanchett 2006).

Understanding why some fall ill and others not

In 2006, AMRF and AITAM Welfare Hospital started work in the Munshiganj district, Lohajang sub-district. Kumerbhog and Kanokshar were the first two villages to be selected. The field staff started surveying, raising awareness on arsenic, installing an arsenic-free deep tube-well and selecting a community-based organisation. Participation of the poor was facilitated in all steps. There were significant challenges in this process, but the village communities are now sharing and looking after the water supply.

In the early stages of the programme, a curious difference was found between the neighbouring villages. The shallow tube-wells in Kumerbhog are less contaminated by arsenic than in Kanokshar[4], yet more people are affected (Table 2). This raises questions about the factors involved in arsenic poisoning.

Our first hypothesis was that a difference in socio-economic status was the distinguishing factor, as this generally indicates a difference in nutrition and general health. Yet, a socio-economic sur-

[4] The difference in arsenic concentrations between Kumerbhog and Kanokshar is possibly the result of geological variations. Differences in levels of contamination have been established over very short distances (BGS and DPHE 2001; Ahmed 2005; Ahmed, Ahuja, et al. 2006).

Table 1
Arsenic contamination and arsenicosis prevalence

Village	Population	Shallow tube-wells	Average arsenic contamination (mg/l)	Number of arsenicosis patients detected
Kumerbhog	1895	65	0.18	27
Kanokshar	1367	61	0.31	1

Data collected on 08/07/2010

Table 2
Socio-economic status in Kumerbhog and Kanokshar

Socio-economic status	Percentage of families		Monthly household income (taka/month)	
	Kumerbhog	Kanokshar	Kumerbhog	Kanokshar
Higher-middle	12%	13%	4,100-6,000	4,000-6,000
Lower-middle	37%	40%	3,100-4,000	3,000-3,900
Poor	42%	42%	2,100-3,000	2,100-2,900
Very poor	9%	5%	500-2,000	500-1,900

Source: AMRF and AITAM 2007

vey revealed this to be similar in both villages (Table 2, dated 08/07/2010). We also rejected the hypothesis that differences between occupations or religion were a factor; there is little difference between the villages (AMRF and AITAM 2007).

Eventually, a historical survey revealed that the period of settlement in the villages varies. A villager from Kanokshar recollects that when his family moved there approximately 15 years ago, there only 5 or 6 other families. The arsenicosis patient from that village says she has been drinking arsenic contaminated water for 9 years. On the other hand, the patients in Kumerbhog settled there on average 26 years ago (as of 2010). Even if the average age of the shallow tube-wells is around 11 years for both villages, patients in Kumerbhog report to have been exposed to the contamination for over 25 years on average, ranging from 7 to 55 years.[5] Although this is not conclusive evidence, the longer exposure to arsenic contaminated water in Kumerbhog would explain the higher number of people diagnosed with arsenicosis.

Beyond such historical factors, the economic gap between and within villages also seems to be a factor when explaining why some fall ill and others do not. We found a positive correlation between poverty and arsenicosis in our working areas. As we selected poor villages in the first place, it is difficult to compare between villages, but we can compare socio-economic groups within villages. In Kumerbhog, although it is only a superficial indicator of poverty,[6] income varies from 500 Taka per month (12 AUD or 6 EURO) to 6,000 Taka per month (144 AUD or 72 EURO). Patient profiles and economic surveys indicate a positive correlation between poverty and prevalence of arsenicosis. Out of 27 patients in Kumerbhog, 23 are 'poor' and 4 from the 'lower-middle' category' (see Table 2 dated: 08/07/2010). This is a general correlation for the rest of our working areas as well.[7] As explained, the link tends to work through malnutrition.

In Kumerbhog, 23 out of 27 patients are women. However, epidemiological studies to date pre-

[5] This is only a rough indication; it is difficult for people to remember exactly. Water was sometimes taken from the shallow tube-wells and sometimes from the river. Most shallow tube-wells were installed about 11 years ago on average. Before that, families were often sharing the first tube-wells. This may not have been happening throughout the year, but families are likely to have been exposed to arsenic for several years before they could afford to install their own tube-well (see Box 1).

[6] Criteria used for the survey also included landownership, education, ownership of livestock and type of house.

[7] Covering all our working areas in Munshiganj, as of 2008, we identified 34 patients of whom 18 earn less that 2,000 Taka per month, 15 earn between 2,000-4,000 Taka per month and only 1 earns over 4,000 Taka per month.

sent somewhat contradictory information on the different ways that arsenic affects men and women. Women of all groups generally have lower status and less social value than men. Women tend to eat last and least in their households. Therefore, if they live in poor families, they are the most likely family members to be malnourished (Hanchett 2006). This seems to imply that arsenic contamination has more severe physiological consequences for them (Crow and Sultana 2002). There are many other factors to consider. After marriage, it is common that the wife moves to the husband's village and house. Exposure to arsenic therefore differs within couples. It is also possible that women feel shy to be diagnosed by male health workers. On the other hand, men may not be identified by doctors, because they work outside the village, or might be exposed to arsenic differently because they drink water from another water source during the day.

The lesson is that an understanding of why some fall ill and others do not is both complex and uncertain. One must take into account geological, socio-economic, cultural, gender, religious and historical factors.

Implementation of a health care scheme

Access to arsenic-free water is imperative. But as we found out, it is also insufficient to counteract chronic arsenic poisoning. Installation of the deep tube-well in Kumerbhog was completed in September 2006, and people quickly stopped using their arsenic-contaminated shallow tube-wells. Yet, new patients are diagnosed even 3 to 4 years after the shift to safe water. It is possible that they are only now coming up, because they have developed a relation of trust with the project staff. But, we suspect that it is mostly because arsenic poisoning accumulated over a long period, and because of the extended latency of arsenicosis.

One lesson is that snapshot surveys about the number of patients in a particular village or region are not conclusive. Another is that arsenic mitigation efforts that only focus on installing safe water technologies without paying attention to the treatment of arsenicosis patients are insufficient.

We now present a possible approach for identification, diagnosis and treatment.

Identification and diagnosis

The field staff were trained to recognise the symptoms of arsenic poisoning. Regular meetings with the community for the implementation of the new water supply opened up opportunities to perform preliminary diagnoses. Potential patients were invited to attend a consultation for further diagnosis by a medical doctor at one of the field offices. The tendency to conceal physical symptoms of arsenic poisoning to avoid a social stigma may have left patients undetected at the start of the programme. In time, with increased trust and with the efforts to reduce some of the misconceptions about the disease, the number of people approaching the staff went up.

The identification of arsenicosis is problematic in itself. Changes in skin colour and the thickening of skin on the palms and soles are possible markers of arsenic poisoning, but may also be normal characteristics of a hard working rural population (Caldwell, Caldwell et al. 2003). For one particular patient, arsenicosis manifested itself as cracks on her soles and these became infected. She was treated with antibiotics and started wearing slippers. It did not eliminate arsenicosis, but at least she was able to work again. It is also conceivable that the effects of arsenic might worsen if someone already suffers from other afflictions of the organs affected by arsenic, and vice versa.

In highly contaminated areas, people without external symptoms might still have internal problems. A full diagnosis may sometimes require clinical pathology tests from hair or nail samples. A biopsy may also be needed for the examination of tissue and suspected tumours. Unfortunately, such costs cannot be borne by the rural poor.

Treatment

AITAM runs a hospital in Dhaka and a field clinic in Munshiganj, but to be closer to the working villages it has a set-up for diagnosis in each field office under the AMRF programme. In an ideal treatment schedule, a medical doctor goes to the field offices once a month to diagnose new patients and follow up on existing patients. From the start, records are kept to monitor changes in the patients' conditions. The staff must handle this information with care due to the risks of social stigma. Medicine is provided on a weekly basis to avoid that patients sell it instead of taking it. Treatment consists of anti-oxidants (vitamin A, C and E), folic acid, anti-histamines against itching and salicylates

Images: Carcinoma before (left) and after surgery (right)

to treat skin lesions. We are following a standard schedule of three months treatment followed by a two-months' breaks in treatment (to avoid toxic accumulation of vitamins). We found that during these interruptions, symptoms sometimes reappear, although less severely.

In some cases, regular treatment is insufficient and serious patients have to be referred to a hospital. In an early stage, tumours can be safely removed surgically. But without assistance, and in the absence of work and medical rights, this is inaccessible to the poor. In one case, the cost of surgery on a carcinoma went up to 40,000 Taka, excluding the foregone income for days missed at work, transportation costs to the referral hospital in Dhaka, food and other incidental expenses for the patient and its carer. So far, only one patient was hospitalised, but more are currently under consideration. The programme currently pays for the operation, but the patients are asked to share in transport and food cost. The AITAM hospital is one of the few in Dhaka to provide cooking facilities so that patients and carers can avoid expensive outside food. Such seemingly small provisions make substantial differences for the poor.

Treatment at the field level is also provided for free. AMRF spends on average 200 Taka (4 AUD or 2 EURO) per patient per visit on medicine alone, which goes beyond what the poor can afford. Moreover, these are not one-off expenses; patients must attend consultations and take medication over an extended period of time. At this level of socio-economic development, the time lost for visiting the clinic is already quite demanding. Moreover, from an ethical, as well as a practical point of view, it is extremely difficult to differentiate arsenicosis from other associated diseases and hence decide how far to go in treating these, especially as many are intricately linked to arsenicosis. Finally, by focusing only on arsenicosis, there is a risk that patients with multiple conditions drop out of treatment because they feel dissatisfied with the overall health benefits. Hopefully, parallel improvements in sanitation will reduce other skin diseases. Some of these efforts in the AMRF working areas have been described by Rammelt and Boes (2007).

Unfortunately, including in our programme, many patients stop attending follow-up consultations. They may not be committed, or cannot be. In Kumerbhog, only 14 out of 27 patients have been regular patients for the last few years.[8] When there is some relief of the external symptoms, other daily problems may receive priority over treatment of arsenicosis. Patients sometimes resume treatment when symptoms reappear. Counselling and motivation from doctors and staff may help a little, but preventive activities need to be developed as well, such as improving nutrition by developing food security and vegetable gardening at the community level.

Conclusions

One conclusive finding is that giving away medicine without ensuring access to safe water supplies, and without follow-up treatment, as many organisations unfortunately do[9], is inadequate; medical care must be integrated with provisions for safe drinking water and it must be long-term. This

[8] By 'regular', we mean someone following the 3 months treatment and 2 months interruption schedule. Four patients are irregular, which means that they come to collect treatment for a few weeks and stop for a few months. Nine patients have discontinued treatment after 1 or 2 months.

[9] In some cases, organisations distribute cash instead of medicine. This has the negative effect of generating the wrong expectations with people.

poses a serious challenge for small initiatives with limited resources.

As arsenicosis is linked to poverty, health and nutrition, homestead gardening could be a more structural way of addressing the problem. Particularly for the landless poor who generally do not produce food for themselves, this could help to slow down the impact of arsenic poisoning. It is important to select those fruits and vegetables that contain the elements needed to help the body get rid of the accumulated arsenic. Although the causal relation with vegetable gardening would be hard to prove, a few years into the programme, the poor in some of the working areas seem to suffer less from arsenicosis. The scenery in Kumerbhog and Kanokshar has changed quite radically since many families started planting fruit and vegetable gardens on small plots of land near their homes. Training has been organised on how to harvest and keep seeds, on the nutritious quality of different food, on how to improve cooking practices to preserve vitamins, on how to produce compost, produce protein-rich mushrooms, and so on.

Finally, the identification, treatment and monitoring of patients is now in the hands of AMRF and AITAM. In terms of the sustainability of these activities, the question is whether they could be handed over to the community. Villagers commonly get medical advice from traditional healers who do not have any formal medical background (Shafie 1999). As part of our programme, AITAM paramedics visit the working areas to provide informal training on arsenic to these local practitioners. This is a first step towards community-based health care schemes.

"[T]he best treatment for arsenic would be to cure poverty since it is people in the lowest income quartile and the malnourished who are most susceptible to arsenicosis" (Atkins, Hassan et al. 2007, p. 2707). Until that happens, there is a need for external and targeted health support for the poor.

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