HSB

Health and Science Bulletin

VOLUME 5 • NUMBER 3 • SEPTEMBER 2007
ISSN 1729-343X

Inside

Responding to the 2007 floods: Record numbers of patients seek care at ICDDR,B's Dhaka Hospital

This summer, Bangladesh was seriously affected by heavy monsoon rains and associated flooding. As usual, these floods were associated with mass outbreaks of water-borne disease. ICDDR,B's Dhaka Hospital, which specializes in care and treatment of diarrhoeal patients, experienced record-breaking numbers of admissions in August; 21,401 patients were admitted. Although 70% of patients arrived with severe dehydration, no deaths occurred in hospitalized patients due to diarrhoea or dehydration during this time. Thirty-five percent of patients during the height of admissions were diagnosed with cholera and 12% with rotavirus, based on a 2% random sample. The strains of *Vibrio cholerae* isolated were especially virulent. Based on the high percentage of patients admitted with severe dehydration and cholera, we estimate that 6,000 lives were saved in August due to the free, effective treatment provided. Aggressive rehydration remains the most important life-saving treatment for patients presenting with diarrhoea.

icddr,b

KNOWLEDGE FOR GLOBAL LIFESAVING SOLUTIONS

This summer, the Asian sub-continent experienced heavy monsoon rains and associated flooding. Bangladesh has been seriously affected, not only because of heavier than usual seasonal rains, but because of the cumulative effect of heavy rainfall throughout the region which has swelled rivers flowing through Bangladesh to dangerous levels. A comparison of the number of days that rivers have surpassed danger levels between 2007 and past flood years conducted by the World Food Programme concludes that the flooding of 2007 was an above average year for flooding, but it was not as severe as flooding in 2004, 1998 or 1988 (1). Nonetheless, reports estimate that tens of millions of people have been displaced.

Bangladeshis are familiar with severe flooding and the numerous crises that usually accompany such natural disasters, including water-borne disease. This year multiple outbreaks of diarrhoea have been reported from flood affected areas. In Dhaka, flood waters were not as disruptive as in 2004; however, they have been sufficient to spread water-borne disease throughout the metropolitan area.

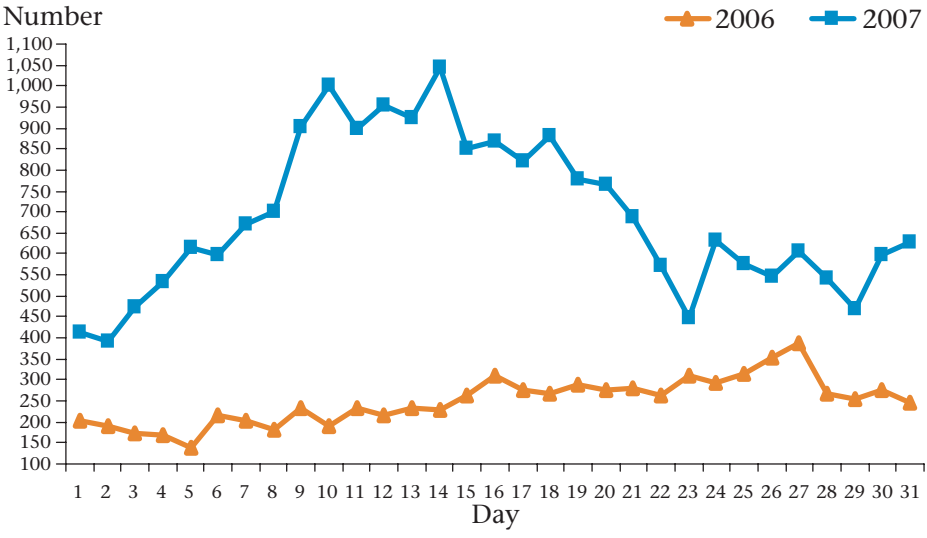
ICDDR,B's Dhaka Hospital is specialized in the treatment of diarrhoea, and has been serving the Dhaka community since 1962. Patients who are able are requested to pay Tk 30 (US$0.45) to cover their treatment costs. Patients unable to pay are treated for free. The hospital is frequently challenged to cope with increased patient admissions during seasonal floods. Every fiftieth patient (2%) who presents to the hospital has their stool cultured for bacteria, tested for rotavirus and other parasitic enteric pathogens to provide ongoing surveillance on causes of diarrhoea throughout the year in Bangladesh and bacterial antimicrobial resistance patterns.

The Dhaka Hospital began to see significant increases in patient admissions beginning the first week of August 2007. By the second week of August, patients were being admitted to the hospital in record numbers (Figure 1). A new record number of daily admissions was set on 14 August when 1,045 patients were admitted. From 1-31 August 2007 the hospital provided treatment to 21,401 diarrhoea patients; this is almost three times the number seen over the same period in 2006 (7,214). The majority of patients reside in the Dhaka metropolitan area; 85% of patients admitted to the hospital from 8-15 August were from Dhaka and 42% of all patients were from Badda, Sabujbag, and Khilgaon thanas. Of those traveling from outside Dhaka, half were from Tongi or Keraniganj thana. During this time, all patients received care free of cost.

Patients admitted to the hospital in August were more severely ill than those who seek treatment during non-flood times. Indeed, 26 patients were dead on arrival to the hospital in August. Over 70% of patients ≥5 years of age presented to the hospital with severe dehydration (based on modified WHO definition) (2). Despite this, there were only 14 patient

deaths from 1-31 August and none of these deaths were due to dehydration or diarrhoea.

Figure 1: Number of patients reporting per day to the Dhaka Hospital, August 2006 and 2007



From 8-23 August, during the height of patient admissions, 35% of patients admitted had a laboratory diagnosis of cholera, 15% of enterotoxigenic *Eshcerichia coli* (ETEC), and 12% had rotavirus; prevalence varied by age group (Table 1). No organism was detected in specimens from 45% of patients tested; in 7% of patients more than one pathogen was identified.

Cholera patients were infected with both Ogawa and Inaba sub-types of *Vibrio cholerae* O1, El Tor (Table 1). These organisms remained susceptible to ciprofloxacin in vitro, as determined by the Kirby-Bauer method, but were somewhat resistant to tetracycline, and 100% resistant to sulfatrimoxazole and furadolizone. (see Surveillance update in this issue) Nineteen strains of cholera were isolated during the peak of the outbreak and their phenotypic and molecular traits were extensively studied. Although the bio-type was El Tor, they exhibited characteristics of the classical bio-type cholera toxin, including 7 markers of virulence. Most ETEC organisms showed multi-drug resistance and remained highly susceptible only to furazolidone (100%), mecillinum (100%), and ceftriaxone (95%).

Reported by: Dhaka Hospital and Laboratory Sciences Division, ICDDR,B

Supported by: ICDDR,B's core donors (see page 21)

Table 1: Causes of diarrhoea in patients admitted to the Dhaka Hospital by age based on a 2% systematic random sample, 8-23 August

Aetiologies	Total (N=252)	<5 years (N=98)	⊠5 years (N=154)
Vibrio cholerae O1	35%	21%	44%
Inaba	20%	14%	24%
Ogawa	15%	7%	19%
Shigella	1%	2%	0%
Salmonella	1%	2%	0%
ETEC	10%	13%	8%
Rotavirus	12%	28%	2%
E. histolytica	1%	0%	1%
Giardia lamblia	2%	1%	3%
No pathogen identified	45%	44%	46%
More than one pathogen identified	7%	21%	4%

Comment

At the beginning of August, the Dhaka Hospital was expanded by tents into the main campus parking lot to accommodate the record number of diarrhoea patients seeking care. Physicians working in all of ICDDR,B's divisions joined the hospital's clinicians in treating these patients. Based on the high percentage of patients admitted with severe dehydration and cholera, we estimate that 30% of patients admitted to our hospital would not have survived without the free, effective treatment they received. Thus, we estimate that approximately 6000 lives were saved in the Dhaka Hospital in August. The number of patient deaths during this period was remarkably low and none were due to dehydration or diarrhoea. This is especially impressive considering that more than 70% of patients presented with severe dehydration which is more than double seen in the past three flood years (3). Taken together this demonstrates an approach that can be used nationally to prevent diarrhoea mortality.

More patients were seen during this flood season than ever before in the hospital's history, despite numerous times in previous years where floods were more severe (1,3). One explanation for this could be that although floods waters were sufficient enough to spread diarrhoeal disease on a large scale, they were not so severe this year as to prevent people with diarrhoea from seeking care. Another contributing factor may be the continued population growth of Dhaka placing increased numbers of low income households in settings with poor water and sanitary infrastructure. In addition, the strains of *V. cholerae* isolated during the peak of the outbreak were exceptionally virulent and could have contributed to the

increase in patient severity and numbers. These strains and their potential to cause epidemics have been previously reported in Bangladesh (4).

Cholera was the most common cause of diarrhoea during this flood season, followed by rotavirus. This pattern of disease is consistent with the pattern observed during the past three flood years of 2004, 1998, and 1988 (3). Surveillance reports and antimicrobial resistance patterns (published quarterly in the Health and Science Bulletin) can serve as a guide to local physicians who treat diarrhoea patients. However, resistance patterns and causes of disease can change quickly (5) and due to a lack of diagnostic support, the aetiology of diarrhoeal disease is rarely determined in most clinical settings in Bangladesh. Even at ICDDR,B's laboratory, no pathogen was identified in 42% of cases seen in August. Therefore, the recommendation is that, first and foremost, all diarrhoea patients receive aggressive rehydration therapy.

Severe flooding in Bangladesh will recur. Based on experience from the past 10 years, we would expect to have at least two years of extreme flooding coupled with massive outbreaks of diarrhoeal disease in the coming decade. These disasters tend to be treated as emergencies. However, they are predictable events and the human suffering and mortality is preventable. Vaccination against cholera would reduce disease burden. Mass distribution of water treatment of household supplies would reduce disease in flood affected communities. Ultimately, however, the poor of Bangladesh will continue to suffer from a heavy burden of diarrhoeal illness until safe drinking water and sanitation is widely available.

ICDDR,B wishes to publicly thank those individiuals and organizations who generously contributed and continue to contribute to our flood relief efforts in 2007.

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Health care utilization of adults with chronic cough and their management by private practitioners in urban Bangladesh

The current tuberculosis case detection in Bangladesh relies upon persons with chronic cough being seen at clinics implementing Directly Observed Treatment, Short-Course (DOTS), under the national tuberculosis control programme. A community-based, household survey in urban Dhaka was conducted to identify adults with cough of three-or-more weeks and record their health seeking practices. Among 60,382 adults surveyed, 1,138 (2%) reported a cough for 3 weeks or more, and 648 of them reported seeking care from a practitioner. Among care seekers, 16% directly attended a DOTS facility. The remaining 84% of initial care seeking was in the private sector; 44% visited unlicensed providers, 17% licensed providers, and 23% drug vendors or other healers. Despite reporting of wide awareness of DOTS programmes, less than 1% of chronic coughers seen in the private sector were referred to a DOTS facility. This study suggests that private practitioners are an under-utilized resource for TB case detection and do not currently utilize DOTS facilities.

In 2005, Bangladesh ranked fifth in TB burden among 22 high burden countries (1). Directly Observed Treatment Short-Course (DOTS) is currently the WHO advocated TB control strategy, however, the case detection rate under this programme remains low globally (60%) and in Bangladesh rates vary between 59% (1) and 71% (2). TB cases are detected as a consequence of interaction between the active care seeking of symptomatic individuals and the case finding activities of health care providers in health centres (3). Early symptoms in adults are usually mild, often starting with a persistent cough (4,5). A chronic cough of more than 2 to 3 weeks is therefore an important criterion for suspecting pulmonary TB among adults above 15 years of age (5). Although the majority of Bangladeshis seek care from private providers, including licensed and unlicensed providers (6,7), the specific care seeking practices of adults with a chronic cough and outcomes of care seeking is poorly understood. The purpose of this study was to describe the health care utilization patterns of adults with chronic cough and better understand the role of urban, private practitioners in their care.

Two surveys were conducted. The first was a household survey of adult chronic coughers living in Dhaka. The second, a survey of private practitioners practising in Dhaka and Chittagong.

Adults with chronic cough

Two administrative areas within Dhaka City Corporation were purposely selected; Kamalapur and Lalbagh. A census survey of households in Kamalapur and three wards of Lalbagh was carried out by trained field assistants. Adults aged 15 years or more with a history of a persistent cough for ≥3 weeks were identified and listed. Trained interviewers visited all listed individuals. They obtained consent and verified the presence of a persistent cough, and then conducted an interview. A second visit was made if the identified person was not at home at the time of the first visit. The interviews took place between March and August 2005. The interview obtained information about health care utilization histories, services received, treatment and referrals for either tests or to a DOTS or other facility.

Private practitioner survey

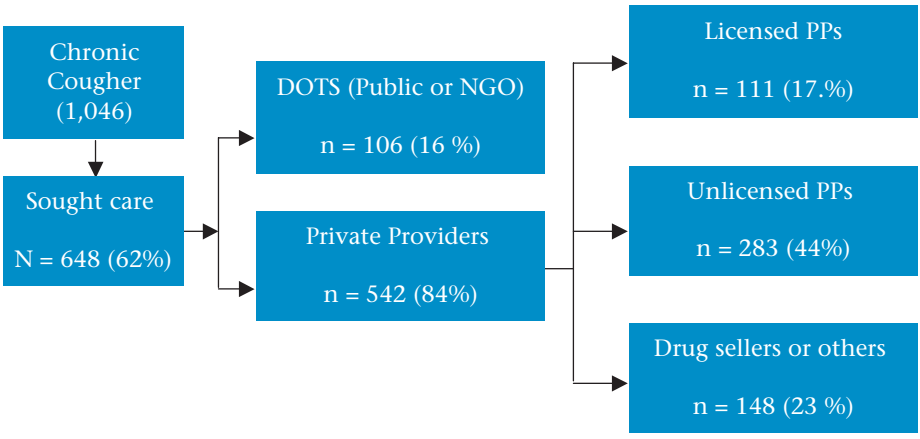
Both licensed and unlicensed health practitioners were surveyed in Dhaka and Chittagong at their chambers. In Chittagong, out of the total 44 wards, 18 of the most populated with the greatest numbers of providers were selected for the study. All providers located in the selected wards were approached. Practitioners with an MBBS degree were classified as licensed providers; all others were classified as unlicensed providers. Any provider practising allopathic medicine in a private chamber, receiving clients with a chronic cough and charging a fee was eligible. In Dhaka, a list of private practitioners was prepared based upon the providers named by adult chronic coughers interviewed. Trained research assistants interviewed non-licensed practitioners, while a medical doctor interviewed licensed medical practitioners. The interviews included information on their medical qualifications, specialization, TB management and practice, duration and type of practice, and knowledge about the DOTS programme.

The survey in Chittagong took place from September to December 2004 and in Dhaka from May to November 2005. Interviews were pre-scheduled and providers were compensated for their time following the interview.

A total of 60,382 adults were available during the Dhaka survey. Among the surveyed population, 1,138 (2%) persons reported cough for ≥3 weeks. Of the 1,138 identified chronic coughers, 1,046 (92%) were successfully interviewed. Of these, 648 (62%) sought care from any provider for this cough. Eighty-four percent (n=542) of initial care seeking was in the private sector. The remaining 16% (n=106) sought care at DOTS centres administered either by NGOs or the government without a referral. Among those who sought care from a private practitioner first, 44% (n =283) attended unlicensed private practitioners, 23% (n=148) sought care from pharmacies and other healers (ayurvedics and homeopaths), and 17% (n=111) from licensed practitioners (Figure 1). Among the 648 adults

seeking care, 26% (n=171) sought help from more than one provider.

Figure 1: Reported care seeking among adults with a chronic cough



Nearly one-third of chronic coughers reported only cough, 38% had additional fever, 53% had chest pain and 12% reported loss of appetite. Seventeen percent had been previously diagnosed with TB, and 20% could correctly recall 3 or more symptoms of TB (cough, fever, chest pain, night sweating, weight loss, loss of appetite, blood in sputum). The likelihood of seeking care from any private provider was somewhat higher among persons who were more educated, had more income, had a previous diagnosis of TB, were female, had three or more additional symptoms, or could recall three or more TB symptoms (Table 1). In 95-98% of cases providers prescribed one or more drugs. Fewer than 1% of those who first sought care from a private practitioner reported they had been referred to a DOTS facility (Table 2).

A total of 557 private practitioners were interviewed, 258 (46%) were licensed and 299 (54%) were unlicensed. A similar proportion of licensed (46%) and unlicensed practitioners (41%) reported that they suspected TB in adults presenting with a cough for ≥3 weeks (Table 3). Compared to unlicensed practitioners, licensed practitioners were more likely to inform the interviewer that they ordered chest-x-rays (96% vs. 81%) and prescribed drugs after investigations (64% vs. 4%), but less likely to refer patients initially (1% vs. 32%) or after investigations (35% vs. 48%) (Table 3). Among private practitioners who reported referring patients with chronic cough, 88% of licensed and 79% of un-licensed practitioners referred patients to a TB clinic.

Table 1: Factors associated with care seeking for a chronic cough

Factors	Care sought from any provider (n = 648) Crude RR (95% CI)	Care sought from licensed PPs (n = 111) Crude RR (95% CI)
Sex		
Male	1.00	1.00
Female	1.16 (1.05-1.3)*	1.01 (0.71-1.4)
Education		
No schooling	1.00	1.00
Some schooling	1.02 (0.91-1.2)	1.24 (0.81-1.9)
Secondary or more	1.06 (0.94-1.2)	1.84 (1.25-2.7)*
Household expenditure		
< Tk 4,500	1.00	1.00
Tk 4,500+	1.15 (1.05-1.3)*	2.01 (1.40-2.9)*
Asset quartiles		
1st (lowest)	1.00	1.00
2nd	0.97 (0.84-1.1)	1.98 (1.02-3.8)*
3rd	0.97 (0.84-1.1)	2.66 (1.42-5.0)*
4th (highest)	1.02 (0.89-1.2)	3.70 (2.04-6.7)*
Experienced additional symptoms**		
1 symptom	1.00	1.00
2 symptoms	1.06 (0.93-1.2)	1.00 (0.60-1.6)
≥ 3 Symptoms	1.16 (1.03-1.3)*	1.61 (1.04-2.5)*
Previously diagnosed as TB		
No	1.00	1.00
Yes	0.96 (0.85-1.1)	1.52 (1.03-2.2)*
Recall 3 or more TB symptoms		
No	1.00	1.00
Yes	1.20 (1.08-1.3)*	1.61 (1.13-2.3)*

* $p<0.05$
** Chest pain, fever, weight loss, night sweats, loss of appetite.

Table 2: Care received as reported by adults with a chronic cough who sought care

Care provided	Licensed PP (n = 111) %	Non-licensed PP (n = 283) %	Drug sellers & others (n = 148) %
Advice given	6.0	1.0	1.0
Investigations ordered	38.0	2.0	5.0
Prescribed a drug	95.0	98.0	95.0
Referred to DOTS centre	0.0	1.0	0.0
Referred to other providers	2.0	1.0	0.0

Table 3: Comparison of practices reported by licensed and un-licensed private practitioners for the management of adults with a chronic cough

Reported practices	Licensed PP (n = 258) % (95% CI)	Unlicensed PP (n = 299) % (95 % CI)
Cough ≥3 weeks		
Suspect TB	46 (40-52)	41 (35-46)
Treatment		
Prescribed drug	0.4 (0.4-1.2)	2 (0.2-3)
Prescribed drug after investigations	64 (58-70)*	4.0 (2-6)
Refer initially	1 (1-3)	32 (27-38)*
Refer after investigation	35 (29-41)	48 (42-53)*
Investigations**	**(98%)**	**(52%)**
X-ray	96 (94-99)*	81 (75-87.4)
Sputum for AFB	81 (76-86)	77 (71-84)
Mantoux test	65 (58-72)	62 (55-70)
Referral practices**	**(36%)**	**(94%)**
TB clinic	88 (82-95)	79 (74-84)
TB specialist	6 (1-4)	14 (10-18)*
Other hospitals	5 (1-10)	24 (19-29)*

*p <0.05 licensed vs. unlicensed providers
**Multiple responses

Reported by: Health Systems and Infectious Diseases Division, ICDDR,B

Supported by: United States Agency for International Development, Dhaka

Comment

Fewer than two-thirds of adults with chronic cough in this study had sought care for their symptoms, which is consistent with findings from India (8,9). Among those who sought care for a chronic cough, over 80% did so in the private sector. Patients presenting with chronic cough in the private setting are often not taken seriously nor thoroughly assessed by the providers (4).

Utilization of private sector providers dominates in most of Asia, with less qualified, unregulated practitioners providing a large proportion of services to rural and lower income populations (8,9). The reasons for choosing less qualified practitioners have not been adequately studied, but is likely related to relatively easy access, low cost, familiarity and user-friendly services. Unlicensed practitioners were found to be the primary choice not only for chronic cough, but also for other illnesses as well (10).

Discrepancies between provider reported practices and the actual recall of referral by patients is striking. The National Tuberculosis Programme and its DOTS facilities were relatively well known among providers and to some extent to their clients. Some patients may, indeed, have been referred, but chose not to show, while there might be real differences between reported and actual practice by the practitioners.

Barriers to refer to DOTS centres are important and need further exploration. Two reasons why private providers might not refer chronic coughers to DOTS centres include the lack of formal contact between the National Tuberculosis Control Programme and the inability of DOTS centres to meet the needs of chronic coughers. Importantly, DOTS centres are equipped to diagnose and treat TB cases, but not to meet the broader needs of patients with chronic cough. We collected anecdotal evidence from providers who claimed they used to make DOTS referrals but stopped because they received no feedback from the centres and their patients were either lost to follow-up or returned with complaints.

The success of DOTS and TB control largely depends on increasing case detection. Findings from this study indicate that, urgent involvement of the under-utilized private practitioners, an important early medical care resource for the vast majority of adults with chronic cough, could improve case detection.

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Does prenatal exposure to arsenic affect infant development?

The ICDDR,B Child Development Unit (CDU) conducted a longitudinal observational study on a sample of 1562 pregnant mothers in Matlab, Bangladesh, to examine the intrauterine effects of arsenic on infants. Drinking water consumed by the mothers during their pregnancy was assessed for arsenic concentration using atomic-absorption-spectroscopy. Infants were assessed for cognitive and psychomotor development at the age of 7 months. Sixty-three percent of all functioning tube wells had arsenic contamination above 50µg/L. Infants whose mothers drank water from wells with >50µg/L of arsenic had slightly lower developmental scores than those whose mothers' drinking water had lower arsenic levels. While the clinical importance and long-term implications of these developmental differences need to be determined, these results provide further evidence of the urgent need to reduce the arsenic contamination in Bangladesh.

Arsenic is a widely distributed environmental pollutant. Many people are exposed to arsenic contaminated drinking water in different regions of the world due to elevated levels in ground water. It is a neurotoxicant and known to cause cancer, skin diseases and other chronic diseases. Recently a few cross sectional studies in school-aged children reported a negative association of arsenic exposure with children's development. Siripityakunkit and colleagues found a significant association between high arsenic levels in hair and impaired visual perception in 6-9 year old Thai children who were chronically exposed to arsenic contaminated drinking water (1). Calderon (2) and Rosado (3) reported co-exposure of arsenic and lead in primary school children from smelter areas in Mexico associated with lower verbal intelligence and long-term memory. Similarly, in Taiwan, long-term arsenic-exposure through drinking water was associated with lower scores in three out of four performance tests in a dose response manner (4). Two studies in Bangladesh reported an association between exposures to high well water arsenic and reduced intellectual function, even after adjusting for covariates (5,6). These studies indicate that children as young as 6 years old may suffer from subtle developmental deficits due to arsenic exposure.

Arsenic has been reported to pass through the placenta in humans (7). It is also reported to cross the blood-brain barrier in animal models (8) and to influence the synthesis of brain enzymes (9). In humans, observational

studies have shown that exposure to highly arsenic contaminated drinking water is associated with reduction in birth weight (10) and increase in foetal loss (11) but we are unaware of any study that reported the effect of arsenic exposure during pregnancy on the later neuro-behaviour of infants. Considering the ability of arsenic to cross both the placental and blood-brain barriers we hypothesized that arsenic exposure during pregnancy might be harmful to the developing brain and lead to lowered cognitive function in infancy (12).

Based on a study in 41 districts of Bangladesh, the British Geological Survey estimated that 21 million Bangladeshis are exposed to water with arsenic concentrations >50µg/L, the maximum allowable level by the Government of Bangladesh (13). A large randomised community based food and micronutrient supplementation trial (MINIMat) was conducted on 5,000 pregnant women in rural Bangladesh where almost 70% of tube wells exceeded the WHO cut-off for excess arsenic which is 10µg/L and 63% exceeded the Bangladeshi national cut-off of 50µg/L. At the same time a parallel study (AsMat) assessed the tube wells' arsenic concentration in that region, using atomic-absorption-spectroscopy to estimate the life time exposure of that population to arsenic. We combined data from these two studies and assessed the association between prenatal arsenic exposure and later infant development. Information on water arsenic exposure was available for 1,562 mothers of MINIMat study whose children were assessed for developmental outcome at the age of 7 months.

We used two problem-solving tests, Support and Cover, to assess infants' cognitive function. The Support test involves placing a long cloth on a table in front of the child, then placing a toy out of the child's reach at the farthest end of the cloth. The infant has to pull the cloth to retrieve the toy. In the cover test a toy is covered with a cloth while the infant is watching. The infant is then required to remove the cloth to retrieve the toy. These procedures were video taped and scored later. Four trials were given in both problem-solving tests. Three behaviours were scored in each trial: cloth-behaviour (the way the child handled the cloth), fixation-behavior (the way the child fixed his/her vision on the toy) and toy-behaviour (the way the child grasped the toy). Each behaviour was scored on a 3 point scale, starting from 0 for no evidence of intention, 1 for possible/ambiguous intention and 2 for clear evidence of intention. The scores for each behaviour were summed to give an intention score for each trial that ranged from 0 to 6, and the scores of 4 trials were then summed to give a total score ranging from 0-24.

For assessment of motor function we used Psychomotor Developmental Index (PDI) of Bayley Scales of Infant Development-II. These are simple

non-language dependent and culturally modified tests designed to detect early behavioural changes from intrauterine insults. The problem solving tests were chosen because they are sensitive to small differences, are relatively easy to perform, and can be scored from videotape which facilitates ongoing quality control. A detailed questionnaire concerning socioeconomic status and anthropometric measurements of the mother-infant pairs were also available from the MINIMat study. The water arsenic levels were categorized under 3 groups: <10µg/L; 10-50µg/L; and >50µg/L for one-way analyses of variance.

Infants whose mothers drank water from wells with >50µg/L of arsenic had slightly lower developmental scores than infants whose mother's drinking water contained less arsenic (Table 1). Using water-arsenic level as a continuous variable and adjusting for all available socio-demographic covariates, the negative effect of arsenic remained significant for both the Support (B±SE:-0.003±0.001,p=0.008) and cover (-.002±0.001,p=0.035) problem-solving tests. Data showed a significant overall linear-trend for both the Cover (p<0.007) and Support tests (p<0.002) with declining scores from the lowest to the highest exposed-group. There was no significant effect of arsenic on Psychomotor Developmental Index (B±SE:-0.003 ±0.002, p=0.199).

Table 1. Means (SD) of developmental outcomes by concentration of arsenic in drinking water during pregnancy

Arsenic exposure (µg/L)	N	Total Cover mean ±SD*	Total Support mean ±SD*	Psychomotor Developmental Index - mean ±SD
0.5-9.99	538	13.6±6.7	12±7.5	104.4±15
10-49.99	190	13.4±6.6	11.7±7.3	104.2±16
≥50	834	12.6±7.1	10.6±7.6	103±16
Total	**1,562**	**13.06±6.9**	**11.2±7.6**	**103.6±15**
Group difference P-value		0.017	0.002	0.36

ANOVA controlling for age (Cover and PDI) and age and sex (Support)

Reported by: Clinical Sciences Division, ICDDR,B

Supported by: ICDDR,B, UNICEF, Sida-SAREC, UK Medical Research Council, Swedish Research Council, DFID, CHNRI, Uppsala University and USAID

Comments

We measured small negative effects of arsenic exposure on problem solving tests in seven-month old infants. There was a trend towards a lower score on the Psychomotor Developmental Index with higher arsenic exposure, but this difference was not statistically significant.

The infants in our study were measured for developmental scores at a very young age (7 months) and over 65% of them were predominantly breastfed until 6 months of age (personal communication with Dr Iqbal Kabir, MINIMat study). In Matlab, from 1978 to 1987, the median duration of exclusive breastfeeding fluctuated around 6 months (14). We found a higher percentage of predominantly breastfed children at 6 months compared to the previous report of Matlab (14) and to the other national statistics. This is because counselling on exclusive breast feeding for the first 6 months was one of the interventions in the main MINIMat study. Breast milk excretes very little arsenic (7) and arsenic exposure through foods/plain water in partial breast-fed children is unlikely to be very high and generally requires several months to exert its chronic impact. Thus, the effect of arsenic seen in this study is likely to be due to intrauterine exposure.

The exact mechanism of action of chronic arsenic exposure on the brain is not clear. The retention of arsenicals in tissues suggests they could exert certain biological effect (15). Functional damage of the brain might occur without causing any structural damage to the brain. In animal models arsenic has been reported to alter brain enzymes (8,9). In experimental pregnant rats arsenic drinking solution resulted in reduced spontaneous locomotor activity and altered special learning task in the pups (16). Some animal studies also report arsenic induced oxidative stress on the brain (17).

One study reported that methylation increases during pregnancy and it might be protective for the developing foetus (7,18); however, our report shows that there is a subtle harmful effect of prenatal arsenic exposure on infant development. The difference is small but statistically significant. We do not know its functional implication, but it is a matter of concern. Our study was part of a large community-based food and micronutrient intervention and all the pregnant mothers received micronutrients supplements, like folic acid that is known to be protective against oxidative damage of arsenic. We also do not know at what point of pregnancy the mothers knew that their tube well contained high arsenic concentrations and whether they switched to a drinking water source with lower arsenic concentrations after getting this information. It is likely that receiving antioxidants and changing water source (if any) reduced the toxic effect of

arsenic on the developing foetal brain, leading to a very small effect size.

This is a large longitudinal study and the children are being followed later in life. We will therefore be able to report the long-term effects of intrauterine and concurrent arsenic exposure on children's development. The effect on problem solving behaviour of infants was small but concerning and provides additional evidence highlighting the need to reduce arsenic exposure in Bangladesh.

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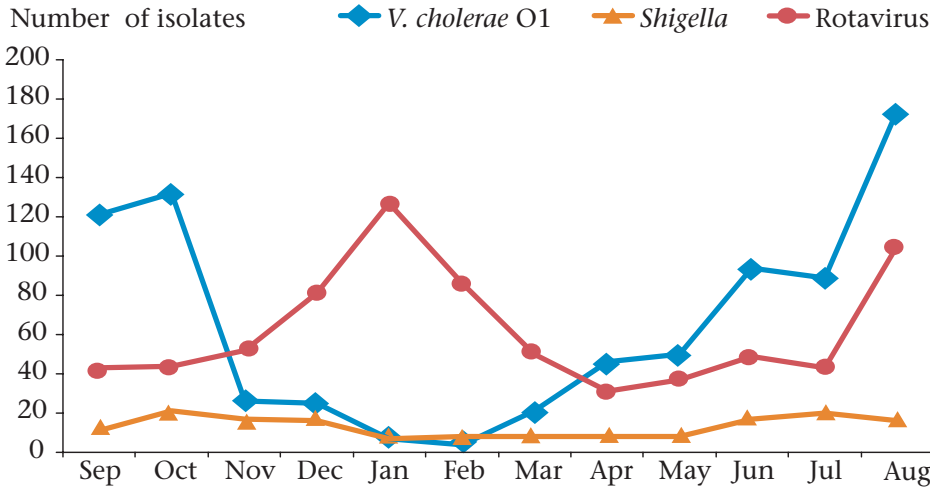
Surveillance update

With each issue of the HSB, updates of surveillance data described in earlier issues are provided. These updated tables and figures represent the most recent observation period available at the time of publication. We hope these updates will be helpful to health professionals who are interested in current patterns of disease and drug resistance.

Proportion of diarrhoeal pathogens susceptible to antimicrobial drugs: September 2006-August 2007

Antimicrobial agents	*Shigella* (n=157)	*V. cholerae* O1 (n=789)
Nalidixic acid	23.6	Not tested
Mecillinam	94.9	Not tested
Ampicillin	55.4	Not tested
TMP-SMX	29.9	0.9
Ciprofloxacin	98.1	100.0
Tetracycline	Not tested	63.2
Erythromycin	Not tested	9.5
Furazolidine	Not tested	0.1

Monthly isolation of V. cholerae *O1,* Shigella *and Rotavirus: September 2006-August 2007*



Antimicrobial resistance patterns of 126 M. tuberculosis *isolates: September 2006-August 2007*

Drugs	Resistance type		Total (n=126)
	Primary (n=115)	Acquired* (n=11)	
Streptomycin	32 (27.8)	4 (36.4)	36 (28.6)
Isoniazid (INH)	12 (10.4)	3 (27.3)	15 (11.9)
Ethambutal	3 (2.6)	2 (18.2)	5 (4.0)
Rifampicin	6 (5.2)	2 (18.2)	8 (6.3)
MDR (INH+Rifampicin)	3 (2.6)	2 (18.2)	5 (4.0)
Any drugs	35 (30.4)	4 (36.4)	39 (31.0)

() column percentage * Antituberculous drugs received for one month or more

Antimicrobial susceptibility pattern of S. pneumoniae *among children <5 years during April-June 2007*

Antimicrobial agents	Total tested (n)	Susceptible n (%)	Reduced susceptibility n (%)	Resistant n (%)
Ampicillin	23	23 (100.0)	0 (0.0)	0 (0.0)
Cotrimoxazole	23	6 (26.0)	0 (0.0)	17 (74.0)
Chloramphenicol	23	20 (87.0)	0 (0.0)	3 (13.0)
Ceftriaxone	23	23 (100.0)	0 (0.0)	0 (0.0)
Ciprofloxacin	23	20 (87.0)	0 (0.0)	3 (13.0)
Gentamicin	23	3 (13.0)	0 (0.0)	20 (87.0)
Oxacillin	23	22 (96.0)	1 (4.0)	0 (0.0)

Source: Children participating in PneumoADIP surveillance in Dhaka Medical College Hospital, Chittagong Medical College Hospital, Sir Salimullah Medical College and Mitfort Hospital, ICH-Shishu Sasthya Foundation, Chittagong Maa Shishu O General Hospital, Dhaka Shishu Hospital, Kumudini Hospital-Mirzapur, and ICDDR,B's urban surveillance in Kamalapur (Dhaka) and rural surveillance in Mirzapur (Tangail).

Antimicrobial susceptibility pattern of S. typhi *among children <5 years during April-June 2007*

Antimicrobial agents	Total tested (n)	Susceptible n (%)	Reduced susceptibility n (%)	Resistant n (%)
Ampicillin	35	18 (51.0)	0 (0.0)	17 (49.0)
Cotrimoxazole	35	18 (51.0)	0 (0.0)	17 (49.0)
Chloramphenicol	35	18 (51.0)	0 (0.0)	17 (49.0)
Ceftriaxone	35	35 (100.0)	0 (0.0)	0 (0.0)
Ciprofloxacin	35	34 (97.0)	0 (0.0)	1 (3.0)

Source: Children participating in PneumoADIP surveillance in Dhaka Medical College Hospital, Sir Salimullah Medical College and Mitfort Hospital. ICH- Shishu Sasthya Foundation, Chittagong Maa Shishu O General Hospital, Dhaka Shishu Hospital and Kumudini Hospital, Mirzapur

Caring for diarrhoea patients in tents at Dhaka Hospital, August 2007. (Courtesy: Fakrul Alalm)

This publication of HSB is funded by ICDDR,B and its donors who provide unrestricted support for its operations and research. Currently donors providing unrestricted support include: Australian International Development Agency (AusAID), Government of Bangladesh, Canadian International Development Agency (CIDA), The Kingdom of Saudi Arabia, Government of the Netherlands, Government of Sir Lanka, Swedish International Development Cooperative Agency (SIDA), and Department for International Development (DIFD), UK. We gratefully acknowledge these donors for their support and commitment to ICDDR,B's research efforts.

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