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Inside . . .

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Documenting effects of the July-August floods of 2004 and ICDDR,B's response

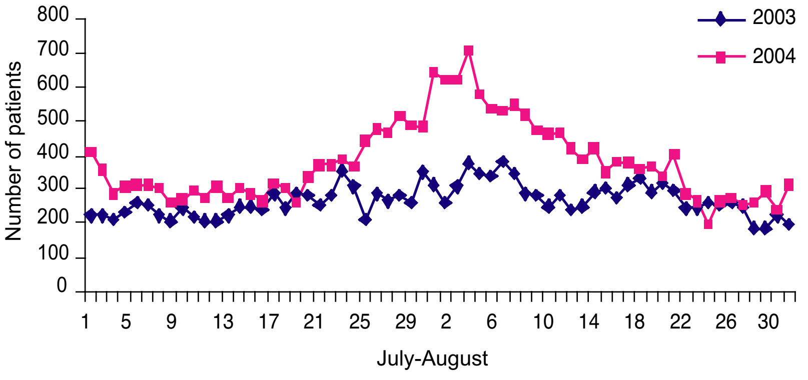
During July and August 2004 Bangladesh experienced its worst flooding since 1998, affecting tens of millions of people around the country. ICDDR,B's diarrhoeal hospital in Mohakhali, Dhaka saw a sharp rise in patient visits as the flood waters increased. At ICDDR,B's health and demographic surveillance site in Kamalapur rapid evaluation documented the need for food, safe water, and medical care among those in flood shelters and in their homes. Based on this evidence, ICDDR,B responded by providing food, free medical care and alum potash (fit-kiri) to those affected. To respond in a more timely manner during the next flood, ICDDR,B is using this year's flood response effort to create a data-driven flood plan which can be put into effect at the start of future floods, and be flexible and adaptable enough to meet future needs.

During July and August 2004 Bangladesh experienced its worst flooding since 1998, affecting tens of millions of people around the country. The severe flooding markedly interrupted normal research activities at ICDDR,B: Centre for Health and Population Research (ICDDR,B) and challenged the institution to address the extreme needs of the communities we work with. It also highlighted the role ICDDR,B can play during a health crisis, in particular its ability to gather sound community-based information and apply this information to responding to the flood crisis and improving health. In the following article we report the impact of flooding and our response during July and August 2004 at our Dhaka Hospital and our Kamalapur urban health and demographic surveillance site in zone 1 of Dhaka.

Impact of flooding at ICDDR,B's Dhaka Hospital and Kamalapur health and demographic surveillance site

ICDDR,B's diarrhoeal diseases hospital in Mohakhali, Dhaka treats approximately 100,000 patients with diarrhoea annually, primarily low income residents of urban and peri-urban Dhaka. In Bangladesh, diarrhoeal diseases are prevalent throughout the year; however, outbreaks and epidemics of diarrhoeal diseases, including cholera, usually occur two times a year–during the hot and humid summer months of April-May, and in September-October following the monsoon floods. Admissions usually increase after floodwaters recede. However, this year, the number of patient visits showed a steep rise from 25 July, coinciding with the onset of the flooding. Figure 1 compares the number of patient visits during the months of July and August, for 2003 and 2004. Patient admissions were considerably higher in 2004, especially during the height of the floods. On some days, the number of visits was more than double compared to the same day last year. During 16-23 July 2004 about a quarter of patients were from Kamalapur, Badda (Gulshan), Demra and Hazaribagh - areas particularly affected by the flooding.

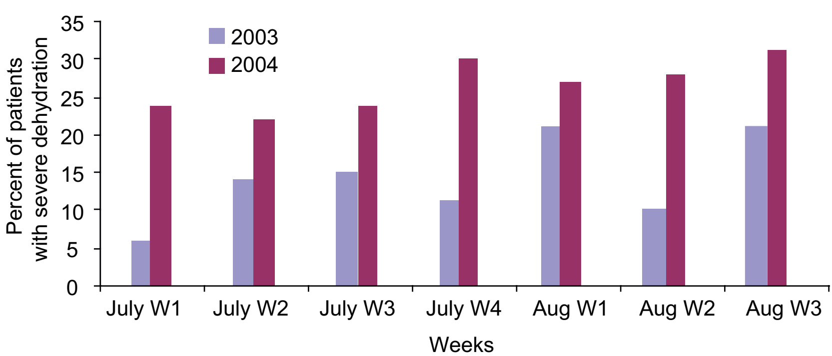
Figure 1: Total number of patient visits per day in Dhaka Hospital during July-August 2003 and 2004



Patients presenting for care during the 2004 floods were more seriously ill than patients who presented during the same period last year. From the first week in July to the third week in August, 27% of patients seen at the Dhaka Hospital had severe dehydration, compared to 14% during the same weeks in 2003 (Figure 2).

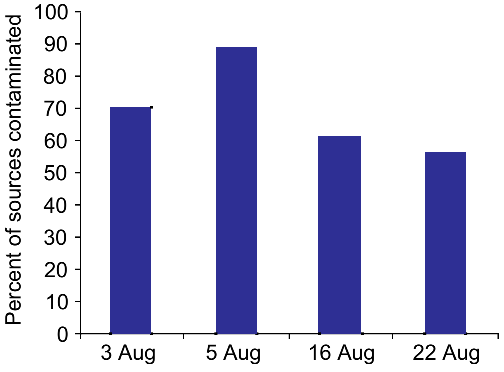
Since 1998, ICDDR,B has operated a health and demographic surveillance and intervention site in Kamalapur, Dhaka. Located in an urban slum area, this population of over 200,000 was severely affected by the rising floodwaters. At the beginning of August, a census of 13 flood shelters in the area documented that 2,266 families (6% of the total population) had taken refuge away from flooded homes. Many of the families in these flood shelters reported an urgent need for food. Most families stayed in their homes despite substantial inundation in order to protect their belongings. Therefore, we attempted to reach these people as well to better understand their needs. Surveys were conducted in 166 study clusters, representing about 40% of the community, to gauge the affects of flooding on food availability and disease among those still living in their homes. Access to approximately half of the areas surveyed was severely restricted due to standing water. The families still in their homes reported that they had daily access to food, and all reported that they had taken at least one meal in the past 24 hours. However, more than 8% of those surveyed in the community reported that they were in need of acute medical attention, but had not been able to obtain it.

Figure 2: Estimated percentage of patients presenting to Dhaka Hospital with severe dehydration by week from 1 July to 23 August 2003 and 2004



Environmental microbiologists collected a series of water samples from twenty public water sources in Kamalapur to evaluate for contamination with thermotolerant coliforms using standard methods. On 5 August 19 (95%) of the samples were contaminated with thermotolerant coliforms, with a median level of

Figure 3: Percentage of public water sources contaminated with thermotolerant coliforms in Kamalapur field site from 3-22 August 2004



contamination of 984 per 100 ml. On 25 August 12 (60%) of the samples remained contaminated (Figure 3). Microbiologists tested four strategies for treating the most heavily contaminated water samples. Treatment approaches included, alum potash, calcium hypochlorite (bleaching powder), and two commercial chlorine based tablets. All of the methods successfully reduced the faecal coliform counts to levels consistent with World Health Organization acceptable guideline values.

ICDDR,B's assistance to flood victims

The diarrhoeal diseases hospital in Mohakhali cared for 23,500 patients during July-August 2004, a 40% increase over last year during the same time period. Extra tents were erected in the ICDDR,B parking lot to accommodate all patients seeking care. Patients arriving during the floods received the same standard care as those seeking care at other times of the year. Patients with malnutrition or complicated diagnoses also received care including food and supplemental feeding for malnourished patients.

Alum potash (fit-kiri) became the method of choice for treating water in the Kamalapur field site because it is inexpensive, easy to find, and well known in the community. ICDDR,B, working with ward commissioners, NGOs (including World Vision, PSTC, and CARE) and other local leaders, distributed messages about water safety, as well as alum potash free-of-charge in the community with instructions on its use. The methodology is to apply 10g (two teaspoons) of the crushed powder to the typical 20L containers in use in the community, let the water stand for three hours, and then decant the purified supernatant into a clean container for drinking or cooking, being careful to leave the residue in the old container.

In addition to safe water, the needs of food and medical care have also been addressed at the Kamalapur field site. Food packets consisting of rice, daal (pulse), salt, oil and potatos were distributed in two rounds. The first round went to 1,650 families living in flood shelters on 9-10 August. The second round was distributed between 14-20 September to vulnerable households, including families with children under five, families with malnutrition or sick persons, and those of the very poor with food packets donated by the World Food Programme.The United Nations Women's Association volunteered services to assist with food distribution. Over 8,000 packets were distributed in a community-wide effort, providing food to over 34,000 people during five days of distribution. To do this, we relied on our experience with conducting large-scale vaccine trials. The Centre's field staff went house to house, using our existing surveillance infrastructure, and identified high-risk families using a standardized criteria set. Batches of these families were issued coupons on a cluster-wide basis on each day of food distribution and told to come to the field office. In this way, the numbers of people coming to the field office was controlled over the course of the day. Workstations were created at the field office including an arrivals queue, registration tables, and a food collection queue. People in the arrivals queue were grouped according the registration table to which they were assigned, using a colour-coding system. Their identities were then confirmed at the registration tables. They were then directed to the food distribution queue where they received their food packets, along with alum potash and instructions on its use.

In collaboration with local government, community leaders, and World Vision five satellite clinics, in addition to the main clinic, were established to provide free emergency medical care in the community. At the height of the floods the number of patient visits dramatically decreased at the field site's main clinic, but during the post-flood period patient visits increased. Since launching emergency services on 12 August, approximately 1,500 patients were treated at the satellite clinics each day. These sites experienced a three-fold rise in dysentery and watery diarrhoea above normal rates for the season, but even a greater rise in acute respiratory diseases, which remained the predominant problem. Emergency medical services at the time of writing this report were scheduled to continue until 30 September.

Reported by: ICDDR,B: Centre for Health and Population Research

Supported by: United Nations Development Programme; World Food Programme; United States Agency for International Development; Duncun Brothers; Lever Brothers; Grameen Phone; Rapid Action Battalion; TMC Japan; British High Commission staff, and Global GHCL.

Comment

Seasonal flooding in Bangladesh each year brings important health consequences, including respiratory and diarrhoeal diseases, and affects access to health resources. This seasonal flooding may worsen as global warming produces rising sea levels and melting snow in the Himalaya (1). In addition, a growing population in Bangladesh means that more people are in competition for what little high ground is available. Urbanization will play an increasingly important role as more people move to over-crowded low lying areas with minimal health services and inadequate shelter. For organizations working in the health and development field, the floods bring more than just a disruption to research or intervention activities; they uncover the real vulnerability of the medically under-served, and inadequacies in supportive infrastructure. If floods of the magnitude of 2004 become a recurrent pattern, the urban poor will increasingly need help in the form of crisis intervention, not only during the floods but even more so as the waters recede. The challenge for the health sector is to develop a timely, appropriate and coordinated response that is informed by rapid appraisal methods. The challenge to the donor and relief agencies will be to create systems to make their aid available as soon as those needs are determined. Together, these will require greater leadership, resulting in improved communication and coordination amongst these parties.

ICDDR,B's health and demographic surveillance sites provided a unique opportunity to gauge the needs of the population at the beginning of the floods. In Kamalapur we quickly determined those in the community who were in greatest need of food, medical care, and safe water, regardless of their participation in our research, and then worked to provide those services through cooperation with our donors and other partners in the area. We gratefully acknowledge the contributions of our donors during this time, which allowed us to meet the needs of those we serve.

It is imperative that we understand these tragic floods as more than just a time to endure but as an opportunity to learn and improve. The lessons learned from this and past floods should influence the way we respond during future crises. As evidenced by contaminated water sources and increases in diarrhoea during this flood, water treatment should be a high priority. We learned that contaminated water could be made safe by using an inexpensive substance, alum potash, which is readily available in the community. We also were able to document acute health care needs, including more severe forms of disease at our Dhaka Hospital and increased barriers to accessing care in the community. Finally, although we were able to quickly document the effects of the floods, it took weeks to put some relief interventions, particularly food distribution, into place. To respond in a more timely manner during the next flood, ICDDR,B is using this year's flood response effort to create a data-driven flood plan which can be put into effect at the start of future floods, and be flexible and adaptable enough to meet future needs.

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Surveillance for *Streptococcus pneumoniae* and other invasive infections among hospitalized children in Bangladesh

Streptococcus pneumoniae is believed to cause a substantial portion of childhood deaths in Bangladesh. The recent development and availability of a highly efficacious conjugate vaccine to prevent pneumococcal disease has engendered high hopes for dramatic public health benefits. However, sufficient evidence is lacking to justify a focused prevention effort. In 2004 a network of hospitals established blood and cerebrospinal fluid culture surveillance for *S. pneumoniae*. In the first three months of surveillance, pneumococcal disease was a major cause of meningitis in children aged two to five months. Multidrug resistant *Klebsiella pneumoniae* was the most common bacterial etiology for septicaemia in neonates.

Pneumococcal disease is estimated to cause 1-2 million deaths in children <5 years of age every year, mostly in developing countries (1). Most deaths are associated with meningitis (2,3) or pneumonia (4,5). A recently published analysis estimated 1.6 to 2.2 million children die from acute respiratory infection (ARI) worldwide each year with about 30% in Southeast Asia, including Bangladesh (6). ARI has been shown to be the most important known cause of death in children in Bangladesh (7). While *S. pneumoniae* is likely the cause of at least 30% of episodes of severe pneumonia, it is not widely recognized as a priority public health problem in Bangladesh. Blood cultures are not done routinely, so the importance of pneumococci is not consistently recognized. The emergence of multi-drug-resistant *S. pneumoniae* has raised the stakes; more expensive antimicrobial regimens are being prescribed to treat presumed pneumococcal disease and treatment failures (especially for meningitis) have been documented.

In 2004, a network of hospitals was established involving seven national institutions in Bangladesh for conducting surveillance of invasive pneumococcal diseases. The aim of the surveillance is to enhance capacity of local laboratories to isolate *S. pneumoniae* and other invasive pathogens from blood and cerebrospinal fluid (CSF). Samples are collected from children <5 years admitted with pneumonia, meningitis or very severe disease according to WHO clinical case definitions[1]. Blood and CSF samples are sent to local laboratories for culture and antimicrobial suscpetibity tests. A reference laboratory, located in Dhaka Shishu Hospital, receives isolates from local laboratories for confirmation and serotyping.

Between May and July 2004, 999 children were enrolled in the surveillance.

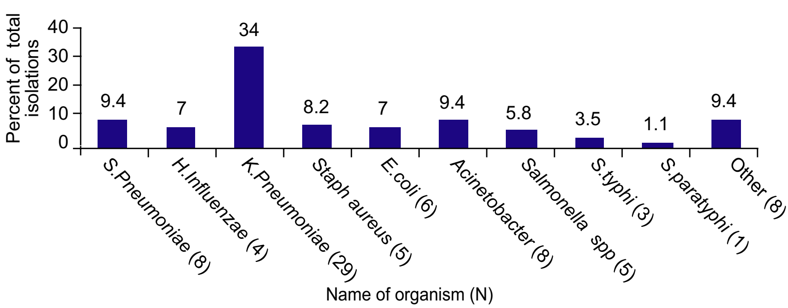
[1]A child is classified with 'very severe disease'if presents with inability to drink, prostration or lethargy, severe malnutrition, stridor in a calm child, hypothermia, central cyanosis and fast breathing or severe chest indrawing in children less than two months.

Blood samples were collected from 886 children (Table 1) and CSF from 290 children. Sixty-three percent of children enrolled were male and 87% were <2 years including 19% neonates, 27% between two to five months, 30% between six to 11 months and 24% between 12-23 months. Eighty-five bacterial isolates were obtained from blood and CSF culture. Of them *Klebsiella pneumoniae* (29 isolates) and *Streptococcus pneumonia* (eight isolates) were the most frequently isolated pathogens (Figure 1).

Table 1: Enrolled and confirmed cases of pneumococcal diseases in hospitalized children

Clinical syndrome	Number of eligible children	Number of blood samples collected (% of eligible)	Number with a pathogen (% of samples collected)	Number with *S. pneumoniae* (% of total isolates)
Pneumonia	1097	264 (24)	23 (8.7)	0
Meningitis	567	209 (37)	16 (7.6)	7 (87.5)
Severe disease	527	413 (78)	46 (11)	1 (12.5)

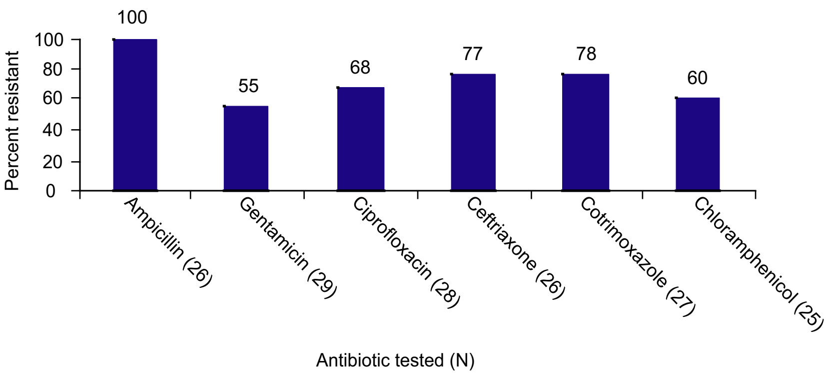
Figure1: Distribution of pathogens isolated from blood or CSF between May and July 2004 in children <5 years of age admitted with pneumonia, meningitis and very severe disease



K. Pneumoniae was most common in neonates (17/29). Most children with Klebsiella (16/29) had a diagnosis of 'septicaemia' and 65% were referred by a health care provider or a health facility. Half of them were brought to the hospital within the second day of onset of illness (median duration 2.5) and samples were mostly drawn on admission (20/29) or within the next 24 hours.

All Klebsiella isolates except one were isolated from blood. The isolates had low susceptibility to commonly prescribed antimicrobial therapy (Figure 2). The majority of children improved (20/29) in the hospital with the median length of hospital stay being six days. Four died in hospital including two neonates. Five children left against medical advice.

Figure 2: Antimicrobial resistance pattern of Klebsiella pneumoniae *(N=29)*



S. pneumoniae was isolated in eight children aged less than two years; five of these isolates (62.5%) were in children two to five months of age. *S. pneumoniae* was not isolated from any neonates. Seven strains were isolated in meningitis cases and the other was from a child with severe malnutrition (classified as very severe disease). Six of these children improved in the hospital and two left against a medical advice. Six of the eight *S. pneumoniae* isolates (75%) were resistant to cotrimoxazole and all were susceptible to other drugs including penicillin. The serotype distribution of *S. pneumoniae* was diverse. Only one of the seven isolates (14%) was a serotype included in the currently available seven-valent pneumococcal conjugate vaccine and only two isolates (28%) were serotypes included in the proposed nine- and 11 -valent vaccines (Table 2).

Table 2: Proportion of serotype distribution of S. Pneumoniae *in Bangladeshi children*

Serotype	Absolute number*
1	1
12A	1
14	1
2	1
45	2
5	1

**Serotyping could not be performed with one strain.*

Reported by: Dhaka Medical College and Hospital; Sir Salimullah Medical College and Hospital; Chittagong Medical College and Hospital; Shishu Sashthya Foundation; Chittagong Maa Shishu O General Hospital; Kumudini Hospital; and Dhaka Children (Shishu) Hospital.

Supported by: PneumoADIP Johns Hopkins University

Comments

Although the number of suspected cases of pneumococcal disease is high among children <5 years of age in Bangladesh, it remains a difficult diagnosis to confirm. Even with the regular culturing of blood and cerebrospinal fluid in this study, the number of isolates of *S. pneumonia* were relatively few in the first three months of surveillance. The low number of *S. pneumonia* isolates reflects the well known insensitivity of blood culture in identifying the organisms responsible for pneumonia.

The isolates thus far identified confirm that *S. pneumonia* is responsible for life threatening infections in Bangladesh. Of particular concern, 75% of the isolates are resistant to cotrimoxazole, the first line drug recommended for the treatment of acute respiratory tract infections in children (8). If this high rate of resistance is confirmed over the course of the study, then the recommended cotrimoxazole treatment for children presenting with acute respiratory illness should be reconsidered.

Among these early *S. pneumonia* isolates the majority are not covered by the current or proposed pneumococcal vaccines. It is possible that the strains causing pneumonia are better covered by vaccines than these first isolates, which are predominately from cerebrospinal fluid. Efforts to further characterize the range of *S. pneumonia* serotypes responsible for serious pneumococcal disease are important to assess in order to predict the potential benefit of introducing such vaccines into Bangladesh.

In this activity designed to identify invasive pneumococcal disease, *Klebsiella pneumoniae* was the organism most commonly identified. Less than half of the identified strains were sensitive to gentamicin and chloramphenicol. *K. pneumoniae* is an important cause of sepsis and death in young children, especially in neonates. Infection with *K. pneumoniae* is commonly transmitted nosocomially. Further studies are indicated to identify risk factors for prevention of *K. pneumoniae* infection in hospitals in Bangladesh, and to identify an appropriate antibiotic regimen.

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An effectiveness trial of Hib vaccine in Bangladesh

Many *Haemophilus influenzae* type B (Hib) infections can be prevented with vaccination, but the amount of Hib disease in Bangladesh, and so the benefit of introducing the vaccine, is unknown. Conjugate Hib vaccine combined with diphtheria, pertussis and tetanus (DPT) vaccine was administered to half of children in three zones in Dhaka. The other half of children received standard DPT vaccine. Children who received the Hib vaccine had 50% protection against purulent meningitis and 34% protection against pneumonia. This suggests that a substantial portion of meningitis and pneumonia in Bangladesh is from Hib, and could be prevented with vaccine.

To assess the impact of a conjugate Hib vaccine (Tetract Hib) on pneumonia and meningitis morbidity in Bangladeshi children <2 years, a birth cohort of approximately 50,000 children residing in three out of ten zones of Dhaka city were evaluated using incident case-control methodology. During the study period from June 2000-October 2003 approximately 75,000 doses of Hib conjugate vaccine was distributed through 31 centres offering child vaccinations in the area. The intent was to replace about 50% of the DPT given in the area with DPT-Hib and to ensure a uniform distribution of the DPT-Hib vaccine. This study was designed to identify children with pneumonia or meningitis and evaluate how much protection the DPT-Hib vaccine provided.

Surveillance for pneumonia and meningitis was set up in six referral hospitals serving the area. Primary health care centres and private providers serving the study area were encouraged to identify children <2 years of age with clinical pneumonia or suspected meningitis according to standard algorithms and to refer them to study hospitals. In the hospitals the children were assessed clinically and with chest radiographs. Blood and cerebrospinal fluid specimens were collected and sent for culture in the laboratory of the Dhaka Shishu Hospital. All x-rays were read by study readers which included a paediatrician and paediatric radiologist from the Dhaka Shishu Hospital and a paediatric radiologist from the Johns Hopkins Hospital. The same set of digitized X-rays was also separately read by WHO radiologists. Radiological and laboratory findings were used to confirm the diagnosis of x-ray positive pneumonia, Hib pneumonia, Hib meningitis and purulent meningitis.

Hospital surveillance identified 254 children with clinical meningitis and 2,620 children with clinical pneumonia. Investigations confirmed 475 x-ray positive pneumonia based on study readers and 672 based on WHO readings. Of these, 343 were positive by both WHO and study readings. Laboratory surveillance confirmed eight Hib pneumonia cases, 19 Hib meningitis, 17 probable Hib meningitis and 88 purulent meningitis (WBC>10 in CSF) cases. For each confirmed case four age and sex matched community controls and two age matched hospital controls without signs of meningitis or acute lower respiratory tract infection were selected. Odds ratios to measure the difference in outcomes between children who received DPT-Hib from those who did not were calculated using conditional logistic regression. The regression accounted for the matched design and adjusted for socioeconomic status.

About 40% of the total vaccine doses given in zones six, seven, and eight of Dhaka city during the study period were Hib-DPT; the rest were DPT only. The coverage for one, two or three doses of DPT or Hib-DPT in recipients also varied. When analyzed using the community controls, Hib vaccine offered 92% protection (95% confidence interval [CI] 49-100%) to children who received at least two doses of the vaccine against confirmed Hib meningitis and 50% protection (95% CI= -9 to 77%) against all purulent meningitis cases although the estimated protection was not statistically significant. Based on x-ray positive pneumonia confirmed by both WHO and study readings, we observed 34% protection (95% CI=7 to 54%) among children who received at least two doses of the vaccine.

Reported by: Public Health Sciences Division, ICDDR,B; Johns Hopkins University; Dhaka Shishu Hospital; Dhaka City Corporation; Bangladeshi NGOs and AMP/France.

Supported by: Asian Development Bank financed Urban Primary Health Care Project (UPHCP), Government of Bangladesh (GOB); United States Agency for International Development (USAID); World Health Organization (WHO); and Aventis Pasteur International, Lyon, France.

Comment

The conjugate Hib vaccine has already been persuasively demonstrated in randomized control trials to prevent serious Hib disease. The question for Bangladesh is whether or not there is enough serious Hib disease to justify the cost of routine vaccination. This study used a case control methodology to assess how much Hib meningitis, purulent meningitis and pneumonia would be prevented if Hib vaccine were widely used (1). The study findings suggest that the vaccine would prevent approximately 50% of bacterial meningitis and 34% of paediatric pneumonia. This estimated protection level against radiologically confirmed pneumonia compares well with findings from the Gambia and Chilean trials. The Hib vaccine trial conducted in the Gambia was the first to demonstrate that radiologically confirmed pneumonia can be reduced by about 20% by giving Hib vaccine indicating that about one-fifth of the severe pneumonia in the Gambia is due to Hib (2). Findings from Chile were similar (3). In short, this study suggests that a substantial portion of meningitis and pneumonia in Bangladesh is from Hib, and could be prevented with vaccine.

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Surveillance Updates

With each issue of the HSB, updates of surveillance data described in earlier issues will be provided. These updated tables and figures will 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 2003-August 2004

Antimicrobial agent	*Shigella* (n=277)	*V. cholerae* O1 (n=698)	*V. cholerae* O139 (n=3)
Nalidixic acid	50.9	NT	NT
Mecillinam	98.6	NT	NT
Ampicillin	57.0	NT	NT
TMP-SMX	35.4	0.1	66.7
Ciprofloxacin	100.0	100.0	100.0
Tetracycline	NT	100.0	100.0
Erythromycin	NT	99.4	100.0
Furazolidine	NT	0.1	66.7

NT=Not Tested

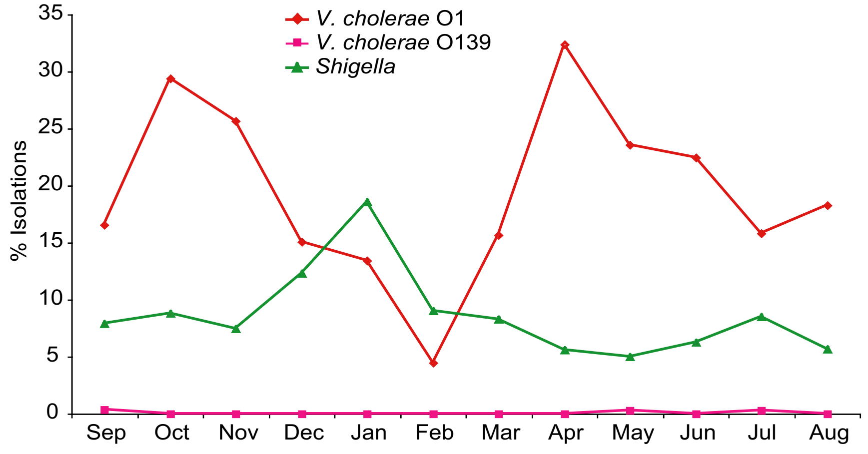
Antimicrobial resistance patterns of 49 M. tuberculosis *isolates*: *June 2003-January 2004*

Drugs	Resistance type		Total (n=49)
	Primary (n=42)	Acquired* (n=7)	
Streptomycin	25 (59.5)	4 (57.1)	29 (59.2)
Isoniazid (INH)	5 (11.9)	4 (57.1)	9 (18.4)
Ethambutal	1 (2.4)	1 (14.3)	2 (4.1)
Rifampicin	2 (4.8)	1 (14.3)	3 (6.1)
MDR (INH+Rifampicin)	2 (4.8)	1 (14.3)	3 (6.1)
Any drug	26 (61.9)	4 (57.1)	30 (61.2)

( ) column percentages

* Antituberculous drugs received for 1 month or more

Monthly isolations of V. cholerae *O1,* V. cholerae *O139 and* Shigella*: September 2003-August 2004*



Antimicrobial susceptibility of N. gonorrhoeae *isolated during April-June 2004 (n=27)*

Antimicrobial agent	Susceptible (%)	Reduced susceptibility (%)	Resistant (%)
Azithromycin	96.3	3.7	0.0
Ceftriaxone	100.0	0.0	0.0
Ciprofloxacin	0.0	0.0	100.0
Penicillin	3.7	14.8	81.5
Spectinomycin	100.0	0.0	0.0
Tetracycline	3.7	11.1	85.2
Cefixime	100.0	0.0	0.0

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Photo: Walking in floodwaters near the Dhaka City Corporation Office in Kamalapur, 28 July 2004, (Courtesy of Ms. Emily Gurley)

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