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Inside . . .

Population-based influenza surveillance, Dhaka

We conducted population-based surveillance for influenza virus among children under age 5 years in the Kamalapur neighbourhood of Dhaka. Between April 2004 and November 2005, 14% of children with acute infectious respiratory illness had influenza virus isolated from their respiratory secretions. The incidence of influenza virus infection was 84.5 episodes/1000 children/year. 58% of isolates were influenza A (H3N2, H1N1) and 42% are influenza B (Shanghai and Hong Kong). Both strains of Influenza A virus and both strains of Influenza B virus that are circulating within Asia are circulating within Bangladesh.

The influenza pandemic of 1918-1919 killed an estimated 10 million persons in India and an estimated 40 million persons worldwide. The reason that this particular strain of influenza was so virulent and led to such a high case-fatality rate remains unclear, though recent data indicate that this virus was a direct adaptation of an avian to human strain (1). Influenza virus tends to mutate frequently, and because of these mutations, prior infection with influenza virus, or prior immunization may not be protective against new strains. Different strains of influenza are adapted to different species, though mutations in a strain of influenza or reassortment of genetic material in a person simultaneously infected with a human and avian influenza virus can permit the virus to acquire the potential to efficiently infect a different species.

A new strain of highly pathogenic avian influenza A (H5N1) has been circulating among domestic poultry and wild birds in eastern Asia since 1996 (2). Infections were first recognized in the Guangdong Province of China and Hong Kong. Since then influenza A (H5N1) has been identified in domestic poultry in 21 countries and in wild birds in 20 countries (3). Between January

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2004 and February 27, 2006, 173 human cases have been laboratory confirmed; 93 have died (4). So far this strain of influenza virus remains an avian virus that is poorly adapted to humans. Most human cases involve persons who had direct contact with infected poultry. There have been reports of mutations in H5N1 since the virus first appeared in 1996 (5). While these mutations do seem to have affected transmission patterns among wild and domestic fowl, they have not had any apparent effect on humans. The virus still does not easily spread from birds to humans or efficiently from human to human. However, previous human pandemics of influenza have been caused by influenza strains that develop the capacity to efficiently infect humans.

Bangladesh is near several countries that have reported avian influenza. Domestic poultry is raised on farms throughout Bangladesh, ranging from families raising a few chickens to produce eggs and meat for their own consumption, to small operators who sell eggs and poultry to their neighbours all the way up to large commercial enterprises. Many residents of Bangladesh have regular contact with live poultry. Bangladesh also has the highest human population density in the world, except for small city states (6). Thus, there is a higher risk of new influenza strains emerging from Bangladesh, than from most other countries.

We conducted population-based surveillance for influenza virus infection in Dhaka to determine the proportion of children with serious respiratory illness due to influenza, and to characterize the influenza strains that are circulating in Dhaka.

Kamalapur is a densely populated low-income community in Dhaka city. The community was divided into 377 household clusters; 168 of these household clusters were randomly selected to participate in surveillance. Within each selected household cluster field workers identified households with children under age 5 years and invited them to participate in the surveillance. Children who were born or moved into the surveillance cluster were enrolled. When a child reached 5 years of age, s/he was no longer followed.

Beginning in April 2004 approximately 5,000 children <5 year old were under regular weekly surveillance. Each week, 40 field workers visited every participating household, and using a standardized questionnaire for each child, asked about signs of illness for each day of the week since the last visit. Children with one major sign of illness – fever (either measured or reported), rapid, laboured or noisy breathing, lethargy, cyanosis, inability to drink or convulsions were referred to ICDDR,B's clinic in Kamalapur for medical evaluation. Similarly if a child had two minor symptoms or signs of illness including cough, runny nose, sore throat, muscle or joint pain, chills, headache, irritability, decreased activity or vomiting, the child was also referred to the clinic. All clinical evaluations were conducted at no cost to the patient. Participating families were encouraged to bring their children to the clinic if

they developed signs or symptoms of illness on days that the field worker did not come to visit them in the home.

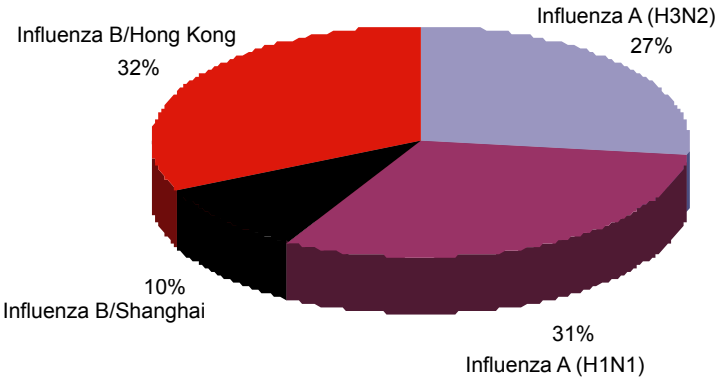
In the clinic, physicians performed a standardized exam, and ordered additional studies based on specific findings. Children with axillary temperature ≥38 °C or elevated respiratory rate (≥60/minute if <60 days of age, ≥50/minute if 60–365 days old, and ≥40/minute if 1–5 years old) and one additional sign localizing disease to the respiratory tract including cough, chest-indrawing, inspiratory crepitations, expiratory wheezes or ronchi were considered to have acute infectious respiratory illness. Every fifth child from the surveillance area who met the criteria for acute infectious respiratory illness had a nasopharyngeal wash specimen collected.

An aliquot of the nasopharyngeal washes was placed on tissue culture in the Virology Laboratory of ICDDR,B, and incubated. If cytopathic effect was noted, the tissue culture supernatant was collected and a haemagglutination inhibition test conducted using the standard WHO Influenza Reagent kits for Influenza A (H1N1), Influenza A (H3N2), Influenza B Shanghai and Influenza B/Hong Kong.

Between April 2004 and November 2005, the Kamalapur clinic evaluated 44,256 children. Of these 5129 met the case definition for acute infectious respiratory illness. Among the 1026 nasopharyngeal wash specimens collected to date, results are currently available on 816.

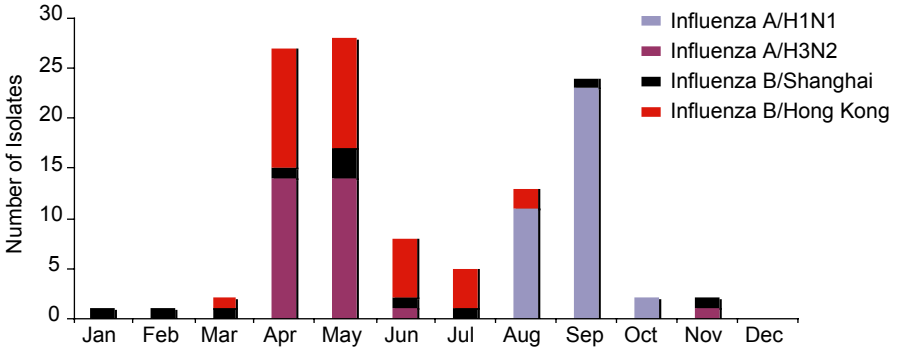
Of the 816 nasopharyngeal wash specimens so far tested 113 (14%) have yielded influenza virus. The adjusted incidence of influenza respiratory disease in this <5 y/o population is 84.5 episodes/1000 children/year. Through November 2005, 58% of isolates are influenza A (H3N2, H1N1) and 42% are influenza B (Shanghai and Hong Kong).

Figure 1: Distribution of influenza virus isolates: Kamalapur, April 2004-November 2005



Influenza virus was isolated year round with the greatest number of cases isolated in April, May and September.

Figure 2: Influenza virus was isolated year round with the greatest number of cases isolated in April, May and September



Reported by: Programme on Infectious Diseases and Vaccine Sciences, ICDDR,B.

Supported by: Centers for Disease Control and Prevention, Atlanta, USA.

Comment

Influenza virus is an important respiratory pathogen for children under the age of 5 years in Kamalapur. As pneumonia is the leading cause of death among children under age 5 years in Bangladesh (7), efforts to reduce childhood respiratory mortality should consider strategies for influenza prevention.

Both strains of Influenza A virus and both strains of Influenza B virus that are circulating within Asia are circulating within Bangladesh. This suggests that if H5N1 avian influenza is circulating among poultry in Bangladesh, there is an opportunity for human co-infection with human and avian influenza strains. Other strains of influenza may also be causing human disease in Bangladesh, though testing for this surveillance was restricted to a single geographic area and to the specific anti-sera that permitted identification of these four strains.

Although influenza virus was isolated more commonly between April and September, influenza transmission occurred year round. This may be important globally, as most temperate zones have peak transmissions during the late fall to winter months (November-March). Populations like Bangladesh may provide a supplemental reservoir, helping to keep the virus in circulation with opportunities for mutation until the following season. If these data are confirmed in other settings it suggests that influenza vaccination in Bangladesh would need to occur early in the year to prevent the high incidence season.

These are data from children under age 5 years. The impact of influenza infection on adult health in Bangladesh is unknown, but the high incidence among children and the multiple circulating strains suggest that influenza virus may also be an important respiratory pathogen in adults. Further research could clarify the magnitude of the problem and permit evaluation of the cost-effectiveness of routine influenza vaccination.

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Estimated deaths due to rotavirus in Bangladesh

We estimated the number of childhood deaths from rotavirus in Bangladesh. We used the under 5 mortality rate and proportion of deaths due to diarrhoea from the Bangladesh Demographic and Health Survey 2004 to derive diarrhoea death figures, and multiplied these figures with the proportion of diarrhoea that was due to rotavirus in two ICDDR,B hospital surveillance systems in Dhaka and Matlab. We estimate that between 5,756 and 13,430 children died each year in Bangladesh between 2001 and 2004 from severe rotavirus gastroenteritis. An effective, affordable rotavirus vaccine could save thousands of lives each year in Bangladesh.

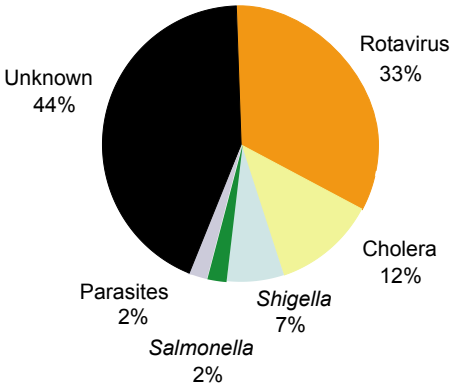
Rotavirus is the leading cause of severe gastroenteritis among young children. Globally, rotavirus is estimated to cause over 500,000 deaths among children aged under 5 years each year (1). Two new vaccines against rotavirus have been demonstrated in large studies to be safe and effective in preventing severe rotavirus disease (2,3). These studies were conducted among well-nourished patients, but additional evaluation is expected in lower income settings with higher levels of malnutrition, including ongoing studies in Bangladesh. Data on the number of deaths from rotavirus disease will help policy makers evaluate the value of these vaccines for their country.

A previous evaluation conducted by Unicomb and colleagues, based on data from 1990-1993 concluded that between 14,850 and 27,000 of the 3 million Bangladeshi children born in 1994 would die of rotavirus by the age of 5 years, equivalent to 1 rotavirus death per 111 to 203 children (4). Since the early 1990s, however, the proportion of all childhood deaths due to diarrhoea has decreased (5). An updated estimate of rotavirus associated deaths will be an important element of the decision on whether or not to introduce new rotavirus vaccines in Bangladesh. Thus, we reassessed the number of deaths from rotavirus in Bangladesh using more recent sources of data on child mortality from diarrhoea and the proportion of severe diarrhoea cases attributable to rotavirus.

ICDDR,B has two hospitals, one in Dhaka and one in Matlab, which treat patients for diarrhoea. Most patients presenting to these facilities are treated as outpatients, but those with more severe illness are admitted. Thus, hospitalized inpatients are a reasonable sample of persons with severe diarrhoea. From 1990 to 1995 a 4% systematic sample of patients admitted to the Dhaka hospital had their stool evaluated for rotavirus and other pathogens; after 1995 the sample was reduced to 2%. All patients from the community that is under active surveillance in Matlab (220,000 persons) who presented to the Matlab hospital with diarrhea since 2000 have had stool evaluation performed.

Faecal samples collected from patients enrolled in the surveillance at both hospitals were tested in the Laboratory Sciences Division of the ICDDR,B for rotavirus antigen using an enzyme-linked immunosorbent assay (ELISA). This

Figure 1: Etiologic agents detected in faecal specimens from 18,544 children <5 years of age admitted with diarrhoea to Dhaka hospital during 1993 to 2004.

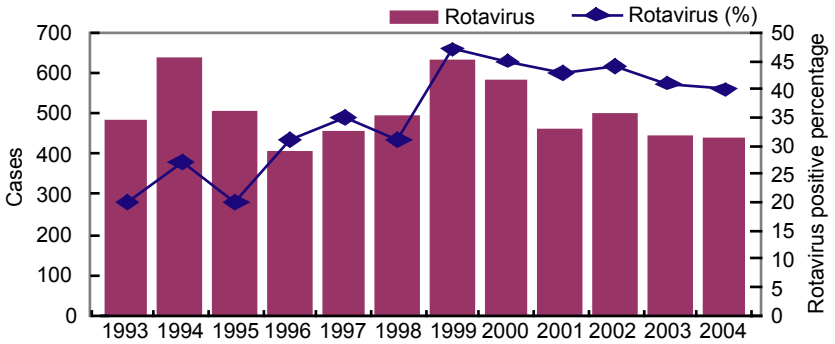


method has not changed since the early 1990s. The same specimens are also tested routinely for *Salmonella* (enteric media), *Shigella* (MacConkey agar), *Vibrio cholerae* O1 and O139 (TCBS agar), *Giardia lamblia*, *Entamoeba histolytica*, and *Cryptosporidium* (microscopic assay and ELISA).

From 1993 to 2004, a total of 18,544 children <5 years of age admitted with diarrhoea to the Dhaka hospital were included in the surveillance. Of these, 33% tested positive for rotavirus, 21% tested positive for bacterial agents including *V. cholerae, Shigella*, and *Salmonella*, and 2% tested positive for parasites, and no agent was identified in 44% of cases (Figure 1).

Since 1993 the proportion of children <5 years of age admitted to the ICDDR,B Dhaka hospital with diarrhoea who tested positive for rotavirus increased steadily from 20% in 1993 to over 40% in 2004 (Figure 2). The number of patients with rotavirus did not appear to increase over this time period, suggesting that the increasing proportion of cases attributable to rotavirus likely reflected a decline in total diarrhoea admissions of non-rotavirus aetiology.

Figure 2: Number and percent of children <5 years of age with rotavirus diarrhoea admitted to ICDDR,B Dhaka hospital, 1993-2004.



Data from Matlab hospital on diarrhoea admissions showed an aetiologic pattern similar to that from Dhaka hospital. Between 2000 and 2004, around

35% of children <5 years of age living in the demographic surveillance area and presenting to the Matlab hospital had positive stool ELISA for rotavirus.

The estimated population of Bangladesh in 2005 was 142 million persons, and the crude birth rate was 26.4/1000 (6). Thus, an estimated 3.7 million infants were born in Bangladesh in 2005. The mortality rate for children <5 years of age estimated by the Bangladesh Demographic and Health Survey is 88 deaths per 1000 children per year (7), and so we estimated that the total number of children <5 years of age in 2005 was 17,100,000. The Bangladesh Demographic and Health Survey used a new method to classify cause of death in 2004. The objective of the reclassification was to reduce the number of children assigned an unknown cause of death. Using this new method, 5.1% of deaths of children <5 years of age were attributed to diarrhoea and 6.8% were attributed to a combination of acute respiratory tract infection, diarrhoea and possible serious infection (5). For the low estimate of rotavirus burden we assumed that only a fraction of the 5.1% of deaths attributed solely to diarrhoea could be attributed to rotavirus. For the upper estimate we assumed that rotavirus could be responsible for the same fraction of deaths due solely to diarrhoea and those due to a combination of acute respiratory tract infection. We assumed that the fraction of rotavirus gastroenteritis among the diarrhoea deaths in Bangladesh were similar to the fraction of rotavirus gastroenteritis cases among diarrhoea patients at the ICDDR,B hospitals in Matlab and Dhaka between 2000 and 2004. Since rotavirus disproportionately causes severe diarrhoea (8,9) this is a conservative assumption.

Taken together, this model estimates that between 5,756 and 13,430 children died each year in Bangladesh between 2001 and 2004 from severe rotavirus gastroenteritis (Table 1). This is equivalent to 1 child death from rotavirus per 275 to 642 Bangladeshi children born each year by age 5.

Table 1: Model for estimating rotavirus burden of deaths among children <5 years of age in Bangladesh.

	Low estimate	Upper estimate
Bangladesh Population <5 year	17,100,000	17,100,000
Death rate among children <5 year	0.088	0.088
Annualizing 5-year death rate	0.2	0.2
Proportion of deaths attributable to diarrhoea	0.051	0.119
Proportion of diarrhoea attributable to rotavirus	0.375	0.375
Deaths attributable to rotavirus	5,756	13,430

Reported by: Programme on Infectious Diseases and Vaccine Sciences, ICDDR,B; Emory University Rollins School of Public Health, Centers for Disease Control and Prevention, Atlanta, USA

Supported by: ICDDR,B and Emory University Rollins School of Public Health, Centers for Disease Control and Prevention, Atlanta, USA

Comment

This analysis confirms that rotavirus remains an important cause of childhood death in Bangladesh, responsible for between 5,700 and 13,400 deaths per year. These estimates are lower than the figure of 14,850-27,000 rotavirus deaths from Unicomb's analysis in the early 1990s. Nevertheless, our data indicate that the introduction of a safe and effective rotavirus vaccine in Bangladesh could prevent several thousand childhood deaths and hospitalizations form diarrhoea each year.

Compared with Unicomb's figures, the lower estimate of rotavirus mortality in the current study largely reflects the decline in the proportion of childhood deaths in Bangladesh attributable to diarrhoea. Unicomb derived her figures based on the assumption that 25% of childhood deaths in Bangladesh were attributable to diarrhoea, whereas we used substantially lower estimates of 5%-10% from recent data. In fact, our data show that while overall deaths from diarrhoea have declined in Bangladeshi children, the proportion of diarrhoea deaths due to rotavirus have actually increased and this pathogen now alone accounts for about 40% of all diarrhoea deaths.

Our findings indicate that increase in the proportion of diarrhoea hospitalizations in Bangladeshi children that are attributable to rotavirus likely reflects a decline in hospitalizations for other causes of childhood diarrhoea rather than an increase in absolute number of rotavirus hospitalizations. This is not surprising, since interventions to improve hygiene and sanitation are likely to have a greater impact on diarrhoea caused by bacterial and parasitic agents, which are transmitted primarily through contaminated food or water, than on rotavirus which is often spread from person-to-person. In addition, oral rehydration therapy is often more difficult to successfully administer to children with rotavirus diarrhoea because of severe vomiting and no effective antimicrobial therapies against rotavirus are available. A recent review of global data reported a similar trend of increasing detection rates of rotavirus in children with severe diarrhoea (10).

An important limitation to this analysis is the uncertainty over attribution of cause of death by verbal autopsy in the Bangladesh Demographic and Health Survey, however we included both a conservative low estimate as well as an upper estimate based on different assumptions.

If the new rotavirus vaccines prove effective in low-income settings with high levels of malnutrition and poor sanitation, and if they are available at an affordable price, then inclusion of rotavirus into the routine childhood vaccination programme in Bangladesh would be expected to save thousands of lives each year. The lack of a decline in rotavirus hospitalizations despite substantial overall reductions in diarrhoea mortality between 1993 and 2004 further underscores the need for targeted interventions against rotavirus, such as vaccines, to sustain the progress in reducing severe morbidity and mortality from diarrhoea in Bangladeshi children.

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Risk factors for neonatal mortality in rural areas of Bangladesh

Neonatal deaths account for about half of all deaths among children under 5 years of age in Bangladesh. This case-control study aimed to identify factors associated with neonatal death in rural areas served by a large NGO programme. Interviews were conducted with mothers of children born alive in 2003 who died within 28 days postpartum (142 cases) and did not die (617 controls). The main risk factors for neonatal death among singleton babies were: complications during delivery (adjusted odds ratio [AOR], 3.1[95% CIs: 1.8-5.3]), prematurity (AOR, 8.3 [95% CIs: 4.2-16.5]), care for a sick neonate from an unlicensed "traditional healer" (AOR, 5.9 [95% CIs: 1.3-26.3]), or care not sought at all (AOR, 23.3 [95% CIs: 3.9-137.4]). The study findings indicate the need for identification of babies at high risk for death, community and home-based interventions, and improved referral facilities.

Neonatal mortality accounts for about two-thirds of infant deaths and about half of deaths among children aged under 5 years in Bangladesh. The Bangladesh Demographic and Health Surveys (BDHS) indicate that the neonatal mortality rate (the number of deaths of children under 28 days of age, per 1,000 live births)declined in the early 1990s, but remained at 41-42 between 1995-1999 and 1999-2003 (1,2,3). Reducing neonatal mortality in Bangladesh will be necessary for achievement of the targets for child mortality reduction under the United Nations Millennium Development Goals (4).

There is evidence of a decline in the neonatal mortality rate of about 50% between 1996-2002 in areas of rural Bangladesh served by 27 non-governmental organizations (NGO) (5). The relatively low neonatal mortality rate of below 30 per 1000 in 2003, compared with Bangladesh as a whole, could in part be due to the high coverage of reproductive health outreach services, although there are other potential explanations, including longer birth intervals, improved standards of living or nutrition, and healthcare seeking practices. The aim of this study was to identify the factors that are predictive of neonatal death in areas where service coverage is good, with a view to maximizing the impact of targeted interventions for neonatal survival in Bangladesh.

The 27 NGOs were contracted in 2000 under an open bidding process by a managing agency, the Bangladesh Population and Health Consortium,[1] from which most had received financial and technical support for several years. In the period 2001-2005, they provided most of the government's essential services package to about 330,000 married women aged 15-49 years in 27 areas spread throughout rural Bangladesh, with funding from the UK Department for International Development. The Bangladesh Population and Health Consortium provided technical support on service delivery, and advice was given by fieldworkers and paramedics on neonatal care based on topics recommended by a World Health Organisation Technical Working Group in 1996. (6) Apart from this, the NGOs had no special interventions or focus on

[1] Now Partners in Health and Development, an independent, not-for-profit organization.

prevention of neonatal deaths.

The NGO health services were fully integrated with the government's local structure and outreach services were consistent with its current strategy (fieldworkers and satellite clinics). There were no government female fieldworkers in the areas served by the NGOs, which employed equivalent family health visitors who provided basic health and family planning counseling and contraceptives in the home, and promoted use of NGO satellite clinics and higher level facilities. In each NGO area, a paramedic conducted about 18 satellite clinics every month, providing family planning, antenatal care, postnatal care and basic curative services. Nine of the 12 study NGOs also had a static clinic at union-level (population 25,000), otherwise women and children were referred to the government sub-district hospital, the upazila health complex.

The 12 study NGOs were selected because they had been providing health services in the same areas since at least 1996. The areas had been allocated to the NGOs by local government health officials because they were remote from the sub-district hospital, or difficult for the government to reach with services. They were in 85 unions of 12 upazilas (sub-districts) spread throughout Bangladesh. The NGOs aimed to provide services to the whole population in about 105,000 households. In 2003, there were 11,253 live births among 96,642 married women of reproductive age (15-49 years) registered in the 12 study areas.

A case-control design was adopted and the study population consisted of all children born alive in 2003 who died within 28 days postpartum (cases) and their mothers, together with control children born in 2003 who survived 28 days and their mothers. In view of the difficulty of identifying separate care given to twins, the study focused on singleton births. Of the estimated 201 case mothers, 184 were identified, and 142 (71%) were interviewed (52 had migrated out, died or were absent). For each case, two children born in the same village in 2003, having the same fieldworker, were selected as neighbourhood controls. We report on interviews with the 122 mothers of singleton cases and 241 neighbourhood control mothers (3 villages with a case only had one other birth in 2003). A further two children born in 2003 were selected at random from the registers of other fieldworkers in the NGO's area (non-neighbourhood controls), and 376 mothers were interviewed. Fieldwork, including structured interviews with mothers, was conducted between May-November 2004.

To assess the factors associated with neonatal death, multiple logistic regression analysis was conducted to control for socio-economic, demographic and other significant factors from bivariate analysis. We report on adjusted odds ratios (exposure/non-exposure to various factors) as estimates of relative risk for neonatal death based on non-neighbourhood controls, although estimates using both sets of controls are shown in Table 2.

Coverage with the main maternal health services was high for both case and

control mothers (Table 1). Women reported that the NGO health workers were the main source of advice on maternal and newborn care: 37-40% of case and control mothers mentioned the NGO fieldworker, and a similar proportion in both groups mentioned paramedics at ANC. Case and control mothers reported receiving similar advice from NGO health workers (data not shown).

Table 1: Use of maternal health services prior to giving birth in 2003, reported by case and control mothers of singleton births

Maternal health service received (reported by mothers)	Case mothers % (95% CIs) (n=122)	Neighbourhood control mothers % (95% CIs) (n=241)	Non-neighbourhood control mothers % (95% CIs) (n=376)
1+ ANC check-ups[1]	92.6 (88.0-97.2)	91.7 (88.2-95.2)	94.1 (91.7-96.5)
ANC at NGO clinic	86.9 (80.9-92.9)	82.6 (77.8-87.4)	89.1 (85.9-92.3)
3+ ANC check-ups	67.2 (58.9-75.5)	69.3 (63.5-75.1)	72.3 (67.8-76.8)
Tetanus toxoid vaccination	88.5 (82.8-94.2)	92.9 (89.7-96.1)	91.2 (88.3-94.1)
Institutional delivery[2]	12.3 (6.5-18.1)	6.3 (3.2-9.4)*	4.5 (2.4-6.6)*
Qualified attendant at home	1.9 (0.0-7.3)	2.7 (0.6-4.7)	3.9 (1.9-5.9)
PNC check-up within 3 days	11.5 (3.8-19.2)	11.2 (7.2-15.2)	13.3 (9.9-16.7)

[1] Medical antenatal care check-up by a qualified practitioner (paramedic or MBBS doctor)
[2] Delivery in government facility or private/NGO clinic
* Significantly lower than for case mothers (p<0.05); includes referrals for complications

Table 2: Estimated risk for neonatal death associated with different factors

Key factors associated with neonatal death	Adjusted odds ratios (95% confidence intervals)[1] Estimated relative risk for neonatal death	
	Neighbourhood controls	Non-neighbourhood controls
Previous child had no measles vaccination[2]	15.1* (3.5-65.4)	32.3* (7.4-142.9)
2+ previous children died/still born	1.8 (0.9-3.7)	1.6 (0.8-3.2)
Any delivery complication(s)	2.6* (1.5-4.5)	3.1* (1.8-5.3)
Pregnancy <8 months	6.7* (3.3-13.7)	7.7* (3.8-15.3)
Treatment from traditional healer (kabiraj)[3]	2.9 (0.9-9)	5.9* (1.3-26.3)
Did not seek care for sickness considered serious	**	23.3* (3.9-137.4)

[1] Controlled for all significant factors from bivariate analysis in separate models (age of mother, length of schooling of mother and father, household expenditure and size, ownership of radio/TV, number of pregnancies, number of ANC check-ups, any complication at delivery, length of gestation, and sex of baby.
[2] Mother reported that no previous child had died
[3] Treatment sought for child considered to be seriously sick: referent group was with children who sought treatment from a qualified provider/facility (paramedics and MBBS doctors at NGO, private and government clinics/hospitals)
* Statistically significant risk based on 95% confidence intervals on the odds ratio
**All control mothers sought care; 29.7% of case mothers did not.

The risk for neonatal death was double for mothers reporting that two or more of their children had died or were stillborn, although this was not significant after controlling for other factors: adjusted odds ratio [AOR] 1.6 (95% CIs: 0.8-3.2). A much higher proportion of case mothers than control mothers experienced at least one complication during delivery, which significantly

increased the risk for neonatal death: AOR, 3.1 (95% CIs: 1.8-5.3). Babies that died were more likely to have been premature with low birth weight, and reported gestation of <8 months significantly increased the risk for neonatal death: AOR, 7.7 (95% CIs: 3.8-15.3). For children born as a twin, the neonatal mortality rate was 15 times higher than for singleton babies (283 per 1000).

The onset of reported sickness was much earlier among children who died (55.9% on the first day; 87.3% in the first 7 days), which was reflected in the day of death (40.2% in the first 24 hours; 72.1% in the first 7 days). Breathing difficulty was the problem most frequently reported by case mothers (46.6%) and control mothers (30.3%). Verbal autopsy reports were completed by only some of the 27 NGOs in the Bangladesh Population and Health Consortium programme, for 381 of the 662 deaths in 2003. The main causes of neonatal death recorded were birth asphyxia (38.6%), low birth weight (27.8%) and infectious diseases (14.7%), including acute respiratory infection (6.8%), jaundice (3.4%), diarrhoeal disease (1.6%), sepsis (1.6%) and tetanus (1.3%). A major difference in the reporting by mothers themselves in the 12 study areas was the attribution of serious sickness and death to 'evil spirits' in some cases. All 24 of the mothers who mentioned 'evil spirits' as being responsible for the death of their baby had lost at least one previous child, and in some cases two or three.

Mothers were asked about treatment sought when their baby got sick, and they considered it serious. Case mothers (21%) were significantly more likely to have consulted an unlicensed 'traditional healer' (kabiraj), compared with control mothers (8%). The risk for neonatal death was significantly higher for those who sought care from a 'traditional healer' rather than a qualified practitioner: AOR, 5.9 (95% CIs: 1.3-26.3). Although nearly all control mothers (98-100%) sought care for a sickness considered serious, 35 (30%) case mothers did not. The risk associated with not seeking care was high: AOR, 23.3 (95% CIs: 3.9-137.4). Most of these children died very soon after birth (21/35 in the first 24 hours), and in many cases mothers reported there was little time to seek care.

The strongest antenatal predictor of neonatal death was not having the previous child vaccinated against measles: 53% of case mothers, compared with 9% of controls. The risk for neonatal death was extremely high: AOR, 32.3 (95% CIs: 7.4-142.9). The estimated neonatal mortality rate was 54 per 1000 for children whose previous sibling had not been vaccinated, compared with 9 per 1000 for other children. Many factors have probably contributed to the higher death rate, although special counseling for these mothers during pregnancy could help to improve their child healthcare seeking practice, generally. Similarly, the estimated neonatal mortality rate for seriously sick children was 75 per 1000 when care was sought care from a traditional healer or not at all, compared with 36 per 1000 when a qualified practitioner was consulted. Clearly, not all sickness considered to be serious would be life threatening, but potentially up to 33% of neonatal deaths in the study areas might be averted if mothers of all these children were able to seek care from a qualified doctor or paramedic (18

mothers to change practice to avert one death). However, in many cases a qualified doctor or paramedic may not be immediately accessible.

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Comment

This study found scope for prevention of neonatal deaths in areas that already have relatively low neonatal mortality and high coverage of reproductive health outreach services. Some babies likely to be at high risk can be identified during antenatal care visits and given special counseling (mothers who have lost a previous child, or did not have it vaccinated against measles). Attendants at delivery could have a role in identifying babies at high risk (multiple births, premature/small babies, delivery complications). The mothers could be given immediate postnatal check-ups in the home by paramedics, which may be feasible in NGO-served areas. Training in resuscitation could help attendants to prevent some deaths due to asphyxia. Improving knowledge among mothers about danger signs and home-based newborn care, and encouraging them to seek care for a seriously sick baby from a qualified doctor or paramedic, could also contribute to further prevention of deaths. Increasing the number of institutional deliveries would be a relevant strategy, together with improvement of the capacity of government sub-district hospitals to provide emergency obstetric and newborn care.

Although improving coverage of reproductive health outreach services in rural Bangladesh as a whole could contribute to neonatal mortality reduction, additional home and community-based strategies would enhance the impact. New strategies are currently being developed in Bangladesh by ICDDR,B (Projahnmo project) and Save the Children (Saving Newborn Lives Initiative). These can be implemented in NGO areas that have high coverage of outreach services, with a view to assessing the potential for maximum impact on neonatal mortality.

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Surveillance updates

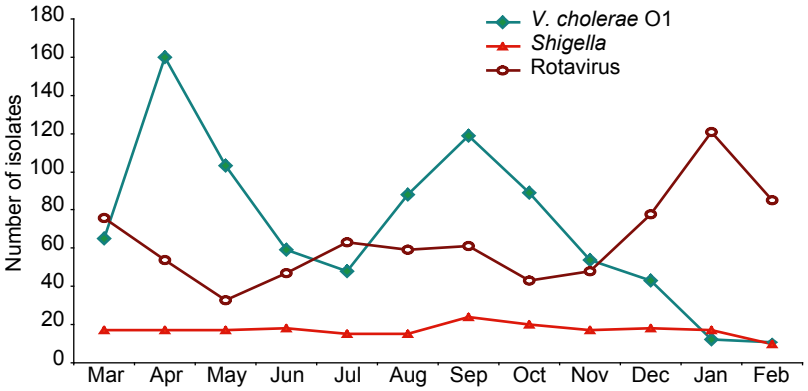
With each issue of the HSB, updates of surveillance data described in earlier issues are provided. These updated tables and figures represent the most recent observation period available at the time of publication. We hope these updates will be helpful to health professionals who are interested in current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

Proportion of diarrhoeal pathogens susceptible to antimicrobial drugs: March 2005-February 2006

Antimicrobial agent	*Shigella* (n=205)	*V. cholerae* O1 (n=851)
Nalidixic acid	34.1	NT
Mecillinam	99.5	NT
Ampicillin	55.6	NT
TMP-SMX	41.5	1.8
Ciprofloxacin	100.0	100.0
Tetracycline	NT	22.9
Erythromycin	NT	36.2
Furazolidone	NT	0.4

NT=Not Tested

Monthly isolation of V. cholerae *O1,* Shigella *and Rotavirus: March 2005-February 2006*



Antimicrobial resistance patterns of 87 M. tuberculosis ***isolates*****:**
June 2004-December 2005

Drugs	Resistance type		Total (n=87)
	Primary (n=73)	Acquired* (n=14)	
Streptomycin	21 (28.8)	4 (28.6)	25 (28.7)
Isoniazid (INH)	12 (16.4)	3 (21.4)	15 (17.2)
Ethambutal	12 (16.4)	3 (21.4)	15 (17.2)
Rifampicin	12 (16.4)	4 (28.6)	16 (18.4)
MDR (INH+Rifampicin)	5 (6.8)	2 (14.3)	7 (8.0)
Any drug	34 (46.6)	7 (50.0)	41 (47.1)

( ) column percentages * Antituberculous drugs received for 1 month or more

Antimicrobial susceptibility of N. gonorrhoeae ***isolated during October-December 2005 (n=13)***

Antimicrobial agent	Susceptible (%)	Reduced susceptibility (%)	Resistant (%)
Azithromycin	100.0	0.0	0.0
Ceftriaxone	100.0	0.0	0.0
Ciprofloxacin	7.7	0.0	92.3
Penicillin	38.5	15.4	46.2
Spectinomycin	100.0	0.0	0.0
Tetracycline	0.0	0.0	100.0
Cefixime	100.0	0.0	0.0

Antimicrobial susceptibility pattern of S. pneumoniae ***among children <5 years during November 2005-January 2006***

Antimicrobial agent	Total tested (n)	Susceptibile n (%)	Reduced Susceptibility n (%)	Resistant n (%)
Ampicillin	19	19 (100.0)	0 (0.0)	0 (0.0)
Cotrimoxazole	19	4 (21.0)	0 (0.0)	15 (79.0)
Chloramphenicol	19	19 (100.0)	0 (0.0)	0 (0.0)
Ceftriaxone	19	19 (100.0)	0 (0.0)	0 (0.0)
Ciprofloxacin	19	19 (100.0)	0 (0.0)	0 (0.0)
Gentamicin	19	1 (5.0)	0 (0.0)	18 (95.0)
Oxacillin	19	15 (79.0)	4 (21.0)	0 (0.0)

Source: Data obtained from children participating in PneumoADIP surveillance - a joint collaboration of ICDDR,B and Dhaka Shishu Hospital which has been conducted in Dhaka Medical College Hospital, Chittagong Medical College Hospital, Sir Salimullah Medical College 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.

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Photo: A rotavirus patient is under treatment at ICDDR,B Dhaka hospital (Courtesy: Fakrul Alam)

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