HSB
Health and Science Bulletin
VOLUME 9 • NUMBER 1 • March 2011
ISSN 1729-343X

Inside

Mass sociogenic illness outbreak in a school feeding programme

A joint investigation team from IEDCR and ICDDR,B investigated an outbreak of suspected food poisoning following consumption of high energy biscuits distributed in a school feeding programme of four primary schools in two upazilas of Gaibandha District in October 2010. Rapid onset followed by rapid recovery of symptoms, inconsistent physical, laboratory and environmental findings, the timeline of events and past experience of similar outbreaks in Bangladesh suggested mass sociogenic illness rather than a foodborne or toxic cause. Sharing the results of the outbreak investigation and reassurance through regular health communication campaigns with students and the school community could limit future outbreaks by alleviating fear and anxiety. Since school-based nutritional supplements reduce malnutrition in Bangladesh, the school feeding programme should be continued.

Outbreaks of mass sociogenic illness, also referred to as epidemic hysteria or mass psychogenic illness, have been reported in various countries of the world (1-3). Rapid onset, followed

icddr,b
KNOWLEDGE FOR GLOBAL LIFESAVING SOLUTIONS

by rapid spread of symptoms and signs among the members of a cohesive group without any organic basis tend to signal the beginning of such outbreaks (4,5). These are also frequently characterized by a rapid recovery, a higher tendency to affect females, and transmission through visual or oral communication channels (6,7).

Several national newspapers reported the occurrence of a suspected outbreak of food poisoning on 27 and 30 October, 2010 following consumption of high energy biscuits distributed by the World Food Programme. This United Nation's agency supports a school feeding programme that provides a daily snack of eight fortified high-energy biscuits in a single packet to 400,000 students in government and non-governmental organization primary schools in targeted vulnerable and food-insecure areas of Bangladesh. The programme is implemented through the Directorate of Primary Education under the Ministry of Primary and Mass Education. Non-governmental organization service providers, along with the school management committee, consisting of parents, guardians, teachers, and school officials, oversee the distribution, hygiene, sanitation and storage process in the primary schools (8,9).

This suspected outbreak of food poisoning affected children of several primary schools in Gobindaganj and Shahghata upazilas (sub-districts) of Gaibandha District. The Upazila Health and Family Planning Officers (UHFPO) of the affected upazilas investigated the situation. The Civil Surgeon of Gaibandha District later reported the occurrence as a panic attack and reported that there was no food borne outbreak.

Following the occurrence of the outbreak, the World Food Programme's school feeding programme was suspended. At the request of the World Food Programme, a combined outbreak investigation team from the Institute of Epidemiology Disease Control and Research (IEDCR) of the Government of Bangladesh and the International Centre for Diarrhoeal Diseases Research, Bangladesh (ICDDR,B) went to the affected district on 6 November, 2010.

The team collected preliminary information from the UHFPO and conducted unstructured interviews with a purposively selected sample of affected school children, their parents, local health authority personnel, headmasters, school teachers and local community leaders to confirm the occurrence of the outbreak and to generate a hypothesis about its potential cause. The team visited the three affected schools in Shahghata and one affected school from Gobindaganj and conducted a descriptive study to define the outbreak in terms of person, place and time.

The preliminary investigation revealed that a substantial number of students reported physical symptoms, including nausea, bitter taste, abdominal pain and vomiting following consumption of the biscuits. Among them, 109 students sought care and were admitted for observation in the upazila health complexes.

We defined a suspected case of high energy biscuit poisoning as any student who reported any two symptoms including nausea, vomiting, diarrhoea, heart burn, bitter taste, headache, neck ache, and/or chest tightness following the intake of high energy biscuits. We prepared a line list of suspected cases using this definition. We then surveyed the suspected cases using a pretested, structured questionnaire to collect exposure histories. In particular, we asked questions about the high energy biscuit intake, current drinking water sources, past 24 hours food intake, drug intake, clinical, and other relevant risk profiles of suspected cases. Using this case definition, we identified and recorded a total of 44 suspected cases from the four affected schools (Table 1). Among the 109 children seeking care in the upazila health complexes, 65 sought care out of fear of illness and did not report any physical symptoms. We did not include them in our line list.

Table 1: The distribution of suspected cases of high energy biscuit poisoning in four schools in Gaibandha District, October 2010

Name of the school, upazila	Number of affected children N=44 (%)	Proportion of suspected cases among students eating the biscuits, (%)
Shahabajerpara Government Primary School, Shahghata	7 (16)	7/161 (4)
Barokona Government Primary School, Shahghata	15 (34)	15/252 (6)
Shujalpur Government Primary School, Shahghata	3 (7)	3/251 (1)
Kalitola Durgapur Government Primary School, Gobindaganj	19 (43)	19/256 (7)

Among the 44 suspected cases, we administered the survey to 30 students who were present in their respective schools during the period of investigation. The mean age was 9.3 years (Range: 7-12) and 70% (21/30) were females. The main clinical symptoms included abdominal pain, burning sensation and bitter taste in their throat, headache, nausea, generalized weakness, vomiting and diarrhoea (Table 2). The average number of biscuits consumed was 6.2 (Range: 1-8). Reliable histories regarding consumption of water on that day could not be elicited. None had taken any antihelminthic tablets during seven days prior to developing the symptoms. About 20% (6/30) complained that the biscuit had either tasted bitter or smelt bad or looked darker than usual (dark brown/black) on that particular day. About 90%

(17/19) of the affected students from Durgapur Government Primary School reported that they had noticed an unusual black ink labeling of the individual biscuit packets that morning. Previously they had always seen the labeling in blue ink. Later we learned from a World Food Programme authority that one factory had changed the ink colour on some biscuit packets to black when the blue ink had run out. A factory spokesperson reported that the ink colour was a minor change as it was neither related to biscuit quality nor previously specified by World Food Programme and therefore did not inform the World Food Programme beforehand.

Table 2: Characteristics and reported symptoms of affected students in four schools in Gaibandha District, 2010

Characteristic or symptom	Number of persons N=30, (%)
Sex	
Male	9 (30)
Female	21 (70)
Student 1	
Class 1	7 (23)
Class 2	11 (38)
Class 3	4 (13)
Class 4	7 (23)
Class 5	1 (3)
Symptoms	
Abdominal pain	28 (93)
Burning sensation in the throat	27 (90)
Bitter taste in the throat	17 (57)
Headache	13 (43)
Nausea	12 (40)
Generalized weakness	9 (30)
Vomiting	6 (20)
Diarrhoea (defined as loose stool at least three times/day)	6 (20)
Chest tightness	5 (17)
Neck pain	3 (10)
Vertigo	2 (7)
Loss of consciousness	2 (7)
Others (blurring of vision, throat ache, dry mouth, chest pain)	7 (23)
Had breakfast in the morning before coming to school	29 (97)
Had eaten 5-8 biscuits at the same time	22 (73)

Two anthropologists visited three of the affected schools to understand local perceptions about the cause of the outbreak and construct a timeline of events (Table 3). They conducted 18 in-depth interviews with affected students and teachers; 11 informal interviews with students and their families; and two group discussions with affected students and doctors who attended to the affected students in the upazila health complexes.

Table 3: Timeline of events at the four affected schools in Gaibandha District, October 2010

Date (approximate time of outbreak) and name of affected school	Events
October 27 (11:00 am) *Kalitola Durgapur Government Primary School*	The female index case, allegedly a child under an evil spell, perceived the change of ink colour on the biscuit packet as an evil deed and that those biscuits were poisonous.
October 30 (11:00 am) *Barokona Government Primary School*	One female student, the index case, shared a story with her classmates about biscuit poisoning affecting students in two schools in Gobindaganj upazila after hearing this from her aunt on October 29th.
October 30 (01:00 pm) *Shabajerpara Government Primary School*	Students of day shift became sick after eating the biscuits.
October 30 (02:00 pm) *Shujalpur Government Primary School*	Three students of day shift became sick after eating the biscuits.

The students, parents, guardians, teachers and the community perceived that the biscuits were responsible for the outbreak. Most students and their parents reported a number of potential causes including the altered biscuit colour, black ink on the packet labels, bitter or medicinal taste, or the moldy smell and possible faulty storage. One headmaster reported that the junior teachers sometimes told him the biscuits became moist after 20 to 25 days of storage. The parents and guardians expressed fear and lack of trust about the programme and subsequently refused to allow their children to take antihelminthic tablets. The guardians were so concerned that many of them even took their children, who had no symptoms, to the upazila health complexes. On the other hand, one mother said her children had been eating

these biscuits since 2007 and believed they did not cause the outbreak. The headmasters and the teachers explained that the rumour of students dying after eating biscuits at the index school spread rapidly among the villagers since all the affected schools were located in small villages. This led the parents to rush to the schools. When they saw their mothers crying, panic seized the school community and combined anxiety spread the outbreak into other schools. The doctors who attended the affected students reported that they considered this outbreak as mass psychogenic illness. All 109 students were discharged within a few hours with complete recovery.

The investigation team visited the warehouse in Gaibandha District where the biscuits were initially stored before distribution and conducted unstructured interviews with concerned personnel to understand the handling process. The high energy biscuits were manufactured in approved local industries that met World Food Programme quality specifications. The team picked and checked the quality of storage of several biscuit packets at random and concluded that the warehouse processes were adequately managed. We inspected the school storage sites and did not find any rancid biscuits. In addition, we collected samples of biscuits from the affected schools, the warehouse and from a student for microbiological analysis.

Three environmental microbiologists conducted unstructured interviews with suspected cases, health workers, personnel from the World Food Programme working in the affected district, non-governmental organization workers, school teachers and local leaders to collect information regarding local water supply and sanitation. They collected water samples from household tube-wells and drinking water storage containers of suspected cases and tube-well water samples from the affected schools. In order to do a comparative analysis, they also collected water samples from tube-wells and drinking water storage containers of age and sex-matched controls defined as children who ate the biscuits, but were not affected. We also collected stool samples from suspected cases and controls. All samples were kept inside an insulated box with ice packs and delivered to the Environmental Microbiology Laboratory of ICDDR,B and processed within 24 hours of collection.

No pathogenic *Vibrio cholerae*, *Shigella* or *Salmonella* were isolated from the 26 stool samples collected from suspected cases or 28 samples collected from controls. However, parasites including *Giardia lamblia*, *Entamoeba histolytica*/ *Entamoeba dispar*, *Ascaris lumbricoides* and *Enterobius vermicularis* were found in stool samples from four of the cases and five of the controls out of the 54 stool samples. Nine (36%) out of 25 tube-well samples and 24 (92%) out of 26 point-of-use water samples collected from suspected cases failed to meet the guidelines of the WHO for microbial quality of drinking water. Similarly, 35% of tube-well water samples and 86% of point-of-use water samples among the controls failed to meet the WHO guidelines (Table 4).

Table 4: Bacteriological test results of water samples collected from various sources

Source of sample	Number of samples exceeding the limit of faecal coliforms[1]	Number of samples exceeding the limit of faecal streptococci[2]	Number of samples exceeding the limit of clostridium perfringes[3]
School tube-well (N=4)	1	2	0
Stored drinking water (suspected cases) (N=26)	18	21	2
Tube-well (suspected cases) (N=25)	4	9	1
Stored drinking water (controls) (N=29)	18	24	5
Tube-well (controls) (N=28)	5	7	1

[1] Maximum allowable limit of faecal coliform - 0 CFU/100ml - WHO guideline
[2] Maximum allowable limit of faecal streptococci - 0 CFU/100ml -WHO guideline
[3] Maximum allowable limit of clostridium perfringes - 0 CFU/100ml -WHO guideline

Microbial analysis of the collected biscuit samples showed the levels of microbiological contamination measured in terms of total coliforms, faecal coliforms, faecal streptococci and total aerobic bacteria to lie within the acceptable limits.

Reported by: Institute of Epidemiology, Disease Control and Research, Government of Bangladesh and Programme on Infectious Diseases and Vaccine Sciences, ICDDR,B

Supported by: Government of the People's Republic of Bangladesh, World Health Organization, Centers for Disease Control and Prevention, Atlanta, USA and World Food Programme

Comments

Epidemiological, anthropological, environmental and laboratory evidence strongly suggest that mass psychogenic illness, rather than food-borne illness from the intake of high energy biscuits, was the primary cause of this outbreak among school students of Gaibandha District. Rapid onset of symptoms, followed by quick recovery, together with physical, laboratory and environmental findings inconsistent with a diagnosis of food poisoning suggest a psychogenic rather than a foodborne cause. This outbreak was quite similar to other outbreaks of mass psychogenic illness that have been investigated in Bangladesh over the last two years (10). The rumor of students dying after eating the biscuits, darker labeling on the packets, colour of the

biscuits and community concern all contributed to the collective anxiety that apparently triggered this outbreak of mass psychogenic illness.

However, lack of proper storage facilities in the schools could have damaged the quality of biscuits, causing some biscuits to become rancid, which might have led to abdominal discomfort among some students. Though we did not find any evidence of microbiological contamination in the biscuit samples we collected, we cannot completely rule out some degree of microbial contamination as we did not collect biscuits on the day of the outbreak. In addition, more than half of the water samples examined in this investigation failed to meet the WHO guidelines for quality of drinking water. This suggests that if there were some gastrointestinal infections that contributed to this outbreak, contaminated water was a likely source.

We did not investigate the Chadpur Arefia Government Primary School of Gobindaganj upazila as preliminary investigation revealed that the 33 affected students had developed benign symptoms of chest tightness and neck ache without even eating the high energy biscuits on that day.

The World Food Programme's biscuit distribution initiative plays an important role in combating the continuing high burden of malnutrition among primary school children in Bangladesh, and should be continued. A review of records at IEDCR identified several outbreaks of high energy biscuit poisoning during the last two years, which shows that such outbreaks are likely to recur in this setting. The result of the investigation should be shared with the children, their parents and the school community to reassure them and limit the impact of additional outbreaks. Appropriate health communication campaigns should be regularly conducted to motivate students and the wider communities to continue to consume the World Food Programme high energy biscuits. Monitoring should be continued in the schools to ensure the quality of the biscuits, particularly in the wet season. Since availability of safe water is a prerequisite for satisfactory practice of food hygiene (11), a multidisciplinary approach addressing both environmental factors (safe water supply and sanitation) and safe preparation and storage of supplementary foods could be additional steps to prevent contamination of foods leading to foodborne diseases in the future.

References

1. Jones TF, Craig AS, Hoy D, Gunter EW, Ashley DL, Barr DB, *et al*. Mass psychogenic illness attributed to toxic exposure at a high school. *N Engl J Med* 2000;342:96-100.
2. Bartholomew RE. "Mystery illness" at Melbourne airport: toxic poisoning or mass hysteria? *Med J Aust* 2005;183:564-6.
3. Dhadphale M, Shaikh SP. Epidemic hysteria in a Zambian school: "the mysterious madness of Mwinilunga". *Br J Psychiatry* 1983;142:85-8.
4. Amin Y, Hamdi E, Eapen V. Mass hysteria in an Arab culture. *Int J Soc Psychiatry* 1997;43:303-6.

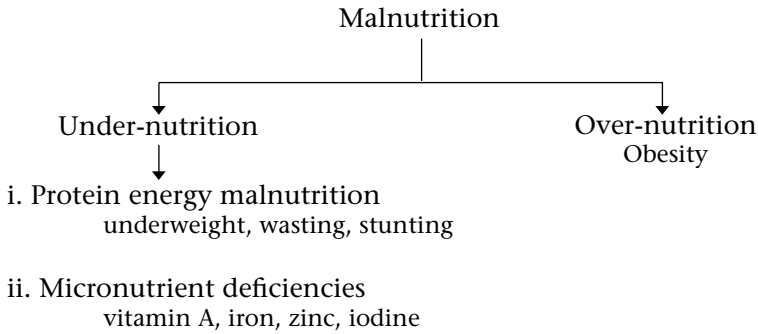
5. Mattoo SK, Gupta N, Lobana A, Bedi B. Mass family hysteria: a report from India. *Psychiatry Clin Neurosci* 2002;56:643-6.
6. Balaratnasingam S, Aleksandar J. Mass hysteria revisited. *Curr Opin Psychiatry* 2006;19:171-4.
7. Ali-Gombe A, Guthrie E, McDermott N. Mass hysteria: one syndrome or two? *Br J Psychiatry* 1996;168:633-5.
8. Ahmed AU. Impact of feeding children in school: evidence from Bangladesh. Washington, DC: International Food Policy Research Institute, 2004. 64 p.
9. Ahmed AU, Del Ninno C. The Food for education program in Bangladesh: an evaluation of its impact on educational attainment and food security. Washington, DC: International Food Policy Research Institute, 2002. (FCND Discussion Paper 138).
10. International Centre for Diarrhoeal Disease Research, Bangladesh. Outbreak of mass sociogenic illness in students in secondary schools in Bangladesh during July-August 2007. *Health Sci Bul* 2008;6:6-12.
11. Kung'u JK, Boor KJ, Ame SM, Ali NS, Jackson AE, Stoltzfus RJ. Bacterial populations in complementary foods and drinking-water in households with children aged 10-15 months in Zanzibar, Tanzania. *J Health Popul Nutr* 2009; 27:41-52.

An overview of under-nutrition in Bangladesh

Under-nutrition has been and continues to be a serious public health problem in Bangladesh. Although there has been a reduction in child under-nutrition in Bangladesh, the prevalence of under weight children <5 is 41%. At the low annual rate of reduction in child under-nutrition of 1.27 percentage points it is unlikely that Bangladesh will be able to achieve the Millennium Development Goal targeting under-nutrition. For sustainable improvement, direct nutrition and health interventions, such as promotion and support for exclusive breast feeding and appropriate complementary feeding, micronutrient supplementation, de-worming, and improved hygiene should be implemented at scale covering at least 70% of the population. In addition to these direct interventions, accelerated actions on the determinants of under-nutrition such as income, agricultural production, girls' education, and gender equality are urgent to improve the overall health and nutrition status.

Malnutrition includes both under-nutrition and over-nutrition. Under-nutrition includes both protein-energy malnutrition and deficiencies of micronutrients, such as essential vitamins and minerals (1). This article provides an overview of the current status of under-nutrition in Bangladesh (1) (Figure 1). Under-nutrition is the underlying cause of 3.5 million deaths worldwide, and accounts for 35% of the disease burden in children under five (2). Child and maternal under-nutrition seriously challenge progress towards national and international economic, health and development goals, including the Millennium Development Goals (3). The consequences of under-nutrition are serious, long-term, intergenerational and mostly irrevocable, resulting in increased morbidity and mortality, increased disease burden, and decreased IQ, physical capacity, and productivity. All of these have negative effects on income and economic growth of the country (3). Of the total global disability-adjusted life years (DALYs), 11% are lost due to child malnutrition (2).

Figure 1: Classification of malnutrition



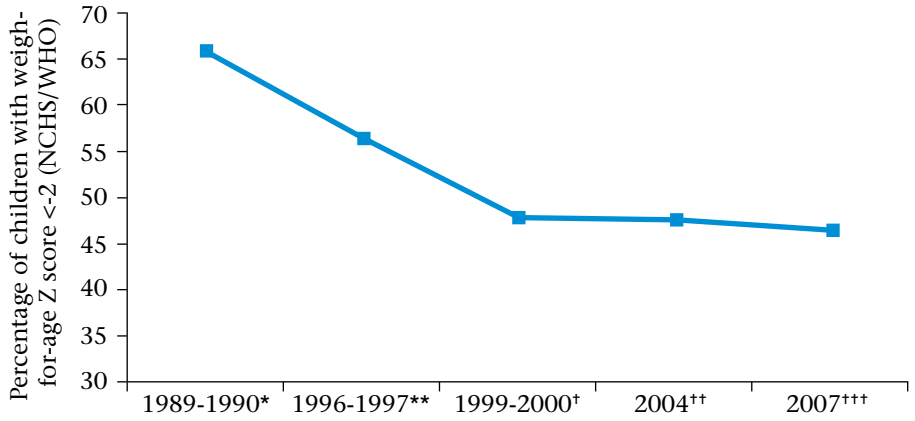
Measures of under-nutrition

There are three commonly used indicators to assess growth faltering in children. These include height-for-age, weight-for-height and weight-for-age. Deficits in these three indicators reflect a distinct process or outcome of growth impairment. Low height-for-age, commonly known as stunting, or chronic malnutrition, reflects a process of failure to reach linear growth potentials as a result of sub-optimal health or nutritional conditions. In younger children, aged 2 to 3 years, it reflects an ongoing process of 'failing to grow', whereas in older children it reflects the state of 'having failed to grow' or being 'stunted'. Low weight-for-height, commonly known as wasting or acute malnutrition, measures thinness and indicates a recent event of weight loss that is often associated with acute disease conditions or starvation. Provided that there is no food shortage, the prevalence of wasting is usually

below 5% even in low income countries. A prevalence between 10%-14% is regarded as serious and above 15% it is critical, warranting public health interventions (4). Low weight-for-age, or underweight, measures body mass relative to chronological age. It is influenced by both the child's height (height-for-age) and weight (weight-for-height). Thus weight-for-age fails to identify whether a child who is underweight is stunted, wasted or both. In children >3, low weight-for-age is primarily caused by stunting in most low-income countries, although in famine situations low weight-for-age usually represents wasting (5).

Under-nutrition has been and continues to be a serious public health problem in Bangladesh (6). The prevalence of underweight children, defined as weight-for-age <-2 Z-score among children <5, was more than 65% in 1989-1990 (7) (Figure 2). Although it decreased to 47% in 2000, there has been little change since then. The most recent national nutrition survey shows that the prevalence of underweight children <5 is 41% (6).

Figure 2: Trends in prevalence of underweight among children <5 in Bangladesh



Source: *(7), **(26), †(27), ††(28), †††(6)

About 43% of children <5 are stunted (height-for-age <-2 Z-score). Wasting is present in 17% of children <5, with 3.4% of children <5 being severely wasted (6,8). This accounts for more than 0.5 million children with severe acute malnutrition in the country. Furthermore, rates of low birth weight among Bangladeshi infants, although reduced from 40%, are still among the highest in the world, ranging from 20-22% (9-11). These children are at risk of death or severe impairment of growth and development.

Unlike children, the nutritional status of women in Bangladesh shows a better trend. In 1997, 52% of women had chronic energy deficiency, defined as body mass index <18.5 kg/m^2. Ten years later, there has been a sustained

reduction in prevalence of chronic energy deficiency (30% in 2007) (6).

Micronutrient Deficiencies

Micronutrient malnutrition is often termed as 'hidden hunger' as the consequences are not always visible. There are four micronutrients that are of particular relevance to public health: vitamin A, iron, iodine and zinc. Vitamin A deficiency disorders include the specific ocular manifestations of xerophthalmia and its blinding sequelae (which encompass – night blindness, bitot's spot, corneal xerosis and xerophthalmia) as well as nonspecific consequences such as anaemia, immune dysfunction, and increased susceptibility to infection, poor growth, and mortality (5). In Bangladesh, there has been a dramatic reduction in prevalence of night blindness among preschool children from the 1980s to 2004, which is attributed to the successful vitamin A supplementation programme launched in 1973 (12-15) with an impressive coverage of 88% (6). Post-partum vitamin A supplementation coverage for mothers, however, is very low at only 20% (6).

Iron deficiency is one of the most common nutrition disorders worldwide. Anaemia is the most commonly used indicator to define iron deficiency in population-based studies or in clinical settings, although anaemia in itself is not specific for iron deficiency. It is generally assumed that 50% of the cases of anaemia are due to iron deficiency (16). However acute and chronic infections, including malaria, cancer, tuberculosis, and HIV can also lower blood haemoglobin concentrations (16). Surveys conducted in 2003-2004 show that 92% of infants aged 6 to 11 months old in Bangladesh suffered from anaemia and that the prevalence of anaemia increased from 2001 to 2004 (17). During that time, the prevalence of anaemia in pre-school children was 68%, in adolescent girls it was 40%, and four out of 10 pregnant women suffered from anaemia, particularly in rural areas (17). An estimated 7.9% of the gross domestic product in Bangladesh was lost due to anaemia (17).

In 1993, the goiter prevalence in Bangladesh was 47%, cretinism 0.5% and sub-clinical iodine deficiency (low urinary concentration of iodine, <100µg/L) was 69% (18). A survey in 2004-2005 showed an improvement in iodine deficiency with the prevalence of goiter among children 6 to 12 years old of 6.2% and among women 15 to 44 years old of 11.7% (19). However, more than one-third of children and women still had sub-clinical iodine deficiency (19).

Zinc is essential for human health due to its critical structural and functional roles in multiple enzyme systems that are involved in gene expression, cell division, growth, and immunologic and reproductive functions. At the population level the prevalence of stunting is a proxy indicator of zinc deficiency: stunting >20% in children <5 is indicative of high risk for zinc deficiency at the country level (2). The 2007 Bangladesh Demographic and Health Survey report found a 43% stunting prevalence, which indicates

that zinc deficiency remains a major nutritional disorder in Bangladesh (6). There are 18.9 million children <5 in Bangladesh and it is estimated that zinc treatment during diarrhoea episodes could save the lives of 30,000 to 75,000 children per year (20).

Breast-feeding and complementary feeding practices

Appropriate feeding practices during infancy and childhood are essential for attaining and maintaining proper nutrition, health, and development of infants and children (21). WHO recommends exclusive breast-feeding for the first six months of life and continuation of breast-feeding for two years. It has been estimated that exclusive breast-feeding in the first six months and continued breast-feeding from 6 to 11 months would prevent 13% of all deaths of children <5 in low income countries (20). Inappropriate feeding practices, particularly after the age of six months, when breast milk alone is no longer sufficient to meet the increasing nutrient requirements for growth, results in high rates of childhood malnutrition in low income countries. Breast-feeding is common in Bangladesh: 99% of infants less than 12 months old are breast-fed (6). However, the prevalence of exclusive breast-feeding is 43% in infants under 6 months, which has not changed over the last decade, with serious implications for nutritional well being and mortality of the children (6). Forty three percent of neonates are breast-fed within one hour of birth. The median duration of breast-feeding is 32.8 months, but exclusive breast feeding is only 1.8 months (6). In Bangladesh, complementary feeding starts too early or too late and foods that are offered are often inappropriate. Among infants less than two months old, 17% drink milk other than breast milk, including fresh or powdered cow milk or infant formula, 6% are given other liquids, while another 6% receive solid or semi-solid food (6). On the other hand, 25% of infants 6-9 months old are not fed any solid or semi-solid food in addition to breast milk. Among infants past exclusive breast-feeding age, only 42% are fed according to the WHO recommended infant and young child feeding practices. A study conducted in Matlab, Bangladesh, showed that the amount of energy from complementary food offered to infants was about 74% of the recommended amount (22). The study found that for children 6-8 months old, the mean intake of vitamin A from breast milk and complementary food together was 44%, and for children 9-12 months old it was 48% of the required nutrient intake. Vitamin D intakes were 12-13% of reference nutrient intake, and zinc was 40-45%. Iron intakes were very low, accounting for only 8-9% of the reference nutrient intake. These study findings imply that it is difficult to improve micronutrient intakes of children by simply increasing the amount of complementary food currently consumed in Bangladesh.

Reported by: Nutrition Programme, International Centre for Diarrhoeal Disease Research, Bangladesh

Comments

Adequate nutrition is a prerequisite for attaining good health, quality of life and national productivity. At the current low rate of decline in under-nutrition of 1.27 percentage points per year, it is unlikely that Bangladesh will achieve its Millennium Development Goals targeting under-nutrition by 2015. Even if this target of reducing under-nutrition prevalence from the level of 1990 by half could be achieved, the prevalence of under-nutrition would still be over 33%, representing a serious public health problem and an impediment to national development (23).

Moreover, the marked increase in price of rice and other staples over the last year raises serious concerns about the country's food security and nutrition situation. Bangladesh is placed in the bottom 25% of the Global Hunger Index ranking, indicating that the country is expected to face a high risk in the context of food price hikes (8). The nationally representative household food security and nutrition survey conducted in 2008-2009, which assessed the impact of price hikes during 2007-2008, revealed that in addition to coping strategies of reduced portion sizes and borrowing money, 22% families also reduced health expenditure (8). The assessment also reported strong linkages between nutritional status of children and women and food security indicators related to food price hikes (8). Nevertheless, the retail price of rice is now 3% higher than its peak in 2008, indicating a continued risk for children and women (24).

The major challenges to improving nutrition in Bangladesh warrant critical planning and significant investments in appropriate interventions integrating both direct and indirect routes of improved nutrition. Cost effective and proven nutrition and health interventions should be prioritized and implemented at scale to cover at least 70% of the total population in order to show tangible outcomes (25). Interventions should include the promotion and support for exclusive breastfeeding and appropriate complementary feeding, micronutrient supplementation, growth monitoring, home fortification of food, health and nutrition education, de-worming, vaccination, promotion and support for hygiene and sanitation, maternal and newborn care, and management of severe acute malnutrition at facility as well as community levels. These interventions should target both mothers and children during the 'window of opportunity' i.e., the 33 months between pregnancy up to the child's second birthday. Adolescent girls who might become mothers in the near future should also be targeted to stop the cycle of low birth weight.

Alongside direct interventions, a multi-sectoral approach addressing the determinants of under-nutrition, including income and agricultural production, gender equality, girls' education, and safe water supply, should also be accelerated to achieve longstanding improvement in the nutrition situation of the country.

References

1 Gibney MJ, Margetts BM, Kearney JM, Arab L, editors. Public health nutrition. Oxford: Blackwell Science, 2004. 378 p.

2 Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M *et al*. Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet* 2008;371:243-60.

3 Shekar M, Heaver R, Lee Y-K. Repositioning nutrition as central to development : a strategy for large scale action. Washington, DC: World Bank, 2006. 246 p.

4. World Health Organization. The management of nutrition in major emergencies. Geneva: World Health Organization, 2000. 236 p

5. Semba RD, Bloem MW, editors. Nutrition and health in developing countries. Second edition. New Jersey, USA: Humana Press, 2008. 931 p.

6. National Institute of Population Research and Training. Bangladesh demographic and health survey 2007. Dhaka: National Institute of Population Research and Training, 2009. 346 p.

7. National Institute of Population Research and Training. Bangladesh demographic and health survey 1989-90. Dhaka: National Institute of Population Research and Training, 1990.

8. World Food Programme. Bangladesh household food security and nutrition assessment report 2009. Dhaka: World Food Programme, 2009. 176 p.

9. de Onis M, Blössner M, Villar J. Levels and patterns of intrauterine growth retardation in developing countries. *Eur J Clin Nutr* 1998;52(Suppl 1):S5-15.

10 Ahmed T, Roy SK, Alam N, Ahmed AS, Ara G, Bhuiya AU *et al*. National nutrition program: baseline survey 2004. Dhaka: International Centre for Diarrhoeal Disease Research, 2005. 319 p.

11 United Nations Children Fund. Bangladesh statistics. (http://www.unicef.org/infobycountry/bangladesh_bangladesh_statistics.html, accessed on 31 July 2010)

12 Helen Keller International. Bangladesh nutritional blindness study 1982-83. Dhaka: Helen Keller International, 1985.

13 Helen Keller International. Vitamin A status throughout the lifecycle in rural Bangladesh: national vitamin A survey, 1997-98. Dhaka: Helen Keller International, 1999.

14 Institute of Public Health Nutrition. Nutritional blindness prevention programme: evaluation report 1989. Dhaka: Institute of Public Health Nutrition, 1989.

15 Helen Keller International. Bangladesh in facts and figures 2004. Annual report of the Nutritional Surveillance Project. Dhaka: Helen Keller

International, 2005.

16 Benoist dB, McLean E, Egli I, Cogswell M, editors. Worldwide prevalence of anaemia 1993-2005: Geneva: WHO global database on anaemia, World Health Organization, 2008.

17 Helen Keller International. The burden of anaemia in rural Bangladesh: the need for urgent action. *Nutr Surveillance Project Bull* 2006;16

18 Yusuf HK, Quazi S, Kahn MR, Mohiduzzaman M, Nahar B, Rahman MM *et al*. Iodine deficiency disorders in Bangladesh. *Indian J Pediatr* 1996;63:105-10.

19 Institute of Public Health Nutrition. National iodine deficiency disorders and universal salt iodization survey of Bangladesh 2004-5. Dhaka: Institute of Public Health Nutrition, 2005.

20 Jones G, Steketee RW, Black RE, Bhutta ZA, Morris SS. How many child deaths can we prevent this year? *Lancet* 2003;362:65-71.

21 Kumar D, Goel NK, Mittal PC, Misra P. Influence of infant-feeding practices on nutritional status of under-five children. *Indian J Pediatr* 2006;73:417-21.

22 Kimmons JE, Dewey KG, Haque E, Chakraborty J, Osendarp SJ, Brown KH. Low nutrient intakes among infants in rural Bangladesh are attributable to low intake and micronutrient density of complementary foods. *J Nutr* 2005;135:444-51.

23 Ahmed T. Policy brief on children and maternal nutrition in Bangladesh. In: National Institute of Population Research and Training. Bangladesh demographic and health survey 2007. Dhaka: National Institute of Population, Research and Training, 2009:13-5.

24 World Food Programme. Bangladesh Food Security Monitoring Bulletin: special issue, January 2011. Dhaka: World Food Programme, 2011. 4 p.

25 Bhutta ZA, Ahmed T, Black RE, Cousens S, Dewey K, Giugliani E *et al*. What works? Interventions for maternal and child undernutrition and survival. *Lancet* 2008;371:417-40.

26 Mitra SN, Ahmed Al-Sabir, Cross AR. Bangladesh demographic and health survey 1996-97. Dhaka: National Institute of Population Research and Training, 1997. 252 p.

27 National Institute of Population Research and Training. Bangladesh demographic and health survey 1999-2000. Dhaka: National Institute of Population Research and Training, 2001. 280 p.

28 National Institute of Population Research and Training. Bangladesh demographic and health survey 2004. Dhaka: National Institute of Population Research and Training, 2005. 339 p.

Improving Human Health through a One Health Approach in Bangladesh

The One Health Initiative is a global movement dedicated to improving the lives of all species—human and animal—through the integration of human medicine, veterinary medicine and environmental science. It recognizes that we cannot have a healthy human population unless our domestic farm animals, our agricultural fields and the broader ecosystem are also healthy. One Health is particularly relevant for Bangladesh because of Bangladesh's high human population density, the importance of the agriculture sector for both livelihood and nutrition, the close contact that people have with their animals and their environment, environmental pressures from population growth, changing land use and industrial and chemical pollution. A major barrier to implementing a One Health approach in Bangladesh is the institutional separation of government ministries responsible for human health, animal health, and the environment. A multi-ministerial approach to outbreak investigations and response could be a first step towards institutionalizing an effective One Health collaboration within the Government of Bangladesh.

The health of human communities depends upon a healthy environment. A healthy environment permits farmers to raise healthy crops and healthy farm animals. A healthy environment provides clean water and clean air for *Homo sapiens* and other species that share the planet. The One Health Initiative is a global movement dedicated to improving the lives of all species—human and animal—through the integration of human medicine, veterinary medicine and environmental science (1). A One Health approach advocates for a broad integrated approach to health. In contrast to a narrow perspective on health that prioritizes clinical care for sick patients, a separate veterinary system to care for sick animals and separate efforts to preserve selected places among earth's fragile ecosystems, a One Health approach recognizes that these dimensions are interconnected and consequently a combined approach is essential. A One Health approach also recognizes that earth's resources including its rivers, oceans, air, plants and animals are shared resources that cross human political boundaries and so sound management requires unprecedented cooperation between nation states.

One Health is a particularly relevant approach to public health for Bangladesh. Bangladesh has the highest population density of any country in the world that is not a small city state. Even with this high population density the great majority of food consumed in Bangladesh is grown within Bangladesh (2), grown on land often treated inappropriately with pesticides (3), and increasingly contaminated with industrial wastes (4). Shallow tube

wells are the most common source of drinking water in Bangladesh, but half of all tube wells have levels of arsenic that exceed the WHO standard for safe drinking water (5), and 40% of drinking water samples collected from tube wells are contaminated with bacteria (6). More Bangladeshi's earn their living from agriculture than from any other sector. The Bangladeshi population has exceptionally close contact with domestic animals. Sixty-one percent of rural Bangladeshi households raise poultry and over half of these keep their poultry inside their home (7).

The poultry sector illustrates the connections among human, animal and environmental health in Bangladesh. Poultry contributes importantly to human health in Bangladesh. Poultry meat and eggs provide essential nutrition for a population with high levels of undernutrition (see the other article in this issue). Raising poultry also provides a critical source of income to low income households. The number of poultry raised throughout Asia including Bangladesh has increased remarkably over the last 30 years. This huge population of domestic poultry creates an ecological niche for new pathogens. Since 1997 highly pathogenic avian influenza A virus subtype H5N1 has spread to many areas of Asia, Africa and even Europe through the movement of infected poultry and poultry products and possibly through wild waterfowl that cross national barriers as part of their annual migration.

Since 2007 highly pathogenic avian influenza H5N1 has caused repeated high mortality outbreaks among domestically raised chickens in Bangladesh. Many poultry producers have lost their entire flocks. Humans are also at risk for infection with this particularly pathogenic strain of influenza. Among the over 500 persons worldwide who have been confirmed to be infected with H5N1 influenza virus, over half have died (8). If the H5N1 virus develops the ability to efficiently transmit from one person to another person, that is if this avian influenza virus becomes more adapted to humans, then the world could face a catastrophic global pandemic. A One Health approach strives to support poultry producers, so that they can continue to earn a living and provide essential nutrients, while simultaneously encouraging poultry raising practices that reduce the risk of avian influenza transmission between poultry and people.

There are two major barriers to implementing a One Health approach in Bangladesh. First, One Health is a new approach for Bangladesh, an approach that is not widely understood. While human health is actually primarily a product of our physical, social and economic environment, human health in Bangladesh is most commonly thought of as an issue overseen by institutional medical care, and the Ministry of Health and Family Welfare. Engagement in a One Health approach requires adopting a broader public health framework, a more holistic approach to health, and devoting attention and resources to those underlying issues that contribute most to help. A

second barrier to implementing a One Health approach in Bangladesh is that the Ministry of Fisheries and Livestock, the Ministry of Agriculture, the Ministry of the Environment and the Ministry of Health and Family Welfare each work separately on their own agenda with minimal communication and collaboration. The ministries are institutionally separate. This means, for example, that a district level livestock officer has little incentive to communicate and collaborate with a district level health officer. They have separate supervisory structures and separate incentives. Physicians working in the Ministry of Health and Family Welfare often know each other because they went to the same medical school or worked together earlier in their career. The social connections facilitate collaborating on a variety of issues. Equivalent social connections among ministries are much less common.

A group of interested professionals have formed an organization, One Health Bangladesh, that provides a forum for discussing the concept of One Health and its relevance for Bangladesh. Over the last two years a diverse group of professionals from across Bangladesh have participated in six conferences (three in Chittagong and three in Dhaka), that discussed scientific and policy issues related to One Health. Several presentations at these conferences have explored zoonotic diseases, infectious diseases that infect both humans and other animals. In Bangladesh recent outbreaks of avian influenza, Nipah virus, and anthrax have highlighted the linkage between animal and human health and provided useful specific local examples to discuss better ways for diverse professionals and groups to work together. Bangladesh hosted a regional One Health forum which convened representatives from human health and animal health from several neighbouring countries to discuss sound approaches to shared concerns.

The Government of Bangladesh exerts major influence by setting policy that affects activities across the environment, agriculture, and human health in Bangladesh. For Bangladesh to benefit from a One Health approach, the approach needs some degree of institutionalization within the government. Collaborative investigations and response to disease outbreaks are government functions that would be a particularly effective area to develop broader multi-ministerial collaboration. The Health and Science Bulletin regularly reports disease outbreaks in Bangladesh that often result from the movement of pathogens or toxins in the environment into domestic animals or crops and into people. Multidisciplinary investigations allow a broad examination of the interrelated steps of the process that led to an outbreak. Social science research has demonstrated that diverse groups of professionals are more effective in solving difficult problems compared with even very capable professionals from a single discipline (9). By working together on outbreak investigations, diverse professionals and diverse ministries will be more effective in understanding the underlying cause of the outbreak and identifying appropriate steps for prevention. Additionally, by working

together these government professionals will begin to develop personal and professional linkages making future communication, coordination and collaborations easier. Myanmar and Thailand have established a combined programme to implement outbreak investigations that includes training of both medical and veterinary epidemiologists within the same programme. Such a shared programme with shared supervision by the respective ministries could be a first step to cross ministerial collaboration, and so to institutionalization of a One Health approach in Bangladesh.

Reported by: Programme on Infectious Diseases and Vaccine Sciences, ICDDR,B; Chittagong Veterinary and Animal Science University; Institute of Epidemiology, Disease Control and Research, Government of Bangladesh.

References

1. One Health Initiative. (www.onehealthinitiative.com, accessed on 2 March 2011).
2. World Food Program. Agricultural production & national food balance—Bangladesh. (http://foodsecurityatlas.org/bgd/country/availability/agricultural-production, accessed on 25 January 2011)
3. Robinson EJZ, Das SR, Chancellor TBC. Motivations behind farmers' pesticide use in Bangladesh rice farming. *Agric Human Values* 2007;24:323-32.
4. Kashem MDA, Singh BR. Heavy metal contamination of soil and vegetation in the vicinity of industries in Bangladesh. *Water Air Soil Pollut* 1999;115:347-61.
5. Smith AH, Lingas EO, Rahman M. Contamination of drinking-water by arsenic in Bangladesh: a public health emergency. *Bull World Health Organ* 2000;78:1093-103.
6. Luby SP, Gupta SK, Sheikh MA, Johnston RB, Ram PK, Islam MS. Tubewell water quality and predictors of contamination in three flood-prone areas in Bangladesh. *J Appl Microbiol* 2008;105:1002-8.
7. United Nations Children Fund. Avian influenza knowledge, attitude and practice (KAP) survey among the general public and poultry farmers in Bangladesh. Dhaka: United Nations Children Fund, 2007.
8. World Health Organization. Cumulative number of confirmed human cases of avian influenza A/(H5N1) reported to WHO. 2011 (http://www.who.int/csr/disease/avian_influenza/country/en/, accessed on 25 January 2011).
9. Hong L, Page SE. Groups of diverse problem solvers can outperform groups of high-ability problem solvers. *Proc Natl Acad Sci* USA 2004;101:16385-9.

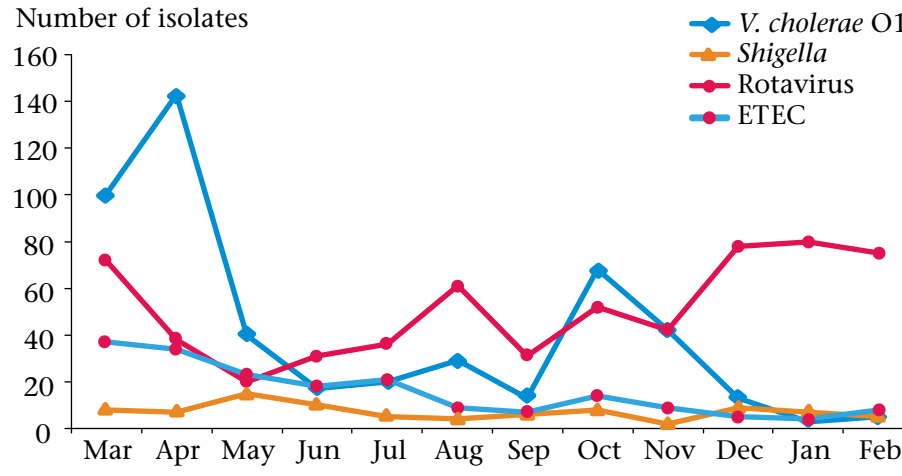
Surveillance updates

With each issue of 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 in Bangladesh.

Proportion of diarrhoeal pathogens susceptible to antimicrobial drugs: March 2010-February 2011

Antimicrobial agents	*Shigella* (n=86)	*V. cholerae* O1 (n=493)
Nalidixic acid	1.2	Not tested
Mecillinam	66.7	Not tested
Ampicillin	53.5	Not tested
TMP-SMX	29.4	1.2
Ciprofloxacin	50.6	99.8
Tetracycline	Not tested	62.9
Erythromycin	Not tested	0.2
Furazolidine	Not tested	Not tested

Monthly isolation of* V. cholerae *O1*, Shigella, *Rotavirus and ETEC March 2010-February 2011



Antimicrobial resistance patterns of 133 M. tuberculosis *isolates: February 2010-January 2011*

Drugs	Resistance type		Total n=133 (%)
	Primary n=121 (%)	Acquired* n=12 (%)	
Streptomycin	22 (18.2)	2 (16.7)	24 (18.0)
Isoniazid (INH)	7 (5.8)	1 (8.3)	8 (6.0)
Ethambutal	1 (0.8)	0 (0.0)	1 (0.8)
Rifampicin	3 (2.5)	1 (8.3)	4 (3.0)
MDR (INH+Rifampicin)	2 (1.7)	0 (0.0)	2 (1.5)
Any drugs	25 (20.7)	2 (16.7)	27 (20.0)

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

Antimicrobial susceptibility pattern of S. pneumoniae *among children <5 years during January-March 2011*

Antimicrobial agents	Total tested (n)	Susceptible n (%)	Reduced susceptibility n (%)	Resistant n (%)
Ampicilin	8	8 (100.0)	0 (0.0)	0 (0.0)
Cotrimoxazole	8	1 (12.0)	0 (0.0)	7 (88.0)
Chloramphenicol	8	3 (37.0)	0 (0.0)	5 (63.0)
Ceftriaxone	8	8 (100.0)	0 (0.0)	0 (0.0)
Ciprofloxacin	8	8 (100.0)	0 (0.0)	0 (0.0)
Gentamicin	8	0 (0.0)	0 (0.0)	8 (100.0)
Oxacillin	8	7 (88.0)	0 (0.0)	1 (12.0)

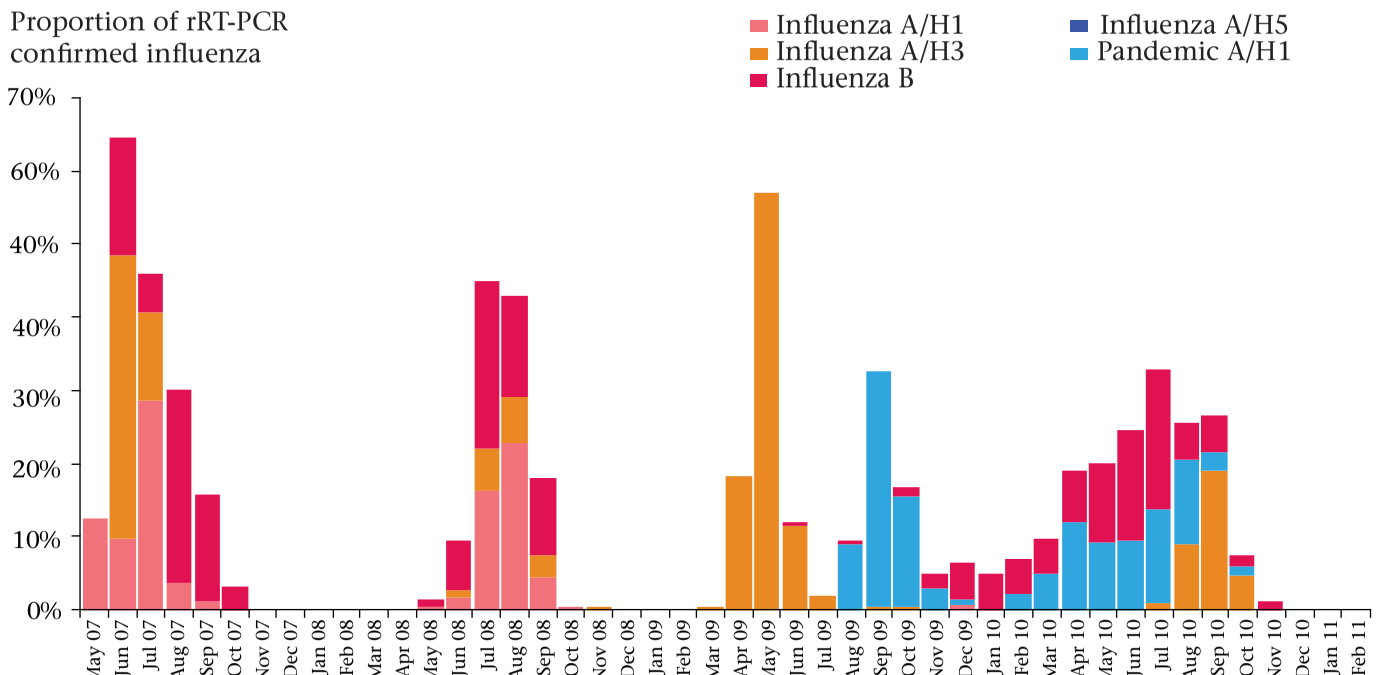
Source: ICDDR,B's urban surveillance in Kamalapur (Dhaka).

Antimicrobial susceptibility pattern of S. typhi *among children <5 years during January-March 2011*

Antimicrobial agents	Total tested (n)	Susceptible n (%)	Reduced susceptibility n (%)	Resistant n (%)
Ampicilin	8	5 (63.0)	0 (0.0)	3 (37.0)
Cotrimoxazole	8	3 (37.0)	0 (0.0)	5 (63.0)
Chloramphenicol	8	3 (37.0)	0 (0.0)	5 (63.0)
Ceftriaxone	8	8 (100.0)	0 (0.0)	0 (0.0)
Ciprofloxacin	8	2 (25.0)	0 (0.0)	6 (75.0)
Nalidixic Acid	8	1 (12.0)	0 (0.0)	7 (88.0)

Source: ICDDR,B's urban surveillance in Kamalapur (Dhaka).

Proportion of laboratory confirmed influenza among hospitalized severe acute respiratory illness (SARI) and outpatient influenza like illness (ILI) cases between May 2007 and February 2011



Source: Patients participating in hospital-based influenza surveillance in Dhaka National Medical College Hospital, Community-based Medical College Hospital (Mymensingh), Jahurul Islam Medical College Hospital (Kishoregonj), Rajshahi Medical College Hospital, Shaheed Ziaur Rahman Medical College Hospital (Bogra), LAMB Hospital (Dinajpur), Bangabandhu Memorial Hospital (Chittagong), Comilla Medical College Hospital, Khulna Medical College Hospital, Jessore General Hospital, Jalalabad Ragib-Rabeya Medical College Hospital (Sylhet) and Sher-e-Bangla Medical College Hospital (Barisal)

High energy biscuits used in School Feeding Programme

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: Government of the People's Republic of Bangladesh (GoB), Canadian International Development Agency (CIDA), Swedish International Development Cooperation Agency (Sida) and Department for International Development (DFID). We gratefully acknowledge these donors for their support and commitment to ICDDR,B's research efforts.

Printed by:
Olympic Printers

ICDDR,B
GPO Box 128, Dhaka 1000, Bangladesh
www.icddrb.org/hsb