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CENTRE
FOR HEALTH AND
POPULATION RESEARCH

Life Cycle Strategy for Research
In general, the ‘life cycle’ approach conceptualizes the health and development priorities of individuals and families and suggests intervention points where efforts can have maximum impact. For example, the Centre places a great emphasis on the periods immediately prior to pregnancy, the pregnancy itself, the delivery of the newborn infant and infancy, thus providing the systemic view of the priorities.

While using the life cycle model and emphasizing certain critical stages, this does not exclude other periods of life (later childhood, adolescence, later adult years), but it suggests that most efforts should target particularly vulnerable periods. Interventions for these periods of increased risk will have the greatest payoff in terms of cost-effective and long-term improvements in health and development. The ‘life cycle’ approach also suggests that the rewards of intervening at these crucial periods are likely to have major benefits for future generations.
ICDR,B: Centre for Health and Population Research published a quarterly journal, a quarterly English newsletter, a 4-monthly Bangla health magazine, a quarterly health and science bulletin, scientific reports, monographs, working papers, and special publications during 2004 on subjects relating to infectious diseases, health, population, and nutrition. Details of some of these publications may be found in the section ‘ICDR,B Publications 2004’ of this report.
Preface

This twenty-sixth Annual Report of the Centre documents many aspects of the activities during 2004, including research, support for research, health services, training, dissemination, and administration.

Important findings of studies have been presented under the eight research programmes of the Centre. A list of ongoing protocols during 2004 with the names of principal investigators and funding agencies has been included to identify and recognize the involvement of scientists in their work.

Scientific papers, abstracts, and other documents produced and published by the Centre staff are also listed in the report. Much of the research included here was initiated in previous years and hence documented in earlier reports. Studies that were completed during 2004 present the final results. Some of the studies initiated earlier are still ongoing, and hence preliminary findings from these studies are reported here.

If you have any comments on this report or would like to have more information about the Centre or the work described here, please write to: Executive Director, ICDDR,B: Centre for Health and Population Research, GPO Box 128, Dhaka 1000, Bangladesh or dsack@icddrb.org.
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**Vision**
All people, especially the poor, can become healthier and can reach their full potential through the application of new knowledge.

**Mission**
To develop and promote realistic solutions to the major health, population and nutrition problems facing the poor people of Bangladesh and other settings.

**Guiding values**
Excellence in research, training and service, high ethical standards, gender equality, responsive to change, promote partnerships, prioritize the needs of the poor and vulnerable, promote equity and diversity, transparency and accountability, effective use and development of resources, fiscal prudence.
ICDDR,B: Centre for Health and Population Research continues with its mission “to develop and promote realistic solutions to the major health, population and nutrition problems facing the poor people of Bangladesh and other settings.” I am often asked whether we are an international centre or a national one. I reply that our name begins with ‘International’ and ends with ‘Bangladesh.’ Yes, we are an international centre with international standards, international governance and international relevance, but our first loyalty is to Bangladesh where we attempt to be a partner with the people and the Government of Bangladesh.

Though several important and exciting events took place in 2004, I first must highlight a major challenge which the Centre faced from late July through September when Bangladesh once again faced severe flooding, the worst since 1998. The country’s infrastructure and economy were badly affected; millions of people had to leave their homes. For the Centre, the floods meant a huge increase in the number of patients in our Dhaka and Matlab hospitals and the need to provide relief supplies for thousands in our flooded field areas. For a time, many research projects had to stop; our staff instead helped care for the flood victims both in the hospital and in the community. At the height of the crisis, the Dhaka hospital received over 700 patients a day. They came with dehydration caused by acute diarrhoeal illnesses, mostly cholera, and enterotoxigenic Escherichia coli because of the sewage-contaminated water in many areas. During the floods and in the weeks that followed, many faced not only life-threatening illness, but also homelessness and loss of their livelihoods.

Our hospital staff once again rose to the challenge. Extra tents were constructed to expand our hospital, and extra personnel were hired to treat the patients. The staff also volunteered to give one day’s salary as a donation for flood relief. Fortunately, the donor community, especially the United Nations, along with many other individuals and organizations, assisted with donations of food supplies and supplemental funds to help cope with the needs. The dedication of the staff working in the Centre’s hospitals and their commitment to devote long hours and work under challenging conditions is extraordinary. These men and women are the humanitarian heroes of ICDDR,B. On some days, our nurses, doctors, and support staff saved the lives of over 100 people who would have died had they not reached our hospital on time.

Changes in Leadership at the Centre

There were several changes in key leadership during this year; we bade farewell to several staff during the year. Professor Barkat-e-Khuda, Associate Director, Policy and Planning, left in July on completion of his contract. Dr. Rob Breiman, Director of the Health Systems and Infectious Diseases Division, left in June; Ms Mary Hadley, Coordinator of Family Health Research Project, left in March; Colonel Tajul Islam Ghani, Head of the Support Services, left the Centre in September, and Ms Julia Ackley, Senior Associate of the External Relations and Institutional Development Office, left the Centre in June.

We welcomed Dr. Marjorie A. Koblinsky seconded from the Johns Hopkins University, Baltimore, who joined as Director of the Public Health Sciences Division; Dr. Steve Luby from the Centers for Disease Control and Prevention (CDC), Atlanta, joined as Head of the Programme for Infectious Diseases and Vaccine Sciences; Mr. A.H. Helal from Bangladesh as Coordinator of the Family
Health Research Project and Ms Nancy Hughart, a US national, as Coordinator of the Child Health and Nutrition Research Initiative (CHNRI).

Finally, we also pay tribute to Professor Kamaluddin Ahmad, a long-time associate of the Centre, who was a member of the Research Review Committee since 1990, a previous chair of the Ethical Review Committee, and recipient of the Host Country Award at the 10th ASCODD 2003. Professor Ahmad passed away on 4 July 2004. The Centre gratefully acknowledges his valuable contributions.

Board of Trustees

The Board held a two-day retreat immediately before the November BoT meeting in November 2004 at the BRAC Centre in Rajendrapur, Bangladesh. Consultant Mary H. DeKuyper facilitated the sessions to assist the BoT in assessing and improving their effectiveness. The action plan that was developed stressed the importance of the Board’s role in the long-term planning for the future of the Centre.

During the year, three members left the Board on completion of their terms. They are: Professor Carol Vlassoff from Canada, Dr. Tikki Pang, the WHO representative on the Board, and Dr. Maimunah Bte Hamid from Malaysia. New Board members include Dr. Tim Evans, as the WHO representative on the Board, Prof. Peter Tugwell from Canada, and Dr. Raj Bte Abdul Karim from Malaysia.

Finances

The Centre’s budget of over US$18 million for 2004 exceeded that of 2003 by more than US$1 million, being the second year in a row to increase by this amount. This increase in budget was due to steadily-increasing project activities and the consistent support of our core donors. This was also the sixth year with a balanced budget, although the Centre is still dealing with a cumulative deficit of about US$2.4 million. We all hope we can eliminate this deficit soon, but at the current rate, it will take several more years.

I can overstate the importance of the endowments to the Centre. When this institution was founded as an international centre in 1978, the “Founding Fathers Founded a Foundling.” It had no financial resources except what could be raised from year to year. It was built on big ideas and a talented staff, but had no consistent financial resources. During the last decade, however, a Centre Endowment and a Hospital Endowment were begun with funding from the governments of Switzerland, the United
importance of building strong institutions in developing countries. It will be these institutions that will deal with the emerging health problems of the future. Providing training is useful, but if there is no institution to use the talents of the newly-trained scientists, the training is wasted. Too often, the scientists migrate to the West to find a fulfilling career. Thus, strong institutions are needed to provide opportunities for the scientific talent which exists in developing countries, leading to 'brain gain' instead of 'brain drain.'

Similarly, targeted projects through specific grants and contracts can be very productive, but if the developing-country institution is not strengthened by the project, it may no longer exist to carry out such projects in the future. The ups and downs of major project funding, in the absence of core support, are certainly disruptive and may, in the long run, work against building strong institutions.

Thus, I believe a major issue facing international health is how to build strong institutions in developing countries that will provide the know-how, the infrastructure and the perspective to solve problems of the future. In recent years, many donors have focused on quick returns at the expense of institution building. Fortunately, the Centre has a strong governance structure based on its ordinance and several key core donors who have supported the Centre based on its Strategic Plan. This combination of governance and core funding has formed the base for institution building at ICDDR,B. What are the lessons from the ICDDR,B experience that may be translated to other institutions?

Alumni Association

Many of the staff members have worked at the Centre for many years, and many others have now retired. For several years, we have been contemplating the continued involvement of our ex-staff; in 2004, this became a reality. On 2 December,
over 150 former employees of ICDDR,B joined the inauguration ceremony of the ICDDR,B Alumni Association.

They approved its Charter and Bylaws, and representatives were elected. An illustrated souvenir was published that displayed historic photos and stories, including memorials for many alumni. We anticipate that alumni chapters will be formed in the USA and Europe, and we welcome continued contact with former staff as well as former Board members.

Child Health and Nutrition Research Initiative

Under the leadership of Dr. Shams El Arifeen, the Centre is now hosting the Secretariat for the Child Health and Nutrition Research Initiative (CHNRI), a special programme initiated by the Global Forum for Health Research. Previously, the CHNRI Secretariat was based in Geneva, but this was shifted to ICDDR,B on 27 July 2004. It is hoped that CHNRI, based in Dhaka, will give increased visibility to the importance of research on child health and nutrition globally, and that ICDDR,B will help CHNRI fulfill its goals more effectively from this developing-country setting.

BRAC James P. Grant School of Public Health

ICDDR,B has agreed to join with BRAC in forming the new BRAC University James P. Grant School of Public Health which will open in February 2005. Many of the classes will be taught at ICDDR,B, and several of the scientists at the Centre will serve as faculty. The new school, with strong commitment from BRAC and from universities in North America and Europe, will be a unique one which will train a new generation of health leaders for Bangladesh and other countries in Asia and Africa. It is anticipated that when the ICDDR,B building is completed, one floor will be devoted to the School.

We find many benefits to ICDDR,B to enter into this initiative with BRAC in addition to the clear benefits to the public health of these countries where the graduates will serve. The School will stimulate the academic atmosphere of the Centre. The students and guest faculty bring inquiring minds, challenging new questions and new perspectives. The School also brings many highly-motivated students who will be working within ICDDR,B projects of the future, and the guest faculty will supplement the skills of the full-time scientists of the Centre. I believe this will open a new chapter in the life of ICDDR,B.

Gender Equality

With great support from the Board of Trustees, the Centre is committed to gender equality as outlined in our Gender Policy published last year. In 2004, the Human Resources Department carried out a gender organizational review which assessed key organizational structures and procedures and how they relate to gender equality goals. The review resulted in a series of short-, medium- and long-term objectives. In 2004, the post of Gender Specialist was established, and a gender awareness workshop was developed in Bangla and English to be attended by all employees over the next 18 months. In addition, the Gender Equality Committee submitted the first annual progress report for gender development activities to the Board of Trustees.

Life Cycle Approach and Millennium Development Goals

Our cover illustrates a model of the life cycle used at the Centre to formulate our research strategies. While stressing the importance of integrating public health programmes, the life cycle identifies several crucial points in the cycle when public health interventions will have maximum impact and will help countries accomplish the MDGs. To reduce infant and maternal mortality (MDG 4 and 5), interventions are needed to improve neonatal survival and improve care during pregnancy and delivery. Thus, the Centre has devoted more resources to these areas of research and service. This involves improving nutrition of mothers, encouraging prenatal care, planning for deliveries, preparing for complications should they occur, strengthening emergency obstetric facilities, caring for the newborn immediately after the delivery, and managing the most common neonatal health problems. Similarly, MDG 6 refers to control of HIV/AIDS and other infectious diseases, and the Centre now has programmes on HIV/AIDS and has continued its Programme on Infectious Diseases and Vaccine Sciences while increasing its scope in both areas to include tuberculosis, respiratory infections, and other emerging diseases.

Tracking the Strategic Plan

The details of the scientific programmes are described more completely in the Annual Report that follows, but we also are using the Strategic Plan to the Year 2010 to monitor our progress toward the long-term goals. The highest priorities were given to eight topics which we expected to accomplish during this decade, assuming the
resources were available. These are shown in the table.

Anticipated Accomplishments Identified in the Strategic Plan

1. Contribute to the introduction of cost-effective strategies for zinc therapy in diarrhea
2. Help reduce maternal morbidity and mortality and improve perinatal and neonatal health
3. Develop an effective package for the prevention of foetal growth restriction
4. Help identify a package of suitable vaccines for diarrhea and acute respiratory infections (ARI)
5. Define the burden of tuberculosis and identify effective strategies for prevention and control
6. Address stagnation of fertility decline
7. Help prevent the epidemic of HIV/AIDS and RTI/STI
8. Contribute to knowledge that can impact the burden of vector-borne diseases

Financial Management: During the coming years, the Centre will be adopting a new computerized package integrating Finance, Human Resources, and Project Monitoring functions.

In each area, the Centre has developed activities and research protocols to accomplish the task.

The SUZY (Scaling Up Zinc for Young Children) Project, with funding from the Bill and Melinda Gates Foundation, is leading our efforts to introduce zinc in tablet form as a standard treatment for diarrhea while continuing the research on the use of zinc for diarrhea and other infectious diseases. The Government of Bangladesh, local pharmaceutical companies, USAID, and WHO are key partners in this effort.

Several projects are addressing the issues of maternal and neonatal mortality. One project has documented a remarkable decrease in maternal mortality in Matlab over the last decade. Further evaluations of this decrease will provide lessons for other areas in Bangladesh. Another project has a new method of defining the unmet need for life-saving obstetric surgery which will assist districts monitor their progress toward providing the needed emergency obstetric care.

The issue of neonatal mortality was previously neglected, assuming that provision of standard child health services would improve child survival rates. These standard services have been successful, but now most infant deaths are occurring during the neonatal period, prior to the time when the first immunization is given. Thus, we have increased our research focus toward the development of cost-effective interventions which are both feasible and effective in reducing neonatal deaths in the villages of Bangladesh where 90% of births take place in the home. Assisting families and birth attendants in improving planning for the delivery is an essential element in this strategy, along with increasing the skills of the birth attendants, and improving the available emergency facilities. In addition, the Centre continues to work with the Government in scaling up and evaluating IMCI (Integrated Management of Childhood Illness).

A large project concentrating on reducing the rate of low birth-weight in Matlab continues. More than 4000 women, who were pregnant at the time of enrolment into this randomized trial of nutritional supplements during pregnancy, have delivered and we continue to monitor the health of these children. In addition, the Centre has been collaborating with the National Nutrition Project (NNP) and government institutions in a baseline nutrition survey in support of this large intervention. The nutritional indices show slow improvement in Bangladesh, and the results of the research will speed this improvement.

Scientists at the Centre continue to study different vaccines for diarrhoeal and respiratory vaccines. Phase II studies of a new oral vaccine for rotavirus diarrhea (RotaRix) was completed, and further studies are underway prior to an efficacy planned for Matlab in 2006. A attenuated oral vaccine for cholera (Peru 15) has nearly completed evaluation in phase I and II trials in adults, children and infants and plans are underway for further studies with this promising vaccine which will enable it to become a useful public health tool. Additionally, the Centre continues its interest in killed oral vaccines for cholera and enterotoxigenic E. coli. If vaccines for these three infectious diseases could be developed and used, these would prevent 60-70% of the diarrhoea cases currently coming to the ICDDR,B hospitals.

Other projects are evaluating vaccines for respiratory infections, including influenza, Haemophilus influenzae type b (Hib) and Streptococcus pneumoniae. To highlight a study carried out in cooperation with GAVI through their
PneumoADIP project, the Centre is defining the disease burden of pneumonia, along with its aetiologies in rural and urban communities in Bangladesh. With seven participating hospitals and other institutions in India, Nepal, and Africa, this study is designed as a collaborative study with national institutions which we trust will help in the decision-making process toward implementation of pneumonia vaccines in the future.

Tuberculosis, even without the common co-presentation with HIV/AIDS as it occurs in many countries, continues as a major health problem in Bangladesh. The Centre has established a laboratory for isolating and characterizing strains of Mycobacteria, including their antibiotic sensitivity and their molecular types and the Centre is participating with the World Health Organization to establish a specimen bank to assist in the development of rapid tests. Scientists have been defining the basic epidemiology of the disease in Matlab and in urban Dhaka and have been working with the Government TB Control Programme on their Global Fund project. A new test developed at the Centre is evaluating the potential for using blood specimens to detect active cases, even in populations with a high background level of antibody from old infections or from BCG vaccination. Tuberculosis research is a relatively new area of research for the Centre, but in a few years, rapid progress is being made.

Regarding research to “restart fertility decline” the Centre has completed studies which provide a greater understanding of determinants of fertility. Based on these, the Centre is now initiating studies to attempt to restart fertility decline by focusing services on those families most likely to have a high number of children. Many critical factors leading to increased fertility are outside the purview of the health system, e.g. age of marriage, general education levels, poverty, etc. However, some new initiatives may help insure services to those families who may not be accessing contraceptive services now. It seems that the family planning programme that reduced total fertility rates from 7 to 3 may need to be adjusted to further reduce it to replacement levels. In addition, our research can assist other sectors (economy, education, etc.) in monitoring the effects of their programmes on fertility.

Projects on HIV/AIDS and sexually transmitted and reproductive tract infections are relatively recent in the Centre, but have grown to become very important programmes. In cooperation with the national programme, the Centre has been conducting second-generation HIV/AIDS surveillance, and in 2004, released the results of the Fifth Round surveillance. Fortunately, Bangladesh continues to have a low prevalence of HIV infection among persons with high-risk behaviours; however, we may be seeing the beginning of an epidemic among injecting drug users. More recently, with support from several donors, the range of studies on HIV/AIDS and STIs have broadened considerably with emphasis on prevention among adolescents. Jagori—the voluntary counselling and testing centre (VCT) of ICDDR,B—has now established three clinics in the country and serves as the model for other such VCTs in the country. The studies on STI continue to show increasing resistance to commonly used antibiotics.

Projects on vector-borne infections are also new to the Centre in recent years, but the Centre has now been conducting surveillance for dengue, and has done pilot studies on malaria, visceral leishmaniasis, and Japanese encephalitis. These initial studies have positioned the Centre to conduct trials of vaccines for dengue and encephalitis, and for other types of studies to reduce the disease burden from malaria and leishmaniasis.

Additional Projects of High Importance

While most of the scientific efforts are directed toward the priorities defined in the strategic plan, some could not be precisely anticipated, but are still within the general direction of the plan and are highlighted here.

Nipah Virus

When an outbreak of encephalitis with high case-fatality rates occurred in the western part of Bangladesh, scientists worked with ICEDR, WHO, and CDC, to understand the aetiology of the outbreak. The team rapidly identified the cause to be Nipah virus. This is a virus transmitted from fruit bats to people, but for the first time, the virus was also found to go from person to person. It appears that this virus may be endemic in Bangladesh and that it infects people during the season from February to April. The reason for this seasonality is not known. With a case-fatality rate of about 75% and the potential to be transmitted between people, this is an especially worrisome infection that will require additional research in coming years.

Baseline Survey for the National Nutrition Programme

The Ministry of Health and Family Welfare, Government of Bangladesh, has initiated the National Nutrition Programme (NNP), a very large
initiative to reduce malnutrition in the country. The programme works through community-based NGOs, focusing on vulnerable segments of the population, i.e. children, adolescent girls, and women. To assist with the programme, ICDDR,B was requested to conduct a baseline survey in 113 sub-districts (44 were just starting the NNP intervention, 53 had previously participated in a similar previous programme (BINP), and 16 were controls. The survey, conducted in collaboration with the Institute of Public Health Nutrition and the National Institute of Population Research and Training, covered a quarter of a million households and 27,000 respondents. Preliminary analyses of data showed that more than 96% of target households could be selected, and over 98% of interviews were successful in the household part of the survey.

Role of Cholera Phage in Ending Epidemics

An unexplained characteristic of cholera epidemics is that they suddenly end, apparently by themselves, only to return again the next year, or after a few years, depending on the geographic region. If one could understand why and how epidemics end naturally, perhaps we could accelerate these ‘natural’ events and force the epidemic to end more quickly. Scientists from the Laboratory Sciences Division have found that one of the reasons may be the balance between vibrios and vibriophage in the environment and in the cholera patients. Phages are viruses that multiply within bacteria and destroy them. During the early phase of the cholera season, there are few phages in environmental water samples, but as the season progresses, the phage titres increase. It may be that these phages in the environment kill the vibrios, signalling the end of the epidemic. The Centre has been studying environmental aspects of the vibrios for many years, and this new work on virbiophage adds another piece to a very complex puzzle.

New Developments on ORS

Though ORS was a great discovery of the Centre many years ago, research on this simple but elegant solution, continues. During 2004, WHO and UNICEF published its recommendation for a revision of the formula for ORS, Based on studies at the Centre and elsewhere, the new solution has a lower concentration of sodium and carbohydrate with a goal of lowering the osmolarity of the solution. Using the new formula, fewer patients require additional unscheduled intravenous fluids. Though the data showing the improvement were solid, there was also a need for phase IV surveillance to assure users that there would not be rare cases of clinically significant hyponatraemia (low serum sodium). This surveillance was carried out with more than 40,000 patients using the new solution and there was no increase in the rates of hyponatraemia, providing further evidence of the safety of the new solution. The Centre continues its interest in further improvements of ORS.

Future Directions

This summary provides only a few hints at the contents of this Annual Report. The Strategic Plan provides an overview of the directions for the Centre, and we believe we are on track to accomplish the objectives identified in the Plan. There appears to be an increasing consensus of the opportunities in international health as reflected in the Child Survival series recently published in the Lancet, and this consensus gives increasing optimism that the results of our research will be utilized by the world community. It is thought that, of 10 to 11 million children who die every year in the developing countries, about 8 million deaths could be prevented with interventions that are available or may readily be available soon. Making these efficacious interventions effective and practical in areas where the problem exists will require continued research. Simply saying that we have an intervention does not make it truly available. The research is still needed to learn how to make it available and cost-effective. This will require operations research, but the basic research needs to continue simultaneously to develop new interventions for the future.

We hope you will find the information provided in this report useful. Please feel free to contact us if you wish to be placed on our mailing list for the ‘Glimpse’ and the ‘Health and Science Bulletin.’ You may also wish to subscribe to the Journal of Health, Population and Nutrition. These are freely available on our web site (www.icddrb.org).

For those who can give, we also ask for your financial support for our patient-care activities. As I am writing this report, our hospital is seeing almost 500 patients per day! I also want to especially thank the groups of Bangladeshi-Americans living in Texas, Georgia, California and Tennessee, who have generously supported the Centre as well as many other individuals who have sent donations. We are grateful to you all.

David A. Sack, MD
Executive Director
April 2005
RESEARCH
PROGRAMMES
The mandate of the Child Health Programme is to contribute to the development of cost-effective child health and survival programmes by enhancing the understanding of the causes of childhood morbidity and mortality and by testing public-health interventions to improve child health and development. Activities in 2004 are highlighted below.

Integrated Management of Childhood Illness

In 2004, preliminary findings from the ongoing Integrated Management of Childhood Illness (IMCI) evaluation study in Matlab were widely disseminated. This study, implemented in collaboration with the Government of Bangladesh, is part of the global Multi Country Evaluation of IMCI, supported by WHO (with funds from the Melinda and Gates Foundation) and USAID. In-country dissemination sessions were held. Presentations were made at the Forum 8 of the Global Forum for Health Research and at the Ministerial Summit on Health Research—both in Mexico City. The highlights of the findings and dissemination activities were published in the Lancet [Arifeen SE et al. 2004;364:1595–602], coinciding with the Ministerial Summit. A Lancet commentary [Gwatkin DR. 2004;364:1557-8] described the study as an unusually thorough effort to assess how well a prominent global health initiative works in the field.

The findings from the first 2 years of this assessment show improvements in the quality of care in health facilities, increases in the use of facilities, and gains in the proportion of sick children taken to an appropriate healthcare provider. The mean index of correct treatment for sick children was 54 in the IMCI facilities compared to 9 in comparison facilities (range 0–100). Use of the IMCI facilities increased from 0·6 visits per child per year at baseline to 1·9 visits per child per year about 21 months after the introduction of IMCI; 19% of sick children in the IMCI area were taken to a health worker compared to 9% in the non-IMCI area. Innovative modifications were made in the guidelines for the management and referral of severely ill children seeking care from the IMCI facilities. Figure 1 and 2 show that the percentage of sick children, with severe illness, who were managed correctly in health facilities, increased by more than 5 folds during 9 months in 2004.
These findings are being used for strengthening child healthcare nationwide as the Government adopts the lessons from Matlab. The levels of the use of health facilities could be increased by investing in quality of care and health systems support. The study itself is expected to continue for another 2 years with final evaluation planned for 2007.

Investigators from the Johns Hopkins University, London School of Hygiene & Tropical Medicine, and Tulane University are collaborating with ICDDR,B in this project.

Neonatal Health Interventions

As reported previously, the Centre is undertaking two major neonatal intervention research projects—PROJAHNMO-1 and PROJAHNMO-2—aimed at evaluating the impact of a package of pregnancy, delivery and newborn-care interventions on neonatal mortality. These cluster-randomized trials are being conducted in 3 upazilas of Sylhet district and in Mirzapur upazila of Tangail district. This study addresses the Centre’s strategic objective of finding cost-effective and reproducible solutions to high neonatal mortality.

The studies are supported by USAID, Saving Newborn Lives Initiative (SNL), and the Wellcome Trust and are being conducted in partnership with Johns Hopkins University, Shimantik (a national NGO), Ministry of Health and Family Welfare of the Government of Bangladesh, Dhaka Shishu Hospital, Kumudini Hospital, Institute of Child and Mother Health, and BRAC. Previous annual reports include project details.

In 2004, a mid-term review of the Sylhet project was conducted. Findings from household surveys showed significant improvements in key delivery and newborn-care practices in the intervention areas, particularly in the home-care model (Fig. 3). Deliveries attended by trained TBAs, umbilical cords cut with clean blades, and the incidence of delayed bathing of the newborn (3 days or later after birth) increased significantly in the home-care area. Improvements in the home-care model were more modest.

By the end of 2004, a second round of adequacy household survey was conducted in Sylhet and the first in Mirzapur. Final evaluations are planned for 2006. Dissemination of these findings have been started with presentations made both within Bangladesh and abroad.

Studies on Child Development

In 2004, the Centre continued its research on child development, which focuses on measuring the effects of nutritional deficits, poor health and deprivation on child development. This evolves from the realization that child development is both an outcome and a determinant of child health and societal progress. A particular aim is to design and evaluate low-cost and feasible interventions.

Studies on child development are summarized below.

Factors associated with development of infants in Bangladesh

In a post-hoc analysis of a randomized, controlled trial assessing the impact of fish-oil (1 g/day) or soy-oil (4 g/day) supplementation to women from 24 weeks of pregnancy until delivery on birth-weight of their babies, the factors influencing mental and psychomotor development and behaviour of poor urban Bangladeshi infants were assessed. Multiple regression analysis was performed on pooled data of 249 infants completing the study. After controlling for age and sex, the mental and psychomotor development indices significantly correlated with socioeconomic status (SES), maternal...
body mass index (BMI), parental education, anthropometry at birth and at 10 months, and stimulation at home. Family assets and availability of play materials at home strongly predicted both mental and psychomotor development, while overcrowding negatively correlated with head circumference at birth and its growth predicted the mental developmental index (MDI), while length at birth predicted psychomotor development index (PDI). SES of the family and birth size strongly influence optimal development of poor infants in developing countries. However, stimulation at home with play material has a strong positive role in later development.

Effect of supplementation of fish-oil or soy-oil during pregnancy: is there an effect on psychomotor development of infants?

Foetal brain and retina dramatically increase the uptake of docosahexanoic acid (DHA), a long-chain polyunsaturated fatty acid, during the last trimester of pregnancy and early post-natal period. Supplementation of DHA to infants improves their neuro-development. This randomized, double-blind, controlled clinical trial was a follow-up of a large study in which 400 pregnant mothers were randomly allocated to either fish-oil (4 g/day) containing DHA or soy-oil (4 g/day) containing DHA precursor, beginning at 25±1.2 weeks of pregnancy and continued until delivery. The aim was to assess their effect on mental and psychomotor development and behaviour at 10 months of age in 249 (62%) of the original infant cohort who could be located at 6 months of age. After controlling for all possible confounders, no significant differences in mental development and behaviour ratings between the groups were observed, although PDI in the fish-oil group approached significance (p=0.062). In a subgroup of low-birth-weight (LBW) infants, a significant interaction effect of ‘sex with treatment’ on PDI was observed. The LBW female infants born to fish-oil-supplemented women performed significantly better than the LBW female infants born to soy-oil-supplemented women at 10 months (mean=101.05 vs 94.06; p=0.03). The results suggest a possible beneficial role of fish-oil supplementation during the last trimester of pregnancy on psychomotor development of infants and a clear benefit to LBW female babies.

Correlation of maternal depression and socioeconomic condition with nutritional status of children

Studies have identified maternal depression as a contributor to childhood malnutrition. In a cross-sectional study at the Dhaka hospital of ICDDR,B, 30 children with diarrhoea and their mothers were interviewed to examine the correlation of current maternal depression state, using the Centre for Epidemiological Studies-Depression (CES-D) questionnaire and their SES with the nutritional status of children. Twenty-three percent of mothers reported mild-to-moderate depressions, and 67% reported severe symptoms of depressions. There was no significant correlation between current maternal depression and nutritional status or SES of children. The BMI of mothers significantly correlated with the nutritional status of children. The asset index was significantly associated with the child’s nutritional status, but there was no significant correlation between the housing and crowding indices and the nutritional status of children. The results indicate that the nutritional status and SES of mothers are related to child nutrition.

Relationship between socioeconomic factors and psychomotor development in infants

Culture, the immediate environment, parental factors, and children’s own biological make-up influence their development, while SES of a population, reflective of the standard of living, influences their early development. This study examined if low sociodemographic factors, consequences of poverty, and food insecurity could affect the development and behaviour of children in an urban population in Bangladesh. Using house-to-house survey in a community of Dhaka city with people of mixed SES, 100 infants, aged 10 months, were identified and enrolled. Information on housing, sanitation and income, possessions, type of job, education, and number of family members was collected to assess SES. The Bayley Scale of Infant Development-II (BSID-II) was used for assessing the development of infants. Behaviour of infants was rated during the test using a modified 5-scaled tool, designed by Wolke. Multiple linear regression was conducted for each developmental and behavioural variable at 10 months to control for possible confounders. The mean±SD psychomotor development score of infants from lower SES was significantly inferior to those from higher SES (96.9±13.8 vs 103.3±11.2; p=0.005). However, their MDI and behaviour ratings were similar, while the difference in PDI approached significance (8=6.03, se=3.1, 95% Confidence Interval [CI] –0.08-12.1, p=0.053). The results, although not conclusive, suggest that SES might have a significant effect on the motor development of children.

Effect of malnutrition on mental, motor and behaviour development in infancy

Childhood malnutrition, in addition to impaired physical growth, leads to poor mental and psychomotor
development. This cross-sectional study assessed the association between malnutrition and development of infants at 10 months of age. Development of infants was assessed using the BSID-II and behaviour assessed on five ratings each with 9-point scale by Wolke, and anthropometry of infants performed using the standard method. The mean±SD psychomotor development score of the stunted infants (height-for-age z-score <-2.2) was significantly lower (96.92±14.44 vs 103.27±11.08; p<0.05), and they were less happy (5.49±1.66 vs 6.06±1.27, p=0.05) and less active (4.95±1.91 vs 6.02±1.31, p<0.05). The families of well-nourished infants had significantly better housing and weight, and their mothers were also significantly taller. After controlling for all confounders, the stunted infants had a significantly lower score on PDI (B=5.43; se=2.52; 95% CI 0.43-10.43) and activity (B=1.02; se=0.32; 95% CI 0.38-1.66), and they also were significantly less happy (B=0.53; se=0.29; 95% CI -0.05-1.11). The results indicate that malnourished infants living in urban Bangladesh had a significantly lower psychomotor development and were less active and less happy.

Perceptions of mothers about development of children: findings from focus-group discussions

To plan for an intervention for malnourished children attending the community nutrition centres (CNCs) of the Bangladesh Integrated Nutrition Programme (BINP), a qualitative research was conducted to understand child-rearing practices of rural Bangladeshi mothers and their perceptions about child development using focus-group discussions (FGDs). After extensive piloting, 7 FGDs with 51 mothers who attended the CNCs and 7 additional FGDs with 50 mothers of adequately-nourished children living in the same villages were held. The results of the FGDs were described, in narrative form, using Creswell’s recommendations (Creswell, 1998). Most mothers talked about the importance of nutrition and education on child development, but mentioned little about the role of play (toys, books). Some felt that development was an innate quality that improves with age on which they did not have any influence. Mothers mentioned the importance of play for keeping children healthy and providing them the physical strength, and most of them felt that play was needed to make the child happy, while a few said that playing helped children learn and improve their intelligence. Most mothers strongly felt that fathers had an important role in the children’s education and upbringing and in playing with them. It was a common idea that the children must be punished—physical punishment was fairly common but scaring and threatening them were more frequent. Giving rewards for a good behaviour, like kissing and giving some cookies or chocolates, was rarely mentioned. The results indicate a serious lack of understanding of mothers about child development and in promoting their development. Mothers pay very little attention to playing and chatting with children and generally fail to recognize the importance of play in child development. Punishing children is fairly common, contrary to rewarding and praising the child, which was least mentioned. Intervention programmes, therefore, must include topics, such as importance of play and encouragement and avoidance of punishment for optimal child development.

Childhood drowning

A mix of qualitative research methods, including cognitive mapping procedures, in-depth interviews, and group discussions is employed to understand better the specifics relating to drowning events, to assess local perceptions of the importance of drowning in relation to other causes of childhood deaths, to elicit input from the community regarding feasible and culturally-appropriate interventions, and to gather information to design messages and appropriate venues for the intervention strategy. Data will be useful to better understand the views on the vulnerability of children to drowning, learn why these deaths or near-deaths occur, and define better how the problem can be addressed.

Information is being obtained from parents and caretakers, healthcare workers, and other stakeholders, particularly those who influence how interventions get implemented at the community level.
There is no local term for drowning. Rather, people are descriptive when they talk about drowning, referring to it as ‘panitay porsay’ [falling into the water] or ‘panitay poira morsay’ [died due to falling into the water]. The most common causal explanation for the incident was that it was linked to evil spirits or some supernatural force, followed by another that it was the fate of the child. Other explanations were that the mother was too busy with work and the substitute childcare providers were unable to take proper care of the child; the parents did not recognize that the water body was potentially dangerous, and the child was too young to understand the danger. Interestingly, it was found that, in only two of 15 cases, the mother was taking care of the child at the time of the incident. Other care providers included older siblings or members of the extended family. We uncovered potentially-dangerous responses to the drowning incident. First of all, when families discover that the child is absent, they first search for the child around the household rather than near or in the water bodies. Moreover, due to the local belief that the rescued child will die if first touched by a parent, mothers who first discover the child in the water body are unwilling to rescue the child. Rather, in most cases, the mothers called others to pull the body from the water. Many traditional practices aimed at extracting water from the child’s body was also uncovered. These include placing the child’s body on the head or shoulders of somebody and spinning the child and applying pressure to the child’s stomach. Other measures include massaging the child with substances to warm the body, including mustard oil, mud or ash, or covering the body with a blanket.

This study is conducted in collaboration with the Johns Hopkins University, USA. A seminar was held at the Johns Hopkins University in November 2004 where preliminary results were presented.

Child Health and Nutrition Research Initiative

In July 2004, the Secretariat of the Child Health and Nutrition Research Initiative (CHNRI) moved from Geneva to ICDDR,B. CHNRI is an international network of interested partners supported by the Global Forum for Health Research in Geneva, Switzerland.

CHNRI is committed to implementing the Millennium Development Goals of eradicating extreme poverty and hunger, reducing child mortality, and combating HIV/AIDS, malaria and diseases in children. CHNRI is helping to set research priorities in child health, development and nutrition, and resolve related methodological issues. It also sponsors research on priority child health and nutrition problems, especially in low and middle-income countries, with a focus on research to inform policies for scaling up effective interventions.

CHNRI aims at increasing the level of communication and discussion among those who work on child health and nutrition, such as nutritionists, child health specialists, and child development specialists. It provides a platform to initiate and maintain debate on the importance and direction of research, bringing together scientists and implementing bodies to discuss issues relevant to the current status of knowledge and the requirements for the future.

Further, CHNRI allows communication with donors and potential contributors, thereby helping direct funds to the cause. The initiative, therefore, makes an effort to ensure that identified gaps are being highlighted and addressed.

The concepts of CHNRI were developed as a result of several meetings convened by the Global Forum for Health Research, starting with a movement from research groups to strengthen and formalize the interactions between researchers in child health and nutrition. The first meeting of CHNRI in June 1999 highlighted some important issues for the child health and nutrition research agenda. In February 2000, a meeting of interested parties led to the identification of priorities in research and analyses. Following initial funding from the World Bank in 2001, issues of governance and strategic planning were addressed, and projects were initiated under commissioned research/analyses and competitive research grants.

A Board selected for their expertise in international public health and medical research governs CHNRI. Dr. Robert E. Black of Johns Hopkins University, USA, currently serves as Chair of the Board. The Board plays a strategic and policy-making role, while the management of the Initiative is carried out by the Secretariat located at ICDDR,B.
The Reproductive Health Programme was established with the mandate to address issues relating to reproductive health research with major emphasis on safe motherhood, family planning, and prevention and treatment of sexually transmitted infections. Based on continuing challenges, opportunities, and relative strengths, the Centre has also identified the following actions for improving reproductive health:

- Develop and test strategies for improving knowledge and practices regarding reproductive health in adolescents
- Understanding the issue of violence against women in the social context and developing public-health strategies to reduce this
- Operationalizing ‘male-involvement’ in reproductive health and monitoring this involvement
- Develop and test different maternal health strategies and tools to monitor progress to achieve Millennium Development Goals (MDGs) and thus to contribute significantly in the fight against maternal mortality.
- Undertake research for development of intervention programmes for prevention and management of sexually transmitted diseases and HIV/AIDS.

Safer Motherhood

Monitoring and evaluation of process and impact indicators of improved basic and comprehensive EOC services on service use at union and upazila levels in Matlab.

During 2004, maternity-care services were available in the Matlab area from 12 different service-delivery points (5 ICDDR,B and 7 government). These include the Matlab Upazila Health Complex (UHC), 6 upgraded government health and family welfare centres, 4 ICDDR,B sub-centres, and the ICDDR,B Matlab hospital. Under the Emergency Obstetric Care Project (May 1998–May 2002) funded by European Union (EU), 8 union-level government facilities were upgraded to provide basic emergency obstetric care (EOC). A comprehensive EOC facility was established within the premises of the Matlab UHC.

Facility-level data on the use of these maternity-care services have been collected since January 2002. Analysis of facility records is also progressing well and is periodically shared with the relevant service providers and programme managers.

Behaviour change communication is ongoing at the community-level, with EU funding, in 4 of 8 intervention unions by the government field workers (family welfare assistants and female health assistants) to increase the awareness of mothers, their mothers-in-law and husbands about life-threatening pregnancy-danger signs, maternal nutrition, pregnancy planning, and the availability of basic and comprehensive EOC services in their locality.

ICDDR,B has demonstrated how to develop basic obstetric care services and make these acceptable and effective for rural women at low cost. The performance of these facilities during 2004 are summarized in Figure 1-3.

Fig. 1. Normal deliveries conducted in 4 ICDDR,B sub-centres
Unmet need for life-saving obstetric surgery in Bangladesh

Worldwide, over 500,000 women and girls die of complications relating to pregnancy and childbirth each year. Over 99% of these deaths occur in developing countries such as Bangladesh. Reduction of maternal mortality is a major objective of the national health programme and of the Millennium Development Goals (MDGs) for Bangladesh. However, maternal mortality ratios vary widely by source and are highly controversial. Measuring maternal mortality ratio is costly and difficult, and hence the ratio cannot be used for planning and monitoring safe motherhood activities at local level and at regular intervals. Alternative process indicators are being used for monitoring the impact of such services and for following overall progress in safe motherhood. The process indicators currently used for monitoring progress towards improved maternal health are: percentage of births with skilled attendants, percentage of births with caesarean section, and percentage of births with complications of those who are admitted to EOC facilities (met need for EOC). Recent data from the national level and Matlab suggest a significant reduction in maternal mortality ratios over the last two decades without a corresponding increase of these maternal health process indicators. A more sensitive indicator is needed to ensure progress at sub-national levels. The major obstetric interventions (MOI) for absolute maternal indications (AMI) is a powerful indicator of unmet need for obstetric care and of the functioning of the health system. By focusing on certain complications for which obstetric surgical interventions are absolutely needed to save the mother’s life, the indicator provides information on one of the most critical components in the reduction of maternal mortality—access to specialized obstetric care by those who really need it.

The Unmet Obstetric Need (UON) project of ICDDR,B started working on this new indicator in January 2001 with the main aim of validating the indicator in Matlab, Bangladesh. Validation was completed in 2003, and it was determined that 1% of deliveries are associated with severe life-threatening complications requiring specialized obstetric care (life-saving obstetric surgery). A second aim of the project was to examine whether this indicator could be introduced in the routine monitoring system in selected districts of Bangladesh. Piloting first started in Tangail district in 2002. Then, in 2004, it continued in 6 other districts from all 6 divisions of the country (Mymensingh of Dhaka division, Noakhali of Chittagong division, Jessore of Khulna division, Patuakhali of Barisal division, Moulvi Bazar of Sylhet division, and Bogra of Rajshahi division). These sites were selected by the Government of Bangladesh (Directorate General of Health Services) and UNICEF. The met need for life-saving obstetric surgery in these districts is assessed through this new indicator (MOI for AMI), which varied from 29% in Mymensingh to 76% in Bogra (see Table).
All EOC facilities (public, NGO, and private) in the pilot districts participated actively and gave full cooperation in data-collection exercises. Workshops were organized at districts to popularize the indicator and to provide hands-on-training on tools and techniques of data collection for the service providers and managers of participating EOC facilities.

The results of the district piloting were shared with all stakeholders involved through district dissemination workshops, and important positive changes were observed among the participants (e.g. taking initiatives for the under-served areas, improved registration, record keeping, etc.).

This new indicator provides information on the extent to which the routine healthcare system of any particular district is able to address the need for specialized obstetric care of its population. It involves the healthcare providers in the process which should facilitate policy-change. It will be complementary to currently-used indicators for safe motherhood and has the advantage that it is easily and reliably measured at low cost. The results of the study are expected to influence policy in giving priority to areas with high unmet need.

### Table. Met and unmet need for life-saving obstetric surgery in the pilot districts, 2004

<table>
<thead>
<tr>
<th>District name</th>
<th>Total population</th>
<th>Crude birth rate/1,000 population</th>
<th>Expected no. of deliveries per year</th>
<th>Expected no. of MOI-for-AMI per year</th>
<th>Met need for life-saving obstetric surgery %</th>
<th>Unmet need %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mymensingh</td>
<td>5,052,457</td>
<td>22.35 ± 112,922</td>
<td>±112,922</td>
<td>±1,129</td>
<td>29 (324 cases)</td>
<td>71 (805 cases)</td>
</tr>
<tr>
<td>Jessore</td>
<td>2,562,424</td>
<td>26</td>
<td>±66,623</td>
<td>±666</td>
<td>36 (237 cases)</td>
<td>64 (429 cases)</td>
</tr>
<tr>
<td>Bogra</td>
<td>3,027,930</td>
<td>20.4 ± 60,559</td>
<td>±60,559</td>
<td>±606</td>
<td>76 (463 cases)</td>
<td>24 (143 cases)</td>
</tr>
<tr>
<td>Tangail</td>
<td>3,612,187</td>
<td>22.8 ± 82,358</td>
<td>±82,358</td>
<td>±824</td>
<td>37 (302 cases)</td>
<td>63 (522 cases)</td>
</tr>
<tr>
<td>Patuakhali</td>
<td>1,636,046</td>
<td>25</td>
<td>±40,901</td>
<td>±409</td>
<td>34 (139 cases)</td>
<td>66 (270 cases)</td>
</tr>
</tbody>
</table>
Use and effectiveness of skilled birth attendance strategies in Matlab

The overall objective of this research is to support the Government of Bangladesh (GoB) in its efforts to design effective strategies to increase access to basic obstetric care for all women and to monitor progress in safe motherhood projects. The study examines the unique experience of a maternity care programme in Matlab, where two different approaches to basic obstetric care have been tested. These two approaches consist of (1) training and posting of nurse-midwives in villages to attend home deliveries and (2) upgrading of health centres to encourage women to give birth in a health facility. The evaluation of the successes and failures of these contrasting strategies will provide the Government with invaluable information on the best strategy to improve access to basic obstetric care in Bangladesh. The findings of this research will also be fed directly into an ongoing project in the broader Matlab administrative area (Matlab upazilla) where the GoB and ICDDR,B are making concerted efforts to strengthen obstetric services. In total, 42,766 birth records collected through a surveillance system and pregnancy-monitoring records were analyzed. Use of trained attendants increased from 5.0% in 1987 to 26.0% in 2001. Among the least poor section of the population, the use rose from 10% in 1987 to 39.3% in 2001 compared to 5.3% to 14.2% respectively among the most poor. For both home- and facility-based strategies, the least poor population was about 2 times more likely to use the services compared to the most poor. While free obstetric care improved the use of services, it did not reduce the socioeconomic inequalities in access to services. In addition, uptake of care was much higher among women who are educated. Specifically, among the women who had completed 10 or more years of schooling, use of services increased from 17.9% to 53.2%, whereas among women with no formal education, the increase was 6.3% to 18.6%. There was also a strong effect of distance to the nearest facility. Within 1 km from home to the facility, 46.7% used skilled care in 1987-2001 compared to 24.4% among women who lived within 1.1 to 2.0 km.

Between 1987 and 2001, there was virtually no reduction in the rate of stillbirths in both MCH-FP and comparison areas (Fig. 6). Although the rate of stillbirths decreased in the MCH-FP area from 38.3 to 34.7 per 1,000 pregnancies (an overall reduction of 11%), this decline was not significant (p>0.05). In the comparison area, the stillbirth rate was over 40 per 1,000 pregnancies in the late 1980s and remained almost the same until the end of 2000.

In regard to neonatal mortality, there was a considerable reduction in the MCH-FP area. Between 1987 and 2001, early neonatal mortality declined from 30.5 to 19.9 per 1,000 livebirths (an overall reduction of 33%, p<0.05) whereas the decline in the comparison area was 35.1 to 30.6 (an overall reduction of 14%, p>0.05) as shown in Figure 7. In regard to neonatal mortality, the reduction was substantial in both MCH-FP and comparison areas (Fig. 7).
comparison areas (overall reduction of over 50% in both the areas) as shown in Figure 8.

Fig. 8. Trends in late neonatal mortality in the MCH-FP and comparison areas between 1987 and 2001

After introduction of the safe motherhood programme in 1987 in the MCH-FP area, pregnancy-related mortality declined from 507 to 129 per 100,000 livebirths. During the same period, direct obstetric mortality declined from 264 to 110 per 100,000 livebirths. However, the reduction in maternal mortality does not correlate with the process indicators. In the mid-1970s when the decline in obstetric mortality was initiated, the use of skilled attendants for delivery was almost non-existent; in the late 1990s, the use was still well below 30% of the total births (Fig. 9). Similar trends were found in the use of emergency obstetric care (EOC) facilities. Between 1987 and 2001, the percentage of total births taking place in EOC facilities increased from 0% to only 4%. Although there has been an increase in caesarean section rates in recent years (0.2% in 1990 to 2.7% in 2001), caesarean sections mostly occur in the highest socioeconomic groups. Specifically, the highest socioeconomic quintile had access to about 10 times higher rates of caesarean sections compared to the lowest quintile. Moreover, this increase in caesarean sections does not necessarily indicate that the caesarean sections were used for life-saving purposes.

The findings suggest that substantial socioeconomic inequalities in the use of skilled attendants persist in Matlab. While we could not demonstrate any effect of the skilled birth attendance strategy in the reduction of stillbirths, the care provided by the skilled attendants may have contributed to a decline in early neonatal mortality. In regard to reduction in maternal mortality, skilled attendants may have played a significant role in early detection and referral of complicated cases. However, there is a lack of correspondence between the process indicators and the decline in the trends in maternal mortality. Further studies are needed to explore the reasons for the recent maternal mortality decline in Bangladesh.

Fig. 9. Percentage of births with a trained attendant in the Intervention area in Matlab between 1987 and 2001
The Nutrition Programme (NP) is hosted in the Clinical Sciences Division (CSD). Twenty affiliated and funded research protocols were in progress during 2004. The health professionals of the Programme provide clinical services and psychosocial stimulation to children with malnutrition, and breastfeeding counselling is provided to mothers. Efforts are being made to strengthen further collaboration with other programmes and divisions within the Centre: a community trial of L-lysine (an amino acid) in reducing diarrhoea episodes, a proposal developed by the NP in collaboration with clinicians, health systems experts, and immunologists, is a good example. The NP, in collaboration with the Ministry of Health and Family Welfare, Government of Bangladesh and the World Health Organization (WHO), organized a 5-day training course on “Nutrition in Emergency” in Dhaka in March. Twenty-five health professionals from public and private sectors of Bangladesh attended the course, the first of its kind in the region. In partnership with Concern Bangladesh, the NP set up nutrition blocks in Chittagong and Khulna Medical College hospitals, which, in addition to providing clinical services, are also the venues for hands-on training in child nutrition for medical and nursing students and doctors. The scientists of the Programme supervised the thesis work of Master’s degree students from the College of Home Economics, Dhaka and facilitated the process of postgraduate training at the University of Uppsala, Sweden, jointly with the CSD. The Head of the Programme attended a consultation meeting on the management of severe childhood malnutrition organized by the WHO in Geneva in September. The proceedings will significantly contribute to achieving the Millennium Development Goal (MDG) of Improved Child Survival. The Head of the Programme facilitated a training course on nutrition and child health in the University of Uppsala for doctors and nurses intending to pursue humanitarian activities in developing countries.

Baseline survey of National Nutrition Programme

The Ministry of Health and Family Welfare, Government of Bangladesh, has initiated the National Nutrition Programme (NNP), the largest nutrition initiative to reduce malnutrition in the country. The goals will be achieved through community-based nutrition interventions, and comprehensive intersectoral efforts to improve nutrition of vulnerable segments of the population, i.e. children, adolescent girls, and women.

ICDR,B is conducting the baseline survey for the NNP for assessing various nutritional and socioeconomic indicators in 113 upazilas or sub-districts (44 NNP intervention upazilas, 16 control upazilas, and 53 upazilas under the erstwhile Bangladesh Integrated Nutrition Project).
The survey, conducted in collaboration with the Institute of Public Health Nutrition (for the micronutrient part of the survey) and the National Institute of Population Research and Training (for pregnancy weight gain and birth weight of newborns), covers a quarter of a million households and 27,000 respondents. The four major components of the survey are as follows:

1. **Household socioeconomic survey**: In this component of the survey, the respondents included household heads, guardians of children aged less than 5 years, adolescent girls, and pregnant women. Body weight, height, and MUAC were measured and recorded. Demographic and socioeconomic variables and variables on caring practices, nutritional gardening, poultry and livestock were also recorded.

2. **Survey on micronutrient status**: The component includes determination of the following: (a) Hemoglobin in children, adolescent girls, and pregnant women (HemoCue method using finger prick blood); (b) Iodine status of adolescent girls and pregnant women from urine samples; (c) Iodine content of table salt samples to investigate extent of salt iodization; and (d) Magnitude of intestinal worm infestation by examination of stool samples for ova of helminths.

3. **Survey on pregnancy weight gain and birth-weight of infants**: This component includes measurement of body-weight of women during the third trimester of pregnancy, and weight of the newborns.

4. **Quality control (QC)**: Teams from ICDDR,B regularly monitor the data-collection process and performing anthropometry, and observe interviewing of a bout 5% of the respondents in the field, re-interviews of 5% of the respondents, and performing of anthropometry by the field staff.

Preliminary analyses of data showed that more than 96% of target households could be selected, and over 98% of interviews were successful in the household part of the survey.

Age, weight, height, MUAC, height-for-age (HA), weight-for-age (WA), and weight-for-height (WH) z-scores of 0 to 23-month-old children did not differ among the NNP, BINP and control areas. However, in children of the 3-5-year age group, the BINP children had significantly better WA z-scores than the NNP and the control children. Although the mean haemoglobin levels did not differ by area, anaemia (haemoglobin <10 g/100 mL) was more common in the control area (30.6%) than in the BINP (14%) and NNP (11.3%) areas. The median urinary iodine excretion of adolescent girls and pregnant women was 138 mg/L, and iodine deficiency, defined as urinary iodine excretion of <100 mg/L, was identified in 39.3%, 35.5%, and 26.3% of the participants in the BINP, NNP and control areas respectively.

Reduction in case fatality among severely-malnourished children with diarrhoea using a standardized management protocol based on the WHO guidelines

The study examined the effectiveness of a standardized management protocol, implemented at the Dhaka hospital of ICDDR,B in 1997, based on the
WHO guidelines, in reducing case fatality among severely-malnourished children hospitalized with diarrhoea and other acute illnesses. The nutritional status of all children, aged 0-5 year(s), admitted to the inpatient units of the Dhaka hospital over a one-year period with diarrhoea and other complicating illnesses, including sepsis, septic shock, and bronchopneumonia, was assessed, and their outcome (died or discharged survived) was recorded. The regular hospital staff followed the standardized protocol while providing care to the children. The case-fatality rates (CFRs) of the children were compared with those of previous years. In total, 6,545 children, including 3,045 (46.5%) severely-malnourished, were treated during the study period, and 264 of all children (CFR 4%) and 164 of severely-malnourished children (CFR 5.3%) died. Data indicate continued decline in the CFR among severely-malnourished children with 68% reduction since the introduction of the protocol (Chi-square for linear trend=57.1; p<0.0001). The results demonstrate that the WHO guidelines for the management of severe malnutrition, even after adaptation to local needs, is effective in reducing the CFR among severely-malnourished hospitalized children with diarrhoea and other acute illnesses.

Plant-based high-protein diet is comparable to animal protein-based diet in respect of nitrogen absorption and nitrogen balance in malnourished children recovering from shigellosis

Earlier studies have observed better absorption of protein and enhanced catch-up growth with an animal protein-based diet (AP; PER 15%). Since animal protein is not affordable by underprivileged communities where children are most likely to suffer from malnutrition, the recommendation of AP may not be a practical intervention. This metabolic balance study assessed the intake of macronutrients and quantified absorption of nutrients from a plant-based, high-protein diet (PP; PER 15%) and another low-protein diet (LP; PER 7.5%—usual diet for poor communities in Bangladesh). In total, 31 moderately-malnourished children, aged 24-59 months, convalescing from shigellosis, were randomized to PP (n=11), AP (n=9), and LP (n=11). The cost of preparing 4,200 kJ diets from PP, AP, and LP was US$0.15, 0.75, and 0.11 respectively. After 2 weeks of adaptation to these diets, a 72-hour metabolic balance study was performed. The average daily energy intake (482-494 kJ/kg,d), coefficients of carbohydrate absorption (89-91%), and energy absorption (88-89%) were similar in the three groups. The coefficient of nitrogen absorption and the mean±SD nitrogen balance (g/Kg,d) were 81% and 0.33±0.17 in the PP, 82% and 0.26±0.14 in AP, and 73% and 0.13±0.06 in LP groups respectively (both PP and AP groups significantly higher than the LP group). The results demonstrate higher absorption of nitrogen and better nitrogen balance from high-protein diets, whether derived from plant or animal source, which might help deposition of more tissue protein. Thus, a less-expensive, plant-based high-protein diet might be used for nutritional rehabilitation in low-income countries where most families are poor and cannot afford to buy animal products.

Fig. 3. Coefficient of nitrogen absorption and nitrogen balance using different diets in malnourished children recovering from shigellosis

Increased food intake after adding amylase-rich flour to supplementary food for malnourished children in rural communities of Bangladesh

Amylase-rich wheat flour (ARF), when added to a food, makes it more tasty and palatable. This study examined the effect of adding ARF to the standard supplementary food (SF)—termed ‘Pushi Packet’ used routinely for malnourished children through the Bangladesh Integrated Nutrition Project (BINP)—on children’s food intake at 9 rural Community Nutrition Centres (CNCs) within the framework of the Bangladesh Integrated Nutrition Project (BINP). One hundred sixty-six malnourished children of either sex, aged 6-24 months, received one of the three diets randomly allocated to the study CNCs. Thirty-five children received the standard SF of the BINP (S-SF), 65 received ARF-added SF (ARF-SF), and 66 received SF to which water was added (W-SF) to make it similar in consistency to that of ARF-SF. The recipe of the diets was the same; however, their consistency and energy densities differed due to addition of ARF or water. All the children received the allocated diets at the CNCs, once daily for 6 weeks, and 90...
of them continued the diets for 9 weeks. The mean±SD intake (g/child) of SF from a single meal by children completing 6 weeks was the highest in children receiving ARF-SF (33.9±8.2) compared to S-SF (25.7±6.7) and W-SF (30.7±8.4) (p<0.05 for both comparisons) and was also the highest for children on the diet for 9 weeks (36.6±6.0 vs 25.5±4.7 and 32.7±8.2 respectively; p<0.05 for both comparisons). Vomiting was significantly higher in children receiving W-SF compared to children in the other two groups. Weight gain and increments in length and weight-for-height were higher in children of the ARF-SF group than in children of the other two groups, but the differences were not statistically significant. ARF-SF was better accepted than the other two diets. The additional cost for adding 2 g (2 g added to each packet of SF) of ARF to the diet was about Tk 0.25 (US$1=Tk 60). The results indicate that addition of ARF to standard supplementary food is simple, acceptable, inexpensive, and effective in improving energy intake by young malnourished children.

Nutritional status of elderly in urban Bangladesh

This study examined selected nutritional status indicators of 1,196 elderly people, aged 60-105 years (718 males and 478 females), visiting the Dhaka hospital of ICDDR,B during January 1993–December 2003. The mean age of men and women was similar (66.4 years and 66.6 years respectively), but overall, men were heavier and taller than women (p<0.001 and p<0.001 respectively). Men and women aged between 60 and 69 years had higher values for weight, height, and body mass index (BMI) than those aged ≥70 years (p=0.001, p<0.001, and p=0.001 respectively for men; p=0.019, p=0.007, and p=0.034 respectively for women); however, no gender difference in mid-upper arm circumference (MUAC) was observed between the two groups. Using a MUAC cut-off point of <22 cm in females and <23 cm in males, 50% of the elderly were malnourished (wasted). Proportions of men and women classified as having severe chronic energy deficiency (BMI <16 kg/m2) were similar among those aged 60-69 years (16% vs 22%, p=0.05) or ≥70 years (25% vs 21%, p=0.50). Low BMI is associated with compromised immune function, increased susceptibility to infectious illnesses, and lower survival rates among the elderly. A significantly higher percentage of elderly women (12%) than men (4%) was overweight with a BMI of 25 kg/m2 or more. Among the elderly, males and females with higher socioeconomic status (SES) had higher BMI and MUAC values than their counterparts with lower SES. The results indicate a high prevalence of malnutrition among the senior citizens of urban Bangladesh, who attended the ICDDR,B hospital.

Daily consumption of Indian spinach (Basella alba) or sweet potato has a positive effect on total body vitamin A stores in Bangladeshi men

Recent evidence suggests a lower vitamin A equivalency of β-carotene from plant sources than previously estimated. This study assessed the effect of 60 days of daily supplementation with 750 µg retinol equivalents (RE) of either cooked, puréed sweet potato, cooked, puréed Indian spinach (Basella alba); or synthetic sources of vitamin A or β-carotene on total body vitamin A stores in Bangladeshi men. The total body vitamin A stores in Bangladeshi men (n=14/group) were estimated using the deuterated retinol dilution technique before and after 60 days of supplementation with either 0 µg RE/d (white vegetables) or 750 µg RE/d as sweet potato, Indian spinach, retinyl palmitate, or β-carotene (RE=1 µg retinol or 6 µg β-carotene) in addition to a low-vitamin A diet providing ≈200 µg RE/d. The mean changes in vitamin A stores in the vegetable and β-carotene groups were compared with the mean change in the retinyl palmitate group to estimate the relative equivalency of these vitamin A sources. The overall geometric mean (±SD) initial vitamin A stores were 0.108±0.067 mmol. Relative to the low-vitamin A control group, the estimated mean changes in vitamin A stores were 0.029 mmol for sweet potato (p=0.2), 0.041 mmol for Indian spinach (p=0.03), 0.065 mmol for retinyl
palmitate (p<0.001), and 0.062 mmol for β-carotene (p<0.002). The vitamin A equivalency factors (β-carotene : retinol, wt : wt) were estimated as ≈13:1 for sweet potato, ≈10:1 for Indian spinach, and ≈6:1 for synthetic β-carotene. The daily consumption of cooked, puréed green leafy vegetables, or sweet potato has a positive effect on vitamin A stores in populations at risk of vitamin A deficiency (Am J Clin Nutr 2004;80:705-14).

Birth-weight affects immune function in early childhood

There is growing evidence to support foetal programming of the immune system meaning that events occurring in early life might have long-term implications in terms of immunocompetence and susceptibility to infectious diseases in later life. This study investigated whether birth-weight is linked to immune function during early childhood (4-6 years of age). Children in Matlab, a rural field site of ICDDR,B, with their sizes and weights measured within 72 hours of birth, were studied. Those with low birth-weight (LBW, <2500 g) had a significantly higher serum concentration of C-reactive protein and a higher lymphocyte proliferation response, but a significantly lower proportion of pan-T cells (CD3) in peripheral blood compared to those with appropriate birth-weight (ABW) (p≤0.05 for all comparisons). Stimulation with lipopolysaccharide (LPS) showed a significant reduction in the intensity of CD14 expression by monocytes in the LBW group compared to the ABW group (p<0.002); however, the groups did not differ in the LPS-induced expression of adhesion molecules or pro-inflammatory cytokines (TNF-a and IL-6) and mitogen-induced respiratory burst (production of oxygen radicals) of monocytes. The serum bactericidal response against an avirulent Escherichia coli strain was greater in the ABW group than in the LBW group (p<0.05). These findings might indicate that birth-weight significantly affects cellular and humoral immunity, evident as early as at 4-6 years of age, and a link between low birth-weight and altered immune functions during childhood, supporting the concept of foetal programming of immune functions and the need for appropriate public-health interventions aimed at maternal, neonatal and child health and nutrition.

Association of neutral fat in stool with aetiology and nutritional status of children with diarrhoea

Thirteen thousand one hundred seventy-one patients aged 5 days to 105 years, enrolled in the ‘Diarrhoeal Disease Surveillance’ system of the Dhaka hospital of ICDDR,B during 1996-2001, were studied to examine the association between neutral fat in stool and aetiology of diarrhoea and nutritional status. The presence of neutral fat in stool specimens, aetiology of diarrhoea, and nutritional status in children aged less than 5 years were determined and analyzed. Neutral fat in stool was present in 58% of the patients, more frequently in the stools of patients of all age groups with rotavirus-associated diarrhoea (p=0.005) and in children, aged 0-23 month(s), with enterotoxigenic E. coli (ETEC)-associated infection (p=0.014) compared to those without these infections. Neutral fat was less frequently (p<0.001) present in the stools of malnourished children, but more frequently in the stools of predominantly breastfed children. Destruction of villous cells in rotavirus infections might lead to release of intracellular neutral fat into the gut lumen and its excretion in stool, and interference with the secretion of pancreatic lipases leading to poor fat digestion has also been implicated. Less intake of dietary fat by malnourished children coming mostly from a lower socioeconomic background, low body fat reserves, and possible partial damage to the intestinal cells are responsible for less fat in the stool of malnourished children compared to the better-nourished peers. An earlier study observed malnourished children to be protected more from rotaviral infections, which could be another possible explanation for this finding. The presence of neutral fat in the stools of children with rotavirus- and ETEC-associated diarrhoea signifies compromised gastrointestinal function associated with these infections and may play a role in worsening the nutritional status of children.

Effect of zinc as adjunct therapy on systemic immune responses in shigellosis

Zinc is lost during diarrhoea, and its deficiency induces inflammatory responses altering the intestinal morphology that can be corrected by supplementation of zinc. This double-blind, placebo-controlled trial assessed the effect of zinc on systemic and mucosal responses of mild-to-moderately malnourished children, aged 12-59 months, infected with Shigella flexneri. Children in the zinc group (n=28) received 20 mg of elemental zinc and multivitamins (vitamins A, D, thiamine, riboflavin, and nicotinamide) plus calcium at twice the dosage of the U.S.-recommended dietary allowance (RDA) daily for 14 days. The control children (n=28) received multivitamins plus calcium but no zinc. All the children, however, received standard antibiotic therapy. Zinc supplementation had a significant effect on serum zinc levels. Using a ≥4-fold increase in serum shigellacidal antibody titres from its baseline values, the proportion of children with the shigellacidal antibody response was significantly greater in the zinc group than
in the control group (p<0.03). There was a significant (p=0.02) time x treatment interaction for the proportions of circulating CD20 and CD20+CD38+ cells, which were higher on day 7 in the zinc group than in the control group. Proportions of CD20 and CD20+CD38+ cells in the zinc group were significantly higher on day 7 than in the control group (p<0.007). No effect was seen on the histopathological features or the expression of innate and inflammatory mediators in the rectal mucosa of children. Adjunct therapy with zinc during acute shigellosis significantly improved seroconversion to shigellacidal antibody response and increased the proportion of circulating B lymphocytes and plasma cells.

Non-compliance with measles immunization: does nutritional status of young children matter?

The relationship of nutritional status and presenting features of young children, aged 12-23 months, with their measles vaccination status was examined. All children (n=4,075) aged 12-23 months, enrolled in the Diarrhoeal Disease Surveillance system of the Dhaka hospital of ICDDR,B during 1994-2003, were studied. Fifty-five percent of these children were stunted, 76% were underweight, and 48% were wasted. Children not immunized against measles (22% of total) comprised the study group, and those with a history of measles immunization constituted the control group. Female children were less likely to be immunized than males (39% vs 61%). Non-immunized children were 2 times more likely to be stunted (odds ratio 2.0; 95% confidence interval [CI] 1.7-2.3, p<0.001), underweight (OR 2.3; 95% CI 1.9-2.7, p<0.001), and wasted (OR 2.0; 95% CI 1.6-2.2, p<0.001). A significantly higher proportion of non-immunized children had signs (some severe) of dehydration (28% vs 22%, p<0.001), required longer (>72 h) hospitalization (15% vs 10%), had abnormal lung auscultation suggestive of lower respiratory infection (8% vs 5%, p<0.001) and a history of measles (11% vs 7%, p<0.001), and received vitamin A capsule less often during the last 6 months (44% vs 64%; p<0.001). The non-immunized children more often had illiterate mothers (66% vs 41%, p<0.001). The results suggest the need to identify illiterate mothers and their non-immunized children attending healthcare and/or immunization facilities and to provide them with measles immunization and vitamin A capsule based on the concept of missed opportunity.

Empiric antimicrobial therapy for malnourished children with presumptive shigellosis

This cross-sectional study, conducted at the Dhaka hospital of ICDDR,B during January 2000–September 2001, examined if certain clinical and laboratory parameters could differentiate culture-confirmed Shigella cases from non-Shigella invasive diarrhoas. In total, 389 patients of all age groups and both the sexes, with a history of diarrhoea of less than 96 hours and presence of visible blood and/or mucus in stool, were presumed to have shigellosis and enrolled in the study. Shigella was isolated from stool cultures of 227 (58.4%) of them. The remaining 162 (41.6%) patients and an additional 238 randomly-selected patients with non-Shigella diarrhoea from the Diarrhoeal Disease Surveillance system database constituted the comparison groups. Higher proportions of children with shigellosis were stunted, wasted, and underweight compared to children with non-Shigella diarrhoea (p=0.009, p<0.001, and p<0.001 respectively). Underweight was the most prevalent (53%) form of malnutrition among children with shigellosis, and 26% of them were severely underweight. The presence of more than 5 macrophages per high-power field in stool microscopic examination was significantly more frequent among patients infected with Shigella. The results indicate the need to consider an empiric antimicrobial effective in shigellosis in the management of malnourished diarrhoeal children with a history of visible blood and/or mucus in stool.

Clinical features, nutritional status, complications, and outcome of critically ill children hospitalized with diarrhoea in urban Bangladesh

In this prospective study, children aged less than 5 years with diarrhoea and associated health problems directly admitted to the Special Care Unit (SCU) of Dhaka hospital of ICDDR,B during January 1999–December 2003 were studied. Over 7,000 seriously ill patients were admitted to the SCU during the study period, and 708 (every tenth) of them—neonates to 80 years old—were enrolled, of whom 584 (82%) were children aged less than 5 years (76% infants, 19% aged 12-35 months, and 5% aged 36-59 months, with similar sex distribution). Neonates more often attended with diarrhoea of <3 days (70% vs 52%, p=0.02) and less vomiting (68% vs 82%, p=0.04) than infants aged 1-11 months. Some and severe dehydration was present in 49% and 24% of the patients. Although stunting was equally distributed, severe underweight and wasting were more frequently observed among infants aged 6-11 months than among infants aged 0-5 month(s) (41% vs 26%, p=0.002 and 8% vs 3%, p=0.01 respectively). Sixteen percent of the children had serum sodium ≤12.4 mmol/L, 44% had hypokalaemia (serum potassium <3.5 mmol/L), 8% had severe hypokalaemia (<2.0 mmol/L, 8% had severe hypokalaemia (<2.0 mmol/L).
mmol/L), 12% had hypernatraemia (sodium >150 mmol/L), 12% had hyperkalaemia (>5.5 mmol/L), 46% had severe acidosis (serum TCO₂ <10.0 mmol/L), 15% had hypoglycaemia (<3.0 mmol/L), and 70% had elevated serum creatinine (>62.0 µmol/L). The overall case-fatality rate was 13%, and 14% of them had a positive blood culture. Vibrio cholerae O1 (31%) and S. flexneri (22%) were the most frequently-isolated bacterial enteric pathogens. The findings indicate the importance of biochemical and microbiological investigations for efficient management of such patients, instituting an appropriate antimicrobial for averting deaths due to bacteraemia or sepsis, and nutritional interventions for early recovery and better survival of these children.

Do severely-malnourished hospitalized children differ in their development and behaviour from severely-malnourished children attending community nutrition centres?

Severe childhood malnutrition, in addition to impaired physical growth, also results in poor mental development, which can have a lasting effect if not timely intervened through psychosocial stimulation. This study assessed mental and psychomotor development and behaviour of severely-malnourished children (weight-for-age <−3SD), aged 6-24 months, admitted to the Nutrition Rehabilitation Unit (NRU) of the Dhaka hospital (n=30), and compared those with age, sex and nutritionally-matched children (n=30) who attended CNCs under the BINP in Monohordi upazila. Development of children was assessed using the revised version of Bayley Scale of Infant Development, their behaviour was rated on a five, 9-pointed scale by Wolke, and mothers were asked about the temperament of their children. The differences between the groups were compared by bivariate and multivariate analyses. The study groups did not differ in parental years of schooling, occupation of fathers, and presence of sanitary latrine. The NRU children lived in significantly less-crowded houses (p=0.03), were significantly more wasted, had smaller heads and thinner arms, and had recovered from diarrhoea along with pneumonia, septicaemia, and electrolyte imbalance, while the community children had minor illnesses. The mean±SD MDI and PDI of the NRU children were 68.67±16.44 and 56.57±11.09 respectively and those of the CNC children were 83.40±14.37 and 78.97±19.23 respectively (p<0.001 for both comparisons). The NRU children were significantly less active (p=0.005), and less oriented (p=0.05), although more soothable (p=0.002) than the community children. The results indicate the need for psychosocial stimulation, in addition to nutritional rehabilitation and treatment of underlying illness, in the management of severely-malnourished young children.

Serum endotoxin in children with diarrhoea and malnutrition

Endotoxin, a component of Gram-negative bacteria, causes excessive production of cytokines triggering the cascade of events leading to sepsis, septic shock, and death. This study examined the association between serum endotoxin, measured by a new and specific method called endospecy, and septic illness, malnutrition, and death. A significant level of endotoxin was detected in 23 (54%) of 42 children with diarrhoea and sepsis, while the levels were below the limits of detection in 32 healthy controls. Antibiotic therapy, rehydration, feeding, and micronutrient supplementation reduced the level of serum endotoxin and improved the general condition of most patients. Non-survivors (n=5) were severely malnourished and had significantly higher amounts of circulating endotoxin before treatment compared to survivors (n=37), suggesting an association among malnutrition, pre-intervention level of serum endotoxin, and deaths.

Nutrition and morbidity among the elderly in rural Bangladesh

In this cross-sectional study, medical health, functional status (physical and cognitive), health-related quality of life, and social functions (four main
domains of health) were assessed in 621 elderly men and women in rural Bangladesh. Clinical examinations were performed on 473 of them to identify chronic conditions, such as hypertension, heart disease, diabetes mellitus, arthritis, vision and hearing problems, and comprehensive tests were performed for assessing their cognitive functions. The standard tests, developed for literate western populations, were substantially modified and pre-tested to facilitate completion of the tests by illiterate respondents and for overcoming different cultural contexts of the images. Blood samples were obtained from 460 respondents for analyzing nutritional markers, including vitamins, diabetes mellitus, and lipid profiles. The study assessed the implications of rapid weight loss or low body mass: 52.2% of the respondents felt that they had a major malnutrition problem, and 50% had a BMI of <18.5, while 8% reported substantial and 39.4% reported some weight loss during the last 3 months. Data analysis is underway to determine whether the risk of having an underlying malignancy is the same at a given weight deficit in developing country as it is in western geriatric practice.

Using clinical scores for diagnosing tuberculosis in children with or without malnutrition

Diagnosis of tuberculosis (TB) in children is difficult due to non-specific clinical manifestations and very low frequency of lung cavitation, detectable by chest x-ray, and rare sputum positivity. Rampant malnutrition in developing countries not only predisposes children to TB and increases the severity of disease, but also makes the diagnosis difficult, as such children often have negative Mantoux test (MT) results. In the absence of proper diagnostic tools, this study is evaluating two clinical scoring systems—the modified Kenneth-Jones score (KJS) and the WHO-recommended TB score (TBS)—for diagnosing TB in children. The KJS is based upon criteria that include age, nutritional status, non-response to therapy (absence of weight gain during nutritional rehabilitation and/or pneumonia not responding to conventional treatment), prior BCG vaccination, history of exposure to TB, MT induration, and radiological evidence of parahilar lymphadenopathy. A KJS of 5 or more indicates probable TB, which justifies therapy. The TBS considers 11 different features, each with its own score, and does not rely upon chest x-ray findings and biopsy, but requires a good clinical history, physical examinations, and MT. TB is likely if the TBS is 7 or higher, and there is no other probable diagnosis. This study applied both the scoring systems to 389 children with clinical features suggestive of TB, of whom 102 children were positive by KJS or TBS or both and were treated for TB. Markers, including AFB smear, culture (both Lowenstein-Jenssen [LJ] medium, and MGIT), and polymerase chain reaction (PCR) using IS6110 and rpoB primers, were performed on gastric aspirate of 102 children diagnosed as having TB and on 31 children without features of TB and with negative scores. Their median age was 15 months, and their median weight-for-age was 55%, indicating a poor nutritional status. Of the 102 children with TB, 47 (46%) were positive by KJS, 96 (94%) were positive by TBS, and 33 (32%) were positive by both the scoring systems. Gastric aspirate for AFB smear, LJ and MGIT cultures were positive in 11%, 17%, and 13%, respectively, of children with TB diagnosed by either or both the scores (9.6%, 9.6%, and 6.5% respectively in children without TB). PCR using IS6110 or rpoB were positive in 62% and 9% of children with TB compared to 38% and 3% respectively in children without TB (p=0.02 for IS6110). Children diagnosed as having TB by KJS had a greater proportion of positive markers compared to those diagnosed by TBS, but the differences were not significant. The modified KJS is less dependent on clinical history, which can be unreliable in developing countries and can be used in the diagnosis of childhood TB in countries like Bangladesh. PCR using the primer IS6110 is also a valuable test for diagnosis where facilities are available.
The Infectious Diseases and Vaccine Sciences Programme was established in 2000. It is a Centre-wide, cross-divisional activity, housed within the Health Systems and Infectious Diseases Division (HSID), with a mission to facilitate and focus the Centre’s expanding role in the prevention and control of infectious diseases important to Bangladesh and other developing countries. The Programme functions to establish priorities and identify resources, and enhance collaboration, communication, and use of existing resources to boost the Centre’s capacity to conduct investigations relevant to preventing suffering and mortality from key infectious diseases. The major changes in 2004 included the departure of the founding head of the Programme Dr. Robert Breiman in June and his replacement in August 2004 by Dr. Stephen Luby, who is also a medical epidemiologist seconded from Centers for Disease Control and Prevention (CDC).

In line with its strategic plan, the Programme focuses on (1) Defining the epidemiology, burden and effective control strategies of key infectious diseases; (2) Developing and evaluating rapid, simple diagnostic tests; (3) Evaluating promising vaccine candidates against key infectious diseases; (4) Enhancing the capacity to investigate and respond to outbreaks of communicable diseases in the region; (5) Assisting with technology transfer to allow other countries to manage emerging infectious diseases; and (6) Using genomic analysis to understand pathogenic microorganisms isolated from this part of the world.

The Programme coordinates ongoing investigations addressing key emerging infectious diseases in Bangladesh and the surrounding region. These investigations include: epidemiology of acute lower respiratory infection, including studies to assess the magnitude and impact of drug-resistant respiratory pathogens and the burden of pneumonia; magnitude of the prevalence of tuberculosis, drug-resistant Mycobacterium tuberculosis, and the effectiveness of control programmes using directly observed therapy; surveillance for novel and emerging strains of diarrhoeal pathogens and define the burden of disease caused by Shigella and Salmonella Typhi; epidemiology and prevention strategies of leishmaniasis; and epidemiology and aetiology of encephalitis.

The Programme is facilitating the Centre’s role as a resource for investigation of outbreaks of severe or novel forms of disease. The Programme supported investigation of two outbreaks of Nipah encephalitis in the western part of Bangladesh in 2004. Nipah virus, a newly-emerging, highly-lethal paramyxovirus, appears to regularly cause sporadic outbreaks in Bangladesh. The collaboration of ICDDR,B with international partners and the Government of Bangladesh has been productive in improving understanding of Nipah virus and improving the Government’s capacity to respond to outbreaks.
The Programme takes a leading role in establishing new alliances and collaborations outside the Centre and had established working relationships with the vector-borne disease staff within the Ministry of Health, Directorate-General of Health Services, Dhaka Medical College Hospital, Holy Family Red Crescent Hospital, Rajshahi Medical College, Mymensingh Medical College, Sir Salimullah Medical College, Chittagong Shishu Hospital, Shishu Shasthya Hospital, Chittagong Medical College Hospital, Kumudini Hospital and Dhaka Shishu Hospital. The Programme also fostered ongoing, active collaborations with the Armed Forces Research Institute for Medical Sciences in Bangkok, Thailand, the University of Brisbane, and the Centers for Disease Control and Prevention, USA.

The Programme works directly with all divisions at ICDDR,B to achieve its mission. The strong infrastructure of the divisions provides remarkable opportunities for the Centre to be a global leader in addressing priority research questions regarding a wide array of key infectious diseases affecting children and adults in developing countries.

**Enteric Diseases**

**Diarrhoea**

Hyperinfectious state in *Vibrio cholerae*

There is a great interest in understanding the factors that enable *V. cholerae* to depart from the aquatic environment, infect the human host, and cause widespread disease. Previous studies at the Centre have shown that the passage of bacteria through the human gut results in a hyperinfectious state in *V. cholerae* causing it to be more pathogenic for the next host and thus contributing to its epidemic spread. After having demonstrated this in humans, this phenomenon was remodelled in infant mice. The passage of bacteria through the infant mouse confers a hyperinfectivity equivalent to that of organisms found in human stool. Using real-time PCR and mutant strains of *V. cholerae* in competition experiments we have assessed the contribution of the type IV pilus (mshA, pilA, and tcpA) to hyperinfectivity. Analyses showed that, of the adhesion genes, the type IV pilus gene, tcpA, might be an important factor conferring hyperinfectiousness due to *V. cholerae*.

Blood group O and risk of infection with *Vibrio cholerae*

To understand the factors that mediate susceptibility to symptomatic and asymptomatic infection with *V. cholerae*, a prospective, observational study of a cohort of cholera patients attending the Dhaka hospital of ICDDR,B was undertaken, involving their household contacts.

Previous studies have demonstrated that blood group O is associated with an increased risk of cholera. It was observed that individuals with blood group O were actually protected from infection with *V. cholerae*, although once infected, they are more likely to develop severe disease. This provides insight into the mechanism of the association between blood group antigens and susceptibility to cholera.

Birth cohort to follow infections due to enterotoxigenic *Escherichia coli* and other pathogens

A cohort of 321 children has been followed from birth up to 2 years of age in Mirpur, Dhaka. Results of studies conducted so far suggest that enterotoxigenic *E. coli* (ETEC) is the most common cause of diarrhoea in infants with a first infection seen within 6 days of birth. The incidence of *V. cholerae* is low, while that of *H. pylori* is very common— increasing from 9 months of age.

Enterotoxigenic *Bacteroides fragilis*-induced diarrhoea

The clinical features of patients with diarrhoea due to enterotoxigenic *Bacteroides fragilis* (ETBF) have not been well-defined. A study was carried out to diagnose patients early during the course of diarrhoea due to ETBF-associated infection and to examine the pathological and immunological changes that take place as a result of the infection. Sixty-eight patients with ETBF-associated diarrhoea were recruited for the study, using rapid immunodiagnostic assays, immunomagnetic separation (IMS), PCR, and enzymelinked immunosorbent assay (ELISA), from most of whom ETBF was the only pathogen isolated. Clinical features and colonoscopic and pathological evaluations in the patients suggest an inflammatory component in ETBF-associated diarrhoea in both systemic and mucosal components in patients.

Introduction of a new hypo-osmolar oral rehydration solution into routine use for the treatment of diarrhoeal diseases: Phase IV clinical trial

The World Health Organization and UNICEF recommended a new formulation of oral rehydration solution (ORS), with Na 75, K 20, Cl 65, citrate 10, glucose 75 mmol/L, osmolarity 245 mosmol/L, for routine management of hospitalized diarrhoeal patients. ICDDR,B conducted a phase IV study as suggested by WHO and UNICEF to monitor the occurrence of seizure associated with hyponatraemia for introduction of this new formulation of ORS. In total, 43,711 patients in the Dhaka hospital and 9,588 patients in the Matlab hospital of ICDDR,B were monitored.
for one year (December 2002-November 2003 and February 2003-January 2004 respectively). During the study period, 21 (0.05%) patients in the Dhaka hospital and 3 (0.03%) patients in the Matlab hospital developed symptomatic (seizure/altered consciousness) hyponatraemia (serum sodium <130 mmol/L). Review of the patient records of the Dhaka hospital for the immediate past 12 months before the study identified 47 (0.09%) patients with symptomatic hyponatraemia. The results demonstrate that the incidence of seizure/altered consciousness associated with hyponatraemia relating to the routine use of the new ORS formulation was infrequent and not higher than that observed with the old ORS formulation, and that the new formulation could be safely used for the management of patients with diarrhoea, irrespective of aetiology and age of patients.

Bacteraemia in patients with diarrhoea and associated illness or complications

This study reviewed the patient-charts and analyzed relevant information to determine the frequency, aetiology, risk factors, and the outcome of bacteraemia in patients, admitted to the longer-stay ward of the Dhaka hospital, with diarrhoea and associated illness or complications. Bacteraemia was documented in 10% of these patients, and 18% of patients with bacteraemia died. Enteric pathogens were isolated in 34% of the cases, of which S. Typhi was the most frequent but rarely associated with death. Other aerobic Gram-negative bacilli constituted 27% of the isolates, Acinetobacter calcoaceticus being the most frequent, which might be attributed to prolonged infusion of intravenous fluids for the management of diarrhoea. Enterobacteriaceae, other than enteric pathogens, were isolated from 17% of the patients, resulting in the highest number of deaths. Respiratory pathogens, such as Staphylococcus aureus, S. epidermidis and others were isolated from 15%, 6%, and 1% cases respectively. Risk of death was higher among bacteraemic patients who were clinically diagnosed to have sepsis compared to those without sepsis (57% vs 11%; RR=5.8; p<0.001) and was also higher when bacteraemia was due to respiratory pathogens compared to either enteric pathogens or other Gram-negative bacilli (RR=2.7; p<0.001 and RR=1.5; p=0.001 respectively). The results indicate that bacteraemia is fairly common among hospitalized patients with complicated diarrhoeal illness and significantly contributes to death in Bangladesh.

Cholera and the environment

Epidemics of cholera are common in Bangladesh, and the people of this country face the consequences of this disease almost every year. V. cholerae, the aetiological agent of cholera, has an extra-ordinary capacity to adapt to the unfavourable environmental conditions and maintain itself in VBNC (viable but non-culturable) state in association with plankton in the aquatic environment. Moreover, cholera maintains a unique seasonal pattern with steep rises in pre- and post-monsoon seasons when the surface water level goes down. The increased nutrient concentration during cholera seasons leads to the occurrence of heavy plankton blooms in most surface water bodies of Bangladesh. Therefore, studies relating to survival potential of V. cholerae in the aquatic environment and their epidemic spread all over the world have drawn much attention from the scientific communities of the world.

A tripartite study on infectious disease risk management in Mozambique and Bangladesh has been carried out in collaboration with Northumbria University, UK, and the Ministry of Health, Mozambique, to determine whether similar environmental factors that contribute to epidemics of cholera in Bangladesh also exist in Mozambique. The overall aim is to transfer technology from ICDDR,B to the Centre for Environmental Hygiene and Medical Exams, Beira, to combat cholera and other diarrhoeal diseases that take place at regular intervals in Mozambique.

In response to adverse environmental conditions, V. cholerae adopts several survival strategies, which are regulated by regulatory genes. Expression of such regulatory genes, together with other genes that are responsible for metabolic activity, dormancy, and pathogenicity, under a given set of conditions, can be measured employing DNA microarray technology.

In another collaborative study with Dartmouth Medical College, New Hampshire, and the University of Maryland Biotechnology Institute, USA, an investigation has been carried out to determine the temporal dynamics of gene expression and regulation under different environmental conditions. The overall aim is to establish an in-situ incubation experiment in Bangladesh that measures gene expression in bacteria as a function of seasonal variations in the aquatic environment and their epidemic spread all over the world have drawn much attention from the scientific communities of the world.
and water chemistry. A representative selection of isolated strains will be further investigated under similar laboratory conditions for gene expression using a microarray technique at the Dartmouth Medical College.

*V. cholerae* is an autochthonous member of the aquatic environment of Bangladesh. However, there are several strategies reported for the survival of these bacteria under adverse environmental conditions. These include high-frequency rugose exo-polysaccharide production, entering into a state in which the growth and multiplication of the bacterium ceases, but the cells may remain metabolically active—the VBNC phenomenon. The bacteria may also reproduce in biofilms, which protect them from the adverse effects of various environmental factors. In a collaborative study with Stanford University, California, USA, investigations are being carried out in the Matlab HDSS area to determine whether *V. cholerae* O1 can undergo biofilm formation in the aquatic environment and can survive in inter-epidemic periods of cholera. Standard biofilm sampling devices were installed at specific depths in a canal to support biofilm formation on the solid surface of Plexiglas discs. Samples are collected at 15-day intervals and processed in the laboratory for culture and detection of VBNC *V. cholerae* using the DFA technique. Samples are preserved for further analyses, including detection of mRNA, corresponding to the exo-polysaccharide gene-cluster and also for rRNA species-specific characterization of the members of that particular biofilm consortium.

In July and August 2004, Bangladesh experienced severe flooding, and an estimated 2 million tubewells were inundated. In response to this contamination of the tubewells, UNICEF carried out a programme in collaboration with the Department of Public Health Engineering, Government of Bangladesh, to disinfect the flooded tubewells using chlorine shock treatment. The water quality of 127 recently-submerged tubewells in Brahmanbaria upazila was investigated, and the effect of chlorination on improvement of microbiological quality was evaluated. It was observed that chlorine treatment of the inundated tubewells did not improve the bacteriological quality of tubewell water.

During the 2004 flood, the overall water and sanitation conditions deteriorated, drinking-water became contaminated with various pathogenic bacteria, and the people of Bangladesh had problems in getting safe drinking-water. Therefore, a study has been undertaken to evaluate the microbiological quality of water collected from 21 households of the flood-affected area in Kamalapur, Dhaka. Investigations were also carried out to find out a suitable technique for disinfection of contaminated drinking-water during and post-flood periods.

### Genetics of *Vibrio cholerae*

To understand the evolutionary events and possible selection mechanisms involved in the emergence of pathogenic *V. cholerae*, in a recent study, 180 diverse strains of *V. cholerae* isolated from environmental samples of waters in Bangladesh by direct enrichment in the intestinal loops of adult rabbits and by conventional laboratory culture were analyzed. Strains of *V. cholerae* isolated by conventional culture were mostly (99.2%) negative for the major virulence gene clusters encoding toxin co-regulated pilus (TCP) and cholera toxin (CT) and were non-pathogenic in animal models. In contrast, all strains selected in rabbits were competent for colonization in infant mice. Of these strains, 56.8% carried genes encoding TCP alone or both TCP and CT. However, despite lacking genes for both TCP and CT, 29.4% of the strains selected in rabbits were able to colonize mice and cause fluid accumulation in the rabbit ileal loops. Restriction analysis of conserved rRNA genes revealed that strains isolated by conventional culture belonged to widely diverse ribotypes (diversity index=0.98), whereas those selected in rabbits included 4 clusters comprising 25 strains and another 26 strains of unique ribotypes. Ribotypes of toxigenic O1 and O139 strains from the environment were similar to the pandemic strains. In contrast, ribotypes of non-O1 non-O139 strains and 2 non-toxigenic O1 strains diverged widely from the 7th pandemic O1 and the O139 strains (mean similarity coefficient <0.5). The results suggest that (a) environmental *V. cholerae* population in a cholera-endemic area is highly heterogeneous, (b) selection...
in the mammalian intestine can significantly contribute to the enrichment of environmental strains with virulence potential, (c) pathogenicity of *V. cholerae* involves more virulence genes than currently appreciated, and (d) most environmental *V. cholerae* strains are unlikely to attain a pandemic potential by acquisition of just TCP and CT genes alone. Since most recorded cholera pandemics originated in the Ganges Delta region, this ecological setting presumably favours extensive genetic exchange among *V. cholerae* strains and, thus, promotes the rare, multiple gene-transfer events needed to assemble critical combination of genes required for pandemic spread.

**Ecology of Vibrio cholerae in Bangladesh**

The ecological part of the NIH Project “Epidemiology and ecology of *V. cholerae* in Bangladesh” began sampling in March 2004 from 8 fixed sites in Bakerganj (monthly) and 6 fixed sites in Mathbaria (fortnightly) and completed 12 rounds in Bakerganj and 18 rounds in Mathbaria up to December 2004.

Experiments were conducted to resolve the major issue of whether prolonged ambient transportation of environmental specimens for 20 hours affects the isolation and detection of *V. cholerae*.

Strategies were adopted to carry out the sampling activities uninterrupted during any natural calamities. Qualitative improvements in sampling and subsequent processing were physically counter-checked by the expert from the University of Maryland Biotechnology Institute, USA. The web-based data-entry system, coordinated by the Emory University School of Public Health, Atlanta, has been updated with substantial modifications, and routine data entry and counter-checking are ongoing.

**Diarrhoeal disease and enteric infection surveillance in Dhaka and Matlab hospitals**

Over 100,000 patients seek medical care from the Dhaka hospital and over 10,000 patients from the Matlab hospital of ICDDR,B each year for their diarrhoeal illnesses and associated health problems. A Diarrhoeal Disease Surveillance System, established at the Dhaka hospital in 1979 to collect information on clinical, epidemiological and demographic characteristics of patients, was extended to the Matlab hospital 7 years ago. A systematic 2% sub-sample of patients who attended the Dhaka hospital and all patients from the Health and Demographic Surveillance System (HDSS) area who attended the Matlab hospital are enrolled into the surveillance programme. Trained personnel interview the patients and/or their attendants to collect information on socioeconomic and demographic characteristics, housing and environmental conditions, feeding practices, particularly of infants and young children, and use of drugs and fluid therapy at home. Information on clinical characteristics, anthropometric measurements, treatment received at the facilities, and outcomes of patients is also recorded. Extensive microbiological assessments of faecal samples (microscopy, culture, and ELISA) are performed to identify diarrhoeal pathogens and to determine antimicrobial susceptibility of bacterial pathogens.

The activity provides valuable information to the hospital clinicians in the decision-making process in providing care to the patients. It enables the Centre to detect the emergence of new pathogens and in early identification of outbreaks and their locations, thereby helping the Government of Bangladesh to take preventive and control measures. Additionally, the surveillance monitors changes in the characteristics of patients and antimicrobial susceptibility of bacterial pathogens. Information collected represents the population and thus provides an important database for conducting epidemiological studies, validation of results of clinical studies, developing new research ideas and study designs, improving patient-care strategies, and introducing preventive programmes. Table 1 shows diarrhoeal pathogens isolated in 2004.

<table>
<thead>
<tr>
<th>Pathogen identified</th>
<th>Dhaka (n= 2,217)</th>
<th>Matlab (n=1,521)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td><em>V. cholerae</em> O1</td>
<td>607</td>
<td>27.4</td>
</tr>
<tr>
<td><em>V. cholerae</em> O139</td>
<td>02</td>
<td>0.1</td>
</tr>
<tr>
<td>Shigella</td>
<td>113</td>
<td>5.1</td>
</tr>
<tr>
<td>Salmonella</td>
<td>38</td>
<td>1.7</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>464</td>
<td>20.9</td>
</tr>
<tr>
<td><em>E. histolytica</em></td>
<td>23</td>
<td>1.0</td>
</tr>
<tr>
<td><em>Giardia lamblia</em></td>
<td>51</td>
<td>2.3</td>
</tr>
</tbody>
</table>
Cholera in Mozambique: variant of *Vibrio cholerae*

Outbreaks of cholera caused by toxigenic *V. cholerae* serogroup O1 frequently occur in many sub-Saharan African countries. While conducting surveillance in the cholera treatment centre in Beira, the second largest city in Mozambique, under the overall supervision of the International Vaccine Institute (IVI), Seoul, Republic of Korea, over 400 rectal swabs or stool samples were examined during January-May 2004, using standard procedures. During this period, 123 strains of *V. cholerae* O1 were isolated. Fifty-eight isolates were transported to the Enteric Microbiology Laboratory of ICDDR,B for further phenotypic and genotypic characterization to determine serotype, biotype, and presence of important virulence genes. All the 58 strains were identified as *V. cholerae* O1 of the Ogawa serotype. Forty strains selected for detailed characterization had characters similar to those of El Tor *V. cholerae* and a similar antimicrobial susceptibility pattern. However, using PCR, it was established that all the 40 strains carried the ctxA gene (constituent gene of the CTX prophage) and the tcpA gene (the El Tor type), a constituent gene of the vibrio pathogenicity island. All the 40 El Tor strains, however, produced a 500-bp PCR product of the rst R gene of the classical type (rst R class), despite belonging to the El Tor biotype. Nucleotide sequence analysis of the rst R gene of 2 representative Mozambique strains showed 100% homology to the classical rst R gene of classical reference strain O395. The findings that El Tor strains of *V. cholerae* O1 from Mozambique are carrying the classical prophage showed the presence of genetic materials associated with the classical biotype in Mozambique. Further, these findings provide the first circumstantial evidence of transmission of the classical CTX prophage. The CTX prophages in El Tor strains give rise to infectious phage particles, but neither of the two CTX prophages integrated at two different sites of the classical genome gives rise to phage particles. Subsequent studies have shown that, although the genes of the classical prophages encode functional forms of all the proteins needed for the production of CTXΦ, the CTX prophage does not yield virions because of the atypical arrangement of its prophage arrays. This subtle genetic change may alter the effectiveness of current cholera vaccines which stimulate antitoxic and antibacterial immunity.

Emergence of *Vibrio parahaemolyticus* pandemic strains in Mozambique caused by serovars O3:K6 and O4:K68

Forty-two cases of *V. parahaemolyticus* were detected during a case-control study conducted after mass oral cholera vaccination by rBS-WC in Beira, Mozambique, in 2004. Of the 42 strains that could be recovered between 24 February and 11 May 2004, 34 (81%) pandemic strains belonged to serovars O3:K6 (76%) and O4:K68 (5%) that were positive in G5-PCR and ORF8-PCR and carried the tdh gene. Seven (17%) strains, belonged to serovar O3:K58 and one (2%) belonged to serovar O4:K13, possessed the tdh gene but negative for G5-PCR and ORF8-PCR. Further molecular characterization is being carried out by PFGE and AP-PCR to detect the clonal infection of this bacterium. Patients from whom *V. parahaemolyticus* could be isolated were older (mean age 27 years) than patients from whom no *V. parahaemolyticus* was isolated (mean age 23 years). This is the first report of an outbreak due to pandemic strains of *V. parahaemolyticus* in sub-Saharan Africa.

Rotavirus typing: distribution of G types of rotavirus strains in Bangladesh

In total, 456 (26.1%) in Dhaka (n=1,750) and 329 (19.0%) in Matlab (n=1,735) group A rotavirus strains were identified in patients who were included in the hospital surveillance system of ICDDR,B in 2003. G typing was carried out on every 10th rotavirus-positive stool specimen among 75 samples. The most prevalent genotype was G1 (45.3%) followed by G9 (24.0%) and G2 (14.7%). A novel G12 strain accounted for 8% of the samples. Mixed infection accounted for 5.3% and G4 for 2.7%.

Detection and characterization of human group C rotaviruses

Group C rotaviruses were detected by RT-PCR in 14 (2.3%) of 611 group A rotavirus-negative stool specimens from patients admitted to the Dhaka hospital of ICDDR,B during July-December 2003. The low rate of detection suggests that infection with group C rotaviruses was an uncommon cause of hospitalization due to gastroenteritis. In addition, co-infections with pathogenic enteric bacteria were frequently observed in patients infected with group C rotavirus. Nucleotide sequence comparison of the VP4, VP6 and VP7 genes revealed that the group C rotavirus in Bangladesh were most similar to Nigerian group C rotavirus strains.

Characterization of a novel P[24],G11 group A rotavirus

A novel rotavirus strain Dhaka6 isolated from a 21-year-old Bangladeshi male patient in 2001 was characterized by sequence analysis of its VP7 and VP4 gene segments. Phylogenetic analysis of VP7 gene of the Dhaka6 strain revealed a common evolutionary lineage with porcine G11 rotavirus.
strains. This isolate is the first reported G11 rotavirus strain that infects a human host. Comparison of the VP4 gene sequences with all currently-recognized 23 different P genotypes revealed only low nucleotide (54-71%) and amino acid (52-76%) sequence identities. This lack of high sequence similarity in the VP4 gene indicates that the Dhaka6 isolate represents a new group A rotavirus P genotype.

**Dysentery**

Population-based evaluation of *Shigella*-associated infections in an urban area of Dhaka, Bangladesh

In collaboration with the International Vaccine Institute, this population-based surveillance for *Shigella*-related dysentery was conducted in the Kamalapur urban surveillance site in Dhaka city during December 2001-October 2004. In addition to determining the disease burden, the study was also designed to identify the common serotypes and their antimicrobial resistance patterns.

During January-July 2004, 869 diarrhoeal patients were enrolled. *Shigella* was isolated from 97 patients (11%). Of the *Shigella* cases, *S. flexneri* was most frequently isolated (63), followed by *S. boydii* (15), *S. sonnei* (11), *S. dysenteriae* other than type I (7) and non-typable *Shigella* spp. (1). Approximately, two-thirds of the shigellosis patients were preschool children. Most shigellosis patients presented with watery stool (49.0%), followed by mucoid (33.0%) and bloody stool (18.0%). This suggests that, in high-endemic areas, disease burden from shigellosis may be underestimated by focusing only on dysentery.

An unusual outbreak of *Shigella dysenteriae* type 4 in Dhaka, Bangladesh

One hundred two strains of *S. dysenteriae* type 4 were isolated from patients attending the Dhaka hospital of ICDDR,B during 1999-2002. Isolation of 71 strains of *S. dysenteriae* type 4 during June-December 2000 compared to 1, 24, and 6 isolates in 1999 (pre-outbreak), 2001, and 2002 (post-outbreak) respectively (Figure 1) suggests the clustering of a single type of *S. dysenteriae* strain. During this period, 59% cases of infection occurred in children aged less than 5 years, and the infection rate was predominant in males (61 %) compared to females (39 %). This age and sex distribution is similar to that of patients treated at the ICDDR,B hospital.

All the 102 strains of *S. dysenteriae* type 4 were resistant to trimethoprim-sulphamethoxazole, and 12.3% (n=13) and 4.2% (n=4) of the strains were resistant to ampicillin and nalidixic acid respectively, but were susceptible to ciprofloxacin and mecillinam. Analysis of plasmid DNA showed that 140-, 70-60-, 4-, and 1.6-MDa plasmids were commonly present in all the 102 strains, and no significant changes in plasmid profiles were observed between the strains of outbreak and the non-outbreak period. All the 71 strains isolated in 2000 were indistinguishable and clustered into a single PFGE pattern type A (designated as the outbreak clone). However, type B was observed in the strain isolated in 1999, whereas PFGE type C and the outbreak clone A were found to be disseminated throughout the post-outbreak period of 2001 and 2002. PFGE analysis revealed that all the strains isolated during June-December 2000 were clonal and seem to be a common source of outbreak. Molecular typing and epidemiological
Analysis confirmed that *S. dysenteriae* type 4 isolated from patients attending the Dhaka hospital of ICDDR,B during June-December 2000 was associated with an outbreak. The findings underscore the need for monitoring the emergence and prevalence of *S. dysenteriae* type 4 in Bangladesh and in other parts of the world as it appears to have the potential to cause outbreaks.

Fluoroquinolone resistance linked to both *gyrA* and *parC* mutations in QRDR of *Shigella dysenteriae* type 1

*S. dysenteriae* type 1 (*Shiga bacillus*), identified by WHO as one of the fastest-growing antibiotic-resistant bacteria posing a major threat to humankind, has been implicated in large-scale epidemics worldwide with thousands of deaths. Resistance of *Shiga bacillus* to common antibiotics, first noted in Bangladesh in 1974, has continued to grow, involving resistance to additional drugs, and this has also triggered consecutive epidemics in an approximately 10-year span. The same clonal type has reported the emergence of fluoroquinolone-resistant *S. dysenteriae* type 1 in some states in India, which subsequently spread to other neighbouring countries, such as Bangladesh and Nepal. Understanding the molecular mechanism of resistance is one of the key essentials to maintain the usefulness of current antimicrobials and to find alternative intervention strategies. The sequence data of QRDR of *gyrA*, *gyrB* and *parC* of recently-isolated fluoroquinolone-resistant *S. dysenteriae* type 1 in the southeast Asian region were analyzed to investigate the possible mechanisms of resistance.

Sequence analysis of QRDR of *S. dysenteriae* type 1 revealed that no mutation was observed in *gyrA*, *gyrB*, and *parC* among the quinolone and fluoroquinolones-sensitive strains associated with the 1978 and 1984 epidemics in India and Bangladesh (Table 2). A single amino acid change (*Ser*<sup>83</sup> → *Leu*) in *gyrA* was observed in the nalidixic acid-resistant strains.

### Table 2. MIC and amino acid changes in *gyrA* and *parC* in *S. dysenteriae* type strains isolated from different geographical locations

<table>
<thead>
<tr>
<th>Strain</th>
<th>Country/year of isolation</th>
<th>MIC (µg/mL)</th>
<th>Amino acid substitutions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NA</td>
<td>CIP</td>
<td>NOR</td>
</tr>
<tr>
<td>BY-127</td>
<td>Bombay, India/1978</td>
<td>2</td>
<td>0.008</td>
</tr>
<tr>
<td>BY-130</td>
<td>Bombay, India/1978</td>
<td>2</td>
<td>0.008</td>
</tr>
<tr>
<td>BG-186</td>
<td>Bangladesh/1984</td>
<td>2</td>
<td>0.008</td>
</tr>
<tr>
<td>BG-188</td>
<td>Bangladesh/1984</td>
<td>2</td>
<td>0.008</td>
</tr>
<tr>
<td>WB-234</td>
<td>West Bengal, India/1984</td>
<td>2</td>
<td>0.008</td>
</tr>
<tr>
<td>WB-253</td>
<td>West Bengal, India/1984</td>
<td>2</td>
<td>0.008</td>
</tr>
<tr>
<td>BG-953</td>
<td>Bangladesh/1994</td>
<td>64</td>
<td>0.125</td>
</tr>
<tr>
<td>BG-84</td>
<td>Bangladesh/1994</td>
<td>64</td>
<td>0.19</td>
</tr>
<tr>
<td>WB-6</td>
<td>West Bengal, India/2002</td>
<td>&gt;256</td>
<td>4.0</td>
</tr>
<tr>
<td>WB-18</td>
<td>West Bengal, India/2002</td>
<td>&gt;256</td>
<td>6.0</td>
</tr>
<tr>
<td>WB-44</td>
<td>West Bengal, India/2002</td>
<td>&gt;256</td>
<td>12.0</td>
</tr>
<tr>
<td>NP33498</td>
<td>Nepal/2002</td>
<td>&gt;256</td>
<td>6.0</td>
</tr>
<tr>
<td>BG-15874</td>
<td>Bangladesh/2003</td>
<td>&gt;256</td>
<td>4.0</td>
</tr>
<tr>
<td>BG-15858</td>
<td>Bangladesh/2003</td>
<td>&gt;256</td>
<td>4.0</td>
</tr>
<tr>
<td>BG-836</td>
<td>Bangladesh/2003</td>
<td>&gt;256</td>
<td>6.0</td>
</tr>
<tr>
<td>NP-15464</td>
<td>Nepal/2003</td>
<td>&gt;256</td>
<td>4.0</td>
</tr>
<tr>
<td>NP-13500</td>
<td>Nepal/2003</td>
<td>&gt;256</td>
<td>4.0</td>
</tr>
</tbody>
</table>

*Wind type; *No substitution
acid (quinolone)-resistant strains isolated during the epidemic of 1994. On the other hand, double mutations in gyrA (Ser → Leu, Asp → Asn or Gly) and a single mutation in parC (Ser → Ile) were found in all recent representative fluoroquinolones-resistant S. dysenteriae type 1 strains isolated in India, Nepal, and Bangladesh.

Interestingly, the Bangladeshi and Nepalese strains showed the same amino acid substitutions in gyrA at the positions 83 (Ser → Leu) and 87 (Asp → Asn), but a different amino acid change in the position 87 (Asp → Gly) of the same gene was observed in the Indian strains. However, no mutation in gyrB was found in any fluoroquinolones-resistant strains.

**Outbreak of Shigella dysenteriae type 1 in Northeastern Bangladesh**

*Shigella dysenteriae* type 1 has caused major epidemics with high mortality at 10-year intervals in Bangladesh for the past several decades. The last *S. dysenteriae* type 1 outbreak in Bangladesh was in 1990. The Centre, in collaboration with the Directorate- General of Health Services of the Government of Bangladesh and the Centers for Disease Control and Prevention (CDC) in Atlanta, USA, initiated nationwide surveillance for *S. dysenteriae* type 1. An investigation on the outbreak of dysentery was conducted during October-November 2004 among 8 persons in a village in Brahmanbaria district. *S. dysenteriae* type 1 was confirmed in the stool of a 16-year-old patient. The antimicrobial susceptibility pattern of the strain was similar to that observed in a previous outbreak. These results underscore the need for ongoing sentinel surveillance for *Shigella dysenteriae* type 1 and a rapid response to minimize the high mortality rate observed in earlier outbreaks.

**Differences in host susceptibility to epidemic and endemic Shigella dysenteriae type 1 strains**

The study compared the innate and specific immune responses against the epidemic and endemic strains of *S. dysenteriae* type 1 to determine if epidemic strains were more virulent, resulting in higher mortality, than endemic strains. Strains from the 1985 outbreak in Teknaf, Bangladesh, during which there was a high rate of mortality were compared with those isolated from patients admitted to the ICDDR,B hospital during 1999-2002, when there was no epidemic. The results showed that, although cellular immune activity (oxygen radical formation by neutrophils and monocytes) was equally active against epidemic and endemic strains of *S. dysenteriae* type 1, the epidemic strains were more resistant to being ingested (phagocytosed) by the white cells (p<0.007). The results suggest that the epidemic *S. dysenteriae* 1 strains are probably more virulent than the endemic strains, explaining the higher mortality associated with *S. dysenteriae* type 1 epidemics. Further studies are being planned to investigate the differences in virulence properties of the epidemic and endemic *S. dysenteriae* type 1 strains.

**Effect of zinc supplementation as an adjunct therapy on the systemic immune responses in shigellosis**

Zinc is lost during diarrhoea, while zinc deficiency induces inflammatory responses that can alter the intestine in such a way as to further impair fluid absorption. A double-blind placebo-controlled study was conducted among mild- and moderately-malnourished children aged 12-59 months to determine what effect zinc might have during treatment for shigellosis—the main cause of dysentery. Children were given either zinc or placebo along with multivitamins (A, D, thiamine, riboflavin, and nicotinamide) and calcium at twice the US-recommended dietary allowance (RDA) daily for 14 days. There were 28 children in each group. All patients received standard antibiotic therapy. The proportion of children with the shigellacidal antibody response (a 4-fold rise in specific anti- *Shigella* antibody) was significantly greater in the zinc group than in the control group (p<0.03). The proportion of CD20+ and CD20+CD38+ cells in the zinc group were significantly higher on day 7 than the control group (p<0.007). These findings suggest that adjunct therapy with zinc during acute shigellosis can significantly improve antibody response to shigellosis and overall immune responsiveness.

**Diagnosis of amoebiasis**

*Entamoeba histolytica* is the cause of intestinal and extra-intestinal amoebiasis, resulting in 100,000 deaths annually worldwide. Historically, diagnosis of amoebiasis was complicated and often unreliable. Before antigen detection and PCR, diagnosis of amoebiasis had to be carried out by microscopic examination of stool, which was notoriously limited in sensitivity and specificity. The traditional PCR assays, however, require processing that is time-consuming and prone to contamination. Therefore, ICDDR,B scientists, in collaboration with TechLab (TechLab, Inc, Blacksburg VA, USA) and the University of Virginia, with funding from the National Institutes of Health, have developed a real-time PCR assay for detection of *E. histolytica* (Fig. 2). In an assessment made in 2004 between the traditional PCR and the real-time PCR assay, as well as the TechLab antigen detection
test, all the 3 methods gave comparable results. The choice of assay is, thus, likely to depend on the expertise, need, and equipment available in the laboratory.

Field studies on human immunity to *Entamoeba histolytica* infection

It is not known if humans acquire immunity against colonization or invasion by *E. histolytica*. The *E. histolytica*-specific antigen detection test provides a useful tool to undertake such a study. To understand the natural history and human immunity to *E. histolytica*-associated infection, scientists in the Parasitology Laboratory of ICDDR,B, in collaboration with the University of Virginia, have been conducting a prospective study in Mirpur, a peri-urban slum in Dhaka since 1999. The study has shown that *E. histolytica*-associated infection occurred at least once in 80% (162/202) of children who completed 4 years of observation. Protection from amoebiasis was associated with a stool giving anti-CRD (carbohydrate recognition domain) IgA response. However, immunity was short-lived, and repeat-infection and disease were frequent. While an effective vaccine might have a pronounced positive effect on the health of these children, a challenge will be to induce more durable immunity than that which occurs naturally.

**Typhoid fever**

Disease burden of typhoid fever, risk factor analysis, and rapid diagnosis

Longitudinal surveillance for *Salmonella Typhi*, the principal causative agent of typhoid fever, was initiated by ICDDR,B in 2001 in Kamalapur, a low-income urban community in Dhaka. A typhoid fever incidence and case-control study, in collaboration with the CDC and the IVI was completed in January 2004. It confirmed higher rates of typhoid fever in preschool children compared to older persons and clinical illness in this age group. Among children aged less than 5 years, *S. Typhi* was the leading bacterial isolate associated with fever (Fig. 3). The case-control study suggests that contaminated drinking-water is the principal vehicle of transmission of typhoid fever in the community.

**Organism**

Detection of decreased ciprofloxacin susceptibility in *Salmonella enterica* serotype Typhi by disk-diffusion test

During 1989-2002, antimicrobial resistance of 3,928 blood culture isolates of *S. Typhi* in Dhaka, Bangladesh, was studied. Overall, 32% (1,270) of the strains were multidrug-resistant (MDR, resistant to chloramphenicol, ampicillin, and trimethoprim-sulphamethoxazole); first detected in 1990 (rate of 8%), increased in 1994 (44%), declined in 1996 (22%, p<0.01 compared to 1994), and re-emerged in 2001 (36%) and 2002.
(42%, p<0.01 compared to 1996). An increased MIC of ciprofloxacin (0.25 µg/mL) indicating decreased susceptibility to ciprofloxacin was detected in 24 (18.2%) of 132 randomly-selected strains during 1990-2002; more frequently in MDR than in susceptible strains (46.3% vs 5.5%, p=0.00000001), and their proportion rose recently to 47% in 2002 from 8% in 2000 (p<0.01). Ciprofloxacin (5 µg) disk-diffusion zone diameters of ≤24 mm as break point had 98% sensitivity and 100% specificity when compared with ciprofloxacin MIC of 0.25 µg/mL as break point for decreased susceptibility being useful and easy screen test (Fig.4). All the strains were susceptible to ceftriaxone. The emergence of MDR S. Typhi with decreased ciprofloxacin susceptibility will further complicate therapy of typhoid fever because of lack of the optimum treatment guidelines.

Fig. 4. Scattergram for 132 S. Typhi isolates. The MICs of ciprofloxacin were compared with inhibition zone diameters of ciprofloxacin (5 µg disc) processed by the NCCLS method. The numbers within the graph indicate the number of isolates having specific MIC values.

S. Typhi with decreased ciprofloxacin susceptibility will further complicate therapy of typhoid fever because of lack of the optimum treatment guidelines.

Respiratory Diseases

Resistance of Streptococcus pneumoniae to macrolide, fluoroquinolones, and tetracycline in Bangladesh and in-vitro activity of telithromycin

Macrolide, fluoroquinolones and tetracycline resistance and the activity of telithromycin in S. pneumoniae in Dhaka, Bangladesh, were investigated. In total, 132 pneumococci, 55 invasive and 77 nasopharyngeal isolates, obtained from children aged less than 5 years, with pneumonia and meningitis during 1999-2002, were screened to investigate the resistance to a range of antimicrobials using the NCCLS guidelines. Erythromycin-resistant phenotypes and genes were determined by the erythromycin-clindamycin-rocikamycin triple-disk test and real-time PCR respectively. MLST was performed for 6 resistant isolates. Overall, rates of erythromycin/azithromycin, ciprofloxacin, levofloxacin and tetracycline resistance were 4.5%, 3%, 1%, and 46% respectively. Higher resistance to erythromycin/azithromycin, clindamycin, chloramphenicol, co-trimoxazole, and penicillin G (4.5%, 8%, 7%, 16%, 90%, and 16% respectively) was observed in tetracycline-resistant than in tetracycline-susceptible isolates (1%, 1%, 1%, 0%, 70%, and 1% respectively). No resistance to telithromycin, moxifloxacin, gatifloxacin, vancomycin, and techoplanin was observed. Partially-inducible MLSB phenotype, IMcLSB (resistant to erythromycin, clindamycin, and intermediate, or susceptible to rokitamycin, positive for erm(B)) were detected in 5 (83%) of 6 erythromycin-resistant strains and exhibited a significant association with tetracycline and multidrug resistance (MDR) traits (p<0.01). The remaining strain was mef(E)–positive and expressed M phenotype. Twenty-three serotypes comprised tetracycline-resistant strain, and the most numerous serotypes were 19F (16), 14 (8), 13 (4), 23F (4), 6A (3), 6B (3), and 7B (3). Of 6 erythromycin-resistant strains, 4 were 7B and had similar MLST patterns. Thus, the prevalence of resistance to macrolide and fluoroquinolones is low in Dhaka, Bangladesh but high to tetracycline. Drug-resistant pneumococcal serotypes observed elsewhere are present in Bangladesh. A new clone of MDR pneumococcus 7B emerged for the first time in Bangladesh. Telithromycin and moxifloxacin are effective in vitro against all pneumococci.

Burden of pneumococcal disease in children in Bangladesh

Pneumonia is responsible for an estimated 20% of all deaths among children aged less than 5 years or 1.9 million deaths per year. Approximately, two-thirds of pneumonia-related deaths occur during infancy and over 90% of these occur in developing countries. Bangladesh has very high rates of childhood pneumonia, particularly in over-crowded urban areas. The main bacterial cause of pneumonia is S. pneumoniae (pneumococcus). In 2004, the Centre became one of two international
surveillance sites for the multi-centre Pneumococcal Vaccines Accelerated Development and Introduction Plan. This project seeks to determine how much illness (pneumonia and meningitis), and what proportion of pneumonia, is caused by pneumococcus among preschool children, and what are the main serotypes associated with clinical illness. As there are different vaccines, which cover different serotypes, this study will help determine the need for a pneumococcal vaccine in this setting, and which vaccine is most appropriate in Bangladesh. The burden of Pneumococcal diseases is being assessed in 3 contexts. First, a hospital surveillance network, including 4 hospitals in Dhaka, 2 in Chittagong and 1 in Tangail, was conducted to build laboratory capacity and identify serotype distribution among hospitalized children. In addition, two population-based field sites were used for determining disease burden and spectrum of illness. These include the Kamalapur urban site (Dhaka) and a rural site (Mirzapur) which have respectively 5,000 and 13,000 children under surveillance. In both the field settings, health workers visit homes of children under surveillance once a week to screen for fever and other signs of illness and refer either to the field clinic (urban Kamalapur) or to hospital (rural Mirzapur) for diagnosis and specimen collection.

During April-December 2004, blood or cerebrospinal fluid (CSF) was collected from 2,259 patients in the hospital surveillance network. In Mirzapur, 77 of 6,435 children were screened and had blood drawn; in Kamalapur, blood samples were drawn from 1,236 children. Overall, there were 29 pneumococcal isolates from among those children—a higher-than-expected rate from the urban population surveillance site. There is a broad range of serotypes, but it is too early to assess what impact current vaccines would have on disease burden or mortality. The study will continue until 2006.

Day care-based management of severe pneumonia in children

The study was conducted to identify an alternative means for providing effective care at an established day-care centre to children with severe pneumonia who, despite the need, are not hospitalized due to any reason. Children of either sex, aged 1-59 month(s), who attended the outpatient clinic of the Radda MCH-FP Centre, Mirpur, Dhaka, with severe pneumonia (WHO criteria), were referred to hospitals for admission. Those who were not hospitalized were enrolled in the study, kept at the clinic from 8:00 am to 5:00 pm, were administered a single daily dose (75-100 mg/kg) of injection ceftriaxone, along with other supportive care, sent home at 5:00 pm with advice to return to the clinic the next morning until improvement, discharged upon completion of therapy, and followed up every 2 weeks for 3 months. In total, 116 children (70 boys and 46 girls) were enrolled during May 2003-April 2004. Their mean±SD age was 7±7 (range 1-38) months—82% were infants, and 91% were breastfed. Clinical findings of these patients revealed lower chest wall in-drawing in 97%; mean±SD body temperature 38±1°C, respiration rate 62±7, oxygen saturation percentage 93±5; and bilateral rales on chest auscultation in 99%. The mean±SD stay at the clinic was 7±2 days; 104 (90%) children completed the study, 4 left against medical advice, 8 required hospitalization, and no child died during therapy. Sixty-one children completed the 3-month follow-up, and 2 children died during this period due to non-pneumonic conditions; follow-up is ongoing for another 36 children. The results, available so far, indicate that severe pneumonia in children can be efficiently managed on a day-care basis with injection ceftriaxone and other supportive care at established day-care clinics, if adequately trained, motivated staff and facilities are available.

Surveillance for influenza and viral aetiologies of influenza-like febrile illnesses in an urban slum in Dhaka, Bangladesh

In the Kamalapur urban field site, surveillance for viral aetiologies for pneumonia is being conducted in the same population of 5,000 children where pneumococcal surveillance is being undertaken. Beginning in April 2004, participating households are visited weekly. All children with fever or signs suggestive of respiratory illness are screened at home by field research assistants and then referred to the field clinic on site for diagnosis and collection of blood cultures, serology for viruses, and nasopharyngeal washes for influenza culture. The studies expect to determine what proportion of pneumonia is attributable to specific.
bacterial and non-bacterial causes, and what is the overall disease burden due to respiratory viruses, specifically influenza, para-influenza, respiratory syncytial virus, adenovirus and human metapneumovirus and bacteria, such as \textit{S. pneumoniae}. The virus study is being done in collaboration with the CDC. As of December 2004, 101 (8.2\%) of 1,236 blood cultures were positive for bacteria and 8 of these (7.9\% of positive cultures) grew \textit{S. pneumoniae}. Of 217 nasopharyngeal washes obtained, 21.4\% of those analyzed yielded influenza, all of which is the common influenza A virus (H3N2). This is the only population-based active influenza surveillance activity in the region, and the results assist global influenza control efforts. Pneumonia surveillance activities are scheduled to continue until April 2006.

Zinc and outpatient non-severe pneumonia

A new randomized, placebo-controlled community-based clinical trial was initiated in 2004 in Kamalapur to determine the treatment effect of zinc on non-severe, community-acquired outpatient pneumonia. This study, jointly funded by the Bill and Melinda Gates Foundation and the Thrasher Foundation, is a follow-on to a recently-reported study performed in Matlab. The study found reductions in the duration of illness and treatment failure among children, aged less than 2 years, who received zinc during the acute phase of illness while hospitalized for severe pneumonia. The new study in Kamalapur is designed to investigate whether similar effects can be achieved for the majority of young children, aged less than 2 years, who are not hospitalized for their pneumonia. Additionally, it seeks to determine whether zinc can prevent their progression to severe pneumonia, and whether there is a protective benefit after treatment with zinc for pneumonia, as has been observed in diarrhoea treatment with zinc. As of December, over 50 children had been enrolled in this study, which will continue for two years.

Tuberculosis

Epidemiology and surveillance of multidrug-resistant \textit{Mycobacterium tuberculosis} and assessment of directly observed therapy short course (DOTS) programme in selected areas of Bangladesh

Tuberculosis is a leading cause of death in Bangladesh and globally. To better understand the burden of tuberculosis, ICDDR,B continued surveillance for tuberculosis in Matlab and in urban Dhaka in 2004. Activities include enrollment of suspected tuberculosis cases, referral of patients, and drug susceptibility of isolates. Thus far, the Matlab project has identified 126 cases of smear-positive tuberculosis; 74 of these were newly-detected cases. The overall population-based prevalence of smear-positive tuberculosis in Matlab was 95/100,000 people aged 15 years and above; significantly higher in males than females (190/100,000 vs 31/100,000). Nearly 50\% of strains were resistant to at least one commonly-used antituberculous medication.

\textit{Mycobacterium africanum} sub-type 1 among cows in a dairy farm in Bangladesh

Acid-fast-bacilli (AFB) were detected in the autopsy lung tissue homogenate samples of 4 cows (variety Frisian cross) in a dairy farm in Bangladesh. Histopathological examination of the lung tissue demonstrated prominent granuloma, caseation necrosis, and calcification indicative of tuberculosis (TB) infection. Mycobacteria could not be cultured from the tissue homogenate samples by the Lowenstein-Jensen-based conventional culture method, although AFB was evident by Ziehl-Neelsen (ZN) staining in the smears of tissue homogenate and in paraffin-embedded tissue slices. Spoligotyping performed on DNA extracts of paraffin-embedded lung tissue samples confirmed AFB as a member of the \textit{M. tuberculosis} complex with a pattern assigned to \textit{M. africanum} sub-type 1. This characterization by spoligotyping was confirmed by subjecting \textit{M. africanum} sub-type 1 isolates from other parts of the world to an alternative identification method based on DNA polymorphism in the \textit{gyrB} gene (Hain Life Science GmbH, Nehren, Germany). Since \textit{M. africanum} is believed to be a human pathogen, general infection in cattle could be a public-health threat. The introduction of these bacteria in the animal reservoir most likely originated from a caretaker. Different spoligo patterns obtained from the lung tissue of samples of the dead cows are shown in Figure 5.
Antimicrobial resistance patterns of *Mycobacterium tuberculosis* isolates of patients

One hundred forty-one sputum samples from suspected multidrug-resistant (MDR) TB patients were collected from the National Institute of Chest Diseases Hospital (NIDCH), Dhaka, as part of an ongoing WHO (TDR)-funded project, over a one-year period. Culture and sensitivity testing of all the samples were done using the conventional (proportion method for drug sensitivity) method. The Mycobacteria Growth Indicator Tube (MGIT) method was also used in addition to conventional culture. The mean time to detect *M. tuberculosis* from clinical specimens using the MGIT method was 9.3 days. According to WHO definition, 48.2% were MDR TB cases (resistant to both isoniazid and rifampicin). (Table 3).

Table 3. Drug resistance in the treatment of TB

<table>
<thead>
<tr>
<th>Drug</th>
<th>Resistance (n=141) No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streptomycin</td>
<td>88</td>
<td>62.4</td>
</tr>
<tr>
<td>Isoniazid</td>
<td>91</td>
<td>69.5</td>
</tr>
<tr>
<td>Ethambutol</td>
<td>78</td>
<td>55.3</td>
</tr>
<tr>
<td>Rifampicin</td>
<td>79</td>
<td>56.0</td>
</tr>
<tr>
<td>MDR (isoniazid + rifampicin)</td>
<td>68</td>
<td>48.2</td>
</tr>
</tbody>
</table>

Molecular mechanism and rapid diagnosis of drug-resistant *Mycobacterium tuberculosis*

DNA sequencing of *rpoB*, *katG*, *rpsL*, *rrs* and *embB* genes was performed on 96 resistant strains to investigate the molecular basis of drug resistance in Bangladeshi *M. tuberculosis* strains. Mutation patterns in different genes were more or less similar to those seen in other countries, except that of streptomycin-resistant genes. Unlike reports from other countries, 76% of the resistant strains had no mutation. Dot-blot hybridization assay for identification of mutation in *rpoB* gene was set up and evaluated on 77 strains. Mutation pattern of all strains could be correctly identified by dot-blot assay. This simple assay could be used for testing rifampicin susceptibility within 2 weeks. Evaluation of this test directly performed on DNA from sputum samples is now in progress.

Parasitic Diseases

Visceral leishmaniasis in Fulbaria, Mymensingh

Bangladesh has experienced a resurgence of kala-azar (visceral leishmaniasis) since early 1990s. To determine risk factors for kala-azar, ICDDR,B conducted cross-sectional surveys over a 3-year period from 2002 to 2004 in a village of Fulbaria, Mymensingh. Through case-history, active case detection, and immunological screening using rK39 ELISA, 155 (6.6%) of 2,356 residents had kala-azar with onset during 2000-2003. Risk of kala-azar was the highest for people aged 3-45 years with no significant difference by sex. In age-adjusted multivariable models, two factors were identified: (a) proximity to a previous kala-azar case (within household or within 50 metres) and (b) consistent use of a mosquito net (not treated with insecticide) in summer. There was no difference by income, education or occupation, land, livestock or other assets, housing materials and condition, or keeping goats or chickens inside bedrooms. The data confirm strong case-clustering and suggest that insecticide-treated nets could be highly effective in preventing kala-azar.

Visceral leishmaniasis vectors in Mymensingh

Although visceral leishmaniasis (kala-azar) has been detected in 34 districts of Bangladesh, 37% of cases over the last 10 years have been identified in Mymensingh district. Seven hundred fifty-two sandflies were collected from 50 homes of leishmaniasis patients in Mymensingh district.
sandflies were dissected and identified at the Parasitology Laboratory at the Department of Zoology, University of Dhaka. The vector—Phlebotomus argentipes—was the species most commonly identified (59%) and was found in 33 of the homes. The other 8 species identified were non-vector sandflies belonging to different species of the genus Sergentomyia. Households with a greater percentage of organic carbon in the soil were more likely to harbour Phlebotomus argentipes.

Pilot evaluation of neem oil application to prevent kala-azar in Trishal, Mymensingh

A study was conducted to evaluate the effectiveness of neem oil in reducing the density of Phlebotomus argentipes—the local sandfly vector for Leishmania. Thirty households were identified that had a kala-azar patient and an overnight sandly number of >20 by CDC light trap collection technique. Households were randomly assigned to have their interior walls sprayed either with neem oil dissolved in a liquid detergent or liquid detergent only (control). After the initial spray, 1,215 sandflies were collected from 30 households (35% were female). Of the female sandflies, 75% were P. argentipes, a vector responsible for kala-azar in Bangladesh. The rest of the sandflies were Sergentomyia spp. Preliminary analysis suggests an 80% lower density of sandflies in neem-treated households compared to the controls. Speciation of sandflies is ongoing.

Impact of climate change on health

The association between weather patterns and hospital admissions for diarrhoea was evaluated at the ICDDR,B hospital in Dhaka. The Bangladesh Meteorological Department and global datasets supplied the weather data, and the Bangladesh Water Development Board supplied the hydrologic data. Two peaks in hospital admissions for diarrhoea were notable in early summer (April to May) and in the late rainy season (August to October). Lower temperature in January was associated with an increased number of admissions in early summer. Heavy rainfall and river discharges were associated with increased admissions in the late rainy season. The cold January in Dhaka was, in turn, related with a southward shift of the Asian subtropical jet near the Tibetan Plateau, which accompanied the cooler climate over the northern part of the Indian subcontinent, and the cooler sea surface temperature in the northern-most part of the Bay of Bengal.

Emerging and Re-emerging Diseases

Nipah virus outbreak investigations

In 2004, ICDDR,B collaborated with the Government of Bangladesh, CDC, WHO, and Health Canada to investigate two outbreaks of Nipah virus encephalitis in Rajbari and Faridpur districts in Bangladesh from January to April. Nipah virus was first identified in Bangladesh during an outbreak of fatal encephalitis in Meherpur district in 2001. During 12-17 January 2004, 12 residents of 2 contiguous villages in Goalando, Rajbari district, developed febrile illnesses progressing to coma; 10 of these illnesses resulted in death. The affected persons were primarily young males. The patients lived in close proximity to each other, and some lived in the same households. Four were diagnosed with Nipah virus infection by laboratory testing; the other 8 died before biological specimens could be collected. The investigation included a case-control study that showed that boys who climbed trees were more likely to develop Nipah than controls (Odds ratio (OR) 15.2, 95% CI 2.3, undefined). Cases (92%) were also more likely than controls (68%) to drink raw date palm juice (OR 6.9, 95% CI 0.98, undefined, p=0.05). Over 450 wild and domestic animals in and near the affected villages were tested for evidence of Nipah infection. Pteropus bats, shown elsewhere to be the natural reservoir for Nipah virus, were the only animals to have antibodies to the virus (14/92, 15%).

From 19 February to 16 April 2004, 36 residents of Faridpur district, became infected with Nipah virus; 27 died. Most patients were adults and relatives of a local religious leader. The spectrum of illness seen in this outbreak was different from previous outbreaks; in addition to encephalitis, patients also presented with mild illness and adult respiratory distress syndrome. It is likely that the virus was transmitted from person to person during the outbreak. Some patients had short, one-time exposure to a Nipah patient and subsequently developed illness. Touching a person with Nipah infection who later died [relative risk (RR) 15.0, 95% CI 4.0-65], touching an unconscious patient with Nipah illness (RR 4.5, 95% CI 1.7-12), and touching an ill person with respiratory symptoms of Nipah infection (RR 5.0, 95% CI 2.0-14) were each strongly associated with developing Nipah infection. Further studies confirmed the presence of Nipah virus antibodies in local Pteropus bats in the area.

During these two outbreaks, the local physicians had a heightened awareness for patients presenting to the hospital with encephalitis, especially clustered cases of encephalitis. Many of these encephalitis cases were tested for Nipah antibodies at the CDC. Consequently, 21 additional cases of clustered and sporadically occurring Nipah virus infection were documented in 9 different districts of central and western regions of Bangladesh.
Investigation of Nipah virus outbreak in Faridpur district: in-depth examination of beliefs and practices associated with the disease

To understand the perceptions of the outbreak and associated behaviours, an in-depth, qualitative study is being carried out in households of confirmed cases and neighbouring households located in the recent outbreak sites. The overall aim of the study is to collect information to guide the development of communication messages aimed at reducing behaviours that increase the risk of exposure and decreasing the spread of Nipah virus during times of outbreak.

Results to date demonstrate that the most common causal explanation is asmani bala (a curse from the sky inflicted by Allah) which respondents linked to sin committed by community members. This was rationalized by the sudden onset of the outbreaks, the high case-fatality rate, and the fact that it affected healthy individuals, the primary symptom was fever, and there is no known treatment. Striking was the absence of explanations relating to contagion despite efforts to educate communities on risk of infection at the time of outbreak.

An examination of caring practices illuminates many potentially-dangerous practices. Provision of care is rooted in emotional support. Care providers continued to share eating-utensil and glasses with the sick patient, and leftovers of food offered to afflicted individuals were commonly distributed to other family members. The family members maintained their regular sleeping arrangements, which often involved sleeping with a sick Nipah patient. The findings also reveal a particularly strong desire to have close physical contact at the time of death, demonstrated by such behaviours as feeding the patient by hand or hugging and kissing the sick patient. The family members and religious leaders are also responsible for the preparation of the dead body for burial, which focuses on special cleansing of the orifices.

Encephalitis

In Asia, particularly in Bangladesh, epidemiology and aetiology of encephalitis are still unknown. The scientists of ICDRR,B and CDC are collecting epidemiological and clinical information, cerebrospinal fluid, throat swabs, urine, and blood from patients with encephalitis in Dhaka, Mymensingh, and Rajshahi Medical College Hospitals of Bangladesh to create a profile of aetiology and epidemiology of the disease in the country. This information will be used locally for preventing and managing the disease, documenting emerging pathogens, and establishing priorities for further research. Over 350 patients have been enrolled in this surveillance project during June 2003-December 2004.

Of the first 176 patients enrolled in the study, 11 (6%) tested positive for Japanese encephalitis, including 11% (7/63) of patients recruited from the Rajshahi Medical College Hospital. This is the first time Japanese encephalitis has been recognized in Bangladesh since an outbreak in 1977. Since Japanese encephalitis is a vaccine-preventable disease, future efforts should focus on characterizing the burden of disease and evaluating the appropriateness of a vaccination programme. Other pathogens identified during preliminary testing included dengue virus, herpes viruses, Neisseria meningitidis, S. pneumoniae, and H. influenzae. Approximately, 28% of the first 110 patients enrolled in the study in Dhaka had positive test results for N. meningitidis. Surveillance for encephalitis is ongoing, and the study has been expanded to include an additional geographic area of Bangladesh, at Sylhet Medical College Hospital.

Epidemiology of hepatitis E virus infections in Bangladesh

This is a population-based study to describe the epidemiology and quantify the burden of hepatitis E virus (HEV)-associated infections and disease in rural Matlab. The age-specific population prevalence of IgM and IgG antibodies to HEV will be determined using an inclusive random sample of 1300 individuals from the Matlab cohort. Risk factors associated with HEV disease will be determined through a case-control study. Active cases of hepatitis are being detected using a clinical algorithm through surveillance. Serum samples have been collect from 1,134 (87.2%) individuals. The study has so far identified 40 cases of acute hepatitis based on the algorithm. The study results
will provide a comprehensive epidemiologic profile of endemic and epidemic HEV in a high-risk population, and could form the basis for a future preventive intervention, such as a vaccine trial.

Antimicrobial resistance surveillance on some bacterial pathogens in Nepal: a technical cooperation

The USAID Nepal Mission launched a programme to help develop the capacity of the Ministry of Health (MoH) of His Majesty’s Government of Nepal to fight infectious diseases. The scientists of the Laboratory Sciences Division of the Centre provided technical support to develop and strengthen laboratory-based surveillance on some selected infectious disease pathogens involving 9 laboratories—5 in the Kathmandu valley, 3 in the Western region, and 1 in the Eastern region—that started in 1999 and continued until December 2003. The pathogens included were *V. cholerae* and *Shigella* to represent diarrhoeal diseases, *S. pneumoniae* and *H. influenzae* to represent acute respiratory infection, and *N. gonorrhoeae* to represent sexually transmitted diseases. Subsequently, *S. Typhi* was added to the programme in 2002. The activity also included assistance to develop an external quality-control network involving the 9 laboratories and to train technical manpower as part of technology transfer.

In 2004, a draft report was prepared using accumulated data on identification, antimicrobial susceptibility, quality assurance of isolates in their identity and determining resistance, technical support and essential laboratory materials provided, including equipment, monitoring, and evaluation of the activities, training and workshops for manpower development, transfer of technology, and orientation for physicians and nurses to raise awareness of the importance of the emerging problem of antimicrobial resistance. The report was handed over to His Majesty’s Government of Nepal and USAID Nepal in a ceremony organized for dissemination of the findings and orientation for physicians and nurses.

**Vaccine Studies**

Safety, reactogenicity and immunogenicity of an orally-administered human rotavirus vaccine (RIX4414) in healthy children in Bangladesh

A safe and effective rotavirus vaccine is urgently needed to reduce the enormous disease burden associated with rotavirus illness. The study evaluated the safety, reactogenicity and immunogenicity of the new oral live human rotavirus vaccine (RIX4414) in Bangladeshi infants. A double-blind, randomized, placebo-controlled trial was conducted in urban Dhaka among toddlers aged 2-4 years and infants aged 6 weeks. In total, 430 subjects were enrolled. The vaccine used in this study was an 'all in one' formulation (vaccine and buffer in the same vial). The vaccine was found to be safe and well-tolerated, but the immunogenicity was low. There were no cases of intussusception. In other international study sites where the vaccine and the buffer were separate, immunogenicity was much better. Thus, future evaluation of RIX4414 in Bangladesh will require using the formulation with the vaccine initially separated from the buffer.

Defining incidence of intussusception in Bangladesh in preparation for a phase III trial of a new rotavirus vaccine

The objective of the study is to establish systematic approaches for the diagnosis and rapid management of intussusception and to define baseline incidence rates before a new-generation rotavirus vaccine is evaluated for clinical efficacy in Bangladesh. Retrospective charts of all admitted patients at Matlab and other ICDDR,B treatment centres are being reviewed to detect suspected cases of intussusception. Prospectively, data are being collected through active surveillance from three ICDDR,B treatment centres at Matlab and from 4 district and sub-district government hospitals and 3 district-based private clinics. A full intussusception surveillance system has been established with detection of cases by clinical examination, examination by ultrasonogram, effective referral system and examination by a paediatric surgeon to manage cases with surgical and non-surgical methods. As of December 2004, no cases of intussusception had yet been identified.

**Future Directions**

The Infectious Diseases and Vaccine Sciences Programme, consistent with its strategic plan, will continue to be engaged in conducting research on important causes of death and disability due to infectious diseases in Bangladesh. Specifically, the Programme intends to continue to expand studies to evaluate pneumonia, the largest single cause of childhood death in Bangladesh. The Programme envisions further work to identify strategies to reduce the burden of tuberculosis, and is also seeking to expand our understanding of the recurrent Nipah outbreaks that occur in Bangladesh and to expand collaboration with the Government of Bangladesh to increase the capacity for investigations of outbreak. The Programme will continue to be actively engaged in vaccine evaluation and envisions a repeat immunogenicity evaluation of an alternately-formulated human rotavirus vaccine (RIX4414). The Programme is actively pursuing further evaluation of pneumococcal, Japanese encephalitis and typhoid vaccines.
HEALTH AND FAMILY PLANNING SYSTEMS

Programme Head
Charles P. Larson

The Health and Family Planning Systems Programme (HFPSP), in close collaboration with the Health Systems and Economics Unit (HSEU) of the Health Systems and Infectious Diseases Division (HSID), is broadly concerned with how people obtain access to healthcare, use of services, and coverage and health outcomes. It aims to measure these through information systems, surveillance and surveys, and through identifying the differences between social and economic groups to assess equity and poverty-focus of services. Other key themes are the organization, cost, and financing of service-delivery systems. The incorporation of new health economics staff in the Unit has enhanced its capacity for research and consultancy activities, including work on health equity, cost-effectiveness of different interventions, and cost of illness. The Unit continues to be a focus for projects under the HFPSP, particularly those relating to the Centre’s priorities of evaluating alternative service strategies, improvement of health and family-planning services, information systems, and promoting evidence-based planning of health systems. During 2004, the HSEU completed 8 projects and had 9 ongoing projects at different stages of implementation. The results of several projects were disseminated through publications and in seminars held at the Centre.

Use of ESP services in the transition to a static clinic system: 1998-2002

The study has provided the only reliable evidence on the use of essential services package (ESP) and coverage of population in a period of major change in the health service-delivery system (1998-2002) of the Government of Bangladesh. Data from the HSID surveillance areas in Abhoynagar and Mirsarai were used for comparing the quarterly trends in coverage of key services for areas where outreach services had been transferred to a community clinic and areas where no community clinics had been made operational. In the 12 surveillance unions, 20 of the 36 planned community clinics were operational for at least 12 months in 2001-2002, but only one had opened before these in 2000. In general, it was observed that women made the major change in health service-seeking behaviour required under the new system. Most women in areas with a community clinic had used one, and the level of coverage of family planning, antenatal care, and immunization services was either maintained or improved despite the major changes in the delivery system. The community clinics rapidly became the main source of supply of contraceptives for married women who did not appear to have become dependent on household delivery of family-planning commodities.

Effectiveness of an NGO primary healthcare programme in rural Bangladesh

Data from the management information system of an NGO programme, serving a population of about 2 million in different parts of rural Bangladesh (Bangladesh Population and Health Consortium—
BPHC), were reviewed. The study found evidence of high and equitable coverage of the main child and reproductive health services compared to rural Bangladesh as a whole. For example, the coverage of pregnant women was considerably higher for 3 antenatal care visits (73% vs 17%), 2 tetanus toxoid vaccinations (90% vs 62%), and a postnatal check-up (73% vs 16%). The coverage of measles vaccination for children aged 12-23 months was also higher (78% vs 69%), as was the use of modern contraceptive methods (58% vs 43%). The most striking feature of the data was the low neonatal mortality of 21 per 1,000 live-births compared to the national rate of 42 per 1,000. In 12 areas where the NGOs had been providing services for several years, neonatal mortality was even lower and had fallen by 50% since 1996. Subsequent checks on the registers and household surveys of women confirmed that neonatal mortality in 2003 was less than 20 per 1,000 in these areas, taking into account errors in recording and registration.

Use of ESP and other factors associated with neonatal survival in rural areas of Bangladesh served by a large NGO programme

As a follow-up to the above study, this study began in May 2004. It is being conducted in 12 areas where the Bangladesh Population and Health Consortium (BPHC) partner NGOs have been providing services since at least 1996. It focuses on children born in 2003, comparing those who died in the first 28 days with those who survived during this neonatal period. The aim is to identify the programmatic and other factors that might be contributing to neonatal survival in these areas where neonatal mortality is relatively low. The preliminary results indicated that neonatal mortality was below 20 per 1,000 livebirths (half the national rate), after taking into account the errors in registration and recording identified. Misclassification of neonatal deaths as stillbirths (about 8% of recorded stillbirths) was the most common source of error. Given the high coverage of mothers with preventive reproductive and child health services, results of preliminary analysis suggest that children who died were more at risk for other reasons, such as delivery-related complications, treatment-seeking behaviour, and problems of access to appropriate care when the child got sick. Final results of the study will complement the findings of an evaluation of the Saving Newborn Lives Initiative of Save the Children-USA that began at the end of 2003 in selected areas of rural Bangladesh. It will provide information on what strategies are likely to have most impact in areas where neonatal mortality has been reduced to half the national average.

Identifying and addressing unmet needs in primary healthcare clinics: evaluation of a screening tool

The application of a screening tool was evaluated in the government and NGO clinics. It was observed that systematic screening significantly increased the amount of checking for additional needs by service providers, the number of additional needs identified, and the proportion of those needs that were met through services. The results suggest that the coverage of reproductive and child health services could be improved through use of the screening tool, which would result in more services being provided on one client visit to a clinic.

Evaluation of a 6-month pilot study to introduce depot-holders in urban areas

The study was designed to evaluate a pilot of NGOs introducing ‘depot-holders’ in 3 types of urban area. These are women who keep a stock of contraceptives and ORS to supply other women and promote the use of clinic services. The study found evidence of depot-holder activities in the community, including providing information, referral, and supply of commodities. A review of clinic-service statistics indicated that the use of ESP at the NGO clinics had generally increased considerably, most likely as a result of the promotional activities of the depot-holders. The intervention was effective, although scaling up might need to be selective, taking into account the programmatic issues that were identified.

Exit survey for assessment of quality of ICDDR,B clinical laboratory services

To assess the user satisfaction of ICDDR,B laboratory services with the aim of improving these services, an exit survey was conducted among 206 users in April-May 2004. Most clients were well-educated (60.2% had bachelor’s degree or above) and financially well-
The mean waiting time was 21 minutes. Fees were reported as ‘affordable’ among 69%. Compared to other laboratories, fees were reported to be ‘less’ by 21%, ‘same’ by 27%, and ‘higher’ by 29%. Eighty percent of the respondents were satisfied with the services received.

Review of the reproductive health status of poor women in Bangladesh

Research was conducted on reproductive health as part of a 5-country study funded by the World Bank. It included an extensive literature review, analysis of data on reproductive health status from existing sources, and a district-level field survey to assess the quality of reproductive health services in Bangladesh. The survey identified the factors hindering the quality of service and suggested possible interventions to improve service-delivery. It also found that the burden of disease was spread relatively evenly across all 4 asset quintiles, thus suggesting that targeting should not be limited to the lowest quintiles. In Bangladesh, at least 80% of households are needing improved quality of reproductive health services.

Socioeconomic status and childhood morbidity in rural Bangladesh

This study used the Matlab health and demographic data to identify the trends in childhood illness burden and service use by socioeconomic status over time. Among the lowest 3 socioeconomic status quintiles, no significant differences were found in the burden of disease or healthcare-seeking behaviour.

SUZY Project

Behavioural studies of caretakers’ practices in relation to knowledge and beliefs about childhood diarrhoea

The overall aim of the study was to understand the key issues affecting the treatment of diarrhoeal diseases in children aged less than 5 years. The research design is qualitative in nature involving such methods as key-informant interviews, semi-structured interviews, cognitive mapping procedures, and group discussions. The information gathered is being used for developing a communication package that will accompany the zinc rollout. Following project implementation, data collection to evaluate the impact of health communication messages and the acceptability of zinc treatment during diarrhoeal episodes will be conducted. During the completed first phase, the research team identified local terminologies, beliefs, and concepts around childhood diarrhoea and common management strategies used for different diarrhoeal illnesses. This involved the identification of healthcare providers offering treatment for a wide range of culturally-constructed diarrhoeal illnesses and an examination of their treatment approaches. Another area of study was related to understanding local perceptions of vitamins and minerals, with a focus on zinc and its acceptability during diarrhoeal episodes.

In the second phase, communication messages were developed, which will be used as part of a mass marketing campaign. For this purpose, findings from the formative research will be combined with critical biomedical information that needs to be communicated when promoting the use of zinc during diarrhoeal episodes. As part of this iterative process, draft messages will be tested in different sites around the country and modified accordingly. Findings of this research will also contribute to the development of training courses and the preparation of provider-counselling cards.

Observation of health behaviour of a family at Kamalapur, Dhaka city

Acceptability of and adherence to treatment with zinc tablet

WHO/UNICEF now recommends the routine use of zinc in the treatment of acute diarrhoea in children. A dispersible zinc tablet formulation has been developed for routine use. However, only limited information is available on the acceptability of and adherence to treatment of diarrhoeal children with this dispersible zinc formulation. This community-based study aimed to determine the acceptability of and adherence to treatment with a dispersible zinc tablet formulation in a cohort of urban and rural children aged less than 5 years. Children with acute childhood diarrhoea were prescribed zinc tablet treatment, free of charge, by drug sellers, and then their homes were visited 2-3 weeks later for follow-up information. The formulation was highly acceptable to children; over 90% of the caretakers perceived that the tablets were equally or even more acceptable to their children when compared with other medicines. Ninety-eight percent
of the children received the standard dose of one tablet per day, and 55.8% completed the full 10-day course of zinc treatment. Adherence rates did not vary by the child’s age or gender. The findings indicate that the tablet formulation is acceptable, but further efforts are required to enhance adherence.

National baseline coverage survey of diarrhoeal illness management practices and expenditure

The survey was conducted to have baseline documentation of diarrhoea-management practices prior to the national rollout of zinc as a treatment for childhood diarrhoea in Bangladesh. Nationally-representative samples of rural and urban children, aged less than 5 years, with an active or recent diarrhoeal episode were included (n=760). Important baseline findings included the following: (a) 60% of caretakers sought help from a health provider; of them, 90% used private-sector providers; (b) ORS was used in 55% of cases and antibiotics in 41%; (c) the median expenditure for a diarrhoeal illness by asset quartile varied from 35 to 42 taka in the rural population and 60 to 100 taka in the urban population; and (d) gender disparity continued to exist, with boys more likely to be brought to a licensed physician and to receive greater treatment expenditure. The results of the survey point out the importance of the private sector and the fact that even the poorest household spends a significant amount of money, well within the estimated 12 taka cost for zinc treatment.

Safety monitoring of zinc tablet

As zinc is scaled up as a routine treatment for childhood diarrhoea, there is a need for phase IV trials to identify, validate, and quantify its possible side-effects in relatively large patient populations. A safety study is being conducted at the Dhaka hospital of ICDDR,B and adjacent PSKP clinic. The zinc therapy is being introduced as part of the standard management for all children with acute or persistent diarrhoea. It is provided through a dispersible zinc sulphate tablet, 20 mg per day for 10 days, in children with acute diarrhoea aged 3 months to 5 years. Monitoring for adverse effects of zinc therapy, particularly unusual or excess vomiting, is being carried out as an integral part of the routine management of a child while in the hospital or in the PSKP clinic. In 2004, 13,978 children were monitored, of whom, 23% had vomiting or regurgitation within one hour of administration of the zinc tablet.

Does zinc treatment cause vomiting?: Randomized clinical trial of children triaged at ICDDR,B hospital facility

Under-five children triaged and treated in either the Short-stay Ward of the ICDDR,B’s Dhaka hospital or an adjacent NGO outpatient clinic (PKSP) are randomized to one of three groups; (1) zinc treatment, (2) placebo, or (3) no treatment. They are being observed for one hour and all vomiting or regurgitation episodes are recorded. When compared with placebo group, zinc treatment resulted in an attributable risk increase of 14% for vomiting and 5.2% for regurgitation. The median time to vomiting among those receiving zinc was 9.6 minutes post-treatment; vomiting attributable to zinc, placebo and the illness episode was estimated to be 40%, 26%, and 34% respectively.

The dispersible zinc sulfate tablet formulation at a dose of 20 mg is associated with increased risks for vomiting and regurgitation. Both are transient side-effects.

Introducing zinc for the treatment of diarrhoea through rural depot-holders in the USAID-NGO service-delivery

Two rural sub-districts have been selected. In one district, the depot-holders (village health workers/commodity distributors) are being trained to prescribe and sell zinc tablet, while the other serves as a comparison population. A baseline survey and training have been completed, with a repeat survey planned early in 2005. The study will assess willingness to pay for zinc treatment, as part of formative research to understand the value households place on this. It will also help identify a potential range of market prices for zinc tablets to be provided by NGOs. A further study is being planned to measure the change in economic burden of diarrhoea after the introduction of zinc treatment.
The United Nations has recently reduced its estimate of the global population in 2050 from 9.3 to 9.1 billion. Nevertheless, 95% of the future growth of 2.6 billion to the year 2050 will occur in developing countries, like Bangladesh. Indeed, Bangladesh will contribute more population growth in absolute terms (101 million) than many larger developing countries, including China, Indonesia, or Brazil. However, there are hints that the decade-long fertility plateau in Bangladesh is coming to an end, but greater efforts will be needed to maintain momentum in family planning, and in responding to the consequences of these major demographic shifts. These consequences include a steady ageing of the population, with a shift from infectious to non-communicable diseases, massive rural-to-urban migration with associated changes in family structure, social support networks, etc.

The Health and Demographic Surveillance System (HDSS) in Matlab is continuously adapting to new demands for data in response to the growing focus on the above issues, as well as the need to monitor where various health and development intervention programmes are actually reaching the intended group—the poor.

Birth spacing and infant and child mortality

Partly as a mechanism to refocus attention on the importance of family planning, there has been some re-examination of the health risks of short and long birth intervals. Using the Matlab data on 145,000 pregnancy outcomes gathered over 20 years, the effects of the lengths of birth intervals on infant and child mortality were examined. Compared to intervals of 3-5 years duration, preceding birth intervals of less than 24 months duration were associated with significantly higher risks of early neonatal mortality, and birth intervals of less than 36 months were associated with significantly higher risks of late neonatal mortality, post-neonatal mortality, and child mortality. A short subsequent birth interval was also associated with a significantly higher risk of mortality for the index child.

These effects persisted when controlled for potentially-confounding factors, such as prematurity, breastfeeding, immunizations, and demographic and socioeconomic variables. A number of the relationships were consistent with the maternal depletion hypothesis.

Pregnancy spacing and maternal morbidity

The study examined the relationship between pregnancy spacing and 7 measures of maternal morbidity (proteinuria, high blood pressure, bleeding, premature rupture of membranes, anaemia, oedema, and pre-eclampsia) using ‘pictorial’ card data of Matlab intervention area. Data were obtained from 11,122 women who visited a health centre during their third trimester of pregnancy between 1996 and 2002. After controlling for sociodemographic variables, pre-eclampsia (Fig. 1) and high blood pressure were significantly more likely for women with preceding inter-pregnancy intervals of less than 6 months, or 75 months or more compared to those with intervals of 27-50 months.

Fig.1. Pre-eclampsia by pregnancy intervals, with and without controls (hollow symbols), indicates non-significant difference
Premature rupture of membranes was significantly more likely following pregnancy intervals of 6-14 months, and oedema was significantly more likely following pregnancy intervals of over 50 months. Based on the findings of the above two studies on birth and pregnancy spacing, programmes are needed to encourage at least 36 months between consecutive pregnancies, for the health of both mother and the baby. This policy/recommendation is also consistent with the current WHO guidelines.

Health interventions and socioeconomic inequalities of mortality of children

The study examined changes in the levels and socioeconomic inequalities with respect to mortality of children aged less than 5 years (under-5 mortality) in an area of rural Bangladesh during a rapid expansion of health services. Using the Matlab HDSS data, two birth cohorts—1983-1985 and 1993-1995—were followed for 5 years in two adjacent areas: ICDDR,B-service area and government-service area, but with similar socioeconomic characteristics.

The percentage of decline in the overall under-five mortality was greater over time in the ICDDR,B-service area than in the government-service area. Most of the difference was due to infant mortality. For 1-4-year mortality, the decline was similar in the two areas. Over the study period, the poor-rich ratio of under-five mortality and infant mortality widened roughly to the same degree in both the areas, while for 1-4-year mortality, the poor-rich ratio declined slightly in the ICDDR,B service area (Fig. 2).

Narrowing the poor-rich difference of 1-4-year mortality in the ICDDR,B-service area could be due to intensive health intervention that has been in operation for about two decades. Children aged less than 5 years in the poorest households died more due to diarrhoea, pneumonia, infection, accidents, and other causes than those children of the least poor households, and difference between the poor and the rich had widened over time in both the areas, except for pneumonia in the ICDDR,B-service area.

Measuring household economic status in rural Bangladesh: can asset-based indicators replace household income and expenditure?

Measuring household socioeconomic status (SES) in developing countries poses considerable problems. Data on two frequently-used indicators of household status—income and expenditure levels—are often unavailable or not reliable. Based on Demographic and Health Surveys, recent research has used data on ownership of assets to derive simple and alternative indicators of household SES. However, the validation of these asset indicators as proxies for household income and expenditure is yet to be intensively addressed. This study aimed at examining the strength of the asset-based alternative indices of household SES as proxies for household income and expenditure.

Household assets significantly correlated with household income and consumption expenditure, but the relationship with expenditure (0.567) was higher than the relationship with income (0.302). Among all indicators, household assets showed larger inequality (measured by the poor-rich ratio) in selected health and social outcomes. Thus, both assets and expenditure are the best indicators of long-term SES, whereas income is the best indicator of current level of SES. This study suggests assets as proxies for household consumption expenditure rather than for income, particularly in the case of measuring inequality.

Women’s mobility and abortion

Using birth-history data from Matlab, collected during 1998-2000, the study examined the factors associated with induced abortion in the first and the second trimester, separating the effects of women’s mobility. The results of analysis showed that, among older women who had an induced abortion, those who had relatively free movement and those who could exert their influence on the decision-making process of the household were more likely to abort their pregnancy during the first trimester, whereas those who had restricted movement were more likely to abort their pregnancy during the second trimester. In other words, the age of women worked through mobility, and decision-making factored for the first-trimester abortion but not for the second-trimester abortion. A lower ratio of induced abortion in the treatment area suggests that the intensive family-planning intervention in that area substantially reduced the induced abortions.

Infertility and divorce

Social factors and cultural anxieties over infertility force women to have a child as soon as they get married. Husband, parents-in-law, and relatives anticipate a pregnancy shortly after marriage. Inability
to bear a child within a few years may lead to marital dissolution. The main research question of this study was whether delay in producing a child leads to a marital dissolution of a newly-wed woman.

It was found that a birth significantly reduces the risk of divorce of a newly-married woman. The likelihood of divorce was low if a woman or her husband had some education but was high if a woman was married to a polygamous man. The finding that early conception after marriage of a girl protects the marriage from breaking up has a strong policy implication for normal family-building strategy and family-planning programmes in Bangladesh. Current strategies to motivate newly-weds to adopt contraception to delay the first birth may disrupt normal reproductive behaviour and jeopardize the marital union. This seeming contradiction between normal reproduction and the fertility reduction programmes needs to be addressed carefully.

Spousal communication and contraceptive use

Using longitudinal data from the Matlab HDSS for the 1984-1994 period, the study examined three forms of spousal communication factors: (a) discussion between spouses on fertility-control measures, (b) number of children wanted, and (c) approval of the family-planning programme and its association with the use of contraceptives to achieve a desired family size. It also examined whether spousal communication had changed during the period studied and whether this had any effect over time. The results showed that all the three forms of spousal communications had a significant positive relationship with the use of contraceptives. Communication between spouses had increased during the study period. This had an increasing effect on the use of contraceptives.

Ageing of the Bangladesh population: mortality and morbidity

A study was conducted in collaboration with staff of the Karolinska Institute, Sweden. This multi-dimensional cross-sectional study of 626 elderly men and women in rural Bangladesh focused on four main domains of health: medical health, functional status (including physical and cognitive functions), health-related quality of life, and social functioning. Of them, 473 underwent clinical examinations covering chronic conditions, such as risk factors and symptoms of hypertension, cardiovascular diseases, diabetes, arthritis, vision, and hearing conditions. In addition, in-depth tests of cognitive function were carried out.

Blood samples were collected from 460 respondents and were analyzed for nutritional markers, vitamins, diabetes, and lipid profiles.

The most common self-reported morbidities were: micturation problems (54%), pain in the waist (75%), pain in the joints which is suggestive of arthritis, and cloudy vision (59% of males and 72% of females) which is suggestive of cataract. Thirty-three percent were the earning members of the family. Forty-seven percent were living with at least one child and 57% with at least one child’s family. Eighty-two percent received financial help regularly from family members, but 5% never received any help from anybody.

The elderly are thought to be intrinsically at greater risk for dietary and nutritional deprivation. The implication of rapid weight loss or low body mass among the elderly living in community-dwelling is assessed in this study. About half (52.2%) of the respondents believed that they have a major malnutrition problem. Fifty percent had body mass index (BMI) less than 18.5.

Elderly people of rural Bangladesh: care, support, and living arrangements in the family

Using longitudinal data from Matlab-HDSS, the present study examined the care, support and living arrangements in the family of elderly people of Bangladesh from 1974 to 1996. Elderly widowers/widows were more likely to stay with children, and the propensity to stay with children has increased over the years, whereas living ‘alone and with others’ has decreased over the period for both widowers and widows. The proportion of the elderly staying with a married daughter, though small, has shown an increase over the years. It was only 1% (among all elderly) in 1974, which increased to 5% in 1996. Most widows and widowers were cared for by their daughters-in-law. Married males were mostly cared for by wives (89%), whereas only a few married women (9%) were cared for by husband. Most widowers (74%) and widows (52%) received financial support from their son(s). About 38% of males and 30% of females regularly performed at
least one form of household work. Females tend to provide greater assistance than males in the household task. The greatest contributions regularly made by elderly women are in helping with food preparation followed by cleaning utensils/dishes and house cleaning. Most men gave assistance in caring for their grandchildren and tending animals regularly. A positive interpretation of these findings would be that the living arrangements of Bangladeshi elderly are favourable for their overall well-being, since co-residence with kin is assumed to be a reliable source of assistance and support. Most support for the elderly is still being provided by the family members.

Rural-urban migration in Bangladesh

Rural-urban migration is one of the major contributors to rapid and unplanned growth of towns and cities. Little is known about the reasons for rural-urban migration and the characteristics of migrants in Bangladesh. This study examined the demographic and socioeconomic characteristics of villagers who are prone to migration; examined the effects of social networks, education, and household economic conditions of villagers on their choice of destination; identified the major reasons for migration and changes in pattern of reasons for migration over time; and examined their intention for further migration. The migration data of the Matlab Health and Socioeconomic Survey conducted in 1996 were used. The results of analysis of data on 10,461 adults, aged 15-59 years, showed that the pattern of reasons for migration is changing over time: more people are migrating to cities to seek jobs and pursue education in recent years than before. Educated males are migrating at a higher rate than uneducated males, and the rich are more likely to migrate to urban areas than the poor. Social networks, in terms of knowing someone who has already migrated, are more important in the decision to migrate for rural-urban than for rural-rural migration.

Health and Demographic Surveillance System-Matlab

Verbal autopsy and causes of death in the Matlab HDSS

With steady ageing of the Bangladeshi population, there is a growing recognition that adult health problem, especially non-communicable disease, is an important consideration in allocation of resources to the health sector. In Matlab, greater efforts have been underway since early 2003 to strengthen the capacity to diagnose adult morbidity and mortality. During 2004, the Medical Assistant (MA) first reviewed old verbal autopsy (VA) tools and assigned possible underlying cause of death for 1,547 deaths. After 6 months, he was provided new modular VA tools to assign possible underlying and associated causes of death. One physician also reviewed independently new modular VA tools to assign causes of death. Preliminary analyses of causes of death assigned by MA and physician to old and new modular VA tools revealed that agreement was higher between MA and physician with the new VA tools than between old and new VA tools assessed by MA. The agreement was higher particularly for deaths due to chronic diseases (i.e. tuberculosis, neoplasms, diabetes, ischaemic heart disease, and stroke) and due to injury and drowning.

Effect of infant immunization on childhood mortality

A report from a demographic surveillance site in Guinea-Bissau showed an increased child mortality even after being immunized with diphtheria-tetanus-pertussis (DTP) and oral poliovirus vaccine (OPV). In collaboration with WHO, a retrospective study was carried out, using the HDSS data from 1986 to 2001, to determine if the same pattern existed in Bangladesh. The findings based on survival of 36,650 infants found that DTP and OPV were independently associated with decreased risk of death before age 9 months, as were amount of maternal education, maternal age, and birth order of the child. DTP vaccination was associated with increased survival between 6 weeks and 9 months of age. Measles vaccination was also associated with increased survival (when data after late immunization with DTP and BCG were excluded). Overall, BCG vaccination was associated with reduced survival; however, children vaccinated with BCG during the first 6 months of life had significantly lower risk of death than those vaccinated later.

Patterns of survival by season of birth in rural Bangladesh and Gambian populations

Analysis of data from rural Gambia has previously shown that being born during the annual hungry season strongly influences susceptibility to mortality from infectious diseases in young children. In rural Bangladesh, pregnancies are exposed to similar seasonality. HDSS data for 172,228 births and 24,697 deaths between 1974 and 2000 were used for retesting the Gambian-derived hypothesis that early life exposures correlated with season of birth predict later patterns of mortality. However, there was no excess of young-adult mortality among individuals born during the annual hungry season (July-December) compared to the harvest season (January-June). This differing pattern in survival, when compared with that in the Gambia, may be a consequence of the greatly-reduced incidence of adult deaths in Bangladesh compared to that in the Gambia. Under such conditions, possible differences in immune function may not be detectable with early adult death as the outcome.
The Poverty and Health Programme, embracing all divisions and relevant research at ICDDR,B, places special emphasis on studying the barriers faced by the poor in accessing health and other development services. The Centre has been exploring a new area of research through various studies examining the interactions of poverty with health and disease and has gained in interdisciplinary and inter-institutional knowledge exchange through these activities. Of significance are the Poverty and Health Knowledge Project and interaction with the Bangladesh Health Equity Watch (a collaboration with BRAC, Bangladesh Institute of Development Studies (BIDS), Bangladesh Bureau of Statistics (BBS), and the Well-being in Developing Countries Project at the University of Bath, UK. These interactions have served to conceptually clarify the meaning of poverty-focused research and illuminate the pathways of interaction between poverty research and different health and development programmes. The Programme is housed in the Social and Behavioural Sciences Unit of the Public Health Sciences Division.

The mandate of the Programme is to include a poverty focus in all research activities throughout the Centre.

Research

Reproductive health status of women and quality of reproductive health services in Bangladesh

A review of the reproductive health status of women and quality of reproductive health services in Bangladesh as part of a 5-country study, funded by the World Bank, was completed. The study comprised two broad sections. The first section focused on the current status of reproductive health of poor women in Bangladesh: this was based on bivariate and multivariate analyses of the Bangladesh Demographic and Health Survey 1999-2000 and a thorough literature review. The analysis identified key determinants for the poor status of reproductive health (focusing mainly on maternal and child health) among poor Bangladeshi women and suggested some potential strategies for improvement. The second section focused on the quality of reproductive health services in Bangladesh, and this was based on the assessment of the different policies and programmes relating to reproductive health in Bangladesh and a field study combining field visits and stakeholder interviews to assess the service quality both from providers’ and clients’ point of view. Results of this section identified the determinants hindering the quality of services and suggested some potential interventions.

Some important policy findings indicated that inequity in maternal and child health is still a concern. However, there is a significant similarity in health outcomes and healthcare-seeking behaviours among the first 3 quintiles in Bangladesh and a significant difference between the first 3 and the 5th quintile. This suggests that, although rich-poor ratios (5th quintile compared to the first) show a significant disparity, targeting interventions, such as demand-side financing options only to this poorest 20%, will miss the majority of the disease burden spread across 60% and sometimes up to 80% of the population. A more universal approach is perhaps more useful for Bangladesh. The study also highlighted the need for family-planning programmes to focus more on adolescents and young women rather than on high-parity or older women, as most pregnancies and unmet needs for family planning are among young women. The analysis also found that women who had 4+ antenatal-care visits were more likely to obtain skilled care for delivery and also to receive postnatal care, thus highlighting the need to focus on interventions that increase the use of antenatal care.

Quality of life

During December 2004, scientists of the Poverty and Health Programme, in collaboration with the
BIDS and Proshika, conducted focus-group discussions and semi-structured interviews in urban sites in Manikganj and Dinajpur districts, as part of Phase 1 of the “Quality of Life Study of the Well-being in Developing Countries Project (WeD)” based at the University of Bath, U.K. The objectives of this fieldwork were to understand the categories and components of quality of life for different people in the specific localities and, within these, the relative influence of the subjective and the material. This marked the completion of fieldwork started in June 2004, when similar focus-group discussions and semi-structured interviews were conducted in rural sites in the two districts. The objective of WeD is to develop a conceptual and methodological approach for understanding the social and cultural construction of well-being in developing countries. An international, interdisciplinary team draws together perspectives from across the social sciences in a major programme of comparative research, focused on 6 communities in each of Ethiopia, Thailand, Peru, and Bangladesh. The research raises fundamental questions for both academic study of development and policy community.

The results from QoL Phase 1 show a high degree of consensus, both among the countries and with domains of quality of life and life satisfaction identified in previous reviews [Cummins 1996 and 1997]. The most important areas for all countries appear to be close affiliation (family, natal family, and partner), followed by material well-being (income, assets, basic need satisfaction, good home environment, good infrastructure for services, and governance within the community), and relations with the community and the wider world (e.g. kin in the cities and abroad, regional government, market relationships). Religion appeared to be very important in Bangladesh and Thailand and fairly important in Ethiopia, and education was a priority for people in Bangladesh and Ethiopia, though not in Thailand or Peru (except peri-urban areas). The data also demonstrate significant divisions according to age and gender, suggesting that there may be much greater commonality between young men in Bangladesh and Thailand than there exists between sons and their mothers in Bangladesh.

Urban poverty

A study examining the socioeconomic characteristics of patients attending the Dhaka hospital of ICDDR,B has been completed. It investigated the changes in household socioeconomic status (SES) of children, aged less than 5 years, attending the hospital by comparing their SES at two time intervals, i.e. before and after the introduction of user fees. A significant reduction in attendance of children, aged less than 5 years, coming from the poorest socioeconomic strata following the introduction of user fees was observed. User fees might have an influence on the poorest children with different clinical and epidemiological characteristics in reporting less to the hospital. Further quantitative and qualitative research is needed to draw more conclusive inferences.

Health-related MDGs in the developing world

A review of the poverty reduction strategies and feasibility of the Millennium Development Goals (MDGs) in a few selected South Asian and sub-Saharan countries was completed. If the present trend continues, only Bangladesh, Ghana, Mauritania, Tanzania, and Uganda are likely to achieve the target of 90 percent immunization coverage while Kenya, Mozambique, Zambia, Nigeria, Malawi, Rwanda, Zimbabwe, and Burkina Faso are very unlikely to achieve this target because they progressed negatively in the reference period. Figure 1 shows that the countries with negative change will have difficulty to achieve the targeted MDG relating to immunization.

Fig. 1. Percentage change in immunization rate against measles since 1990

Poverty measurement

Existing data on household consumption expenditure/income from the BRAC-ICDDR,B Joint Research Project in Matlab, collected during 1995-1999, were analyzed to assess the poverty situation in Matlab. The household income/consumption was translated into purchasing power parity (PPP) dollar (taken from 1993, 1 PPP US$=12.7 taka). The findings indicated that 40.5% of the population of the study villages in 1995 and 35.8% in 1999 were living on less than 1 US dollar per day, when evaluated in terms of household consumption data. Evaluation on the basis of household income data indicated that, in 1995, 57.6% of people were living on an income of less than 1 US dollar per day. Emphasis is being placed on developing appropriate tools for measuring poverty based on household consumption expenditure or household income data. The tools and methods of the BRAC-ICDDR,B expenditure/
income data in terms of internal and external validity and methodological issues are being explored. It is hoped that these tools with some modifications can also be adopted in the Matlab Health and Demographic Surveillance System (HDSS).

Data from the Child Nutrition Survey (CNS) 2000 carried out by the BBS and from the Multiple Indicator Cluster Survey carried out by the BBS and UNICEF were analyzed with a focus on equity. The percentage of stunted and underweight children was higher in households with lower per-capita annual expenditure. Education of mothers had a negative association with malnutrition of children. The gender differential, on the other hand, seemed to have disappeared. Some results of this study are presented in Figure 2 and 3.

Poverty and Health Knowledge Project
The DFID-supported Poverty and Health Project: Building the Knowledge Base for Attaining Equitable Health in Poor Countries seeks to identify cost-effective solutions for prevention and management of major health problems faced by the poorest segment of the population in Bangladesh by studying their inter-relation with poverty. The issues being researched include: safe motherhood; neonatal health; child care and development; adult health and the burden of diseases of the elderly; reducing the burden of tuberculosis; and measuring poverty and health.

Eighteen-year old Begum (not her full name) was an inhabitant of a village in Chakaria. Her husband (35), a rickshaw puller and originally from another district, came to Begum’s village about one and a half years ago and married Begum. Begum herself was not from a well-off family. Her father was a day-labourer and could barely maintain his family of 6 members with his income. He did not have any cultivable land of his own. Begum’s father did not know much about her husband and his family before the marriage, but still he agreed to this marriage because he did not have to pay any dowry for Begum. He knew that if he wanted to get his daughter married to a local person, he would have to pay a heavy dowry, which he was not capable of.

After 4 months of their marriage, Begum got pregnant. But, unfortunately, after 2 months of conception, she had a miscarriage and lost the baby. She again conceived 2 months later. At the primary stage of pregnancy, she started vomiting and could not eat properly. Her husband brought medicines for her from a pharmacy in the nearby town. From the 5th month of pregnancy, Begum developed oedema. This time also her husband consulted a village doctor and brought medicines for her. After a few days, her husband left her without informing anybody of his whereabouts. Without her husband’s support, Begum was passing her days in great hardship. She was struggling to get enough food for herself during her pregnancy. With time she developed severe negative association with the prevalence of both chronic and recent illnesses. Healthcare-seeking behaviour was positively associated with the extent of educational level of mothers. As before, the gender difference remained, irrespective of educational level of mothers.

Case study of maternal death
Poverty is also a major barrier in reducing maternal mortality in poor settings. This sad story is about one of the 16 maternal deaths that took place in the Chakaria field site of ICDDR,B during 2002-2004.
Dowry was a social evil which her mother could not bear. She did not want to bring her daughter to a man whom she had not even heard of. When she was 18 years old, she was forced to marry a man who was twice her age and had five children. She did not want to live with him and asked her parents to take her back to her mother. Her parents refused and left her with her husband. She was subjected to physical and mental abuse and was forced to have unwanted pregnancies. She also had to pay the dowry, which was a heavy burden for her poor family.

Begum had breathing problems, and the breathing sounds were coming out from her throat. The next morning her parents again called in the village doctor. Begum had a high fever at this time; the doctor examined her and gave an injection. He then waited for another 15 minutes before he gave her the second injection. Begum was feeling a little better after this and rested for a while. In the evening of the same day, she again became restless and was having breathing problems, and the breathing sound increased.

Begum’s parents were poor and could not afford to pay the dowry, so they had to marry someone who they had never heard of. Her husband left her when she was ill. Begum did not get any proper treatment due to their poor economic condition and also due to lack of awareness, and all these led to the tragic end of her life.

Bangladesh Health Equity Watch

Bangladesh Health Equity Watch (BHEW) is a collaborative effort of ICDDR,B, BBS, BIDS, and BRAC. The Social and Behavioural Sciences Unit of ICDDR,B hosts the secretariat of the project. Its ongoing work in monitoring the disparity in health status and access to, and use of, health services in Bangladesh began in 2001. The BHEW has made notable progress in terms of incorporating equity dimensions in various data-collection systems. Some data-collection systems include those of the BBS, BRAC, ICDDR,B, UNICEF, and Save the Children (UK). New data, which were not present in the existing system, have been collected through the data-collection system of BRAC. Data were analyzed, and findings were presented in national conferences. Publication of the working paper series, the bibliographic alert services, and the Equity Dialogue newsletter has been an ongoing activity. A website for the BHEW has been developed. Young researchers are involved in various stages of the BHEW activities to provide hands-on-training. A national health equity forum has been formed.

Research Fellows

The first group of Poverty and Health fellows completed their assignments in the first quarter of 2004. Three are still employed by other projects in the Centre. A regional fellow from the Pakistan Institute of Development Economics was recruited as a Regional Poverty and Health Fellow and began his assignment in February 2004. Three more national fellows have been recruited. This time, the recruitment notice stipulated that candidates should obtain leave of absence from their present institution while they are employed as Poverty and Health Fellows at the Centre. Furthermore, the research activities carried out by them should be of interest both to their home institution and to ICDDR,B. This is intended to strengthen the national network of institutions involved in poverty research. Three national fellows were recruited on these terms, and they began work in August 2004. The fellows have developed research proposals under the mentorship of senior researchers at the Centre. The studies, which will be carried out in collaboration with the home institutions, explore the following topics: (a) Education and health services for the underprivileged children in Dhaka city: a case study of Surovi schools; (b) Antenatal healthcare-seeking behaviour of adolescent street-based sex workers of Dhaka city; and (c) Poverty and well-being: dimensions of well-being in livelihood and health behaviour in an urban community.

The Regional Research Fellow has been working on issues relating to poverty-reduction strategies in low-income countries and the Millennium Development Goals.

Poverty and Health Resource Centre

The Poverty and Health Programme maintains a poverty and health resource centre at the ICDDR,B library. This resource unit was built to facilitate...
poverty, health, and equity-related research work both within and outside ICDDR,B by providing a strong knowledge base with the most recent books, articles, and papers published on poverty-related issues. The growing collection of books, articles, etc. at the unit covers a wide range of topics, including various methods of poverty measurement, rural-urban poverty status within the country, and poverty situation in different parts of the world. Work on making a poverty database available online is progressing well in the Centre’s library.

Training Courses and Workshops

The Poverty and Health Programme contributes to developing the capacity of researchers within and outside ICDDR,B to carry out poverty and health-related research through organizing training courses and workshops and by establishing collaborations with relevant organizations within and outside Bangladesh. A workshop to train researchers on the participatory qualitative methods of poverty research was held in collaboration with the Training and Education Unit of ICDDR,B and Water Aid between 13 September and 25 November 2004. The 10-day workshop titled “Exploring poverty and health using participatory rural appraisal (PRA) techniques” focused on the dimensions of poverty as defined by the local people and access to health services.

Other Dissemination Activities

The Poverty and Health Programme holds monthly meetings with participation of members from various divisions across the Centre. Members’ interests include measurement of poverty in its multidimensionality, relationship of various socioeconomic indicators with health, pro-poor monitoring of the use of health services, capacity-building, targeting the poor with maternal health programmes, prospects of achieving the Millennium Development Goals in developing countries, morbidity and healthcare-seeking, cost of catastrophic illness and poverty, poverty and well-being, use of zinc and its equity impact, pregnancy-related practices among street-based sex workers, maternal self-efficacy and its socioeconomic variation, the cultural construction of sexuality among Hijras and others. Research findings are shared, new directions of research are explored, and skill-building sessions are held in the meetings.

Four round-able seminars of the Poverty and Health Programme took place in 2004. The round-table discussion meetings were initiated to generate a continuing dialogue between researchers and policymakers. The first speaker, Imran Matin, Director, Research and Evaluation Division of BRAC, spoke on “Targeting in BRAC’s programme for the ultra poor”. Frances E. Aboud, Professor at McGill University, Canada, spoke on “Community programmes: who does participate, implement, and benefit?” The third speaker was Arnab Acharya of the Research Triangle Institute, USA, who spoke on “Towards a universal health standard.” The fourth seminar was given by Raja Ajmal Jahangeer, the Regional Poverty and Health Research Fellow, on “PRSP health nexus and the Millennium Development Goals.”

The Poverty and Health Programme web pages included news on ongoing ICDDR,B poverty research projects and collaborative ventures, bibliographical data of current articles on related topics from world literature, other resource sites on health equity research, such as the Bangladesh Health Equity Watch website, and links to various sources of poverty research, such as Eldis and the International Society for Equity in Health.

Collaborative work with the Bangladesh Health Equity Watch on the publication and dissemination of working papers and newsletters is continuing. One working paper titled “Socioeconomic inequalities in child nutritional status: evidence from CNS 2000” has been finalized for publication. One combined issue (issue 3 and 4) of the Equity Dialogue newsletter was published. The 9th issue of the Bibliographical Alert on poverty, health, and inequity was also published and distributed among interested individuals and organizations, including some university libraries of the country.

Educational collaboration

The schedule for the 1-2-week elective courses for the first year of the BRAC University James P. Grant School of Public Health has been issued and includes one on poverty and health, which will involve the participation of the Head of the Poverty and Health Programme as one of the two faculty members.
HIV Epidemic: Surveillance Data

Data from the Fifth Round of the annual second-generation surveillance for HIV, conducted during June 2003–March 2004, were released on 22 November 2004. The Fifth Round had an increased geographical coverage, and new population sub-groups were accessed for both serological and behavioural surveillance. The new groups for the serological surveillance included casual (part-time) female sex workers and regular sex partners of Hijras, whereas heroin-smokers were the new group for the behavioural surveillance.

Bangladesh still remains a low-prevalence country for HIV. Injecting drug users (IDUs) in Central city A where the highest prevalence of HIV has been recorded in all rounds are still at 4% as in the last round. IDUs were also sampled from 7 new cities, of which 6 were new to interventions. Surprisingly, no HIV was detected in IDUs from these cities, except Central city A. Hepatitis C was highly prevalent among IDUs of most cities (Fig.).

An ongoing cohort study on IDUs in Dhaka city showed that, in one neighbourhood of the city, 8% of IDUs were HIV-positive. This finding prompted to see whether the surveillance could detect differences in the prevalence of HIV in different neighbourhoods of Central city A. An analysis of the IDU samples in Central city A, according to the 7 Drop In Centres (DICs) covered during the serological surveillance, revealed that 8.9% and 2.1% of the IDUs from the neighbourhoods of DIC 1 and DIC 2 respectively were HIV-positive. As with HIV, prevalence of hepatitis C virus (HCV) was the highest (73.2%) in DIC 1, followed by DIC 2 (67%). The prevalence of HCV in the remaining DICs in Central city A varied from 25.0% to 61.5% (Table 1).

<table>
<thead>
<tr>
<th>DIC (no.)</th>
<th>HIV No.</th>
<th>HIV %</th>
<th>Hepatitis C No.</th>
<th>Hepatitis C %</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIC - 1 (157)</td>
<td>14</td>
<td>8.9</td>
<td>115</td>
<td>73.2</td>
</tr>
<tr>
<td>DIC - 2 (94)</td>
<td>2</td>
<td>2.1</td>
<td>63</td>
<td>67.0</td>
</tr>
<tr>
<td>DIC - 3 (59)</td>
<td>0</td>
<td>27</td>
<td>45.8</td>
<td></td>
</tr>
<tr>
<td>DIC - 4 (25)</td>
<td>0</td>
<td>8</td>
<td>32.0</td>
<td></td>
</tr>
<tr>
<td>DIC - 5 (24)</td>
<td>0</td>
<td>6</td>
<td>25.0</td>
<td></td>
</tr>
<tr>
<td>DIC - 6 (32)</td>
<td>0</td>
<td>12</td>
<td>37.5</td>
<td></td>
</tr>
<tr>
<td>DIC - 7 (13)</td>
<td>0</td>
<td>8</td>
<td>61.5</td>
<td></td>
</tr>
<tr>
<td>Total 404</td>
<td>16</td>
<td>4.0</td>
<td>239</td>
<td>59.2</td>
</tr>
</tbody>
</table>
Studies on Men and Male Sexuality

Virus or vitality? Seminal discourse in the AIDS era

In Bangladesh, sexual health concerns of men have received less attention compared to their sexually transmitted infections (STIs). To address this gap, meanings of sexual health concerns of men, particularly semen loss, in the masculinity framework, were investigated in a qualitative study on male sexuality. In total, 50 men, aged 18-55 years, from diverse sociodemographic backgrounds and 7 medical practitioners were interviewed. Men considered semen the most powerful and elegant body fluid representing their sexual performance and reproductive ability. Rather than recognizing vulnerability to transmission of STIs, concerns of men about semen were grounded in their desire to preserve and nourish seminal vitality. Loss of semen was considered to be a major sexual health concern, further instigated by traditional practitioners within a patriarchal society where male heritage configures male sexuality. Public health focuses on eradication of STIs/HIV and ignores culture-bound sexual health concerns, such as semen loss. This may not ensure participation of men in reproductive health programmes and are less likely to improve the quality of sexual life of men and women.

Male sexuality and masculinity: implications for STIs/HIV and sexual health interventions in Bangladesh

This study concerns male sexuality in contemporary urban and rural Bangladesh. It pursues what men think it means to be a man, dimensions of manliness and manhood, and male influences on the construction of male-female relationships. Significant meanings men attribute to sexual acts, pleasure, pain, risk, and safety in multiple social realities, particularly in the HIV/AIDS era, were explored.

Using qualitative research methods, the study conducted 50 in-depth interviews with 50 men, aged 18-58 years, from diverse socio-occupational backgrounds. Twenty key-informants included religious leaders, traditional and Western medical practitioners, teachers, community leaders, and media professionals. Ten focus-group discussions were held. The researchers spent time in various male venues to observe men’s social life and interactions. The 15-month fieldwork was conducted in Mohammadpur thana of Dhaka city and in some villages of Sadar and Panchbibi upazila (sub-district) of Joypurhat district. Tape-recorded interviews in Bangla were transcribed, and data were subjected to inter-subjective interpretations through contextual and thematic analyses.

Manhood and relationships of men with women in Bangladesh are expressed within the obligatory marital framework of patriarchy. Notions of men as ‘providers’ and ‘protectors’ construct male sexual authority over women originating from gen-
under inequalities and power relations with women. This creates a sexual double-standard and undermines women’s sexual rights, pleasure, and equality in relationships. However, traditional male-roles as ‘providers’ are increasingly threatened in the context of economic hardship and participation of women in income-generation in Bangladesh. Crisis of masculinity is reflected in exaggerated notions of male sexual prowess which are often hard to achieve, resulting in frustration among men. This negatively affects sexual health and relationships of men with women. If public-health priorities do not correspond to these general sexual health concerns of men and ignore the pleasure, preference, and emotions of their female sexuality, conventional HIV interventions based on disease and safety models are less likely to be effective.

Meanings of male sexuality are fluid, contested, and contradictory among and between men. A minority of men opposed the dominant version of male sexuality, claiming to live pleasurable and responsible sexual lives. The project identifies a space for a creative rethinking of male sexuality recognizing that while men are beneficiaries of patriarchy, they are as well vulnerable because of it.

Empowering men to value the role of women can construct an alternative version of male sexuality. Educating men by providing positive information on sexual pleasure, eroticism, bodies of men and women, and their sexual needs may contribute to improving sexual health of men and women. Men must be encouraged to reconstruct their roles of caring and loving fathers and husbands, together with sharing the providers’ roles with women. An attempt to reconstruct traditional male sexuality affects both men and women, as masculine sexuality is not isolated from the sociocultural construction of feminine sexuality. Research, thus, needs to focus on sociocultural institutions contributing to hierarchical relationships of inequality between men and women in all spheres of life, including the sexual acts.

MSM: a new way of imposing sexual inequity

Many scholars use the term ‘MSM’ to identify those males having sex with males who do not necessarily identify themselves as ‘gay’ or ‘homosexual’. This study attempted to dissect the concept of categorizing people based on their sexual practices and describes the consequences of such categorization. A survey was conducted with 302 males having sex with males in a city of Bangladesh to explore their sexual practices and other related concerns. A focused qualitative approach was also applied to understand perceptions of men about their sexual practices and identity issues and their impact on their life.

No males having sex with males called themselves ‘MSM’ nor did they like the terminology. Only 20% of interviewed men were aware of the term MSM, and most of them were annoyed and confused with this special taxonomy. In-depth interviews with informants and key-informants revealed impacts of imposing this terminology in diverse ways. They expressed their concerns and experience of stigmatization due to this labelling by ‘outsiders’. The term MSM created confusion, incongruity, and complexities in terms of working with males having sex with males and also to reach their sexual partners for STI/HIV interventions. Categorizing people based on their sexual practices further stigmatizes and discriminates a person that essentially obliterates the scope of enhancing human dignity, rights, and equality of people irrespective of their sexual practices or preferences.

Understanding reproductive health practices and sexual network among men in general population of Bangladesh

The study, just commenced, will conduct a survey among general male population of Bangladesh to understand their sexual behaviours, network, and STI/HIV/AIDS-related knowledge and self-perceptions of risk to design pragmatic HIV/AIDS-prevention interventions. The survey will cover men, aged 18-49 years, in 3 urban and 3 rural areas in 3 selected administrative divisions of Bangladesh. Prior to starting the main survey, a pilot study was conducted to collect information about sexual and other behaviours using the following 3 randomly-assigned data-collection methods: (a) face-to-face interview by directly asking the questions, (b) face-to-face interview with responses to sensitive questions being provided using a ballot-box, and (c) using a ballot-box by asking sensitive questions by an audio system. Comparisons were made for response rates to sensitive questions while using methods b versus c.

The preliminary results of the pilot study showed that the overall positive response rate to sensitive questions (defined as having at least pre- or extra-marital penetrative sexual act in the last one year (21.6%) in ballot-box with the audio system compared to the other two methods (19.7% in face-to-face interview and 17.6% in ballot-box without audio). About 23% of the rural respondents in ballot-box with audio had at least one pre- or extra-marital sex in the last one year. The corresponding figure in ballot-box without audio and face-to-face interview was 18% and 21% respectively. In urban areas, response rates on sensitive ques-
tions in ballot-box with audio, ballot-box without audio, and face-to-face interview was 19.4%, 17.2%, and 18.5% respectively. The ballot-box with audio was a suitable tool of data collection for sensitive questions in urban settings where there were problems of isolating the respondents for asking sensitive questions in households. This method also worked well in rural areas among the illiterate and those with a lower level of education. The internal consistency of the responses was high in both urban and rural areas.

Based on the results of the pilot study, it has been decided that half of the subjects (3,000) will be interviewed face-to-face by asking direct questions, and the remaining half (3,000 subjects) will be interviewed using the ballot-box with audio system.

Factors influencing unprotected group sex by males who have sex with males

MSM commonly report unprotected group sex, which carries a high risk of spreading HIV. MSM, from Central city A, who had group sex in the last month, were selected from the dataset of the 2003-2004 round of the national HIV behavioural surveillance in Bangladesh. To identify the factors associated with unprotected group sex, bivariate and multivariate analyses were used. Of 420 MSM interviewed, 230 (54.76%) had group sex in the last month. Of them, 92 reported that not a single partner had used condoms. Bivariate analyses revealed that, of those not using condoms, fewer were living with regular partners (p=0.004), more had their first sexual experience with females (p=0.001), and more identified themselves as ‘manly’ (p<0.001). Age, educational and marital status, and involvement with NGOs showed no differences. Logistic regression showed that the factors associated with unprotected sex were the following: not living with a regular partner (odds ratio [OR] 2.3, 95% confidence interval [CI] 1.1-4.9), having the first sexual encounter with a female (OR 2.7, 95% CI 1.3-5.6), and identifying oneself as ‘manly’ (OR 4.9, 95% CI 2.6-9.0). Therefore, promoting safer behaviours among MSM cannot merely be restricted to providing information about condoms and making condoms available, but messages must also address and incorporate more complex issues, including one of gender role.

Study on Injecting Drug Users

Behavioural factors associated with a localized epidemic of HIV in IDUs in a neighbourhood of a city in Central Bangladesh

In the Fifth Round of national surveillance of the Government of Bangladesh conducted during 2003-2004, the prevalence of HIV in a particular neighbourhood (area A) of Central city A was 8.9%, while in the rest of the same city, 0.8% of IDUs were HIV-positive. The Behavioural Surveillance System (BSS) sampled IDUs from the same areas of the city, and comparisons of demographic features and risk behaviours of IDUs between area A and IDUs from the rest of the city were done to gauge whether any factors could be associated with the localized HIV epidemic. The results showed that the IDUs from area A were significantly less educated (p<0.001), fewer were currently married (p<0.001), had a lower monthly average income (p=0.001) and more commonly lived on the street (p<0.001) than IDUs from the rest of the city. No differences were observed in injection-sharing behaviour of IDUs between the two areas. However, among those IDUs who shared injections in the last week and said they had shared with different partners, the mean number of persons who shared injections was higher in area A than in the rest of the city (p=0.026). Also, IDUs from area A took more injections on average in the last day and in the last week (p<0.001 for both). Fewer IDUs in area A had sex with commercial or non-commercial female partners in the last year or had group sex (p=0.002, p<0.001 and p=0.009, respectively). More IDUs had a lower perception of risk in area A than in the rest of the city. It, therefore, appears that features distinguishing IDUs from area A from the rest of the city are all factors that can fuel the spread of HIV.

Services

Voluntary counselling and testing services for HIV in Bangladesh

Jagori, the Voluntary Counselling and Testing (VCT) Unit of ICDDR,B, has continued to provide counselling and clinical services during 2004 in 3 cities: Dhaka, Sylhet, and Chittagong (Table 2). Counselling is provided to those clients who visit the Jagori clinics and in the field if required and often in nearby cities. The VCT Unit also provides training for counsellors in response to specific requests from other organizations. Besides, the VCT Unit also provides a one-week internship to selected trainees under an ongoing collaboration with HIV/AIDS and STD Alliance, Bangladesh (HASAB) as part of HASAB’s training of counsellors programme.

ICDDR,B, in collaboration with CARE Bangladesh, has been conducting a study among HIV-positive IDUs. Twenty-nine HIV-positive IDUs have currently been receiving regular counselling—both brief counselling and in-depth sessions. Brief counselling sessions are held for about 5 minutes in the field.
and serve to keep regular contact with IDUs and to reinforce messages on prevention. HIV-positive IDUs are encouraged to notify their sex partners about their HIV status, and notification and counselling have so far been provided to two spouses only.

Table 2. Counselling and clinical services from clinics of Jagori in three cities

<table>
<thead>
<tr>
<th>Characteristics of clients receiving services and counselling</th>
<th>Dhaka</th>
<th>Chittagong</th>
<th>Sylhet</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of clients</td>
<td>407</td>
<td>42</td>
<td>55</td>
<td>504</td>
</tr>
<tr>
<td>Number of HIV-positive cases</td>
<td>43</td>
<td>5</td>
<td>14</td>
<td>62</td>
</tr>
<tr>
<td>HIV-positive : male : female</td>
<td>32 : 11</td>
<td>2 : 3</td>
<td>8 : 6</td>
<td>42 : 20</td>
</tr>
<tr>
<td>Number of clients aged less than 15 years</td>
<td>12</td>
<td>6</td>
<td>8</td>
<td>26</td>
</tr>
<tr>
<td>HIV-positive children</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mean age (years) of all clients (range), excluding children</td>
<td>29.5 (16-57)</td>
<td>29.1 (18-50)</td>
<td>29.1 (16-45)</td>
<td>29.4 (16-57)</td>
</tr>
<tr>
<td>Mean age (years) of HIV-positive clients (range)</td>
<td>31 (18-57)</td>
<td>33.6 (22-50)</td>
<td>31.4 (19-45)</td>
<td>31.3 (18-57)</td>
</tr>
</tbody>
</table>

Providing clinical services to people with HIV/AIDS

Outdoor clinical services are provided in Dhaka to people with HIV/AIDS, and they include clients of the VCT Unit in Dhaka, HIV-positive IDUs, and

Roadside counselling on HIV/AIDS
members of an NGO called Ashar Alo Society that provides support to HIV-positive persons. Some clients also receive antiretroviral therapy, and clinical support with CD4 counts is provided to them.

Up to July 2004, clinical care was provided to 34 HIV-positive IDUs (Table 3). CD4 counts were done on 29 of them, 20 of whom were repeated 2-8 months later. Only one IDU had a CD4 count of less than 200, and he died. Twenty-two had AIDS-related complex. Based on the staging of HIV infection by WHO, 10 IDUs were in stage I, 23 in stage II and III, and one in stage IV. Sixteen IDUs were referred to 5 hospitals for further treatment.

Sexually Transmitted Infections

Studies on STIs, being conducted by the STI/RTI Laboratory of ICDDR,B, include: providing an understanding of the overall scenario of RTIs/STIs in different population groups in Bangladesh; identifying the appropriate and cost-effective management strategy; evaluation of new diagnostics; development of human resources for diagnosis of RTIs/STIs; networking of laboratories; and providing quality assurance.

<table>
<thead>
<tr>
<th>Medical problem</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral thrush</td>
<td>22</td>
</tr>
<tr>
<td>Upper respiratory tract infection (cough)</td>
<td>16</td>
</tr>
<tr>
<td>Abscess</td>
<td>14</td>
</tr>
<tr>
<td>Fever (prolonged or intermittent)</td>
<td>13</td>
</tr>
<tr>
<td>Diarrhoea/dysentery</td>
<td>14</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>7 (2 confirmed, 5 suspected)</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>5</td>
</tr>
<tr>
<td>Skin rash</td>
<td>3</td>
</tr>
<tr>
<td>Fracture of bones</td>
<td>3</td>
</tr>
<tr>
<td>Others, including herpes zoster, infective endocarditis, meningitis, and haemorrhoids</td>
<td>6</td>
</tr>
</tbody>
</table>

Simple rapid tests in the diagnosis of syphilis have been evaluated in the field. Staff with high and low skills are evaluating two different Treponema-specific rapid tests. The study aims at identifying a simple, rapid, and cost-effective diagnostic test for syphilis in primary healthcare settings in Bangladesh.

Identifying cost-effective intervention for RTIs/STIs has long been a priority of the Laboratory. The Laboratory has recently started a project to evaluate enhanced syndromic management of STIs and compare it with the periodic presumptive treatment strategy. The Laboratory is also studying the incidence of gonococcal and chlamydial infections among hotel-based sex workers in Dhaka.

During 2004, the Laboratory, in collaboration with Family Health International, Nepal, conducted a study among MSM/MSWs in Nepal. The Laboratory has provided consultancy services to studies on HIV and STIs in Pakistan.

International AIDS Candlelight Memorial Day

The staff of ICDDR,B observed the International AIDS Candlelight Memorial Day on 16 May by lighting candles at the entrance circle of the Centre. The International AIDS Candlelight Memorial, the world’s largest and oldest annual grassroots HIV/AIDS event that takes place on 16 May every year, is designed to honour the memory of those lost to HIV/AIDS, show support for those living with HIV/AIDS, raise awareness of HIV/AIDS, and mobilize community involvement in the fight against HIV/AIDS.

The theme for the 2004 Memorial was “Turning Remembrance into Action”. The 2004 Memorial gave each individual across the globe an opportunity to come together to remember and support those who have been touched by HIV/AIDS. United Nations Secretary-General Kofi Annan said, “We must make people everywhere understand that the AIDS crisis is not over; that this is not about a few foreign countries, far away. This is a threat to an entire generation, that it is a threat to an entire civilization.”
ONGOING PROTOCOLS 2004

Clinical Sciences Division

Ahmed T. Identification and validation of an optimum clinical scoring system for diagnosis of tuberculosis and estimation of prevalence of multiple drug resistance in children
Funded by: Department for International Development (DFID), UK

Alam NH. Efficacy of benefiber-added, reduced-osmolarity WHO-ORS in the treatment of cholera in adults
Funded by: University of Basel, Switzerland and Novartis Consumer Health SA, Switzerland

Alam NH. Efficacy of salovam egg-powder containing antisecretory factor in the treatment of severe cholera in adults
Funded by: Novartis Consumer Health SA, Switzerland

Alam NH. Introduction of new hypo-osmolar ORS to routine use in the management of diarrhoeal disease
Funded by: United States Agency for International Development (USAID)/Dhaka

Alam NH. Oral rehydration solution containing amylase-resistant starch in severely-malnourished children with watery diarrhoea due to Vibrio cholerae
Funded by: Nestle Foundation, Switzerland

Ashraf H. Daycare-based management of severe pneumonia in under-5 children when hospitalization is not possible due to the lack of beds
Funded by: University of Basel, Switzerland

Hamadani DJ. Correlational study of maternal depression and child nutritional status in the short-stay ward
Funded by: DFID

Hossain MJ. Epidemiology and aetiology of encephalitis and other arboviral diseases in Bangladesh
Funded by: Centers for Disease Control and Prevention (CDC), USA

Hossain MJ. Long-term neurologic and functional outcome in patients with Nipah virus infections
Funded by: CDC, USA

Jamil KMA. Estimation of the average vitamin A requirement of adult males
Funded by: University of California at Davis (UC-Davis), USA

Jamil KMA. A pilot study to assess antioxidant status in healthy and malnourished Bangladeshi children
Funded by: UC-Davis, USA

Khan AM. Introduction of routine zinc therapy for children with diarrhoea: safety, compliance and acceptability
Funded by: Bill and Melinda Gates Foundation, USA

Nahar B. Effect of psychosocial stimulation and parental counselling on cognitive function of severely-malnourished children in a nutritional rehabilitation unit
Funded by: Swedish International Development Agency (Sida), Sweden
Rabbani GH. Clinical trial of L-histadine in childhood shigellosis
Funded by: Thrasher Research Fund (TRF), USA

Rabbani GH. The effectiveness and utility of a green banana diet in the home management of acute and persistent childhood diarrhoea
Funded by: USAID/Dhaka

Rabbani GH. Effects of plant-polyphenols on arsenic-induced toxicity in rabbits
Funded by: Institut Pasteur, France

Saha D. Calcium homeostatis, cramping, and tetany in patients infected with V. cholerae O1 or O139
Funded by: GlaxoSmithKline, UK

Salam MA. Evaluation of early childhood initiatives of Plan Bangladesh
Funded by: Plan International, Bangladesh

Salam MA. Randomized, double-blind, controlled clinical trial to compare the efficacy of a single-dose of azithromycin versus a single-dose of ciprofloxacin in the treatment of adults with clinically severe cholera due to V. cholerae O1 or O139
Funded by: New England Medical Center, USA

Sarker SA. Prebiotic effects of daily fructooligosaccharide intake on weight gain and reduction of diarrhoea incidence among young children in urban Bangladesh: a pilot study
Funded by: Siebold University of Nagasaki, Japan

Sarker SA. The usefulness of ferrous fumarate and ferric pyrophosphate as food-fortificants in developing countries
Funded by: University of Basel, Switzerland, Nestle Foundation, Switzerland, and Nutrition Third World, Belgium

Health Systems and Infectious Diseases Division

Funded by: DFID, Bangladesh

Brooks WA. Efficacy of zinc in the treatment of outpatient pneumonia in an urban slum among children aged less than 2 years
Funded by: Bill and Melinda Gates Foundation, USA

Brooks WA. Surveillance for influenza and the viral aetiologies of influenza-like febrile illnesses in an urban slum in Dhaka, Bangladesh
Funded by: CDC, USA

Breiman RF. A prospective, randomized, double-blind, placebo-controlled, multi-centre trial to assess safety, efficacy, tolerability, and immunogenicity of influenza virus vaccine, trivalent, types A and B, live cold-adapted, liquid formulation (CAIV-T), administered concomitantly with a combination of live, attenuated, mumps, measles, and rubella vaccine in healthy children aged 11-24 months
Funded by: Quintiles East Asia Pte Ltd., Thailand

Gazi R. Evaluation of a six-month pilot to introduce depot-holders in three types of urban areas
Funded by: USAID/Dhaka

Hossain SAS. Management of tuberculosis by private practitioners and healthcare-seeking behaviour of symptomatic adults/TB suspects
Funded by: USAID/Dhaka

Islam Z. Cost of illness of cholera in Matlab, Bangladesh
Funded by: International Vaccine Institute (IVI), South Korea
Islam Z. Economic evaluation of shigellosis in an urban area of Dhaka, Bangladesh
Funded by: IVI, South Korea

Khanam R. Vulnerability to HIV/AIDS of migration-affected families
Funded by: USAID/Dhaka

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Funded by: Save the Children, USA

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Funded by: Save the Children, USA

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Funded by: Bill and Melinda Gates Foundation, USA

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Funded by: CDC, USA

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Funded by: USAID/Dhaka

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Funded by: DFID, Bangladesh

Naheed A. Establishment of laboratory-based community surveillance for typhoid fever to define incidence of typhoid fever and to identify modifiable risk factors which may be useful in subsequent interventions to reduce the burden of disease
Funded by: CDC, USA, and IVI, South Korea

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Funded by: CDC, USA

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Funded by: Johns Hopkins University (JHU), USA

Wagatsuma Y. Community-based epidemiologic study of visceral leishmaniasis in Bangladesh
Funded by: CDC, USA

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Funded by: London School of Hygiene & Tropical Medicine (LSHTM), UK

Laboratory Sciences Division

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Funded by: United States Department of Agriculture (USDA), USA
Bhuiya A. Improvement of health through community development-oriented programme in rural Bangladesh
Funded by: Consortium of Swiss, German, and Dutch Red Cross, Switzerland

Bhuiya A. Monitoring the disparity in health status and access to and utilization of healthcare services: Bangladesh Health Equity Gauge—Phase I
Funded by: Rockefeller Foundation, USA

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Funded by: USAID/Dhaka

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Funded by: USAID/Dhaka and ICDDR,B

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Funded by: Tokyo University, Japan and Government of Japan

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Funded by: Monash University, Australia

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Public Health Sciences Division

Alam A. Nature of ageing and family care for the elderly in rural Bangladesh
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Alam DS. Prenatal exposure to Bangladesh famine (1974-1975): association with blood pressure, glucose tolerance, lipid profile, and coronary heart disease among young adults
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Funded by: UNICEF, Bangladesh

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Funded by: LSHTM, UK

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Funded by: Sida, Sweden

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Funded by: LSHTM, UK, Government of Japan, Umea University, Global Forum for Health Research, Johns Hopkins Bloomberg School of Public Health, and UNICEF, Bangladesh

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Funded by: Howard Hughes Medical Institute (HHMI), USA

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Funded by: NIH through JHU, USA

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Funded by: IVI, South Korea, USAID/Washington, and JHU, USA

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Funded by: ICDDR,B

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Funded by: Family Health International (FHI), Dhaka

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Funded by: DFID, Bangladesh

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Funded by: Australian Agency for International Development (AusAID)

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Funded by: DFID, Bangladesh

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Funded by: Government of Bangladesh

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Funded by: Harvard Medical School, USA

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Funded by: National Institutes of Health (NIH), USA

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Funded by: University of Vermont, USA
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Funded by: WHO, Switzerland

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Zaman K. Epidemiology and surveillance of multidrug-resistant Mycobacterium tuberculosis and assessment of directly-observed therapy short course (DOTS) programme in selected areas of Bangladesh
Funded by: USAID/Washington, ICDDR,B, DFID and Global Fund through BRAC, Bangladesh

Zaman K. Randomized comparison of maternal and infant immunization strategies to prevent pneumococcal disease
Funded by: JHU, USA

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Funded by: WHO, Switzerland, USAID/Washington, and ICDDR,B
CLINICAL SCIENCES DIVISION

Executive Director

Director

Division Office

Office of Head Nutrition Programme

Research
- Clinical and Metabolic Research Ward
- Physiology Laboratory
- Child Development Unit
- Hospital Surveillance
- Community Research

Services
- Registration and Triage
- Short Stay Ward
- General Ward
- Special Care Unit
- Mother and Child Health Services
- Breastfeeding Counselling
- Special Procedure Clinic
- Logistic and Support Services

Training
- Clinical Fellowship
- Nurse Fellowship
- Research Fellowship
- Elective Training
The Clinical Sciences Division (CSD) continued its research, patient-care and training activities in 2004 with the support of 2 international professional staff, one seconded international consultant, 180 fixed-term core staff, and 21 fixed-term project staff. Another 73 health workers, 54 employees on contractual service agreement, 15 trainee doctors, and 10 trainee nurses significantly contributed to the activities of the Division. One consultant paediatrician continued to facilitate training of the staff and clinical fellows in 2004.

In total, 113,941 patients (26% higher than in 2003) attended the Clinical Research and Service Centre (CRSC) seeking treatment for diarrhoeal diseases and associated health problems. Of them, 260 (0.08% less than in 2003) died. In total, 33,475 patients with mild diarrhoea were referred to the Progoti Samaj Kallyan Prothisthan (PSKP) clinic, and 3,159 (9.4%) of them were referred back for hospitalized management.

Of the 113,941 patients, 72.7% were admitted to the Short Stay Ward (SSW); 47% of them were discharged within 12 hours, 26% within 24 hours, and 0.02% died. Another 8,656 (7.6%) patients required admission to the longer-stay General Ward (GW), Special Care Unit (SCU), Research Ward (RW), and Nutrition Rehabilitation Unit (NRU), of whom 2.9% were admitted to the RW under 6 different research projects conducted by the CSD alone or jointly with the Laboratory Sciences Division. Of the remaining 8,408 patients, 22% were admitted to the SCU with a very severe disease, of whom 238 (12.8%) died. Of the 6,546 patients treated solely in the GW, 7 died compared to 8 in 2003. Of the 8,656 patients admitted to the longer-stay wards, 247 absconded, 200 took discharge against medical advice, and 68 were referred to other hospitals for the management of complications. In total, 143,169 litres of intravenous fluids (1.3 litres/patient), and 491,727 litres of ORS (4.3 litres/patient) were used at the CRSC in 2004.

Flood of 2004 and Its Impact on Patient-care Activities of the Clinical Research and Service Centre (Dhaka hospital)

In Bangladesh, diarrhoeal diseases are prevalent throughout the year, but outbreaks/epidemics of diarrhoeal diseases, including cholera, usually occur twice a year—during the hot and humid summer months of April–May and in September-October following monsoon and floods. The Dhaka hospital of ICDDR,B had fewer patient-visits in the first 5 months of 2004 compared to 2003, but had a higher number of patient-visits since the beginning of June 2004, before the floods, which was unusual.
The number of patient-visits continued to remain high since then, and a steeper rise was observed during the last week of July, after the flood had affected Dhaka city—an unusual event because outbreaks of diarrhoea generally begin as flood-water starts receding. On 3 August 2004, the record highest number of 703 patient-visits was observed since the great floods of 1998 (Fig. 1). The patient-care activities of the CRSC and the Centre’s role were highly appreciated by the people of Dhaka as reflected by articles in the press.

Fig. 1. Comparative patient-visits to CRSC during 2003 and 2004

The honourable Minister for Health and Family Welfare, Government of Bangladesh, while visiting the hospital to observe its expanded activities during the flood, appreciated the hard work of the hospital staff.

In Bangladesh, outbreaks/epidemics of diarrhoea are usually caused by the pathogens that are responsible for diarrhoea throughout the year. Only the frequency of isolation of some, particularly *V. cholerae* and enterotoxigenic *E. coli* (ETEC), dramatically increases during outbreaks/epidemics of diarrhoea. Percentages of various pathogens isolated in July are shown in Figure 2.

An unusual higher number of patient-visits during floods often necessitates the extension of the patient-care area and requirement of additional human and other resources. In 2004, the physical facilities were expanded, beyond the permanent shed, in areas outside the hospital. Necessary supplies were procured and, most importantly, 64 physicians, nurses, health workers, and attendants were hired on a short-term basis to provide care to the increased number of patients. The situation demanded shutting research activities temporarily as the research ward was used for patient-care, and the researchers were engaged in patient-care services. The hospital needed additional volumes of intravenous fluids, ORS, drugs, and food. Epidemic of diarrhoea is featured by increase in the proportion of severely-dehydrated patient, and management of such patients requires the use of higher volumes of intravenous fluids and ORS. Additional amounts of various janitorial and other hospital supplies were also required.

Fig. 2. Isolation of diarrhoeal pathogens at ICDDR,B’s Dhaka hospital by week

Extension of permanent shed for accommodating additional patients

Extension of patient-care services in the main lobby of the hospital building
In addition to heightened patient-care activities, the Division was also involved in humanitarian services and assistance in the form of provision of healthcare facility at its field clinic in Nandipara and its field site, along with distribution of food (received from the World Food Programme) among affected people in the community participating in the Centre’s research work.

Mother and Child Health Services Coordinator: Tahmeed Ahmed

Although a nutritional rehabilitation unit (NRU) had been operational at the Dhaka hospital since the early eighties, a formal and comprehensive preventive healthcare-delivery system was established in 1988 under the name ‘Child Health Programme’. In 2003, the name of the programme was changed to ‘Mother and Child Health Services’ (MCHS) to reflect the recent change in the Centre’s organogram. Thirty-seven staff members, including medical doctors, paramedics, and health workers, carry out the MCHS activities.

Most children and mothers who had visited the hospital for treatment of diarrhoeal diseases did not receive any preventive health services in the past. The MCHS offers these services, free of charge, based on the concept of ‘missed opportunities’. The services combine curative and preventive activities, a blend that is not commonly available in hospitals in developing countries. The services are provided in 9 areas as follows:

Nutritional rehabilitation of severely-malnourished children: Research at the Centre has documented that severely-malnourished children are more likely to die after discharge from hospital with treatment for their acute illnesses, e.g. diarrhoea and lower respiratory tract infections. Their nutritional status needs to be quickly improved to prevent such deaths through an appropriate and sustainable nutritional rehabilitation, which is done in the NRU. Rapid catch-up growth is achieved following a standardized diet protocol using low-cost, culturally-appropriate, nutritious food based on locally-available ingredients. Essential micronutrients are also provided. The NRU successfully rehabilitated 336 very severely-malnourished children in 2004.

Growth monitoring and promotion of severely-malnourished children: The Nutrition Follow-up Unit (NFU) of the MCHS monitors the growth of severely-malnourished children discharged after being rehabilitated in the NRU and those with less severe malnutrition discharged from the hospital with advice. Their illnesses are treated, and health and nutrition education is reinforced. In total, 1,908 severely-malnourished children were treated in the NFU in 2004.

Health and nutrition education: Trained health workers lead group discussions for 5-6 mothers on important preventive and promotional health topics throughout the hospital at scheduled times on 365 days of the year. The topics include: preparation of low-cost, nutritious food, home management of diarrhoea, importance of immunization, and promotion of birth spacing. In 2004, 16,100 health-education sessions were conducted with mothers and female caregivers of hospitalized children, covering an estimated 95,934 individuals.

Immunization: The MCHS runs the largest, fixed-site immunization centre in the country and provides vaccines against the six EPI killer diseases, using vaccines from the national EPI. In 2004, 3,836 doses were given to children, while 14,376 doses of tetanus toxoid were given to women of childbearing age. As part of the government initiative, a programme of hepatitis B vaccination was started in November 2004, and 238 children received the vaccine since then.

Supplementation of vitamin A: Supplementation of vitamin A reduces both childhood morbidity and deaths. The Health Workers of the MCHS identify and routinely administer high-potency vitamin A capsules to children who need it. In 2004, vitamin A...
was administered to 5,607 children who would not have received it otherwise.

**Promotion of oral rehydration therapy:** Oral rehydration is the cornerstone of treatment for diarrhoea. The MCHS personnel routinely assist mothers in providing ORS to children and also demonstrate correct and hygienic preparation of rehydration solutions at home using locally-available ingredients.

**Childhood tuberculosis programme:** Most public-health focus is on adult tuberculosis (TB), and childhood TB is a neglected disease. The MCHS diagnoses and manages TB in children attending the hospital and their close contacts (e.g. parents and siblings). The MCHS has treated over 600 children with tuberculosis (TB) till date. Anti-TB medicines are provided free of charge to patients. Seventy-five new patients were diagnosed in 2004.

**Birth-spacing counseling and services:** This unit provided birth-spacing counselling services and materials to 490 parents of children who attended the hospital during 2004.

**Training of health professionals:** The success of the MCHS as a model for dissemination of knowledge and practice of healthcare in the community has made its activities and role a part of the training courses for national and international health professionals. In 2004, institutions that received help in the form of technical advice included Chittagong Medical College Hospital (CMCH). The CMCH has already established a nutrition service block in the Department of Paediatrics with assistance from the MCHS. The nutrition block will not only provide service to the large number of children brought to the hospital for treatment but will also serve as a training platform for medical and nursing students and postgraduate doctors.

**Research**

The MCHS is the hub of the Centre’s research on severe malnutrition. Ongoing research includes studies on simplifying diagnosis and treatment of TB in children, effect of psychosocial stimulation on psychomotor development of severely-malnourished children, and finding ways of improving outcome of children who refuse nutritional rehabilitation or those who default on follow-up.

**Curriculum for Training on Psychosocial Stimulation of Severely-malnourished Children**

A curriculum and a manual have been developed to train the MCHS staff on psychosocial stimulation of severely-malnourished children. The manual has been translated into Bangla, and the first round of staff training has been completed.

**Management of Children with Severe Malnutrition and HIV/AIDS**

A small number of severely-malnourished children with HIV/AIDS are currently being managed by NGOs. Although the children are given antiretroviral therapy, management of severe malnutrition is far from satisfactory. It is anticipated that the number of severely-malnourished children with HIV/AIDS would increase, and they may be referred to the NRU. The MCHS personnel have been counselled on maintaining patient confidentiality, and they received refresher training on universal precaution. A seminar was recently held in which the staff of the Centre’s HIV/AIDS Programme discussed post-exposure prophylaxis.

**Franchising Patient-care Services**

Coordinators: M. Shahadat Hossain, Hasan Ashraf, M. Ramzan Ali, and M.A. Salam

ICDDR,B, in collaboration with the PSKP, a health services provider NGO, financially supported by the National Service Delivery Programme, established an ICDDR,B-franchised clinic for providing protocolized management of diarrhoeal diseases and malnutrition, developed at ICDDR,B, along with an essential services package under the supervision of the CSD. The clinic offers services from 6:00 am to 10:00 pm on each day of the year. During the reporting period, 33,475 of 113,941 patients who attended the Dhaka hospital of ICDDR,B were referred to the franchised clinic for treatment, and 3,159 (9.4%) of them returned back to the ICDDR,B hospital for further management.

**Promotion of Breastfeeding**

Coordinator: I. Kabir

Based on encouraging results of research, counselling services have been added to the routine activities of the Dhaka hospital two years ago, aiming at promoting and supporting exclusive breastfeeding in infants aged less than 6 months, continuing breastfeeding along with appropriate complementary feeding by trained breastfeeding counsellors, and providing training to physicians, nurses, and paramedics to promote and support breastfeeding at the CRSC. During 2004, 3,967 mother-infant pairs were included in the breastfeeding counselling sessions, of whom, 1,296 mothers of infants aged less than 6 months were counselled to re-establish exclusive breastfeeding,
and another group comprising 2,671 mothers of infants aged 6-24 months was counselled to continue breastfeeding for 2 years and beyond and to start complementary feeding after 6 months. On admission, all the babies were partially breastfed, and at discharge 74% of mothers were breastfeeding their babies exclusively. This finding indicates that the breastfeeding counselling programme of the Dhaka hospital, initiated several years ago, is highly effective.

Special Procedure Clinic
Coordinator: P.K. Bardhan

The Clinic provides consultation on payment and manages and processes specimens submitted by various individuals and clinics within Dhaka city for clinical, microbiological, pathology and biochemical tests. Additionally, it conducts gastrointestinal endoscopic examinations and offers vaccinations against poliomyelitis, diphtheria, pertussis, tetanus, measles, mumps, rubella, varicella, hepatitis A, hepatitis B, and H. influenzae type b and also offers typhoid and BCG vaccines. In 2004, 1,745 persons availed of the services of the Clinic.

Nursing Services
Nurse Manager: Mohammad Ullah

The nursing services of the CRSC, with 61 nurses—1 nurse manager, 4 nursing officers, 38 senior staff nurses, 4 aid nurses, and 4 assistant staff nurses, and 10 trainee nurses—provide care to patients who attend the Dhaka hospital with diarrhoea and associated health problems and take care of patients enrolled under different research protocols. The trainee nurses received practical training on nursing management of diarrhoeal diseases and contributed to the patient-care service of the CRSC.

The nursing services also actively participate in training activities of the Centre and organize in-service training for nurses and facilitate bedside training activities at the CRSC. The services established a collaboration with the State University of Bangladesh for teaching undergraduate nursing students. The Nurse Manager co-authored a textbook titled 'Medical Surgical Nursing' published by the Bangladesh Open University in July 2004.

X-Ray Unit

In 2004, 2 radiographers performed 11,553 X-ray examinations. In addition, they performed 489 ECG examinations.

Physiology Laboratory
Coordinator: G.H. Rabbani

The Physiology Laboratory, equipped for clinical and animal experimentation, provides opportunities to the CSD and LSD scientists to conduct pathophysiological studies on intestinal and metabolic disorders in selected fields with direct relevance to clinical research and Centre's Strategic Plan. The Laboratory is currently supporting studies on animals and humans relating to the pathophysiological mechanisms of enteric infections, electrolyte transport, development of antisecretory agents, and environmental toxicity studies. Current activities include the following topics:

Short-chain fatty acids

Short-chain fatty acids (SCFAs) are produced in the mammalian colon by bacterial fermentation of unabsorbed carbohydrates. SCFAs are the major sources of energy for the colonocytes; they also have other colonotrophic actions.

We have recently observed that SCFAs are useful in therapeutic modulation of enteric infections due to Shigella and Vibrio cholerae in animals. In these studies, myeloperoxidase (MPO) activity in stool has been measured as a biomarker of gut inflammation. Encouraged by the preliminary observations, we have evaluated the role of SCFA in children with bacterial dysentery due to Shigella infection, who were given a green banana diet as a source of SCFA. The results indicate that green banana diet significantly reduced clinical severity of shigellosis and increased the production of SCFA in the stool. These observations will be useful to develop dietary management of shigellosis using resistant starch.

The following new assays have been set up in the laboratory for the studies involving oxidative stress and biomarkers of inflammation: GSH, TBARS, TNFα, PGE2, LTC4, and INF gamma.

Child Development Unit
Coordinator: J.D. Hamadani

Since its establishment in 1996 within the CSD as a small unit with only 2 small projects and 7 staff, the Child Development Unit (CDU) has undergone changes and experienced many challenges to finally establish itself as an active and visible unit within the Centre. The Unit is involved in research, training, and patient-care activities. It mainly aims at examining the effects of nutritional deficits, poor health and deprivation on development of children, and designing and evaluating innovative, low-cost and sustainable methods to address the issues.
The Unit collaborates extensively with scientific divisions and research programmes of the Centre and also with national and international organizations, e.g. Institute of Nutrition and Food Science (INFS) of the University of Dhaka, PLAN Bangladesh, Institute of Child Health of the University College London, Cornell University, Uppsala University, and the Karolinska Institute. It also collaborates with the national Child Development Network called ‘Shishu Bikash Network’, a forum of multidisciplinary professionals working in the field of child development.

Professor Frances Aboud from the Psychology Department of the McGill University, Canada, an adjunct scientist of the Centre attached to the CDU, returned to Canada after spending 2 years at the Centre. She evaluated 3 research projects on early childhood initiatives of PLAN Bangladesh—preschool, Shishu Bikash Kendra, and parenting programmes. Dr. Anna Moore joined the Unit in collaboration with Professor Aboud and is currently working on a project to evaluate the impact of changes made to the curriculum and teaching materials following the initial preschool evaluation. She is also following up the initial preschool cohort after 1 year to monitor their progress in primary schools and has completed an observational study on responsive complementary feeding.

The Unit remained involved in the Child Development Component of the MINIMat project; data collection on mental development of the infant cohort was completed in July 2004. These data are being analyzed. Data collection for the childhood measurements was started in January 2004, the 12-month measurements were completed in December 2004, and the 18-month measurements are half way through. An addendum to the MINIMat project assessed the ‘family psychosocial care indicators’, developed by the UNICEF’s working committee. Another study has been initiated in January 2004 to examine the association between urinary arsenic and mental development of children.

Dr. Baitun Nahar completed a project to compare the effectiveness of the existing child-development activities at the NRU with that of a low-cost, culturally-appropriate systematic programme of psychosocial stimulation and parental counselling. The results are being analyzed.

The CDU has conducted a 5-day training course on child development for the internship programme of the students of the Department of Psychology, University of Dhaka, which was equally appreciated by the students and the department head; they requested for continuation of the programme. In 2004, the Unit organized several seminars and training workshops on child development for the staff of the Centre and national organizations, e.g. BRAC, National Institute of Preventive and Social Medicine, and INFS. CDU personnel joined the ‘Technical Working Group’ to develop indicators and monitoring systems for the Early Childhood Development (ECD) Programme of UNICEF/ICMH as part of the national ECD programme of the Government of Bangladesh.

Nandipara Clinic
Coordinator: S.A. Sarker

The Nandipara Clinic, situated in peri-urban area near Dhaka city (12 km from the Centre) and established in 1985, continued to provide opportunities to the CSD scientists in conducting community-based research. The Clinic supports primary health needs of the community that has been recently expanded to the adjacent communities of Trimohoni, Mothertek, and Dakhingaon and now covers over 4 sq km with a population of nearly 8,000. The Clinic also supported a number of studies, including evaluation of the role of Helicobacter pylori in gastric acid output and iron absorption, and iron deficiency. In fact, the role of H. pylori on depressed gastric acid output and iron-deficiency anaemia in children and women was established from this clinic-based study area. Currently, the study area is providing opportunity to examine the efficacy of different iron salts, e.g. ferrous sulphate, ferrous fumarate, and ferric
pyrophosphate, as food fortificants in preventing iron-deficiency anaemia in most vulnerable groups of children. A randomized, double-blind, placebo-controlled community-based trial has been designed, and the selected children are being fed cereal diet containing different fortificant salts daily for 9 months. Haemoglobin, serum ferritin, and soluble-transferring receptor are being measured at baseline, at 4.5 months, and at 9 months. Of 240 children, 140 were enrolled so far in the project. The Clinic also provided support for minor illness to the family members of the study children, approximating 15,000 people. During the last devastating flood in August 2004, the Clinic also distributed relief materials, including food, drugs, and ORS packets, to the stranded people there.

Case-management Fellowship Programme

The CSD has established case-management training programmes for medical doctors and nurses over a decade and a half ago. The objective of the Clinical Fellowship Programme is to provide further training to young medical graduates with demonstrated initiatives for postgraduate studies in paediatrics and internal medicine. In total, 15 fellows receive hands-on training for 1-2 year(s) on case management of diarrhoeal diseases and associated problems. The University of Dhaka and the Bangladesh College of Physicians and Surgeons recognize the training programme for higher studies in Paediatrics and Internal Medicine. Similarly, there is a programme for providing hands-on-training to 10 nurses at the CRSC.

Recent Changes

The Division continued its efforts to improve the physical facilities, including establishment of adequate hand-washing facilities. During 2004, relocation of the Special Care Unit and the Pharmacy and establishment of a Procedure Room and an Isolation Room were completed. Establishment of paying-beds in the Short Stay Ward and longer-stay General Ward, and addressing the issue of privacy are underway.

Membership of CSD Scientists in Working Groups

In June 2004, UNICEF/ICMH selected Dr. Jena D. Hamadani as a member of the Technical Working Group to develop indicators and monitoring system for the Early Childhood Development programme. The British Medical Journal and the Lancet initiated a campaign in 2002 to promote and revitalize academic medicine. A 20-member international working party, representing different geographical regions and disciplines, was formed in a retreat held in London in June 2004, and Dr. Tahmeed Ahmed, Scientist, CSD, was included as a member of this international body.

Awards

Professor Frances Aboud of McGill University, Canada and an Adjunct Scientist attached to the Child Development Unit, CSD, received the 2004 Public/Community Service Award from the Canadian Psychology Association for her work in Bangladesh.

Dr. Tahmeed Ahmed, Acting Head of the Nutrition Programme and Scientist of the Division, was awarded Dr. Sultan Ahmed Choudhury Gold Medal of the Bangladesh Academy of Sciences in recognition of his outstanding work in child nutrition, particularly his research in reducing deaths among severely-malnourished children and for disseminating the results of the study both within Bangladesh and in other countries where childhood malnutrition is a major public-health problem. Dr. Ahmed was earlier awarded the International Health Research Award for 1999 by the Ambulatory Pediatric Association in the Congress of the Pediatric Societies of America.

Dr. Baitun Nahar was awarded ‘The Young Investigator Award’ by the organizer of the 2nd World Congress of Pediatric Gastroenterology, Hepatology and Nutrition, held in Paris, on 3–7 July 2004 for her oral presentation titled “Do severely-malnourished hospitalized children differ in their development and behavior from severely-malnourished children attending community nutrition centres?”
The mandate of the Health Systems and Infectious Diseases Division (HSID) is to strengthen health systems through operations research and to conduct investigations that will reduce the burden of infectious diseases in less-advantaged populations. The researchers in the Division design, test, and facilitate replication of cost-effective and sustainable interventions that are applicable to developing-country populations, in particular those living in poverty. These include the effective delivery of primary healthcare, testing of new vaccines, investigation of disease outbreaks, and prevention of the spread of infectious diseases. The researchers in the Division identify findings of research from fieldwork conducted within the Centre and elsewhere and then provide a testing ground to determine what adaptations are needed to make positive findings from controlled research studies applicable to ‘real-world’ settings.

The Division uses its own real-world field sites. These include two rural field stations in Mirsarai upazila of Chittagong district and Abhoynagar upazila of Jessore district, and an urban slum field station in Kamalapur, Dhaka city. In all these 3 settings, people benefit from government and NGO-provided health services. However, the primary source of health services remains the private sector.

The HSID provides infrastructure and expertise for centre-wide operations research with adaptation and implementation of benefits of interventions identified in research work into real-world applications. The Division focuses on a multi-disciplinary approach of inquiry through both quantitative and qualitative methods. It partners with the Ministry of Health and Family Welfare (MoHFW) of the Government of Bangladesh (GoB), non-governmental organizations (NGOs), and the private sector to facilitate testing of interventions in the Division’s research sites.

The HSID staff includes 8 international personnel (1 Britain, 1 Canada, 1 Netherlands, 1 Japan, 1 India, 3 USA), 42 national officers, and 219 general services and field-level staff. Six staff members were abroad during 2004 for Masters (1) or PhD degrees (5).

Surveillance and Data Resources Unit

The Unit has two sections: Data Resources and Demographic Research. The first is responsible for receiving, cleaning, checking, entering, and archiving the surveillance data collected by the Division. These come from two rural surveillance areas—Mirsarai in Chittagong district and Abhoynagar/Keshobpur in Jessore district—where data are collected every 3 months, and one urban site—
Kamalapur—where demographic data are collected once a year. Kamalapur is a part of Dhaka city with about 200,000 inhabitants, many of whom live in slums. Surveillance for special studies takes place among a sample of the population of this area. This is the only urban health and demographic surveillance in Asia.

The Data Resources Section is also responsible for data management for the other units of the Division. This includes assistance with questionnaire design and preparation of data entry and editing for surveys, and tabulation and provision of statistical analysis expertise to different protocols. The Section has a computer engineer who provides hardware and software assistance to the Division staff.

Work is continuing on the creation of a user-friendly version of the surveillance databases, while at the same time verifying their contents. The most important tables have been already created, enabling the Unit to provide researchers with the requested data in a much shorter time. When completed, it will allow, under strict conditions, researchers to access the surveillance database directly by themselves.

The Demographic Research Section is responsible for demographic research in the Division. It executed the protocol “Levels, trends and determinants of unwanted pregnancies in rural Bangladesh.” This USAID-funded protocol was started in December 2002 and ended in 2004. The Unit staff also participated in, and gave technical support to, the USAID-funded “Plateauing of the Bangladesh fertility decline” study of the Population Sciences Programme of the Centre. All surveillance staff in Abhoynagar and Mirsarai received training on the revised verbal autopsy guidelines (ICD-10) that covered all deaths occurring in 2004.

The HSID surveillance is a member of INDEPTH, the network of health and demographic surveillance sites in the world. The researchers from the Unit or from other Units of the Division took part in the INDEPTH workshops on: surveillance data management in Ghana; causes of mortality in Ghana; site and financial management, (also in Ghana); migration in Kenya; Asian reproductive health in Thailand; grant proposals in Ghana; and verbal autopsy (also in Ghana); and annual scientific conference of INDEPTH in Vietnam, followed later in the year by a regional conference of the Asia and Pacific members in Indonesia. Multi-site studies, funded through INDEPTH in which the HSID surveillance areas are involved, are taking place in the areas of reproductive health, non-communicable diseases, and adult health.

**Family Health Research Project**

The Family Health Research Project (FHRP) has been functioning since 2001, having evolved from the former Operations Research Project. Since its inception, with funding from USAID, the Project has been conducting applied research, disseminating results of research, and providing technical assistance to scientists and clients of research as needed. The major focus of studies undertaken is to develop and implement appropriate and sustainable service-delivery and support systems for the Essential Services Package (ESP), design and evaluate specialized interventions, and assist partners to replicate those interventions successfully.

The FHRP aims at “improving the health of the people of Bangladesh by improving the effectiveness of the Essential Services Package (ESP) that provides basic medical services to the families of the country with emphasis on improving services to vulnerable populations, and on developing new, more cost-effective methods for using resources.”

The FHRP is administered by its Leadership, Coordination and Research Development (LRCD) Unit. The Unit facilitates the development of new research, dissemination of research findings, collaboration with the Government and NGOs, the formation of technical interest groups, and the provision of research-generated information for policy-makers and programme implementers to improve ESP and develop cost-effective service-delivery systems. The Unit provides guidance to individual research projects through mentoring, critique, and reviews. The Unit also ensures compliance with the USAID regulations, organizational policies and procedures, and the Cooperative Agreement. Finally, it provides the administration and support staff to manage the logistics and financial supervision of projects funded by the FHRP.
In 2004, the FHRP facilitated the development of 22 new research concepts/protocols submitted to USAID/Dhaka. For each, these included consultation with stakeholders from within and outside the Centre, periodic meetings with the USAID technical staff to discuss research ideas, progress, and other issues, and meetings within the Centre to gain an awareness of research carried out within the Centre that could be funded through the FHRP. The LRCD Unit helped organize 7 dissemination seminars in 2004 to share the major research findings with researchers, academicians, policy-makers, programme implementers, physicians, national and international NGOs, and donor agencies. These dissemination seminars are the platform to share research findings, obtain constructive criticisms, obtain new ideas, and campaign for changing policy and/or programme implementation strategy through providing evidence and results. The FHRP also participated in the America Week held in Rajshahi from 29 February to 2 March 2004.

The FHRP maintained close collaboration with different departments of MoHFW, national and international NGOs, and development agencies working in the field of health. These included: the Ministry, National Institute of Population Research and Training, Institute of Child and Mother Health, National Nutrition Project, National Tuberculosis Control Programme, Dhaka Medical College and Hospital, local Upazila Health Complexes, World Health Organization, BRAC, CONCERN Bangladesh, NGO Service-delivery Programme, etc. This is not, however, a complete list of all the partners with whom the FHRP worked in 2004 and will be working with in the coming year.

In 2004, 7 studies were completed. Results of these studies provided evidence-based information to policy-makers and programme implementers in improving the current essential services-delivery policies and programme implementation strategies. Activities for an additional 12 studies have also been conducted throughout the reporting period. The studies spanned many disciplines and subject areas to include research into the introduction and evaluation of new tools to promote healthcare delivery and management, effectiveness of community-based strategies, risks of HIV/AIDS and sexually transmitted diseases, and ways to identify and protect. These covered the areas of population sciences, emergency obstetric care, neonatal care, general health, family planning, and HIV/AIDS.

A list of ongoing studies under FHRP, with names of PIs, are provided below

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<tr>
<th>SL</th>
<th>Name of protocol</th>
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<tbody>
<tr>
<td>1</td>
<td>Levels, trends, and determinants of unintended births in rural Bangladesh</td>
<td>Dr. Carel van Mels</td>
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<td>2</td>
<td>The community-based component of the evaluation of the health and economic impact of the IMCI strategy in Bangladesh</td>
<td>Dr. Shams El Arifeen</td>
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<tr>
<td>3</td>
<td>Community-based interventions to reduce neonatal mortality</td>
<td>Dr. Shams El Arifeen</td>
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<td>4</td>
<td>The effectiveness and utility of a green banana diet in the home management of acute and persistent diarrhoea in children</td>
<td>Dr. G.H. Rabbani</td>
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<td>5</td>
<td>Management of tuberculosis by private practitioners and health-seeking behaviour of symptomatic adults/TB suspects</td>
<td>Dr. Sk. Shahed Hossain</td>
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<td>6</td>
<td>Vulnerability to HIV/AIDS of migration-affected families</td>
<td>Dr. Rasheda Khanam</td>
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<td>7</td>
<td>Field evaluation of simple rapid tests in the diagnosis of syphilis</td>
<td>Dr. Motiur Rahman</td>
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<td>8</td>
<td>Investigation of the Nipah virus outbreak in Faridpur district</td>
<td>Dr. Lauren Blum</td>
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<td>9</td>
<td>Re-initiating fertility decline by meeting the needs of high-parity couples with long-term family planning methods</td>
<td>Dr. Abbas Bhuiya</td>
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<td>10</td>
<td>Community-based intervention to reduce childhood drowning</td>
<td>Dr. Lauren Blum</td>
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<td>11</td>
<td>Feasibility, acceptability and programme effectiveness of misoprostol in preventing postpartum haemorrhage</td>
<td>Dr. M.A. Quayum</td>
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<tr>
<td>12</td>
<td>Essential laboratory services</td>
<td>Dr. Motiur Rahman</td>
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Green banana, an indigenous treatment for diarrhoea
Scaling Up Zinc for Young Children (SUZY) Project

In developing countries, diarrhoea remains one of the leading causes of preventable morbidity and mortality, killing nearly 2 million children every year. Research carried out at the Centre has shown that zinc provides a very effective treatment for diarrhoea, especially among children aged less than 5 years. Zinc treatment reduces the severity and duration of diarrhoea and the likelihood of its future episodes and the need for hospitalization. Zinc treatment can save a child’s life both as a treatment for diarrhoea and by preventing future infectious illnesses. Based on these findings, it is estimated that, globally, zinc treatment could save the lives of over 400,000 children each year and in Bangladesh up to 75,000 children per year. The SUZY Project aims at providing zinc treatment for diarrhoea to all Bangladeshi children, aged less than 5 years.

Dissemination activities

Curricula must be developed and training planned that is health provider-specific and appropriate for public, private and NGO delivery systems. A wide range of providers needs to be considered, beginning with licensed allopaths, then moving down to unlicensed providers of healthcare, drug-sellers, homeopaths, and traditional healers. Training materials are being developed for each of these stakeholders. Guidebooks have been developed for paramedics, flip-charts have been developed for depot-holders, and information sheets have been developed for members of village-development committees and the general population. A series of workshops with paediatricians and a day-long workshop with all civil surgeons in Bangladesh were conducted as part of the pre-scaling up phase of the Project. A special training curriculum was developed for sales officers working with the Social Marketing Company in Bangladesh.

The information dissemination team of the SUZY Project keeps all stakeholders informed about the project activities and maintain good working relationships. In 2004, the team organized two meetings of the Project’s Technical Interest Group to update key players from MoHFW, UN agencies, NGOs, and donors with the latest developments of the Project and to receive their valuable input for further improvement of the implementation activities. In April 2004, the first International Conference was held at the Centre. National and international scientists and public-health experts shared their findings and experience. The Advisory Committee meeting following the conference provided important recommendations and advice for scaling up zinc as treatment for childhood diarrhoea nationwide. To provide updated information about the Project to a broader audience, the team has published the first and second issues of the SUZY Newsletter. The newsletter is distributed to national and international professionals, institutions, and organizations. The dissemination team also maintains the SUZY web page, which covers the overall activities of the Project. Updated news, ongoing protocols, and events are disseminated. Literature on global zinc research, zinc research at ICDDR,B, and frequently-asked questions are also available.

The research findings of ICDDR,B, over the past 26 years, have had direct relevance to health practitioners and policy/decision-makers in Bangladesh. However, the results of this important research were not readily available to them; as such results are published in international journals or are presented at conferences with limited local participation. These forums do not reach the vast majority of health practitioners, policy-makers, public-health professionals, and NGOs working for the people of Bangladesh. Stressing the need for the widespread timely dissemination of research results, the HSID introduced the Health Science Bulletin (HSB) in late 2002, and since then it has been published quarterly. More than 7,500 professionals at home and abroad receive the Bulletin.
A ‘Readers’ Survey’ was conducted to better understand whether or not readers found it useful. A questionnaire was sent to 7,280 enlisted readers of the HSB asking about how and if they used the HSB and its relevance to their work. Of 530 respondents, more than 70% reported that they either read the Bulletin cover-to-cover or read most articles with care. Most respondents were health practitioners. Of them, 93.5% reported that the HSB fills an important gap in their knowledge, and 91.5% reported that they use its information in their jobs. Topics included Nipah encephalitis, Neisseria meningitidis, family-planning services, Streptococcus pneumoniae, and arsenic contamination. The HSB is also available on the Centre’s website (www.icddrb.org/hsb).

As the SUZY Project staff begin to meet caretakers and providers, many questions about zinc arise. The Project team is putting together a compendium of frequently-asked questions and posting these on the website. Examples of the type of questions asked and the answers are listed below.

How does zinc work in diarrhoea?
It is clear that zinc is vital for a wide range of biological functions. In the case of diarrhoea, we have come to know that zinc helps in the following ways:
1. It boosts up the immune system
2. It helps in healing the intestine
3. It improves absorption of fluids

Can diarrhoea be treated with zinc only?
We recommend that ORS always be given for the treatment of diarrhoea. If the diarrhoea is bloody, healthcare providers may also prescribe an antibiotic.

Can the zinc tablet be taken by chewing (sucking)?
No. While it is possible to chew the tablet, this is not recommended. It needs to be dissolved in water and then administered to the child. This will ensure that the child takes the full dose.

Should a child be given another course of zinc treatment if he/she experiences a second episode of diarrhoea?
Yes, all episodes of diarrhoea should be treated with zinc. Even if a child has recently completed a full course of zinc treatment it is still safe to give a second dose.

Can a breastfeeding mother take zinc instead of her child?
No. While it is true that if a breastfeeding mother takes zinc some of it will pass through the breastmilk, it is not sufficient to treat a child suffering from diarrhoea. To ensure that s/he gets the complete dose, it is important to administer zinc directly to the child.

Are there any side-effects of zinc?
At the dose being provided in this tablet, there may be transient nausea or vomiting. If a child is vomiting, we recommend settling the child first and ensure the child can hold down ORS before administering zinc.

Would the zinc dose vary according to the weight of the child?
The zinc treatment is given according to age, not to weight. Irrespective of weight the recommended dose of zinc tablet is:
2 months up to 6 months: 10 mg zinc once daily for 10 consecutive days
7 months to 5 years: 20 mg zinc once daily for 10 consecutive days

Why is the zinc tablet needed as zinc syrups are already available in the market?
Zinc tablets are preferred over syrup for the following reasons:
- Easier distribution and storage
- Lower cost
- Easier for caretakers to administer properly and keep track of duration treated for
- Longer shelf-life

In which type of diarrhoea should zinc be used?
Zinc can be used in all types of diarrhoea.

The HSB production team at work
The Laboratory Sciences Division (LSD) performs research in accordance with the Strategic Plan of the Centre. The Division extends services to the research projects of the Centre and to the public at large using its modern diagnostic laboratories. The scientists of the Division also supports the projects of other divisions and programme-based activities within the Centre, initiates research collaboration with national, regional and international research and educational institutions, and participates in different scientific conferences, workshops, symposia, and training programmes.

The scientific and technical staff of the Division comprises 5 International Scientists, 1 Adjunct Scientist, 20 National Scientists, and 253 technical and support services staff, of whom 58 are female and 220 are male. The Ranking Committee promoted Dr. Tasnim Azim, Head of the Virology Laboratory and of the HIV/AIDS Programme to the position of International Scientist, Dr. Zeaur Rahim to Scientist, and Dr. Goutam Podder to Assistant Scientist in recognition of their excellent performance. Mr. A.K.M. Rahamtullah was appointed Head of the Biomedical Engineering Unit, succeeding Mr. Saiful Huq who emigrated to Canada.

In 2004, the Division completed 6 research protocols and initiated 12 new research protocols; 34 protocols were ongoing. The Molecular Genetics Laboratory and the Helicobacter pylori Laboratory were renovated, and a new management information system was introduced to improve the activities relating to clinical diagnostic services.

As per the renewed agreement between ICDDR,B and the International Vaccine Institute (IVI), Mr. M. Ansaruzzaman, Associate Scientist, Enteric Microbiology Laboratory, visited the Laboratory of Hygiene, Water and Food, Beira, Mozambique, twice in 2004. His main tasks were to set up a microbiology laboratory for isolation and identification of *Vibrio cholerae* and related enteric microorganisms and to train laboratory technologists and supervisors for carrying out routine laboratory tests following standard laboratory procedures and to set up quality-control test. This work has led to the identification of a new hybrid strain of *V. cholerae*.

Mr. M.A. Wahed, Head of the Nutritional Biochemistry Laboratory, provided consultancy to UNICEF for the national micronutrient survey in Afghanistan, which included training of government health technologists on the estimation of serum zinc by atomic absorption spectrophotometry. He also attended the NEASIA Food Composition Workshop in Korea as a resource speaker.
from SAARC countries and presented a paper entitled “Nutrition scenario in SAARC countries: gaps and scopes in food composition database.” Dr. Tasnim Azim, Head of Virology Laboratory and of HIV/AIDS Programme and Dr. Motiur Rahman, Head, RTI/STI Laboratory, provided technical support for STI/HIV activities in Pakistan carried out by the Family Health International.

In February 2004, the Division organized a WHO-funded workshop on shigellosis. The workshop was participated by 45 scientists from different countries.

Acute Respiratory Infection Laboratory
Head: Mahbubur Rahman

Acute lower respiratory infection (ALRI), primarily pneumonia, is a leading cause of morbidity and mortality in children aged less than 5 years in Bangladesh. About 25% of all deaths of children aged less than 5 years and about 40% of deaths in infants in the country are associated with pneumonia. *Streptococcus pneumoniae* and *Haemophilus influenzae* frequently cause the disease. The present hospital-based surveillance in urban Dhaka was carried out to study the epidemiology of pneumonia and antibiotic resistance among bacterial pathogens of pneumonia in children aged less than 5 years for better case management, to disseminate the relevant information timely, and finally to improve the use of such data for policy decisions, particularly in the ARI control programmes of the Government of Bangladesh.

Enteric Microbiology Laboratory
Head: G. Balakrish Nair

The investigators of the Laboratory are mainly involved in molecular epidemiological research on various enteric pathogens isolated from both clinical and environmental sources. The technical facilities available in this laboratory include: gel electrophoresis (conventional agarose gel electrophoresis, pulsed-field gel electrophoresis [PFGE], polyacrylamide gel electrophoresis), nucleic acid preparation, hybridization using non-radioactive probes, ribotyping, Western and Southern blotting, oligonucleotide preparation by Oligo 1000 DNA Synthesizer, DNA amplification by polymerase chain reaction (PCR), and fluorescent actin staining test (FAST). Diagnostic techniques routinely used include: conventional bacteriological culture method, enzyme-linked immunosorbent assay (ELISA), tissue culture assay, rapid identification of cholera using paper strips, phage isolation and characterization, colony-blot hybridization, DNA probe, and PCR assays for rapid identification of diarrhoeal pathogens. Establishment of real-time PCR for the detection of these pathogens directly from stool is ongoing. Molecular fingerprinting of enteric pathogens is routinely performed by plasmid analysis; enterobacterial repetitive intergenic consensus-PCR (ERIC-PCR), random amplification of polymorphic DNA (RAPD), PFGE, ribotyping, PCR-RFLP, and RFLP of O-antigen sequence by long PCR. Sequencing and phylogenetic analysis was recently introduced as the latest advancement to determine the clonal diversity among pathogens at inter- and intra-species levels. Experiments with animal model for studying pathogenicity have been conducted, and production of antisera against atypical strains of *Shigella* has been performed with the facilities of the Centre’s animal resources. Extensive studies being carried out by the investigators of the Laboratory on both phenotypic and genotypic levels include: *V. cholerae*, *V. parahaemolyticus*, *Campylobacter*, *Escherichia coli* (especially on Shiga toxin-producing *E. coli*), *Shigella*, *Salmonella*, and *Aeromonas*. The work on food microbiology will begin soon at this laboratory in collaboration with research projects with the Public Health Sciences Division of the Centre where food samples from a number of street vendors are being analyzed to assess the burden of enteric pathogens, including *Salmonella enterica* serovar
Typhi (S. Typhi) and faecal coliforms. An extensive study on the molecular mechanism of multiple antibiotic resistance (MDR) in Shigella and S. Typhi is also being conducted.

Environmental Microbiology Laboratory
Head: Md. Sirajul Islam

The Environmental Microbiology Laboratory is involved in the research on water microbiology, especially on the ecology and epidemiology of Vibrio cholerae. Presently, the Laboratory is involved in developing guidelines for point-of-use water treatment for surface and ground water in Bangladesh. In total, 5 studies have been conducted during 2004 in this laboratory. The Laboratory also provides inter-departmental services for testing environmental samples supplied by the Clinical Sciences Division, Public Health Sciences Division, Health Systems and Infectious Diseases Division, and some received through the Information Sciences Division. Various environmental samples from different national and international institutions and non-government organizations of Bangladesh are also tested in this laboratory. In total, 1,585 environmental samples including water, juice, beverage, prawn, etc. were tested in this laboratory during 2004.

Immunology Laboratory
Head: Firdausi Qadri

In addition to new and sustained collaboration with national and international institutions, the Laboratory has expanded interactions with different programmes and divisions within the Centre. Areas of interest include: studies on infectious diseases caused by Shigella spp., V. cholerae, V. parahaemolyticus, enterotoxigenic E. coli (ETEC), S. Typhi, Mycobacterium tuberculosis, and Helicobacter pylori. Nutrition-related immunological studies, specifically relating to micronutrients, intrauterine growth restrictions, birth-weight, and different environmental factors are also being carried out. These interests focus on the use of vaccines in different fields for the protection of vulnerable populations. The transfer of novel and sensitive microbiological and immunological techniques as a result of active collaborations with different universities and research centres have helped upgrade the research facilities in the Laboratory. Ten funded protocols were ongoing. Six staff members from the Laboratory were undergoing postgraduate studies in collaboration with national and international institutions.

Molecular Genetics Laboratory
Head: Shah M. Faruque

The Laboratory is involved in the development and application of molecular techniques to identify and characterize diarrhoeagenic microorganisms. The technical facilities available in this laboratory range from gel electrophoresis, DNA hybridizations using both radio-labelled and non-radioactive probes to the more sophisticated techniques of DNA amplification by PCR. In addition, advanced techniques of DNA sequencing and microarray analysis are conducted through collaboration with various international institutions. Recent diagnostic techniques routinely used in the Laboratory include: DNA probe assays of diarrhoeal pathogens, genetic fingerprinting of pathogenic strains as an aid to epidemiological studies, and PCR assays for rapid identification of diarrhoeal pathogens.

In addition to applied research, the investigators of the Laboratory are involved in addressing basic research questions regarding the emergence and evolution of pathogens. Research in this laboratory has contributed considerably to understanding the emergence and evolution of pathogenic V. cholerae strains and factors controlling epidemics of cholera. Development and evaluation of a suitable cholera vaccine is also under progress. Among other research activities, environmental occurrence and biology of diarrhoeal pathogens, including Shigella, and diarrhoeagenic E. coli are also being investigated.
Some studies are reported in the chapter on Infectious Diseases and Vaccine Sciences.

**Nutritional Biochemistry Laboratory**  
Head: M.A. Wahed

The Laboratory performed 5,367 tests in 2004 to support 11 research projects. New methods were developed for: (a) determination of arsenic in biological samples, such as urine, hair, and nail with atomic absorption spectrophotometer attached to a hydride vapour generator and (b) preparation of emulsifying agent using neem oil, which is under application as a trial to reduce the production and growth of sandfly, a vector responsible for kala-azar, at Trishal, Mymensingh. Data cleaning and analyses are in progress for the project “Effectiveness of small fish rich in vitamin A to improve vitamin A status in children living in urban slums.” A pilot study “Prebiotic effects of daily fructooligosaccharide (FOS) intake on weight gain and reduction of diarrhoea incidence among young children in urban slums” has started in Mirpur, Dhaka; 150 selected children were randomly assigned to receive either glucose or FOS syrup daily to see a beneficial effect, if any, of FOS on the nutritional status of children and on the incidence of diarrhoea episodes among them.

**Parasitology Laboratory**  
Head: Rashidul Haque

The Laboratory, primarily working on amoebiasis, has recently started to work on malaria and Cryptosporidium. Work on the epidemiology and immunity of amoebic infection is being conducted in collaboration with the University of Virginia, USA. The work on malaria is being conducted in collaboration with other divisions within the Centre, Centers for Disease Control and Prevention (CDC), USA, and Armed Forces Research Institute of Medical Sciences (AFRIMS), Bangkok. The Laboratory also provides diagnostic support to different projects and is involved in training activities of the Centre.

The Laboratory is currently conducting studies to understand immunity to amoebiasis in Bangladeshi children and on the development of simple tests for diagnosis of common intestinal parasites, such as Entamoeba histolytica, Giardia lamblia, and Cryptosporidium. The major aims of these studies are to understand innate and acquired immunity to infection due to *E. histolytica* and to establish molecular and rapid diagnostic tests for these intestinal protozoan parasites. A prospective cohort study and a case-control study are being conducted to achieve the goals of these studies. Longitudinal and epidemiological data on *E. histolytica*-associated infection and re-infection in preschool children in an urban slum of Dhaka showed for the first time that immunity was of short duration and repeat-infections were common. Despite a high intensity of infection, 20% of children were never infected. These results provide insight into the contributions of a short-lived mucosal immune response, host susceptibility, and high rates of re-infection, to the substantial burden of childhood amoebiasis.

To understand drug resistance in the treatment of malaria in Bangladesh, some work was carried out in 2004 in collaboration with the Health Systems and Infectious Diseases Division (HSID) of the Centre and AFRIMS. A collaborative study to understand human immunity to cryptosporidiosis is also ongoing. The Laboratory provided support for diagnosis of leishmaniasis to the “Community-based epidemiologic study of visceral leishmaniasis in Bangladesh” carried out by HSID in collaboration with CDC. The aims of the study are to understand transmission patterns, identify risk factors, and diagnose pre-clinical infection in Bangladesh.

**RTI/STI Laboratory**  
Head: Motiur Rahman

The Laboratory is conducting epidemiological studies on RTIs/STIs among different population
groups, validating different diagnostic tests for syphilis and monitoring antimicrobial susceptibility of Neisseria gonorrhoeae in Bangladesh. It has recently started a study to evaluate enhanced syndromic management (ESM) for STIs and compare it with the periodic presumptive treatment (PPT) strategy. The Laboratory is also studying the incidence of gonococcal and chlamydial infections among hotel-based sex workers in Dhaka, Bangladesh. The Laboratory provides diagnostic services to national and international STI projects, including national HIV surveillance. It is also undertaking a survey of primary healthcare (PHC) facilities among NGOs of the National Service Delivery Programme (NSDP) throughout Bangladesh. The project plans to develop a guideline and Standard Operating Procedure (SOP) for laboratories in Bangladesh. The Laboratory is actively involved in revising the national STI guidelines for Bangladesh. It has DNA-sequencing facility, provides sequencing facilities across the Centre, and harbours the Centre’s core expertise in bioinformatics. A new bioinformatics core group is being developed. Two new scientists have joined the Laboratory after completing training in the UK and India. The Laboratory contributes significantly to the Centre’s efforts to release data of public-health importance by routinely publishing those on antimicrobial resistance of N. gonorrhoeae in the Health and Science Bulletin of the Centre. The Laboratory, in collaboration with Family Health International, Nepal, during 2004, has conducted a study among males having sex with males in Nepal.

The Laboratory works as a focal point for Bangladesh in the Global Network for Perinatal and Reproductive Health and Gonococcal Antimicrobial Susceptibility Program of WHO. During 2004, the Laboratory provided consultancy services to HIV and STI studies in Pakistan.

Helicobacter pylori Laboratory
Head: Motiur Rahman

H. pylori-associated infection is one of the most common gastric infections in Bangladesh, and considerable research interest has grown in the Centre in recent years to undertake studies on H. pylori. To cope with the research interest, the Laboratory was renovated in 2004. The renovated laboratory will be involved in (a) molecular characterization of H. pylori strains, (b) basic studies on antimicrobial resistance mechanism in H. pylori, and (c) population genetics studies of H. pylori.

Tuberculosis Laboratory
Head: Zeaur Rahim

Bangladesh is one of the countries where the burden of tuberculosis (TB) is high. To study and reduce the burden of TB, the Laboratory is collaborating with scientists across the Centre, National TB Control Programme, National Institute of Diseases of Chest and Hospital, Damien Foundation, and BRAC since its inception. For this purpose, the Laboratory is providing adequate facilities for the diagnosis of TB by IS6110-based PCR, Mycobacteria Growth Indicator Tube-based rapid culture, and Lowenstein-Jensen-based conventional culture. Usually, clinical specimens, such as sputum, gastric aspirate, endometrial tissue, and lymph-node aspirate samples of TB-suspected paediatric and adult patients are processed. The Laboratory is actively participating in the surveillance of multidrug-resistant Mycobacterium and molecular epidemiology and rapid immunological diagnosis of TB and leprosy. In 2004, the Laboratory cultured 789 clinical specimens (638 sputum, 130 gastric aspirate, 3 endometrial tissue, 18 lymph-node aspirate, etc.). The senior staff members of the Laboratory are guiding students to carry out research on tuberculosis for their MSc and MD theses under the University of Dhaka and Bangabandhu Sheikh Mujib Medical University respectively. The Laboratory invites research collaboration from investigators from home and abroad.
Virology Laboratory
Head: Tasnim Azim

The Virology Laboratory is working on group A rotavirus, HIV, dengue, and influenza. The main effort is concentrated on group A rotavirus for which, in addition to providing diagnosis of rotavirus, studies are carried out on its epidemiology, immune responses to natural infection, and support for vaccine studies. Molecular epidemiological studies have identified several new strains of rotavirus. For HIV, laboratory support for various activities of the HIV/AIDS Programme is provided. These include: serological surveillance for HIV for Bangladesh which continues to be conducted by this laboratory, research on injecting drug-users, services including voluntary counselling and testing for HIV and determining absolute CD4 counts in people living with HIV. Influenza is being identified by serological methods to support ongoing influenza surveillance in the community. Dengue typing by PCR and isolation by tissue culture are being continued.

CLINICAL LABORATORY SERVICES
Head: M. Anowar Hossain

The Clinical Laboratory Services is composed of multidisciplinary diagnostic units, namely Clinical Haematology, Biochemistry, Microbiology, and Molecular and Serodiagnostics, Out-patient Service in Dhaka, and Clinical Laboratory in Matlab and Chakaria. It provides diagnostic support to patient-care activities of the Clinical Research and Service Centre (CRSC) in Dhaka and Matlab, paying-users, medical units of British High Commission, U.S. Embassy, and U.S. Peace Corps, Japan International Cooperation Agency, and also to clinical, community, and field-based studies of the Centre’s scientists. Scientists of the clinical laboratories carry out research and train national and international fellows, graduate and postgraduate students on laboratory research and diagnostic techniques. In 2004, the laboratories processed 148,147 specimens and conducted 411,416 tests. The outpatient unit handled 52,142 patients. Blood samples were collected from 31,848 of these patients. Safe blood was made available for transfusion to patients in the Dhaka and Matlab hospitals. The cost of blood bags, testing, and documentation was borne by the Clinical Laboratory Services.

An online multifunctional laboratory management system, developed and installed, has been operating for paying-users, which helped reduce their turn-around time, enhanced early reporting, eliminated hand-written reporting, and facilitated automatic laboratory data-archiving and generating financial and management reports. Another achievement was the completion of community-based Shigella-associated disease-burden study carried out at the Kamalapur urban surveillance field site. This was funded by the Bill and Melinda Gates Foundation through the DOMI Programme of WHO and coordinated by the International Vaccine Institute, Republic of Korea. Data entry was almost complete, and data cleaning and writing of the project report were ongoing. The Laboratories supported 20 research protocols in 2004. The Laboratory staff trained 12 national fellows—4 from international institutions and NGOs (Medecins Sans Frontieres, The Netherlands), and mentored 2 research students from the King’s College, London, UK.

A new laboratory was inaugurated in Chakaria to provide diagnostic support to research protocols carried out there and also to provide services for paying-users. New tests were adopted for viral load of hepatitis B and C, markers of some common tumours, infectious diseases, auto-immune diseases, and molecular typing of diarrhoegenic E. coli in the molecular and serodiagnostic unit; arsenic from biological samples (hair, nail, urine, blood, etc,) in the biochemistry unit; coagulation factors and D-Dimer in the haematology unit; and characterization and serotyping of C. jejuni in the microbiology unit.
New equipment added included: DNA workstation, thermal cycler, gel electrophoresis, immunochemistry analyzers, micro-centrifuge, bench-top balance, coagulation analyzer, ESR reader, and blood-mixing machine. The physical facilities in the outpatient waiting area were further improved by adding more computers and printers, a good laboratory lighting system, and new fixtures for blood-drawing and microbiology laboratory areas.

Under the staff development programme, Dr. Dilruba Ahmed was accredited with a PhD degree for her thesis on *H. pylori* submitted to the Department of Microbiology, Otago University, New Zealand. Dr. Dilruba was reassigned as Assistant Scientist. Dr. Anowar Hossain visited Kathmandu in November 2004 to submit the draft report of the “antimicrobial resistance surveillance on selected pathogens of infectious diseases in Nepal” to the Ministry of Health, His Majesty’s Government of Nepal and USAID-Nepal. He also presented the findings at the dissemination workshop on the importance of the emergence of antimicrobial resistance among pathogens of infectious diseases organized by the National Public Health Laboratory for physicians and nurses.

Clinical Haematology Laboratory
Head: M. Anowar Hossain

The Laboratory performs tests/assays on routine blood-testing, coagulation and haemostasis, provides safe blood transfusion services, detects blood and faecal parasites, and deals with cerebrospinal fluid (CSF) cytology, etc. The Laboratory performed 132,940 tests/assays on 57,888 specimens of blood, serum, plasma, stool, urine, CSF, etc.; 66.3% of the specimens were collected from paying-cases for testing. Of 6,257 blood specimens of CRSC patients, 63.7% were collected by finger-prick. Malarial parasites (*Plasmodium vivax* and *P. falciparum*) were detected from 0.8% of 1,311 cases. The laboratory staff worked for 18,780 man-hours and produced 10,68,582 workload units (WLUs). The Laboratory supported 16 research protocols and trained 2 national and 2 international fellows. The staff collaborated with scientists of other divisions within the Centre on dengue, typhoid and encephalitis studies.

Adoption of an online laboratory management system improved the reporting quality, and installation of automated equipment reduced the turn-around time of tests. The major contribution was the provision of safe blood transfusion for Dhaka and Matlab hospitals. The External Quality Assurance Scheme (EQAS) in routine haematology, coagulation and parasitology continued, and the performance was rated ‘excellent’ as evident from the EQAS scores of the College of American Pathologists.

Safe Blood Transfusion
Head: M. Anowar Hossain

In 2004, 131 bags of safe blood were purchased having blood group A(31), B(29), AB(17) and O(54). Blood was screened for HIV, syphilis, hepatitis B and C, and malaria. Forty-five bags were discarded due to being positive either for any diseases and 66 bags due to expiry of date after collection. Fourteen blood bags were used in the Dhaka hospital and 6 bags in the Matlab hospital.

Molecular and Serodiagnostic Laboratory
Head: Khairun Nessa

This new unit was created by separating the Serological Tests Unit from the former Pathology Laboratory to expand serodiagnostic markers for infectious and non-infectious diseases and autoimmune diseases and to add molecular technology for diagnostic services. The Laboratory already had a diagnostic set up for typhoid, rheumatic fever, rheumatoid arthritis, dengue, syphilis, hepatitis, brucellosis, HIV, and some cancer markers. It is equipped with PCR technology, gel electrophoresis, and immuno-chemiluminescence to broaden the infectious disease markers. In 2004, the Laboratory processed 10,562 specimens for 13,208 tests/assays using 355,185 WLUs. Most commonly (79.0%), the paying-users obtained the services of this unit.

The major achievement in 2004 was the adoption of multiplex PCR assay for the characterization of human diarrhoeagenic *E. coli*, qualitative and quantitative estimations of viral load for HBV (10 cases) and HCV (31 cases) from blood specimens. The genotyping of HCV is under development. Cancer markers for CA 15-3, CA 19-9, and CA 125 and markers of auto-immune diseases, ANA, and anti-dsDNA were adopted.

Of 150 selected *E. coli* specimens, 119 (79.33%) were characterized for various pathogens with enteroaggregative *E. coli* (EAEC) as the predominant strain (55.46%) followed by ETEC (18.49%), enteropathogenic *E. coli* (EPEC) (1.68%), and Shiga toxin-producing *E. coli* (0.84%). Mixed infection with EAEC and ETEC was 14.29%, with EAEC and STEC 5.04%, and with EAEC and EPEC 1.68%. The hepatitis profile showed antibody to HAV 40.0% (59 of 147), HBsAg 15.0% (404 of 2,691), HCV 10.0% (60 of 593), and HEV 38.4% (88 of 229). Dengue was positive in 50.5% of 515 cases of...
paying-patients and staff. There was a cluster outbreak of dengue in Dhaka during the post-monsoon period (Fig.1). Antibody (IgG) to *H. pylori* was positive for 56.8% of 37 cases.

Clinical Biochemistry Laboratory
Head: Ashish Kumar Chowdhury

The Laboratory processed blood, serum, plasma, stool, urine, CSF, intravenous fluid, oral rehydration solution, etc. and performed 152,771 tests/assays on 42,198 specimens. The overall workload increased by 12% for paying-cases (66.1%). The Laboratory produced 134,702 WLUs in 23,757 work-hours. Several new tests/assays were introduced. The major achievement was the acquisition of immuno-chemiluminescence technology and one semi-automated photometer. JICWELS, Japan, donated another atomic absorption spectrophotometer to estimate and quantitate arsenic from biological samples. Another achievement was the online use of the laboratory management system.

The Laboratory continued its participation in the EQAS sponsored by WHO through Wolfson EQA Laboratory, Birmingham, UK. The rated scores indicated its performance as ‘grade 1’ standard. The Laboratory assisted the Institute of Public Health, Government of Bangladesh, in the estimation of electrolytes, glucose, pH lactate, and magnesium as part of the assessment of the quality of intravenous fluid product. The Head of the Laboratory assisted the Kidney Foundation, Dhaka, to develop its laboratory. The Laboratory supported 18 research protocols and participated in the training of 2 national and 2 international fellows.

Clinical Microbiology Laboratory
Head: Md. Khorsed Alam

The Laboratory processed 37,499 specimens for culture, isolation, identification, and testing for antimicrobial susceptibility from various clinical samples, such as blood, stool, rectal swab, urine, throat swab, sputum, CSF, pus, etc. 55.5% of the specimens came from hospitalized patients of the CRSC. The staff worked for 32,287 man-hours producing 1824,216 WLUs. The Laboratory continued its participation in the EQAS with the College of American Pathologists. The overall score was 96.5%.

The common diarrhoeal pathogens isolated (52.71%) from 19,767 faecal samples included: 2,122 *V. cholerae* O1, 16 *V. cholerae* O139, 1291 *Shigella*, 75 *S. Typhi*, and *S. paratyphi* A, 327 non-Typhi *Salmonella* spp., 488 *Aeromonas* spp., and 133 *Plesiomonas*. 216 *C. jejuni* were isolated from 2,738 faecal samples. Of the *V. cholerae* O1 isolates, 19 (0.90%) El Tor Ogawa isolated in mid-November 2004 showed multiple drug resistance against tetracycline, furazolidone, co-trimoxazole, and erythromycin and were sensitive only to ampicillin, mecillinam, and ciprofloxacin. The major achievements were the comparison of candle jar technique with Cape Town protocol of filter technique, characterization of *Campylobacter* spp., and determination of the serotypes of *C. jejuni* following Penner’s Serotyping Schema. A pilot study on Guillain Barré Syndrome strains was initiated.

The overall rate of isolation of bacteria from blood was 19.74% with *S. Typhi* (5.9%, 440 of 7,402), *S. paratyphi* A (1.11%), *S. pneumoniae* (0.41%), *H. influenzae* type b (0.25%), *N. meningitidis* (25%), and *Shigella* spp. (0.06%). Of the *S. Typhi* isolates, 200 (45.45%) showed multiple drug resistance against ampicillin, chloramphenicol, co-trimoxazole, and nalidixic acid with reduced susceptibility to ciprofloxacin and other fluoroquinolones (Fig.2) and only sensitive to third-generation cephalosporin and azithromycin. Automated blood culture facilitated early recovery and reporting of blood pathogens even from patients who had taken an antibiotic.
prior to blood sampling. *E. coli* was predominant (13.41%, 1,007 of 7,510) among the urine isolates (20.03%).

The Head of the Laboratory conducted methodological research, participated in conferences and seminars, and collaborated with the University of Cape Town in determining the serotyping pattern of *C. jejuni*. The Laboratory supported 18 research protocols in 2004 and actively participated in data analysis of the antimicrobial resistance surveillance project of Nepal. The Laboratory also maintained the microbial quality control of the Matlab field laboratory. In 2004, the staff trained 12 national and 2 international students from King’s College, London, UK, and 40 students from the Biochemistry Department, University of Dhaka, Bangladesh.

Matlab Clinical Laboratory
Head: Md. Golam Yeahia Khan

The Laboratory processed 9,846 clinical specimens, such as blood, faeces, urine, CSF, other biological fluids, etc., of patients hospitalized in Matlab diarrhoea treatment centre and from some field-based research protocols and the staff clinic. In total, 14,902 tests were performed on these specimens. The microbiological tests performed on 2,338 specimens (24.0%) included dark-field microscopy, culture along with enrichment for isolation, identification, and antimicrobial susceptibility testing. 2,023 stool/rectal swab cultures yielded 488 *V. cholerae* O1, 2 *V. cholerae* O139, 220 *Shigella*, and 40 *Salmonella* spp. Three hundred fifteen specimens for blood, urine, throat swab, etc. yielded 23.2% isolates; 10,541 tests were performed on 7,508 specimens (76.0%) for electrolytes, renal function tests, blood glucose, routine haematological tests, and urinalysis and stool microscopy for parasites. Microscopy of 2,589 faecal specimens detected *E. histolytica* (1.3%), *G. intestinalis* (3.6%), *Ancylostoma duodenale* (1.4%), *Ascaris lumbricoides* (21.9%), *Trichuris trichiura* (14.2%), and *Strongyloides stercoralis* (1.4%). The physical facilities of the Laboratory were further improved by replacing autoclave and increased storage capacity by deep freezers. In 2004, the Laboratory supported 5 research protocols.

Chakaria Diagnostic Laboratory
Head: M. Anowar Hossain

A new laboratory facility was opened in Chakaria under the Public Health Sciences Division of the Centre to support research protocols to be carried out in that field and to provide diagnostic facility for the local community. Prof. David A. Sack, Executive Director of the Centre, formally inaugurated the Laboratory in May 2004.

Media and Lyophilization
Head: Qazi Shafi Ahmad

The Media and Lyophilization section, comprising Media Preparation-Decontamination unit and Bacterial Stock Culture Collection unit, has 8 personnel. Its primary responsibilities include preparation of bacteriological culture media, preservation of bacterial stock culture, and decontamination of infectious laboratory waste materials. The media, prepared and supplied to various research projects and clinical laboratories in Dhaka and Matlab, were used for the growth
and isolation of microorganisms. In 2004, the section supported 44 research projects by supplying 160,900 culture plates and 670 litres of liquid media of different types. The following table shows the bacteriological media produced in 2004.

<table>
<thead>
<tr>
<th>Media</th>
<th>Production (litres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture media solid</td>
<td>3,218</td>
</tr>
<tr>
<td>Culture broth</td>
<td>620</td>
</tr>
<tr>
<td>Carbohydrate fermentation broth</td>
<td>39</td>
</tr>
<tr>
<td>Amino acid broth</td>
<td>11</td>
</tr>
</tbody>
</table>

The bacterial stock culture collection unit is equipped with 4 lyophilizer samples ranging from 0.2 mL samples to 300 mL bottles. In 2004, the unit supported 11 research projects and lyophilized 4,521 samples, which included *V. cholerae*, *Shigella*, *Salmonella*, and other research specimens.

As the primary decontaminating area of the Division, the section decontaminates and properly disposes of various infected and non-radioactive biohazard wastes. Depending on the material risk factor, decontamination and disposals are done by autoclaving, burial, or incineration.

The Media Preparation-Decontamination unit staff provided one-week extensive training to a technician from the National Institute of Population Research and Training, Dhaka.

Animal Resources Branch
Acting Head: K.M. Nasirul Islam

In 2004, the Branch performed animal experiments to support the research activities of the Centre’s scientists. The Branch arranged breeding of the required number of laboratory animals.

In total, 388 rabbits, 436 guineapigs, 646 rats, 8,514 Swiss albino mice, and 374 Balb/c mice were produced and supplied for research work. A total volume of 36,725 litres of blood of different research animals were also supplied from the Branch.

Forty-six internee doctors of the Government Veterinary Colleges in Bangladesh received training from the Animal Resources Branch.

Biomedical Engineering Cell
Head: A.K.M. Rahamatullah

The Cell offers installation, routine maintenance, repair, and calibration of analytical and biomedical equipment and ensures safe and reliable operation. In 2004, the Cell maintained 600 pieces of equipment without hiring any outside services. The first phase of the electrical safety work was completed, and the second phase to overcome the electrical load unbalancing and overloading problem is underway. The Cell provided technical assistance to the Institute of Public Health, Bangladesh Council of Scientific and Industrial Research, and Bangabandhu Sheikh Mujib Medical University.

Laboratory Logistics and Archive
Head: Md. Bodrul Ahsan Prodhan

The Laboratory Logistics and Archive section provides logistic, archival and managerial support to the laboratories of the Division; coordinates the installation, repair, renovation, and security; oversees the procurement of scientific equipment, reagents, chemicals, consumables, stationery, and other materials; maintains the Cold Room; and preserves the Specimen Bank for future use. It provides routine support to the scientists and researchers of the Centre by retrieving archived data, maintaining computerized data, and produces monthly recovery reports for the Clinical Laboratory Services and for the Media Preparation-Decontamination Unit. The Section produced and added 63,167 records to the existing database. Circulating the weekly surveillance report on major diarrhoeal pathogens isolated from stool/rectal swab samples, collected from a systematic 2% sub-sample of patients attending the Dhaka hospital of the Centre, is another important work of the section.
The Public Health Sciences Division (PHSD) brings the population perspective to the Centre’s mission and focuses on the development and evaluation of population-based packages of interventions to address major health problems, such as those used for reducing maternal and newborn deaths and managing childhood illnesses. It also provides the infrastructure to test vaccines (e.g. rotavirus, pneumococcus), determine drug resistance (e.g. to *Mycobacterium tuberculosis*), explore the epidemiology and consequences of specific problems (e.g. hepatitis E, arsenic, HIV/AIDS), and provide surveillance for such illnesses/conditions as cholera, intussusception, and tuberculosis. The behavioural scientists within the Division cut across projects to ensure an understanding of the barriers and facilitators to the use of health interventions (e.g. care-seeking, equity dimensions) and its provision (e.g. home-based delivery care). Generally, the Division determines how health and diseases are generated in the community with a focus on vulnerable or disadvantaged groups. It searches for simple, cost-effective approaches that could be widely applied and could increase the level of health equitably.

To structure the research efforts of the Division, it is divided into six units: Reproductive Health, Child Health, Health and Demographic Surveillance, Social and Behavioural Sciences, Epidemic Control Preparedness, and Matlab Health Research Centre, and houses four theme-based Centre-wide research programmes: Child Health, Reproductive Health, Population Sciences, and Poverty and Health. Through these units and programmes, the Division locates its research efforts in several sites throughout the country, most notably at rural Matlab in Chandpur district and at Chakaria in Cox’s Bazar district. Activities are also ongoing in other urban and rural sites of the country, including Sylhet, Mirzapur, Chowddagram, and Kapasia. The International Training Centre at Matlab provides facilities for local, regional and international training courses, and the one at Chakaria mostly caters to local training needs.

The scientific staff comprises public-health professionals, epidemiologists, social scientists, population specialists, and health economists. More than 800 staff members worked in the Division during the reporting period, of whom, 8 are at international level, 79 national officer level, and over 700 in other categories. Thirteen staff members are currently undertaking PhD degrees, and 7 are studying for master degrees at foreign universities.
The Division continues to expand with 35 ongoing research protocols.

Dr. Marjorie A. Kobinsky, a U.S. national, joined as Director of the Division on 1 September 2004, returning to the Centre after an 18-year absence. She had previously worked at the Centre in 1984-1986 as Project Director of the then MCH-FP Extension Project. Over the past 25 years, Dr. Kobinsky’s focus has been on reproductive health, specifically safe motherhood issues. Before joining ICDDR,B, she was Senior Scientist at the Johns Hopkins Bloomberg School of Public Health and Coordinating Researcher at the U.S. Office of IMMPACT (University of Aberdeen, Scotland).

Matlab Health Research Centre
Head: Md. Yunus

Located in Matlab upazila in Chandpur district approximately 57 km from Dhaka, the Matlab Health Research Centre (MHRC) provides a unique facility for conducting research and training on diverse issues concerning public health in developing countries. Clinical, epidemiological, nutritional and environmental health research is carried out alongside health services for the approximately 225,000 people in Matlab that address such health problems as diarrhoea, acute respiratory infections (ARIs), malnutrition, and other child and reproductive health problems, including basic maternity care. The Matlab field site serves as the largest and oldest population-based field site of ICDDR,B for research with medical support for these projects. Lessons learnt from research in Matlab have been used for policy formulation in Bangladesh. These also have the potential for policy and action in other developing countries. Research findings have been used also by international agencies, such as WHO, which stopped using a cholera vaccine based on the findings of the trials in Matlab. Comprising research and support branches (clinical, community health, and health and demographic surveillance; and administrative support services), the MHRC includes a team of well-trained and committed village-based Community Health Research Workers (CHRWS), four sub-centre clinics (each serving approximately 28,000 people) run by paramedical staff, and a primary care hospital for diarrhoea, respiratory problems, and maternity care, with basic laboratory facilities.

In 2004, 14,776 patients with diarrhoea received treatment at the Matlab health facility (23.6% more than in 2003). Of these, 20% required admission, and the overall case-fatality rate was 0.2%. Ten percent of these patients came from the Matlab Health and Demographic Surveillance System (HDSS) area. Culture of stool specimens from the patients of the HDSS area (n=1,533) found *Vibrio cholerae* O1 in 20.8% and *Shigella* spp. in 12.6%. No *Shigella dysenteriae* type 1 or *V. cholerae* O139 were found. In addition, 2,950 diarrhoea patients received treatment at the 3 community-based treatment centres.

Another 13,664 patients (6,970 women of childbearing age and 6,694 children aged less than 5 years) from the ICDDR,B service (MCH-FP) area received medical care at the MCH-FP clinic or Matlab facilities in 2004: 87% as outpatients and 12.7% as inpatients. Of 666 inpatient women with labour pains, 587 delivered at Matlab, while the remaining 12% plus 76 women with complicated labours from the outpatient clinic were referred to the Matlab upazila/Chandpur hospital. In total, 750 children aged less than 5 years were admitted as inpatients, and of them, 68% were treated for acute lower respiratory tract infections (ALRIs).

In addition, 31,031 patients comprising women of childbearing age, children aged less than 5 years, and adult males from the ICDDR,B service (MCH-FP) area received medical care for various health problems, including male sexual health problems, at the four sub-centre clinics. Three hundred sixty-eight deliveries were also conducted in the four clinics.

Moreover, the CHRWS provided primary treatment to 31,082 patients comprising children aged less than 5 years and women of childbearing age for common illnesses, such as fever and common cold, pneumonia, skin diseases, worm infestation, etc. These services were provided from 57 fixed-site clinics run by the CHRWS once a week in the ICDDR,B service (MCH-FP) area.

The International Training Centre at Matlab hosted several local and international training courses and seminars in 2004. One hundred and forty-four national and international visitors visited the Matlab facilities and ongoing research activities.

Arsenic exposure and health effects

There is growing concern about health risks resulting from widespread exposure to arsenic in many areas of Bangladesh and elsewhere in the region. To elucidate these health risks, a project in Matlab is screening the entire population for early identification of arsenic-induced effects in the form of skin lesions. An assessment of arsenic exposure is based on concentrations in all tubewells, in combination with individual retrospective histories of water sources used over time and arsenic concentrations in urine. In cases of elevated arsenic concentrations in water, mitigation activities are initiated. Various mitigation activities have been explored for acceptability and feasibility and their effect on arsenic exposure. An arsenic database is linked to the Matlab HDSS and includes geographical coordinates, age, depth and arsenic concentration of tubewells, information on arsenic exposure (urine metabolites), and skin lesions of individuals and their water-consumption pattern over the years.
The project activities so far have provided answers to the following questions:

- Who develops skin lesions and what are the risks at different exposure levels? Are there gender differences in the risk of developing skin lesions at a given dose and duration of exposure to arsenic-contaminated water?
- Has arsenic exposure resulted in excess numbers of miscarriages, stillbirths, and neonatal deaths in the past?
- What are the experiences of the village-based arsenic mitigation activities carried out so far as an integrated part of the project?
- To what extent does arsenic (and its metabolites) in the blood of pregnant women cross the placenta and is it present in the newborn child?

**Arsenic contamination**

In total, 16,461 tubewells were identified in Matlab. Water samples from 11,045 tubewells were analyzed by atomic absorption spectrophotometer and water samples from 2,689 tubewells by field-kits for arsenic content. The arsenic concentration ranged from 0.5 to 3,644 mg/L. Of the samples evaluated, 8,473 (62%) had arsenic levels of >50 mg/L and 1,273 (9%) had arsenic levels of >500 mg/L. The sensitivity and specificity of the field kit was 98% and 86% respectively.

**Table 1. Arsenic concentrations in tubewell water in Matlab, 2004**

<table>
<thead>
<tr>
<th>Arsenic concentration (mg/L)</th>
<th>Number (n=13,734)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>1,422</td>
<td>10.4</td>
</tr>
<tr>
<td>1-49</td>
<td>3,839</td>
<td>28.0</td>
</tr>
<tr>
<td>50-149</td>
<td>1,383</td>
<td>10.1</td>
</tr>
<tr>
<td>150-299</td>
<td>3,048</td>
<td>22.2</td>
</tr>
<tr>
<td>300-499</td>
<td>2,769</td>
<td>20.2</td>
</tr>
<tr>
<td>&gt;500</td>
<td>1,273</td>
<td>9.3</td>
</tr>
</tbody>
</table>

In total, 1,742 urine samples have so far been analyzed for arsenic. The average concentration is 137 µg/L, which is 10 times higher than in the non-exposed populations, 14 times higher than the WHO maximum, and 3 times higher than the Bangladesh standard. The findings demonstrate that the people are highly exposed to arsenic through drinking-water.

**Arsenic and skin lesions**

In all, 166,933 individuals were examined and interviewed, and content of arsenic in their drinking-water measured. Among them, 504 arsenic-induced cases were identified. The overall crude prevalence was 30/10,000. The male-to-female ratio was 1.2:1 (Fig. 1). Males had a significantly higher prevalence than females (3.6 vs 2.5/1,000). There was a clear gender-related dose-response relationship. The risk doubled when people consumed 100-199 mg/L and increased by nearly 15 folds in the >500-mg/L category which implies a clear dose-response relationship for arsenic-induced skin lesions in Bangladesh, with males being much more affected than females.

**Fig. 1. Prevalence of skin lesions in Matlab**

**Arsenic and reproduction**

An elevated risk of foetal loss and infant deaths was observed in relation to arsenic in drinking-water in a cohort study of 34,318 pregnant women in Matlab. The risk was significantly higher among women exposed to >50 mg/L arsenic in their drinking-water.

**Association of arsenic with maternal and cord blood**

This project will generate new and highly-needed knowledge on the association between arsenic exposures and determination of the extent to which arsenic and other chemicals in the blood of a pregnant woman crosses the placenta and is present in the blood of the newborn child. Further, the study will...
provide answers to examine the extent to which mothers and newborn children can methylate arsenic and determine whether blood homocysteine, folate and vitamin B12 concentrations are related to arsenic methylation. This information may provide useful knowledge in taking appropriate measures to help reduce the harmful effects of arsenic exposure in pregnant women and neonates in Bangladesh and other countries where environmental arsenic exposure is a problem. So far, 52 mother-cord blood samples were analyzed. Preliminary analysis revealed that the relationship between maternal cord-blood arsenic and lead is significant compared to selenium and manganese (Fig. 2). The collection of maternal cord-blood samples is underway, which is expected to be completed by early 2005.

### Table 3. Proportion of pregnancy outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number</th>
<th>Proportion(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livebirth</td>
<td>30,385</td>
<td>879</td>
</tr>
<tr>
<td>Spontaneous abortion</td>
<td>1,914</td>
<td>55</td>
</tr>
<tr>
<td>Stillbirth</td>
<td>982</td>
<td>28</td>
</tr>
<tr>
<td>Induced abortion</td>
<td>1,351</td>
<td>39</td>
</tr>
<tr>
<td>Infant mortality(^b)</td>
<td>1,646</td>
<td>54</td>
</tr>
</tbody>
</table>

\(^a\) Proportion per 1,000 pregnancies; \(^b\) Proportion per 1,000 livebirths

**Arsenic mitigation**

Several mitigation options were installed in the affected area of Matlab. No single intervention is universally affordable and acceptable, but villagers are using several methods. The most popular household method is the Alcan filter. This method efficiently removes arsenic, but requires a replacement element after 2 years that costs money. The 30 pond-sand filters installed reached more persons than all of the household-level interventions combined. However, construction of a pond-sand filter does not guarantee that families will always collect their water from the pond-sand filter, rather than from their typically more conveniently-placed tubewells. Nevertheless, these data demonstrate that there are several potential strategies to reduce arsenic exposure among at-risk populations in Bangladesh. Further research is necessary to evaluate the most effective, sustainable approaches.

**Fig. 2.** Scatter plot showing concentrations of arsenic, lead, selenium, and manganese in maternal and cord-blood
However, criteria for distribution of the safe water options are as follows:

- Willingness to bear 20% of the installation cost and 100% of the operational and maintenance costs
- Arsenic concentrations in water in the village
- Symptoms of arsenic toxicity in the village
- Poor socioeconomic condition

The study enrolled 105 households for 12 weeks. One woman in each household was taught how to treat tubewell water. Drinking-water and spot-urine samples were collected at baseline and 2, 5, 9, and 12 weeks after the intervention. Water and urinary arsenic and its metabolites were measured at different weeks of the intervention. The mean baseline arsenic concentration in tubewell water was 162 mg/L (range 15-543). Following initiation of the intervention,

### Table 4. Distribution of different village meetings performed by BRAC staff and community members on awareness of arsenic problems

<table>
<thead>
<tr>
<th>Component</th>
<th>Number of meetings</th>
</tr>
</thead>
<tbody>
<tr>
<td>General information on arsenic and about the project</td>
<td>142</td>
</tr>
<tr>
<td>Water-testing, skin screening, information about mitigation</td>
<td>142</td>
</tr>
<tr>
<td>Share test results and motivate to accept mitigation options</td>
<td>69</td>
</tr>
<tr>
<td>Follow-up meetings for sustainable use of the options</td>
<td>83</td>
</tr>
</tbody>
</table>

### Table 5. Distribution of different motivational activities performed by BRAC staff and community members on awareness of arsenic problems

<table>
<thead>
<tr>
<th>Component</th>
<th>Number of meetings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordination meeting</td>
<td>79</td>
</tr>
<tr>
<td>Street meeting</td>
<td>159</td>
</tr>
<tr>
<td>Meeting at educational institutions</td>
<td>22</td>
</tr>
<tr>
<td>Popular theatre</td>
<td>27</td>
</tr>
<tr>
<td>Video show</td>
<td>40</td>
</tr>
</tbody>
</table>

### Table 6. Safe water options distributed during the study period

<table>
<thead>
<tr>
<th>Safe water options</th>
<th>Total number of options</th>
<th>Total families covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household-based option</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three-pitcher filter</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td>Alcan filter</td>
<td>653</td>
<td>653</td>
</tr>
<tr>
<td>Safi filter</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Bishudhwa filter</td>
<td>140</td>
<td>140</td>
</tr>
<tr>
<td>Rainwater harvester</td>
<td>115</td>
<td>115</td>
</tr>
<tr>
<td>Community-based option</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pond-sand filter (PSF)</td>
<td>16</td>
<td>1,600 (100/PSF)</td>
</tr>
<tr>
<td>Total</td>
<td>1,047</td>
<td>2,631</td>
</tr>
</tbody>
</table>

**Arsenic and flocculent-disinfectant**

This mitigation effort aims at evaluating the effectiveness of a point-of-use flocculent-disinfectant for arsenic mitigation and improving the quality and microbial safety of surface water. The study enrolled 105 households for 12 weeks. One woman in each household was taught how to treat tubewell water. Drinking-water and spot-urine samples were collected at baseline and 2, 5, 9, and 12 weeks after the intervention. Water and urinary arsenic and its metabolites were measured at different weeks of the intervention. The mean baseline arsenic concentration in tubewell water was 162 mg/L (range 15-543). Following initiation of the intervention,
markedly reduced arsenic levels in tubewell water and, to a lesser extent, urinary arsenic in women who consumed treated water. All pre-treatment samples (n=101) were non-potable and were contaminated with a mean of 2.9x10⁴ CFU/100 mL faecal coliforms. Turbidity ranged from 6 to 92 NTU. Following treatment, 97 (96%) samples met the potability guideline. Treatment resulted in a mean reduction of 87% in turbidity (mean 4 NTU) with 93% of the samples meeting the WHO turbidity guideline of <5 NTU. Free chlorine was detected in 83% of the samples. Further 35 surface-water samples were collected and treated with the flocculent-disinfectant 3 times at one-month interval and were analyzed for faecal coliforms. Following treatment with the flocculent-disinfectant, 96% of the surface-water samples met the WHO bacterial potability guideline. The samples showed markedly-improved clarity. This strategy may be useful in programmes for improving the quality and safety of drinking-water.

The findings of this population-based study showed that more than half of the population in a rural area of Bangladesh has been drinking arsenic-contaminated water for many years. Hence, public health/biomedical interventions for early diagnosis and treatment of arsenic-induced skin lesions are urgently required, among other steps, to make inroads to this massive public-health problem in Bangladesh.

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**Epidemic Control Preparedness Unit**
Head: A.K. Siddique

**Surveillance of cholera at sentinel sites**

During 2004, the sentinel surveillance of cholera continued with new funding from the National Institutes of Health, USA. The 114-day clinical surveillance was conducted in Bakerganj and Mathbaria Upazila Health Complexes (UHCs) of greater Barisal district. Despite the countrywide flood and disruption of the communication system during July-September 2004, none of the scheduled surveillance sessions was missed.

Of 8,445 patients who attended the two surveillance sites, 255 attended for treatment of acute watery diarrhoea, and 140 were hospitalized. The surveillance physicians collected 204 rectal swabs, of which, 47 were positive for *V. cholerae* O1. Eight (17%) of the 47 cholera cases were aged less than 5 years and 32 (68%) were aged 5-44 years. More than one-third (40.4%) of the cases had severe dehydration, and 51% had some dehydration. Geographic information system (GIS) personnel visited the surveillance sites and completed mapping of the water bodies (ponds and canals) for the environmental component of the study in the sentinel areas. The GIS mapping was also completed for the households of cholera patients to observe the relationship between clinical cholera and environmental factors.

During the year, no *V. cholerae* O139 was detected from any cholera patients (Fig. 3). *V. cholerae* O1 was isolated in Bakerganj almost every month throughout the reporting period, whereas in Mathbaria, 92% of *V. cholerae* O1 was isolated in April and May 2004.

![Conducting health counselling sessions with the community members, mainly women of childbearing age, is a regular activity of the ICDDR,B sub-centres.](image)
Health and Demographic Surveillance Unit
Head: Peter Kim Streatfield

The Health and Demographic Surveillance Unit (HDSU) evaluates the impact of different interventions relating to population, health, and socioeconomic issues. The Unit has two functional sub-units: (1) Health and Demographic Surveillance System (HDSS) and (2) Geographic Information System (GIS). Demographic surveillance in Matlab started in 1966, and the surveillance of health conditions was added in 1978 in one half of Matlab (ICDDR,B service area). The GIS component was initiated in 1994. This system for collecting demographic data on more than 200,000 people for over 36 years is the longest-running demographic surveillance system in the world. Activities during 2004 are reported in the chapter on Population Sciences.

Child Health Unit
Head: Shams El Arifeen

The Child Health Unit (CHU) contributes to the development of cost-effective child health and survival programmes by enhancing the understanding of causes of childhood morbidity and mortality and by testing cost-effective public-health interventions. The mandate of the Unit is (a) to conduct programmatic and policy-relevant child health research in collaboration with different research programmes and divisions within the Centre and with national and international institutions and (2) to assist the Government of Bangladesh and other partners in programme development, policy review, and analysis. The CHU has identified the following broad areas of priority research: (a) enhancing the understanding of causes of childhood, perinatal and neonatal morbidity and mortality, (b) prevention and management of low birth-weight, (c) studying child growth and development, including caring, care-seeking practices, and nutritional interventions, (d) testing and evaluation of different vaccines for reducing child morbidity and mortality, and (e) strengthening health systems for delivery of child health practices. Activities during 2004 are reported in the chapter on Child Health.

Reproductive Health Unit
Head: Marjorie Koblinsky

The Reproductive Health Unit (RHU), created in 1996, is mandated to address issues relating to

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Case studies for Safe Motherhood: Learning from South Asia

With the achievement of MDG 5 (reduce maternal mortality ratios by three-quarters between 1990 and 2015) as the stimulant and ultimate goal, we will work with policy-makers and programme managers in up to six sites in South Asia (Pakistan, Bangladesh, and the Indian states of Tamil Nadu, Uttar Pradesh, Rajasthan, and Gujarat) to develop recommendations for policies and benchmarks for programme performance. The focus will be settings with maternal mortality rates (MMR) greater than 300 that report little or no progress over the past decade towards MMR reduction or uptake of skilled birth attendants as a proxy. Information to support the recommendations will come from local assessments of programme elements associated with successful MMR reduction in Malaysia, Sri Lanka, and China. These include:

- high availability of birthing facilities and skilled birth attendants
- reduction of known barriers to the use of intrapartum care, including transport, costs, distance, perceived poor-quality care, and social barriers
- supportive government policies
- coordination of the health system to effect referrals
- targeting of disadvantaged areas

These elements will also be assessed in other successful South Asian settings (e.g. Kerala and Matlab) to enhance their usefulness.

Steps to determine the recommendations include a stakeholder analysis; stakeholder meetings to advise and interpret research; assessment of programme elements by local researchers through operations research and case studies of past programme inputs and policies; and an assessment of affordability of selecting programme elements across settings. Policy-makers will be asked to help interpret the research through periodic informal and formal meetings during the assessments and a workshop with their peers from successful settings to determine future directions following data collection.

By examining how the elements are approached through policy and programme implementation, how they influence the interface of services with women in less and more successful settings, and their affordability and replicability in resource-poor settings, recommendations for feasible context-specific programming for safe motherhood can be made and benchmarks for progress set.
reproductive health research in line with the Centre’s mission. The Unit conducts research in critical and priority areas of reproductive health in various parts of Bangladesh. The Unit conducts programmatic and policy-relevant research in collaboration with other programmes in the Centre and national and international organizations. The Unit works with the Government of Bangladesh to address policy and programme issues of national relevance. Presently, the RHU is: (1) developing and testing strategies for improving knowledge and practices regarding reproductive health in adolescents; (2) understanding the issue of violence against women in the social context and developing public-health strategies to reduce this; (3) operationalizing ‘male-involvement’ in reproductive health and monitoring this involvement; (4) developing and testing different maternal health strategies and tools to monitor progress to achieve Millennium Development Goals (MDGs) and thus to contribute significantly in the fight against maternal mortality; and (5) undertaking research for development of intervention programmes for prevention and management of sexually transmitted diseases and HIV/AIDS. Activities during 2004 are reported in the chapter on Reproductive Health.

Social and Behavioural Sciences Unit
Head: Abbas Bhuiya

The goal of the Social and Behavioural Sciences Unit is to institutionalize social and behavioural science research in ICDDR,B. Towards this end, pertinent research on issues, such as community development, poverty mapping, nutritional status, health and equity, HIV/AIDS, violence against women, sexual behaviour, safer motherhood, are being carried out. The secretariats of the Bangladesh Health Equity Watch and the Poverty and Health Programme are also housed in the Social and Behavioural Sciences Unit.

Fourteen research projects led by the SBSU researchers were ongoing in 2004. Support was also extended to other research studies. Building capacity of the staff continued in 2004. At present, 3 staff members are pursuing their higher studies abroad under the Centres’ Staff Development Programme. Activities during 2004 are reported in the chapter on Poverty and Health.

Re-initiating fertility decline in Bangladesh by meeting the needs of high-parity couples

Total fertility rate in Bangladesh has been stagnant at around 3.0 for the last 10 years. Analysis of national data revealed that 33% of births in a year took place among couples with 3 or more living children. Around 90% of the couples with three or more living children did not want any additional child; nevertheless, the contraceptive use-rate among them is only 48%. Thus, a higher contraceptive use-rate among the high-parity couples can easily reduce total fertility rate significantly. This is now being tested through a project, which will fulfill the unmet family planning needs of high-parity couples in two rural areas of Bangladesh. This quasi-experimental study, in intervention and comparison areas, is being implemented in partnership with Directorate of Family Planning, National Institute of Population Research and Training, and Engender Health, an NGO working on long-term contraceptive methods.

Improvement of health through community development-oriented programme in rural Bangladesh

Chakaria Community Health Project

The Chakaria Community Health Project, initiated in 1994, has mobilized the community people through indigenous self-help organizations and made them aware of their health needs, available health resources, and use of these resources in improving
their health conditions through participatory methods. The purpose is to establish self-help for health through community participation.

Health resources established by the villagers include the village health posts staffed with project doctors and paramedics who provide health education and curative care services. In 2004, ICDDR,B established a diagnostic laboratory to provide services to villagers at a reasonable cost. The money generated by the laboratory is being utilized to support health services in Chakaria. In 2004, 3,232 diagnostic tests, including biochemical and haematological tests, urine and stool analyses, and serological tests, were done in the laboratory. The community midwives, trained by the Project, provide antenatal and postnatal care services to the community.

Figure 4 shows that antenatal care increased in the intervention area significantly during 1999-2004.

A major goal of the Project is to create a health impact among the disadvantaged groups. Figure 5 shows the comparative attendance of patients at the village health posts by gender.

In 2004, most patients visiting the village health posts were female. A socioeconomic and demographic surveillance, covering 7,000 households, is ongoing to monitor the impact of the Project in the community, particularly among the poor.

The Pilot study on epidemiological and socio-economic factors related to malaria in endemic communities of Bangladesh was carried out by Dr. Yukiko Wagatsuma, a Scientist of ICDDR,B.

We are grateful to the “Friends of Dr. Muntazirul Hye Sabir” for the generous gift to support part of this larger malaria project. That support went towards prototype testing of insecticide for impregnated mosquito nets in Chakaria upazila of Cox’s Bazar district.

Paramedics are diagnosing malaria using dipstick test in a community clinic operated by Kakara Community Cooperative in Chakaria upazila, Cox’s Bazar district. Previously, patients had to wait for 1-2 days to get blood smear result from Chakaria town commercial laboratories. Now they can be diagnosed for falciparum malaria within 5 minutes and receive appropriate second-line drug at the same consultation visit at community clinic.
The Information Sciences Division is responsible for the two-way flow of information and knowledge transfer into and out of the Centre.

The Division is now made up of Training and Education Unit, Publications Unit, Library and Information Services Unit (LISU), Computer Information Services Unit (CISU), Audiovisuals Unit, and Data Management Unit.

During the latter part of 2004, the Dissemination and Information Services Centre (DISC) was divided into Publications Unit and Library and Information Services Unit. This move is intended to provide the administrative background for an expansion of the role of the Publications Unit in working with other divisions on increasing the publications output of the Centre. In addition, the physical separation of the two units will allow each to expand and provide long-needed additional space for library users and materials on the one hand, and publications processes and storage on the other.

The Division has again been active during 2004 in the DFID-supported Poverty and Health Project, being responsible for two components of the project—communications and training.

In addition to providing logistic assistance for research-related training courses in the area, the TEU is also responsible for managing the recruitment and monitoring of Poverty and Health Fellows. The first group of fellows completed their assignment in the first quarter of 2004. Three are still employed by other projects in the Centre. A staff member of the Pakistan Institute of Development Economics was recruited as a Regional Poverty and Health Fellow who began his assignment in February 2004. Three more national fellows were recruited, who began work on 1 August 2004.

Upgrading of infrastructure in the CISU continued throughout 2004 to ensure an improved and more secure environment, both for our website and for the Internet and email use by Centre staff. The Centre’s computer system is now placed behind a firewall; incoming emails and web pages are automatically checked for viruses, and a more secure IP addressing system has been introduced.

The Computer Training Laboratory has been in almost continual use during the year for training all staff in the use of the Navision Management Information System which was implemented in February 2004. In addition, a number of training courses organized by the TEU, such as the measurement of poverty, epidemiology and biostatics and the health and demographic surveillance system courses, continue to benefit from the use of this facility.

The introduction of the MS Navision system early in 2004 meant that several members of the CISU have been kept busy troubleshooting the system and providing guidance and assistance to users throughout the Centre. A Help Desk has been set up to facilitate user service and assistance. The CISU is now responsible for the routine management of the system,
and so far implementation and initial use has progressed very smoothly for users throughout the Centre. The Division has been working closely with the BRAC University James P. Grant School of Public Health which will welcome its first students early in 2005. Intensive 1-2-week short courses scheduled for the second half of the year will involve almost continual use of one of the training rooms of the Centre; scientific staff are also involved in some of these courses.

A notable step to upgrade the services provided by the LISU was the acquisition of Alice for Windows, an integrated library software package installed in the Centre’s library in May 2004. It is now in use for all new library accessions. This software package was selected because it offers all of the functions required by the library, including management of orders, loans, and journal receipts, in addition to bibliographic searching of the catalogue and other databases maintained by the Unit. The most striking feature of the software from the users’ perspective is that the databases will be available from their desktop computers and where PDF files of materials are available, these will also be available to view immediately. Efforts to implement these facilities continued throughout the year.

Notable among the Centre’s publications in 2004 were two special issues of the Journal of Health, Population and Nutrition on healthcare use and on the introduction of new vaccines in developing countries.

Consultancy

WELL is a resource centre network providing access to information and support in water, sanitation and environmental health for the UK Department for International Development (DFID). WELL is managed by a core team led by the Water, Engineering and Development Centre (WEDC) at Loughborough University (UK), working in partnership with IRC: International Water and Sanitation Centre (The Netherlands) and the London School of Hygiene & Tropical Medicine (UK). The Centre is one of six network partners from developing countries who participate in WELL activities.

The Director of ISD, Peter Thorpe, has been working with WELL as a consultant to develop a distance-learning course in the dissemination of research findings. This course was completed during 2004 and involved two pre-testing workshops, both held at the African Medical and Research Foundation (AMREF) in Kenya. During the coming year, the course will be piloted by other WELL network partners and also be made available on the WELL website.

Training and Education Unit
Head: A.N. Alam

The Centre organizes national and international training courses and workshops to fulfill its objectives of: (a) increasing capacity to conduct research in developing countries; (b) improving skills of health personnel through hands-on training on specific aspects of diarrhoeal diseases and nutritional problems; and (c) improving response to new and emerging issues in health and population science. The courses and workshops, organized in collaboration with Centre’s scientific divisions and, at times, with national and international organizations, are designed to provide participants with the knowledge and skills applicable to their needs.

In 2004, 450 scientists, physicians, health administrators and other health personnel, and trainers from 18 countries participated in 19 courses and workshops (Table) conducted by the TEU. Another 821 persons received orientation training on different aspects of diarrhoeal diseases, nutrition, and reproductive health.

Japan International Corporation of Welfare Services (JICWELS), Office of the Foreign Disaster Assistance (OFDA), USAID/Washington, World Health Organization (WHO), DFID, Government of Japan, and University of Uppsala, Sweden, provided support to most training programmes.

A new training venture for the Centre was the Global Medicine Course arranged at the request of Uppsala University, Sweden. The course was organized for 21 medical and nursing students from the Department of Women’s and Children’s Health of the University’s Academic Hospital during 23 May-3 June 2004. They received training on the management of diarrhoeal diseases and malnutrition, both in hospital setting and in field. They spent the first week in Dhaka when they received classroom teaching, followed by hands-on bedside training in the hospital. They participated in clinical rounds and other activities in Dhaka and Matlab and in the villages under the Matlab Health Research Centre. The Unit is planning to introduce this training opportunity to other western universities in the coming years.

Future strategy

The future strategy of the Unit is to: (a) strengthen collaboration with universities within and outside Bangladesh that could offer postgraduate diplomas/degrees; (b) collaborate with regional institutions to develop and offer new courses; and
**Table. Details of training activities in 2004**

<table>
<thead>
<tr>
<th>Title of courses/workshops</th>
<th>No. of courses/workshops (n=19)</th>
<th>No. of participants (n=450)</th>
<th>Countries represented (n=18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health research training</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introductory course on epidemiology and biostatistics</td>
<td>3</td>
<td>48</td>
<td>Bangladesh</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>International courses/workshops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course on emerging and re-emerging pathogens</td>
<td>1</td>
<td>6</td>
<td>Japan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course on emergency response to cholera and <em>Shigella</em> epidemics</td>
<td>1</td>
<td>10</td>
<td>Afghanistan-2, Bangladesh-2, Germany-1, Indonesia-2, Japan-1, Kenya-1, USA-1</td>
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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Workshop on management of severe malnutrition</td>
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<td>Afghanistan-2, Bangladesh-8, Laos-2, Nepal-2, Pakistan-3, Yemen-2</td>
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<tr>
<td>Global medicine course with students from Sweden</td>
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<td>21</td>
<td>Sweden</td>
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</tr>
<tr>
<td>National courses/workshops</td>
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<tr>
<td>Clinical management of diarrhoeal diseases (SWIT)</td>
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<td>10</td>
<td>Bangladesh</td>
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<tr>
<td></td>
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<tr>
<td>Course on Exploring poverty and health using PRA</td>
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<td></td>
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<tr>
<td>Course on flood-related health problems</td>
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<td>201</td>
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<tr>
<td>Course on clinical management of diarrhoeal diseases for FCGP</td>
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<td>Course on clinical management of diarrhoeal diseases for DCH/MD</td>
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<td></td>
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<tr>
<td>Fellowship programme</td>
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<tr>
<td>International fellowship (elective, post-graduate, diploma students)</td>
<td>-</td>
<td>56</td>
<td>Afghanistan-1, Austria-1, Bangladesh-32, Canada-2, Germany-1, Hungary-1, India-1, Japan-1, New Zealand-3, Thailand-1, USA-12</td>
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<tr>
<td>Clinical fellows (1 year)</td>
<td>8</td>
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<td>Bangladesh</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurse fellows (1 year)</td>
<td>8</td>
<td></td>
<td>Bangladesh</td>
</tr>
</tbody>
</table>
In October 2004, the Centre’s Dhaka hospital was as busy as ever. However, this time, not only with patients, their caretakers, and the hospital’s regular healthcare staff but also with groups of health workers from local NGOs. In another example, of how the Centre has responded to this year’s flooding crisis, the Training and Education Unit has been running courses to give NGO staff a first-hand opportunity to improve their knowledge and skills in the treatment of patients suffering from diarrhoeal and other health problems common during and after floods. In total, 201 health workers were each given an intensive two-day training, with both theoretical and bedside sessions. Eight such courses were held from 3 to 26 October. On return to their organizations, the performance of the trainees will be evaluated during follow-up visits to their own clinics and field sites by the training team. Staff from 4 NGOs: Bangladesh Women’s Health Coalition, Shimantik, Population Services & Training Centre, and the Urban Primary Health Care Project, who have recently been providing flood relief services in the area to the east of Dhaka, benefited from the training funded by the Government of Japan.

Publications Unit
Head: M. Shamsul Islam Khan

Under a reorganization programme, two separate units—Publications Unit and Library and Information Services Unit—were created at the end of September 2004 by dissolving the Dissemination and Information Services Centre (DISC). The Head of DISC was reassigned to lead the Publications Unit to organize it and initiate more programmes. Mr. Peter Thorpe was assigned as Head of Library and Information Services Unit. The mission of the Publications Unit is to disseminate the results of research on health, population, and nutrition for solving the common health, nutrition and population problems, especially in the context of the developing world.

Important tasks of the Publications Unit include editing and production of the Centre’s annual report, a peer-reviewed quarterly journal, newsletters, working papers, and scientific reports, extending editorial advisory services to projects and other units of the Centre, and dissemination of the findings of research carried out at the Centre through various publications and the website. The Unit maintains a mailing database of over 4,000 individuals, organizations, and libraries as recipients of selected publications produced by the Centre. Five personnel managed the activities and services of the Unit.

(c) identify new donors for additional funds to implement future plans and to make the training programmes self-supportive. A new initiative will be undertaken to arrange production of CDs containing training materials for introducing distance learning.

Major achievements
In 2004, the Publications Unit staff organized, edited, and produced: (a) Annual Report 2003, (b) 4 issues of Glimpse, (c) 4 issues of Journal of Health, Population and Nutrition (JHPN), (d) 2 issues of Shasthya Sanglap, and (e) 1 Souvenir of the ICDDR,B Alumni Association. With the June 2004 Issue of Glimpse, the newsletter was given a new look, and the contents were disseminated in a more attractive way. In 2004, the JHPN received 134 manuscripts from 34 different countries for publication; 54 papers were published in four issues; two of these issues were exclusively devoted to ‘Healthcare Use’ and ‘New Research Agenda for Introducing New Vaccines in Developing Countries: Translational Research’; The Journal rejected 75 manuscripts after careful expert review. The two special issues were produced in collaboration with the International Vaccine Institute, Seoul, Republic of Korea.

In October 2004, the Centre’s Dhaka hospital was as busy as ever. However, this time, not only with patients, their caretakers, and the hospital’s regular healthcare staff but also with groups of health workers from local NGOs. In another example, of how the Centre has responded to this year’s flooding crisis, the Training and Education Unit has been running courses to give NGO staff a first-hand opportunity to improve their knowledge and skills in the treatment of patients suffering from diarrhoeal and other health problems common during and after floods. In total, 201 health workers were each given an intensive two-day training, with both theoretical and bedside sessions. Eight such courses were held from 3 to 26 October. On return to their organizations, the performance of the trainees will be evaluated during follow-up visits to their own clinics and field sites by the training team. Staff from 4 NGOs: Bangladesh Women’s Health Coalition, Shimantik, Population Services & Training Centre, and the Urban Primary Health Care Project, who have recently been providing flood relief services in the area to the east of Dhaka, benefited from the training funded by the Government of Japan.

Publications Unit
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(c) identify new donors for additional funds to implement future plans and to make the training programmes self-supportive. A new initiative will be undertaken to arrange production of CDs containing training materials for introducing distance learning.
In addition, the publications staff edited the June 2004 Issue of the Health and Science Bulletin, a Bangla document on the HIV/AIDS Surveillance Report, and the bilingual document on Gender Policy, published from other units of the Centre. The Unit also assisted in the production of 5 internal publications by other units of the Centre. To ensure the quality of publications, the Publication Unit rendered services to the scientists by editing 11 papers (504 pages).

The Centre’s website was further enriched by putting the Centre’s internal publications produced in 2004. Besides, 107,900 copies of different publications were distributed/mailed to over 120 countries. The Unit arranged display and distribution of publications in various important meetings, workshops, and conferences as part of the promotional activities of the Centre. Three hundred new addresses were added to the mailing database, and 500 addresses were updated.

The Head of the Publication Unit was invited to give lectures on the use of and access to electronic information resources in various training programmes and workshops in Dhaka. Mrs. Hamida Akhter, Information Assistant, attended the one-year Postgraduate Diploma Course in Library and Information Science at the Institute of Library and Information Science under the National University, Dhaka.

Future programmes

Several initiatives are planned in the coming years to strengthen the publication and dissemination activities of the Centre. These include: (a) organization and updating of ICDDR,B publications database, (b) publication of fact sheets based on, and dissemination of, findings of research and/or studies carried out by the scientific staff of the Centre, digitization of information resources, (c) publication of a health, population, and nutrition research bulletin for disseminating findings of studies and research in progress at the Centre, (d) compilation of bibliographies of the ICDDR,B publications to supplement the previous ones, including an annotated bibliography on Matlab studies, and the JHPN articles and to publish these for wider dissemination and also for putting these in the website, (e) expansion of the distribution base of the JHPN and newsletters, (f) organizing courses on development of editing and writing skills and on the digitized knowledge-base system, and (g) earning of increased revenues by enhancing subscriptions level of the JHPN and from training programmes.
and installed Alice for Windows, an integrated library management software for managing library operations. The acquisitions, catalogue, serials control, stocktaking and circulation modules were obtained to improve library services to the patrons. All existing CDS/ISIS-based library databases have been transferred to Alice. During this period, the library staff generated 821 barcode levels for books, 874 for bound journals, 2,524 for loose journals, 1,081 for ICDDR,B publications, 122 for CD-ROMs, and 411 for documents. These materials can be charged and discharged using the barcodede-generated library cards. To render better circulation services, 749 cards were issued to the Centre staff and library members.

Computerized literature searches were requested by, and provided to, 400 staff members and 175 external users. In total, 40,581 of pages of photocopies were done and supplied to the users (28,165 pages to outside library users).

Under the inter-library loan programme, 887 books and bound journals were lent and 3 CD-ROMs and 42 books were donated to outside organizations for their use. Under corporate membership, the library borrowed books and videos from the British Council Library in Dhaka. As usual, the Nuffield Library of the British Medical Association provided photocopies of journal articles, free of charge.

During this period, the Unit conducted 11 batches of a three-hour training session on web-based literature search for library patrons and outsiders. About 184 persons (35 from the Centre) participated in these sessions. Six students from the University of Dhaka and one from the Institute of Library and Information Science participated in the training programme provided by the Unit.

Two Senior Information Officers of the Unit attended several national and international workshops and conferences.

Audiovisuals Unit
Head: Asem Ansari

The Audiovisuals Unit (AVU), with 3 staff members, provides support to the Centre’s scientists by preparing graphics material for their documents and audiovisual presentations. The Unit is also responsible for the cover design of all publications and formatting of the Centre’s quarterly newsletter Glimpse and the Annual Report.

In 2004, production of digital multimedia presentation materials, like PowerPoint presentations, etc, pictures, microphotography, gels, animal dissection photography, graphs, and charts continued. The Unit arranged audio- and video-recording of important meetings, seminars, symposia, and conferences organized at the Centre, in addition to taking photographs of important visitors to the Centre. The Unit gives service for multimedia projection for all kinds of activities of the Centre.

During the reporting year, the Unit designed covers, laid out pages, and processed graphics output for the Annual Report 2003, all issues of the newsletter Glimpse published during 2004 and produced the Centre’s calendar and year planner for 2005, along with a number of brochures, posters, and many other display materials. A big photographic coverage was given for the floods which occurred in July 2004 in Bangladesh.

Renovation work is going on to give a new look and more organized performance. The Unit plans to add new upgraded Apple Macintosh computer for more efficient graphic-based work for the Centre.

Computer Information Services Unit
Head: M. Farhad Hussain

The Computer Information Services Unit (CISU) provides, coordinates, and manages information and communication technology (ICT)-related services at the Centre. It supports the research and management programmes of the Centre with efficient, cost-effective information systems, networking, and communication services. The objectives of CISU are to: (a) provide state-of-the-art computing and communication facilities; (b) provide high-quality, centralized and integrated support services; and (c) develop appropriate ICT policies, standards, and guidelines. The Unit carried out its activities with 11 personnel.
ICDDR,B has a new research initiative on the “Impact of Climate Change on Health.” To facilitate acquisition of the meteorological data needed for this study, an automatic weather station was installed on the rooftop of one of the buildings on the ICDDR,B campus in Dhaka earlier in 2004. The weather station enables us to have a continuous supply of every minutes data on key meteorological variables, including wind speed (scalar average and vector average), wind direction, wind direction turbulence, wind speed nurturance, temperature, relative humidity (%), pressure (hPa), sunshine (W/m²) and precipitation (mm/min). This equipment was provided by the Disaster Prevention Research Institute (DPRI), Kyoto University, through an agreement between DPRI and ICDDR,B. The data are transferred from Dhaka to Kyoto via the Internet and after processing are available on the project website.

Major achievements

The Centre’s computer network is connected to the international Internet backbone through a satellite-based communication system, and its Dhaka and Matlab stations are connected through a microwave link with the Internet, email and data-transmission facilities. The Unit maintains the communication infrastructure and local-area network of the Centre with more than 700 computers. CISU also maintains several servers for databases, applications, email, web-hosting, and domain authentication. It holds a file and print server to provide centralized data backup and printing services. The database-driven, knowledge-based dynamic website of the Centre (http://www.icddrb.org) was made more user-friendly and interactive with provision of online update of web pages. The intra-website (http://Centre) has also been developed as a database-driven, interactive and dynamic website. The Internet bandwidth was upgraded from 512 kbps to 768 kbps. A firewall, a gateway virus protection, and an intrusion detection system now secure the Centre’s network.

CISU has intensively worked to implement the Integrated Laboratory Management System for the Clinical Laboratories Services Programme. It has developed disaster-recovery plans for the servers and has been playing a major role in the process of implementation, maintenance, and support of the Suchona MIS at the Centre.

Despite an increased number of the Internet, email system and network users, mission-critical tasks, and also the growing need for information and communication by the researchers and scientists, the Unit kept the network up and running with minimum congestion and negligible downtime. Services relating to the repair of, and support for, computers, printers, and networking equipment were provided as usual. The software and hardware support teams worked both at user-end and in computer hardware laboratory to make certain prompt and quality services for the computer users. During the last quarter of 2004, work began to develop an integrated web-enabled Contacts Management System to provide facilities for adding, editing, and viewing information by individuals associated with the Centre and for communication electronically. The system will allow interested persons, libraries, and organizations to subscribe to publications, and potential trainees will be able to apply online to participate in training courses organized by the Centre. The system will maintain information about the participants of various conferences organized by the Centre and will provide facilities for searching the database at the end-user level.

Future planning

CISU is working to ensure high availability of computing resources at the Centre. It plans to leverage the existing ICT infrastructure and is looking into data protection solution that will provide disaster-recovery requirements while simplifying backup and accelerating time-to-recovery. It is also looking to implement simple-to-manage, cost-effective solutions for database infrastructure that need mission-critical 24x7 availability with minimal downtime. It expects to install a system that will make tedious tasks, such as load-balancing storage space or backing up or restoring terabytes of data, to improve productivity and use of critical resources in the ICT environment.

Data Management Unit

Head: M. Farhad Hussain

The Data Management Unit, working with 2 personnel, under the administrative and technical supervision of the Head of CISU, provides support and solutions to those units of the Centre which have nso data-management staff of their own. The Unit developed, customized, and maintained a Patient Management System for the Centre’s Staff Clinic, developed a Laboratory Management System for the Nutritional Biochemistry Laboratory, and developed an Inventory Management System for the RTI/STI Laboratory. It played an active role in the process of implementing the Suchona MIS and continues to provide support to the Suchona users at the Centre. The Unit is providing maintenance and enhancement support for the developed applications.
EXECUTIVE DIRECTOR'S DIVISION

Executive Director

- External Relations and Institutional Development
- Executive Director's Office
- Grants and Contracts Administration
- Human Resources
- Staff Development
- Finance
Human Resources
Director: Ann Gauvin Walton

As a strategic partner of the Centre, Human Resources, with 19 staff members, is committed to providing quality HR management services. These include: recruitment and placement; contract administration; compensation and benefits; gender issues; staff training and development; performance management; staff and succession planning; staff welfare and counselling; development of HR policy; and HR management information system. Human Resources also looks after the well-being of employees and their dependants by providing free or subsidized medical care through its Staff Clinic.

Throughout the year, Human Resources provided support to the recruitment of 124 Fixed-term employees, 321 Contract Services Agreement (CSA) holders, and 462 Daily Wagers. At the end of December 2004, the Centre had a staff complement of 1,953. Table 1 depicts the gender distribution of total staff in various employment categories, and Table 2 shows the number of newly-recruited employees.

Following the adoption of the Gender Policy by the Board of Trustees in June 2003, the Centre has taken a number of steps towards its implementation.

A Gender Organizational Review conducted by Human Resources was a significant achievement for the Centre in 2004. The review assessed key organizational structures and procedures to identify whether they promote or hinder the gender equality goals formulated in the Gender Policy and identified possible measures to overcome these biases.

Table 1. Number of national and international employees by gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Fixed-term</th>
<th>Short-term</th>
<th>Seconded</th>
<th>Fixed-term</th>
<th>Contractual</th>
<th>Daily wager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>13</td>
<td>2</td>
<td>8</td>
<td>738</td>
<td>168</td>
<td>70</td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>483</td>
<td>382</td>
<td>77</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>6</td>
<td>11</td>
<td>1,221</td>
<td>550</td>
<td>147</td>
</tr>
</tbody>
</table>

These recommendations, combined with the objectives and activities in the Policy, have formed the basis for short-, medium- and long-term objectives. In 2004, the post of Gender Specialist was established, and a Gender Awareness Workshop was developed in Bangla and English to be attended by all employees over the next 18 months. In addition, the Gender
Equality Committee submitted the first annual progress report for gender development activities to the Board of Trustees.

Another key development for HR was implementation of the new computerized Management Information System—Suchona, which provides a unified system for Finance, HR, and projects. The system ‘went live’ on scheduled 1 February 2004 and has radically changed the manner in which HR provides services to the Centre. While Suchona is working well, increased benefits will be realized over the next several years as the entire Centre develops not only the capacity to fully use the information available but uses this for improved management.

New International Professional Staff

Two persons joined the Centre as new International Professional staff. One was promoted to the international level.

Dr. Marge Koblinsky, an American national, joined as Director of the Public Health Sciences Division on 1 October 2004; Dr. Stephen P. Luby, an American national, joined on secondment from the Centers for Disease Control and Prevention, USA, on 10 August 2004; and Dr. Md. Yunus was promoted to International Professional level on 1 January 2004 as Senior Scientist and Head of the Matlab Health Research Centre.

Staff Development Office
Manager: Bejoy R. Saha

Under the staff-development programme, 126 staff members benefited in 2004 with financial support from the Bill and Melinda Gates and Bangladesh Government to the Centre, Circle-Around-the-Centre Fund, and fellowships from several agencies and various projects of the Centre.

Foreign training: Fifty-one personnel attended training courses and study programmes in Australia,
Canada, France, India, Japan, New Zealand, the Netherlands, Sweden, Thailand, UK, and USA. Nineteen completed their studies and training. One received a PhD degree, 7 returned after completing the partial requirement for the doctoral studies, 5 obtained masters degree, and another 9 completed non-degree training in various disciplines. During the year, 22 staff members (15 male and 7 female) left to begin their higher studies or training abroad. At the end of the year, 28 (17 male and 11 female) were studying abroad—20 for PhD degree and 10 for masters degree.

**In-country training:** Seventeen members of the staff received in-country training in various disciplines. Of them, 1 was sent for long-term study at the masters programme in business administration, 1 for the BSc programme in medical technology, and another for a diploma course in computer science. One acquired an MBA.

**In-house training:** Under the in-house training programme, 36 personnel attended several workshops and training courses organized by the Training and Education Unit (TEU).

**Finance Department**  
Director: Aniruddha Neogi

The Finance Department has the overall responsibility for financial operations, Centre’s procurement along with inventory control and management of fixed assets. The financial operations include: cash management and custodianship of all funds, management of staff compensation, preparation of the annual budget, recording of all financial transactions and commitments, preparation of financial reports for the Board of Trustees, Management and Donors. The Finance Department is also responsible for facilitating the annual audit and assure timely audit for all donors’ contributions. The Procurement and Materials Unit purchases sophisticated scientific equipment, perishable and non-perishable chemicals and reagents, drugs and medicines, consumables and the like from overseas and local markets. This unit also facilitates the contract for logistics and support services.

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**Following are the highlights for 2004:**

- Total contribution from donors was US$17,533,000 [inclusive of US$400,000 from Hospital Endowment Fund (HEF)], which was greater by 6% over the previous year.

- Core contribution increased by US$285,000 (5%). The increase was primarily due to enhanced contributions from Canada-CIDA, Switzerland-SDC and funds received for Flood Relief.

- Project contribution increased by US$739,000 (7%) compared to that of 2003. The increase was mainly due to net effect of increased project activities under Gates Foundation and DFID and reduced project activities under USAID, Dhaka.

- Total expenditure increased by US$1,144,000 (7%) to US$18,161,000 compared to that of the previous year.
Personnel cost for national and international staff was 60% of total expenditure, which was similar to that of earlier years.

Procurement of consumables and capital items was US$2,825,000, which was similar to that of the prior year.

Operating surplus for the year increased by US$43,000 (26%) from US$163,000 to US$206,000.

Year-end market value of Endowment funds was US$9,738,000. During the year, US$400,000 was utilized from HEF for hospital patient-care activities. This comprises salaries and benefits (nurses, health workers and attendants), hospital supplies and medicines, laboratory tests for patients, patient-food cost, and utilities.
AUDITORS’ REPORT

TO THE BOARD OF TRUSTEES OF
INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH

1. We have audited the financial statements of INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH (ICDDR,B) for the year ended December 31, 2004, from which these abridged financial statements were derived.

2.1 We report that:

Certain capital expenditure pertaining to Enterprise Resource Planning systems have been classified as deferred expenditure. This is not in compliance with the stated accounting policies. Had the above costs been fully expensed in accordance with the stated policies, net surplus before depreciation for the year and the net assets would have been lower by US$160,000.

2.2 Non-recognition of “ICDDR,B Employees Separation Payment Fund” balance as at December 31, 2004 of US$12,627,462 and corresponding investments with Generali Worldwide Insurance Company Limited of Guernsey, Channel Islands.

3. In our report of same date, we expressed an opinion that the financial statements, from which these abridged financial statements were derived, present fairly the financial position of the Centre in all material respects in accordance with the accounting policies disclosed therein, subject to our observation in Paragraphs 2.1 and 2.2 above.

4. In our opinion, the attached abridged financial statements are consistent, in all material respects, with the aforesaid financial statements from which they were derived and on which we issued a qualified report as indicated above.

5. For a better understanding of the Centre’s financial position and the results of its operations for the year and of the scope of our audit, the abridged financial statements should be read in conjunction with the financial statements from which these abridged financial statements were derived and our report thereon.

Hoda Vasi Chowdhury & Co KPMG
Chartered Accountants
Dhaka, April 10, 2005

Prof. A.K. Azad Khan, Chair of the Finance Committee of the Board of Trustees, signing the 2004 Annual Financial Statements in Dhaka, together with Prof. David A. Sack, Executive Director of ICDDR,B; Partner of Hoda Vasi Chowdhury & Co. (local auditors); Dr. Istiaque A. Zaman, Head, ER&ID Office; Mr. Aniruddha Neogi, Director, Finance; and senior personnel of the Finance Department. In the inset, Partner of KPMG, India (international auditors) is seen signing the document in New Delhi.
INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH
STATEMENT OF FINANCIAL POSITION AS AT DECEMBER 31, 2004 (US$ 000) - ABRIDGED

<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Assets</strong></td>
<td>22,130</td>
<td>23,192</td>
</tr>
<tr>
<td><strong>Assets</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash and bank</td>
<td>4,875</td>
<td>5,094</td>
</tr>
<tr>
<td>Accounts receivable</td>
<td>3,438</td>
<td>3,409</td>
</tr>
<tr>
<td>Hospital Endowment Fund Investments</td>
<td>5,330</td>
<td>5,758</td>
</tr>
<tr>
<td>Centre Endowment Fund Investments</td>
<td>3,803</td>
<td>3,672</td>
</tr>
<tr>
<td>Inventories</td>
<td>396</td>
<td>420</td>
</tr>
<tr>
<td>Fixed assets</td>
<td>4,128</td>
<td>4,519</td>
</tr>
<tr>
<td>Deferred Expenditure</td>
<td>160</td>
<td>320</td>
</tr>
<tr>
<td><strong>Total Liabilities and Fund Balances</strong></td>
<td>22,130</td>
<td>23,192</td>
</tr>
<tr>
<td><strong>Current Liabilities</strong></td>
<td>9,278</td>
<td>9,875</td>
</tr>
<tr>
<td><strong>Fund Balances</strong></td>
<td>12,852</td>
<td>13,317</td>
</tr>
<tr>
<td>Fixed Assets Fund</td>
<td>4,128</td>
<td>4,519</td>
</tr>
<tr>
<td>Hospital Endowment Fund</td>
<td>5,330</td>
<td>5,758</td>
</tr>
<tr>
<td>Centre Endowment Fund</td>
<td>3,803</td>
<td>3,672</td>
</tr>
<tr>
<td>Reserve Fund</td>
<td>2,005</td>
<td>2,004</td>
</tr>
<tr>
<td>Operating Fund</td>
<td>(2,414)</td>
<td>(2,636)</td>
</tr>
</tbody>
</table>

STATEMENT OF ACTIVITY (OPERATING FUND) (US$ 000) – ABRIDGED

<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Income</strong></td>
<td>18,367</td>
<td>17,180</td>
</tr>
<tr>
<td>Contributions</td>
<td>17,133</td>
<td>16,110</td>
</tr>
<tr>
<td>Contributions from Hospital Endowment Fund</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Other items</td>
<td>834</td>
<td>670</td>
</tr>
<tr>
<td><strong>Expenditure</strong></td>
<td>18,161</td>
<td>17,017</td>
</tr>
<tr>
<td>Salaries and benefits</td>
<td>10,971</td>
<td>10,476</td>
</tr>
<tr>
<td>Supplies and materials</td>
<td>2,273</td>
<td>1,975</td>
</tr>
<tr>
<td>Capital expenditure</td>
<td>552</td>
<td>858</td>
</tr>
<tr>
<td>Other items</td>
<td>4,365</td>
<td>3,708</td>
</tr>
<tr>
<td><strong>Surplus for the year before depreciation</strong></td>
<td>206</td>
<td>163</td>
</tr>
<tr>
<td>Depreciation (without effect on Operating Fund)</td>
<td>(943)</td>
<td>(1,001)</td>
</tr>
<tr>
<td>(Deficit) for the year after depreciation</td>
<td>(737)</td>
<td>(838)</td>
</tr>
</tbody>
</table>

STATEMENT OF CASH FLOWS (US$ 000) – ABRIDGED

<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash flows from operating activities</td>
<td>(350)</td>
<td>2,758</td>
</tr>
<tr>
<td>Cash used in investing activities</td>
<td>(392)</td>
<td>(1,178)</td>
</tr>
<tr>
<td>Cash flow from financing activities</td>
<td>523</td>
<td>233</td>
</tr>
<tr>
<td>Net Increase/(decrease) in cash and cash equivalents</td>
<td>(219)</td>
<td>1,813</td>
</tr>
<tr>
<td><strong>Cash and cash equivalents at beginning of the year</strong></td>
<td>5,094</td>
<td>3,281</td>
</tr>
<tr>
<td><strong>Cash and cash equivalents at end of the year</strong></td>
<td>4,875</td>
<td>5,094</td>
</tr>
</tbody>
</table>

Executive Director, ICDDR,B
Dhaka, April 10, 2005

Member, Board of Trustees

This is the abridged form of the Financial Statements referred to in our report of same date.

Hoda Vasi Chowdhury & Co
Chartered Accountants
Dhaka, April 10, 2005

KPMG
New Delhi, April 10, 2005
## INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH DONORS CONTRIBUTIONS (US$ 000) - ABRIDGED

<table>
<thead>
<tr>
<th>Contributions</th>
<th>2004</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia - AusAID</td>
<td>367</td>
<td>292</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>949</td>
<td>969</td>
</tr>
<tr>
<td>Belgium - BADC/BTC</td>
<td>42</td>
<td>111</td>
</tr>
<tr>
<td>Canada - CIDA</td>
<td>1,479</td>
<td>859</td>
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<tr>
<td>CDC-Atlanta</td>
<td>415</td>
<td>281</td>
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<tr>
<td>European Union</td>
<td>39</td>
<td>(10)</td>
</tr>
<tr>
<td>Gates-GoB Award</td>
<td>509</td>
<td>730</td>
</tr>
<tr>
<td>Gates Foundation</td>
<td>1,295</td>
<td>311</td>
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<tr>
<td>Howard Hughes Medical Institute</td>
<td>35</td>
<td>195</td>
</tr>
<tr>
<td>International Vaccine Instit. (IVI)</td>
<td>226</td>
<td>545</td>
</tr>
<tr>
<td>Japan-JICWELS &amp; Others</td>
<td>73</td>
<td>66</td>
</tr>
<tr>
<td>MGH-Harvard University</td>
<td>122</td>
<td>150</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1,533</td>
<td>2,312</td>
</tr>
<tr>
<td>New England Medical Center (NEMC)</td>
<td>93</td>
<td>137</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>51</td>
<td>50</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Sweden - SIDA/SAREC</td>
<td>1,216</td>
<td>937</td>
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<tr>
<td>Swiss Red Cross</td>
<td>80</td>
<td>161</td>
</tr>
<tr>
<td>Switzerland - SDC</td>
<td>1,000</td>
<td>750</td>
</tr>
<tr>
<td>The Johns Hopkins University (a)</td>
<td>277</td>
<td>97</td>
</tr>
<tr>
<td>Thrasher Research Fund</td>
<td>77</td>
<td>93</td>
</tr>
<tr>
<td>UNICEF</td>
<td>58</td>
<td>117</td>
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<tr>
<td>United Kingdom - DFID</td>
<td>2,568</td>
<td>1,998</td>
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<tr>
<td>United States - AID</td>
<td>2,158</td>
<td>3,277</td>
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<tr>
<td>USA - NIH</td>
<td>715</td>
<td>167</td>
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<tr>
<td>University of Virginia (NIH) (a)</td>
<td>156</td>
<td>56</td>
</tr>
<tr>
<td>UNOCAL</td>
<td>-</td>
<td>19</td>
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<tr>
<td>WHO</td>
<td>248</td>
<td>163</td>
</tr>
<tr>
<td>World Bank</td>
<td>-</td>
<td>48</td>
</tr>
<tr>
<td>Disaster Fund (UNOCAL, Shell, Cairn, Others)</td>
<td>22</td>
<td>-</td>
</tr>
<tr>
<td>Centre Endowment Fund</td>
<td>5</td>
<td>49</td>
</tr>
<tr>
<td>Flood Relief-2004 (b)</td>
<td>526</td>
<td>-</td>
</tr>
<tr>
<td>Others (c)</td>
<td>795</td>
<td>1,176</td>
</tr>
</tbody>
</table>

a) Includes subcontracts from the National Institutes of Health (NIH), USA

b) **Flood Relief 2004:** consists of contributions from UNDP, USAID-Dhaka, American Express Bank Ltd, Bangladesh-American Society (Houston), Bangladesh Association of Georgia, Duncan Brothers Bangladesh Ltd, United Leasing Co. Ltd, United Insurance Co. Ltd. and from many individuals. This does not include Flood Relief obtained in kind from UNDP/WFP (food items, I.V. saline, etc.), Duncan Brothers Bangladesh Ltd. (drinking water), QCCL Ltd. (medicine), Grameen Phone (medicine) & INMED (hospital supplies).

c) **Contributions in 2004 from ‘others’ for project funds include:** Bangladesh Rural Advancement Committee (BRAC), Canadian HC - LFMO, CARE Bangladesh, Circle Around the Centre, Concern, Dartmouth College, Ellison Medical Foundation, Global Forum for Health Research, International Center for Research on Women, Institut Pasteur, Intercell-Cistern Biotech, International Science & Technology Institute, International Nutrition Foundation, Karolinska Institute, National Institute of Ageing, Nestle Foundation, New York University School, Novartis Consumer Health SA, Nutrition Third World, Plan Bangladesh, Pathfinder International, Program for Appropriate Technology in Health (PATH), Self Sustaining Units, Seibold University of Nagasaki, SpaandanB USA, The Rockefeller Foundation, Urban Family Health Partnership (UFHP), UMEA University, University of Oslo, University of Basel, UNDP- Bangladesh, United Nations - UNAIDS, Uppsala University, Urban Primary Health Care, US-Japan, Board of the Netherlands Foundation for the Advancement of Tropical Research (WORTO) and Wyeth.

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**Executive Director, ICDDR,B**  
**Member, Board of Trustees**
Support Services Department
Senior Manager: Colonel Tajul Islam Ghani (Retd.) (until September)

The Support Services Department played an important role in developing and sustaining the Centre’s infrastructure and facilities, while providing logistics support to various activities of the Centre. Activities of the Department are managed by 243 personnel in the 6 units, namely Travel and Estate, Civil Engineering, Electrical and Telecomm Engineering, Transport, General Services, and Cafeteria Services.

In 2004, the Travel and Estate Unit coordinated in-country and foreign travels of 465 staff and visitors; the Civil Engineering Unit planned and initiated several renovation and construction projects to accommodate different offices in new settings. The Transport Unit coordinated transport services for approximately 474 personnel daily. On an average, 450 members of the staff use the canteen facilities on every work day, and the Cafeteria Services Unit also provided catering services for various events organized by the divisions/departments during the year.

With the departure of Colonel Tajul Islam Ghani (Retd.) in September 2004, the units of the Support Services Department have been reporting to Finance and Human Resources.

Committees

Board of Trustees
Chairperson: Prof. Ricardo Uauy Dagach

Following a decision at the November 2003 Board that, to make the Board as efficient as possible and to save costs, the full Board would meet once a year, usually in the fourth quarter to correspond with key planning activities of the Centre and that the second BoT meeting (in mid-year) will run as an Executive Board with only the Executive Committee members attending, but including the entire Board in a telephone conference call at the end of the meeting. Thus, the Executive Committee of the Board met in Dhaka in June 2004. The meeting included an email report of key issues and the draft resolutions, and a phone conference with all BoT members where key issues emerging from the Executive Committee meeting were discussed and voting on the resolutions occurred.

In reconsidering the above decision, the Board felt that...
that the benefit of having two full BoT meetings outweighed the cost of doing so and at the November 2004 meeting the Board resolved that meetings of the Full Board will be held twice a year.

The Board held a two-day retreat immediately prior to the November BoT meeting in November 2004 at the BRAC Centre in Rajendrapur, Bangladesh. The Consultant Mary H. DeKuyper facilitated the sessions to assist the BoT in assessing and improving their effectiveness. The action plan that was developed stressed the importance of the Board’s role in the long-term planning for the future of the Centre.

As it is customary that the scientific divisions be reviewed once every three years by external experts, an external review of the Clinical Sciences Division (CSD) was carried out with Dr. Claudio Lanata acting as Chair of the Review Team in 2003. During 2004, the Board followed up with the recommendations of the review, and the Division responded with its plans. At the November 2004 meeting, it was decided that the Information Sciences Division be reviewed in May 2005 with Professor Terrence Hull, member, BoT, as Chair of the Review Team.

Each meeting generally bids farewell to Board members who have completed their service. In 2004, the Centre bade farewell to Dr. Carol Vlassoff who left in June at the end of her term and was replaced by Prof. Peter Tugwell of McGill University, Canada. Dr. Tikki Pang, the WHO representative on the Board, also left on completion of his term and was replaced by Dr. Tim Evans, Assistant Director-General, Evidence and Information for Policy, World Health Organization. The Board also selected Dr. Raj Bte Abdul Karim, Regional Director, International Planned Parenthood Federation, Kuala Lumpur, Malaysia as a new Board member, who replaced Dr. Maimunah Bte Hamid.

The Board elected Professor Terrence Hull as Chair of the Board of Trustees to begin following the June 2005 meeting to replace Dr. Ricardo Uauy Dagach who will be completing his term then. The Board also announced a salary raise for all staff at the General Services and National Officer level.

Programme Coordination Committee
Chairperson: Prof. M.A. Matin

The Programme Coordination Committee (PCC) is mandated to strengthen coordination between the Centre and the national health institutions through capacity-building for collaborative research. The Committee is composed of members with representatives from the Centre, Ministry of Health and Family Welfare and health departments or institutions of the Government of Bangladesh, universities, and non-governmental organizations involved in health, nutrition, education, population studies, and development programmes in Bangladesh.

Research Review Committee
Chairperson: Prof. David A. Sack

The Research Review Committee (RRC) rigorously reviews research protocols and evaluates their scientific merit, competence of principal investigators, and relevance of protocols with the objectives, priorities, and Strategic Plan of the Centre.

In 2004, the Committee, in its 14 meetings, approved 51 new protocols, 21 proposals for addendum to, and modifications of, proposals, and time extension for a number of already-approved protocols. It also reviewed the reports of already-completed protocols. In 2004, the highest number of research protocols was approved.

Professor Kamaluddin Ahmad, a long-time well-wisher, a trusted friend, and an associate of the Centre and since 1990, a member of the RRC, died on 4 July 2004. The Centre gratefully acknowledges his valuable contributions. He also served as member, Co-chairperson, and Chairperson of the Ethical Review Committee. In recognition of his outstanding contributions to science, the 10th Asian Conference on Diarrhoeal Diseases, held in Dhaka in December 2003, conferred upon him the ‘Host Country Award’.

The database of research protocols was transferred to the Centre-wide online database—Suchona. The Centre is in the process of developing a database for preserving all full-text research protocols.

Ethical Review Committee
Chairperson: Prof. A.K.M. Nurul Anwar

The Ethical Review Committee (ERC) met 14 times during the year and approved 45 research protocols involving human subjects; many of these had to be modified to incorporate the observations of the Committee. In addition, 22 proposals for addenda to, and modifications of, ongoing research protocols were approved. The Committee followed the ethical principles laid down in the ERC guidelines and made risk/benefit analyses and assessed the scientific merit of the protocols while reviewing them. The protocols were approved ensuring the welfare and rights of the subjects participating in the research projects. The Committee
obtained yearly reports of ongoing research protocols involving study participants to monitor their implementation and to know whether there were any serious adverse events that could warrant stopping of the research protocol.

Centre’s Federal-wide Assurance (no. FWA 00001468) from the Office for Human Research, U.S. Department of Health and Human Services, was renewed for three years.

Animal Experimentation Ethics Committee
Chairperson: Dr. Mirza M.A. Jalil

The Animal Experimentation Ethics Committee (AEEC) met once in 2004 and reviewed and modified the AEEC Guidelines and the Application Form for submission of research protocols for consideration of the Committee to the ICDDR,B Board of Trustees for its approval. The Committee also reviewed and suggested modification of the ‘Manual for care and use of laboratory animal.’

Staff Welfare Association
President: Md. Shahadat Hossain

The ICDDR,B Staff Welfare Association (SWA), an association of 1,182 fixed-term local staff members and run by an Executive Committee (EC), looks after the welfare of the staff by maintaining a healthy and congenial job atmosphere within the Centre.

In response to the severe flooding in August and September 2004, the SWA negotiated with the management for granting a donation to staff members in Grade I and II for their rehabilitation during the floods, a salary advance for other staff members, and arranged an annual picnic and amusement tour at Fantasy Kingdom located near Dhaka city; gave a grand reception to all meritorious children of staff members who received GPA 5 in the Secondary School Certificate Examination 2004; and awarded stipends to the school-going children of low-paid staff members.

The SWA also helped the flood-affected people of the country by contributing one day’s salary to the Prime Minister’s Relief Fund and donated oral saline packets to different NGOs for distribution among the diarrhoeal patients in the flood-affected areas.

ICDDR,B Alumni Association
President: Mr. M.R. Bashir

In Bangladesh, recent Old Timers’ Get-togethers offered networking experiences of great power and personal gratification. In an effort to recognize the outstanding contribution of the alumni, trustees, long-term friends, and colleagues of the Centre, the ICDDR,B Alumni Association was formally established in December 2004. Alumni celebrate the power of their long-term relationships and contributions in the Pakistan–SEATO Cholera Research Laboratory and Cholera Research Laboratory during 1960-1977, and ICDDR,B since 1978.

Today, hundreds of former employees and colleagues spread around the globe, through their contributions, have changed the health outcomes for millions of people in the world. By joining together in an alumni network, memories of their achievements will be preserved for many years to come.

The Election Commission, headed by Mr. M. Shamsul Islam Khan, conducted the 2004 election of the Executive Committee of the ICDDR,B Alumni Association for a two-year term as per the Article 7 of the Charter and Article 7 of the Bylaws of the ICDDR,B Alumni Association. The members elected to the Executive Committee for a 2-year term are as follows: President—Mr. M.R. Bashir; Vice Presidents—Dr. K.M.S. Aziz and Dr. M. Badrud Duza; General Secretary—Mr. M.A. Wahed; Treasurer—Mr. K.M. Abdus Samad; Joint Secretaries—Mr. Subash Saha and Mr. A.M. Sardar; Members—Mr. Jyotsnamoy Chakraborty, Dr. Sufia Islam,
Mrs. Obaida Kabir, Mr. M. Shamsul Islam Khan, Dr. Aliya Naheed, Dr. A.S.M. Hamidur Rahman, Mr. Muhammad Mujibur Rahman, and Mrs. Jean Sack. The Executive Director of ICDDR,B, SWA President, and Matlab SWA Vice-President are ex-officio members.

The Bylaws allow the inclusion of nominees from Chapters (one nominee from each chapter) as Members of the Executive Committee.

**External Relations and Institutional Development Office**

Head: Ishtiaque Zaman

The External Relations and Institutional Development (ER&ID) Office generates resources so that the Centre can undertake its planned activities. In 2004, the Office orchestrated increased communication with the Development Partners, Government of Bangladesh (GoB), NGOs, business community, and various institutions throughout the world to raise the profile of, and the funding for, the Centre. The Office continued to lead efforts for the growth of the Centre Endowment Fund and the ICDDR,B Hospital Endowment Fund.

Ms Julia Ackley, Senior Associate, left the Centre in June after serving for nearly two years. Ms Armana Ahmed joined the ER&ID Office as Grants Management Officer.

The ER&ID staff updated the database of the Centre’s donor-funded activities by posting all records electronically to facilitate the flow of information on donors, grant tracking, and financial reporting.

To meet the programme priorities and institutional development detailed in the Strategic Plan, the Centre’s budget will need to be increased by about US$1-2 million annually from its present budget of about US$18 million until it reaches US$20 million. To achieve this, the ER&ID Office, in close collaboration with the Executive Director and the Centre Directorate, is currently implementing a Resource Mobilization Strategy.

The ER&ID Office worked with the Centre’s Events Committee in organizing the Annual Fundraising Dinner at the Sheraton Hotel in February 2004. The Office initiated discussions with local and international businesses interested in expanding
their support to the ICDDR,B’s Dhaka hospital as an important community care-provider. Ms Julia Ackley, Senior Associate of the ER&ID Office, was the Chairperson of the Centre’s Hospital Endowment Fund campaign. A sum of over US$35,000 was raised from ticket sales, raffles, and generous contributions from private individuals and corporations. The fundraising dinner was fully underwritten by the local American Express Bank. This annual event, participated by more than 400 people, provided an opportunity for the community to help support the work of the Centre’s hospital and to enjoy a social evening together.

To ensure open lines of communication with development partners, meetings of the Centre’s Development Partners Group (DPG) are held after each Board meeting. Dr. Neil Squires of DFID/Bangladesh chaired the DPG meeting in June 2004, and Dr. Iurlumun Uhaa presided over the DPG meeting in November 2004. The Centre arranged a farewell for three DPG members who left the country upon completion of their tenure in Bangladesh. They were Dr. Neil Squires, Dr. Kayode Oyegbite, UNICEF, and Mr. Hans Rhein, European Union.

Comprehensive visits were organized for Ambassadors and High Commissioners, senior civil servants, policy-makers, academicians, and journalists, which included tours to the Centre's Mohakhali campus and to rural Matlab and urban field sites in Mirpur and Kamalapur. The Office also arranged two field trips for leading Bangladeshi journalists to visit Matlab and other field sites. It also organized a reception for 130 journalists in Dhaka.

**Grants and Contracts Administration**

Grants and Contracts Administrator: Vanessa Brooks

During 2004, the Centre entered into 38 agreements with foreign universities and research institutions, an additional 21 agreements with local NGOs largely providing service components to research initiatives and 8 agreements with foreign non-governmental institutions, 7 agreements with UN agencies, 3 agreements with institutions of the Government of Bangladesh. The Centre has also entered into confidentiality agreements and material transfer agreements with pharmaceutical and research companies in its conduct of vaccine-related research. Additionally, in undertaking the role of Secretariat of the Child Health and Nutrition Research Initiative (CHNRI), the Centre through the Office of Grants and Contracts Administration, negotiated guidelines for the Centre’s role, including responsibilities and liabilities as the Secretariat. With local institutions, the Centre primarily drafts the agreements, including some cases, where local NGOs are the prime institution and the Centre is the subcontracting party.

A recent NIAID/NIH Foreign Organization System (FOS) Review required the Grants and Contracts Office to coordinate the responses of ER&ID Office, Human Resources, and the Finance Department to an NIH auditor’s review that demonstrated to NIH the Centre’s capacity to meet international administrative standards for managing an NIAID/NIH subcontract. In response to the auditor’s evaluation, the GCA and ER&ID offices revised their administrative procedures to eliminate redundancies in the review process and clarify the distinctive roles undertaken by both the offices.

Preparation of documents and guidelines relating to Board of Trustees’ governance issues and the drafting of revisions to the Board’s governing By-laws are among the responsibilities of the GCA. In 2004, the GCA worked closely with the Executive Director, BoT Chairperson, and the Consultant/Facilitator of the November 2004 Board of Trustees Governance Retreat to ensure that
supporting documents and information were disseminated among the retreat participants and to provide them the necessary framework to deliberate on new issues. Other key documents prepared by the GCA in preparation for the BoT Retreat and BoT meeting included a revised Conflict of Interests Policy to be finalized and implemented in 2005.
Visitors in 2004

A number of dignitaries from home and abroad visited the Centre and/or its Matlab field station in 2004. The following is a list of many of these visitors:

Dr. Khandaker Mosharraf Hossain, Hon’ble Health and Family Welfare Minister, Government of Bangladesh (GoB); Mr. Abdul Mannan Bhuiyan, Hon’ble Minister for Local Government, Rural Development and Cooperatives, GoB; Mr. A.F.M. Sarwar Kamal, Secretary, Ministry of Health and Family Welfare (MoHFW), GoB.

Mrs. Carin Jamtin, Minister for International Development of Swedish Foreign Ministry; Dr. Hamad Bin Abdullah Al-Manea, Hon’ble Health Minister and Dr. Mansour Bin Nasser Al-Hawasi, Hon’ble Deputy Minister for Executive Affairs, Kingdom of Saudi Arabia.

H.E. Mr. David Sproule, Canadian High Commissioner in Bangladesh; H.E. Mr. Matsushiro Horiguchi, Japanese Ambassador to Bangladesh; H.E. Mr. Walter Gygger, Swiss Ambassador to Bangladesh; Mr. Jurg Casserini, Charge d’Affairs, Swiss Embassy, Dhaka; H.E. Mr. Abdullah Bin Mohammed Al-Obaid Al-Namlah, Saudi Arabian Ambassador to Bangladesh; Dr. Neil Squieres, Senior Health Advisor, Ms Joanna McGowan, Economic Adviser, Ms Sheelagh Stewart, Senior Program Manager, Human Development, DFID, Dhaka; Dr. Sekhar Bonu, Asian Development Bank, The Philippines; Mr. Douglas Coutts, Country Representative, World Food Programme, Bangladesh; Mr. Jacques Martin, Deputy Head of UN Development Division and Senior Advisor of Health and Population, SDC, Switzerland; Mr. Markus Waldvogel, Country Director, SDC, Dhaka; Mr. John Rogosch, Chief, Division of Maternal and Child Health, USAID/ Washington; Mr. Stuart Iliffe of PricewaterhouseCoopers, Canada; Mr. Gary Hopper, NIH-appointed independent reviewer; delegation from the Bill and Melinda Gates Foundation led by Dr. Regina Rabinovich; Ms Janik Bouchard, Program Manager, CIDA, Canada; Mr. Bill Berger, Regional OFDA Adviser (USAID, Nepal); Dr. William Petri, University of Virginia, USA; Mr. Charles Llewellyn, Team Leader, PHN Team, USAID, Dhaka; Dr. Iyorlumun Uhaa, Head, Health and Nutrition, UNICEF, Dhaka.

Dr. Josef Amann, Dr. Michael Bell, Dr. Darin Carroll, Dr. Caryn Bern, Dr. Lora Davis, Dr. Pavaneri Kalluri, Dr. Natalie Keeler, Ms Katherine Kurkjian, Dr. Ivan Kuzmin, Dr. Joel Montgomery, Dr. Susan P. Montgomery, Ms Lora Davis,
Ms Erin Murray, Dr. Michael Niezgoda, and Ms Anoopa Sharma, Centers for Disease Control and Prevention (CDC), USA; Professor Steve Calderwood, Professor of Medicine, Harvard Medical School and Chief, Division of Infectious Diseases, USA; Dr. Omar Dary, Food Fortification Advisor, International Science and Technology Institute, Inc., USA; Dr. R. Bradley Sack, Professor of International Health, Johns Hopkins Bloomberg School of Public Health, USA; Prof. Joseph H. Graziano, Mailman School of Public Health, Columbia University, USA; Dr. Victoria Hale and Dr. Ahvie Herskowitz, Institute for One World Health, USA; Dr. James Herrington, Health Scientist, United Nations Foundation, USA; Dr. Anwarul Huq and Dr. Afsar Ali, University of Maryland Biotechnology Institute, USA; Professor Karl Klose, Professor, University of Texas, USA; Mr. Kees Kostermans, Lead Public Health Specialist, and Ms Meera Shekar, Senior Nutrition Specialist, World Bank, Washington, DC, USA; Dr. Jane Menken, Professor of Sociology, Faculty Associate, Population Program Institute of Behavioural Science, University of Colorado at Boulder, USA; Dr. Azhar Nizam, University of Emory-Atlanta, USA; Professor W.A. Petri, Jr., University of Virginia, USA; Dr. Ed Ryan, Division of Infectious Diseases and Dr. Brian Schwartz, Massachusetts General Hospital, USA; Dr. Ondine S. von Ehrenstein, Research Epidemiologist, Project Director, University of California-Berkeley School of Public Health, USA; Dr. Alan Smith, Professor, University of California-Berkeley, USA; Dr. Robert M. Suskind, Professor of Pediatrics, Rosalind Franklin University of Medicine and Science, USA; Professor D.C. Whitcomb, Department of Medicine, University of Pittsburg, USA.

Mr. Andrew Clark, Mr. Damien Walker, Dr. Sophie Moore, Department of Human Nutrition, London School of Hygiene & Tropical Medicine, UK; Dr. Mike Golden, Ms Fiona Duby, and Ms Jenny Goodwin, Save the Children, UK; Professor S.M. Grantham-McGregor, CICH, Institute of Child Health, University College London, UK; Professor Kenneth Lee, Director, Centre for Health Planning and Management, Keele University, UK; Mr. Peter O’Neil, Senior Research Manager, Dr. David Pratt, and Dr. Martin Smith, Health Research Programme Manager, DFID, UK.

Dr. Markus Rudolf Czub, Dr. Allen Ronald Grolla, and Dr. Heinrich Ulrich Feldmann, University of Manitoba, Health Canada; Dr. Ken Reimer, Director, ESG, Professor, Department of Chemical Engineering, RMC Professor, Queen’s University, School of Environmental Studies and Department of Biology, ICDDR, B: CENTRE FOR HEALTH AND POPULATION RESEARCH ANNUAL REPORT 2004

Australian High Commissioner in Bangladesh, Her Excellency Ms Lorraine Barker, signing a new multi-year grant for ICDDR.B

Japanese Ambassador to Bangladesh, H.E. Mr. Matsushiro Horiguchi, listening to Dr. GB Nair, Director, Laboratory Sciences Division
Environmental Sciences Group (Royal Military College of Canada, Canada; Mr. Carl Bjarne Mikkelsen, Director, Research and Development, Compact A/S, Denmark; Professor J.F. Desjeux, Chair de Biologie, CNAM, France; Dr. Nadine Honore and Dr. Cristine Sadorge, Head, Vaccine and Burnedud Research Center, Institut Pasteur, France; Ms Beatrice Simkins, IDD, NUTRISET, France; Dr. Lajpat Rai Sood, Senior Vice President, Sera and Vaccines, Biological E. Limited, India.

A six-member team headed by Mr. Yuko Ohsawa of Economics Faculty, Nagoya City University, Japan; Dr. Shoichi Kunikane, Director, Department of Water Supply Engineering, National

Bacteriology, Karolinska Institute, Sweden; Dr. Lena Davidsson, Laboratory of Human Nutrition, Swiss Federal Institute of Technology, Switzerland; Dr. Eleanor Gouws, Department of Child and Adolescent Health and Development, WHO, Switzerland; Professor Klaus Gyr, Professor of Medicine, Department of Internal Medicine, University Hospital-Basel, Switzerland.

Institute of Public Health, Japan; Dr. Hiroshi Tokunaga, Director, National Institute of Health Science, Japan; Dr. Haaruo Watanabe, Deputy Director General, National Institute of Infectious Diseases, Japan; Dr. Jaco J. Verweij, Department of Parasitology, Leiden University Medical Centre, The Netherlands; Professor Lars Ake Persson, Professor and Chair, Department of Women’s and Children’s Health, International Maternal and Child Health, Uppsala University, Sweden; Professor Ann-Mari Svennerholm, Department of Medical Microbiology, University of Göteborg, Sweden; Dr. Andrej Weintraub, Department of Laboratory Medicine, Division of Clinical

Scientists from Göteborg University, Sweden, and from Massachusetts General Hospital, USA, visiting the Immunology Laboratory of ICDDR,B

Sri Lankan High Commissioner in Bangladesh, H.E. Mr. Gamini Munasinghe handing over their annual contribution to ICDDR,B

Canadian High Commissioner in Bangladesh H.E. Mr. David Sproule at the Nutrition Rehabilitation Unit of the Dhaka hospital of ICDDR,B
Collaborations

International

Aichi University School of Medicine, Japan
Applied Science Institute, India
Armed Forces Research Institute for Medical Science, Thailand
B.P. Koirala Institute of Health Sciences, Nepal
Centers for Diseases Control and Prevention, Atlanta, USA
Centre for Southeast Asian Studies, Kyoto University, Japan
Cera Products, Inc., USA
Cornell University, USA
Creative Research Management, USA
Belgian Technical Cooperation
Dartmouth Medical School, Hanover, USA
Ellison Medical Foundation, USA
Emory University, Atlanta, USA
European Union
Faculty of Human Life Sciences, Jyssen Women’s University, Japan
Food and Consumer Product Safety Authority (VWA), Region East, The Netherlands
Fukui Medical University, Japan
Graduate School of Food Technology, Agrobiotechnology, Nutrition and Health Sciences (VLAG), Wageningen University and Research Centre, The Netherlands
Harvard University, USA
Health Canada
Howard Hughes Medical Institute, Maryland, USA
INDEPTH-Network
Indian Institute of Management
Indian Institute of Population Sciences, India
Institut Pasteur, France
Institute of Child Health, London, UK
Institute of Medicine, Tribhuban University, Nepal
Indian Institute of Management, Ahmedabad
International Vaccine Institute, Republic of Korea
IEC International Water and Sanitation Centre, The Netherlands
Johns Hopkins University, USA
Kantonsspital, Switzerland
Karolinska Institute, Sweden
Laboratory of International Prevention of Epidemics, Osaka Prefecture University, Japan
London School of Hygiene & Tropical Medicine, UK
Mahidol University, Thailand
McGill University, Canada
Massachusetts General Hospital, USA
Ministry of Health, Mozambique
Monipal Medical College, Nepal
Nagasaki University, Japan
National Institute of Aging, USA
National Institute of Infectious Diseases, Japan
National Institute of Immunology, India
National Institute of Cholera and Enteric Diseases, India
National Institutes of Health, USA
New England Medical Center, USA
Nestle Research Foundation, Switzerland
Netherlands Interdisciplinary Demographic Institute
Northumbria University, UK
Novartis Consumer Health, Switzerland
Nutriset, France
Nutrition Third World, Belgium
Oxford University, UK
Pennsylvania State University, USA
Population Council, Delhi, India
Population Studies Center, University of Pennsylvania, USA
RAND Corporation, USA
School of Health Sciences, Okayama University, Japan
School of Medicine, University of Tokushima, Japan
SIDA, Sweden
Society for Applied Studies, India
Southampton University, UK
Stanford University, USA
Swiss Federal Institute of Technology, Switzerland
Thrasher Research Foundation, USA
United Nations Children’s Fund, USA
United Nations University, Japan
University of Basel, Switzerland
University of Brisbane, Australia
University of California-Davis, USA
University of Colorado, USA
University of Leuven, Belgium
University of Edinburgh, UK
University of Goteborg, Sweden
University of Maryland, USA
University of Maryland Biotechnology Institute, USA
University of Texas Medical Branch at Galveston, USA
University of Umea, Sweden
University of Virginia, USA
Uppsala University, Sweden
U.S. Agency for International Development
USAID and HMG Ministry of Health, Nepal
U.S. Department of Agriculture
USAID/Washington, USA
USC Canada
Wageningen Agricultural University, The Netherlands
Wellcome Trust, UK
Water, Engineering and Development Centre, Loughborough University, UK
World Health Organization, Switzerland

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National

American International School
APOSH
ARI Programme, Government of Bangladesh
Ashar Alo
Bandhu Social Welfare Society
Bangladesh Agricultural University
Bangladesh Association of Voluntary Sterilization
Bangladesh Breastfeeding Foundation
Bangladesh Bureau of Statistics
Bangladesh Center for Communication Programs
Bangladesh Institute of Development Studies
Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders
Bangladesh Livestock Research Institute
Bangladesh Population and Health Consortium
Bangabandhu Sheikh Mujib Medical University
Bangladesh Women's Health Coalition
BRAC
CARE, Bangladesh
Central Drug Treatment Centre
Central Skin and Social Hygiene Centre
Chittagong Medical College Hospital
Chittagong Shishu Hospital
College of Home Economics
Concern, Bangladesh
Concerned Women for Family Planning
Department of Public Health Engineering
Dhaka Medical College Hospital
Dhaka Shishu Hospital
Directorate General of Health Services
Directorate of Family Planning
Dhaka City Corporation
Durjoy Nari Sangha
Family Health International
Field Laboratory at Refugee Camp, Chittagong Hill Tracts
Gonoshasta Kendra
Health Economics Unit, Ministry of Health and Family Welfare
Jahangirnagar University,
Holy Family Red Crescent Hospital
Independent University, Bangladesh
Institute of Child Health & Shishu Hospital
Institute of Health Economics, University of Dhaka
Institute of Epidemiology, Disease Control and Research
Institute of Mother and Child Health
Institute of Nutrition and Food Science, University of Dhaka
Institute of Public Health
Institute of Public Health Nutrition
Jatiya Jubo Sangha
Karmajibi Kallyan Sangha
Khulna Medical College Hospital
Kumudini Hospital
Kumudini Welfare Trust (Kumudini Hospital)
Lamb Hospital
Marie Stopes Clinic Society
Ministry of Health and Family Welfare
Radda MCH-FP Centre, Mirpur
Ministry of Industries
Mukti Lawrence Foundation
Mukti Mahila Samity
Mymensingh Medical College Hospital
Nari Mointree
Nari Mukti Sangha
National Expanded Programme on Immunization
National Institute of Population Research and Training
National Institute of Preventive and Social Medicine
National Nutrition Programme
National Nutrition Project
National Tuberculosis Control Programme
National Integrated Population and Health Programme
NGO Forum for Drinking Water Supply and Sanitation
NOVA Medical Centre
NGO Service Delivery Program
Paricharja
Partners in Health and Development
Pathfinder
Plan International
PIACT Bangladesh
Popular Diagnostics
Population Council
Prochesta
Progoti Samaj Kallyan Protisthan
Radda MCH-FP Centre
Rajshahi Medical College Hospital
Rangpur Medical College Hospital
The Salvation Army
Save the Children Fund (Australia)
Shishu Shastha Hospital
Shishuk, Bangladesh
Sir Salimullah Medical College Hospital
Social Marketing Company
Square Pharmaceuticals
Sylhet MAG Osmani Medical College Hospital
University of Chittagong
University of Dhaka
World Bank
World Vision, Bangladesh
ICDDR,B PUBLICATIONS 2004

A. Internal Publication Series


Journal and newsletters

2. Glimpse V. 26, no. 1-3, 2004
3. Equity Dialogue V. 1, no. 3-4, 2003*
5. SUZY News V. 1, no. 1-2, 2004
6. Shasthya Sanglap V. 12, no. 1-3, 2003-2004 (combined issue) and V. 13, no. 1-2, 2004 (combined issue)

Working papers


Special publication


Scientific report


B. Scientific papers, including review articles and short reports, in journals


*Not listed in earlier annual reports


38. Haskell MJ, Jamil KM, Hassan F, Peerson JM, Hossain MI, Fuchs GJ, Brown KH. Daily consumption of Indian spinach (Basella alba) or sweet potatoes has a positive effect on total-body vitamin A stores in Bangladeshi men. Am J Clin Nutr 2004 Sep;80(3):705-14


C. Book chapters, papers in conference proceedings, and monographs


D. Scientific letters, editorials, and abstracts in journals


