



ANNUAL
REPORT
2013

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icddr,b is an independent, non-profit health research institution dedicated to improving the lives of people living in poverty in its host country Bangladesh and globally. Through the generation of knowledge, and translation of research into treatment, training and policy advocacy, icddr,b addresses some of the most critical health concerns facing the world today.

RESEARCH

Over 200 research projects ongoing, 270 peer-reviewed papers published, 200 collaborators from across the world: year-on-year icddr,b researchers generate evidence to address some of the most critical health challenges facing people living in poverty.

TRAINING

Each year more than 1,000 healthcare professionals and students visit icddr,b to learn from the institution's collective knowledge, technical expertise and unique resources. Around the world, there are experts and emerging experts in public health whose careers have been influenced by icddr,b.

SERVICES

Some 120,000 of the poorest people in Dhaka were treated in icddr,b's world famous hospital in 2013, the majority of them children under 5 years of age. Clinical care and relevant research go hand in hand at icddr,b's hospitals, treatment centre and field sites.

ICDDR,B THANKS ITS CORE DONORS FOR THEIR SUPPORT



Government of the People's
Republic of Bangladesh

Canada



INNOVATING FOR HEALTH

Bangladesh has achieved spectacular health gains, to which icddr,b research has made significant contributions. However, major challenges remain, and we need to ensure our work enhances health outcomes more systematically across the developing world.



Professor John D Clemens

In its brief history, Bangladesh has undergone little short of a health revolution. Maternal mortality has fallen by 75% since 1980, infant mortality has more than halved since 1990 and, at 68.3 years, life expectancy is higher than in neighbouring countries. There is still much to be done but these achievements deserve recognition. Moreover, lessons learnt from Bangladesh have deep relevance across the developing world.

In November 2013, *The Lancet* recognised these achievements and published a special series on Bangladesh (Bangladesh: Innovations for Universal Health Coverage), which was co-edited by icddr,b's Deputy Executive Director, Dr Abbas Bhuiya. In their introduction, editors Pamela Das and Richard Horton pay tribute to the research carried out by icddr,b and its partners, acknowledging their contribution to Bangladesh achieving remarkable gains in health, despite deep and enduring poverty. It was a great honour that the launch of *The Lancet* series was attended by the President of Bangladesh Mr Md Abdul Hamid—a reflection of the close relationship we enjoy with the Government.

UN Secretary-General Ban Ki-moon also praised icddr,b and Bangladesh for making significant progress towards the UN Millennium Development Goals at an event held at the United Nations in New York in May 2013. The event was co-hosted by Abdul Momen, the UN Permanent Representative of Bangladesh and Geir Pedersen, the Permanent Representative of Norway.

I want to pay credit to the outstanding work of my forebears who have made such a significant contribution to national and global health outcomes. It is the opportunity to build on their legacy and on icddr,b's unique attributes that attracted me to the executive director's position.

I believe that icddr,b is remarkably well-placed to drive forward research to improve health and wellbeing in Bangladesh, regionally and globally. We have a comprehensive cadre of scientists—carrying out studies on locally relevant and internationally significant health issues, and contributing to large-scale international multicentre trials. Thanks to the farsightedness of our core donors—the governments of Australia, Bangladesh, Canada, Sweden and the United Kingdom—we can develop long-term plans and act strategically to identify and address existing and emerging priority health issues.

In addition, our research infrastructure—including clinical facilities at the Dhaka Hospital, our demographic surveillance site at Matlab and our laboratories—is a unique resource. Our extensive international connections with world-leading research centres enable us to draw on global pools of knowledge and expertise.

Equally important is our strong relationship with the Government of Bangladesh, which ensures that research is oriented to national needs and that dissemination supports the implementation of evidence-based policy and practice.



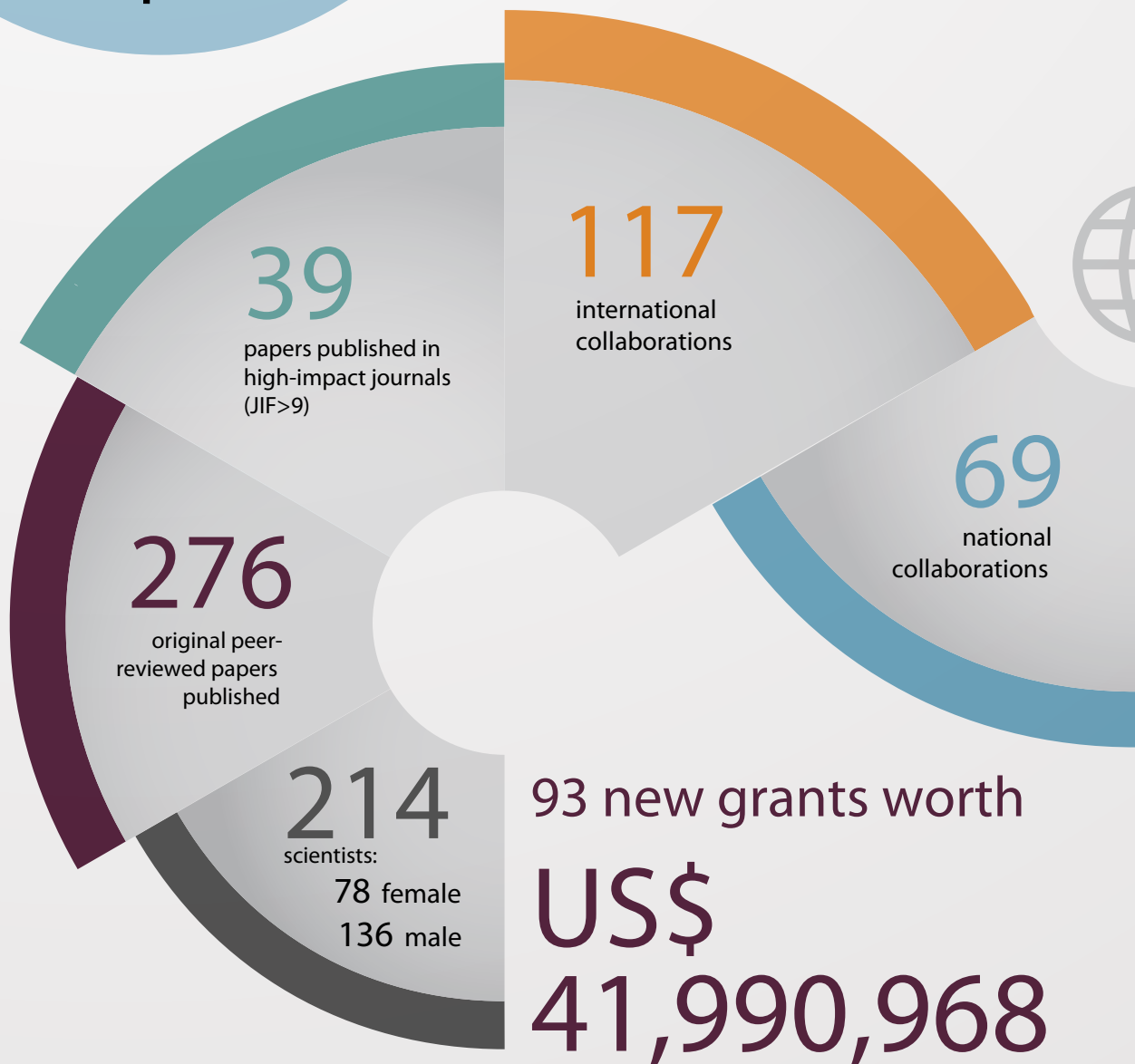
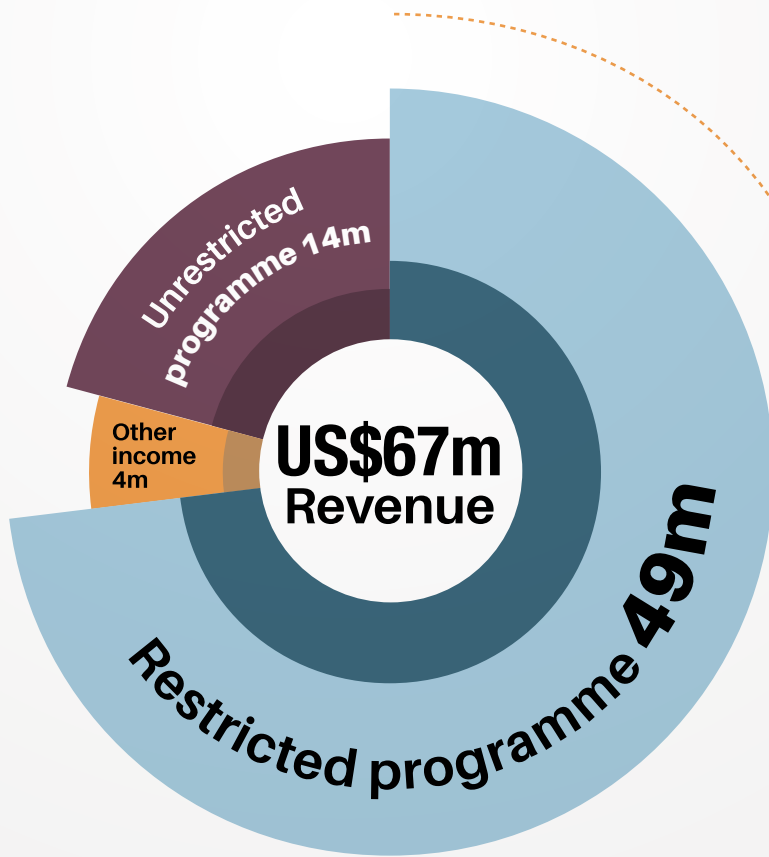
May 2013. At an event in New York recognising icddr,b's contribution to Bangladesh's MDG health success, the UN Secretary-General, Ban Ki-Moon (middle picture, second from left) listens while Professor John D. Clemens presents. Also attending were former icddr,b executive directors, Dr David Sack (right picture, left) and Dr William B. Greenough (right picture, right).

The challenge now is for us to fully exploit our unique strengths: our expertise, connections both national and international, and our unique infrastructure of laboratories and field sites. We must ensure swift uptake of proven interventions not just in Bangladesh, but other relevant contexts. We need to draw on the latest research to tackle intractable problems, such as premature birth, childhood malnutrition and non-communicable diseases, as well as emerging threats to health such as zoonotic infections and the impacts of urbanisation and climate change. We also need to continue our work on training and capacity building while also thinking about how we can expand our global reach and promote knowledge transfer to other developing world settings.

To ensure the ongoing success of our research efforts, we have accelerated plans to strengthen our business processes. This has included creating the post of Chief Operating Officer, to which we welcome Ingrid Renaud, a seasoned professional with an impressive track record in managing not-for-profit institutions. We have also benefitted from working with The Faculty, an Australian consultancy firm that is strengthening our Procurement service, and Deloitte, Haskins and Sells, which is developing our Internal Audit function. I am confident that these initiatives will deliver the strong foundations upon which future success depends.

icddr,b played a major role in developing an intervention—oral rehydration therapy—that has saved tens of millions of lives globally, and continues to save the lives of vulnerable children every day. I am confident that we are uniquely placed to develop and implement additional interventions that will significantly improve the health and wellbeing of people in Bangladesh, in the region and globally.

Professor John D Clemens



2013 IN NUMBERS

A snapshot of icddr,b's funding, research activities, and clinical services



OUR RESEARCH

Research at icddr,b addresses the major health challenges facing Bangladesh and other developing countries.

icddr,b's ultimate goal is to improve the health and wellbeing of people in Bangladesh and in developing countries across the world. Its research priorities, therefore, reflect the country's major health challenges. While infectious diseases remain an important focus, particularly among children, there is a growing emphasis on chronic, non-communicable diseases that now account for the greatest burden of disease in Bangladesh. icddr,b also has particular strengths in maternal and child health, and in nutrition.

icddr,b is committed to **scientific excellence**, and disseminating information through the scientific literature, including high-impact journals. However, we also place high priority on **policy-relevant research**, generating findings that have direct and immediate relevance to national (and ideally international) policy and practice. Hence, our research spans the entire translational pathway, or the '4Ds':

- Discovery: understanding the basis of disease
- Development: identifying potential new interventions
- Delivery: assessing the impact of new interventions
- Delivery evaluation: assessing the implementation of new policies and practice.

International collaboration is a key feature of icddr,b's work. Many icddr,b researchers contribute to international research programmes, are part of global networks in their specialist areas, and sit on international advisory boards.

icddr,b has an outstanding *research base*. In addition to well-equipped laboratories, we have the infrastructure to carry out clinical studies at our main hospital in Dhaka and at other sites, and to carry out large-scale clinical trials in urban and rural locations. We run one of the world's longest-running health and demographic surveillance sites, at Matlab, 50 km south of Dhaka, as well as an extensive network of field stations.

To facilitate **knowledge transfer**, research groups have developed strong links with policy-makers and other stakeholders, such as NGOs. A wide range of dissemination methods are used, including policy briefings and seminars, conferences, policy reports and periodicals, and work with the popular media.

Since many health issues cut across these disciplinary boundaries, there is extensive collaboration between researchers in different centres. There is a strong emphasis on **interdisciplinarity**, with health problems being tackled from multiple complementary directions.

Senior Field Research Assistant Shikha Jin Costa examines 5 year old Shamima during a routine household visit to collect health data and update demographic data of a surveillance household in Kamalapur, one of icddr,b's key urban study areas



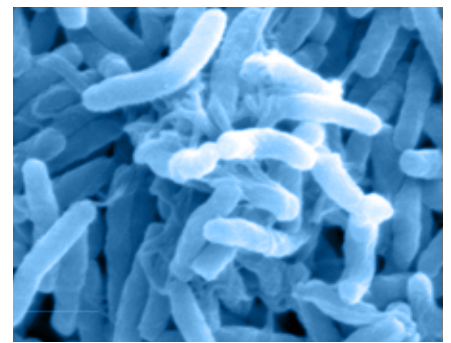
To achieve its aims, research at icddr,b is organised into 10 research centres focusing on key national and international health issues:

RESEARCH CENTRE	NUMBER OF SCIENTISTS
CHILD AND ADOLESCENT HEALTH	22
CONTROL OF CHRONIC DISEASES	10
COMMUNICABLE DISEASES	49
EQUITY AND HEALTH SYSTEMS	31
FOOD AND WATERBORNE DISEASES	11
HIV AND AIDS	4
NUTRITION AND FOOD SECURITY	18
POPULATION, URBANISATION AND CLIMATE CHANGE	7
REPRODUCTIVE HEALTH	14
VACCINE SCIENCES	26

HIGHLIGHTS

A CROSS-SECTION OF RESEARCH AND ACTIVITIES FROM 2013 THAT CAPTURE THE RANGE AND SCOPE OF ICDDR,B'S OUTPUTS.

BACTERIAL CROSSTALK MAY TRIGGER CHOLERA EPIDEMICS



Discovery of a mechanism that reactivates dormant Vibrio cholerae could have important implications for understanding the spread of cholera, as well as for surveillance and disease control.

Vibrio cholerae flourish in estuarine and freshwater aquatic environments, and can be readily identified in water sources during seasonal epidemics. Outside these periods, however, they are harder to detect, in part because they convert to a dormant state that is not easy to culture using conventional microbiological approaches. This dormant form of the pathogen can be detected in water from around Bangladesh, using fluorescent microscopy or molecular techniques. However, the natural mechanism that causes these dormant bacteria to become active and trigger cholera outbreaks was not known.

Influenza surveillance is an integral part of icddr,b's vaccine trials. Medical Officer Dr. Chanchala Rani Saha collects nasal samples from young children as part of the influenza surveillance work in the Kamalapur study area

To try to understand the factors that trigger the 'resuscitation' of dormant cells, the research team, led by Dr Shah M Faruque with researchers from icddr,b and Harvard Medical School, funded by the US National Institutes of Health, focused on autoinducers—molecules that trigger changes in gene expression in response to cell density or signals from other bacterial species. Sure enough, biologically synthesised or entirely artificial autoinducers dramatically reactivated dormant *V. cholerae* from surface waters.

The results suggest a possible basis for the marked seasonality of cholera infections. Autoinducer signals from growing bacterial populations may stimulate *V. cholerae* to reawaken and begin multiplying when environmental circumstances are favourable. As well as shedding important light on the ecology of the organism, the results also raise the prospect of improved methods of surveillance, prevention and control. Furthermore, the findings may also be relevant to the many other human pathogens that have dormant states.

Bari SM et al. Quorum-sensing autoinducers resuscitate dormant *Vibrio cholerae* in environmental water samples. *Proc Natl Acad Sci USA*. 2013;110(24):9926–31.

A MULTIFACETED ATTACK ON INFLUENZA

Our researchers have been evaluating a growing range of vaccines against influenza, a common and serious cause of respiratory illness in young children.



Influenza affects all age groups but poses a particular threat to young children. Vaccination is an effective way of controlling disease, and icddr,b researchers have been carrying out several vaccine trials to assess their potential for use in Bangladesh and other developing countries. These have included a major international trial, funded by GlaxoSmithKline, demonstrating that a new quadrivalent flu vaccine—which contains additional B strains of virus—is effective at preventing flu in children aged 3–8 years. Additional studies are assessing its impact in younger children.

In ongoing PATH-funded work, icddr,b is leading a randomised controlled trial of a trivalent seasonal live attenuated influenza vaccine (LAIV) in children aged 2–5 years. The vaccine is delivered intranasally rather than by injection and may provide greater protection in young children.

Infants less than six months of age are particularly susceptible to influenza but vaccination is not recommended for this age group. Following up a landmark

study showing a substantial drop in influenza among the offspring of influenza-vaccinated mothers, icddr,b researchers have now found that vaccination led to increased levels of influenza-specific IgA in breastmilk and reduced levels of respiratory illness in breastfed infants up to six months of age. Hence, antenatal vaccination could protect infants for considerable periods after birth, if breastfeeding is maintained. In addition, flu vaccination during pregnancy significantly improves the birth weight of newborns.

Other studies have shown that combined antenatal influenza vaccination of mothers and 7-valent pneumococcal vaccination of infants provides greater protection from respiratory illness than either vaccine used alone.

Jain VK et al. Vaccine for prevention of mild and moderate-to-severe influenza in children. *N Engl J Med*. 2013;369(26):2481–91.

Schlaudecker EP et al. IgA and neutralizing antibodies to influenza A virus in human milk: a randomized trial of antenatal influenza immunization. *PLoS One*. 2013;8(8):e70967.

Omer SB et al. Combined effects of antenatal receipt of influenza vaccine by mothers and pneumococcal conjugate vaccine receipt by infants: results from a randomized, blinded, controlled trial. *J Infect Dis*. 2013;207(7):1144–7.



EVIDENCE-BASED KNOWLEDGE INTO PRACTICE: PERINATAL CARE

icddr,b researchers have developed a package of measures proven to significantly reduce perinatal mortality and are now attempting to extend the approach into Bangladesh's Government-run health system.

In Matlab, icddr,b has long maintained a demographic surveillance system, operated a field hospital and tested intensive in-home outreach and service delivery strategies in maternal and child health. Evaluation of interventions in intensive service areas provides valuable evidence to inform the development of services in areas served only by government health systems.

In 2007, icddr,b introduced a successful model of integrated maternal, neonatal and child health into its existing intensive

service area, rapidly reducing perinatal mortality by 36%. This approach provided strong evidence of the benefits of a 'continuum of care' model spanning pregnancy, delivery and postnatal periods, based on improving established links between community- and facility-based services.

The continuum of care approach draws on a range of evidence-based interventions but its key feature is coordination of services. As such, the obstacles to its implementation are largely organisational rather than financial or technical. icddr,b researchers are now working with health officials to implement the programme within Bangladesh's existing public health systems without the need for additional investments.

This study is funded by Partnerships for Enhanced Engagement in Research-Health, National Academy of Sciences and USAID.

'Continuum of care' model reduces perinatal mortality by **36%**

CHILD MARRIAGE

A national survey organised by icddr,b researchers has identified alarmingly high levels of child marriage in Bangladesh.

The national survey found that 64% of women aged between 20 and 24 years in Bangladesh were victims of child marriage, which was more common in rural than urban areas and in women with low levels of education. A further study examining the roots of child marriage found that it is not perceived as a problem by the community. Key actors can play a vital role in preventing child marriage by enforcing compulsory birth registration and by verifying the actual age of a bride at marriage.

A report of the survey and recommendations can be downloaded at <http://bit.ly/1roynya>

RESPIRATORY VIRUSES UNDER THE SPOTLIGHT

icddr,b has been at the forefront of global efforts to tackle respiratory infections affecting children.

In 2013, icddr,b researchers contributed to a landmark analysis of the global burden of severe acute lower respiratory tract infections in young children. A review of the evidence not only provided a sobering picture of the immense burden of disease – 12 million episodes of severe disease,

3 million very severe episodes, more than 250,000 deaths in hospital—but also revealed that most deaths actually occur outside hospital settings.

One important challenge is respiratory syncytial virus (RSV), though its precise impact is uncertain. In a study funded by the Gates Foundation, icddr,b researchers analysed data from population-based surveillance for respiratory disease in urban Dhaka to map the disease burden and seasonal variation in RSV, though challenges remain in assessing its wider contribution to mortality. Our scientists also contributed to an international study examining links between RSV and climate factors, providing more information on the epidemiology of the virus and factors affecting its spread. This greater understanding of RSV is leading to renewed interest in RSV vaccine development for developing countries.

The urgent need to tackle respiratory tract infections prompted the launch, late in 2012, of a major WHO initiative—BRaVe (Battle Against Respiratory Viruses)—promoting enhanced surveillance, interventions and management in the community. As we have advocated, the Gates Foundation is now supporting cross-cutting surveillance platforms to determine disease burden (incidence and prevalence) of pneumonia, diarrhoea and febrile illness in children under 5. icddr,b has been selected as one of two sites (along with South Africa) to pilot such surveillance.

Nair H *et al.* Global and regional burden of hospital admissions for severe acute lower respiratory infections in young children in 2010: a systematic analysis. *Lancet*. 2013;381(9875):1380-90.

Stockman L J *et al.* Challenges to evaluating respiratory syncytial virus mortality in Bangladesh, 2004–2008. *PLoS One*. 2013;8(1):e53857.

Haynes AK *et al.* Respiratory syncytial virus circulation in seven countries with Global Disease Detection Regional Centers. *J Infect Dis*. 2013;208 Suppl 3:3246–54.

WORKING WITH VULNERABLE COMMUNITIES

icddr,b's ongoing Global Fund-supported work is ensuring that vulnerable groups gain access to HIV/AIDS services and has helped limit the spread of the virus through Bangladesh.

icddr,b is one of the principal recipients of the Global Fund Rolling Continuation Channel grant on HIV, which aims to reduce transmission of HIV among groups most at risk of infection (sex workers, men who have sex with men, other sexual minorities, such as the *hijra* community and people who inject drugs). Our researchers work with the Bangladeshi Government and national NGOs that deliver services on the ground, mainly through a network of 65 drop-in centres, which provide services to some 40,000 people.

icddr,b also produces materials to support training of staff to work with vulnerable communities. We also carry out research on the needs and vulnerabilities/risks of such groups, to inform the development of services. Study findings have been used to develop the programme and enhance service uptake.

icddr,b has actively promoted the use of oral substitution therapy (e.g. methadone) to reduce the spread of HIV among people who inject drugs in Bangladesh—the group with the highest prevalence of HIV. This programme was adopted by the Government, and recent analyses suggest that this move has had a major impact on the harm-reduction programme in Bangladesh.



PREVENTING DROWNING

A new icddr,b project aims to reduce the alarmingly high numbers of children who die by drowning in Bangladesh.

Drowning is the leading cause of mortality in Bangladeshi children aged 1–4 years, accounting for more than 40% of deaths. In collaboration with Johns Hopkins University and the Centre for Injury Prevention and Research, Bangladesh, icddr,b researchers are testing the effectiveness of the Saving of Lives from Drowning (SoLiD) intervention, which is based on distribution of playpens and enrollment in crèches to improve adult supervision, alongside awareness raising and educational activities.

MICRONUTRIENT SURVEY

On behalf of the Government, researchers conducted a nationwide survey to assess the micronutrient status of women and children in Bangladesh.

The survey found that vitamin A deficiency (VAD) was still 'high' and 'stagnant'—around one in every five children were found to be affected by VAD, with the highest prevalence amongst slum dwellers. A national average of 5.4% was observed among non-pregnant non-lactating (NPNL) women. Although Iron Deficiency Disorder (IDD) had decreased by 10% from previous findings, it was still prevalent among 10.7% of preschool children, 3.9% of 6-11 year-old children, 9.5% of 12-14 year-old children and 7.1% of NPNL women. Although anaemia was found to be less prevalent than previously thought, around 33% of preschool children, 18% of school-age children and 26% of NPNL women were found to be anaemic. Around 50% of the sample was found to be zinc deficient, with the primary cause being attributed to low zinc intake, and the presence of phytate in diet. Despite a significant number of households still using non-iodized salt, the iodine level of the population was found to be sufficient. Additional findings show that among the NPNL group, one in ten women were folate deficient, and one in five women had vitamin B12 deficiency. These policy-relevant results were utilised in the formulation of Bangladesh's first National Micronutrient Strategy.

(UN)HEALTHY HOMES

icddr,b researchers have identified a range of household factors potentially having a significant impact on health.

Household monitoring has revealed that children in Dhaka are exposed to indoor levels of airborne particulates far in excess of WHO air quality guidelines. Particulates, which significantly increase the risk of lower respiratory tract infections, are produced by indoor biomass- or kerosene-burning stoves but the pronounced seasonality of particulate levels—which peaked in the dry and cold season—points to a major contribution from environmental sources outside the home. An important source may be brick kilns, which are active almost continually during the dry season and are known to contribute to environmental particulate pollution.

We have also found that low levels of household environmental cleanliness are associated with abnormal gut function (enteropathy) and poor growth in rural Bangladeshi children. Our findings support the idea that faecal environmental contamination increases the risk of enteropathy, leading to poor nutritional intake and impaired growth (as well as other effects such as weakened responses to oral vaccines). Improved household hygiene could thus have benefits beyond a reduction in acute infections.

In new work aiming to improve gut health, we have begun a trial examining the safety and efficacy of probiotics in infants in low-income areas of Dhaka. As well as nutritional benefits, probiotics could provide additional benefits by boosting responses to oral vaccines.

Gurley ES et al. Seasonal concentrations and determinants of indoor particulate matter in a low-income community in Dhaka, Bangladesh. *Environ Res.* 2013;121:11–6.

Lin A et al. Household environmental conditions are associated with enteropathy and impaired growth in rural Bangladesh. *Am J Trop Med Hyg.* 2013;89(1):130–7.

MAPPING URBAN HEALTH FACILITIES

Using GIS technologies and on-the-ground surveys, icddr,b researchers have mapped the full range of health facilities in Sylhet city in northern Bangladesh, helping to identify gaps in service provision and guiding the development of more comprehensive coverage.

Funded by DFID, the project has provided a unique visualisation of the complex urban health landscape in Sylhet city, a focal point for icddr,b's health systems research. The atlas provides policy-makers with an interactive tool for understanding the nature and distribution of services across the urban space.

The maps revealed significant gaps in proximate emergency care in certain wards of the city and considerable duplication in others, pointing to a need for coordinated service provision across NGO, public and private sectors, especially for the urban poor.

The work has informed DFID's new urban health strategy, which is concentrating efforts where important gaps and inadequate coordination have been identified. We have received additional funding from the German Society for International Cooperation (GIZ) to support these efforts in collaboration with local government in other urban centres in Bangladesh. Opportunities to introduce the interactive mapping tool at the community level are being explored with the NGO health and development sectors.



PRACTICAL VACCINATION

A range of clinical trials have generated important evidence to inform vaccine-use in Bangladesh and internationally.

icddr,b's demographic surveillance site at Matlab, plus infrastructure in Dhaka city, provides a platform for large-scale vaccine studies in urban and rural settings. Such trials provide a more realistic picture of vaccine effectiveness, reflecting both the practicalities of vaccine delivery and the typically lower vaccine responses seen in developing countries.

Among the most significant recent studies, a rotavirus vaccine has been found to be moderately effective when used in a routine immunisation programme. It is likely to have a major public health benefit, however, due to high disease burden and the potential to lower the absolute number of rotavirus cases and deaths.

In a poliovirus vaccine trial, immunisation of infants at two-week rather than four-week intervals was found to induce similar immune responses, suggesting protective immunity could be achieved more rapidly

by shortening the interval between doses. The findings will inform the Global Polio Eradication Program's strategies for controlling polio outbreaks.

Oral cholera vaccines for control of dehydrating diarrhoeal disease are a major focus. The affordable and easily-administered oral cholera vaccine, Shanchol offers a public health benefit because of its potential to prevent disease directly as well as providing the benefit of indirect herd protection. In the large feasibility study 'Introduction of Cholera Vaccine in Bangladesh', funded by the Gates Foundation, more than 267,000 vaccine doses were delivered to participants in a high-risk setting in urban Dhaka. The study has shown that the vaccine can be delivered successfully, is acceptable to the target population, and reduces cholera.

Further studies may help extend oral cholera vaccine usage in developing countries. These include assessing other important practical issues, such as delivery in rural areas, the necessity for cold chain, and understanding the effectiveness of single-dose Shanchol vaccine for controlling disease in epidemic settings.

CONTROLLING LEISHMANIA

icddr,b research is supporting ambitious plans to eradicate Leishmania from the Indian subcontinent.

Leishmania donovani, a parasite spread by sandflies, is endemic in parts of Bangladesh, with some 20 million people potentially at risk. India, Bangladesh and Nepal have jointly committed to eradicate the parasite, and icddr,b's work on infection and nutrition interaction, treatment and vector control will help these Governments achieve their ambitious aim.

In terms of treatment, a single intravenous infusion of amphotericin B has been shown to be safe, effective and practical for use even in rural locations. This study was instrumental in the Government of Bangladesh's decision to make this regimen the first-option treatment in the National Visceral Leishmaniasis Elimination Programme.

icddr,b researchers have been evaluating several approaches to vector control, with insecticide impregnation of bed-nets reducing the incidence of visceral leishmaniasis by 67%. Insecticide-impregnated durable wall linings within dwellings and other environment-friendly methods of vector control are also being investigated, and the likely impact of climate change on sandfly distribution is also being explored.

Other research has shown that community-based surveillance and rapid referral can also significantly reduce disease incidence. Detection and treatment of 'hidden' untreated cases has the potential to reduce transmission by eliminating a reservoir of disease.

As well as providing advice to the National Visceral Leishmaniasis Elimination Programme, icddr,b researchers are also collaborating on research into new diagnostic tools and therapies, with the Infectious Disease Research Institute, Seattle, USA, and the Drugs for Neglected Diseases Initiative.

Mondal D et al. Reducing visceral leishmaniasis by insecticide impregnation of bed-nets, Bangladesh. *Emerg Infect Dis* 2013;19(7):1131-4.

Mondal D et al. Efficacy and safety of single-dose liposomal amphotericin B for visceral leishmaniasis in a rural public hospital in Bangladesh: a feasibility study. *Lancet Global Health* 2014;2(1):e51-e57.

Ferdousi F et al. Visceral Leishmaniasis Eradication is a Reality: Data from a Community-based Active Surveillance in Bangladesh. *Trop Med Health* 2012;40(4):133-9.

Maintz EM et al. Introducing single dose liposomal amphotericin B for the treatment of visceral leishmaniasis in rural Bangladesh: feasibility and acceptance to patients and health staff. *J Trop Med* 2014;2014:676817.

Research reviewed here was funded by WHO-TDR, the German Academic Exchange Service and Japan's Ministry of Health, Labor and Welfare

MALNUTRITION AND PNEUMONIA: A DEADLY COMBINATION

Clinical studies in Dhaka have important implications for the treatment of children affected by malnutrition and pneumonia.

Globally, pneumonia kills 1.4 million children under 5 every year. Notably, the risk of death is some 15 times higher in children with pneumonia who are also severely malnourished. However, surprisingly little is known about pneumonia in such children, particularly outside Africa, even though the co-morbidity burden of pneumonia and severe malnutrition is highest in Asia. In recent years, icddr,b researchers have generated a wealth of important information about the interplay between these two deadly conditions.

For example, icddr,b researchers recently found that low blood potassium levels due to diarrhoeal disease can mask clinical signs of pneumonia, especially in severely-malnourished children. The findings underscore the need for careful assessment for pneumonia for early initiation of injectable antibiotics in young children at risk of low potassium because of malnutrition and/or diarrhoea, even in the absence of signs, such as rapid breathing.

Other research has revealed that the causes of pneumonia often differ in severely-malnourished children—unusually, nearly a quarter of cases are linked to pulmonary TB, underlining the importance of looking for TB in such children.

Further research has identified a range of clinical signs associated with increased risk of death while blood transfusion to treat low blood pressure (in septic shock) was also linked to higher death rates. These simple measures could be used for identifying high-risk cases requiring more intensive treatment. Some specific signs have also been identified that could be used to guide the use of supplementary oxygen therapy when pulse oximetry is not available to assess blood oxygen levels.

Chisti MJ et al. Clinical risk factors of death from pneumonia in children with severe acute malnutrition in an urban critical care ward of Bangladesh. *PLoS One* 2013;8(9):e73728.

Chisti MJ et al. Predictors and outcome of hypoxemia in severely malnourished children under five with pneumonia: a case control design. *PLoS One* 2013;8(11):e71376.

Chisti MJ et al. Clinical signs of radiologic pneumonia in under-five hypokalemic diarrheal children admitted to an urban hospital in Bangladesh. *PLoS One* 2013;8(8):e71911.

Chisti MJ et al. A prospective study of the prevalence of tuberculosis and bacteraemia in Bangladeshi children with severe malnutrition and pneumonia including an evaluation of Xpert MTB/RIF assay. *PLoS One* 2014;9(4):e93776.

Globally,
pneumonia
kills 1.4 million
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PUBLICATIONS

icddr,b is committed to disseminating the results of its research to the wider scientific, medical and policy communities through the scientific literature. Publication in peer-reviewed journals is an important route through which wider impact can be achieved.

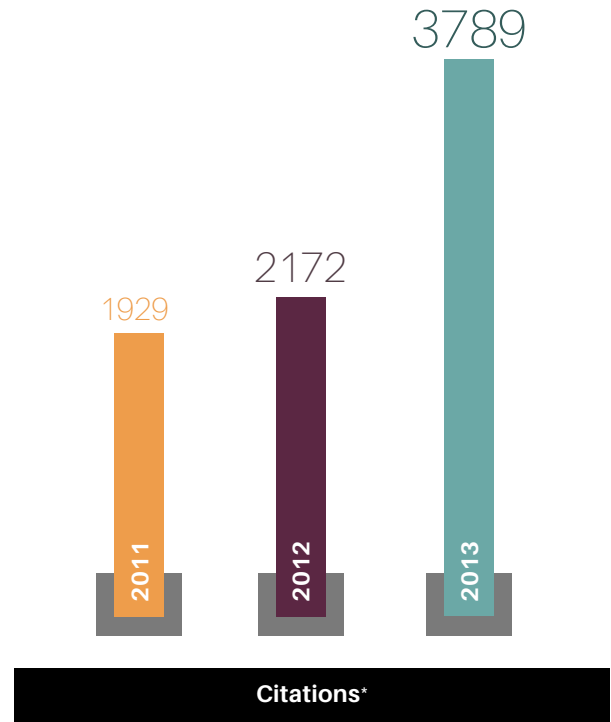
The number of original papers with icddr,b authors published in peer-reviewed journals increased to 276 in 2013, up from 237 in 2012.

The total number of international publications including an author from icddr,b rose to 349 in 2013 from 332 in 2012. These publications included 10 book chapters/monographs, and 64 letters/editorials.

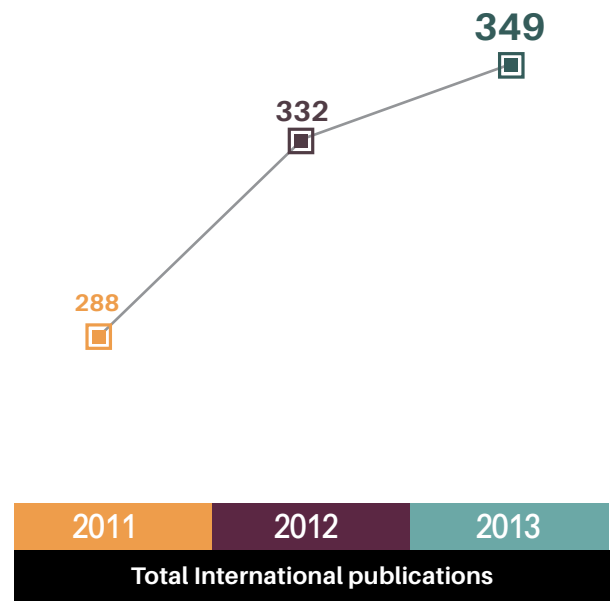
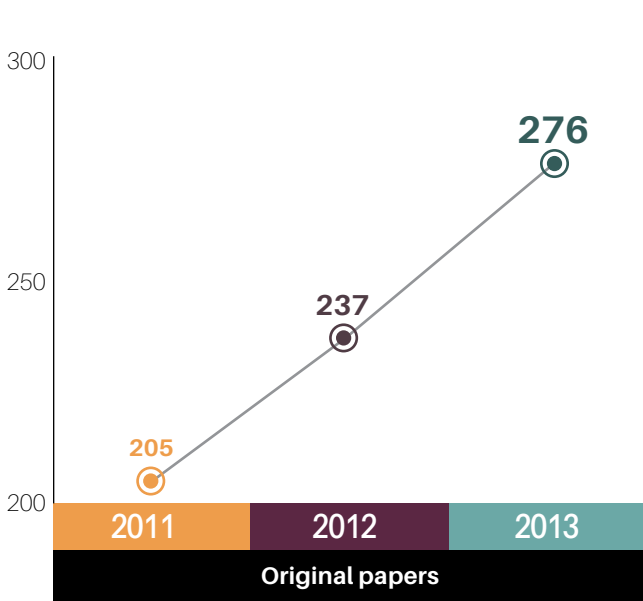
In 2013, icddr,b scientists were authors on papers published in a wide range of leading publications, including the *New England Journal of Medicine*, *the Lancet*, *Lancet Infectious Diseases*, *PLoS Medicine*, *Circulation*, *Gastroenterology*, *Science Translational Medicine*, *Proceedings of the National Academy of Sciences of the USA* and *Clinical Infectious Diseases*.

The number of citations of papers with icddr,b authors also increased significantly, from 2172 for the period 2010 – 12 to 3789 for 2011–13.

A full list of all publications can be found at: www.icddr.org/AR2013_Publications.



* Total number of citations over preceding three years.



INTERNATIONAL RECOGNITION



The 2013 C.N.R Rao Prize from The World Academy of Sciences, awarded to Dr. Firdausi Qadri, Director, Centre for Vaccine Sciences

icddr,b staff continued to be honoured globally. In 2013, this included more junior and mid-level scientists.



Dr Mustafa Mahfuz, Asst. Scientist, Centre for Nutrition and Food Security, received a special Mycotoxin Grant Award from the Bill & Melinda Gates Foundation. He is the first scientist in Asia to receive the award, which is open only to scientists and organisations with significant research experience in malnutrition and enteric diseases. Dr Mahfuz was also selected as one of the 20 Associate Scientific Advisors for Science Translational Medicine, a sister journal of Science.



Dr Sayeeda Huq, Asst. Scientist, Centre for Nutrition and Food Security, received AusAID's Alumni Excellence Award



Dr Taufiqur Rahman Bhuiyan, Assoc. Scientist, Centre for Vaccine Science was selected as a Young Ambassador by the American Society of Microbiology



Dr K Zaman, an Epidemiologist and Sr. Scientist, Centre for Child and Adolescent Health was selected to serve as an advisor to the Global Rotarix Advisory Board and the Global Advisory Board on Novartis Vaccines



Dr Munirul Alam, Sr. Scientist, Centre for Food and Waterborne Diseases was elected as a Fellow of the American Academy of Microbiology for the year 2013

CENTRE FOR CHILD AND ADOLESCENT HEALTH

We aim to improve the health and wellbeing of children and adolescents in Bangladesh, through a wide-ranging programme of research in nutrition, infectious disease and child development.

Bangladesh is a relatively young country—one-third of the population is aged 14 years or younger, while adolescents, aged 10–19 years, represent a fifth of the total population. Child mortality has declined significantly in recent decades, although it remains relatively high in global terms. Major health challenges include diarrhoeal diseases, respiratory tract infections and malnutrition—more than half of pre-school children show stunted growth, and micronutrient deficiencies are extremely common.

We aim to improve child and adolescent health through research that informs policy and practice and strengthens programmes, using evidence-based interventions. Our work spans all areas of maternal and young people's health, including control of infectious disease, child development, nutrition and adolescent health.

We have particular interests in childhood vaccination, generating evidence to shape the Ministry of Health and Family Welfare's Expanded Programme on Immunization. We have had a long-standing interest in nutrition and child development, including the 'MINIMat' longitudinal study of nearly 4,500 pregnant women given food and micronutrient supplementation.

Much of our work focuses on child health services. We evaluate services provided through government systems, generating evidence to support improved service delivery.



RESEARCH GROUPS

The *Childhood Nutrition* group aims to generate evidence to support scaling up of nutrition interventions during the 1,000-day 'window of opportunity' from before pregnancy to 24 months of age.

The *Childhood Immunisation* group collects data on vaccine safety, reactogenicity, efficacy and effectiveness. Studies are conducted in the community as well as in hospital/clinic facilities, generating information on vaccine effectiveness (and cost-effectiveness) as well as lab-based data on immune responses.

The *Child Development* group studies numerous biological and psychosocial factors affecting children's development, behaviour and temperament, including malnutrition, maternal morbidity, psychosocial stimulation, nutritional supplementation and exposure to toxins.

The *Adolescent Health* group has carried out work to identify adolescents' reproductive health needs, developed and tested strategies for improving reproductive health services for adolescents, and provided assessments of youth-friendly health services.

The *Monitoring, Evaluation and Health Informatics* group aims to ensure that technically sound data are used in health decision-making. Our main focus is the country's routine health information system as well as the monitoring and evaluation system of the Ministry of Health and Family Welfare. We also support monitoring and evaluation across all of the centre's research projects.

The *Child Health Services* group works with the Government of Bangladesh and development partners to evaluate the effectiveness of child health programmes, especially community-based public health interventions. Areas of interest include improving delivery of maternal, neonatal and child health services at government facilities, capacity building of health programme managers and operations research.

The *Childhood Illness: Epidemiology, Burden and Risk Factors* group carries out research related to childhood illness and provides training on the use and interpretation of data in public health and clinical practice.

A major international clinical trial showed that a new quadrivalent flu vaccine was effective in children



CENTRE HIGHLIGHTS

QUADRIVALENT FLU VACCINE

A major international clinical trial showed that a new quadrivalent flu vaccine was effective in children (see page 9).

ROTAVIRUS VACCINE

In a cluster-randomised controlled trial, a rotavirus vaccine was found to be moderately effective when used in a routine immunisation programme. It is likely to have a major public health benefit, however, due to high disease burden and the potential to lower the absolute number of rotavirus cases and deaths.

POLIOVIRUS VACCINE

Immunisation of infants at two-week rather than four-week intervals induced similar immune responses. The findings will inform the Global Polio Eradication Program's strategies to control new outbreaks, supporting shorter intervals between polio vaccine doses.

CHILD DEVELOPMENT

The Maternal and Infant Nutritional Intervention study, Matlab (MINIMat) on a cohort of 4,446 pregnant mothers given food and micronutrient supplementation, continues to generate important data. Iron deficiency, for example, was found to affect the impact

of psychosocial stimulation of children, an effect not entirely reversed by iron supplementation, while poverty was found to influence child development as early as seven months and to have increasing effects on cognitive performance as children grew older.

VITAMIN D

High-dose maternal vitamin D3 supplementation during the third trimester of pregnancy increased infants' early postnatal growth. Routine supplementation may, therefore, help reduce poor early growth, a risk factor for a multitude of later-life health problems.

Roth DE, Perumal N, Al Mahmud A, Baqui AH. Maternal vitamin D3 supplementation during the third trimester of pregnancy: effects on infant growth in a longitudinal follow-up study in Bangladesh. *J Pediatr*. 2013;163(6):1605-1611.e3.

EVALUATION OF HEALTH SYSTEMS

Through evaluation of the scale up of the 'Helping Babies Breathe' intervention, introduction of protocolised management of maternal and neonatal sepsis and new approaches for under-five case management, the centre has generated important information to guide health service development.

Hoque DE et al. Improving and sustaining quality of child health care through IMCI training and supervision: experience from rural Bangladesh. *Health Policy Plan*. 2013. [Epub ahead of print]

BIRTH DEFECTS

The impact of birth defects in Bangladesh is unknown, although across South-East Asia as a whole prevalence is estimated at 54.1-64.3 per 1,000 livebirths. To focus attention on this neglected area, the Centre for Child and Adolescent Health collaborated with Bangladesh's Directorate General of Health Services and the Bangabandhu Sheikh Mujib Medical University to organise a national workshop on birth defects. The workshop discussed ways in which surveillance could be integrated into health systems to provide a better picture of the burden of disease as a first step towards improved understanding, prevention and management of birth defects.

ADOLESCENT HEALTH QUESTION DATABANK

By consulting a wide range of adolescents from varying backgrounds, the Centre for Child and Adolescent Health has collated a databank of reproductive health 'frequently asked questions'. Such information will provide important input into adolescent health programmes linked to the recently released National Adolescent Reproductive Health Plan of Action 2011-2016.



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CENTRE FOR COMMUNICABLE DISEASES

Our aim is to reduce the public health burden of communicable diseases in Bangladesh, by conducting multidisciplinary research on endemic and emerging infectious diseases, developing and testing new interventions, and evaluating disease-control programmes.

As well as highly prevalent diarrhoeal diseases and respiratory tract infections, Bangladesh also has one of the world's highest burdens of tuberculosis, while parasitic diseases such as malaria and leishmaniasis are endemic in parts of the country. Emerging infections, such as avian flu and Nipah virus, have potentially serious implications for Bangladesh, the region and globally.

Our research covers multiple infectious diseases, including emerging and zoonotic infections, and spans surveillance and interventions. Improving hygiene practices is an important focus in domestic and commercial settings. We also play an important role in responding to infectious disease outbreaks, in partnership with the Institute of Epidemiology, Disease Control and Research (IEDCR), Ministry of Health and Family Welfare.

By actively engaging with local stakeholders, we aim to tackle communicable diseases of greatest local importance. We also strive to make the results of our research available to decision-makers, for example through dissemination seminars and our open-access newsletter, the *Health and Science Bulletin*, published in English and Bengali. We also act as technical consultants to health authorities.

Our work also has global significance, particularly that linked to emerging infections. We have a long-standing collaboration with the US Centers for

Disease Control and Prevention (CDC) and are a key collaborating partner with CDC's Global Disease Detection Center in Bangladesh. This network of international centres plays a major role in identifying and controlling emerging infections and epidemics worldwide.

RESEARCH GROUPS

The *Water Sanitation and Hygiene* group develops and tests water, sanitation and hygiene interventions to prevent diarrhoea and respiratory disease. Interventions typically combine innovative products (hardware) and behaviour change communication materials and methods. Rigorous evaluation designs are employed to measure the health and behaviour impact of our interventions and those undertaken by other agencies. We also examine barriers to uptake of interventions.

The *Tuberculosis and Leprosy* group's research encompasses the burden of tuberculosis and leprosy, the development of rapid diagnostic methods, and identification of cost-effective strategies for disease prevention and control.

The *Zoonotic Diseases* group carries out epidemiological and sociological studies of infections such as highly pathogenic avian influenza A/H5N1 virus, Nipah virus, Japanese encephalitis virus and rotavirus. We participate in joint outbreak investigations, including recent work on anthrax in livestock and humans and avian influenza in humans and poultry.

The *Respiratory Viruses* group studies influenza and other respiratory viruses, conducting surveillance for seasonal influenza and novel influenza A subtypes, estimating the burden of severe illness, developing novel surveillance and diagnostic methods, and evaluating intervention programmes.

The *Surveillance and Outbreak Investigation* group focuses on emerging infections and other priority diseases affecting humans, such as rotavirus, Chikungunya, dengue, cholera, Japanese encephalitis virus, anthrax and Nipah virus. We also estimate the burden of disease for vaccine-preventable and emerging infections to inform decision-making.

The *Parasitology* group studies the epidemiology of malaria and leishmaniasis, carries out drug trials, develops and evaluates point-of-care diagnostics, and assists government agencies in control of disease.



Research Officer Sara Sabrina Ferdous collects plasma from blood to test for tuberculosis

Ongoing surveillance of avian influenza, in partnership with the Government of Bangladesh



CENTRE HIGHLIGHTS

TRACKING BIRD FLU

We have identified the first human death from H5N1 avian influenza in Bangladesh. A young boy became ill after playing with the carcasses of backyard poultry, later found to be infected with H5N1 virus. Ongoing surveillance for possible avian influenza infection in humans, in partnership with the IEDCR, focuses on poultry workers in Bangladesh's bird markets. Poultry and other birds around markets are also being monitored for the H7N9 virus that has recently caused outbreaks of human disease in China. In other work, investigation of a major die-off of crows and in-depth analysis of recent H5N1 viruses isolated in our studies revealed a new variety of H5N1 virus introduced into Bangladesh, highlighting the ongoing dynamic nature of influenza infection in poultry and the need for active surveillance.

*Nasreen S et al. Seroprevalence of antibodies against highly pathogenic avian influenza A (H5N1) virus among poultry workers in Bangladesh, 2009. *PLoS One* 2014;13(8):e73200.*

*Khan SU et al. Investigating a crow die-off in January-February 2011 during the introduction of a new clade of highly pathogenic avian influenza virus H5N1 into Bangladesh. *Arch Virol* 2014;159(3):509-18.*

*Gerloff N et al. Multiple reassortment events among highly pathogenic avian influenza A(H5N1) viruses detected in Bangladesh. *Virology* 450-451: pp.297-307 (2014)*

OSELTAMIVIR FOR FLU

In a landmark study of more than 1,000 urban Bangladesh patients, funded by the US Centers for Disease Control and Prevention, oseltamivir reduced both the severity of

illness and the likelihood of transmission, by lowering virus shedding. Importantly, while oseltamivir is recommended for use within 48 hours of infection, the study found that the drug also had beneficial effects when given after this time. The results argue that oseltamivir could play an important role in controlling influenza outbreaks in Bangladesh or other developing countries.

*Fly AM et al. Efficacy of oseltamivir treatment started within 5 days of symptom onset to reduce influenza illness duration and virus shedding in an urban setting in Bangladesh: a randomised placebo-controlled trial. *Lancet Infect Dis* 2014; 14(2): 109-18.*

DOMESTIC HEALTH

We have identified several household factors that increase children's susceptibility to infectious disease, and are assessing the impact of probiotics to improve health in infants (see page 13).

INFLUENZA IN PREGNANT WOMEN

We have begun surveillance of influenza in pregnant women and newborn infants. Pregnant women are a high-risk group for severe illness due to influenza, which can also have serious consequences for foetuses and newborns. Recent studies (see page 9) suggest that influenza vaccination is beneficial to mother and child, and data on prevalence will inform the Government's decision whether to target the vaccine to pregnant women.

CHANGING BEHAVIOUR

Our evaluations of the large-scale Sanitation Hygiene Education and Water Supply in Bangladesh (SHEWA-B) project and interventions in Dhaka's live-bird markets have found minimal evidence of beneficial behaviour change. Our work suggests that a better understanding of the obstacles preventing the uptake of good hygiene practice and targeted behaviours is required to make progress.

ANALYSING OUTBREAKS

In partnership with the IEDCR, we have investigated a range of disease outbreaks, including Nipah virus, H5N1 influenza (see above) and a cholera outbreak in Netrakona in north Bangladesh. Although cholera outbreaks are common in Bangladesh, the Netrakona episode was notable for its

scale and severity. We assisted both in the treatment of patients and describing the drinking-water system contamination that contributed to the outbreak.



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CENTRE FOR CONTROL OF CHRONIC DISEASES

Our aim is to improve lifelong health by promoting healthy lifestyles and by contributing to the prevention and control of chronic diseases in Bangladesh.

Trends, such as rapid epidemiologic and demographic transitions, urbanisation and the adoption of westernised diets and lifestyles, are leading to a rise in the prevalence of chronic health conditions in Bangladesh. Non-communicable diseases such as cardiovascular diseases, diabetes, chronic respiratory diseases such as chronic obstructive pulmonary disease (COPD) and cancer now account for the major burden of disease.

We aim to provide a clear picture of the growing health and economic burden of non-communicable diseases, and insight into their development. We also develop and test interventions to reduce the burden of disease and investigate approaches for long-term management of chronic conditions. Our ultimate aim is to reduce chronic disease burden in Bangladesh by one-third by 2020.

We work in partnership with BRAC, Johns Hopkins Bloomberg School of Public Health, USA, and the Institute of Development Studies (IDS), UK. The centre was founded through an initial grant from the Oxford Health Alliance and subsequently supported by the US National Heart, Lung and Blood Institute and the UnitedHealth Group.

We work closely with national policy-makers to identify key issues and to evaluate public health and health systems interventions for non-communicable diseases. We are strongly committed to knowledge translation and transfer. We have formed a Technical Advisory Group, a national platform for chronic diseases in Bangladesh, which brings together representatives from the Government of Bangladesh, the WHO, clinicians, academics and researchers.

RESEARCH GROUPS

The *Chronic Disease Epidemiology and Genetics* group is assessing the prevalence and determinants of chronic conditions, such as COPD, hypertension, diabetes and pre-diabetes, and obesity. We are evaluating educational interventions to raise awareness for prevention and control of such conditions. Other studies are looking at early life experiences and health outcomes in later life. We are also exploring the effects of indoor air pollution on the health of women and young children.

The *Chronic Diseases Systems and Society* group is assessing the consequences of COPD and hypertension on household functioning, the healthcare-seeking behaviour of households of different sociodemographic groups, and the responses of health service providers to these conditions. Findings will be used to develop tools to control COPD and hypertension in Bangladesh.

The *Chronic Diseases and Implementation* group develops and tests new implementation strategies for chronic diseases, extending national policy-making to facility and community levels in urban and rural settings. Our work is expected to influence national decision-making, involvement of expert groups and national institutions, and implementation of selected strategies.

The *Economics of Chronic Diseases* group focuses on the economic burden (poverty and cost of illness) of chronic diseases, equity in disease outcomes, and economic evaluations of health interventions. We also have an interest in healthcare financing mechanisms.

In Bangladesh,
NCDs account
for over 60%
of total deaths



Non-communicable diseases, such as hypertension, is increasing in Bangladesh across all income groups and ages and affect women as well as men. Health Research Officer Molina Rani Roy examines a young woman at an icddr, b sub-centre in Khadergaon, Matlab

CENTRE HIGHLIGHTS

SMOKING-ATTRIBUTABLE MORTALITY

Our recent study has suggested that 25% of all deaths in Bangladeshi men aged 25–69 years are linked to smoking. In 2010, this amounted to 42,000 excess deaths. More than half of all Bangladeshi men over 25 years smoke, some 20 million in total. Without effective smoking cessation strategies, the numbers dying from smoking-related diseases are likely to increase in the future.

Alam DS et al. Smoking-attributable mortality in Bangladesh: proportional mortality study. *Bull World Health Organ*. 2013;91(10):757–64.

CHILDHOOD OBESITY

We have carried out the first survey of obesity prevalence and patterns of diet and physical activity in urban children and adolescents. We found that one in 10 children aged 5–18 years are overweight, and 4% are obese. The study has generated the first data on the growing

problem of childhood obesity, an issue with potentially major long-term implications for health and will support the development of interventions to prevent the spread of an obesity epidemic.

HEALTH SYSTEM PREPAREDNESS TO COMBAT NON-COMMUNICABLE DISEASE

This study assessed the health system preparedness and the country capacity to address non-communicable disease burden in Bangladesh. The study found that the importance of non-communicable diseases is slowly being recognised but Bangladesh is yet to develop a clear national non-communicable disease plan. The study raised several issues to guide policy-makers and development partners.

WILLINGNESS TO PAY

An educational intervention with workers in the informal sector has been shown to increase participants' willingness to pay for health insurance. Pre-payment systems could be a way for citizens to avoid potentially catastrophic medical expenses

but a 'literacy gap' may inhibit their take up. Educational interventions could help close this gap and increase uptake of health insurance schemes.

Khan JA, Ahmed S. Impact of educational intervention on willingness-to-pay for health insurance: a study of informal sector workers in urban Bangladesh. *Health Econ Rev*. 2013;3(1):12.



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CENTRE FOR EQUITY AND HEALTH SYSTEMS



We generate evidence to improve health outcomes, especially for the disadvantaged, in Bangladesh and other resource-poor countries, and through research and partnership, we aim to develop more effective, equitable and accountable health systems.

The underlying principle of the work of the icddr,b's Centre for Equity and Health Systems is that all people, irrespective of their social and economic position, should have access to affordable, high-quality and responsive healthcare that enables them to achieve optimal physical, mental and social wellbeing. Although rooted in local issues, our work often has wider relevance to

health systems development in resource-poor countries.

A conceptual framework for our work is provided by the six building blocks of health systems identified by the WHO, which encompass service delivery, the health workforce, information systems, medical products, financing, and leadership and governance. We have a particular interest in areas such as urban health, healthcare financing mechanisms, gender-related issues, and innovative use of new technologies.

We have strong connections with the James P Grant School of Public Health at BRAC University in Dhaka. As well as joint appointments and collaborations, we also jointly run a fellowship programme for public health professionals. We also support other icddr,b centres' work on health systems, health economics, urbanisation and related areas.

RESEARCH GROUPS

The *Gender and Social Determinants of Health* group is exploring the impact of gender and other social determinants on health, and developing and testing approaches to promoting more equitable health outcomes.

The *Universal Health Coverage* group is developing and assessing efforts to increase financial accessibility, quality and effective coverage of health services.

The *Human Resources* group is working with the Centre of Excellence for Universal Health Coverage, a joint venture between icddr,b and the BRAC Institute of Global Health, to strengthen human resources for health. Areas of focus include identifying distributional inequities and gaps in skills mix and capacity, and testing novel approaches to deploying limited human resources more effectively.

The *Governance and Accountability* group aims to strengthen the governance and accountability functions of health systems, by developing and testing tools to assist monitoring and planning. Examples include a GIS application for assessing geographic coverage of services, and a checklist to assess pro-poor service delivery.

The *Urban Health Systems* group addresses challenges to health systems posed by rapid urbanisation, including its impact on health risks and health inequities, the absence of urban health governance, the lack of institutionalised primary care, and unregulated proliferation of the private health sector.

The *Information Communication Technology* group develops, tests and evaluates innovations in information communication technologies (ICT), such as e/m-health and GIS-based data visualisation methods. We are also exploring the use of ICT for collaboration, knowledge translation, behaviour change and capacity building.

The *Health Economics and Financing* group conducts research to increase the efficient and equitable use of resources for health interventions, including costing analyses and economic evaluation. As well as working on a healthcare financing model for informal sector workers, we are providing input into the Government's Healthcare Financing Strategy and National Health Accounts.



CENTRE HIGHLIGHTS

URBAN HEALTH FACILITY ATLAS

Using GIS technologies and on-the-ground surveys, we have generated a comprehensive map of health facilities in Sylhet city (see page 14).

STRENGTHENING EMERGENCY OBSTETRIC AND NEWBORN CARE (EmONC) SERVICES

We have carried out research to enable health planners to deliver improved EmONC services, and to increase access to 24/7 care. We have also begun to evaluate a new mechanism to promote 24/7 EmONC service coverage. Funded through USAID's TRAction project, we are testing whether a financial incentivisation system spanning public and private sector providers leads to increased 24/7 service availability and greater uptake of services.

INSURANCE SCHEMES

We are studying the potential of micro-health insurance schemes to make healthcare more affordable. Currently, most Bangladeshi citizens pay out-of-pocket healthcare expenses, which can have a disastrous impact on family finances or reduce access to healthcare. We have also had significant input into the Government of Bangladesh's first healthcare financing strategy.

mHEALTH

We are exploring the potential of mobile technologies in healthcare. Bangladesh now has more than 100 million mobile phone subscriptions, and we are carrying out various projects to exploit this infrastructure to improve health, for example by enabling village doctors to access medical advice by phone during consultations and by using text messaging to disseminate health messages about smoking and antenatal care.

TACKLING VIOLENCE AGAINST WOMEN

Over the past decade, we have documented worryingly high levels of violence against women in Bangladesh, the impact of that violence and the factors associated with it. As well as continuing to gather evidence of its impact, we are now exploring possible policy

options and have developed an intervention to promote women's reproductive rights and to reduce women-directed violence in Dhaka slums. The project has also engaged with legal and law enforcement agencies, leading to changes in the way victims of violence are assessed.



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CENTRE FOR FOOD AND WATERBORNE DISEASES

Food Safety Laboratory Research Officer
Subarna Roy looks for typical colonies of
coliform bacteria from a food sample

We aim to reduce the burden of foodborne and waterborne diseases in Bangladesh and other developing countries by carrying out research to gain a better understanding of the biology and transmission of microbial pathogens and by testing interventions to prevent the spread of disease.



Many of the most important infectious diseases affecting Bangladesh (and other developing countries) are primarily transmitted through contaminated water and foodstuffs. Diarrhoeal disease remains common in Bangladesh due to contamination with bacteria such as *Vibrio cholerae*, *Shigella* spp, *Salmonella* spp, diarrhoeagenic *E. coli* and other pathogens.

Research in icddr,b's Centre for Food and Waterborne Diseases focuses on the clinical and environmental monitoring and characterisation of microbial pathogens, to shed light on disease burden and microbial ecology, and to support the development of strategies for blocking disease transmission. We also develop and test locally-applicable interventions to improve water safety and hygiene practices.

In our food safety work, we characterise routes of disease transmission through the food chain. We also work closely with commercial partners to understand the nature of contamination and identify appropriate points of intervention to prevent bacterial contamination of foodstuffs.

RESEARCH GROUPS

The *Enteric Bacteriology and Epidemiology* group conducts research on diagnosis and characterisation of enteric pathogens. We also study diarrhoeal disease burden, and monitor the emergence of diarrhoeal pathogens, especially new variants.

The *Food Safety* group's key aim is to estimate the burden of disease due to foodborne pathogens and to track transmission routes in food chains. We also carry out risk assessments to identify opportunities for interventions to improve food safety.

The *Water and Environment* group investigates inter-epidemic reservoirs of cholera. We also study how safe water can be provided using low-cost technology, and the impact of raised awareness of personal, domestic and environmental hygiene.

The *Molecular Microbiology and Ecology* group studies the biology of bacterial pathogens, including their genetic characteristics, persistence in natural environments and interactions with other environmental organisms using, contemporary molecular approaches. We also study the impact of bacteriophages in the epidemiology and evolution of path.

The *New Diagnostics and Therapeutics* group develops improved methods of diagnosis, particularly of enteric infections, and promotes new approaches for management of infections and malnutrition.

The *Emerging Diseases and Immunobiology* group studies autoimmune diseases developing from bacterial infections, including peripheral neuropathy and central nervous system diseases such as Guillain-Barré syndrome (GBS), acute transverse myelitis and encephalitis.

The *Diagnostics and Drug Resistance* group standardizes diagnostic tests, and studies different clinical parameters in Bangladeshi subjects, with a view to setting reference values for the local population. We also study the effect of developing antibiotic resistance on disease epidemiology.

Analysis of tap water samples from Dhaka city isolated *E. coli* in 63% of samples



CENTRE HIGHLIGHTS

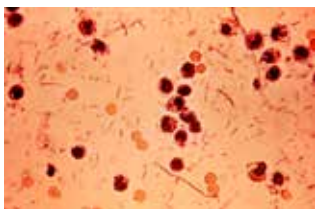
RESUSCITATING *V. CHOLERA*

We have identified a molecular mechanism responsible for converting aquatic *V. cholerae* from a dormant to active form (see page 8).

THE CHANGING FACE OF *SHIGELLA*

An analysis of more than 10,000 *Shigella* isolates collected in Bangladesh between 2001 and 2011 has revealed a marked shift in the prevalence of *Shigella* species, with multidrug-resistant *S. sonnei* becoming significantly more common. Between 2001 and 2011, the prevalence of *S. flexneri* dropped from 66% to 47% while that of *S. sonnei* leapt from 7% to 25%.

Ud-Din Ali et al. Changing Trends in the Prevalence of *Shigella* Species: Emergence of Multi-Drug Resistant *Shigella sonnei* Biotype g in Bangladesh. *PLoS One* 2013;8(12):e82601.



DRUG-RESISTANT BACTERIA IN DRINKING-WATER

We have discovered that the domestic water supply in Dhaka is frequently contaminated with gut bacteria, such as *E. coli*, and isolates show worryingly high levels of antibiotic resistance. In an analysis of tapwater samples from Dhaka city, we isolated *E. coli* from 63% of samples. Strikingly, almost three-quarters of the *E. coli* isolates were resistant to at least one antibiotic, and half were multidrug resistant. The presence of *E. coli* is of immediate public health concern. An equally important concern is that water supply contamination is creating a reservoir in which multidrug resistance genes can be transmitted.

Talukdar PK et al. Antimicrobial resistance, virulence factors and genetic diversity of *Escherichia coli* isolates from household water supply in Dhaka, Bangladesh. *PLoS One*. 2013;8(4):e61090.

FOOD SAFETY AND CAPACITY BUILDING

We have entered into an agreement with the UN's Food and Agriculture Organization to provide assistance in training and establishing a Food Microbiology Laboratory at Bangladesh's Public Health Institute. We are discussing the possibility of developing research programmes to support rapid detection of microbial contaminants in foods. We have also worked with food exporters to overcome issues of contamination in important food exports.



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CENTRE FOR HIV AND AIDS



Our aim is to reduce the spread and impact of HIV and AIDS in Bangladesh, particularly among vulnerable and marginalised groups.

Although Bangladesh is a low HIV-prevalence country, it is important that prevention efforts are maintained to limit further spread of the virus. Certain key populations, such as people who inject drugs, show a significantly higher prevalence of HIV while other groups, including men who have sex with men, female sex workers and transgender individuals, are highly vulnerable and important targets for interventions.

Our key aim is to support government efforts to control the spread of HIV and AIDS. This includes the development of nationwide surveillance systems as well as molecular epidemiological studies to understand HIV transmission within Bangladesh and introductions of strains from other countries.

We have long-standing programmes of work with vulnerable communities and are a principal recipient of a large grant from the Global Fund to Fight AIDS, Tuberculosis and Malaria to improve access of such groups to HIV prevention services. We also evaluate HIV control interventions, provide training in counselling, and carry out clinical studies on the impact of HIV infection.



RESEARCH GROUPS

The *HIV Vulnerability and Marginalisation* group aims to enhance understanding of the risks and vulnerabilities of populations most at risk of HIV, generating knowledge to guide evidence-based prevention, care and support programmes.

The *Surveillance, Monitoring and Evaluation* group conducts surveillance and surveys and monitors and evaluates programmes on HIV and AIDS in Bangladesh and regionally. It is also helping establish the national management information system for HIV on behalf of the National AIDS/STD Programme.

The *Clinical Care and Support* group collects information on the clinical profile and needs of those infected and affected by HIV and AIDS.

The *Sexually Transmitted Infections (STI)* group is assessing the burden of STIs among key populations and monitoring STI services provided through intervention programmes. It is also working on expanding and conducting quality control for HIV testing and counselling systems.

CENTRE HIGHLIGHTS

WORK WITH VULNERABLE COMMUNITIES

Our ongoing Global Fund-supported work has ensured that vulnerable groups gain access to HIV and AIDS services and has helped to limit the spread of the virus in Bangladesh (see page 11).

NATIONAL REPORTING

We have established a national reporting system for HIV and AIDS, feeding data into the national health information systems database. Although Bangladesh is officially classified as a low-prevalence country, accurate and up-to-date figures on infection rates are essential to track infections and assess the impact of interventions.

MODELLING

We have used data from national surveillance and other sources to model likely future trends in the HIV epidemic. Modelling has also revealed that Bangladesh's early adoption of an HIV and AIDS control strategy and harm reduction services have helped avert a large-scale epidemic within the country.

HIV TRANSMISSION

Our analysis of HIV gene sequences from Bangladeshi isolates suggests that HIV circulation within Bangladesh is largely restricted to people who inject drugs but new strains are constantly being introduced by

returning migrants. An analysis of 118 HIV-1 subtype C isolates revealed that most are from a regional Asian cluster and have been introduced multiple times. The results suggest that targeted interventions have managed to keep the lid on the HIV epidemic in Bangladesh but reintroductions are common and returning migrants and their families should be an important target for disease control.

Bontell J et al. Molecular dating of HIV-1 subtype C from Bangladesh. PLoS One. 2013;8(11):e79193.

HIV AND AIDS IN CHILDREN

Little is known of the clinical impact of HIV and AIDS in Bangladesh, particularly in children. We have carried out the first clinical characterisation of hospitalised HIV-infected children, which revealed that those most badly affected had severe wasting and were malnourished. Most of the children had been infected through vertical transmission, and their parents had a history of migration. The study highlights the need for early diagnosis and strategies for avoiding mother-to-child transmission, and suggests migrants would be an important group to target.

Shahrin L et al. Clinical profile of hospitalized HIV-infected children in Bangladesh, a low-HIV-prevalence country. Paediatr Int Child Health. 2014; 34(2): 133-7.

HIV AND AIDS EDUCATION IN SCHOOLS

We have shown that training of teachers significantly enhances the implementation of an HIV and AIDS education programme in schools. In a randomised controlled trial, we found that teachers who had received training were more likely to use an HIV and AIDS education programme, were more comfortable discussing sensitive issues with students, and were more likely to use engaging teaching methods. The results suggest that the cascading training system used for training teachers is equipping them to deliver HIV and AIDS education more effectively, arguing for a wider scale-up.

Sarma H, Oliveras E. Implementing HIV/AIDS education: impact of teachers' training on HIV/AIDS education in Bangladesh. J Health Popul Nutr. 2013;31(1):20-7.

Sarma H, Islam MA, Gazi R. Impact of training of teachers on their ability, skills, and confidence to teach HIV/AIDS in classroom: a qualitative assessment. BMC Public Health. 2013;13:990.

Our ongoing Global Fund-supported work has ensured that vulnerable groups gain access to HIV and AIDS services



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CENTRE FOR NUTRITION AND FOOD SECURITY

We aim to reduce the burden of nutritional disorders in Bangladesh, particularly for vulnerable groups such as children and pregnant women, and with a focus on evaluation of interventions to prevent stunting.

Food insecurity remains a critical concern in Bangladesh. Some 41% of children under 5 years are suffering from chronic malnutrition, while several million children are acutely malnourished and at risk of dying. More than one-third of young children have nutritional anaemia, increasing the risk of intellectual impairment while 26% of all women are anaemic.

icddr,b's Centre for Nutrition and Food Security carries out research across the translational spectrum. Discovery research has included work on biomarkers to identify environmental enteropathy, which leads to stunting. We develop new interventions, including ready-to-use foods from locally-available food ingredients that have the potential to transform treatment for malnutrition. We are involved in the delivery of interventions and in the evaluation of maternal and infant nutrition interventions run by the Government of Bangladesh. We also investigate the impact of malnutrition on infectious diseases, such as kala azar (leishmaniasis) and tuberculosis.



RESEARCH GROUPS

The *Maternal and Child Nutrition* group develops and tests nutritional interventions, with a particular focus on severe acute malnutrition, complementary feeding, supplementary and therapeutic feeding, and nutritional anaemia.

The *Nutrition-Infection Interactions* group focuses on associations between enteric or other infections, malnutrition and cognitive development, to inform the design of intervention strategies for reducing childhood morbidity and mortality.

The *Food Security and Monitoring and Evaluation* group conducts epidemiological and sociological studies on food security. We contribute to the evaluation of nutritional programmes implemented by the Government of Bangladesh, UN agencies and NGOs. We are also assessing the impact of climate change on food security.

The *Diet and Drugs in Diarrhoeal Disease Management* group designs and evaluates interventions to prevent malnutrition caused by enteric diseases, through dietary therapy and medication.

The *Micronutrients* group aims to estimate the burden of micronutrient deficiency, and to design strategies for preventing such deficiencies.

The *Food Safety* group focuses on microbiological, chemical and other forms

of contamination and adulteration of food in Bangladeshi children and adults.

The *Nutrition and Metagenomics* group is studying a range of factors that influence the ability of the gut to absorb nutrients, including host genotype, gut microbiota and its gene content (microbiome), and enteropathogen infections.

The *Food Fortification and Biofortification* group is engaged in a wide spectrum of studies ranging from development of zinc-biofortified crops to implementation at field sites and scaling up of new interventions.

The *Infant and Young Child Feeding* group focuses on the critical first 1,000 days of life. We are involved in an integrated infant and young child feeding programme in slum populations and monitoring the implementation of a government-led intervention in 16 subdistricts of Bangladesh.

The *Supplementary and Therapeutic Feeding* group develops diets and interventions for both emergency and non-emergency situations. We are developing and testing local, ready-to-use supplementary and therapeutic foods.

The *Implementation and Training Research* group organises training workshops on management of child malnutrition, infant and young child feeding and other issues, in Bangladesh and other developing countries.

CENTRE HIGHLIGHTS



SHAPING NATIONAL POLICIES IN BANGLADESH

The Centre for Nutrition and Food Security led the drafting subcommittee preparing the National Nutrition Policy of the Government of Bangladesh. We are also contributing to the National Micronutrient Deficiency Control Strategy as well as to the National Social Protection Strategy of Bangladesh.

CONTRIBUTING TO GLOBAL GUIDELINES

We have contributed to the World Health Organization's revised guideline on the management of severe acute malnutrition, published in 2013. We also contributed to formulating the global nutrition research agenda through

an exercise led by the New York Academy of Science. In particular, we led work on unresolved issues of nutrition in the lifecycle: malnutrition, infection, developmental and functional outcomes and their interaction with nutrition interventions.

MALNUTRITION AND PNEUMONIA

Severe malnutrition has important implications for the diagnosis and treatment of pneumonia in children (see page 15).

NUTRITIONAL INTERVENTIONS

The centre was represented on *The Lancet* Nutrition Interventions Review Group that contributed to an exhaustive review of international interventions to improve maternal and child nutrition.

Bhutta ZA et al. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? *Lancet*. 2013;382(9890):452-77.

VITAMIN A

Infants with a history of vitamin A supplementation experience less severe diarrhoea when admitted to hospital with diarrhoea and pneumonia. The findings reveal an important benefit of vitamin A supplementation in early life.

Chisti MJ et al. History of vitamin A supplementation reduces severity of diarrhea in young children admitted to hospital with diarrhea and pneumonia. *Food Nutr Sci*. 2013;4(2):150-5

READY-TO-USE FOOD TREATMENTS

We have developed a range of novel food supplements and therapeutic foods based on locally-available ingredients—rice, lentils and chickpeas—which are now being tested in clinical trials in children. After a successful acceptability trial, we have begun a randomised trial in north Bangladesh—in collaboration with Johns Hopkins University and the World Food Programme—to assess the ability of our food supplements to prevent malnutrition in 5,000 children aged 6–18 months. A second trial, being run in collaboration with UNICEF, DFID and Nutriset, is evaluating the impact of the therapeutic food products on severe malnutrition in children aged 6–59 months. If effective, the products could be sustainable and highly

cost-effective interventions in Bangladesh and potentially other countries affected by childhood malnutrition.

ERADICATING LEISHMANIA

We have carried out important work on the identification, treatment and control of leishmaniasis, supporting governmental efforts to eradicate the parasite from the Indian subcontinent (see page 15).



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CENTRE FOR POPULATION, URBANISATION AND CLIMATE CHANGE

We are studying the health impacts of demographic and population changes, including urbanisation, and the likely social and health impact of climate change in Bangladesh.

Bangladesh is experiencing major demographic shifts. With more than 160 million citizens, it is the world's eighth most populous country but annual population growth has slowed significantly to 1.4%. Meanwhile, the proportion of people living in cities has risen to 25%. As a low-lying country, Bangladesh is also vulnerable to climate change and sea-level rise.

Research carried out in icddr's Centre for Population, Urbanisation and Climate Change aims to capture the key changes affecting the population of Bangladesh and their likely implications for health and health systems. The profound changes that Bangladesh is experiencing will have impact in multiple areas, including food security, the spread of infectious diseases, non-communicable diseases, and demands on health service infrastructure.

By documenting and analysing these changes, we aim to generate evidence to support longer-term planning and decision-making in Bangladesh. We plan to make a series of 'big picture' projections for Bangladesh through 2050, to capture likely changes in demand for resources (e.g. schools, hospitals, jobs); health issues affected by ageing (e.g. non-communicable diseases); migration and urbanisation (especially slums); and climate change and adaptation by relocation.

We also make use of the Matlab demographic surveillance system to explore various aspects of family life and health, including fertility, infant and child health and development, and family support.



RESEARCH GROUPS

The *Climate Change and Infectious Diseases* group aims to assess the health consequences of climate change at a population level and to identify cost-effective solutions to limit the harm caused at individual (e.g. heat stroke) and population level (e.g. migration due to rising sea-levels or other natural calamities). We also study the impact of climate change on infectious diseases.

The *Epidemiological Transition* group studies changes in burden of diseases due to factors such as increasing life expectancy, declining fertility, a shift away from agriculture, and urbanisation. We are working to improve verbal autopsy methodology, including computer-based categorisation of cause of death, and work with the Government to improve the quality of health management information systems, particularly mortality data.

The *Demographic Surveillance Research* group studies infant and child mortality, unwanted pregnancy and its consequences, social determinants of mortality, disease transition and its consequences for households and health systems, family support for the ageing population, benefits of health on wellbeing, and its effect on later life. We are also examining the long-term effects of health and development interventions and of infant wantedness in Matlab.

The *Migration and Urbanisation* group aims to strengthen the monitoring system for migration from rural to urban areas as a consequence of population transitions, economic factors and climate change. Our research focuses on comparisons of risk factors and health problems between urban, migrant and rural groups, monitoring of healthcare service-use by migrants, and monitoring of migrants' water, sanitation and hygiene practices.

A national survey has found that

64%

of women aged between

20 and 24

in Bangladesh were victims of child marriage



CENTRE HIGHLIGHTS

CHILD MARRIAGE

A national survey has found that 64% of women aged between 20 and 24 years in Bangladesh were victims of child marriage. Child marriage was more common in rural than urban areas and in women with low levels of education. A further study examining the roots of child marriage found that it is not perceived as a problem by the community. Key actors can play a vital role in preventing child marriage by enforcing compulsory birth registration and by verifying the actual age of a bride at marriage. A report of the survey and recommendations can be downloaded at <http://bit.ly/1roynya>

DECLINING FERTILITY

Research at Matlab has suggested that falling fertility may be linked to socio-economic developments, such as improvements in women's education, a shift away from agricultural work, and an increase in wage labour, although lower mortality rates, healthcare interventions and access to contraception also had significant impact. The analyses suggest that focusing on education and economic development may be an effective strategy for motivating people to reduce fertility.

Shenk MK, Towner MC, Kress HC, Alam N. A model comparison approach shows stronger support for economic models of fertility decline. Proc Natl Acad Sci USA. 2013; 110(20):9045-50.

DELTA

We are contributing to a major multicentre international initiative mapping the demographic and socioeconomic characteristics of the population in the southwestern front of the Bengal delta, to better understand links between ecosystem service-use and wellbeing. Modelling through to mid-century and beyond will project how services and wellbeing may alter as a result of climate change, feeding into policy-making in Bangladesh and other delta regions.

POST-MENSTRUAL REGULATION SERVICES

We have found that good quality care after use of menstrual regulation planning services was associated with greater use of contraception, emphasising the value of such services in effective family planning.

Sultana F, Nahar Q, Marions L, Oliveras E. Effect of post-menstrual regulation family-planning service quality on subsequent contraceptive use in Bangladesh. Int J Gynaecol Obstet. 2013; 123(Suppl 1):e38-42.

MALARIA SEASONALITY

Mapping of malaria cases around Chittagong has revealed a pronounced seasonality, coincident with the rainy season, and tight geographic clustering in 'hotspots'. Such mapping will feed into the National Malaria Control Programme's strategies for elimination of the disease.

Ahmed S et al. Malaria hotspots drive hypoendemic transmission in the Chittagong Hill Districts of Bangladesh. PLoS One. 2013; 8(8):e69713.

HEALTH INDICATORS

We have found that self-rated health predicted mortality better than three WHO-proposed health indicators. A simple and reliable indicator of health status would be a great aid for understanding and assessing changing patterns of population health.

Razzaque A, Mustafa AH, Streatfield PK. Do self-reported health indicators predict mortality? Evidence from Matlab, Bangladesh. J Biosoc Sci. 2013; 1-14. [Epub ahead of print]

CLIMATE AND DIARRHOEA

Extreme weather factors, additional hot days and days with heavy rainfall were associated with increased incidence of childhood diarrhoea, emphasising the potential for climate factors to affect health.

Wu J, Yunus M, Streatfield PK, Emch M. Association of climate variability and childhood diarrhoeal disease in rural Bangladesh, 2000-2006. Epidemiol Infect. 2013; 1-10. [Epub ahead of print]

DEMOGRAPHIC EVENTS

In research at Matlab, death of adults and marriage of girls were associated with deterioration in household economic circumstances while out-migration of adult males (but not females) to urban areas or other countries and marriage of boys were associated with improved household economic conditions. The findings suggest that high priority should be given to adult health and to abolition of dowry payments.

Alam N, Barkat-ekhuda. Demographic events and economic conditions of rural households in Bangladesh. Asian Pop Stud. 2014; 7(1):35-50.



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CENTRE FOR REPRODUCTIVE HEALTH



Health Attendant Rina Rani Das checking in on a mother and her baby in the neonatal ward in icddr,b's Matlab Hospital

RESEARCH GROUPS

The *Family Planning, Menstrual Regulation and Post-abortion Care* group studies factors underlying unintended pregnancy and unsafe abortions, to inform the development of services and policy, and with the ultimate aim of reducing unsafe abortion-related mortality and morbidity.

The *Fetal and Neonatal Health Research* group carries out epidemiological research related to prematurity, stillbirth and early neonatal mortality to generate evidence to support enhanced quality of care during pregnancy, childbirth and immediately after birth.

The *Maternal and Reproductive Nutrition* group conducts fundamental, multidisciplinary and clinical research to improve understanding of maternal and child nutrition, and to assess nutritional interventions. Our ultimate aim is to inform clinical practice and the development of policy related to maternal and child nutrition to improve public health.

The *Maternal Health* group aims to improve maternal and neonatal health service delivery and decrease maternal and neonatal morbidity and mortality. We carry out operational research on service delivery, explore barriers and facilitators affecting service delivery, identify country-specific evidence-based services to improve maternal and neonatal health, and address issues facing hard-to-reach areas.

The *Health System and Reproductive Health* group is exploring current practice and gaps in reproductive healthcare, and ways to address such gaps. Through health policy and systems research, we aim to inform the development of policy and practice to improve reproductive health outcomes.

The *Reproductive Infection and Cancer* group is assessing the burden and epidemiology of cervical and breast cancer in Bangladesh. We also aim to identify feasible programmatic approaches to reducing the risk of reproductive infections and cancer.

We aim to promote universal access to comprehensive reproductive health in Bangladesh and beyond, by developing and facilitating the uptake of innovative, sustainable and equitable reproductive health services.

Maternal mortality rates in Bangladesh have declined significantly but remain above Millennium Development Goal targets. Our ultimate goal is to reduce maternal and neonatal mortality still further, through a wide-ranging programme of research encompassing biomedical and social approaches to reproductive health and wellbeing. Much evidence now exists on ways to ensure healthy pregnancies, childbirth and neonatal care. Our work, therefore, focuses not just on the development or testing of novel interventions, but particularly on implementation of evidence-based

practices in local or other developing world settings.

A key role is played by our Matlab demographic surveillance site. Here, we organise reproductive health services in around half the surveillance area, allowing us to compare interventions with standard government-provided services.

We have particular interests in the management of pre-eclampsia/eclampsia in the community and in excessive blood loss after delivery—the single most common cause of maternal mortality. Family planning services are another important priority. We also work on topics such as maternal nutrition and cervical cancer.

We work closely with the Government of Bangladesh on the implementation and evaluation of reproductive health services. As well as disseminating information on evidence-based practice, we also carry out research to understand the factors accelerating or inhibiting the uptake of evidence-based practice.



CENTRE HIGHLIGHTS

PERINATAL KNOWLEDGE INTO PRACTICE

We are working with the Government of Bangladesh to integrate an evidence-based 'continuum of care' model into existing health systems (see page 10).

ICDDR,B-MAT

Following positive initial studies covering 77,000 deliveries, the icddr,b-mat—designed to identify dangerous levels of blood loss after childbirth—is undergoing validity testing to assess its potential for wider implementation. Excessive bleeding after childbirth accounts for almost a third of all maternal deaths, but is difficult to assess. The icddr,b-mat absorbs a set volume of blood which, once exceeded, provides a simple visual indicator that excessive blood loss has occurred and medical help is required. Extremely well-received in pilot studies—98% of participants said they benefited from the icddr,b-mat, 87% said they would use it again and 89% said they would purchase it—a biodegradable version of the mat is being evaluated for wider use. The possibility of adapting the mat for use in Africa is also being discussed. This study was funded by Venture Strategies Innovations, and the Gates Foundation/Grand Challenges Explorations.

PROMOTING PERINATAL INTERVENTIONS

We are developing a tool enabling policy-makers to assess the local health context for implementation of evidence-based perinatal interventions. A number of simple interventions have repeatedly been shown to be effective at reducing maternal and child mortality but are not implemented in practice in many developing country settings. We are working as part of an international collaboration to develop a tool that will enable health system managers to assess their local infrastructure and identify what changes need to be made to facilitate the introduction of evidence-based perinatal interventions. The tool is being tested in a range of real-world settings in Asia and Africa. The study is funded by Uppsala University, Sweden.

PILLS FOR MENSTRUAL REGULATION

We have shown that mifepristone–misoprostol is an effective and popular option for menstrual regulation in Bangladesh. Menstrual regulation, evacuation of the uterus in early stages of pregnancy, is an accepted form of birth control in Bangladesh. Recently, pharmaceutical approaches, such as mifepristone–misoprostol, have emerged as a highly effective alternative. Our clinical study of women seeking menstrual regulation services found that

the overwhelming majority preferred the pharmaceutical approach. In part, thanks to this trial, mifepristone–misoprostol has been approved for use in Bangladesh's national menstrual regulation programme. This study was funded by Gynuity Health Projects, USA.

Alam A et al. Acceptability and feasibility of mifepristone–misoprostol for menstrual regulation in Bangladesh. *Int Perspect Sex Reprod Health*. 2013;39(2):79–87.

HUMAN PAPILLOMAVIRUS

We have generated the first prevalence data on human papillomavirus (HPV) in Bangladesh and provided evidence of the risk factors associated with HPV infection. The prevalence of HPV, which has been linked to cervical and other cancers, was 7.7%, with no significant difference between urban and rural women. Urban women working as housemaids or in

the garments industry were at higher risk of HPV infection than non-working women while rural women whose husband lived overseas were almost two times as likely to be infected as those women whose husbands lived with them. The data will support the Government's efforts to obtain GAVI Alliance funding to introduce HPV vaccination. This study is funded by Swedish International Development Cooperation Agency (Sida)-SAREC, Sweden.



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CENTRE FOR VACCINE SCIENCES

Our aim is to improve health locally and globally through research, development and implementation of vaccines and other methods of infectious disease control.

Although Bangladesh has a well-established vaccination programme, there is potential for additional therapies to be introduced. Moreover, a significant burden of infectious disease remains unaddressed, making new vaccine development an urgent priority.

An important challenge is to understand the effectiveness of vaccines in resource-poor, high-risk settings. For a variety of reasons, vaccine responses in the developing world are typically lower than those seen in industrialised countries. Understanding why will be important for the development of approaches to boost vaccine responses and for informing decision-making on vaccine implementation.

As well as assessing efficacy in large pragmatic trials, icddr,b's Centre for Vaccine Sciences works closely with health authorities in Bangladesh to address key questions about the practical implementation. We also work with private enterprises and public-private consortia to promote the development of new vaccines.

Current priorities include vaccines to control diarrhoeal diseases, including major trials of oral cholera and rotavirus vaccines and to prevent respiratory tract infections, the biggest global killer of children. We have been strong supporters of the WHO's BRaVe (Battle Against Respiratory Viruses) initiative. We actively support WHO's oral cholera vaccine stockpile initiative and the Global Task Force on Cholera Control and Prevention. In addition to other initiatives, we have recently received major support from the Gates Foundation to establish surveillance systems for respiratory diseases (and other conditions) across Bangladesh.

RESEARCH GROUPS

The *Enteric Vaccines* group's main aim is to understand immune responses against enteric infections, including responses to natural infections and after vaccination. Our interests include factors resulting in poor efficacy and lowered immune responses in children receiving oral vaccines. Our work spans laboratory studies and phase I/III and large phase IV feasibility studies.

The *Systems Vaccinology* group studies factors influencing responses to vaccination and infections in developing country settings, such as prenatal and postnatal nutritional status, exposure to environmental toxins, past history of vaccination and infection, interactions between enteric vaccines, nutrient supplementation and the gut microbiome. We are also exploring prenatal immunisation and possible methods to predict vaccine immunogenicity.

The *Emerging Vaccines* group studies emerging vaccines and their potential for use in Bangladesh. As well as current work on rotavirus and polio vaccine, possible future targets include hepatitis, dengue, Japanese encephalitis, tuberculosis, leishmaniasis and malaria.

The *Vaccine Surveillance* group conducts surveillance, in urban and rural communities as well as clinical facilities, to obtain data on vaccine safety, reactogenicity and efficacy. Such surveillance may reveal changes in circulating strains following vaccination, generate laboratory data on immune responses, and provide evidence of herd immunity.

The *Respiratory Vaccines* group's research spans phase I and II development studies, phase III efficacy and effectiveness studies, and phase IV post-licensing evaluation and

impact assessment. We have a particular focus on investigational vaccine trials against pneumonia-related pathogens, and on licensed vaccines that have not been systematically evaluated for pneumonia.

The *Economics of Vaccines* group aims to generate evidence to ensure vaccines are available to all people, especially the poor and vulnerable, in an effective way and at an affordable price.





CENTRE HIGHLIGHTS

RESPIRATORY VIRUSES

The major global burden of respiratory diseases in children is leading to renewed efforts in surveillance and vaccine development (see page 11).

INFLUENZA VACCINATION

Trials of influenza vaccines have been an important focus of our recent work (see page 9).

ORAL CHOLERA VACCINE

Our clinical trials are providing evidence to support use of oral cholera vaccine in Bangladesh (see page 14).

UNDERSTANDING POOR VACCINE RESPONSES

We have identified several factors that influence responses to oral vaccines, including malnutrition, diarrhoea and abbreviated breastfeeding. In collaboration with the University of Virginia,

USA, we are studying biologic factors limiting responses to oral poliovirus and rotavirus vaccines in Bangladesh. We are also investigating whether vitamin A supplementation for mothers can improve vaccine responses in infants. Although the WHO does not currently recommend vitamin A supplementation, its possible benefits on vaccine responsiveness and improved infant survival have not been fully assessed.

Qadri F, Bhuiyan TR, Sack DA, Svennerholm AM. Immune responses and protection in children in developing countries induced by oral vaccines. *Vaccine*. 2013;31(3):452-60.

NEW VACCINE DEVELOPMENT

We have worked with private-sector organisations, and public-private partnerships, to further the development of new vaccines and to accelerate their introduction into developing world settings. For example, we have worked with Sanofi on a phase I common

protein pneumococcal vaccine trial. Encouraging results have led to discussions with donors with regard to a phase II trial targeting developing countries with a high pneumococcal pneumonia burden, including Bangladesh.

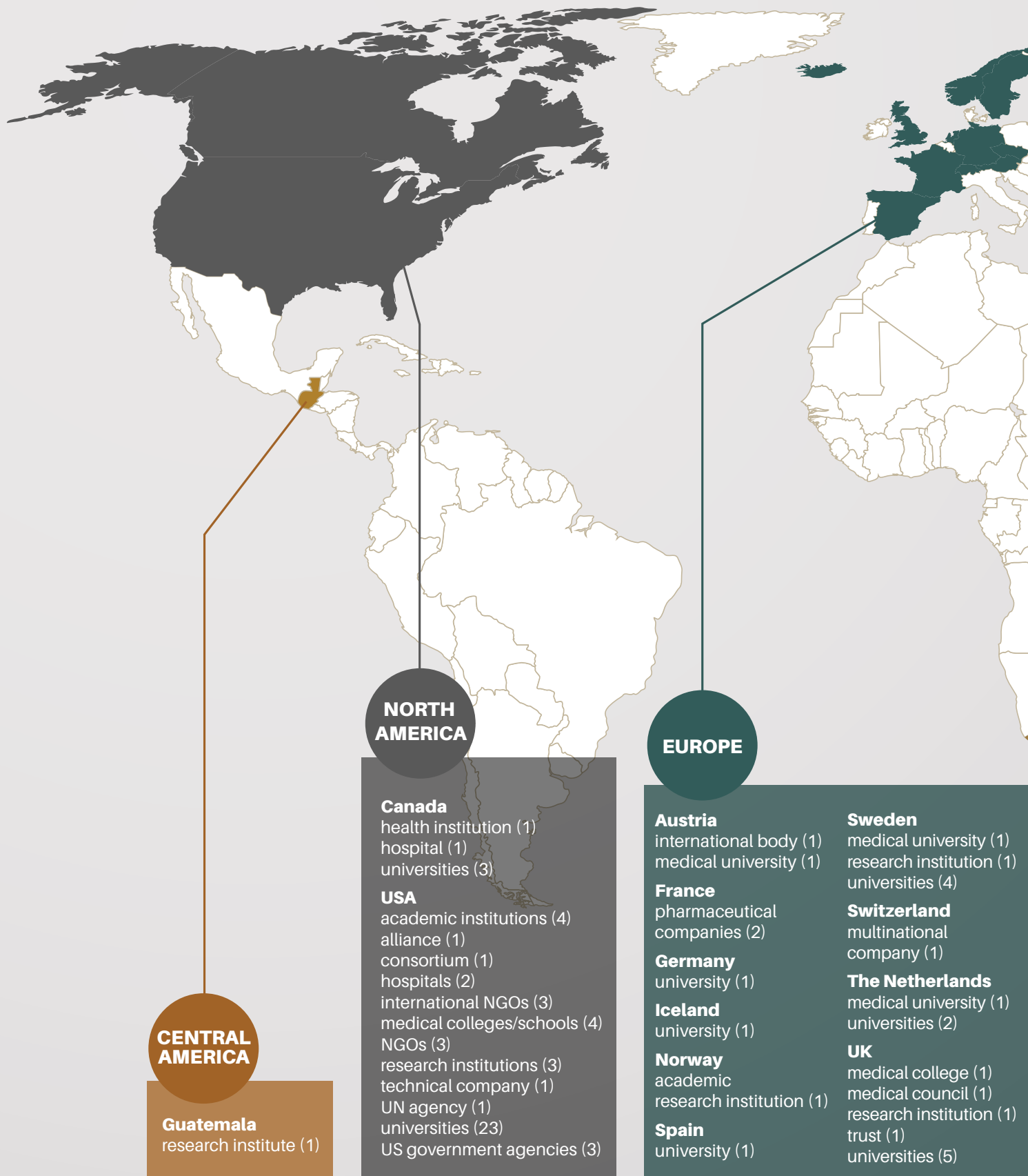
We have also collaborated with PATH and the Serum Institute of India, Ltd (SIIL) on a new live attenuated

influenza vaccine. Through discussions with SIIL, and in light of findings from a phase II trial we conducted, the phase III evaluation will be extended to two-year-old children, and will examine impact on childhood pneumonia. This vaccine is being specifically developed for low-income, high-burden countries.

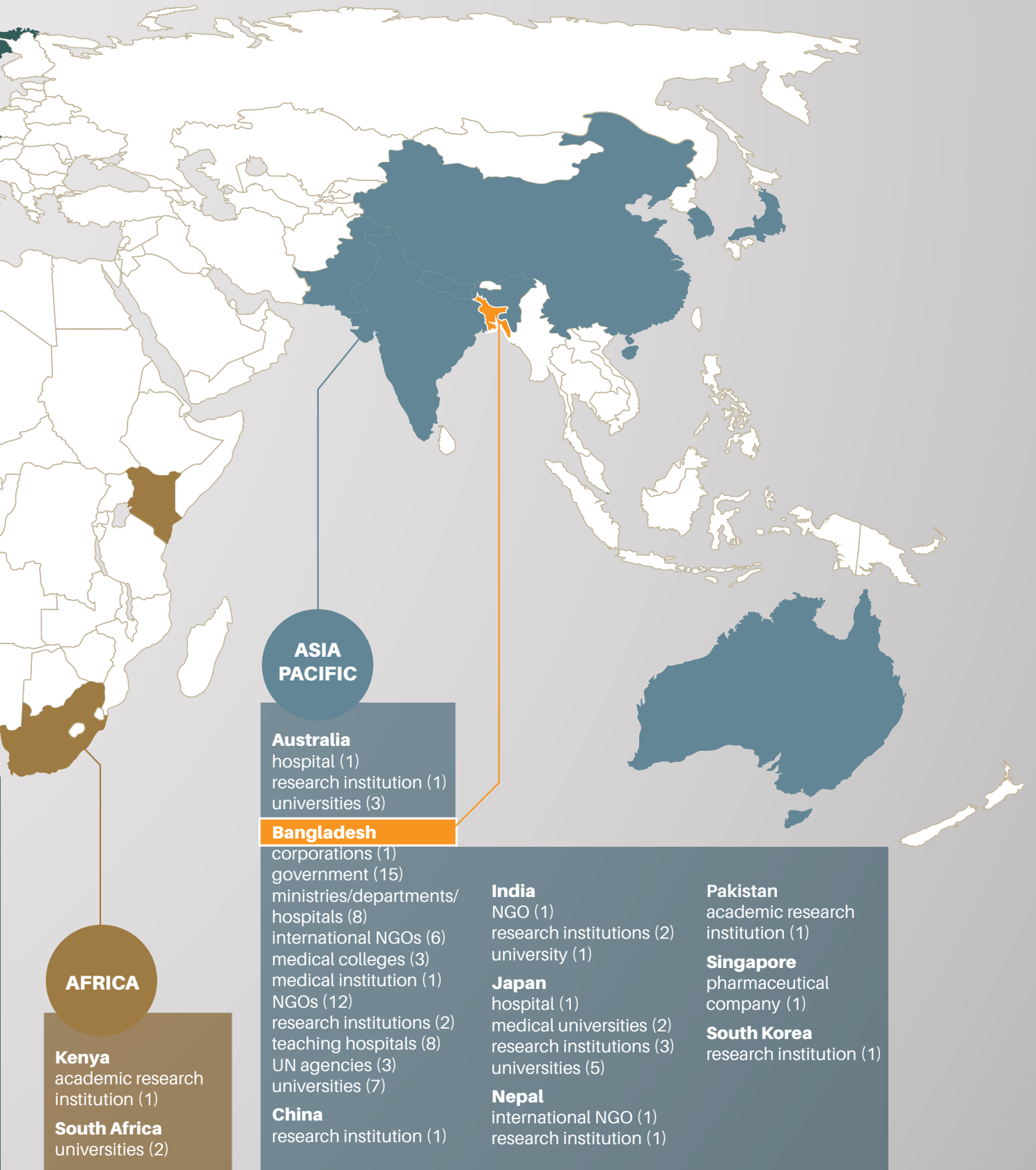


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OUR PARTNERS



Developing collaborations with scientists, researchers, health professionals, government and NGO representatives nationally and internationally is central to icddr,b's research. Today, more than ever, a concerted global effort is essential to make significant advances in addressing the critical public health issues faced by those living in poverty. icddr,b contributes a unique perspective to global knowledge benefiting from its proximity to the issues, the breadth and cohort of researchers, and its relationship with the Government of Bangladesh, which allows for rapid translation of research evidence into policy action.

OUR TRAINING

icddr,b has a long history of offering researchers and healthcare professionals exposure to the public health challenges affecting people living in poverty, and the low-cost interventions that icddr,b has developed to meet them.

Working alongside icddr,b researchers and clinicians, programme participants are offered the chance to learn from experts, witness the generation of critical new evidence and knowledge, and to see

low-cost interventions in action. Across the world, thousands of health professionals consider their time at icddr,b as formative to their career.

In addition to specialist training provided by icddr,b's Technical Training Unit, icddr,b's research centres also provide needs-based training and technical assistance in Bangladesh, the region and globally.

2013 saw political unrest across Bangladesh, and over 60 days were lost to hartals (political strikes). Due to this instability, fewer international students visited but icddr,b continued to offer a range of formal and informal training opportunities.

INNOVATIVE TRAINING PARTNERSHIP

icddr,b has been contracted by ACI Pharmaceuticals Ltd as part of an innovative CSR programme to run a 3-year joint project to refresh the knowledge and skills of 1,800 rural medical practitioners in Bangladesh.

Specialised Technical

Training Unit: Courses aimed at building capacity in the health workforce

25 training events

499 health professionals participated

59% males and 41% females

James P Grant School of Public Health, BRAC University

17 senior icddr,b scientists on the faculty

353 lectures delivered

27 MPH students supervised

Field Experience

Programme: Aimed at Masters and PhD students seeking practical insights into, and experience of, public health in a low-resource setting

86 institutions represented

171 students attended:

35% male and 65% female

86 Bangladeshi and 85 International

Orientation Programme:

Tailored to meet specific curricular needs, primarily for medics interested in research and humanitarian activities

19 national institutions represented

1,005 students trained:

39% male and 61% female

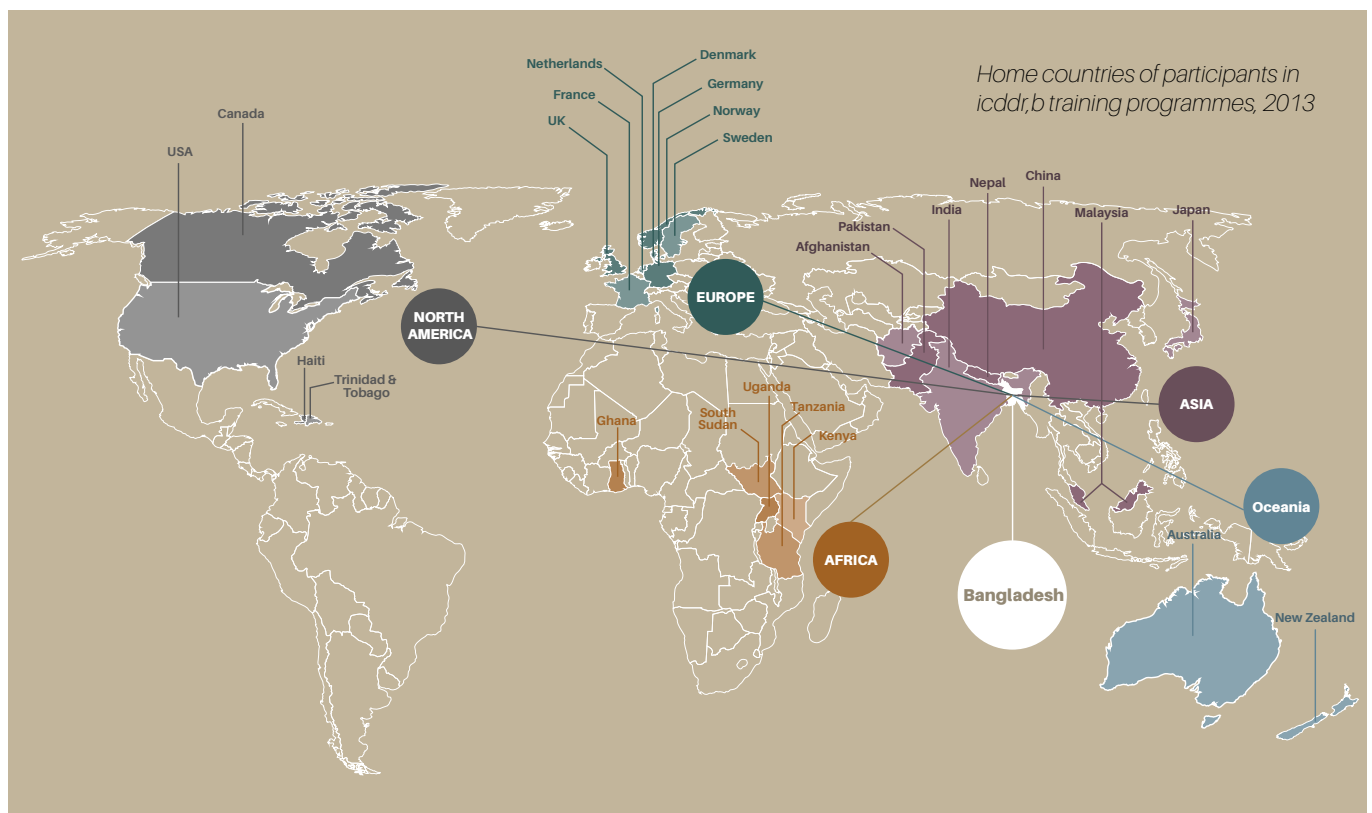
938 Bangladeshi and 107 international

HERFINA NABABAN



An internship at icddr,b in 2011 as part of her Masters in Global Health studies proved career-defining for Indonesian health researcher Herfina Nababan. Her goal is to continue as a researcher and, in time, to study for a PhD.

"Dhaka was my first encounter with urban slums. I found it overwhelming and very hard to see people living in conditions without basic amenities." In 2012, Herfina returned to icddr,b as a Research Fellow on a project investigating how to improve equity in the provision of urban healthcare. Formal training provided by icddr,b included courses in qualitative and quantitative research, report writing and a general writing workshop. "At university, it's sometimes hard to comprehend everything you are taught but here you get formal training and learn on the job. I've learnt so much and also know my strengths and where I need to improve. I feel I made the right decision coming to icddr,b."



OUR SERVICES

icddr,b's Dhaka Hospital provides an essential platform for icddr,b's clinical research and training activities. As well as assessing new treatments, it is a site at which new interventions can be implemented, and acts as a showcase of best practice—illustrating what can be achieved in hospital settings in resource-poor locations.

Clinical facilities also make important contributions to disease surveillance in Bangladesh, providing insight into short-term outbreaks and long-term trends in disease prevalence.

During 2013, fifty three clinical studies were in progress, with 14 new studies beginning during the year. A great diversity of research is being undertaken, including large randomised controlled vaccine trials, studies of experimental diagnostic tools, and psychosocial interventions to enhance children's recovery from diarrhoeal disease.

In support of icddr,b's commitment to the principle of universal access to healthcare, services at Dhaka Hospital are free to all. The high quality of the services provides major collateral benefits to the local population, quantified in terms of 'deaths averted'.

icddr,b also manages a hospital in its Matlab field site, providing clinical infrastructure within its demographic surveillance area. The Matlab Hospital provides services in maternal and child health, family planning and the management of diarrhoeal disease. In response to high demand, a treatment centre has been established at Mirpur, in northeast Dhaka, to manage cases of diarrhoeal disease.

DR MD TAREQ IMTIAZ



Working as a Clinical Fellow in the icddr,b hospital has prepared Dr Md Tareq Imtiaz for his next assignment as a medical officer with the Bangladesh Ministry of Health & Family Welfare.

"My time at icddr,b has helped me enormously. I've worked with patients with diarrhoea—over 50% of whom are children—treated malnutrition, pneumonia and TB. At icddr,b everything has a protocol that is followed strictly. We applied the guidelines and didn't face any problems. In the public hospital I will be

able to treat many people drawing on the knowledge and experience I have gained here. My late grandfather said I should become a doctor and it has been my dream since then to become a paediatrician."

OPERATION IRAQ



In July 2013, a team of experts from icddr,b's Dhaka Hospital travelled to Iraq to assist the World Health Organization in assessing the risk of a cholera outbreak amongst Syrian refugees

Since the armed conflict began in Syria in 2011, approximately 160,000 Syrians have sought refuge in Iraq, with the majority concentrated in the Kurdistan Region. Many of those fleeing Syria arrive sick or injured and traumatised by their experiences. Almost all the camps are

overcrowded, with limited water and sanitation provision: in these conditions waterborne diseases such as cholera, shigellosis, and typhoid fever can spread rapidly.

Invited by the Kurdistan Regional Government's Ministry of Health, the icddr,b team worked to improve epidemic preparedness—detection, prevention and control—and to ensure that any potential outbreak amongst refugees would not spread to the local population.

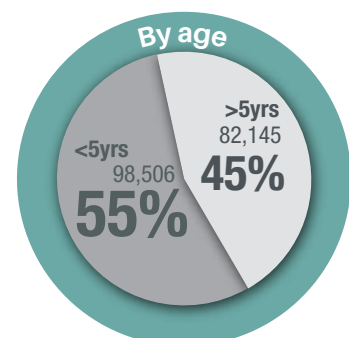
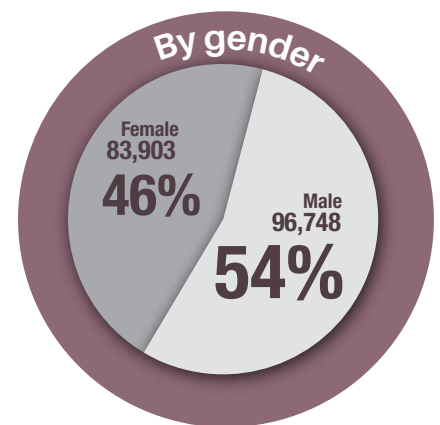
As a founder member of WHO/GOARN icddr,b remains committed to serving the public good, wherever its expertise is needed.

In support of its research mission, icddr,b provides high-quality clinical services in Dhaka, Matlab and other field sites across Bangladesh.

180,651
patients treated

No. of children <5 yrs
98,506 (55%)

69,000
lives saved



DR MOHAMMAD JOBAYER CHISTI



For icddr,b scientist Dr Mohammad Jobayer Chisti the Dhaka Hospital is the ideal place to develop low-cost, low-technology interventions with the potential to save lives globally.

Dr Chisti joined icddr,b as a clinical fellow in 1998 but soon discovered an interest in research. "icddr,b has given me the opportunity to develop as a scientist. Here in the Dhaka Hospital, I have the

opportunity to work with researchers from around the globe and to develop and test new clinical interventions." Among his current projects, Dr Chisti is developing a simple but effective device for delivering oxygen to infants and children suffering from pneumonia.

37%
of patients earning less than \$5/day

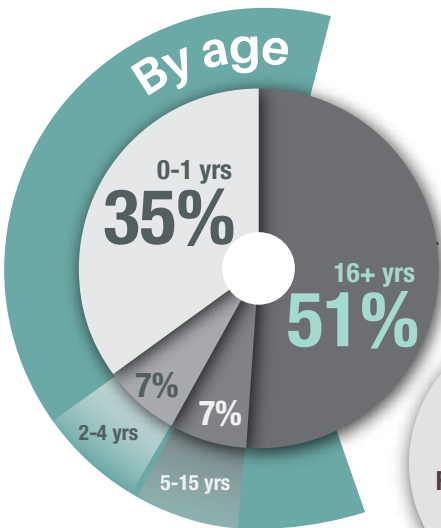
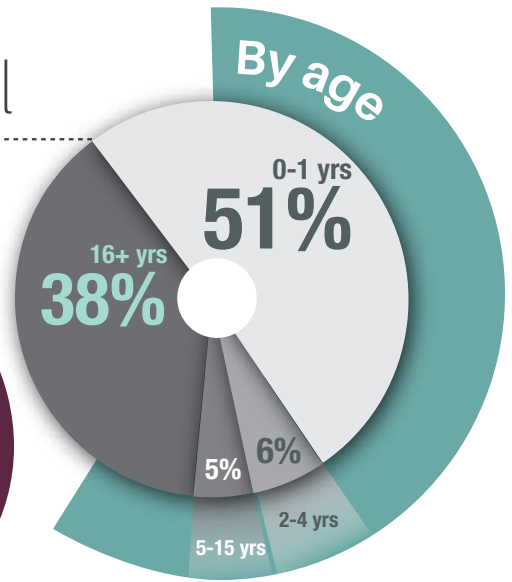
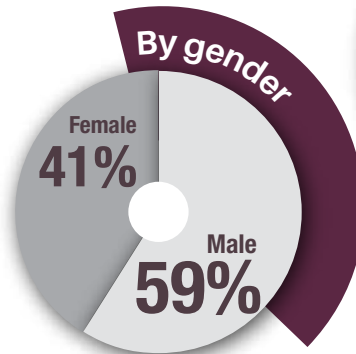
Over 7,000
health education and counselling sessions held

No. of patients and family members trained in disease management and prevention:
47,418

No. of clinical studies in progress:
53

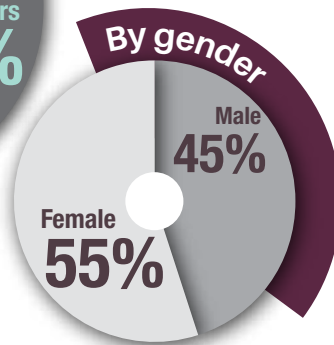
Dhaka Hospital

Patient total **117,499**



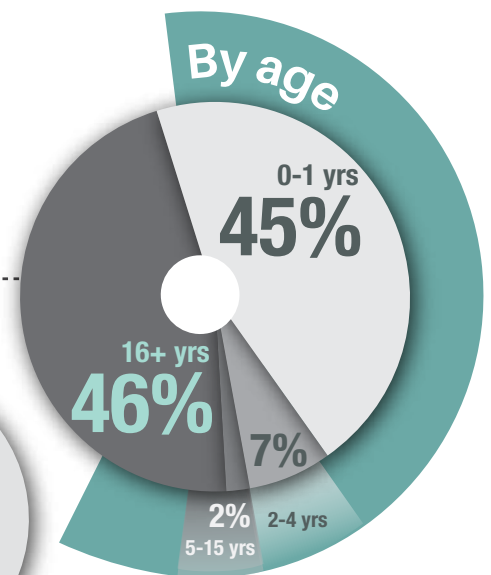
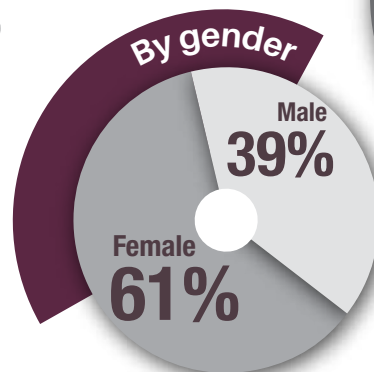
Mirpur Treatment Centre

Patient total **20,426**



Matlab Hospital

Patient total **42,726**





180,651
patients treated in 2 hospitals
and 1 treatment centre

Medical Officer Dr Rafia Akter updates a patient's data during her round in icddr, b's Matlab Hospital

OUR PEOPLE

SENIOR LEADERSHIP TEAM

Executive Director Professor John D Clemens is an international expert in vaccine development and evaluation in developing countries. He led the development of the world's only WHO-recommended, low-cost oral cholera vaccine, which is now being used in a global stockpile. He has authored over 350 original scientific papers and also is a Professor of Epidemiology at UCLA. A graduate of Stanford (B.S.) and Yale (M.D.) Universities, he was awarded the 2010 Sabin Gold Medal for excellence in vaccine sciences.

Deputy Executive Director and Director, Centre for Equity and Health Systems Dr Abbas Bhuiya has more than 30 years' experience in the field of community health research with special focus on health services for the poor/vulnerable and equity issues, behaviour change, and facilitation of community initiatives for the improvement of health, especially of the poor. He has academic training in Statistics and Demography from Chittagong University, Bangladesh, and from the Australian National University, Canberra, Australia.

Chief Operating Officer Ingrid Renaud has extensive global experience optimising operational efficiency and effectiveness of non-profit organisations. She is especially skilled in developing, leading and supervising cross-functional areas, including finance, legal services, human resources, information technology, and administration. Ingrid received a Master of Science degree in Applied Behavioural Science and Organizational Development from Johns Hopkins University and a Bachelor of Arts degree in Fine Arts with a minor in Psychology from Southampton College. Before joining icddr,b she was Chief Operating Officer at Global Rights, an international human rights organisation.

Director, Finance Dr Simba Mandizvidza has over 25 years experience of senior and progressive financial and operational management in public accounting, governmental, non-profit and commercial organisations. Simba holds a Bachelors degree in Accountancy from the University of Zimbabwe, a Nottingham Trent University Post Graduate Certificate in Management, an MBA degree in Finance, and a Doctorate degree in Public Administration both from the University of La Verne, California. He is also a Zimbabwe Chartered Accountant and a California Certified Public Accountant.

Director, Research and Clinical Administration and Strategy Dr Mohammed Abdus Salam graduated in medicine from the Dhaka Medical College in 1976. He joined icddr,b in 1981 and served in various capacities, including Director, Clinical Sciences Division, before assuming responsibility for icddr,b's Research Administration function in 2011. Since 2013 he has also been responsible for overseeing icddr,b's clinical services and laboratories.

Director, Communications and Development Graham Judd is a communication specialist with extensive experience of the development sector. Working in icddr,b since 2010, he is responsible for external relations and institutional fund development. He brings to his position a background in broadcast media, having spent 25 years working for the BBC in the UK, and public television in the USA. Graham holds a Bachelor of Science degree from the University of Sheffield, UK.

Director, Centre for Nutrition and Food Security Dr Tahmeed Ahmed

has extensive experience on treatment and public health measures to address undernutrition, childhood tuberculosis and diarrheal diseases. He is also a Professor of Public Health Nutrition at the James P Grant School of Public Health, BRAC University, Bangladesh and an Honorary Professor at the University of Queensland, Australia. He is currently serving as Chair of the sub-committee formed by the Government of Bangladesh to formulate the National Nutrition Policy.

Interim Director, Centre for Control of Chronic Diseases Dr Dewan S Alam

has a medical degree from the University of Dhaka, master's degrees in nutrition and epidemiology from the University of Queensland, and a PhD degree from Wageningen University, The Netherlands. He holds an adjunct professor position at North South University, Dhaka. His major research interests include developing and testing preventive interventions and management of non-communicable diseases at primary care level in resource-poor settings.

Director, Centre for Child and Adolescent Health Dr Shams El Arifeen

has over 25 years' experience in child and neonatal health, health services and health systems research. He specialises in community and facility-based trials and evaluations of interventions and programmes, implementation research as well as monitoring systems. He is also an Adjunct Professor at the James P Grant School of Public Health at the BRAC University in Bangladesh where he teaches epidemiology.

Director, Centre for HIV and AIDS

Dr Tasnim Azim qualified in medicine at the University of Dhaka, Bangladesh, and undertook a PhD in immunology and virology at the University of London, UK. She is a member of numerous national and international committees, including the Reference Group to the United Nations on HIV and injecting drug use and the regional advisory group on the regional project on cross-border mobility (EMPHASIS) under CARE, UK.

Director, Centre for Food and Water-borne Diseases, Dr Shah M Faruque

has a master's degree from the University of Dhaka, Bangladesh, and a PhD from the University of Reading, UK. After holding positions at the University of Dhaka, he joined icddr,b in 1989. From 1996 to 2007, he was also Senior Associate in the Department of International Health at Johns Hopkins University, USA. A world expert on *Vibrio cholerae* and other enteropathogens, he was awarded the World Academy of Sciences Prize in Medical Sciences in 2005 and elected a fellow of the World Academy of Sciences in 2007.

Interim Director, Centre for Communicable Diseases Dr Emily S Gurley

is an infectious disease epidemiologist who has been involved in research on emerging infectious diseases in Bangladesh since 2003. She studied for a Master's in Public Health at Emory University, Atlanta, USA, and undertook a PhD in Epidemiology at Johns Hopkins University, Baltimore, USA. She is also an Adjunct Assistant Professor at Johns Hopkins Bloomberg School of Public Health.

Director, Centre for Vaccine Sciences

Dr Firdausi Qadri has worked in the field of infectious disease and vaccines for more than 25 years. She obtained her PhD in biochemistry from the University of Liverpool, UK, relocated from her position as Associate Professor at the University of Dhaka to the icddr,b in 1988. The accolades she has received include the 2006 Gold Medal for Outstanding Research in Biological Sciences from the Bangladesh Academy of Science, the Christophe and Rodolphe Mérieux Foundation Grand Prize in 2012 and the C.N.R Rao prize from TWAS in 2013. She is Adjunct Professor at the BRAC University and actively involved with the Dhaka University in mentoring MS and PhD students.

Interim Director, Centre for Reproductive Health Dr Md Anisur Rahman

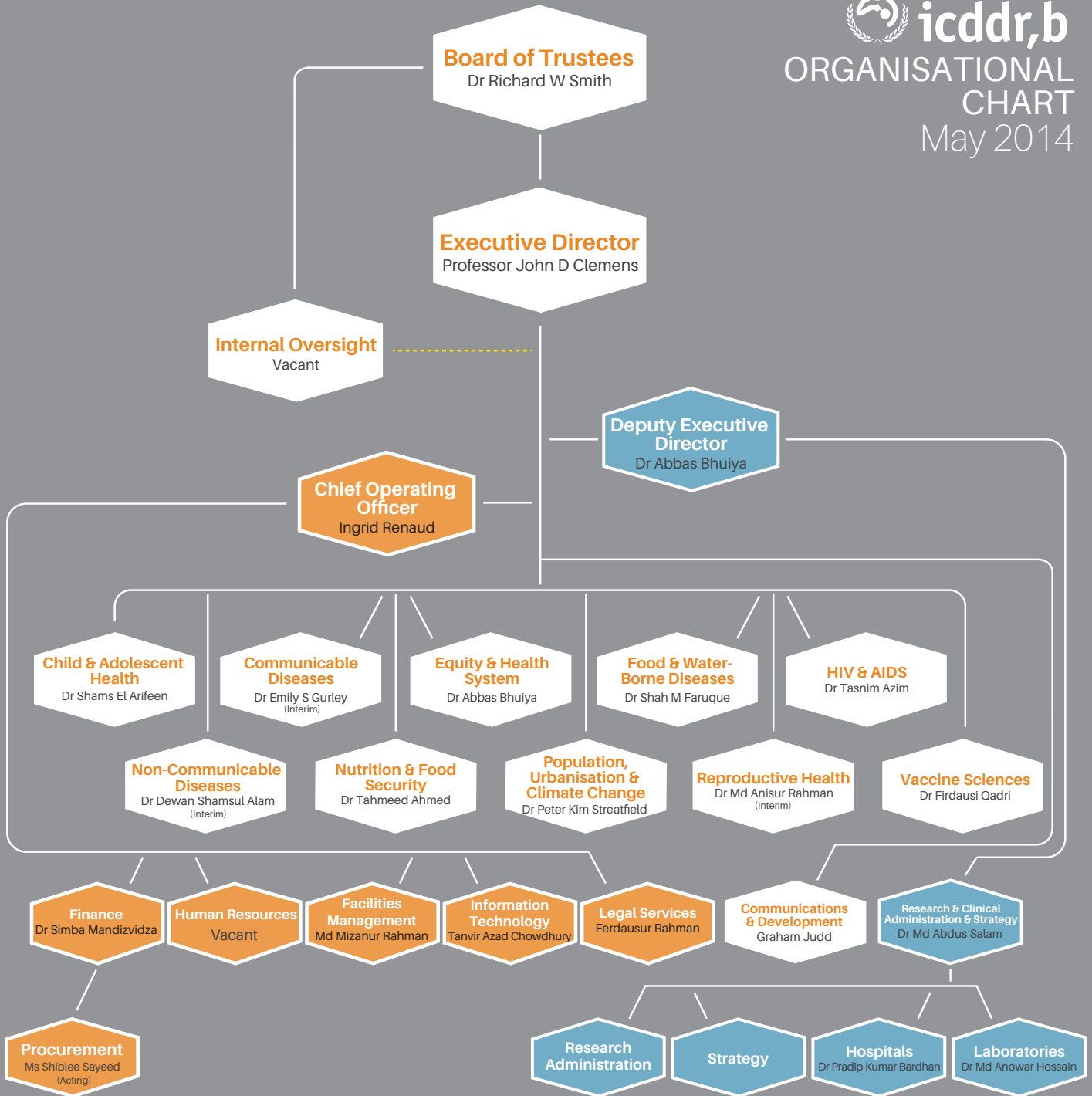
qualified in medicine at Chittagong University, Bangladesh, and obtained his PhD from Uppsala University, Sweden. He is also Head of the Matlab Health Research Centre. His main areas of research are arsenic exposure and reproductive health, preterm and stillbirth issues, quality of care during pregnancy, delivery and postpartum periods, and also implementation research related to improving perinatal health.

Director, Centre for Population, Urbanisation and Climate Change Dr Peter Kim Streatfield

has worked in health and population research and training in developing countries for four decades, including 25 years living in Asia. He has master's degrees from the University of Melbourne, Australia and the London School of Hygiene and Tropical Medicine, London, and a PhD in demography from the Australian National University, Canberra, Australia. Since 1999, he has managed icddr,b's Matlab health and demographic surveillance system.

OBSERVER**Head, Information Technology Tanvir Azad Chowdhury**

received his Masters in Computational Engineering from Ruhr University Bochum, Germany. Tanvir's experience includes directing the design and delivery of advanced technology solutions with strong innovation, transformation and turnaround leadership. He is experienced with information technology best practices, ranging from CISA, ITIL, PMBOK and COBIT. At icddr,b, Tanvir is accountable for applications and infrastructure supporting all icddr,b functions, including enterprise systems, networks, servers and data centres.



BOARD OF TRUSTEES

As of May 2014

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Dr Richard W Smith

Director, UnitedHealth Chronic Disease Initiative

MEMBER SECRETARY (EX-OFFICIO)

Professor John D Clemens

Executive Director, icddr,b

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Secretary, Economic Relations Division, Ministry of Finance.

Mr M M Neazuddin

Secretary, Ministry of Health and Family Welfare

Professor (Dr) Md Suhrab Ali

Professor of Biochemistry, Northern International Medical College, Bangladesh

REPRESENTING UNICEF

Sanjay Wijesekera

Associate Director of Programmes and Chief of Water Sanitation and Hygiene Programme Division, New York, USA

REPRESENTING WHO

Vacant

INDEPENDENT MEMBERS

Dr Zulfiqar A Bhutta

Husein Laljee Dewraj Professor and Chairman of the Department of Paediatrics and Child Health at the Aga Khan University Medical Center, Karachi, Pakistan.

Dr Norma Binsztein

Microbiologist, Instituto Nacional de Enfermedades Infecciosas, National Ministry of Health, Buenos Aires, Argentina.

Dr Somsak Chunharas

Senior Public Health Advisor and Secretary General of the National Health Foundation, Bangkok, Thailand

Kenneth M Dye

International development consultant on governance and accountability. Former Auditor General of Canada

Professor Nirmal K Ganguly

Distinguished Biotechnology Professor and Advisor, Translational Health Science and Technology Institute, New Delhi, India

Dr Ann-Mari Svennerholm

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Dr Jeanette Vega

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Dr Maxine Whittaker

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Dr Mary Wilson

Adjunct Associate Professor of Global Health and Population, Harvard School of Public Health, USA Associate Clinical Professor of Medicine, Harvard Medical School, USA

Zhongwei Zhao

Professor, Australian Demographic and Social Research Institute, the Australian National University, Australia.

OBSERVERS

Dr Abbas Bhuiya

Deputy Executive Director. icddr,b

Rajesh Agrawal

Assistant Director General of Finance (Chief Finance Officer) at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, India.

OUR FINANCES

OVERVIEW

Revenue for 2013 totalled US\$67 million—a total increase of US\$8m over 2012. US\$50 million represented restricted funds while US\$17 million was unrestricted. Tight expenditure control allowed icddr,b to end 2013 with a surplus of US\$3.4m. The implementation of a full cost recovery system in 2014 is expected to further improve icddr,b's financial sustainability. As part of organisational systems strengthening, the finance policies and procedures will be revised to improve internal control and compliance and to promote greater efficiency and effectiveness.

Table 1 (right) shows a US\$63 million increase in net assets. This is mainly due to a revaluation of donated land to \$57.5 million. Current and other assets increased by US\$7 million, mainly due to the Centre Endowment investments being re-valued at market price.

An increase in accounts receivable of US\$5.5 million is largely due to US\$2.5 million outstanding from UKAID (DFID) at the end of the year. Deferred contributions decreased by US\$1.9 million, reflecting utilisation of advanced funds from the Bill and Melinda Gates Foundation, the Rockefeller Foundation and UNFPA.

Accounts payable provisions increased by US\$2 million, partly due to increases in leave and consultancy provisions.

Unrestricted net assets represent the part of net assets that is used to finance day-to-day operations without constraints established by donors, or other requirements. These assets have increased by \$5 million, mainly due to an end-of-year surplus of US\$3.4 million, and the increase in Centre Endowments, which is due to the change in valuation policy.

Table 2 (right) shows that total expenses went up by US\$6.7 million largely due to programme cost increases of US\$5.3 million. Management and administration expenses went up by US\$1.4 million due to increases in local salaries. A surplus of US\$3.4 million was recorded in 2013, which is US\$1.3 million more than the previous year. The surplus will allow icddr,b to build cash reserves. The target for cash reserves is currently set at US\$8m.

SUMMARY OF THE FINANCIAL ACTIVITIES OF ICDDR,B FOR THE FISCAL YEAR ENDED DECEMBER 31, 2013

TABLE 1: NET ASSETS

	Amounts in US\$'000s	
	2013	2012
Current and other assets	78,042	70,937
Capital assets	72,079	15,139
Current and other liabilities (including the Employee Separation Payment Fund)	(60,228)	(58,700)
Net assets	89,893	27,376
Restricted	69,443	11,967
Unrestricted	20,450	15,409
Total net assets	89,893	27,376

TABLE 2: CHANGES IN NET ASSETS

	Amounts in US\$ '000s	
	2013	2012
Revenue		
Contributions	63,476	55,397
Other Revenue	3,766	3,917
Total Revenues	67,242	59,314
Expenses		
Programme	47,134	41,811
Management and administration	16,338	14,966
Fundraising	383	440
Total Expenses	63,855	57,217
Increase in net assets	3,387	2,097

BUDGETARY HIGHLIGHTS

The surplus of US\$3.4 million for 2013 is well above the forecast surplus of US\$2.5 million. This was made possible by improved expenditure control and closer monitoring of salary allocation to projects. Certain activities were also delayed. Management will continue to take steps to identify areas of inefficiency and control costs by monitoring performance on a monthly basis.

The forecast surplus for FY 2014 is \$600K.

TABLE 3: OTHER PERFORMANCE INDICATORS

	2013	2012	
National staff	4,506	4,059	Total staffing numbers remain high compared to number of scientists
International staff	48	48	
Total number of staff	4,554	4,107	
Indirect Cost Ratio	37%	40%	Efficiency measures: target Indirect cost rate < 25%
Current Ratio	1.24	1.17	Liquidity indicators
Deferred contributions	69%	74%	
Total current liabilities			

Table 3 (above) is a selection of performance indicators. The workforce increased to a total of 4,554. This is due to a 447 increase in national staff. As of December 31, 2013, the total scientific staff complement was 213.

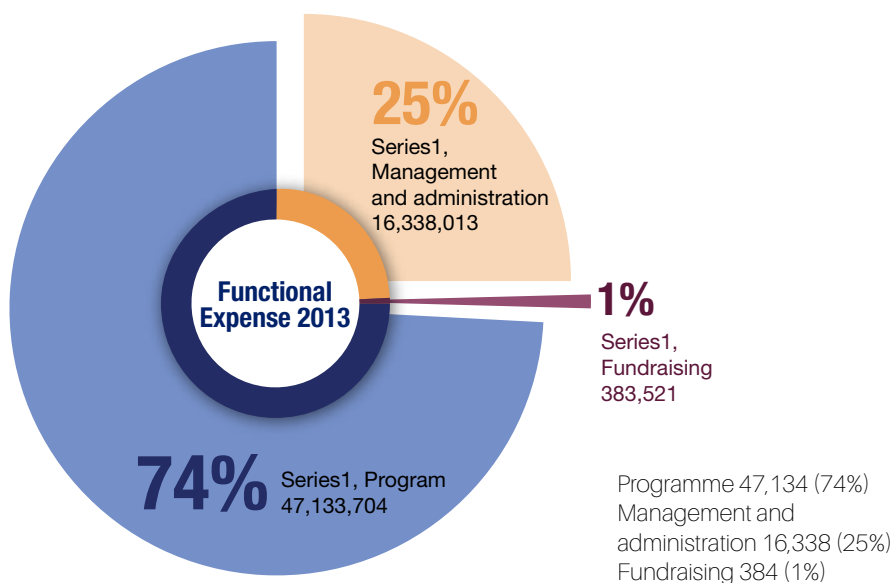
Indirect costs represent the expenses that are not readily identified with a particular grant, contract, project function or activity, but are necessary for the general operation of the organisation. An indirect cost rate represents the ratio between the total indirect costs and the benefiting direct costs. This ratio fell slightly in 2013.

The current ratio reflects the ability to pay short-term obligations. It has marginally increased but ideally should be double the present level. A significant portion of icddr,b's liabilities relate to contributions received in advance from donors. A high proportion of contributions in advance of available cash balances could increase the institution to liquidity risk.

Figure 1 (right) is a summary of expenses by function. Expenses classified by their function provide information about the purpose of the expenses, such as for a

specific programme or for administrative purposes. It classifies expenses based on why money was spent instead of what it was spent on. The figure shows that programme costs at 74% of total expenditure, marginally increased over the previous year, level of 72%.

FIGURE 1: FUNCTIONAL EXPENSES SUMMARY 2013



For our audited financial statements, please go to: www.icddrb.org/2013_financial_statements

RECOGNISING OUR SUPPORTERS

icddr,b thanks the foundations, institutions, corporations, development agencies, NGOs, and multilateral bodies that support its work. A full list is included in the financial report at www.icddr.org/2013_financial_statements.

Top 10 donors in 2013

Sl. No	Name of the Donors	Amount in US \$	
		Restricted	Unrestricted
1	Gates Foundation (a)	11,427,657	
2	USA - NIH	6,543,047	
3	United Kingdom - DFID	1,796,952	4,083,750
4	Australia - AusAID		3,898,930
5	Centers for Disease Control & Prevn. (CDC)-Atlanta	3,797,437	
6	Canada - CIDA		3,750,831
7	Global Fund for AIDS, TB and Malaria (GFATM)	3,742,186	
8	USAID-Washington	3,184,031	
9	Johns Hopkins University (JHU)	2,139,659	
10	Sida	320,562	1,517,000

We are especially grateful to our core donors, the governments of Australia, Bangladesh, Canada, Sweden and the United Kingdom who—in keeping with the Paris Declaration on Aid Effectiveness—provide long-term core funds to icddr,b to support the advancement of its Strategic Plan. Representatives from each of the development agencies meet regularly with icddr,b to monitor progress and discuss emerging research priorities and outputs of note. Every year, icddr,b reports performance against an agreed log-frame, and a joint donor report is commissioned to monitor progress.



Government of the People's Republic of Bangladesh



CORE DONOR FUNDING HAS

1. Enabled icddr,b to focus on and pursue its strategic research objectives rather than chase adhoc research funds
2. Increased the institution's financial stability, making it less vulnerable to changes in the external supply-led science research-funding environment
3. Enabled icddr,b to invest in maintaining and improving core infrastructure essential to scientific advances but for which project grants rarely provide, e.g. disease surveillance networks, laboratory upgrades, humanitarian services at icddr,b hospitals and clinics
4. Enabled icddr,b to develop and modernise its business processes—financial, HR, communications, and M&E—which are fundamental to the institution being able to operate to international standards.

Together these and future investments and advances ensure that icddr,b can continue to generate high-quality research knowledge, and attract funds in a highly-competitive global environment.

The research outputs of icddr,b, which focus on the public health challenges of developing nations, have value not only to the people and Government of Bangladesh but also to neighbouring countries in the region and beyond. It is the application of icddr,b's research and its continued contribution to the global public health agenda that has attracted and retained investments by the world's leading development agencies.

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