icddr,b

Annual Report 2015

icddr,b is an international health research institute based in Bangladesh. Policy-makers and practitioners utilise our evidence and expertise to improve health outcomes and prevent premature death and disability worldwide. Established more than 50 years ago, we continue to provide life-saving services to the people of Bangladesh, and to nurture the next generation of global health leaders.

VISION

A world in which more people can survive and enjoy healthy lives

MISSION

To solve public health problems through innovative scientific research

VALUES

Excellence
We are single-minded in our pursuit of scientific rigour and operational efficiency.

Integrity
We are a responsible and accountable organisation, committed to the highest standards of behaviour.

Inclusivity
We work collaboratively throughout the organisation and with our partners.

WE ARE GRATEFUL TO OUR CORE DONORS FOR THEIR LONG-TERM COMMITMENT TO OUR WORK:

Government of the People's Republic of Bangladesh

SWEDEN

Canada

UKaid from the British people

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LETTER FROM THE EXECUTIVE DIRECTOR

Our new strategy reaffirms our commitment to tackle current and emerging public health challenges facing Bangladesh and the global South.

In 2015, we launched our new three-year strategic plan. An important goal is a consolidation of our research around five main programmes, enabling us to focus our energies on health issues that are of great significance to Bangladesh and other countries of the global South, and where we have outstanding strengths in research. We also aim to build up two developmental programmes in areas that are posing a growing threat to public health in Bangladesh and elsewhere – non-communicable diseases and climate change.

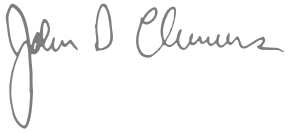
The new strategy will see us continuing to address the questions that matter, while also redoubling our efforts to ensure that the fruits of our labours really make a difference, by influencing policy and practice. Innovation remains at the heart of our work, but it is innovation with a purpose – designed to tackle a locally important health issue – and appropriate innovation, with a realistic prospect of being implemented in Bangladesh and other low- and middle-income countries. Above all, we remain committed to generating high-quality evidence, which policy-makers and programme managers can rely on in their decision-making.

Indeed, we have identified 'excellence' as one of our three core values. Our other values emphasise how we wish to operate – with integrity, as a well-respected organisation operating to the highest possible international standards, and with inclusivity, working collaboratively internally and with international partners.

In 2015, the intergovernmental Organisation of Islamic Cooperation (OIC) named icddr,b one of 10 centres of scientific excellence across the OIC's 57 member states. The announcement was made during a visit to icddr,b by OIC Secretary General, His Excellency Mr Iyad Ameen Madani (fourth from right).

In our strategic plan we set ourselves six strategic goals. As mentioned previously, the first two are to implement a focused research strategy and to increase the visibility and impact of our research evidence. Goals 3 and 4 recognise the need to invest in our unique research platforms and in the development of people to achieve our ambitious research aims. The final two goals, to improve organisational efficiency and to ensure financial sustainability, reflect the importance of aligning the institution with our research aims so we can achieve our full potential, now and in the future.

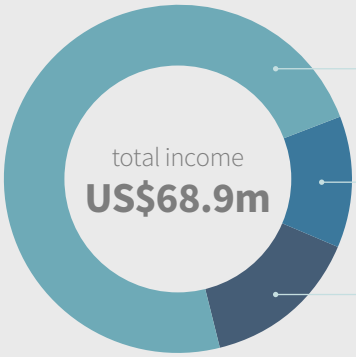
More generally, 2015 saw the launch of the Sustainable Development Goals (SDGs). Much of our work obviously falls under SDG3, ensuring healthy lives and promoting wellbeing. But health does not exist in isolation, and there are mutually reinforcing links with the themes of several other SDGs. Our work has the potential to impact directly on hunger, gender equality, water and sanitation, cities, and climate change. But better health can also have indirect effects, for example by boosting economic activity. Much progress was made in pursuit of the Millennium Development Goals, and we will do all in our power to generate the evidence needed to maintain this momentum in the coming decades.



Professor John D Clemens
Executive Director
May 2016

2015 IN NUMBERS

A snapshot of icddr,b funding, research, training and clinical services



$50.5m funding from competitive sources

$8.3m funding from core donors

$10.1m other income

221 scientific staff

64% male

36% female

356 active projects

145 national collaborations

259 original papers published*

108 new projects begun

88 international collaborations

5,841 citations (2012-14)

*with icddr,b scientists as authors

205,885

patients treated in 2 hospitals and 1 treatment centre

55% male

45% female

570

participants enrolled in clinical research at icddr,b's Dhaka Hospital

112

national policy review committees with icddr,b representation

62

international policy review committees with icddr,b representation

1,290

attendees of icddr,b training courses

1,387

students hosted by icddr,b's orientation programme for medical students

202

academic lectures delivered by icddr,b staff

20

faculty positions held by icddr,b staff at the James P Grant School of Public Health (a joint venture with BRAC and BRAC University)

Research highlights

In 2015, we published key findings across all our priority areas.

In the year that we released our new strategic plan, we made important contributions to the knowledge base, and to the development and implementation of policy, in all our focus areas.

Our studies spanned the full spectrum of translational research, from fundamental studies on the impact of diet and microbial populations on transit times through the gut, through major clinical trials of an oral cholera vaccine and a new form of oxygen therapy for young infants with severe pneumonia, to health systems research mapping urban health facilities and implementation-focused work on Kangaroo Mother Care.

Importantly, our research has the potential to influence policy and practice in Bangladesh and other countries of the global South.

ORAL CHOLERA VACCINE

Large-scale trials have delivered more evidence of the benefits of an affordable oral cholera vaccine.

An effective and affordable oral cholera vaccine could have a significant impact on the control of cholera, which currently kills around 4,500 people every year in Bangladesh. Building on past trials demonstrating that the WHO-prequalified vaccine Shanchol is highly effective at preventing cholera, the Introduction of Cholera Vaccine in Bangladesh study has shown that it has significant protective effects when delivered through existing Government immunisation services.

The cluster randomised controlled trial, led by Dr Firdausi Qadri and colleagues, was carried out in Mirpur, an area of Dhaka with a high incidence of cholera. A two-dose vaccine strategy was compared with a placebo and a combination of vaccine and a behavioural intervention to promote good hygiene practices.

Although high levels of migration and other factors meant that overall coverage was relatively low (around 65%), the vaccine showed substantial protective effects – 37% in the vaccination-only group and 45% in the vaccination and behaviour change group. For participants who received two vaccine doses, hospitalisation rates were more than halved. No serious adverse events were detected.

The results suggest that delivery of the vaccine through an existing healthcare infrastructure can deliver major public health benefits. Despite the importance of good hygiene practice, the behavioural intervention appeared to offer few if any additional benefits.

In more recent work, Dr Qadri and colleagues have examined whether a single dose of the vaccine – which would be easier to implement – is as effective as the two-dose regimen. A further trial in Mirpur showed that one dose of Shanchol was 40% protective against all cholera episodes up to 6 months after dosing and 63% protective against severely dehydrating cholera. However, it was not protective for children under the age of five years. Nevertheless, as even one dose provides benefits in older age groups, the findings support use of the vaccine even when the two-dose regimen may be difficult to implement, such as in epidemic situations.

Qadri F *et al*. Feasibility and effectiveness of oral cholera vaccine in an urban endemic setting in Bangladesh: a cluster randomised open-label trial. *Lancet*. 2015;386(10001):1362–71.

Qadri F *et al*. Efficacy of a single-dose, inactivated oral cholera vaccine in Bangladesh. *N Engl J Med*. 2016;374(18):1723–32.

• The Introduction of Cholera Vaccine in Bangladesh trial was funded by the Bill and Melinda Gates Foundation.

A mother tends to her child in the Intensive Care Unit of icddr,b's Dhaka Hospital.

A LOW-COST TREATMENT FOR SEVERE PNEUMONIA

A clinical trial in icddr,b's Dhaka Hospital has demonstrated the life-saving potential of 'bubble CPAP' oxygen therapy for severely ill children with pneumonia.

Bubble CPAP (continuous positive airway pressure) is widely used in high-income countries to deliver oxygen to infants experiencing severe breathing difficulties, but is rarely used in low-income countries due to the high cost of equipment. Working with Professor Trevor Duke of the University of Melbourne, Australia, Dr Md Jobayer Chisti and colleagues have developed a low-cost version of bubble CPAP equipment and, in a randomised controlled trial at icddr,b's Dhaka Hospital, have shown that it is as least as good as the WHO's currently recommended approach for oxygen therapy.

The trial compared bubble CPAP treatment of children under the age of five who had been diagnosed with severe pneumonia and low blood oxygen levels (hypoxaemia), with the current WHO-recommended approach, low-flow oxygen therapy, whereby oxygen is delivered via nasal prongs, and a similar strategy but with higher oxygen flows. The trial was stopped early when it became clear that children receiving the WHO-recommended approach were at significantly higher risk of treatment failure and death.

The study provided the first clinical outcomes data from a randomised controlled trial of low-cost bubble CPAP to treat severe pneumonia and hypoxaemia in a resource-poor setting. The results suggest that low-cost bubble CPAP is at least as good as currently recommended treatments.

The bubble CPAP setup tested, based on low-cost, widely available materials (such as simple plastic tubing and recycled plastic bottles) and an oxygen concentrator, was designed specifically for use in resource-poor settings. The positive findings suggest that bubble CPAP could be introduced into a much wider range of healthcare facilities in the global South.

Chisti MJ *et al*. Bubble continuous positive airway pressure for children with severe pneumonia and hypoxaemia in Bangladesh: an open, randomised controlled trial. *Lancet*. 2015;386(9998):1057–65.

• The trial was part-funded by the Centre for International Child Health, University of Melbourne, through a grant from the Australian Agency for International Development.

MAPPING URBAN HEALTH FACILITIES

A newly developed online 'Urban Health Atlas' provides both policy-makers and the public with detailed information about local health services.

The Urban Health Atlas has been designed to provide a comprehensive overview of health facilities – public and private – in the cities of Dhaka, Khulna, Narayanganj, Rajshahi and Sylhet. Developed by a multidisciplinary team of public health researchers, social scientists, geographic information system (GIS) experts and computer programmers, the Atlas encompasses information gathered on some 19,000 health facilities, including GPS (global positioning system) coordinates, enabling each facility to be positioned on an online map.

Public users of the Atlas can search for local facilities based on facility type, location or the services they offer, and find out key information such as opening hours and the number of trained medical personnel on site.

The Urban Health Atlas will also be a valuable resource for policy-makers, helping to identify gaps in service provision and supporting moves to improve urban residents' access to services. The Atlas will be maintained and developed, through feedback from users and the Government.

http://urbanhealthatlas.dghs.gov.bd

• Development of the Urban Health Atlas has been supported by the UK Department for International Development (DFID) and the German development agency Gesellschaft für Internationale Zusammenarbeit (GIZ).

IMPLEMENTING KANGAROO CARE

icddr,b researchers are playing a key role in the national rollout of Kangaroo Mother Care in Bangladesh.

Kangaroo Mother Care, in which a newborn is placed directly onto a mother's or caregiver's chest, ensuring skin to skin contact, has been shown in trials to be highly beneficial to babies born prematurely. However, it has proven unexpectedly difficult to implement in routine practice, in large part because of the time and expertise needed to ensure that the technique is applied correctly.

In 2015, the Government of Bangladesh launched new national guidelines designed to implement Kangaroo Mother Care at Government health facilities. icddr,b researchers helped develop the new guidelines, drawing on the experience of running a successful Kangaroo Mother Care service at Matlab Hospital for several years. icddr,b researchers also carried out a health systems bottleneck analysis to identify possible obstacles to the implementation of Kangaroo Mother Care and ways they might be overcome.

To support national implementation, and in collaboration with Save the Children's Saving Newborn Lives Programme, the icddr,b team, led by Dr Ahmed Ehsanur Rahman, is also conducting an operations research project in three facilities to analyse practical difficulties in the introduction of Kangaroo Mother Care and strategies by which they can be addressed.

Pervin J *et al*. Implementing Kangaroo Mother Care in a resource-limited setting in rural Bangladesh. *Acta Paediatr.* 2015;104(5):458–65.

A mother with her premature baby in the Kangaroo Mother Care Ward of icddr,b's Matlab Hospital.

DIET, BACTERIA AND GUT MOTILITY

The speed at which food passes through the gut depends not just on diet but also on the bacterial communities present in the gut.

The speed at which food passes through the gut – gut motility – can have important implications for health. Slow transit can lead to constipation, for example, but rapid transit can trigger conditions such as irritable bowel syndrome. With colleagues at Washington University School of Medicine, St Louis, USA, Dr Tahmeed Ahmed has discovered that gut motility is affected not just by diet but also by interactions between diet and the gut's bacterial communities. Moreover, the presence of a single ingredient, turmeric, can have a remarkably large impact on transit speeds, depending on which bacterial species are present in the gut.

To examine the interplay between diet and gut bacteria, the team made use of mice raised and housed in bacteria-free conditions. The guts of these animals could then be colonised with bacteria collected from people living in different parts of the world – the USA, Bangladesh, Venezuela and Malawi.

To mimic sudden changes in diet, as experienced by intercontinental travellers, the mice were then fed a succession of diets characteristic of the four different countries.

The results revealed that gut bacterial communities had a significant impact on transit times through the gut, but their effects depended on the nature of the diet being consumed. Notably, certain combinations of microbes and diets led to greatly accelerated transit.

Furthermore, studies of Bangladeshi diets and gut bacteria revealed a mechanism by which foodstuffs and the gut's microbial residents act together to influence motility. Turmeric in the Bangladeshi diet can accelerate gut transit by stimulating the liver's secretion of bile salts into the intestine. However, this acceleration depends on the conversion of bile salts into unconjugated bile acids by certain gut microbes. As some microbial communities produce only small quantities of the enzyme that converts bile salts, turmeric has much less impact on motility in people harbouring these communities.

Dey N *et al*. Regulators of gut motility revealed by a gnotobiotic model of diet-microbiome interactions related to travel. *Cell*. 2015;163(1):95–107.

• This research was funded by the National Institutes of Health, the Bill and Melinda Gates Foundation, the Crohn's and Colitis Foundation of America, and the Global Probiotics Council.

CHRONIC DISEASES CENTRE-STAGE

icddr,b research has shone light on the impact of non-communicable diseases on poor households, and on the country's response to this growing threat to public health.

Non-communicable diseases are responsible for a large and growing proportion of the disease burden in Bangladesh. An analysis of 24 years of data from Matlab has shown how the burden of disease has shifted. In 1982, deaths from chronic diseases were highest among the most affluent socioeconomic groups, but around 1996 this pattern shifted, with the poorest groups becoming the most badly affected. These patterns are being reinforced, as a household death from a chronic disease increased the risk that a household would fall into poverty.

icddr,b researchers have also contributed to an international 'scorecard' revealing how well countries are addressing the non-communicable disease threat.

Inspired by a 2011 UN declaration on the need to tackle non-communicable diseases, the GRAND South coalition of 11 centres developed a list of some 51 indicators of progress, under four main headings – governance, risk factors, surveillance and research, and health systems. A questionnaire was used to gather data on these indicators from experts in 23 countries, and these inputs were converted into a single score for each of the four headings.

In common with other countries in South Asia, Bangladesh performed relatively poorly in each category, scoring best for 'governance' – reflecting the Government of Bangladesh's recent development of a five-year plan to tackle non-communicable diseases. The scorecard provides a way in which progress can be systematically monitored over time and compared with that achieved in other countries.

In practical terms, improvements in hypertension management may emerge from a recently launched major new trial. The US$3m COBRA-BPS trial, supported by the UK Department for International Development, Medical Research Council and the Wellcome Trust, will evaluate a range of simple interventions that could be readily implemented if they are shown to be effective. The trial is being led by Professor Tazeen Jafar from the Duke National University of Singapore, with Bangladesh studies being led by Dr Aliya Naheed.

Khan JA *et al*. Distribution of chronic disease mortality and deterioration in household socioeconomic status in rural Bangladesh: an analysis over a 24-year period. *Int J Epidemiol*. 2015;44(6):1917–26.

Roman AV, Perez W, Smith R; GRAND South. A scorecard for tracking actions to reduce the burden of non-communicable diseases. *Lancet*. 2015;386(9999):1131–2.

TYPHOID FEVER IN CHILDREN

Use of a novel diagnostic test has revealed that typhoid fever affects young children in much the same way as it affects older children and adults.

Children under the age of five years are particularly badly affected by typhoid fever, but relatively little is known about the condition in young children, in part because it is difficult to diagnose.

Dr Firdausi Qadri, Dr Farhana Khanam and colleagues have developed a new, highly specific test to identify infection with *Salmonella* Typhi, the cause of typhoid fever, based on the detection of *S*. Typhi-specific antibodies released by bloodstream lymphocytes. They have now shown that this test, TPTest, is a reliable indicator of typhoid fever even in young children, and have characterised the clinical features and immune responses of children with confirmed typhoid fever.

Their results revealed that young children experience clinical illness very similar to that seen in older children and adults. Their immune responses were also very similar. The researchers also discovered that many infections were resistant to multiple antibiotics, but found no evidence that multidrug-resistant infections were particularly severe.

The significant levels of antibiotic resistance strongly support the use of vaccination and other measures to control typhoid fever. Furthermore, the demonstration that the TPTest can accurately identify typhoid fever in young children suggests it could play an important role in control programmes. In collaboration with a local biotech firm, the team is working on a version of the test that would not require advanced laboratory skills and could be used more routinely.

Khanam F *et al*. Typhoid fever in young children in Bangladesh: clinical findings, antibiotic susceptibility pattern and immune responses. *PLoS Negl Trop Dis*. 2015;9(4):e0003619.

• This work was supported by the National Institutes of Health, including the National Institute of Allergy and Infectious Diseases, a Fogarty International Center Training Grant in Vaccine Development and Public Health, the Bill and Melinda Gates Foundation and Sida/FORSK.

JAUNDICE AND HEPATITIS E VIRUS

An analysis of nationwide mortality data has emphasised the huge impact of jaundice in pregnant women – with hepatitis E virus the most important likely culprit.

Discovered as recently as 1983, hepatitis E virus (HEV) is typically fatal in less than 1% of cases, but appears to pose a much greater threat to pregnant women. In a recent analysis of data from Bangladesh's Maternal Mortality Health Surveys, Dr Emily Gurley and colleagues found that jaundice was associated with the deaths of one in five pregnant women, and it is likely that HEV is the cause of most of these deaths.

In 2012, Dr Gurley and colleagues analysed verbal autopsy data from four large population-based studies, estimating that 19–25% of maternal deaths (and 7–13% of neonatal deaths) were linked to jaundice. Analysis of published studies that had determined specific causes of disease implicated HEV in 58% of maternal deaths from acute liver disease.

The more recent analysis used data from 2001 and 2010 Maternal Mortality Health Surveys. For 1998–2001, 19% of maternal deaths were associated with jaundice, compared with 23% of such deaths in 2008–10.

The findings highlight the potentially major impact of HEV on maternal health (although specific data on HEV are still required). This impact could be mitigated by an HEV vaccine, which is being evaluated in a trial recently launched at icddr,b's Matlab field site in a US$5.5m initiative funded by the Norway-based GLOBVAC initiative.

Some 20,000 women aged 16–39 will be enrolled in a clinical trial being carried out by icddr,b's Dr K Zaman and colleagues from the Norwegian Institute of Public Health, which is also examining risk factors for HEV infection.

The vaccine, HEV 239 (Hecolin), has been developed in China by Xiamen University and Innovax Biotech. An important additional aim of the trial is to establish the capacity to produce the vaccine locally.

Shah R, Nahar Q, Gurley ES. One in Five Maternal Deaths in Bangladesh Associated with Acute Jaundice: Results from a National Maternal Mortality Survey. *Am J Trop Med Hyg*. 2016. pii: 15-0662.

NEW INTERNATIONAL PARTNERSHIPS

icddr,b has established new partnerships to promote South–South collaboration.

OIC Secretary General, His Excellency Mr Iyad Ameen Madani, meeting patients in icddr,b's Dhaka Hospital.

icddr,b is committed to developing links with like-minded institutions in the global South, to share its knowledge and expertise and to coordinate activities against common health challenges.

In 2015, icddr,b was named by the intergovernmental Organisation of Islamic Cooperation (OIC) as one of 10 centres of scientific excellence across the OIC's 57 member states. The announcement was made during a visit from a high-level delegation including OIC Secretary General, His Excellency Mr Iyad Ameen Madani, and Ambassador Abdul Moiz Bokhari.

icddr,b also hosted a visit from a 10-strong delegation from the Islamic Development Bank in 2015. The visitors heard about icddr,b's work on high-impact, low-cost solutions to local health problems and toured icddr,b laboratories and the Dhaka Hospital.

In further evidence of its commitment to South–South cooperation, icddr,b also signed a memorandum of understanding with Ethiopia's Armauer Hansen Research Institute (AHRI). The agreement was signed during a visit from Dr Abraham Aseffa, AHRI's Scientific Director.

Finally, icddr,b has continued its long-standing commitment to global efforts to control infectious disease in crisis situations. In 2015, we dispatched a team of clinicians and researchers to Mozambique, to build the capacity of Government and local WHO officials and NGO workers to tackle a persistent cholera outbreak triggered by extensive flooding, and also assisted outbreak control in refugee camps in northern Iraq and in Baghdad.

MATERNAL BEHAVIOUR CHANGE

Community-based approaches are likely to be key to improved maternal and neonatal health.

Although Bangladesh has made great progress in reducing maternal mortality, childbirth remains a dangerous time for women – particularly in remote rural areas and urban slums.

Dr Bidhan Krishna Sarker from icddr,b and colleagues at CARE Bangladesh have explored why women in the remote rural Sunamganj district, where maternal mortality is more than twice the national average, tend to give birth at home, with the support of traditional birth attendants, rather than seeking specialist services.

The study identified a complex mix of factors that affect decision-making. Traditional birth attendants were seen as trusted members of the local community, and specialist facilities were often perceived unfavourably. A range of social and religious reasons were given for avoiding healthcare facilities, while husbands and older family members, who often held traditional views, were highly influential.

The results suggest that a multifaceted approach will be required to alter behaviour, targeting traditional birth attendants, mothers and their families.

In urban areas, the Manoshi programme, run by the NGO BRAC, has used local community health workers to provide home-based antenatal advice and support. An evaluation of this programme, led by Dr Alayne Adams, found that its success owed much to the influence of social networks encompassing the Manoshi community health workers.

Over five years, the Manoshi programme significantly increased rates of facility delivery and the number of women receiving four antenatal care visits. The evaluation found that women who counted community health workers as important members of their social network were twice as likely to give birth with a trained birth attendant, five times more likely to use postnatal care services, and three times more likely to give nutrient-rich colostrum to their babies.

As well as providing information and practical and emotional support, the Manoshi community health workers may also be exerting a social influence, countering the more traditional (and often less helpful) views of older family members.

Sarker BK *et al*. Reasons for preference of home delivery with traditional birth attendants (TBAs) in rural Bangladesh: A qualitative exploration. *PLoS One*. 2016;11(1):e0146161.

Adams AM, Nababan HY, Hanifi SM. Building social networks for maternal and newborn health in poor urban settlements: a cross-sectional study in Bangladesh. *PLoS One*. 2015;10(4):e0123817.

Reducing maternal and neonatal mortality

Programme lead
Dr Shams El Arifeen

We discover, develop and evaluate new interventions, and help improve the delivery and scale-up of existing interventions, to prevent and treat maternal complications, adverse birth outcomes and life-threatening neonatal conditions.

Dr Sabrina Rashid (on right) with a low-cost breast milk pasteurisation machine designed for use in garment factories.

Our work spans the full spectrum of research, including epidemiological studies, operations and implementation research, clinical trials, evaluation of healthcare delivery systems, and health systems research.

We are studying key aspects of maternal and newborn health, including biological and social factors associated with increased risk of preterm birth and low birth weight, newborn infections, and other major maternal and newborn complications. We use this new understanding to develop and test possible solutions for use in resource-poor settings.

We also advise on the design of appropriate delivery strategies and evaluate existing programmes at scale. Our focus is on generating evidence to support scale-up of cost-effective interventions globally. We also work closely with the Government of Bangladesh in formulating policies and programmes.

KANGAROO MOTHER CARE

icddr,b researchers are playing a key role in the national rollout of Kangaroo Mother Care (see page 10).

MOTHER'S MILK

An icddr,b team is assessing the impact of a low-cost breast milk pasteurisation machine and breast pumps in a Dhaka garment factory, to enable working mothers to provide breast milk for their babies. The machine uses a low-cost water-efficient heating process to pasteurise milk, rendering it safe for consumption for up to eight hours, so it can be fed to babies while their mothers are at work or in the evening. The project has been funded by Grand Challenges Canada.

GROUP PRENATAL CARE

icddr,b researchers have begun a trial to assess whether group prenatal care increases take up of specialist antenatal, delivery and postnatal care, and improves maternal and neonatal outcomes.

Prenatal care is generally provided in individual consultations, but group sessions may help to build women's networks and skills, and enhance peer support.

PRETERM AND STILLBIRTHS

icddr,b has begun a major cohort study to explore the biological and social factors responsible for preterm births and stillbirths. More than 4,500 pregnant women at Matlab will be followed through pregnancy and into the early postnatal period. An international consortium of researchers will investigate a wide range of factors potentially contributing to preterm birth, such as the vaginal microbiome and immune responses, hormonal and immunological responses, nutritional deficiencies, and sociodemographic and behavioural factors. Other work will focus on possible biomarkers to identify women at risk of preterm birth. In addition to the prospective cohort, the study will also analyse previously collected data from Matlab on 59,000 pregnancies over 23 years.

An icddr,b researcher demonstrates the effectiveness of a low-cost warming jacket for preterm babies.

WARMING JACKET

icddr,b researchers have been assessing the acceptability and feasibility of an innovative chemical warming padded jacket for preterm babies. Developed by researchers at Johns Hopkins University and George Mason University, the jacket could be a low-cost way to maintain the body temperature of preterm babies. The icddr,b team has been exploring its acceptability in communities and among healthcare professionals, and possible obstacles and enablers to its use. Early findings were discussed at a stakeholder workshop in December 2015. The project is also exploring the potential for the jacket to be produced locally.

EMERGENCY OBSTETRIC CARE

A nationwide health facility assessment by icddr,b has found that access to free-of-charge or subsidised emergency obstetric care is very low in Bangladesh. The country has 8.6 obstetric facilities per 500,000 citizens, but on average only two of these are public sector and only one offers basic emergency obstetric care. At many facilities, a lack of specialist services reflected a lack of appropriately trained providers. The researchers suggest that public–private partnerships could be a way to enhance access to emergency obstetric services, while incentive packages could be used to boost the public sector labour force.

Alam B *et al*. Coverage of emergency obstetric care and availability of services in public and private health facilities in Bangladesh. *Int J Gynaecol Obstet*. 2015;131(1):63–9.

THE POWER OF EDUCATION

Parental education – particularly that of mothers – has been found to have a major impact on child survival. An examination of data collected during a trial of Integrated Management of Childhood Illness in rural Bangladesh found that the odds of under-five mortality were 38% lower for children of mothers with secondary education than for those with an uneducated mother. For fathers, the odds were 16% lower. Promoting girls' education will therefore have spin-off benefits on child mortality.

Akter T *et al*. Is there any association between parental education and child mortality? A study in a rural area of Bangladesh. *Public Health*. 2015;129(12):1602–9.

ANTIBIOTIC TREATMENT FOR NEONATES

Researchers from icddr,b, Johns Hopkins University and other organisations have contributed to a major trial examining alternative antibiotic treatments that require reduced numbers of injections and could be used when hospitalisation for neonates and young infants with severe infections is not an option. The novel approaches were as effective as currently recommended treatments, and may offer new options for resource-poor settings where hospital facilities may not be available.

Baqui AH *et al*. Safety and efficacy of alternative antibiotic regimens compared with 7 day injectable procaine benzylpenicillin and gentamicin for outpatient treatment of neonates and young infants with clinical signs of severe infection when referral is not possible: a randomised, open-label, equivalence trial. *Lancet Glob Health*. 2015;3(5):e279–87.

EARLY CHILDBIRTH

A qualitative study carried out by researchers from icddr,b and Johns Hopkins University in rural Sylhet District has identified sociocultural factors influencing early marriage and childbirth among women in adolescence – a medical risk factor for both mother and child. As well as social and family pressures promoting childbirth soon after marriage, women also expressed concerns that contraceptive use before childbirth could affect fertility. The findings highlight attitudes and knowledge gaps among women and other key family members that could be targeted in interventions.

Henry EG *et al*. Sociocultural factors perpetuating the practices of early marriage and childbirth in Sylhet District, Bangladesh. *Int Health*. 2015;7(3):212–7.

DETECTING SEVERE INFECTION

Researchers from icddr,b and the University of British Columbia, Canada, have contributed to a study showing that a relatively simple model can identify young children with severe infections requiring admission to hospital. As well as readily discernible clinical signs, the model used recordings of blood oxygen levels, heart rate and respiratory rate collected by a low-cost device linked to a smartphone and associated app. The model's predictions correlated well with the independent clinical decisions made at a rural tertiary care hospital. Ultimately, the model could be used in the community to rapidly identify young children in need of hospital care.

Raihana S *et al*. Development and internal validation of a predictive model including pulse oximetry for hospitalization of under-five children in Bangladesh. *PLoS One*. 2015;10(11):e0143213.

Preventing and treating maternal and childhood malnutrition

Programme lead
Dr Tahmeed Ahmed

We study the biological and non-biological mechanisms underpinning maternal and childhood malnutrition, develop innovative interventions to prevent and treat these conditions, and evaluate the efficacy, feasibility and scalability of new interventions.

icddr,b researchers are testing a cream containing essential fatty acids that may accelerate the recovery of children suffering from severe acute malnutrition.

We carry out a wide range of research, from basic laboratory studies to evaluations of implementation of preventive and treatment programmes and support for policy development.

We aim to develop a better understanding of the origins and implications of malnutrition, taking a broad perspective encompassing the many biological and social factors affecting gut health and nutrition.

We have developed ready-to-use supplementary and therapeutic foods based on locally available ingredients (such as rice, lentils and chickpeas). We have been evaluating their acceptability to children, their efficacy and their impact in field trials.

We also work closely with the Government of Bangladesh, analysing barriers to the effective implementation of maternal nutrition programmes and ensuring that national nutrition policy-making is based on high-quality evidence.

GUT MOTILITY

The speed at which food passes through the gut has been found to depend on interactions between diet and bacterial communities in the gut (see page 12).

PREVENTING STUNTING

A new community-based cluster randomised trial in rural Habiganj district is evaluating five different ‘bundles’ of nutritional interventions aiming to improve maternal nutrition and reduce stunting in their offspring. The interventions include prenatal nutritional supplementation, intensive counselling to promote exclusive breastfeeding and food supplementation at ages 6–23 months.

DAY CARE FOR SEVERE PNEUMONIA AND MALNUTRITION

A randomised controlled trial has been launched to evaluate the ‘day care’ approach for managing severe pneumonia in children with malnutrition within Bangladesh’s existing health system. Ideally, severe pneumonia in young children is treated in hospitals, but many low- and middle-income countries lack the capacity to treat all such children in hospitals, and parents may be unable to stay with their children in hospital. Alternatively, day care can be provided at ‘9 to 5 outpatient clinics’. Following successful efficacy trials, the new study will test the effectiveness of day care in a ‘real world’ setting.

Mothers in icddr,b's Nutrition Rehabilitation Unit are taught how to prepare nutritious meals for their children.

MALNUTRITION SYMPOSIUM

icddr,b hosted an international symposium on childhood acute malnutrition in June 2015. Funded by UKAid, the symposium provided an opportunity for researchers, policy-makers and NGOs to share learning on the causes and treatment of malnutrition and to discuss challenges for the future.

TOPICAL EMOLLIENT THERAPY

A new exploratory randomised trial is assessing whether a cream containing essential fatty acids (sunflower seed oil) applied to the skin improves skin barrier function and accelerates weight gain and recovery in children with severe acute malnutrition. The novel approach will be tested in 100 young children treated at icddr,b's Dhaka Hospital.

TACKLING STUNTING

Two ready-to-use supplementary foodstuffs developed at icddr,b have been found to have similar effects on stunting as the widely used 'Plumpy'doz'. In a large controlled field trial in rural Bangladesh run in partnership with researchers from Johns Hopkins University and elsewhere, daily supplementation with ready-to-use foods based on chickpeas and a rice–lentil mix from 6 to 18 months of age reduced the rate of growth slowing. At 18 months, stunting affected 44% of control children but was 5–6% lower in groups receiving Plumpy'doz or locally produced foods – a decrease of public health significance.

Christian P *et al*. Effect of fortified complementary food supplementation on child growth in rural Bangladesh: a cluster-randomized trial. *Int J Epidemiol*. 2015;44(6):1862–76.

ASSESSING MALNUTRITION

Arm circumference may be a better measure than weight to identify malnutrition in children with diarrhoea. In a study of 720 young children attending icddr,b's Dhaka Hospital, researchers from icddr,b and Brown University found that mid-upper arm circumference was a more reliable guide to nutrition status than weight, which can be significantly affected by dehydration due to diarrhoea. In separate work, icddr,b researchers have shown that, in adults, mid-upper arm circumference correlates closely with body mass index and its measurement could be a more convenient way to detect malnutrition.

Modi P *et al*. Midupper arm circumference outperforms weight-based measures of nutritional status in children with diarrhea. *J Nutr*. 2015;145(7):1582–7.

Sultana T *et al*. Assessment of under nutrition of Bangladeshi adults using anthropometry: can body mass index be replaced by mid-upper-arm-circumference? *PLoS One*. 2015;10(4):e0121456.

PNEUMONIA, SEPSIS AND MALNUTRITION

icddr,b researchers have carried out detailed investigations of pneumonia and sepsis in hospitalised young children suffering from severe malnutrition. The work has identified risk factors associated with severe invasive disease and suggests new treatment strategies may be necessary for this highly vulnerable group of patients.

Chisti MJ *et al*. Severe sepsis in severely malnourished young Bangladeshi children with pneumonia: A retrospective case control study. *PLoS One*. 2015;10(10):e0139966.

Chisti MJ *et al*. Treatment failure and mortality amongst children with severe acute malnutrition presenting with cough or respiratory difficulty and radiological pneumonia. *PLoS One*. 2015;10(10):e0140327.

Chisti MJ *et al*. Lack of BCG vaccination and other risk factors for bacteraemia in severely malnourished children with pneumonia. *Epidemiol Infect*. 2015;143(4):799–803.

Controlling enteric and respiratory infections

Programme lead
Dr Firdausi Qadri
(until 31 March 2016)

We are generating a better understanding of key disease-causing organisms and host immune responses, and developing and evaluating low-cost potentially scalable preventive and therapeutic interventions.

Dr Firdausi Qadri with some of her team responsible for implementing the 'Introduction of Cholera Vaccine in Bangladesh' project.

Our work spans the full spectrum of research, from studies aiming to generate a better understanding of pathogenic organisms and the body's responses to them, through the development and testing of new therapeutics and preventive interventions, and evaluation of the implementation of such interventions. We also aim to develop improved diagnostics for efficient and rapid detection of pathogens.

We are also assessing a range of therapeutics and hygiene-based interventions for disease prevention. In addition, we aim to translate our work to support the implementation of existing affordable vaccines.

We are internationally recognised for the quality of our research in cholera, typhoid and other diarrhoeal diseases, including pioneering molecular-genetic studies of pathogens.

ORAL CHOLERA VACCINE

Large-scale trials have delivered more evidence of the benefits of an affordable oral cholera vaccine (see page 8).

SEVERE PNEUMONIA

A clinical trial has demonstrated the life-saving potential of 'bubble CPAP' oxygen therapy for severe pneumonia in young children (see page 9).

TYPHOID FEVER IN CHILDREN

Use of a novel diagnostic test has provided new insight into typhoid fever in young children, using low volumes of blood (see page 13).

ETEC VACCINE TRIAL

A phase I/II trial of a second-generation vaccine against enterotoxigenic *E. coli* (ETEC) has begun in Dhaka, in partnership with PATH and Scandinavian BioPharma. An oral inactivated ETEC vaccine, ETVAX, is being given to adults, children and infants to test its safety and ability to stimulate immune responses against key ETEC antigens. The trial is also testing the impact of an adjuvant, dmLT, on mucosal ETEC-specific immune responses. ETEC is a common cause of severe diarrhoeal disease in low- and middle-income countries, including Bangladesh.

• https://clinicaltrials.gov/ct2/show/NCT02531802

TB DETECTION

Dr Md Zeaur Rahim has been awarded a CAD$100,000 grant from Grand Challenges Canada to evaluate 'electronic nose' technology for point-of-care diagnosis of tuberculosis in Dhaka slums. The project will compare the nose's performance with laboratory-confirmed diagnosis of TB.

icddr,b's Matlab field site serves as a platform for important vaccine trials.

PNEUMOCOCCAL PROTEIN VACCINE

A phase I trial of a trivalent pneumococcal protein vaccine has shown that it is safe and immunogenic in adults, toddlers and infants. In the long term, pneumococcal protein vaccines may provide better protection than currently used polysaccharide-based vaccines.

Brooks WA *et al*. Safety and immunogenicity of a trivalent recombinant PcpA, PhtD, and PlyD1 pneumococcal protein vaccine in adults, toddlers, and infants: A phase I randomized controlled study. *Vaccine*. 015;33(36):4610–7.

TARGETING CHOLERA HOUSEHOLDS

An intervention designed to improve hygiene practices in households affected by cholera has shown marked and sustained impact. The CHoBI7 trial targeted people living with a patient affected by cholera, who are themselves at greatly increased risk of becoming infected. The intervention led to significant improvements in hygiene-related behaviours which were sustained at six months follow up.

Principal investigators Dr Christine Marie George from Johns Hopkins University and icddr,b's Dr Munirul Alam have received a US$1.5m grant to refine and scale-up the CHoBI7 intervention.

George CM *et al*. Randomized controlled trial of hospital-based hygiene and water treatment intervention (CHoBI7) to reduce cholera. *Emerg Infect Dis*. 2016;22(2):233–41.

George CM *et al*. Sustained uptake of a hospital-based handwashing with soap and water treatment intervention (Cholera-Hospital-Based Intervention for 7 Days [CHoBI7]): A randomized controlled trial. *Am J Trop Med Hyg*. 2016. pii: 15-0502.

ADJUNCTIVE THERAPY FOR TB

Vitamin D3 and phenylbutyrate, a drug licensed for use in treatment of kidney disease, have been found to boost the effects of antibiotic treatment of tuberculosis and reduce clinical symptoms. The drugs appear to act by stimulating production of antimicrobial peptides. These or other adjunctive therapies could be used to enhance antibiotic treatment of TB or shorten treatments.

Mily A *et al*. Significant effects of oral phenylbutyrate and vitamin D3 adjunctive therapy in pulmonary tuberculosis: A randomized controlled trial. *PLoS One*. 2015;10(9):e0138340.

POLIOVIRUS VACCINE TRIALS

icddr,b has provided a platform for several trials gathering evidence on poliovirus vaccine use, as part of the global strategy to eradicate polio. Trivalent oral poliovirus vaccines are being superseded by monovalent and bivalent oral poliovirus vaccines, which will in turn be phased out in favour of inactivated poliovirus vaccine. icddr,b researchers have contributed to international programmes evaluating novel vaccines and vaccine schedules, and investigating possible interference with rotavirus vaccination.

Estívariz CF *et al*. Immunogenicity of three doses of bivalent, trivalent, or type 1 monovalent oral poliovirus vaccines with a 2 week interval between doses in Bangladesh: an open-label, non-inferiority, randomised, controlled trial. *Lancet Infect Dis*. 2015;15(8):898–904.

Emperador DM *et al*. Interference of monovalent, bivalent, and trivalent oral poliovirus vaccines on monovalent rotavirus vaccine immunogenicity in rural Bangladesh. *Clin Infect Dis*. 2016;62(2):150–6.

Anand A *et al*. Early priming with inactivated poliovirus vaccine (IPV) and intradermal fractional dose IPV administered by a microneedle device: A randomized controlled trial. *Vaccine*. 2015;33(48):6816–22.

Mychaleckyj JC *et al*. Effect of substituting IPV for tOPV on immunity to poliovirus in Bangladeshi infants: An open-label randomized controlled trial. *Vaccine*. 2016;34(3):358–66.

Detecting and controlling emerging and re-emerging infections

Programme lead
Dr Emily Gurley

We work with partners in Bangladesh and internationally to detect, characterise and respond to emerging and re-emerging infectious disease threats.

Detection of emerging and re-emerging infections is important both locally and internationally, with the potential for rapid and global dissemination of infectious agents. Our work depends on extensive surveillance platforms and close collaboration with local and international partners to identify and respond to disease outbreaks.

We have a long-standing collaboration with the US Centers for Disease Control and Prevention, which has enabled us to build platforms to track infections, through hospital-based surveillance and population-based surveys.

We use our understanding of likely routes of transmission to develop new interventions. We aim to identify methods that are practical and affordable, and so would be suitable for wider scale-up.

We routinely respond to infectious disease outbreaks in Bangladesh in partnership with the Institute of Epidemiology, Disease Control and Research (IEDCR), and in collaboration with the local One Health initiative.

PREVENTING NIPAH VIRUS INFECTION

icddr,b researchers have helped to develop public service announcements broadcast on national television to discourage the drinking of raw date palm sap, a risk factor for transmission of potentially lethal Nipah virus. The announcements were produced as part of a behaviour change intervention, developed in collaboration with the IEDCR, which aimed to discourage drinking of raw sap unless skirt-like barriers had been used to prevent contamination by bats during collection.

Nahar N *et al*. Raw sap consumption habits and its association with knowledge of Nipah virus in two endemic districts in Bangladesh. *PLoS One*. 2015;10(11):e0142292.

HEPATITIS E VIRUS

New light has been shone on the huge impact of jaundice in pregnant women (see page 14).

ANTHRAX: A 'ONE HEALTH' APPROACH

icddr,b contributed to a cross-border workshop on anthrax in January 2015, which emphasised the importance of cooperation between India and Bangladesh and the need to consider both human and animal anthrax infection – the 'One Health' approach. The meeting was organised by the IEDCR and was also supported by the US Centers for Disease Control and Prevention.

Close proximity of animals and humans in Bangladesh makes the country vulnerable to the spread of zoonotic diseases.

In new work, icddr,b researchers have begun investigating anthrax outbreaks in humans and animals in Bangladesh, to provide a clearer picture of the local spread of disease, risk factors for infection (in humans and animals), possible sources of livestock infections, and the potential for disease to be spread through infected animal by-products.

BRUCELLOSIS IN BANGLADESH

A new project in Shahjadpur subdistrict aims to provide insight into the health and economic burden of brucellosis (infection with *Brucella* bacteria). The population-based study in a region of high milk production is screening for antibodies to *Brucella* in local people and animals. It will also aim to identify risk factors for infection and the economic impact of brucellosis, to support the development of preventive interventions.

AVIAN FLU

Further important information has been gathered on H5N1 avian flu in Bangladesh. Studies on a cohort of workers at live bird markets revealed that some 2% of workers started producing antibodies to H5N1 avian flu virus over a period of around a year. Hence, despite ongoing exposure to the virus, relatively few workers appear to be becoming infected. The study also identified work practices associated with increased risk of infection.

A second study investigated the sudden deaths of large numbers of ducks, geese and chickens in north-eastern Bangladesh. The deaths were linked to a highly pathogenic strain of H5N1 not previously seen in Bangladesh, emphasising the need for heightened surveillance to identify novel influenza strains.

Several new projects have been launched to understand the risk factors for transmission of avian flu to humans and to test interventions designed to prevent transmission, including:

- A pilot study testing the acceptability of workstations designed to reduce environmental contamination and improve hygiene practices in live bird markets.
- A study examining the impact of cleaning and disinfection practices, infrastructure and biosecurity practices on avian influenza virus contamination levels in live bird markets.
- A study exploring the potential role of mobile poultry vendors in spreading H5N1.
- A study aiming to gain a better picture of H5N1 infection in wild bird populations, including its possible contribution to mass bird deaths.

JEV VACCINATION

A new study is examining the persistence of immune responses following vaccination against Japanese encephalitis virus (JEV). Children who were vaccinated in a trial in 2012 will be traced and blood samples tested for the presence of anti-JEV antibodies. Responses to a JEV booster dose will also be assessed. The findings will provide evidence on the need for and timing of a JEV booster vaccination programme.

Achieving universal health coverage

Programme lead
Dr Abbas Bhuiya

We evaluate gaps in access, delivery, quality, financing, policy and governance in the health sector in Bangladesh, and test interventions to remedy deficiencies.

icddr,b is committed to the principle that all people, irrespective of their social and economic position, should have access to affordable, acceptable, high-quality and responsive healthcare.

We have particular expertise in areas such as urban health, healthcare financing mechanisms, gender-related issues, innovative use of new technologies, implementation research and systematic reviews, strengthening capacity building of the national health programme, and demographic surveillance.

A major aim is to provide a clearer picture of the healthcare landscape in Bangladesh and people's care-seeking behaviour. We have also developed a range of interventions to enhance access to healthcare and improve the quality of services.

We are also actively engaged in capacity building of Government officials to strengthen management and service delivery. We are working closely with Government officials to strengthen Bangladesh's district health information system, and to ensure health systems monitoring and evaluation are in place and that local evidence is used for health planning.

We are developing a road map to establish the practical steps by which universal health coverage can be achieved in Bangladesh and are establishing a 'learning platform' to support sharing of knowledge.

JOINT LEARNING NETWORK

The Government of Bangladesh has selected icddr,b health economist Dr Jahangir A M Khan as one of five members of its panel for the Joint Learning Network for Universal Health Coverage (JLN). JLN spans an international network of countries and aims to make evidence and best practice related to universal health coverage more accessible to policy-makers and other stakeholders.

GENDER VIOLENCE

A dissemination seminar was held in January 2015 to discuss the results of a study, conducted in partnership with BRAC, of the experience of NGOs that support women and girls affected by violence. In-depth interviews with 69 NGO workers identified a host of challenges faced by NGOs, particularly the pervasive view of women as 'second-class citizens', women's reluctance to speak out for fear of reprisals, and difficulties seeking legal redress. NGO workers can also be threatened or socially ostracised because of their work.

EVALUATING PRIVATE SECTOR CARE

A new project is using a 'participatory stakeholders' monitoring and feedback' approach to evaluate maternal and neonatal healthcare service provision in the private sector. Despite the importance of private for-profit facilities in Bangladesh, they operate largely outside any regulatory framework. The project will assess the impact of participatory stakeholder monitoring and feedback on the quality of services, factors affecting its application, and costs and the potential for wider scale-up.

icddr,b is pioneering a number of mHealth initiatives using mobile phones.

URBAN HEALTH ATLAS

A new online tool provides both policy-makers and the public with detailed information about local health services (see page 10).

FAMILY PLANNING

An icddr,b team is testing whether an integrated family planning intervention can reduce the incidence of unwanted pregnancies in married adolescent girls in urban slums. Currently, more than half the pregnancies in this group are unwanted. The project will test the impact and acceptability of using marriage registrars and married adolescent girls' clubs to provide family planning information, and of strengthening the capacity of female community health workers to provide such information and advice.

mHEALTH FOR MOTHERS

An evaluation of the 'Aponjon' mHealth initiative has found that it has a positive impact on the knowledge and practices of expectant and new mothers, but only when they listened to at least three messages a month for at least six months. Women signing up for the Aponjon service receive health-related text and voice messages. These messages were found to be acceptable to mothers, and helped increase knowledge and awareness of recommended healthcare behaviours during pregnancy and after childbirth. However, only around 10% of women in the study area used the Aponjon service for at least three months, and many subscribers either did not receive messages or listen to them carefully.

MICRO HEALTH INSURANCE

A preliminary analysis of the 'Amader Shasthya' ('Our Health') micro health insurance scheme run by icddr,b in Chakaria has identified a 50% reduction in out-of-pocket healthcare expenditure among scheme members. Nearly 8,000 households, 20% of the total, had enrolled at least for one year and the renewal rate has been around 35%. Amader Shasthya is a large-scale exploration of the feasibility of risk pooling and risk protection against the potentially catastrophic financial impact of ill-health.

THE PROMISE OF mHEALTH

The use of mobile phone text message reminders significantly increased the use of infant vaccination services in hard-to-reach rural and urban areas of Bangladesh. The 'mTika' app was adapted so health workers could register pregnant women, who were then reminded about forthcoming vaccination dates after birth. While vaccination rates actually dropped by 10% in control areas, in rural intervention areas they increased by 18.8% and in urban areas by 16.5%.

With interest in mHealth growing, icddr,b researchers have developed a conceptual framework for exploring communities' readiness to adopt mHealth approaches. Piloted in a survey of some 5,000 residents in rural Bangladesh, the framework encompasses technological, motivational and resource readiness. While the population was generally in favour of mHealth, mobile phone ownership and use was not uniformly spread across the population. The tool may help policy-makers develop and implement mHealth initiatives.

Uddin MJ *et al*. Use of mobile phones for improving vaccination coverage among children living in rural hard-to-reach areas and urban streets of Bangladesh. *Vaccine*. 2016;34(2):276–83.

Khatun F *et al*. Determinants of readiness to adopt mHealth in a rural community of Bangladesh. *Int J Med Inform*. 2015;84(10):847–56.

REPRODUCTIVE HEALTH

An evaluation of a reproductive health programme targeting unmarried adolescents, in both rural and urban areas, has found significantly improved knowledge of key issues such as family planning methods, sexually transmitted infections and healthcare facilities. The Demand-Based Reproductive Health Commodity Project focused on training of Government service providers, dissemination of behaviour change materials and use of community-based health promoters.

Kabir H, Saha NC, Gazi R. Female unmarried adolescents' knowledge on selected reproductive health issues in two low performing areas of Bangladesh: an evaluation study. *BMC Public Health*. 2015;15(1):1262.

Examining the health consequences of climate change

Programme lead
Dr Quamrun Nahar

We evaluate the impacts of climate change and migration patterns on population health in Bangladesh and ways in which populations can adapt.

Our Climate Change and Health initiative is a developmental research programme. As climate change is of great importance to Bangladesh and other low-income countries, especially those in major river deltas, we plan to build our research capability in this area and generate evidence to support national, regional and global policy-making.

As well as infectious diseases, particularly cholera and mosquito-transmitted diseases such as malaria and dengue fever, the programme is building expertise in multidisciplinary fields such as integrated water resources management and environmental science, as well as in social science. This will build on our extensive experience of health and population research in Bangladesh.

We plan to provide the Government of Bangladesh with regular updates on global and national impacts of climate change on health, and also ensure that discussions are relevant to other countries facing similar challenges.

HEALTH IN POPULOUS DELTAS

A prototype model has been developed to test plausible future scenarios in the context of biophysical changes (climate change, sea level rise, salinity increase, subsidence etc.) and social and economic changes (poverty, livelihood etc.) in Bangladesh up to mid-century. The model has been produced collaboratively as part of the 'Assessing Health, Livelihoods, Ecosystem Services and Poverty Alleviation In Populous Deltas' (ESPA Deltas) project, a collaboration with the University of Southampton, UK and other UK organisations, as well as numerous academic institutions, government bodies and NGOs from Bangladesh and India.

The model can operate at 'union' level (the smallest administrative unit in Bangladesh) and incorporate changes in environmental and demographic factors such as temperature, rainfall patterns, river flows and sedimentation, land use patterns, employment patterns, incomes and food prices. icddr,b provided socio-economic data from three rounds of household surveys. An early version of the model has been demonstrated to the

Many residents of Dhaka's Korail slum have moved to the city from coastal regions affected by climate change.

Government of Bangladesh, and it is likely that ESPA Deltas research findings will be incorporated into the Bangladesh Delta Plan 2100, a project of the General Economics Division of the Bangladesh Planning Commission funded by the Government of The Netherlands.

ESPA Deltas is a multidisciplinary project encompassing disciplines such as hydrology, climatology, earth and ocean sciences, economics, agriculture and fisheries. It has developed the concept of 'social–ecological systems', enabling coastal areas of Bangladesh to be categorised into different social–ecological zones based on inhabitants' livelihoods and geographical location, which has broader policy implications.

DRINKING WATER SALINITY

Research is continuing on the health impact of salt water contamination of drinking water in coastal areas vulnerable to climate change. Early findings suggest high levels of pre-hypertension and full hypertension in affected areas but, surprisingly, no clear dose–response relationship.

POPULATION MIGRATION

The 2013 Urban Health Survey of slum and non-slum urban populations, as well as other official sources, is being used to estimate the numbers of internally displaced people in Bangladesh and to project future trends, especially in numbers of rural inhabitants likely to be forced to relocate to urban areas because of environmental changes. Bangladesh is highly vulnerable to climate-induced land loss, but exactly how many people are being affected is currently unclear.

NEW COURSE

With colleagues from Griffith University, Australia, icddr,b researchers contributed to a new icddr,b course on 'Climate Change and Health: Impacts to Adaptation'. Held for the first time in December 2015, the course is designed to provide policy-makers, NGOs and others with an introduction to the key issues.

Preventing and treating non-communicable diseases

Programme lead
Dr Aliya Naheed

We aim to assess the burden of non-communicable diseases (NCDs) in Bangladesh, document the epidemiology and risk factors of the most common NCDs in Bangladesh, and evaluate new interventions relevant to low-income countries, with a focus on cardiovascular diseases and diabetes.

As NCDs become an issue of ever-greater importance in Bangladesh and other low-income countries, icddr,b has initiated a developmental research programme dedicated to research on NCD prevention and control.

Our goal is to identify cost-effective strategies for early detection of NCDs and risk factors, and to establish evidence-based best practices for improving the health-seeking behaviours and quality of care in Bangladesh.

Our initial priorities are to identify the risk factors for cardiovascular diseases and diabetes, to support the development of targeted interventions. In addition, we have an interest in formative, epidemiological, health systems and implementation research on chronic respiratory diseases (chronic obstructive pulmonary disease, asthma), cancer, and brain, mental health and neurodevelopmental disorders (depression, autism).

We also explore healthcare-seeking behaviour to identify patients' preferences for particular providers and obstacles to timely care-seeking. Based on rigorous research, we aim to develop and test interventions suitable for low-resource settings. We also actively disseminate research results to various stakeholders and the Government of Bangladesh.

MEETING THE CHRONIC DISEASE THREAT

icddr,b research has shone light on the impact of NCDs on poor households, and on the country's response to chronic disease (see page 13).

AUTISM IN BANGLADESH

icddr,b hosted a high-level workshop on autism in August 2015. The condition, likely to affect around 1% of the population, has to date received little attention in Bangladesh, and parents of children with autism typically receive little support. Dr Aliya Naheed discussed preliminary results of research into the mental health of mothers who care for children with autism in Dhaka, which will provide insight into the kind of support that parents need.

GEOHEALTH HUB

icddr,b and the University of Chicago, USA, have been awarded a five-year US$1.5m grant from the US National Institutes of Health (NIH) to establish a regional research and training hub focusing on emerging environmental and occupational health threats. The hub, to be known as the Bangladesh Center for Global Environmental and Occupational Health, will study the health impacts of household air pollution from burning biomass fuels, such as wood or dung, as well as the adverse health effects associated with locally important issues such as climate change and employment in garment factories. The grant was awarded by the NIH through its Fogarty International Center Global Environmental and Occupational Health (GEOHealth) programme.

A paramedic in one of Matlab's three sub-centres takes a woman's blood pressure.

THE HYPERTENSION CHALLENGE

icddr,b research has shone more light on the growing challenge of hypertension in Bangladesh. A study at rural surveillance sites revealed that 16% of people aged 25 years and above had hypertension and a further 32% had a precursor condition, pre-hypertension. Furthermore, there was substantial 'hidden' hypertension – 11% of individuals were unaware of their condition (23% of those aged 60 and above). Even when recognised, the condition was poorly treated, with 55% of patients having uncontrolled hypertension.

Khanam MA *et al.* Prevalence and determinants of pre-hypertension and hypertension among the adults in rural Bangladesh: findings from a community-based study. *BMC Public Health*. 2015;15:203.

Khanam MA *et al.* Undiagnosed and uncontrolled hypertension among the adults in rural Bangladesh: findings from a community-based study. *J Hypertens*. 2015;33(12):2399–406.

CHILDHOOD OBESITY

Nearly 20 years of data from urban Dhaka Hospital and rural Matlab Hospital have provided an early warning of rising levels of childhood obesity. While under-nutrition levels have fallen substantially at both sites, obesity levels have begun to rise. Although still far less common than under-nutrition, the proportion of overweight children increased from 0.6% to 2.6% in Dhaka and from 0.8% to 2.2% at Matlab.

Das SK *et al.* Changing childhood malnutrition in Bangladesh: trends over the last two decades in urban-rural differentials (1993-2012). *Public Health Nutr.* 2015;18(10):1718–27.

DIABETES AND DEPRESSION

Two recent studies have shed light on the risk of depression in people with diabetes. Some 62% of patients with type 2 diabetes attending a Dhaka hospital had depressive symptoms, with women and older people particularly badly affected. A case control study suggested a prevalence of 45% in cases compared with 20% in matched controls. Patients with diabetes are thus at high risk of depression, emphasising the need for screening of diabetes patients for depression and for management strategies suitable for use in resource-poor settings.

Islam SM, Rawal LB, Niessen LW. Prevalence of depression and its associated factors in patients with type 2 diabetes: A cross-sectional study in Dhaka, Bangladesh. *Asian J Psychiatr.* 2015;17:36–41.

Islam SM *et al.* Association between depression and diabetes amongst adults in Bangladesh: a hospital based case-control study. *J Glob Health.* 2015;5(2):020406.

ARSENIC AND HEALTH

Further evidence has emerged of the damaging impact of arsenic on health, particularly from research at Matlab. Notably, arsenic exposure has been found to double the risk of pneumonia in young children, possibly through an effect on immune system function. Curiously, prenatal exposure to arsenic has been found to be associated with an increased risk of drowning in young children, which could reflect the damaging impact of arsenic on the developing nervous system.

Other studies have found that, while exposure to arsenic in drinking water has fallen, children at Matlab are still exposed to worryingly high levels of arsenic. The source may be rice grown in contaminated water. A new project is examining whether lentils naturally rich in selenium can counter the effects of arsenic exposure – selenium being an arsenic antagonist.

George CM *et al.* Arsenic exposure is associated with pediatric pneumonia in rural Bangladesh: a case control study. *Environ Health.* 2015;14:83.

Rahman M *et al.* Prenatal arsenic exposure and drowning among children in Bangladesh. *Glob Health Action.* 2015;8:28702.

Kippler M *et al.* Elevated childhood exposure to arsenic despite reduced drinking water concentrations - A longitudinal cohort study in rural Bangladesh. *Environ Int.* 2016;86:119–25.

Our publications

COMMITMENT TO PUBLICATION

We are committed to the rapid and full publication of research findings in international peer-reviewed journals.

Publication in the peer-reviewed scientific literature is a key indicator of quality, and an important step in the dissemination of new information to scientific, clinical, policy and programme communities.

HIGH-PROFILE PUBLICATIONS IN 2015

In 2015, icddr,b researchers were authors on 259 original publications, and also contributed to 41 letters, editorials, book reviews and abstracts. These included outputs in leading journals, such as the *Lancet, Lancet Global Health, Lancet Infectious Disease, Cell, Vaccine* and the *International Journal of Epidemiology*. The majority of papers were co-authored with national and international colleagues.

A full list of all publications can be found at: www.icddrb.org/AR2015_Publications

2015 PUBLICATIONS

259

Original papers*

5

Reports/ monographs

9

Book chapters

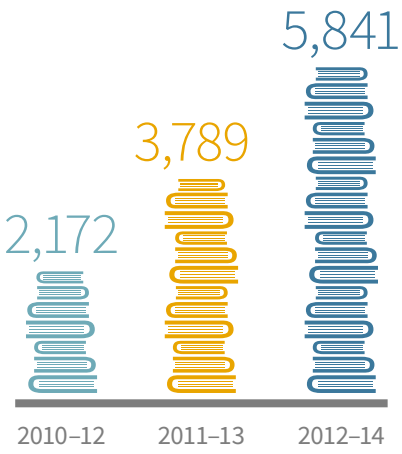
41

Letters, editorials, etc.

*including review articles and short reports in journals

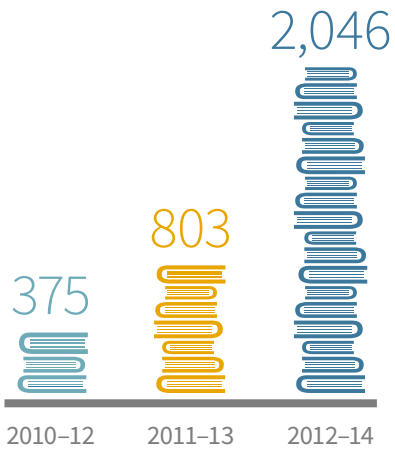
icddr,b's library is one of the preeminent health research libraries in South Asia.

CITATIONS I: ALL PAPERS



Citations during three-year periods of all papers with icddr,b authors published in peer-reviewed journals.

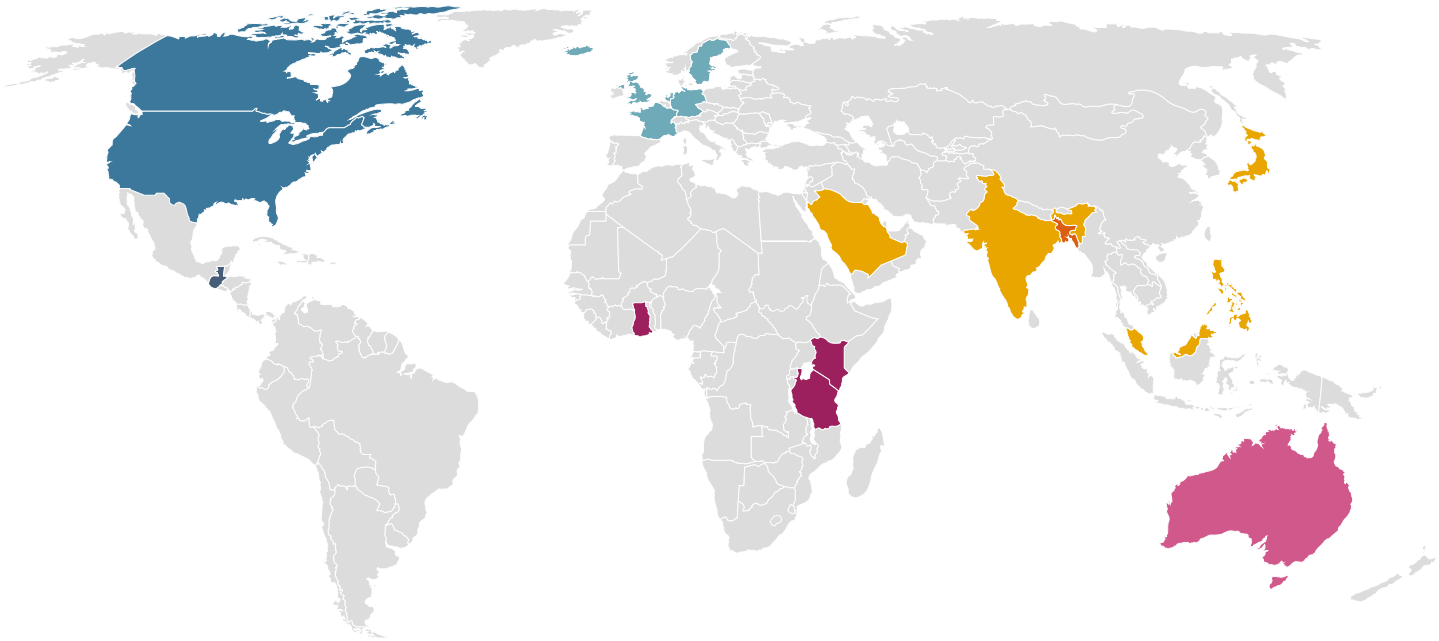
CITATIONS II: PAPERS IN HIGH-IMPACT JOURNALS



Citations during three-year periods of all papers with icddr,b authors published in peer-reviewed journals with journal impact factor greater than 9.

Collaborations

We work with a global network of scientific collaborators in leading research institutions. We have also established strong links with multiple academic, Government and NGO partners in Bangladesh and across South Asia, as well as partnerships with major international agencies, national and international companies, and other research institutions in the global South.



COLLABORATING INSTITUTIONS

NORTH AMERICA

- Academy of Educational Development, Washington DC, USA
- Boston University School of Public Health, USA
- Centers for Disease Control and Prevention, USA
- Children's Hospital of Richmond at VCU, USA
- Columbia University, New York, USA
- Consortium for Conservation Medicine, New York, USA
- Dartmouth Medical College, USA
- EcoHealth Alliance, New York, USA
- Emory University, Atlanta, USA
- Fenway Institute, Boston, USA
- Gynuity Health Projects, New York, USA
- Harvard Medical School, Boston, USA
- Hospital for Sick Children, Toronto, Canada
- Infectious Disease Research Institute, Seattle, USA
- Institute for Disease Modeling, Bellevue, USA
- Institute of Health Metrics Evaluation, University of Washington, USA
- Jibon Health Technologies, Inc., USA
- Johns Hopkins Bloomberg School of Public Health, Baltimore, USA
- Johns Hopkins University School of Medicine, Baltimore, USA
- Massachusetts General Hospital, Boston, USA
- McGill University, Montreal, Canada
- Oklahoma State University, USA
- Pan American Health Organization, USA
- PATH, Seattle, USA
- Pennsylvania State University, USA
- Peter Gilgan Centre for Research and Learning, Toronto, Canada
- Population Council, New York, USA
- PREVENT, USA
- Public Health Agency of Canada
- Rhode Island Hospital, USA
- Rollins School of Public Health, Emory University, Atlanta, USA
- Seattle Biomedical Research Institute, USA
- Stanford University School of Medicine, USA
- Stanford University, USA
- Texas Medical Center, USA
- University at Buffalo, USA
- University of Alberta, Canada
- University of Arkansas Medical School, USA
- University of British Columbia, Canada
- University of Calgary, Canada
- University of California, Berkeley, USA
- University of California, Davis, USA
- University of California, San Francisco, USA
- University of California, Santa Cruz, USA
- University of Chicago, USA
- University of Colorado, Boulder, USA
- University of Denver, USA
- University of Florida, USA
- University of Manitoba, Winnipeg, Canada
- University of Maryland, Baltimore, USA
- University of Michigan, USA
- University of Missouri, USA
- University of North Carolina School of Medicine, USA
- University of Pittsburgh, USA
- University of Saskatchewan, Canada
- University of Texas at Galveston, USA
- University of Toronto, Canada
- University of Vermont, USA
- University of Virginia Health System, USA
- University of Virginia, USA
- University of Washington, USA
- Vanderbilt University, USA
- Walter Reed Army Institute of Research, USA
- Western Human Nutrition Research Center, Davis, USA
- Yale School of Medicine, USA

EUROPE

- Children's Investment Fund Foundation, London, UK
- DNDi, Geneva, Switzerland
- Eawag, Dübendorf, Switzerland
- Ecole Polytechnique Fédérale de Lausanne, Switzerland
- Enfants du Monde, Geneva, Switzerland
- Erasmus MC University Medical Centre, Rotterdam, The Netherlands
- Foundation for Innovative New Diagnostics, Geneva, Switzerland
- GlaxoSmithKline Medicines Research Centre, Stevenage, UK
- Imperial College London, UK
- Institut Pasteur, Paris, France
- International Atomic Energy Agency, Vienna, Austria
- Karolinska Institute, Stockholm, Sweden
- Laboratorio de Referencia de Leishmaniasis, Spain
- London School of Hygiene and Tropical Medicine, UK
- Ludwig-Maximilians University of Munich, Germany
- Medical University of Vienna, Austria
- Nestlé Research Centre, Lausanne, Switzerland
- Nutriset SAS, Malaunay, France
- Sahlgrenska Academy of University of Gothenburg, Sweden
- Sint Antonius Ziekenhuis, The Netherlands
- TDR, WHO, Geneva, Switzerland
- UCL Institute of Child Health, London, UK
- University College London, UK
- University of Amsterdam, The Netherlands
- University of Basel, Switzerland
- University of Cambridge, UK
- University of Copenhagen, Denmark
- University of Exeter, UK
- University of Glasgow, UK
- University of Gothenburg, Sweden
- University of Heidelberg, Germany
- University of Iceland, Iceland
- University of Manchester, UK
- University of Newcastle upon Tyne, UK
- University of Oxford, UK
- University of Paris, France
- University of Southampton, UK
- University of Sussex, UK
- University of Warwick, UK
- Uppsala University, Sweden
- Wellcome Trust Sanger Institute, UK

BANGLADESH

- Autism Welfare Foundation
- Bandhu Social Welfare Society
- Bangabandhu Sk. Mujib Medical University and Hospital
- Bangladesh Forest Department
- Bangladesh Institute of Child Health (Dhaka Shishu Hospital)
- Bangladesh Institute of Research and Rehabilitation in Diabetes
- Bangladesh Legal Aid and Services Trust
- Bangladesh Lung Foundation
- Bangladesh University of Engineering Technology
- Bangladesh University of Health Sciences
- BRAC
- BRAC Development Institute
- BRAC University
- CARE-Bangladesh
- Central Veterinary Hospital
- Centre for Injury Prevention and Research, Bangladesh
- Chittagong Maa O Shishu Medical College Hospital
- Chittagong Medical College and Hospital
- Chittagong USTC hospital, Pahartoli
- Damien Foundation Bangladesh
- Department of Livestock Services
- Dhaka City Corporation
- Dhaka Medical College and Hospital
- Dhaka North City Corporation
- Dhaka Shishu Hospital
- Dhaka South City Corporation
- Directorate General of Health Services
- EngenderHealth
- Faridpur Medical College Hospital
- Food and Agriculture Organization, Bangladesh
- Global Alliance for Improved Nutrition, Bangladesh
- Holy Family Red Crescent Medical College and Hospital
- Institute of Chest Diseases Hospital
- Institute of Child Health and Shishu Sasthya Foundation Hospital
- Institute of Epidemiology, Disease Control and Research
- Institute of Public Health Nutrition
- Institute of Water Modelling
- James P Grant School of Public Health
- Kumudini Hospital
- LAMB
- Lepra Bangladesh
- Light House
- Marie Stopes Clinic Society, Bangladesh
- Mawlana Bhashani Science and Technology University
- MBM Garments Ltd
- Ministry of Health and Family Welfare
- Ministry of Home Affairs
- Mymensingh Medical College and Hospital
- National Centre for Tuberculosis and Research
- National Institute for Population Research and Training
- National Institute of Cardiovascular Diseases
- National Institute of Diseases of Chest and Hospital
- National Institute of Mental Health
- National Institute of Neurosciences and Hospital
- National Medical College and Hospital
- National Tuberculosis Control Programme
- Obstetrical and Gynecological Society of Bangladesh
- Consumers Association of Bangladesh
- Parents Forum for Differently Able
- Pathfinder International, Bangladesh
- Popular Medical College Hospital
- PRAN-RFL Group
- Radda MCH-FP Centre
- Revitalization of Community Health Care Initiative in Bangladesh
- Salvation Army, Bangladesh
- Save the Children, Bangladesh
- Shaheed Suhrawardy Medical College
- Shimantik
- Shyamoli TB Clinic
- Sightsavers, Bangladesh
- Sir Salimullah Medical College and Hospital
- Smiling Sun Franchise Program
- Society for the Welfare of Intellectually Disabled, Bangladesh
- Tauri Foundation (School for Gifted Children)
- Terre de Homes, Bangladesh
- United Nations Children's Fund (UNICEF), Bangladesh
- University of Dhaka
- University Research Corporation, Banani
- Urban Primary Health Care Project
- Water Aid Bangladesh
- World Food Programme, Bangladesh
- World Health Organization, Bangladesh

OTHER ASIA

- Aga Khan University, Karachi, Pakistan
- Aichi Medical University, Japan
- Clinogent, India
- Duke-NUS Graduate Medical School, Singapore
- Futures Group International India Pvt. Ltd, India
- Interactive Research and Development, Karachi, Pakistan
- International Food Policy Research Institute, New Delhi, India
- International Vaccine Institute, Seoul, South Korea
- Mahidol University, Bangkok, Thailand
- National Institute for Cholera and Enteric Diseases, Kolkata, India
- National Institute of Infectious Diseases, Japan
- PATH, India
- Rajiv Gandhi Centre for Biotechnology, Kerala, India
- Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, India
- Standard Diagnostics Inc., South Korea
- SUI Associates Co. Ltd, Japan
- Tokyo University Hospital, Japan
- Tokyo-Kasei University, Japan
- University of Colombo, Sri Lanka
- University of Kelaniya, Sri Lanka
- University of Nagasaki, Japan
- University of Tokyo, Japan
- We Can Campaign, India
- Xiamen University School of Public Health, China
- Yamaguchi University Graduate School of Medicine, Japan

AUSTRALIA

- Charles Sturt University
- Griffith University
- Macfarlane Burnet Institute for Medical Research and Public Health
- Menzies School of Health Research, Darwin
- Royal Children's Hospital, Melbourne
- University of Melbourne
- University of Queensland
- University of Sydney

AFRICA

- Ardhi University, Dar es Salaam, Tanzania
- MO Resources Ltd, Tanzania
- School of Public health, Moi University, Eldoret, Kenya
- Sokoine University of Agriculture, Morogoro, Tanzania
- University of Cape Town, South Africa
- University of Venda, South Africa

SOUTH/CENTRAL AMERICA

- Institute of Nutrition of Central America and Panama, Guatemala

Awards and other recognition

TOP 10 PAPER

Dr Emily Gurley and colleagues

A paper from icddr,b researchers and international colleagues on acute lower respiratory tract infection and exposure to indoor pollution was named one of the top 10 articles of the year published in the *American Journal of Epidemiology*. The paper, from Dr Emily Gurley and colleagues at icddr,b, Johns Hopkins University, the University of Virginia and the State University of New York, showed that exposure to indoor pollution lowered the age at which young children suffered their first acute lower respiratory tract infection.

Gurley ES *et al*. Indoor exposure to particulate matter and age at first acute lower respiratory infection in a low-income urban community in Bangladesh. *Am J Epidemiol*. 2014;179(8):967–73.

INNOVATION IN PNEUMONIA TREATMENT

Dr Md Jobayer Chisti

Dr Md Jobayer Chisti won a People's Choice Award for Most Promising Child Pneumonia Innovation, following an online global voting competition. Dr Chisti led a trial at icddr,b's Dhaka Hospital demonstrating that low-cost 'bubble CPAP' equipment could deliver life-saving oxygen therapy to young infants with severe pneumonia (see page 9). The competition was run in conjunction with the Pneumonia Innovations Summit in New York in November 2015. The Summit was organised by the Pneumonia Innovations Team, a global network of more than 200 organisations and individuals committed to accelerating the development and adoption of new technologies to reduce child deaths from pneumonia.

JOINT LEARNING NETWORK

Dr Jahangir A M Khan

The Government of Bangladesh has selected icddr,b health economist Dr Jahangir A M Khan as one of five members of its panel for the Joint Learning Network for Universal Health Coverage (JLN). JLN spans an international network of countries and aims to make evidence and best practice related to universal health coverage more accessible to policy-makers and other stakeholders.

BIOTECHNOLOGY GOLD MEDAL

Dr Md Mustafizur Rahman

Dr Md Mustafizur Rahman has been awarded a gold medal by the Global Network of Bangladeshi Biotechnologists, a global forum of more than 400 resident and expatriate scientists established in 2004 to foster international dialogue and collaboration in biotechnology. The Network awards two gold medals every two years, one to a resident researcher and one to an expatriate.

OTHER RECOGNITION IN 2015

Dr Zhahirul Islam was selected for a Global Health Equity Scholar award for 2015–16.

Dr S M Shariful Islam has been selected by the World Heart Federation as a member of its Emerging Leaders Programme.

Dr Mohammad Abdul Aleem and **Shahana Parveen** received the International Conference on Emerging Infectious Diseases 2015 Leaders Award.

Lutfe Ara was the winner of the Best International Abstract Award at the Association for Professionals in Infection Control and Epidemiology (APIC) 2015 Annual Conference.

Two abstracts presented by icddr,b researchers **Md Didar Hossain** and **Dr S M Shariful Islam** won first and fifth prizes at the International Conference on Universal Health Coverage.

Our training

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

icddr,b scientists, clinicians and research facilities, including field sites, offer a rich wealth of learning resources for the next generation of researchers, clinicians and practitioners. Participants in training programmes are provided with the opportunity to learn from leading experts, gain valuable field experience and see first-hand how low-cost interventions are developed and implemented in a low-income setting.

In addition to specialist training provided by icddr,b's Technical Training Unit, icddr,b's research divisions also provide needs-based training and technical assistance in Bangladesh, the region and globally. In 2015, highlights included:

Health systems research training for Government of Bangladesh staff

icddr,b's Health Systems and Population Studies Division conducted a series of training sessions on 'Health systems research and evidence informed policy making' for Government officials. Some 49 Government officials, including the deputy director, assistant directors and assistant director general of the Directorate General of Health Services, Government of Bangladesh, attended the programme. The Health Systems and Population Studies Division also conducted joint venture training programmes in partnership with University College London and Graphic Science, UK on 'Health policy analysis' and 'Public engagement training' respectively for Government health professionals to enable them to increase their capacity to generate evidence and support policy advocacy.

Training on acute malnutrition and diarrhoeal diseases

The Clinical and Hospital Services Division conducted training on malnutrition and diarrhoeal diseases for external stakeholders, including participants from the Institute of Child Health and Shishu Sasthya Foundation.

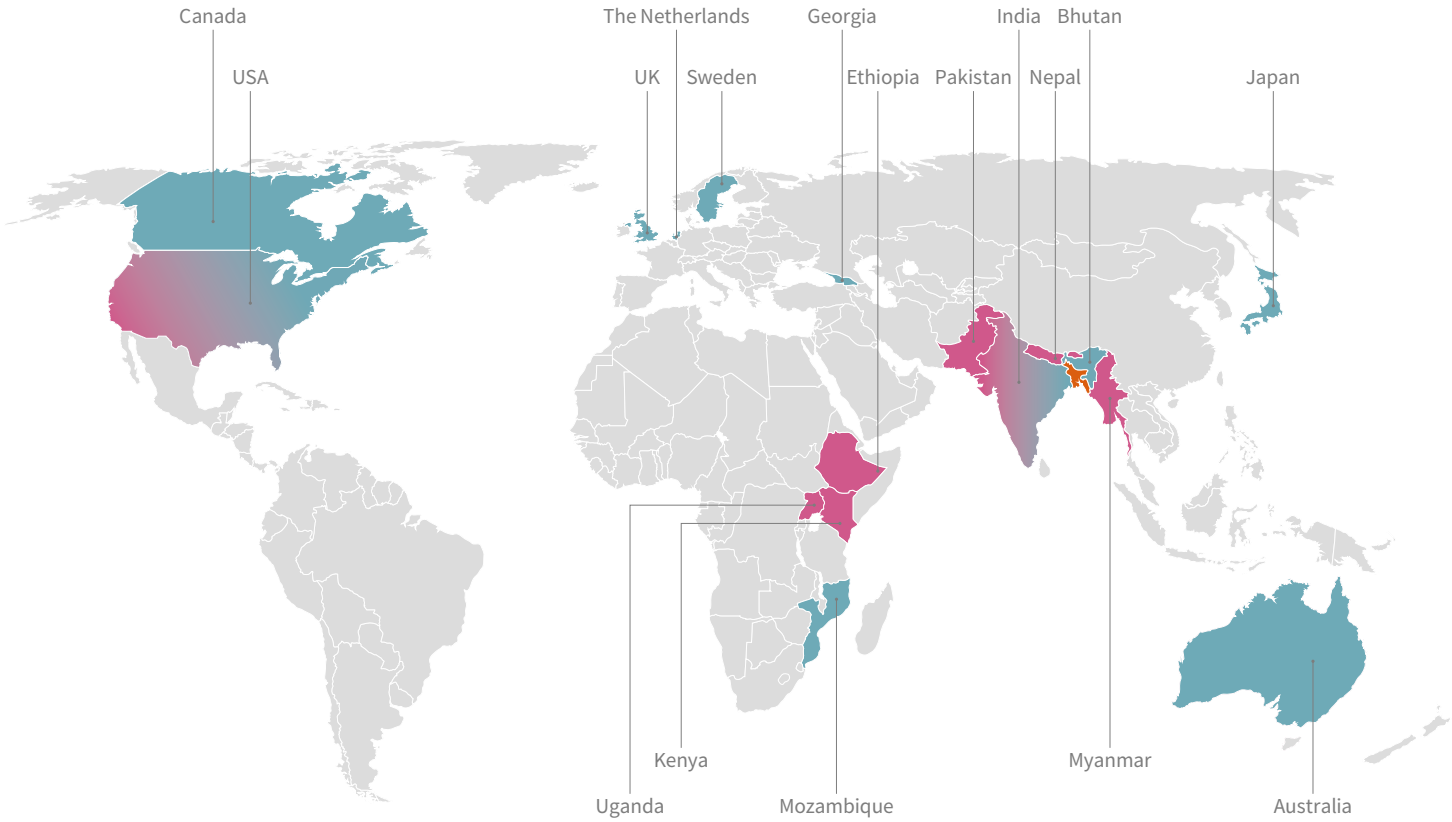
Countries represented by students attending icddr,b training courses, and field experience and orientation programmes:

Field experience and orientation programmes:

Australia, Canada, Denmark, Georgia, India, Japan, Mozambique, The Netherlands, Sweden, UK, USA

Technical training courses:

Bhutan, Ethiopia, India, Kenya, Myanmar, Nepal, Pakistan, Uganda and USA.



Technical training unit	**71 training events** **1,290 participants**
James P Grant School of Public Health (a collaboration with BRAC and BRAC University)	**20 (13 male and 7 female) icddr,b staff hold academic positions**
Field experience programme: Aimed at master's and PhD students seeking practical insights into, and experience of, public health in a low-resource setting	**125 students hosted:** **70 national, 55 international**
Orientation programme: Tailored to meet specific curricular needs, primarily for medics interested in research and humanitarian activities	**1,387 students hosted:** **1,228 national, 159 international**

Our services

As part of our 'social contract' with the communities with whom we work, we provide a range of high-quality clinical services free of charge to those in need in Dhaka and Matlab. We also make important contributions to international disease control efforts in crisis situations.

For decades, icddr,b has provided high-quality clinical care through its Dhaka and Matlab Hospitals and at the Mirpur Treatment Centre. In 2015, icddr,b treated more than 200,000 patients, principally at the Dhaka Hospital.

Being intimately involved in the delivery of care enables our clinical researchers to develop a deep understanding of the key health issues facing local populations, and to identify appropriate interventions that have the potential to be implemented locally or in similar facilities if they are shown to be effective.

Our hospital facilities are important sites for surveillance, clinical training and the testing of new interventions. icddr,b also has a duty of care to the local communities who make such an important contribution to public health research.

205,855

Patients treated

117,385

(57%)

No. of children <5 years

57,486

(28%)

Number of underprivileged patients

57% of patients attending icddr,b's hospitals are children under 5 years of age.

DHAKA HOSPITAL

Patient total
138,341

By gender:
M: 59% F: 41%

By age:
<5 years: 59%
>5 years: 41%

MATLAB HOSPITAL

Patient total
46,461

By gender:
M: 43% F: 57%

By age:
<5 years: 58%
>5 years: 42%

MIRPUR TREATMENT CENTRE

Patient total
21,083

By gender:
M: 55% F: 45%

By age:
<5 years: 43%
>5 years: 57%

EMERGENCY RESPONSES

icddr,b is a founding member of the WHO's Global Outbreak Alert and Response Network (GOARN) and continues to offer its assistance and expertise to deal with cholera outbreaks during humanitarian crises.

In 2015, icddr,b scientists helped develop the capacity of government and non-governmental organisations to deal with a protracted cholera outbreak in Mozambique. The severe outbreak of cholera was triggered by a period of extensive flooding early in the year. icddr,b responded to the crisis by sending an experienced team of clinicians and scientists to build the capacity of the Mozambique Government, the local WHO office and other local NGOs.

The icddr,b team delivered a week-long 'training of trainers' workshop in the Mozambique capital, Maputo, with participants from the Ministry of Health, Government of Mozambique, the local WHO office and other partner NGOs. The team then travelled to Zambezia, a province badly affected by cholera, to lead another week-long workshop for healthcare providers, and a training course for laboratory scientists and technicians. They also visited a number of health facilities, advising local healthcare staff on patient management practices.

As well as this work in Mozambique, icddr,b staff also supported WHO infectious disease control efforts in Iraq. These included an evaluation of the risk of outbreaks of cholera or other diarrhoeal diseases in Syrian refugee camps in the Kurdistan region of Iraq in May 2015, as well as investigation of a cholera outbreak and advice on treatment protocols in Baghdad in October 2015.

Our corporate services

Ingrid Renaud
CHIEF OPERATING OFFICER

With the publication of icddr,b's new strategic plan in 2015, our corporate services were focused on achieving three goals: investing in our people, improving organisational efficiency and cost effectiveness, and ensuring financial sustainability.

During the year, considerable progress was made in modernising our organisation and its operations to ensure that we meet internationally recognised standards of governance, compliance, transparency and efficiency in all areas. This was accomplished as a result of the efforts and dedication of our staff.

In line with our newly articulated values of 'excellence' and 'integrity', we have continued to strengthen our operational structure and services, in order to support the highest standards of business and ethical behaviour, and fulfil our responsibilities to our donors and extended audiences.

Benchmarking our financial, procurement, IT and human resources services against world-class peer organisations has been key to ensuring that we meet international standards in all operational areas. Building the capacity of our existing staff has been central to this endeavour, as well as recruiting new team members. A key area of focus for 2015 was strengthening our internal oversight function in order to improve our risk management.

To achieve long-term financial sustainability, we have focused on cutting costs, and are now beginning to recover the full costs of all projects. In addition, we have implemented a governance process to ensure organisational regulatory and legal compliance, and to ensure the delivery of operational excellence to all our stakeholders.

We aim to create a workplace that ensures people are always treated with dignity and respect. We believe that different ways of thinking complement each other, and that diverse teams are more creative and inclusive, better reflecting the communities we serve. We aim to recruit and nurture the best qualified people to ensure the sustainability of icddr,b into the future, and continue to embed a culture that affirms equal opportunities for all staff, regardless of gender, race, religion, marital or family status, sexual orientation or disability.


icddr,b

Our people

Our 4,400 plus staff are led by Executive Director Professor John D Clemens and the Senior Leadership Team. Together they are responsible for the day-to-day running of the organisation.

SENIOR LEADERSHIP TEAM

As of 1 May 2016

Professor
John D Clemens
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. He has authored over 350 original scientific papers and is also a Professor of Epidemiology at the University of California, Los Angeles, USA. A graduate of Stanford (BS) and Yale (MD) Universities, he was awarded the 2010 Albert B Sabin Gold Medal Award for excellence in vaccine science.

Dr Abbas Bhuiya
Deputy Executive Director
Senior Director, Health Systems and Population Studies

Dr Abbas Bhuiya has some 30 years' experience in the field of community health research with a special focus on health services for the most vulnerable, 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.

Ingrid Renaud
Chief Operating Officer

Ingrid Renaud serves as Chief Operating Officer (COO) for icddr,b. Previously, she was COO at Global Rights where she provided day-to-day leadership for operations and offices in Africa, Asia, Latin America and the USA. She has extensive global experience in managing operations of non-profit start-ups. She is a proven leader in developing, leading and supervising cross-functional areas including human resources, information technology and administration. Ms Renaud is a volunteer Career Counsellor at New Hope, a non-denominational group who gather to share job search experiences. She is affiliated with the American Society of Association Executives, Inside NGO and the Society for Human Resources Management. She holds an MS in Applied Behavioral Science, Organizational Development, from Johns Hopkins University, USA.

Dr Shams El Arifeen
Senior Director, Maternal and Neonatal Health

Dr Shams El Arifeen has nearly 25 years of experience in child and neonatal health, health services and health systems research with a focus on health interventions for developing world populations. He has extensive experience in research and evaluation, with particular expertise in cluster-randomised trials, large-scale surveys as well as with community and facility-based evaluations of interventions and programmes. He actively participates in national efforts within Bangladesh to scale-up evidence-based neonatal and child health interventions and currently leads the team assisting the Bangladesh Government and its partners in monitoring and evaluating health services and programmes. He holds an MBBS and DrPH and is trained in medicine, public health, nutrition and epidemiology.

Dr Tahmeed Ahmed
Senior Director, Nutrition and Clinical Services

Dr Tahmeed Ahmed has extensive experience of treatment and public health measures to address undernutrition, childhood tuberculosis and diarrhoeal 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 holds a PhD in Paediatrics from the University of Tsukuba, Japan, and an MBBS in Medical Science from the University of Dhaka, Bangladesh.

Thomas Barry
Director, Finance

Thomas Barry has over 25 years' experience in financial management in the health and research sector. He graduated from University College Dublin, Republic of Ireland, and began his accounting training with the National Health Service in the UK, qualifying as a certified chartered accountant. He is now recognised as a Fellow of the Association of Chartered Certified Accountants (FCCA). He also obtained membership as a certified public accountant (CPA). He completed further studies in business administration with Edinburgh Business School, acquiring a postgraduate diploma. He has worked as a finance director in several research organisations and has managed multiple grants for the EU, USAID, NIH and other donors.

Dr Emily S Gurley
Interim Senior Director, Infectious Diseases (since March 2016)

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.

Dr M Abdus Salam
Director, Research Administration Services
Interim Director, Laboratory Sciences and Services

Dr M Abdus Salam oversees research support functions, such as exploring research funding opportunities and assisting researchers in writing grant applications, grants agreements, grants management, institutional review board, and dissemination of research findings. Dr Salam is a graduate of Dhaka Medical College, University of Dhaka, Bangladesh. He received training in paediatric medicine and surgery and served in icddr,b's Dhaka Hospital. Dr Salam has published over 100 original articles and review papers and is a regular reviewer for several peer-reviewed international journals. He has chaired several committees and is a life-member of the Bangladesh Medical Association.

icddr,b restructure

To align the organisation's structure with its new strategic plan, icddr,b restructured its Senior Leadership Team in January 2016. The following individuals made important contributions as part of the Senior Leadership Team during 2015:

Dr Dewan S Alam
(Acting Director, Centre for Control of Chronic Diseases)

Dr Tasnim Azim
(Director, Centre for HIV and AIDS)

Dr Shah M Faruque
(Director, Centre for Food and Water-Borne Disease)

Dr Quamrun Nahar
(Acting Director, Centre for Population, Urbanisation and Climate Change)

Dr Md Anisur Rahman
(Acting Director, Centre for Reproductive Health)

Christine Dennehy
(Director, Human Resources)

Graham Judd
(Director, Communications and Development)

Dr Simba Mandizvidza
(Director, Finance)

Samuel L Rose
(Director, Supply Chain Management and Facilities Management)

BOARD OF TRUSTEES

As of 1 May 2016

The Board of Trustees is icddr,b's governing body and provides strategic oversight. It includes three members nominated by the Government of Bangladesh, one representative each from the WHO and UNICEF, and leading researchers and health professionals split between the global North and the global South who act in a personal capacity.

Chair
Dr Richard S W Smith
Adjunct Professor, Imperial College Institute for Global Health Innovation, London, UK

Member Secretary
Professor John D Clemens
Executive Director, icddr,b *(ex officio)*

Representing the Government of Bangladesh

Mohammad Mejbahuddin
Senior Secretary, Economic Relations Division, Ministry of Finance *(ex officio)*

Syed Monjurul Islam
Secretary, Ministry of Health and Family Welfare *(ex officio)*

Professor Md Suhrab Ali
Professor of Biochemistry, Northern International Medical College, Dhaka, Bangladesh

Representing UNICEF

Sanjay Wijesekera
Associate Director and Chief of Water, Sanitation and Hygiene Programme Division, UNICEF, New York, USA

Representing the WHO

Awaiting appointment

Independent members

Rajesh Agrawal
Assistant Director General of Finance (Chief Finance Officer), International Crops Research Institute for the Semi-Arid Tropics, India

Professor Zulfiqar Ahmed Bhutta
Husein Laljee Dewraj Professor and Founding Chairman, Division of Women and Child Health, Aga Khan University, Karachi, Pakistan

Kenneth M Dye
International Development Consultant on governance and accountability; former Auditor General of Canada

Professor Ann Marie Svennerholm
Professor of Infection and Immunity, Department of Microbiology and Immunology, Sahigrenska Academy at the University of Gothenburg, Sweden

Dr Jeannette Vega
Managing Director, Rockefeller Foundation Santiago, Chile

Professor Maxine Whittaker
Dean, College of Public Health, Medical and Veterinary Sciences, James Cook University, Townsville, Australia

Professor Zhongwei Zhao
Professor, Australian Demographic and Social Research Institute, Australian National University, Canberra, Australia

We would like to thank former board members Dr Norma Binsztein, Professor N K Ganguly, Dr Mary Elizabeth Wilson and Dr Prakin Suchaxaya for their service in 2015.

Together with its hospital and field sites, icddr,b's laboratories provide a world-class research platform for cutting-edge research.

Our finances

icddr,b's overall revenues for 2015 amounted to US$68.9m compared with a total expenditure of US$68m, generating a surplus for the year of US$0.9m.

REVENUE

Our overall revenue for 2015 of US$68.9m (see below) represented a decrease of US$4.55m compared with 2014. Research grant income fell slightly, by US$1.63m to US$50.5m. Unrestricted funding fell by US$4.76m, as a result of changes in core donor funding.

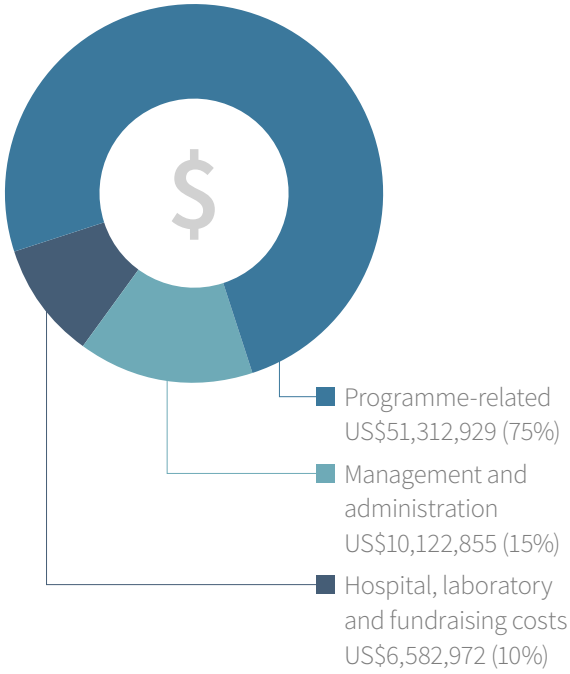
Breakdown of revenues 2015

Restricted grant contributions	US$50,496,273 (73%)
Unrestricted grant contributions	US$8,268,970 (12%)
Deferred income	US$3,557,194 (5%)
Exchange gain	US$204,030 (1%)
Other revenue - restricted	US$776,365 (1%)
Other revenue - unrestricted	US$5,611,665 (8%)

EXPENDITURE

Total expenditure for 2015 amounted to US$68m, a decrease of US$1.4m compared with 2014. The bulk of expenditure (75%) related to programme-specific activities (see below). Management and administration accounted for 15% of total expenditure and hospital and fundraising 10%. The table below provides a detailed breakdown of costs.

Breakdown of expenditure 2015



A detailed analysis of expenditure for 2015

Salaries and benefits	US$35,720,842
Supplies and materials	US$8,753,607
Collaborative partnership costs	US$6,365,340
Depreciation and amortisation	US$5,562,320
Travel and vehicle hire charges	US$3,639,433
Consultancy fees	US$2,374,453
Rent, communication and utilities	US$1,643,460
Training, dissemination and staff development	US$1,123,369
Hospital patient expenses	US$826,472
Cleaning and security	US$708,107
Repair and maintenance	US$605,729
Printing and publications	US$445,474
Mandatory committee expenses	US$216,375
Doubtful debts	US$166,588
Other operational costs	US$135,485

OTHER 2015 KEY FINANCIAL STATISTICS

1. At the end of the year, icddr,b had US$76.2m in net assets.
2. Cash and cash equivalents amounted to US$29.4m at the end of the year.
3. Accounts receivables (debtors) were reduced by 18%, marking an improvement in debt collection.
4. Accounts payables and provisions also decreased by 11% as payment processes improved.
5. The current ratio (liquidity) has improved by 6% from 1.26 in 2014 to 1.33 in 2015, reflecting reduced debtors and creditors.
6. Stock inventories have also been reduced by 35% as a result of improved stock utilisation.
7. The workforce increased marginally from 4,438 in 2014 to 4,444 in 2015. The total number of scientific staff at year end was 221, an increase of three staff compared to 2014.
8. Indirect costs (expenses that are not readily identified with a particular grant, contract, project function or activity, but are necessary for the general operations of the organisation) fell from 34% to 33%; this figure includes hospital costs of 10%.
9. Overall expenditure was under-spent against the approved annual budget for 2015 as a result of two factors: first, disruption caused by general strikes in Q1 and, second, revenue being lower by 14% as a result of restricted activities facing delays and hence lower reimbursement.

icddr,b received an unqualified (healthy) audit opinion from ACNABIN chartered accountants in respect of its financial statements for 2015. These statements are available at **www.icddrb.org/about-us/reports/financial-reports**

Recognising our supporters

We are indebted to the foundations, institutions, corporations, development agencies, NGOs and multilateral bodies that support our work.

TOP 10 DONORS DURING 2015

	Donor partners	Restricted (US$)	Unrestricted (US$)	Total (US$)
1	Bill and Melinda Gates Foundation	9,675,795	-	9,675,795
2	UK – Department for International Development (DFID)	3,926,957	3,794,318	7,721,275
3	USA – Centers for Disease Control and Prevention (CDC)	5,065,382	-	5,065,382
4	USA – National Institutes of Health (NIH)	4,474,101	-	4,474,101
5	The Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM)	4,246,611	-	4,246,611
6	Johns Hopkins University (JHU)	3,595,003	-	3,595,003
7	Canada – Global Affairs Canada (GAC)	325,857	3,061,465	3,387,322
8	USA – US Agency for International Development (USAID)	1,673,362	-	1,673,362
9	Sweden – Swedish International Development and Cooperation Agency (Sida)	1,595,763	-	1,595,763
10	Canada – Grand Challenges Canada (GCC)	1,479,354	-	1,479,354

A complete list of donors is provided in Note 22 to the financial statements: **www.icddrb.org/about-us/reports/financial-reports**

CORE DONOR FUNDING:

1. Enables us to focus on and pursue strategic research objectives, aligned with the new global development agenda, including increased capacity building, advocacy and policy development activities
2. Enhances our financial stability, reducing our vulnerability to changes in the volatile research-funding environment, and giving us more independence to prioritise our own research agenda and to support worthwhile activities that are not funded by other donors
3. Facilitates our investment in maintaining and improving our core infrastructure essential to scientific advances, such as disease surveillance networks, state-of-the-art laboratories, and humanitarian services at icddr,b hospitals and clinics, which provide care free of charge to the poorest communities
4. Allows us to continue to modernise our operations – financial, human resources, communications, and monitoring and evaluation – to improve our organisational efficiency and cost-effectiveness.

Together, these and future investments will ensure that icddr,b continues to generate high-quality research knowledge.

Government of the People's Republic of Bangladesh

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