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Solving public health problems through innovative scientific research
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icddr,b is an international health research institute based in Bangladesh. Policymakers and practitioners utilise our evidence and expertise to improve health outcomes and prevent premature death and disability worldwide. Established more than 60 years ago, we continue to provide life-saving services to the people of Bangladesh, and to nurture the next generation of global health leaders. Our work has substantial impact here in Bangladesh and globally.

VISION
A world in which more people 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.
LETTER FROM THE EXECUTIVE DIRECTOR

Building on strength: Our new Strategic Plan seeks to build on our areas of strength to achieve significant public health impact.

icddr,b IN NUMBERS

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

SPOTLIGHT

The following stories highlight five areas – humanitarian efforts in Bangladesh, tuberculosis control and antibiotic resistance – where we are having national and international impact.

RESEARCH HIGHLIGHTS

In 2019, we published findings of national, regional and international significance.

PROGRAMME SUMMARIES

- REDUCING MATERNAL AND NEONATAL MORTALITY
- PREVENTING AND TREATING MATERNAL AND CHILDHOOD MALNUTRITION
- CONTROLLING ENTERIC AND RESPIRATORY INFECTIONS
- DETECTING AND CONTROLLING EMERGING AND RE-EMERGING INFECTIONS
- ACHIEVING UNIVERSAL HEALTH COVERAGE
- ACHIEVING GENDER EQUALITY AND PROMOTING SEXUAL AND REPRODUCTIVE HEALTH AND RIGHTS
- EXAMINING THE HEALTH CONSEQUENCES OF CLIMATE CHANGE
- PREVENTING AND TREATING NON-COMMUNICABLE DISEASES

KEY VISITORS IN 2019

Key visitors (national and international visitors) who visited icddr,b’s hospital and facilities in Dhaka, Matlab and Cox’s Bazar in 2019.

CENTRAL MANAGEMENT SERVICES

Central Management Services (CMS) has continually improved and efficiently increased its support to science. We have improved on capacity building, strengthening departments and increasing effectiveness by adopting policies and procedures to improve overall governance, accountability and transparency.
PUBLICATIONS IN 2019

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

COLLABORATIONS

We work with multiple government, academic and NGO partners in Bangladesh, ensuring a strong focus on local health issues, and have long-standing ties with scientific collaborators in leading research institutions across the world.

AWARDS AND ACHIEVEMENTS

Selected awards and achievements

TECHNICAL TRAINING UNIT

icddr,b provides a wealth of training opportunities for researchers, practitioners, policymakers and others, from Bangladesh and globally.

CLINICAL SERVICES

Our hospitals in Dhaka and Matlab provide free care to those in need, and provide a basis for an extensive programme of clinical research and training.

LABORATORY SCIENCES AND SERVICES

The Laboratory Sciences and Services Division provides diagnostic and other laboratory services to icddr,b and external clients, and contributes to icddr,b research in microbial genetics and genomics.

SENIOR LEADERSHIP TEAM

Our staff of over 4,000 are led by Executive Director Professor John D Clemens and the Senior Leadership Team.

BOARD OF TRUSTEES

icddr,b’s Board of Trustees comprises of 16 health professionals and researchers representing both developed and developing countries.

FINANCE

icddr,b’s overall revenue for 2019 amounted to USD 71.98 million compared with a total expenditure of USD 71.42 million, generating a net surplus for the year of USD 558k.

RECOGNISING OUR SUPPORTERS

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

OUR DONORS IN 2019

All donors in 2019
LETTER FROM THE EXECUTIVE DIRECTOR

The coronavirus pandemic has reinforced the need for constant vigilance against infectious diseases.
This year, 2020, is the 60th anniversary of the founding of icddr,b. Initially known as the Cholera Research Laboratory, our origins lie in the regional threat posed by cholera and other diarrhoeal diseases. One of our greatest achievements was to pioneer the development, testing and rollout of oral rehydration therapy (ORT), a treatment that has since saved many millions of lives.

We have maintained a strong focus on cholera, for example demonstrating the additional benefits of zinc supplementation in cholera treatment, and have also played a pivotal role in the testing of an affordable oral cholera vaccine (OCV). Globally and in Bangladesh, this too is beginning to be used more widely, saving the lives of people in vulnerable low-income settings, including camps for displaced people and in fragile settings.

A further important contribution we have made has been in refining hospital care for patients with cholera and other severe diarrhoeal diseases. We have achieved remarkable survival rates in our treatment centres, where we care for more than 200,000 patients and save an estimated 80,000 lives every year. Over the years, we have also actively shared our knowledge with others, contributing to multiple global relief efforts and advising on treatment and control of transmission in fragile settings across the world (as well as on our own doorstep).

Cholera remains a key focus of our work. However, we have greatly expanded our research interests since our early days. We have internationally recognised programmes in areas such as maternal, neonatal and child health, nutrition, women’s health and wellbeing, and respiratory and other infections. We have begun to address emerging challenges in Bangladesh, such as non-communicable diseases and the health impacts of climate change.

But one of our most important areas of focus has been on emerging and re-emerging infections. We have carried out vital work on Nipah virus, a regionally important zoonotic disease with epidemic potential, and on avian influenza, a well-recognised potential source of human infection. As COVID-19 has unfortunately demonstrated, novel human infections can have a catastrophic impact, both directly in terms of lives lost but also indirectly by absorbing health services and other resources and by inflicting enormous economic damage on countries.

COVID-19 also illustrates the huge value of vaccines. Without a vaccine, control of COVID-19 has been based primarily on social distancing and isolation to lower infection rates and prevent smouldering embers from turning into uncontrollable wildfires.

The world is looking to a COVID-19 vaccine to allow a return to some kind of normality. Yet vaccine development is not straightforward. Many questions will remain unanswered, including how well candidate vaccines perform in low-income settings or in specific population groups. icddr,b has established a reputation as one of the world’s leading sites for vaccine testing in a low-resource setting. As well as OCV, we have carried out impactful work on influenza, polio, rotavirus, *Haemophilus influenzae*, typhoid, enterotoxigenic *E. coli* (ETEC) and hepatitis E vaccines. And as development of COVID-19 vaccines is moving rapidly, we are already discussing with vaccine developers the possibility of running field trials of promising vaccine candidates in Bangladesh.

PROFESSOR JOHN D CLEMENS
Executive Director
June 2020
icddr,b
IN NUMBERS

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

TOTAL INCOME
USD71.9m

$51.2m
funding from competitive sources

$11.4m
other income

$8.1m
funding from core donors

$2.1m
other restricted income

387
scientific staff

3,894
non-scientific staff

39%
61%

50%
50%
283,551 patients treated in 2 hospitals and 1 treatment centre

46% female patients
54% male patients

119 new grants
394 ongoing projects

92 national collaborations
193 international collaborations

426 original papers published*  
33,121 citations from 2015-2018

196 national policy review committees with icddr,b representation

225 international policy review committees with icddr,b representation

803 attendees of icddr,b training courses

894 students hosted by icddr,b’s orientation programme for medical students

1,839,993 number of tests carried out

* with icddr,b scientists as authors
The following stories highlight five areas – humanitarian efforts in Bangladesh, tuberculosis control and antibiotic resistance – where we are having national and international impact.
icddr,b continues to play a key role in protecting the health of forcibly displaced Myanmar nationals in Bangladesh.

In 2017, more than 700,000 forcibly displaced Myanmar nationals arrived in the Cox’s Bazar region of Bangladesh, bringing the total number of displaced people to more than a million. Collectively, this would make the population the fourth largest city in Bangladesh.

Prompt action by icddr,b researchers and national and international partners led to highly successful pre-emptive use of oral cholera vaccine (OCV) to prevent a cholera outbreak (see page 28). Importantly, icddr,b studies have also shown that the OCV used is as immunogenic in the displaced population as in Bangladeshi individuals [1].

Displaced individuals have a range of other health needs, of which access to clean water is a high priority. An icddr,b study found that, while 28% of tube wells in refugee camps were contaminated with faecal bacteria, 74% of stored household water sources were contaminated, suggesting that secondary contamination is having the greatest impact on infectious disease risk [2].

icddr,b researchers are carrying out a range of studies to inform health protection activities among the forcibly displaced Myanmar nationals. One important study is mapping water supply sanitation and hygiene (WASH) practices, barriers to the use of healthy WASH practices, and the capacity of local bodies to implement WASH-related interventions. Interviews and focus groups with communities and other stakeholders will then be used to develop a participatory WASH plan for refugee camps.

A further study is exploring the prevalence of soil-transmitted helminth (parasitic worm) infections, and the interplay between such infections and malnutrition in the development of abnormalities in gut function – enteric enteropathy – that can impair child growth and development.

Finally, a project has been launched to find out more about the sexual and reproductive health needs of displaced women, as well as their use of antenatal and maternal health services. Contraceptive use is currently low owing to limited availability, misconceptions about health risks, and social stigma associated with use of contraception. Reproductive health seeking is also low, primarily because of mistrust of medical professionals and practices, as well as transportation challenges.

Surveys and in-depth interviews are being undertaken to gather information that can be used to inform the design of interventions to promote the uptake of culturally appropriate sexual and reproductive health services.


Despite some positive news, question marks remain over the potential of current approaches to water, sanitation and hygiene (WASH) interventions to achieve large and sustained effects.

There has been a long tradition of water, sanitation and hygiene (WASH) interventions to reduce the risk of infectious disease. As well as the water-chlorination project highlighted on page 21, icddr,b researchers have generated encouraging data on other possible WASH interventions.

For example, installation of water-chlorination points in primary schools led to the widespread adoption of chlorinated water drinking by children [1]. In addition, behaviour change communication and use of hand sanitisers halved the incidence of influenza in primary schools [2].

However, a major trial of individual and combined WASH and nutritional interventions – the WASH Benefits trials – recently found little evidence that WASH interventions were sufficient to reduce infections enough to normalise growth.

Further analyses of WASH Benefits data suggest that water treatment had some modest impact on hookworm infections [3] and single WASH interventions reduced respiratory infections to a degree [4]. Although WASH interventions also reduced the prevalence of gut function abnormalities (enteric enteropathy) in early life, no benefits were seen at 28 months [5].

The results of the WASH Benefits trial were very similar to those obtained in a sister trial in Zimbabwe and the similarly conceived SHINE trial in Kenya. The trials achieved high levels of compliance and were stringently designed to avoid bias. It is likely that the interventions, even in combination, were simply not able to sufficiently reduce exposure to pathogens to achieve a major clinical and developmental impact.

While better hygiene and sanitation clearly remain central to infectious disease control, the investigators of the three trials are encouraging the WASH community to pause and consider how to develop radically more effective solutions [6].

icddr,b researchers are leading efforts to detect and treat TB more effectively in Bangladesh. Bangladesh has one of the world’s highest burdens of TB, with an estimated 360,000 new cases in 2016. However, only 224,000 were officially reported. As well as missing out on treatment, undiagnosed cases play a critical role in the spread of infection.

icddr,b has piloted an innovative approach to engage the private sector to improve tracing of individuals with TB. When consulting local physicians, individuals are questioned about their symptoms and potential cases are referred by physicians to mobile screening centres established by icddr,b in Dhaka. High-quality DNA-based and X-ray tests provide an accurate diagnosis, and patients return to the referring physician for treatment and are put in touch with the National TB Control Programme. The system is proving highly effective and has been incorporated into Bangladesh’s national TB strategy. To further improve reporting, icddr,b has developed and piloted an app for reporting of TB cases. The ‘Janao’ app was trialled with 500 service providers, and formally launched in partnership with the National TB Control Programme. In ongoing work, icddr,b researchers are working with private sector service providers to find out how the app is being used and could be enhanced, and exploring with TB patients the factors behind delayed diagnosis and initiation of treatment.

The screening platform has also provided an opportunity to explore interactions between TB and type 2 diabetes. An estimated 8.4% of adults in Bangladesh have diabetes, and people with diabetes are more likely to develop active TB disease and die of TB.

By offering free diabetes screening alongside TB testing, the icddr,b team found that the number needed to screen to identify a new case of diabetes was 35, but just 21 if only those with a TB diagnosis were considered [1]. Treatment failure and death were more common in those with TB and diabetes, and diabetes was the most important predictor of poor treatment outcome. The findings emphasise the significant impact of diabetes on TB and the potential advantage of co-screening to improve TB care.

icddr,b researchers have also worked with US colleagues on drug responses in patients with multidrug-resistant TB. Pharmacokinetic modelling of data from Bangladesh, Georgia and the USA revealed that the dosing of one TB drug, cycloserine, may not be sufficient to kill some resistant strains [2]; spreading daily dosing out may provide a way to increase dosing without incurring additional side effects.

A second study found that second-generation fluoroquinolones (such as levofloxacin and moxifloxacin) killed TB bacteria quicker than previous generation drugs, but higher doses may need to be used [3].

Ongoing studies are exploring the use of the Xpert MTB/RIF Ultra platform to detect TB in children using stool samples – detection using sputum samples can be difficult in children. Following a successful pilot, a larger study is being undertaken at five large public and private hospitals.

New studies have provided an alarming picture of antibiotic resistance in Bangladesh, as well as insight into key factors contributing to the overuse of antibiotics.

Antibiotic resistance is a growing challenge globally. Drug-resistant infections currently account for an estimated 700,000 deaths a year, a figure that could rise to 10 million by 2050 without prompt action.

Asia may be at particular risk for the emergence and spread of drug-resistant bacteria. NDM-1-producing *E. coli*, which produce an enzyme that disables certain commonly used antibiotics, originated in India and has spread globally, while resistance to colistin, an antibiotic of last resort, was first detected in China in 2016 and has rapidly spread around the world.

Surveillance for antibiotic resistance in Bangladesh is limited, but icddr,b-led research has generated worrying evidence of its spread. For example, a study of healthy infants in rural Bangladesh found that 82% were colonised with *E. coli* resistant to third-generation cephalosporins, a mainstay of treatment for drug-resistant Gram-negative bacteria [1]. Three-quarters of these *E. coli* were multidrug-resistant.

Such high levels of drug resistance in the community – one third of *E. coli* colonies overall were resistant to third-generation cephalosporins – are extremely concerning from a public health perspective.

Also worrying are the high levels of resistance to colistin found in a range of environmental and biological samples in Dhaka. Out of 65 *E. coli* isolates analysed from street food, hand rinse, surface water and healthy human stool samples, 13 carried the mcr-1 colistin resistance gene [2]. The mcr-1 gene sequence was the same in different isolates, suggesting that it is being transmitted horizontally among *E. coli* strains.

An additional study of ready-to-eat foods in Dhaka found that 22% of samples were contaminated with *Staphylococcus aureus*, and a quarter of these were multidrug-resistant (MRSA) [3].

One of the main drivers of antibiotic resistance is overuse of antibiotics. To address this challenge, it is important to identify how antibiotics are being accessed and used. icddr,b researchers and international colleagues have carried out in-depth interviews with urban and rural households to find out when antibiotics are sought for family members or animals and from which sources. These consultations identified the key role played by unregulated drug shops in providing access to antibiotics [4]. However, targeting such drug shops could remove an important source of antibiotics for many when they are needed.

This study is part of a wider programme of activities, Pathways of Antibiotic Use in Bangladesh (PAUSE), which aims to provide insight into the attitudes and behaviours of antibiotic providers and sellers as well as households [5]. Such work will underpin the development of interventions to promote more appropriate use of antibiotics.

4. Lucas PJ et al. Pathways to antibiotics in Bangladesh: A qualitative study investigating how and when households access medicine including antibiotics for humans or animals when they are ill. *PLoS One*. 2019;14(11):e0235270
The BEAN (Bangladesh Early Adversity Neuroimaging) project is carrying out pioneering studies on the impact of poverty on early brain development.

Poverty has a detrimental impact on an infant’s life chances. In part, these are mediated through deficits in cognitive and emotional development, which can have long-lasting impacts into adulthood. However, which specific aspects of early-life adversity have greatest impact is not clear.

The international collaboration behind the BEAN project is using a range of technologies to explore associations between different aspects of early-life adversity and brain function, to identify abnormal brain activity linked to delayed cognitive, emotional and behavioural development in childhood and beyond. Work has focused on two cohorts, six-month old infants and three-year old children growing up in poor urban areas, providing an opportunity to examine how measures of brain activity are linked to developmental trajectories.

EEG (electroencephalography) provides a convenient way to record activity across the brain through the scalp. Analysis of EEG responses to visual stimuli identified a pattern of brain activity that was associated with both current and future cognitive abilities [1]. This signature varied according to caregiving experiences, and may be a valuable biomarker for tracking the impact of adversity on the brain.

EEG studies have also identified correlations between height-for-age, the degree of connectivity of brain activity, and cognitive abilities at age four [2]. Hence brain functional connectivity may be a pathway through which under-nutrition impacts on cognitive development.

The BEAN project has also explored use of a second portable brain-imaging technology, functional near-infrared spectroscopy (fNIRS). This study revealed early evidence for specific brain responses to social stimuli, the magnitude of which varied with factors such as maternal education, maternal stress and the caregiving environment, hinting at key factors influencing the social development of the infant and child brain [3].

Notably, the BEAN team was able to carry out the first functional magnetic resonance imaging (fMRI) study on infants in a low-resource setting, using facilities at the National Institute of Neurosciences and Hospital. This pilot study identified differences in functional brain activity in the amygdala between infants from impoverished and more affluent areas [4]. More generally, it demonstrated the feasibility of carrying out infant fMRI studies in challenging settings.

An important aim of these studies is to provide markers of brain development, to facilitate studies of interventions to improve cognitive and emotional development. This requires a good understanding of the pathways through which early adversity impacts on the brain. The BEAN team has therefore also worked with the cohorts to examine associations between a range of exposures and developmental outcomes [5]. This work suggests that a wide range of factors independently affect outcomes – arguing for integrated interventions targeting multiple aspects of biological and psychosocial environments.

Recent studies have highlighted alarming HIV-related and other health risks among marginalised populations in Bangladesh.

icddr,b manages a major programme of work on evidence-based policy and actions for HIV prevention among key populations, funded through a USD 8m grant from the Global Fund to Fight AIDS, Tuberculosis and Malaria. An implementation science framework is used to enhance the support and HIV prevention services provided to key populations, with support of local NGOs.

HIV testing and counselling services for sexual minority populations are mainly delivered through specific drop-in centres. In the long-term, sustainable HIV services need to be integrated into the national health infrastructure. However, work with key populations has identified a reluctance to use public healthcare facilities, mainly because of fears of judgmental attitudes, poor previous experiences, and lack of trust in public service providers [1]. This work has led to changes in the National Strategic Plan for HIV and AIDS Response, and development of a pilot intervention to improve services for sexually transmitted infections in public facilities.

icddr,b researchers have also assessed the acceptability of point-of-care HIV testing using saliva samples in potentially high-risk populations. Following this study, this approach to testing was incorporated into the 2019 national testing services guidelines.

In ongoing work, icddr,b researchers are engaging with the users of drop-in centres to explore ways to better detect TB infections in service users. Although verbal screening of sexual minority individuals takes place, it is not proving effective at identifying cases of TB, and referral to TB services is suboptimal.

A further project is exploring the prevalence of HIV among the female partners of male HIV-positive people who inject drugs (PWID). HIV is becoming more common among male PWID, who place partners at risk when they have unprotected sex. The project is engaging with male PWID, their partners, and the children of their sexual partners, to understand risk factors and to inform the design of potential interventions.

Infections with HIV and hepatitis C virus (HCV) are rising with alarming speed among PWID [2]. In 2017, 38% of new HIV cases were in PWID. Although an opioid substitution therapy programme operates in Dhaka, it is only reaching 3% of the PWID population. A preliminary analysis of needle/syringe sharing behaviour has documented networks that could promote the spread of bloodstream viruses [2].

Although treatment of marginalised communities can be challenging, a pilot project exploring antiviral treatment of HCV among PWID attending drop-in centres achieved high levels of adherence and suppression of viral replication [3].

Ongoing work is examining drug-using culture, reasons for needle/syringe sharing, and attitudes of PWID to current harm reduction programmes. For example, recently completed work identified a range of reasons why different sexual minority populations use metamphetamine [4]. These kinds of studies will provide important insights to guide intervention design and policymaking to reduce HIV transmission and other harms.

RESEARCH HIGHLIGHTS

In 2019, we published findings of national, regional and international significance.

Last year, icddr,b researchers and their national and international collaborators made important contributions across our focus areas, influencing both national and international policy and practice.

Our work spans critical studies on novel treatment for malnutrition, a new vaccine for diarrhoeal disease, and community-based treatment of high blood pressure.

Our research addresses many of the key health concerns affecting Bangladesh and other countries in the global South.
Food components have been identified that can reverse abnormalities in the gut’s microbial communities that may be responsible for the long-term effects of malnutrition.

The effects of malnutrition are not fully reversed by therapeutic feeding. Past work has suggested that malnutrition may delay the development of the gut’s microbial communities (microbiome), leading to a state of ‘immaturity’ that is not resolved by therapeutic feeding. The hope is that, by identifying food components that promote the maturation of microbial communities, the long-term impacts of malnutrition could be avoided.

To this end, icddr,b and US researchers mapped the changing patterns of microbial growth in Bangladeshi children treated for severe acute malnutrition, and tracked the levels of key metabolites in the blood, such as those implicated in childhood growth. This revealed a good correlation between changes in microbial communities, metabolite levels and growth parameters [1].

Mice were then colonised with microbes characteristic of different stages of gut microbiome development, and complementary foods were found to advance the development of beneficial microbial strains and raise levels of key metabolites [1].

Furthermore, particular food components were found to boost microbiome development and metabolite levels in mice and piglets colonised with microbial communities from infants with severe malnutrition. In infants, a randomised controlled trial of standard therapy versus the most promising food components identified a lead component having the greatest impact on normalising blood metabolite levels [1].

The gut microbiome is a complex ecosystem of multiple interacting microbial species – at least 100 in total – and the impact of individual species depends on which other species are also present. This presents a major challenge, given the potentially astronomical number of microbial combinations that could be present in the gut. Borrowing network analysis methods used in economics, the researchers were able to pinpoint 15 microbial species whose levels correlated with each other and could be used to track gut microbiome development and responses to therapy [2].

The findings are a major step towards the development of foodstuffs that not only resolve the immediate challenge of malnutrition but also reverse its harmful impact on gut microbiome development, reducing the risk of longer-term harms.

AN *E. coli* VACCINE FOR CHILDREN

The second-generation ETVAX vaccine is safe and immunogenic in children.

Enterotoxigenic *E. coli* (ETEC) is a leading cause of diarrhoeal disease in children in resource-poor settings. Work on the first-generation ETVAX vaccine against ETEC was set back by high rates of vomiting in Bangladeshi infants. The more powerful second-generation ETVAX can be used at lower doses, reducing the likelihood of such adverse reactions in children.

The ETVAX vaccine is based on an engineered version of *E. coli* that expresses high levels of key proteins used to colonise the gut and one of the *E. coli* toxins responsible for symptoms of diarrhoea. To evaluate responses to the different components of ETVAX in infants, new methods were needed to quantify antigen-specific antibody levels in small volumes of blood. In initial studies in adults, researchers from icddr,b, Sweden and the USA showed that a new method of detection, based on electrochemiluminescence, produced similar results to conventional assays [1].

The second-generation ETVAX vaccine was also found to be safe and immunogenic in adults, enabling the vaccine and the new detection technology to be tested in progressively younger children. This showed that ETVAX was safe and tolerated in infants as young as six months old and stimulated good immune responses [2]. An adjuvant boosted immune responses, particularly in the youngest age groups.

This world-first study on ETVAX in children supports further trials of efficacy in children and infants, the groups that stand to benefit most from disease prevention.


New methods may provide a clearer picture of the burden and distribution of cholera.

An understanding of the disease burden due to cholera and its distribution would provide policymakers with evidence to support prioritisation of cholera control, as well as guidance on where control efforts should be focused. However, data on cholera infections come from a limited number of surveillance sites.

To provide a clearer picture of the nationwide distribution and seasonal patterns of cholera infection, icddr,b researchers analysed samples from more than 26,000 diarrhoeal disease patients at 22 sites across Bangladesh. Just over 6% of cases were found to be caused by cholera based on microbiological cultures, with locations such as Dhaka and Chittagong showing particularly high rates [1]. Cases peaked at pre- and post-monsoon times of year, although the degree of seasonal variability varied across the country.

The reliability of microbial culture has been called into question, with highly sensitive molecular tests identifying *Vibrio cholerae* in culture-negative stool samples. However, a re-examination of data from a large oral cholera vaccine trial carried out in the 1980s revealed that, while the vaccine showed good protective efficacy against microbiologically confirmed cholera, it had no impact on cases of culture-negative acute watery diarrhoea [2]. This suggests that culture methods are not missing significant numbers of cases of cholera.

Over the longer term, other methods for detection of cholera would be welcome. One possibility is serosurveillance – analysis of blood samples to detect recent cholera infections in populations. A step towards this goal has been taken by researchers from icddr,b and US collaborators, who compared immune responses in known cholera patients and unaffected family contacts and used machine-learning approaches to identify immunological signatures associated with cholera infection in the past year.

Remarkably, just six markers provided very high discriminatory power, and even two markers were almost as reliable [3]. Although further work is needed to validate the findings and generate practical tools, the findings open up the possibility of population-wide testing to track cholera disease.

A practical in-line drinking water chlorination system significantly reduced childhood diarrhoea in low-income urban areas.

Globally, around one billion people access water that does not meet international safety standards. Water chlorination is a highly effective way to purify drinking water, but the taste of residual chlorine is off-putting and use of chlorination systems at the household level has shown limited success – in part because very high levels of adherence are necessary for chlorination to be effective and household systems are not convenient to use.

A possible alternative is chlorination at communal points of delivery, as many such sources deliver contaminated water. One key advantage is that such systems do not require any changes in water-collecting practices.

New technologies for in-line water chlorination are becoming available, and icddr,b researchers and US colleagues have carried out a randomised controlled trial of one such technology in two urban areas of Bangladesh. Dispensers were introduced that treated water with either chlorine or vitamin C as a control, with chlorine levels low enough not to be detectable when the water was drunk.

Children in the chlorine-treated group were significantly less likely to have diarrhoea (7.5% versus 10% in the control group) [1]. This also led to lower expenditure on treatment, less healthcare seeking, and lower use of antibiotics – another important outcome given the rise in antibiotic resistance due to overuse.

The study suggests that in-line chlorination systems, which are low cost, do not require power, are compatible with many water delivery systems, and do not require significant behaviour change, could reduce the childhood burden of diarrhoea in low-income urban settings.

A trial has found good evidence of the effectiveness of fractional dosing of inactivated poliovirus vaccine (IPV).

IPV is critical to the global campaign to eradicate polio, yet limitations in its supply have led WHO to recommend ‘fractional dosing’ – use of one-fifth the normal dose – when necessary. Data suggest this should be as effective as the full dose, but this has not been formally assessed in a clinical trial.

To close this important evidence gap, researchers from icddr,b and the US Centers for Disease Control and Prevention have carried out a clinical trial comparing two doses of fractional IPV with one dose of IPV in routine immunisation schedules, as well as use of fractional IPV as a booster to mimic outbreak responses.

The study found that vaccine responses were markedly higher in children receiving two doses of fractional IPV [1]. In addition, fractional IPV was non-inferior as a booster when given to children previously receiving either IPV or fractional IPV.

The findings highlight the suitability of fractional IPV use in routine immunisation and outbreak responses. As well as providing an important option when IPV supplies are limited, fractional IPV could also significantly improve the cost-effectiveness of outbreak responses, allowing five times as many children to be vaccinated compared to use of full-dose IPV.

In ongoing work, the icddr, b team is also testing a novel oral poliovirus type 2 vaccine (nOPV2) in children. Data on this genetically more stable vaccine are urgently required so it can be used instead of conventional OPV2, which has led to multiple outbreaks of circulating vaccine-derived poliovirus globally.

A nationally representative survey has revealed great heterogeneity in dengue infection across Bangladesh.

Dengue is a viral infection posing an increasing public health challenge globally. As symptoms vary widely, from mild to severe, determining the true picture of infection is difficult. In Bangladesh, most information comes from Dhaka, where infection rates are high.

To generate a deeper understanding across the country as a whole, icddr,b researchers and US colleagues undertook a nationwide survey, screening blood samples from nearly 6,000 individuals at 70 randomly selected community sites for antibodies to dengue virus.

The results suggested that 24% of the population had at some point been infected with dengue, but infection rates varied from 3% in the north to more than 80% in Dhaka [1]. An estimated 2.4 million infections occur each year.

The findings suggest that dengue has become established in only a small number of urban centres. Most rural centres are at low risk, possibly because of the scarcity of the main mosquito vector for dengue.

The results provide important evidence to guide the national public health response to dengue, including possible use of the Dengvaxia vaccine, which is recommended for use only in those known to have been infected previously. The innovative methodology – the study is the first ever nationwide dengue serosurvey – also holds important wider lessons for assessing the distribution of dengue or other infections.

Early initiation of breastfeeding may be beneficial because of its impact on sepsis.

Bangladesh has more than halved neonatal mortality since 1990, but declines in neonatal mortality have not matched those seen in under-fives. Neonatal deaths now account for 62% of deaths of children under-five, and 65% of neonatal deaths occur in the first week of life. Sepsis and severe infections are responsible for a quarter of neonatal deaths in Bangladesh.

Early initiation of breastfeeding is known to be beneficial, and WHO recommends starting breastfeeding within one hour of birth. However, this occurs in only half of births in Bangladesh.

Even so, the mechanisms underlying the protective effect of early breastfeeding are not well understood. icddr,b researchers and colleagues from Australia and the USA explored its possible contribution to protection against neonatal sepsis and severe illness. Data from nearly 30,000 newborns revealed that the longer the delay in initiation of breastfeeding, the greater the risk of severe neonatal illness [1]. The risk for babies initiating breastfeeding after 48 hours was three times that of babies starting within one hour (36.7% versus 12.0%).

The findings suggest that severe neonatal illness could be reduced by 16% by universal adoption of early breastfeeding, re-emphasising the need to promote and support early initiation of breastfeeding.

A child development programme incorporating psychosocial stimulation and integrated within routine health systems has significantly enhanced children’s cognitive and emotional development.

Children growing up in poverty show delayed brain development and cognitive deficits compared with their less disadvantaged peers, long-lasting effects that prevent them achieving their full potential. Research from icddr,b and elsewhere has shown that interventions that include psychosocial stimulation can at least partially ameliorate these early-life disadvantages.

Even so, a major challenge is to move from proof of concept to implementation into practice. To address this issue, icddr,b researchers and colleagues from Canada and the UK ran a randomised controlled trial exploring the impact of an early childhood development programme integrated into routine care.

The programme focused on underweight children attending community clinics, with government health workers showing mothers how to support their child’s development through play and interactions over 25 sessions. Compared with controls, children receiving psychosocial stimulation showed significantly improved cognition, language development, motor skills and behaviour ratings [1].

This large-scale study, involving more than 1,700 children at 90 clinics, shows that an effective intervention at a crucial stage in a child’s life can be delivered through routine health systems. Further work is exploring the potential for healthcare workers rather than researchers to deliver initial training, so that full responsibility for the programme is held within the health system.

In related work, icddr,b researchers have begun a study in rural Bangladesh exploring the impact of adding psychosocial stimulation to social security payments made to new mothers living in poverty [2].

Further evidence of the benefits of psychosocial stimulation have come from a trial carried out by icddr,b researchers and colleagues from Australia exploring how peer counselling and psychosocial stimulation affect feeding practices and child growth and development. The intervention, delivered in urban slums, led to significant increases in early initiation of breastfeeding and exclusive breastfeeding at five months, greater length gain at 12 months, and improved social and emotional development [3].

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Addition of a toxic yellow pigment to turmeric is exposing people in Bangladesh to dangerously high levels of lead.

The neurotoxic effects of lead and its impact on intellectual development are well known. Many countries have taken steps to reduce lead exposure, for example by banning its use in vehicle fuels. High levels of bloodstream lead have been noted in Bangladesh. In a study of pregnant women, researchers from icddr,b and the USA identified a range of possible sources of lead [1]. A detailed follow up revealed that the isotopic lead signature which is most closely matched and seen in turmeric samples – lead chromate, a yellow pigment – is used to enhance the distinctive golden colour of turmeric, a widely used ingredient in curries [2].

Investigation of turmeric production, including structured interviews with 152 individuals involved in its production and distribution, as well as analysis of more than 500 turmeric and associated environmental samples, revealed widespread adulteration of turmeric [3]. The practice is driven by consumer demand for brightly coloured dishes, leading producers to use pigment to disguise poor quality product. Awareness of the dangers of lead chromate was low.

To address this major public health issue, interventions are required that target both consumers and turmeric producers.

The COBRA-BPS trial has shown that a low-cost and scalable multicomponent intervention can significantly reduce blood pressure in rural populations.

Cardiovascular disease is on the rise across South Asia and high blood pressure is increasingly common. Although effective medications and control strategies exist, there is an urgent need for approaches that can be implemented at scale in low-resource settings.

The COBRA-BPS randomised controlled trial, run in Bangladesh, Pakistan and Sri Lanka, tested a highly practical multicomponent intervention centred on community health workers. Key components included blood pressure monitoring at three-monthly intervals by community health workers, with referral to a physician when necessary, home health education for participants and family members delivered by community health workers, and training of physicians in blood pressure monitoring and management of high blood pressure.

More than 2,500 adults with high blood pressure were recruited. After two years’ follow up, those in the intervention group had significantly lower blood pressure [1]. Blood pressure control was achieved in 10% more participants and all-cause mortality was 2.9% compared to 4.3% in the control group. Although the number of events was small, far fewer cardiovascular-related deaths occurred in the intervention group. Participants also reported better overall health.

The findings suggest that a low-cost intervention – the estimated annual cost of scale up is just USD10.70 per patient – is effective and feasible to implement in routine health systems. Furthermore, reductions in disease have the potential to deliver additional social and economic benefits.

An evaluation of vaccine coverage among forcibly displaced Myanmar nationals in Bangladesh has found remarkably high levels of coverage for oral cholera vaccine.

In November 2017, around 700,000 forcibly displaced Myanmar nationals, mainly women and children, arrived in the Cox’s Bazar region of Bangladesh, joining 300,000 previously displaced individuals. Living in makeshift shelters with limited access to clean water and sanitation, the population was at significant risk of infectious diseases, including cholera.

To avert a health catastrophe, the Government of Bangladesh and national and international partners, including icddr,b, rapidly organised vaccination campaigns with oral poliovirus vaccine (OPV), measles and rubella (MR vaccine), and oral cholera vaccine (OCV).

A survey of nearly 40,000 forcibly displaced Myanmar nationals found excellent coverage for OCV – 94% for a first dose and 92% for a second dose [1]. Coverage levels were somewhat lower for OPV1 and OPV2 (75% and 88%) and lower still for MR vaccination (38%). The involvement of highly experienced icddr,b staff in OCV vaccination likely contributed to the high coverage achieved.

The findings demonstrate that effective vaccination campaigns can be carried out even in challenging humanitarian emergency situations.

PROGRAMME SUMMARIES
BREASTFEEDING

Early initiation of breastfeeding may protect against neonatal sepsis (see page 24).

PSYCHOSOCIAL STIMULATION

A psychosocial stimulation intervention has been successfully implemented in routine care (see page 25).

FACILITY DELIVERY

Innovative data modelling has been used to explore spatiotemporal patterns in facility-based deliveries. Although facility-based delivery is associated with reduced risk of maternal mortality, fewer than 50% of women in Bangladesh currently give birth in a facility. Focusing on Mirzapur, an area with a population of just under 500,000 people, the project drew on demographic surveillance data to plot the distribution of facility delivery and changes over time, revealing ‘hot spots’ and ‘cold spots’ [1]. The visualisations provide tools to prioritise interventions to increase facility usage, for example by using hot spots as diffusion centres.

A separate study has used data on more than 28,000 births in the Bangladesh Maternal Mortality Survey to investigate individual- and community-level factors influencing facility delivery. As well as individual influences, multiple community-level factors were associated with facility delivery [2], suggesting that multifaceted approaches targeting individuals and communities will be needed to increase facility usage.

**MATERNAL DEPRESSION**

A survey in urban slums in Dhaka has identified strikingly high levels of post-natal depression. Among 376 women interviewed, 39% had been affected by depression within a year of giving birth [1]. A range of factors were associated with post-natal depression, including job loss, unintended pregnancy, intimate partner violence, and working after delivery. The findings highlight the need to include mental health services in maternal care, factors that need to be addressed to improve maternal mental health, and the need for evidence-based, culturally appropriate and scalable mental health interventions.


**PRE-TERM BIRTH**

An analysis of 25 years of data from Matlab has provided unique insights into trends in pre-term birth – the leading cause of under-five mortality. Between 1990 and 2014, pre-term birth rates fell from 29% to 11% [1]. More than a quarter of this drop could be ascribed to increases in women’s educational levels and decreases in family size. Marked and persistent seasonal variation was also noted. The findings indicate that women’s education programmes and family planning could have a significant impact on pre-term birth and child mortality.

In other work, icddr,b researchers have helped to validate an algorithm developed in Canada for determining gestational age based on blood metabolite levels and clinical factors. Establishing gestational age is essential for determining levels of pre-term birth, but can be difficult to assess accurately without ultrasound facilities. Use of the algorithm on heel-prick blood samples collected at Matlab could pinpoint gestational age to within 1–2 weeks [2]. Accuracy was slightly lower with more convenient cord blood samples, although further refinement of the algorithm should be feasible.


**URINARY TRACT INFECTIONS**

A community-based programme screening for and treating urinary tract infections and abnormal vaginal microbial growth had no impact on pre-term birth [1], even though such infections are a well-established cause of premature birth. The lack of effect probably relates to low clearance rates – among those successfully treated, pre-term delivery was the same as for uninfected women. The findings highlight the need for a deeper understanding of the specific microbial abnormalities responsible for pre-term birth as well as initiatives to address antibiotic resistance.

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

We undertake a wide range of research, from basic laboratory studies to evaluations of preventive and treatment programme implementation to support policy development. We focus on the main challenges facing Bangladesh and the global South, pursuing research and innovations to produce credible solutions.

Our research has already highlighted the factors responsible for and causes of under-nutrition among children and women. Collecting inputs from needs-based clinical, basic and community research, we are generating evidence to develop solutions that can be implemented at scale and disseminating information to policymakers and other stakeholders.

Our current area of concern is under-nutrition, but we work collaboratively with our non-communicable disease initiative, recognising that poor and unhealthy diets have created a dual problem of malnutrition and obesity. We benefit from cross-departmental collaboration on joint projects on water, sanitation, hygiene and nutrition; maternal nutrition; and treatment of pneumonia in public healthcare facilities.

Specific priorities include the development and evaluation of interventions for women and adolescent girls to prevent low birth weight, as well as studies to shape the design of new interventions to prevent and treat childhood wasting and stunting.

Results from the MAL-ED cohort have also shown that stunting, and less severe limited weight gain, have harmful impacts on the development of cognitive, motor, language and socio-emotional skills [3]. The findings emphasise the critical importance of enhancing maternal health to benefit both mothers and their offspring.


AFFORDABLE THERAPEUTIC FOOD

A soy-based ready-to-use therapeutic food (RUTF) has been shown to have similar efficacy to a standard milk-based product in treatment of severe acute malnutrition [1]. A randomised controlled trial of 260 children aged 6–59 months found that the soy-based product was equally acceptable, had no side effects, and achieved a similar rate of weight gain. Although milk powder is an excellent source of high-quality protein, it is expensive, and soy protein may be a cheaper and equally effective alternative.


THE BENEFITS OF BIFIDOBACTERIUM

Vaccine responses at two years have been found to depend on levels of the gut bacterium Bifidobacterium in early infancy [1], illustrating the long-lasting impact of healthy microbiome development. A related study found that neonatal vitamin A supplementation promoted growth of Bifidobacterium, but primarily in boys, who typically have lower levels of the bacterium than girls [2]. The results point to a potential additional benefit of supplementation with vitamin A, known to be important for development of the gut and mucosal immunity.


SUPPLEMENTATION FOR STUNTING

A combination of egg, cow milk and micronutrient supplementation increased the growth of young children of short stature [1]. A study of nearly 500 children aged 12–18 months found that supplementation up to 90 days improved growth compared to that seen in a similar cohort receiving no nutrition intervention. Eggs and cow milk are culturally acceptable and easily available products with the potential to boost growth during a critical phase of infant development.

ETVAX VACCINE

A phase I trial of the ETVAX ETEC vaccine has been successfully completed in adults and children (see page 19).

OSP RESPONSES

icdri,b and US researchers have generated new insights into immune responses against the cholera antigen OSP (O-specific polysaccharide), thought to be critical to the development of protective immunity. Experimental cholera infection in cholera-naïve North American volunteers revealed OSP-specific responses, which differed significantly from those seen in infected adults from endemic regions [1].

In addition, administration of oral cholera vaccine (OCV) to adults in Bangladesh elicited OSP-specific immune responses, but these were not significantly boosted by a second dose after 14 days [2]. The findings highlight the potential importance of previous cholera infections in vaccine responses, and raise questions about the use of two-dose schedules in endemic areas, at least in adults.


TURMERIC

Toxic lead chromate has been found to be widely used to colour turmeric (see page 26).
CHOLERA
A nationwide survey has quantified the cholera burden in Bangladesh (see page 20).

CHLORINATION
An in-line chlorination system for water supplies has reduced episodes of diarrhoeal disease (see page 21).

POLIO VACCINATION
Fractional inactivated poliovirus vaccine (IPV) has proven highly immunogenic (see page 22).

ORAL CHOLERA VACCINE
An OCV campaign among forcibly displaced Myanmar nationals achieved very high coverage (see page 28).

OCV IN PREGNANCY
An analysis of clinical trial data suggests that OCV given to pregnant women has no impact on birth outcomes [1]. Although a large OCV trial excluded pregnant women, some women who were unaware of their pregnancy status were enrolled. Follow up of these women found no differences in birth outcomes between those receiving OCV and those given a placebo. The results support use of OCV in pregnant women.


ROTAVIRUS VACCINES
An increased inoculum does not increase rotavirus vaccine ‘take’, icddr,b and US researchers have discovered [1]. Rotavirus vaccine efficacy is reduced in low-income countries, and higher doses have been suggested as a possible way to improve vaccine responses. However, a randomised controlled trial in Dhaka slums found that double the standard dose of vaccine did not improve take (antibody responses or faecal vaccine shedding). However, a correlation was found between antibody responses and vaccine replication in the gut, suggesting that impaired gut function underlies lower vaccine efficacy in low-income countries.

In a separate study, a phase I/II trial has demonstrated that a new heat-stable rotavirus vaccine is safe and immunogenic in children [2]. An effective heat-stable vaccine would not require refrigeration, making it easier to use in remote resource-poor settings.


SHIGELLA AND ETEC
A new vaccine against Shigella sonnei, WRSS1, has been found to be safe and immunogenic in adults and children [1], paving the way for efficacy trials in young populations.

In addition, icddr,b is part of a global consortium aiming to develop a novel vaccine protecting against both Shigella and enterotoxigenic E. coli (ETEC). Most Shigella vaccines have targeted the highly immunogenic O-antigen, which is highly variable. The SHIGETEVCVX consortium is developing an engineered version of Shigella lacking O-antigen, exposing antigens generating a wider spectrum of antibodies, and with additional ETEC antigens. The involvement of icddr,b will ensure that vaccine testing involves endemic populations, which generally respond less well to oral vaccines.


TYPHOID VACCINE
Work has begun on the largest clinical trial to date of the typhoid conjugate vaccine Typbar-TCV. Prequalified by WHO in 2018, Typbar-TCV has been recommended for use despite limited data. The trial, being undertaken by icddr,b and UK researchers, will involve more than 30,000 children and provide key data on the vaccine’s effectiveness in an endemic setting [1].

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

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

Our laboratory capacity allows us to study emerging infections and antimicrobial-resistant pathogens. We are also partnering with USAID’s Emerging Pandemic Threats programme, and routinely respond to infectious disease outbreaks in partnership with the Institute of Epidemiology, Disease Control and Research of Bangladesh and in collaboration with the local One Health initiative. As a member of the Asia Pacific Malaria Elimination Network, we are contributing to the regional elimination of malaria by 2030.

We are also working in partnership with the Coalition for Epidemic Preparedness Innovations (CEPI) in order to trial new vaccines under development for Nipah virus and to examine the immunogenetic profile of survivors.

Future priorities include developing a better understanding of antimicrobial resistance nationally, evaluating Nipah virus diagnostics, vaccines and therapeutics, and adopting a One Health approach to investigate and limit the impact of infections spanning the human–animal interface.

DENGUE

A national serosurvey has shone light on the distribution of dengue infections across Bangladesh (see page 23).

NIPAH VIRUS

An analysis of 14 years of data on Nipah virus infections in Bangladesh – 248 cases, 40% of the global total – has identified key factors associated with its person-to-person spread [1]. Nipah virus is carried by bats; human infections are rare, but sustained person-to-person transmission could have a devastating impact as fatality rates exceed 70%. A third of cases were found to be due to person-to-person transmission, which was associated with older patients and those with respiratory symptoms. Close family members were most likely to become infected and few asymptomatic infections were seen. The data provide important guidance for control of person-to-person transmission.

In addition, modelling has been used to generate a better picture of the disease burden of Nipah. By exploring how distance from surveillance hospitals and severity of symptoms affected attendance, the team estimated that 119 Nipah outbreaks occurred during 2007–14, around half of which were not picked up by hospital surveillance [2].


HEPATITIS E VIRUS

Nationwide hospital surveillance has revealed that hepatitis E virus (HEV) is the leading cause of jaundice in Bangladesh [1]. Investigation of jaundice cases at six tertiary hospitals found that 34% of cases were due to HEV. Three-quarters of cases were male, but fatality rates were higher for women – reaching 12% for pregnant women; 15% of surviving pregnant women had a miscarriage or stillbirth and 19% of children born alive died within one week.

The findings highlight the potential benefits of an HEV vaccine. icddr,b is leading a major trial evaluating an HEV vaccine developed in China, HEV 239 (Hecolin), in pregnant women [2]. The project is also helping to establish HEV vaccine-manufacturing capacity in Bangladesh.

2. Zaman K et al. HEV study protocol : design of a cluster randomised, blinded trial to assess the safety, immunogenicity and effectiveness of the hepatitis E vaccine HEV 239 (Hecolin) in women of childbearing age in rural Bangladesh. BMJ Open. 2020;10(1):e033702.

AVIAN FLU

A review of highly pathogenic avian flu in Bangladesh suggests that, despite multiple control efforts, it is firmly established in bird populations and remains a potential threat to human health [1]. Since 2007, 556 outbreaks of H5N1 in poultry have been reported, as well as eight human cases and three mild cases of H9N2. Genetic analyses suggest viral mutation over time. Continuing surveillance and an integrated one-health approach are needed to limit risks to human health.

In addition, surveillance at live poultry markets detected the appearance of H5N6, probably introduced in 2016, and 14 other subtypes of influenza A virus [2]. Although no human infections have been identified, the viruses have genetic signatures associated with the ability to infect people.


ZOONOTIC SURVEILLANCE

icddr,b and US researchers have developed a novel zoonotic surveillance system, making use of an existing nationwide platform run by icddr,b and the Institute of Epidemiology, Disease Control and Research. Although rare, human-to-animal transmission of novel infections has the potential to seed global pandemics. The new platform was based on hospital-based surveillance networks for meningoencephalitis and severe respiratory infections. Admitted patients were additionally screened for contact with wild or domestic animals in the preceding three weeks. Out of 11,429 patients screened, 2% reported animal contact [1]. In 88% of cases, patients had no confirmed diagnosis. The findings suggest that building on existing hospital surveillance networks may be a stepping stone towards more comprehensive surveillance for zoonotic transmission.

CAESAREAN SECTION

Categorisation of Caesarean section births at private facilities has revealed some of the underlying reasons for over-use of the procedure [1]. WHO suggests that Caesarean section rates should be 10–15%, but rates are much higher in Bangladesh. A study at 34 urban private hospitals found a Caesarean section rate of 82%. Using a recognised and simple categorisation system, researchers could examine the cited reasons for use of a Caesarean section, a first step towards limiting inappropriate use of the procedure.


COPING STRATEGIES

Households adopt a range of coping strategies, mainly financial, following the death of a household member from a non-communicable disease [1]. Data from Matlab found that financial adaptations, including cutting back on basic expenditure, were more common than changes to household composition such as addition of a new female. However, financial choices often had long-term harmful implications for the household, particularly for the most impoverished. The findings have the potential to inform the design of social safety nets.


HEALTH PROTECTION

icdrr,b researchers are evaluating the Government of Bangladesh’s Shasthyo Surekhasa Karmasuchi health protection scheme, which has been piloted in the Tangail district to address catastrophic out-of-pocket expenditure on healthcare. The project will explore user and supplier experience with the scheme, to inform the planned wider rollout of the scheme.
HEALTH SYSTEM EFFICIENCY
A comparison of countries in Asia has found that Bangladesh has a relatively efficient health system [1]. The analysis compared per capita health expenditure and a range of health outcome indicators to provide a measure of the efficiency of resource use. Only four out of 46 countries were deemed to be efficient—three high-income countries and Bangladesh. The findings suggest that other countries could deliver health improvements even with existing resourcing.


HEALTH GOVERNANCE
A systematic literature review has identified key areas of primary healthcare policy and governance in low- and middle-income countries where evidence is lacking [1]. Significant evidence gaps were found for social accountability, public–private partnerships and intersectoral collaboration. The analysis identifies where evidence is available to inform the development of governance strategies and where further research is needed.


HEALTH INSURANCE
A community-based health insurance scheme has been found to lower out-of-pocket expenditure on medically trained providers, but not overall expenditure [1]. Community-based schemes may be a way to protect households against catastrophic out-of-pocket expenditure and encourage use of medically trained providers. Participants in the scheme for informal workers in Chandpur incurred lower costs in use of medically trained providers but, surprisingly, use of informal providers (not covered by the scheme) did not fall as expected.


MATERNAL VOUCHERS
An evaluation of a voucher scheme for mothers has found that it did increase the uptake of services across the entire continuum from antenatal care through delivery and postnatal care, particularly among the most disadvantaged women [1]. Surveys in two cities found that recipients of vouchers were particularly well represented in a ‘high-utilisation’ group of women. Poor voucher recipients were much more likely to be in this group than poor women who did not receive vouchers.


EMERGENCY ACCESS
Incorporation of traffic congestion and use of GIS mapping has provided a more realistic picture of the urban poor’s access to emergency care in Dhaka [1]. Speed can be vital in emergency responses. Although under moderate traffic conditions all urban slums were within 60 minutes of emergency facilities, under congested conditions only 63% of slum populations had access within 60 minutes and only 32% were within 60 minutes of a burns unit. Ignoring traffic congestion leads to a threefold overestimation of service coverage.


GENERAL PRACTICE
A new project has been launched to explore the possibility of introducing a general practitioner (GP) system into primary care in Bangladesh. In several high-income countries, GPs deliver primary care services and act as gatekeepers to additional specialist services, but they are rare in low-income countries. The project is mapping the current numbers of GPs and the services they provide, satisfaction with their services, and local policy context, and will suggest a possible model for a Bangladeshi GP system.

Violence against women is a major public health issue in Bangladesh, where the overwhelming majority of women have experienced physical or emotional ill-treatment. Bangladesh is also characterised by high levels of child marriage. The country has multiple sexual minorities and other vulnerable populations who face significant barriers in accessing sexual and reproductive health services.

icddr,b has a long history of work on gender inequalities and on sexual and reproductive health service provision for vulnerable communities. We have explored levels of and contributors to intimate partner violence in Bangladesh and developed interventions that have significantly reduced levels of violence against young women. We have established strong links with minority populations and the groups that work with them.

Building on our existing strengths, we have a strong focus on prevention of gender-based violence, particularly intimate partner violence (e.g. the ‘HERrespect’ study). We also evaluate approaches for reducing child and forced marriage, and the reduction of unintended pregnancies, particularly among married adolescents. The sexual and reproductive health and rights of women in vulnerable situations is another important focus of work. We also work with colleagues across the organisation to ensure that gender parity is considered in all research.

PARENTAL DECISION-MAKING
Experience of equitable parental decision-making may make men less likely to engage in intimate partner violence [1]. A study of 1,500 married men found that those who had grown up in a household characterised by equitable parental decision-making were less likely to have perpetrated intimate partner violence; equity of decision-making within men’s local community had no impact. The findings emphasise the intergenerational impact of parental decision-making on men’s perpetration of violence.


GARMENT WORKERS
Two recent studies have highlighted some of the physical and mental health risks faced by women working in the garment industry. Some four million women work in garment factories in Bangladesh, generally in low-paid and arduous roles. A qualitative study found women experienced a range of ailments, including back and joint pain, eye pain and headaches, and felt permanently tired [1]. They also felt compelled to combine paid work with domestic duties. Factory doctors considered that the working conditions were impacting on the health of women workers.

A second study uncovered high levels of workplace violence – experienced or witnessed by 73.5% of workers over the preceding four weeks; 63.5% of managers acknowledged perpetrating emotional workplace violence [2]. Such harmful practices may be being driven by the pressures created by demands for high productivity in the workplace.


ADDRESSING ANAEMIA
An intervention based on provision of hot lunchtime meals with fortified rice, weekly iron–folic acid supplements and behaviour change communication reduced anaemia in female garment workers by 22%; a similar intervention without the hot meal reduced anaemia by 12% [1]. Around 80% of female garment workers are anaemic, affecting both their health and productivity. A trial in four garment factories found that the intervention including a daily nutritionally enhanced hot lunch had the greatest impact of anaemia and haemoglobin levels. The findings suggest that workplace nutrition programmes could have major health and economic benefits.

We are evaluating the impact of climate change and migration patterns on population health in Bangladesh and ways in which populations can adapt.

Bangladesh is highly vulnerable to climate change. It is likely to experience floods during the wet season, and potentially droughts in the dry season as neighbouring countries limit cross-border fresh water supply. It is also likely to face more extreme weather events.

There are concerns that climate change could affect the distribution and burden of vector-borne diseases such as malaria, dengue fever, kala-azar and Japanese encephalitis virus infections. Cholera outbreaks may also become more frequent as sea surface and river temperatures rise.

Health may also be affected in other ways. Heat stress is already occurring in urban areas, while rising salinity levels in coastal districts are likely to reduce crop production and exacerbate conditions such as hypertension. Large-scale population displacements are highly likely.

We have a history of research on the links between climate and spread of infectious diseases, and in recent years we have been building our expertise in environmental science. Our interdisciplinary projects examine human–environment interactions in vulnerable coastal areas, including its impact on health and well-being.

Drawing on our long experience in health and population research in Bangladesh, we are well placed to shape and inform discussions on the appropriate response to climate change (e.g. National Health Adaption Plan, transmission of vector-borne diseases, drinking water and salinity, human migration), while also ensuring that discussions are relevant to other countries facing similar challenges.


HEALTH IMPACTS

icdrr researchers have collated evidence on the health impacts of climate change in Bangladesh [1]. Climate change can have both direct (e.g. increased heat stress) and indirect (e.g. displacement-related) effects on health, leading to complex pathways of impact. Sociodemographic factors also have a key influence on how climate-driven changes play out. Limited evidence is available on these issues and information is widely scattered. The new publication brings together insights into one place to inform policymaking.

FEEDBACK LOOPS

A recent study has drawn together evidence on the interactions between people and water sources and their impact on salinisation [1]. As well as sea-level rise, salinisation can also be driven by factors such as agricultural practices and upstream water diversion, and trigger adaptation strategies that actually worsen salinisation.

LIFE SATISFACTION

icddr,b researchers have contributed to an innovative project exploring subjective wellbeing among farmers. A novel mobile phone-based tool was used to collect weekly feedback for the entirety of a year. The study found that life satisfaction was mostly stable and mid-range, and showed seasonal changes that were not simply due to lean times of year [1]. For example, life satisfaction was higher at times of land preparation and harvesting. The study suggests a novel way in which wellbeing data can be collected and adds to the more nuanced view of the factors beyond income and consumption that influence wellbeing.


SOIL SALINITY

A comparison of different approaches for soil salinity assessment has found that models combining direct and indirect measurements have the best predictive capacity [1]. Changes in soil salinity will be a growing challenge, yet monitoring over time and large areas will be difficult. Models that incorporated data from remote satellite imaging, where land use features and other environmental variables can be used to estimate salinity, as well as direct soil measures delivered best predictive performance and could help to identify affected areas to inform risk mitigation and to provide early warning.


WATER SALINITY

Exposure to highly saline drinking water, likely to increase with climate change, has been found to be associated with an increased risk of hospital visits associated with cardiovascular disease, diarrhoea and abdominal pain [1]. The study of 157 participants from three coastal areas also found low levels of awareness of the health risks of salt intake in high-salinity areas.


ION BALANCE

A study of different ion levels in drinking water has raised questions about the impact of saline water on blood pressure. Consumption of saline water has been associated with increased Na\(^+\) intake and elevated blood pressure. However, analysis of blood pressure measurements from two cohorts in coastal Bangladesh found that people exposed to mildly saline water had lower blood pressure than those who drank fresh water and were less likely to have hypertension [1]. They also had higher urinary levels of Ca\(^++\) and Mg\(^++\), greater intake of which could be having a protective effect on blood pressure.


HEALTH NEEDS

New work is being undertaken to provide a better understanding the health needs of populations living in coastal regions of Bangladesh, particularly disabled and other disadvantaged groups. A cross-sectional household survey is being undertaken alongside an assessment of health facilities and qualitative studies to understand health needs and health-seeking behaviours. The project will provide insight into the key health issues facing a highly vulnerable population as well as the social, political and biological factors associated with responses to those needs.

HYPERTENSION
A low-cost package of interventions significantly improved control of hypertension (see page 27).

NCD INEQUALITIES
Recent studies based on analysis of Bangladesh Demographic and Health Survey data have painted a complex picture of NCDs and care-seeking in Bangladesh. For example, the risk of hypertension and diabetes was higher among the better educated (but also the unemployed) as well as women [1]. Risks were higher among those of greater wealth, while healthcare use was lower among those of lower wealth. NCD risk factors were also found to be higher among those of higher socioeconomic status [2].

Nevertheless, many cases of NCDs are not diagnosed. For example, among nearly 9,000 participants studied, hypertension was undiagnosed in 60% of those fulfilling the criteria for abnormally high blood pressure [3]. Being poor and low levels of education increased the risk of having undiagnosed hypertension.

MULTIMORBIDITY

The COBRA-BPS study has found extremely high levels of cardiometabolic multimorbidity. Out of 2,228 individuals assessed, one in four had two or more cardiometabolic conditions [1]. Specifically for pre-diabetes and diabetes, 53.5% of those analysed had pre-diabetes and 27.7% diabetes (47.4% and 23.1%, respectively, in Bangladesh) [2]. Comorbidity was associated with greater wealth, more education, waist circumference and triglyceride levels. The findings highlight the importance of developing affordable and integrated models of care spanning common co-morbidities.


MENTAL HEALTH

icdrlr researchers have contributed to a systematic review on the prevalence of mental health conditions among people with NCDs in Bangladesh, India and Pakistan [1]. Very high levels of depression were found, ranging from 44% for patients with chronic obstructive pulmonary disease to 38% for those with high blood pressure. The findings emphasise the need to integrate mental health support into the care of people with NCDs.


DEMENTIA BURDEN

Work has begun on a project aiming to provide a clearer picture of the prevalence and impact of dementia in Bangladesh. Although an estimated 14% of the ageing population lives on the Indian sub-continent, very little is known about the prevalence of dementia in the region. Surveys are being undertaken in rural and urban areas to provide an estimate of the prevalence of dementia, risk factors associated with its development and the burden on caregivers.

NCD PREVENTION

A new project is taking advantage of the long-running MINIMat cohort, which has followed participants since birth in 2003/04, to examine cardiometabolic disease risk profiles in adolescents. The project is measuring environmental, nutritional and behavioural risk factors as well as cardiometabolic disease markers, all of which can be linked to early-life data. The project will also explore the potential of new digital technologies for risk factor assessment and health promotion.

CHRONIC KIDNEY DISEASE

An analysis of ten years of laboratory testing data – from more than 200,000 adults – has revealed alarmingly high levels of chronic kidney disease (renal insufficiency). Serum creatinine levels, a marker of kidney filtering function, were above the limit of laboratory reference cut-off for one in three samples; the prevalence of stage 2 to stage 5 renal insufficiency was 24%, 17%, 8% and 6%, respectively. Although renal insufficiency increases with age, 2% of adults younger than 44 years had stage 4 or stage 5 renal insufficiency; women were also at elevated risk of the condition. The findings emphasise the likely major burden of renal insufficiency in Bangladesh and the need for preventive measures given the lack of access to treatments.

Rt Hon Penny Mordaunt, MP (Secretary of State for International Development, UK), Mr Pete Vowles (Director for AsCOTT) and Mr Jim McAlpine (Head of UKaid) visited icddr,b to learn more about the hospitals.

HE Earl R Miller (U.S. Ambassador to Bangladesh, Dhaka), Dr Michael S Friedman (Country Director, CDC Bangladesh Office), and Ms Stephanie Doan (Deputy Country Director, CDC Bangladesh Office) met with icddr,b’s senior leaders.

Dr Teresa Soop (Senior Research Advisor – Health, Sida, Stockholm) at icddr,b’s field research site in Cox’s Bazar.
Mr Derrick S Brown (Mission Director, USAID Bangladesh), Mr Joseph Monehin (Director - A, OPHNE, USAID Bangladesh), Mr Fida Mehran (Newborn Health Specialist, OPHNE, USAID Bangladesh) and Ms Dorothy Dixon (Communications, OPHNE, USAID Bangladesh) visited icddr,b’s Matlab Hospital.

HE Mrs Arunrung Phothong Humphreys (Ambassador, The Royal Thai Embassy of Bangladesh) and her delegation team visited icddr,b’s hospital and laboratory facilities.

Mr Tomoo Hozumi (Country Representative, UNICEF Bangladesh), Ms Veera Mendonca (Deputy Representative, UNICEF Bangladesh) and a delegation from UNICEF Bangladesh visited icddr,b’s Dhaka Hospital.

Ms Pia Engstrand (Senior Advisor, SRHR, Sida, Stockholm) and Dr Zahirul Islam (Programme Officer - Health, Sida, Dhaka) visited icddr,b’s Dhaka Hospital.

Ms Sunghee Cho (Program Manager, KOICA HQ) and Ms El Eunyoung Lee, icddr,b Representative, East Asia visited icddr,b’s laboratory facilities.
Complementing Science

Demonstrating excellence of service with improved governance has been the key achievement of the support departments under the Central Management Services (CMS) Division in 2019. Continuous improvement in supporting science and research has had an impact on sustainable development of the functions and processes performed by an efficient team of dedicated colleagues. Introducing and implementing new and revised policies and procedures have strengthened accountability and transparency of our functions, progress recognised by our donors, collaborators, partners and government institutions.

Deputy Executive Director, Mr Syed Monjurul Islam, has been providing excellent leadership in the CMS division, creating a progressive environment to build capacity of people and utilising resources optimally to support icddr,b’s operations. The innovative work of our scientists and researchers has been supported by CMS, with high-quality administrative services ensuring compliance as well as effective and efficient service delivery.

In 2019, icddr,b has made substantive improvement in operations by re-engineering of our business processes, cost-effective systems, and excellence in service delivery towards our stakeholders; automation; donor and audit compliance; improving organisational policies; bringing in new technology; optimum use of valuable resources; introducing four effective ‘go green’ initiatives; creating awareness and practising the values; ensuring recognition for our research and innovations; increasing our partnership with the Government of Bangladesh, international donors and collaborators; and raising icddr,b’s national and global profile through recognition and acknowledgment of our commendable work for the community.

For the first time in icddr,b’s history, the implementation of an employee attendance and timesheet management system for all staff took place in 2019 – a great achievement, and one long requested by our core donors. With the upcoming implementation of Enterprise Resource Planning (ERP) system, CMS will be able to automate business processes and provide the highest level of support to our research and science, keeping icddr,b in a most advantageous position as the world’s largest diarrhoeal disease treatment facility.
DEVELOPMENT AND COMMUNICATIONS

The Development Unit has overseen continued positive engagement with icddr,b’s core donors (the UK Department for International Development (DFID), Global Affairs Canada (GAC), the Swedish International Development and Cooperation Agency (Sida) and the Government of Bangladesh), as well as the US Government. A new director was appointed in 2019, who successfully merged the Development and Communications Units to move forward as a single department.

An impressive array of visitors in 2019 included representatives from DFID, GAC, the Royal Thai Embassy, Dhaka, Sida, the British High Commission, Dhaka, and UNICEF Bangladesh. Particularly noteworthy were the visits by UK Secretary of State for International Development, Penny Mordaunt, and by the newly arrived US Ambassador, Earl Miller. In addition, USAID Bangladesh’s Mission Director, Derrick S Brown, visited icddr,b’s Matlab field site.

The Government of Bangladesh provided unrestricted funding and has continued to provide increasing funding for ongoing construction projects, including bilateral funding for research.

The Prince Mahidol Award Ceremony has led to the cultivation of icddr,b’s close relationship with the Prince Mahidol Foundation and with the Government of the Kingdom of Thailand. A reception was held by the Thai Ambassador to Bangladesh celebrating our win of the Prince Mahidol Award. The arrival of Prince Mahidol Foundation scholars at icddr,b further strengthened our relations with the Foundation and the Government of the Kingdom of Thailand.

We continued to maintain successful coverage in national and international media with over 700 news reports, which include reports in Der Spiegel, The Daily Telegraph, BBC, The Washington Post, Pacific Standard and Project Syndicate. In addition, articles were also published on icddr,b’s website, blogs and with our advocacy partners, such as Defeat DD and Devex.

Work continued on a revamped icddr,b corporate brochure, and videos were produced for International Nurses Day and World Pneumonia Day. Social and digital media content was viewed around 2.5 million times, and over 160,000 new followers were gained. Media, content and editorial support was provided for the 1st Scientific Congress on Noncommunicable Diseases and the Community Health Workers Symposium.

The new intranet (Shetu) was launched with added features, and communications played a significant role in implementing the employee attendance and time management system in icddr,b. The ‘go paperless’ initiative created a positive impact within the organisation and coverage of events by our in-house creative team throughout the year made great visual impact on all stakeholders.

FINANCE

2019 has been a relatively successful year both in terms of growth in funding, moving from an approved annual budget of USD 55.3 million to USD 69.5 million by 31 December 2019 and, generating a healthy surplus of USD 558k.

We also achieved a successful unqualified audit report for 2019. Finance has continued to manage icddr,b resources effectively and efficiently and undertaking the acquisition of a new ERP integrated system with implementation expected to take two years, going live in 2022.

Full cost recovery targets have been achieved, but we continue to appreciate support from donors which represents a significant contribution towards meeting our central management costs. Achieving 100% overhead funding entirely from projects remains a challenge as, some donors will not approve our official overhead and generally provide between 10 to 15% overhead rates, leaving a shortfall. Developing a wider portfolio of donor sources, supporting laboratory income generation, hospital appeal funds, negotiating tariffs and appropriate allocation of costs to the projects, that are acceptable to all donors, should help icddr,b to be more sustainable in the future.
SUPPLY CHAIN AND FACILITIES MANAGEMENT

Supply Chain and Facilities Management (SCFM) is a dynamic department, which supports core business functions by creating an effective and efficient operating environment for clients, occupants and visitors. This is achieved at the same time as maintaining interactions with external parties such as facilities management consultants, contractors, suppliers and service providers.

Strategically, SCFM has achieved a reduction in icddr,b’s carbon footprint through the installation of a central heating, ventilation and air-condition system, solar power panels, replacement of fluorescent and incandescent lighting system by LED lighting, and installation of motion sensors to become more energy efficient. In addition, arrangements have been made with local vendors to recycle plastic waste from icddr,b.

Operationally, SCFM has undertaken dedicated activities to obtain a fire licence from the Bangladesh Fire Service and Civil Defence. A set of standard operating procedures on fire and safety has been implemented. A fire protection system and detection system has also been put in place. Regular fire/mock drills involving Fire Service and Civil Defence and bi-monthly training for supervisors on firefighting equipment were provided.

As a part of the commitment to safety, the improvement of security infrastructure has been achieved through a boundary wall, installation of safe rooms, gates, barriers, security lights on the periphery wall and grills of the icddr,b campus. Facility upgrades were achieved in the intensive care unit and other areas of the hospital.

From a supply chain perspective, the manual has been updated and, as a result of increased compliance, monitoring and more effective supplier negotiation, a saving of 14% of the total yearly purchase budget has been achieved in 2019. In addition, stock inventory has been reduced by 18% through the implementation of departmental demand forecast planning and just in-time deliveries. Strategic procurement services have been enhanced to secure best value through 138 long-term agreements.

SCFM supported effective patient care by working with suppliers to guarantee an uninterrupted supply of test kits and vaccine supplies during all major outbreaks, including dengue fever and cholera outbreaks in the forcibly displaced Myanmar national camps. The efficiency of the department has improved, with a reduction in lead time from purchase request to purchase order from 30 to 13 days.

HUMAN RESOURCES

Attracting, sourcing and managing talent is one of the Human Resources (HR) department’s core and primary responsibilities. This is vital to support icddr,b’s mission and programmes. 2019 was a challenging and positive year for the department. Recruitment was completed for 148 fixed-term positions, with an average time of 23 days to recruit each position. In addition, HR processed 796 Contractual Service Agreements, 1,370 on Daily Wager contracts and 42 Fellows positions, for a total recruitment of 2,356 positions in 2019.

Notable progress was made in the area of populating talent pools through a number of generic vacancy announcements, for research and non-research divisions. This resulted in strengthening of these pools, providing 1,251 additional individuals and enriching the talent pool for future openings.

The Talent Rewards team received 24 requests, a 24% increase over 2018, with an average time to classify a post in 15 days. For individual consultants, HR received 26 requests. To make the hiring process competitive, HR created a reserve list, with 1,072 consultants showing interest in 14 specialised areas.

Key to successful management of the HR function is effective policy development and administrative compliance. This is focused on managing the risks associated with the HR function. HR efforts have concentrated on updating and simplifying policies and processes, which were reviewed and streamlined in 2019. In addition, HR has delivered awareness sessions on Protection of Sexual Exploitation and Abuse and Unconscious Bias.

The HR department will continue a series of transformation initiatives, to establish a more strategic HR function across the organisation. HR consists of a team of committed staff. We remind ourselves that icddr,b is its staff – people who are passionate about its mission to solve public health problems through innovative scientific research.
RESEARCH ADMINISTRATION

Research Administration is the information repository of all existing and ongoing research and potential new funding opportunities for icddr,b. In 2019, after inclusion of the Library, this unit has become the 'knowledge/information hub' for the organisation.

Research Administration plays a pivotal role in reviewing research proposals, grant applications and exploring research funding opportunities. As in 2018, steady progress has been observed in 2019 in terms of new grants and new research protocols. In comparison to the previous year, the number of ongoing research grants and protocols has increased by 5% and 3%, respectively, in 2019. In 2019, more than 500 new funding opportunity announcements were circulated. The success rate of proposals submitted through the unit during the period Q3 2018 – Q3 2019 was 17%. The unit also coordinated the capacity development grant for young researchers funded by one of icddr,b's core donors, Sida, and 10 promising young researchers obtained support through a rigorous peer-review process.

INFORMATION TECHNOLOGY

In 2019, the Information Technology (IT) department focused on effectiveness, efficiency and sustainability. More than 94% of IT projects were completed on time and within budget. IT implemented automated solutions for 33 organisational business processes. Notable software developments and accomplishments in 2019 included a revamp of the organisational intranet (Shetu), scientific ranking in HRIS, online data management software applications, web portals for various projects, and development of campaign management for the icddr,b website.

Implementation of the Software Defined Data Centre is a milestone towards cost-effectiveness and efficiency in IT infrastructure. The department has built a data centre in which all infrastructure is virtualised and delivered as a service. Virtualisation includes servers, network and storage. Holistically, control of data centre infrastructure is automated by an intelligent software system. Progress has also been made on the new ERP sourcing process.

Information security was enhanced by introduction of a web application firewall and boarded intelligent next-generation end-point security, including server and network security. User awareness training continued as best practice. A rigorous three-layer backup process has been introduced for disaster recovery.

REGULATORY AND LEGAL AFFAIRS

The Regulatory and Legal Affairs (R&LA) department processed 787 legal documents in 2019, a 10% increase from 2018, and the timeline for contract review has been reduced with the recommendations from all divisions. For the first time in icddr,b’s history, an intellectual property rights policy was introduced successfully by R&LA, with the Board of Trustees’ approval. In addition, R&LA has also contributed towards drafting and introducing other important organisational policies, including a safeguarding policy.

Throughout 2019, R&LA carried out intellectual property capacity development programmes, including seminars and training for icddr,b staff, which were facilitated by national and international governmental officials and keynote speakers. R&LA is also advising and facilitating icddr,b scientists and researchers on intellectual property rights registration applications. For the first time in icddr,b, one application for patent registration and one for copyright registration have been filed, and three patent applications are in the pipeline.

The Institutional Governance Framework (IGF) was updated to version 1.7 with the initiative of R&LA in 2019. Important modifications include bringing it into line with the Strategic Plan 2019–2022 and updating the organisational structure. Under the guidance of icddr,b’s Executive Director and Deputy Executive Director, and in collaboration with investor, R&LA has registered a new venture, ‘Bangladesh Clinical Trials Limited’, a joint-venture company that will operate as a Clinical Research Organisation (CRO). In the long run, it is hoped that this entity will generate surplus and help icddr,b to become self-sustaining.

R&LA has represented icddr,b in various crucial hearings at different administrative trials and advised on high-value international procurements. Issues with governmental offices have been resolved with R&LA’s initiative under the guidance of icddr,b’s Deputy Executive Director.
In 2019, icddr,b researchers were authors on 426 original publications – a 16% increase over 2018 – and also contributed to 85 letters, editorials, book reviews and abstracts. These included outputs in leading journals, such as the *New England Journal of Medicine*, the *Lancet*, *Lancet Global Health*, *Lancet Infectious Diseases*, *PLoS Medicine*, *PLoS Neglected Tropical Diseases* and *Vaccine*. The majority of papers were co-authored with national and international colleagues. icddr,b researchers also contributed opinion pieces to leading journals such as the *Journal of the American Medical Association*.

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 information to scientific, practitioner, policy and programme communities.
CITATIONS I: ALL PAPERS

- Original Papers: 426
- Reports/Monographs: 6
- Book Chapters: 7
- Abstracts in Conference Proceedings: 21
- Letters, Editorials, etc.: 85

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CITATIONS II: PAPERS IN HIGH-IMPACT JOURNALS

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Collaborations are central to our work. We work with multiple government, academic and NGO partners in Bangladesh, ensuring a strong focus on local health issues, and have long-standing ties with scientific collaborators in leading research institutions across the world. We are also members of a range of regional networks, and work closely with partners across South Asia and in the global South.
• Obstetrical and Gynaecological Society of Bangladesh
• Patuakhali Science and Technology University
• R&M General Hospital
• Rajshahi Medical College and Hospital
• Salvation Army, Bangladesh
• Save the Children, Bangladesh
• Shaheed Suhrawardy Medical College
• Shimantik
• Sir Salimullah Medical College and Hospital
• Society for the Welfare of Autistic Children
• Sunamganj 250 bed District Sadar Hospital
• UChicago Research Bangladesh, Bangladesh
• United Nations Children's Fund (UNICEF), Bangladesh
• United Nations Population Fund (UNFPA), Bangladesh
• University of Dhaka
• Urban Primary Health Care Project
• World Vision Bangladesh

AFRICA
• Armauer Hansen Research Institute, Ethiopia
• Chris Baragwanath Hospital, South Africa
• INDEPTH Network, Ghana
• KEMRI-Wellcome Trust Research Programme, Kenya
• Makerere University, Uganda
• South African Medical Research Council, South Africa
• University of Global Health Equity, Rwanda

AUSTRALIA
• Central Queensland University
• Griffith University
• Menzies School of Health Research
• Royal Children’s Hospital
• University of Melbourne
• University of New South Wales
• University of Queensland
• University of Sydney
• University of Technology Sydney
• Western Sydney University

NORTH AMERICA
• Albany Medical College, USA
• Binghamton University, USA
• Boston Children’s Hospital, USA
• Boston University School of Public Health, USA
• British Columbia Centre for Disease Control, Canada
• Brown University, USA
• Centers for Disease Control and Prevention, USA
• Children’s Hospital Medical Centre, USA
• Children’s Hospital Oakland Research Institute, USA
• Children’s Hospital of Richmond at VCU, USA
• Columbia University, USA
• Consortium for Conservation Medicine, USA
• Duke Global Health Institute, Duke University, USA
• EcoHealth Alliance, USA
• Emory University, USA
• Evolve BioSystems, Inc., USA
• Gynuity Health Projects, USA
• Harvard Kennedy School, USA
• Harvard Medical School, USA
• Hospital for Sick Children, Canada
• Infectious Disease Research Institute, USA
• Johns Hopkins Bloomberg School of Public Health, USA
• Johns Hopkins University School of Medicine, USA
• Massachusetts General Hospital, USA
• National Academy of Sciences, USA
• National Institute of Allergy and Infectious Diseases, USA
• Nationwide Children’s Hospital, USA
• Northwestern University, USA
• Novavax, Inc., USA
• Nutrition International, Canada
• PATH Vaccine Solutions, USA
• PATH, USA
• Pennsylvania State University, USA
• PREVENT, USA
• Pure Earth, USA
• Rollins School of Public Health, USA
• RTI International, USA
• St Michael’s Hospital, Canada
• Salu Design, Canada
• Stanford University, USA
• TechLab Inc., USA
• Tufts University School of Medicine, USA
• United States Agency for International Development, USA
• United States Department of Agriculture, USA
• University of Alberta, Canada
• University of Arkansas Medical School, USA
• University of British Columbia, Canada
• University at Buffalo, USA
• University of Calgary, Canada
• University of California, Berkeley, USA
• University of California, Davis, USA
• University of California, Los Angeles, USA
• University of California, San Diego, USA
• University of Central Florida, USA
• University of Chicago, USA
• University of Colorado, USA
• University of Florida, USA
• University of Georgia College of Veterinary Medicine, USA
• University of Maryland School of Medicine, USA
• University of Maryland, USA
• University of North Carolina, USA
• University of Notre Dame, USA
• University of Pennsylvania, USA
• University of Saskatchewan, Canada
• University of Southern California, USA
• University of Texas at Galveston, USA
• University of Texas Health Sciences Center, USA
• University of Toronto, Canada
• University of Utah, USA
• University of Vermont, USA
• University of Virginia Health System, USA
• University of Virginia, USA
• University of Washington, USA
• Vanderbilt University, USA
• Virginia Commonwealth University, USA
• Walter Reed Army Institute of Research, USA
• Warren Alpert Medical School of Brown University, USA
• Washington State University, USA
• Washington University School of Medicine, USA
• Washington University, USA
• Western Human Nutrition Research Center, USA
• London School of Hygiene and Tropical Medicine, UK
• Loughborough University, UK
• Max Planck Institute for Evolutionary Anthropology, Germany
• Ministry for Social Affairs and Health, Finland
• Nestlé Research Center, Switzerland
• Nestlé Nutrition, Switzerland
• Norwegian Institute of Public Health, Norway
• Norwegian University of Science and Technology, Norway
• Örebro University Hospital, Sweden
• REGA Institute, Belgium
• Sahlgrenska Academy of University of Gothenburg, Sweden
• Sheffield Hallam University, UK
• Stockholm University, Sweden
• Swiss TPH, Switzerland
• Umea University, Sweden
• University of Aberdeen, UK
• University of Basel, Switzerland
• University of Bath, UK
• University of Bergen, Norway
• University of Bristol, UK
• University of Cambridge, UK
• University College London, UK
• University of Copenhagen, Denmark
• University of Durham, UK
• University of Edinburgh, UK
• University of Glasgow, UK
• University of Gothenburg, Sweden
• University of Heidelberg, Germany
• University of Oxford, UK
• University of Sheffield, UK
• University of Southampton, UK
• University of St Andrews, UK
• University of Stirling, UK
• University of Warwick, UK
• University of York, UK
• Uppsala University, Sweden
• World Health Organization, Switzerland

**EUROPE**

- Antoni van Leeuwenhoek Hospital/the Netherlands Cancer Institute, The Netherlands
- Bangor University, UK
- Bilthoven Biologicals, The Netherlands
- Children’s Investment Fund Foundation, UK
- Drugs for Neglected Diseases initiative, Switzerland
- Eawag, Switzerland
- Erasmus MC University Medical Centre, Rotterdam, The Netherlands
- European Molecular Biology Laboratory, Germany
- European Vaccine Initiative, Germany
- EvelQure Biotechnologies GmbH, Austria
- Fondation Mérieux, France
- Georg-August-Universität Gottingen, Germany
- Imperial College London, UK
- Institut Pasteur, France
- Institute of Development Studies, UK
- Institute of Tropical Medicine, Belgium
- International Atomic Energy Agency, Austria
- KalaCORE Program, UK
- Karolinska Institute, Sweden
- King’s College London, UK
- KU Leuven, Belgium
- Laboratorio de Referencia de Leishmaniasis, Spain
- Liverpool School of Tropical Medicine, UK

**OTHER ASIA**

- AXIS Clinicals Ltd, India
- Banaras Hindu University, India
- Centre for Development Studies, India
- Chinese Center for Disease Control and Prevention, China
- Christian Medical College, Vellore, India
- Clinogen, India
- Duke-NUS Graduate Medical School Singapore, Singapore
- Greentech Knowledge Solutions Pvt Ltd, India
- Hiroshima University, Japan
- Institute for Human Development, India
- Institute of Social and Economic Change, India
- Interactive Research and Development, Pakistan
- International Food Policy Research Institute, India
- International Vaccine Institute, South Korea
- Kagawa University, Japan
- Mahidol University, Thailand
- Matsutani Chemical Industry Co. Ltd, Japan
- Ministry of Health and Welfare, Government of South Korea
- Myanmar Ministry of Health and Sports
- National Institute of Infectious Diseases, Japan
- Nay Pyi Taw, Myanmar,
- Postgraduate Institute of Medical Education and Research, India
- Rajendra Memorial Research Institute, India
- Serum Institute of India Ltd, India
- Sinovac Biotech Co, China
- SK Bioscience, South Korea
- See Chitra Tirunal Institute for Medical Science and Technology, India
- Tokyo-Kasei University, Japan
- University of Tokyo, Japan
- University of Tsukuba, Japan
- XIAMEN Innovax BIOTECH CO. Ltd, China
icddr,b WINS GLOBVAC AWARD FOR RESEARCH

icddr,b has once again received the Global Health and Vaccination Award (GLOBVAC) to conduct research on the influenza vaccine among pregnant women and children. The research will focus on the overall effectiveness of influenza vaccination in reducing acute respiratory infections due to laboratory-confirmed influenza in pregnant women and children under-five. Dr K Zaman from the Infectious Disease Division will lead this research at the Matlab Surveillance Site.

DR FIRDAUSI QADRI
Senior Scientist Dr Firdausi Qadri received numerous awards in 2019 including the Kazi Mahbubullah Award 2018 for her contribution in vaccines and research on diarrhoeal diseases; 'Joya Alakita Nari 2019' award for her contribution to vaccine development and infectious disease research; and the Global Network of Bangladeshi Biotechnologists Award 2019 in the category of 'Outstanding Bangladeshi scientists working in Bangladesh'.

DR TAHMEED AHMED
Senior Director Dr Tahmeed Ahmed has been selected as an Honorary International Fellow of ASTMH for 2019. He attended the Opening Plenary session in 2019’s Annual Meeting of ASTMH for this accomplishment.
**DR SHAHANA PARVEEN**

Assistant Scientist Dr Shahana Parveen has been selected as “SHEA International Ambassador 2019” by the Society for Healthcare Epidemiology of America, Arlington, VA. This prestigious award has been conferred in recognition of her commitment to advancing healthcare epidemiology, infection prevention, and the goals of SHEA in Bangladesh.

**LUTFE ARA**

The Association for Professionals in Infection Control and Epidemiology (APIC) selected Lutfe Ara, (Head, Clinical Governance and Systems, Hospital) as the recipient of the APIC/AJCIC Implementation Science Award 2019. This award is presented each year for implementing a research, which is innovative, employs sound methodology, and represents a potentially significant contribution to the principles and practices of infection prevention.

**DR K ZAMAN**

Dr K Zaman, scientist won the 2019 Charles C. Shepard Science Award for the second time for the very impactful article published on polio research in the Lancet Infectious Diseases, 2018. The award recognises scientific achievement and Dr Zaman led different polio vaccine studies in collaboration with CDC scientists as a part of developing Polio Endgame strategy.

**DR KARIM**

Dr Karim, scientist won the 2019 Charles C. Shepard Science Award for the second time for the very impactful article published on polio research in the Lancet Infectious Diseases, 2018. The award recognises scientific achievement and Dr Karim led different polio vaccine studies in collaboration with CDC scientists as a part of developing Polio Endgame strategy.

**DR HARUN**

Dr Harun, scientist won the 2019 Charles C. Shepard Science Award for the second time for the very impactful article published on polio research in the Lancet Infectious Diseases, 2018. The award recognises scientific achievement and Dr Harun led different polio vaccine studies in collaboration with CDC scientists as a part of developing Polio Endgame strategy.

**DR SHARFUL ISLAM KHAN**

Dr Shariful Islam Khan (Head of the Programme for HIV and AIDS, icddr,b) has been selected as the Vice President of the AIDS Society of Asia and the Pacific (ASAP). The ASAP is a professional body comprising experts and organisations from the Asia-Pacific region.

**DR FATEMA KHATUN**

Associate Scientist Dr Fatema Khatun was awarded under Grand Challenges Explorations of the Bill and Melinda Gates Foundation for the project titled ’Using Birth Registry Data to Increase Timely Vaccination’. She also received first prize in the poster competition at the Global Health Norway Conference. The title of the poster was, ‘Evaluation of palm-based biometric identification among women in rural Bangladesh’.

**WINNERS OF SIDA’S YOUNG RESEARCHER GRANT FOR 2019-2020**

We proudly reveal the ten winners of SIDA’s Young Researcher Grant 2019-2020!

A total of 10 projects have been selected of which 40% projects are led by female researchers.

**DR NISHAT SARKER**

**NURUN NAHAR NAILA**

**MANSURA KHANAM**

**DIPIKA SHANKAR BATTACHARYYA**

**DR SYED MOHAMMAD MAZIDUR RAHMAN**

**MD. MONJUR RAHMAN**

**ISRAT JAHAN**

**MASUD PARVEZ**

**MD. ANIK ASHFAQ KHAN**

**SARKER**
icddr,b offers a rich learning environment for the next generation of researchers, clinicians and practitioners. Participants in training programmes have 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 2019, aligned with icddr,b’s strategic goals, the Technical Training Unit (TTU) has played a vital role in development of early-career and mid-level icddr,b researchers. It also helped to disseminate icddr,b’s expertise and experience acquired through research and other programmes to external stakeholders to increase the visibility and impact of our work.

The TTU offered flagship training courses, and developed new training and programmes such as Spatial Analysis for Public Health Decision Making, Certificate Course on Chronic Obstructive Pulmonary Disease (COPD) for Primary Care Physicians (blended and conventional) and Training on Pulmonary Function Assessment by Spirometry, Training on Clinical Management on Dengue Syndrome and Ultrasonogram Training on Obstetrics and Gynaecology in collaboration with both internal and external partners. In total, the TTU attracted 1,894 participants – 870 male and 1,024 female, 1,554 from Bangladesh and 340 from outside – from 20 countries who attended training, field experience and academic activities at icddr,b. Participants included researchers, public health professionals, clinicians, trainers, interns, fellows, and medical, public health and allied students from 70 national and international institutes, universities and other organisations (public and private).

Internally, one notable achievement was the building of institutional capacity through the training of 170 early-career and mid-level icddr,b scientific staff (53% female) on various aspects of scientific practice, including results-based management and Good Clinical Practice, with Sida support.

Externally, the TTU also brought in external funding by maintaining partnerships and collaboration with key stakeholders, including the Government of Bangladesh, NGOs, universities and donors, activities that will eventually help to develop health system capacity.
Countries represented by students attending icddr,b training courses, and field experience and orientation programmes:

FIELD EXPERIENCE AND ORIENTATION PROGRAMMES

Orientation: Bangladesh, Canada, India, Nepal, South Africa

Field experience: Australia, Canada, India, South Korea, Malaysia, The Netherlands, Sweden, UK, USA

TECHNICAL TRAINING COURSES

Bangladesh, Germany, Greece, Italy, Japan, The Netherlands, Norway, Somalia, Sudan, Spain, Sweden, UK

Technical Training Unit

Field experience programme
Aimed at master's and PhD students seeking practical insights into, and experience of, public health in a low-resource setting

197 students hosted:
152 national, 45 international

Orientation programme
Tailored to meet specific curricular needs, primarily for medical students interested in research and humanitarian activities

13 academic training events, 9 institutes
894 students hosted:
635 national, 259 international
Our hospitals in Dhaka and Matlab provide free care to those in need, and provide a basis for an extensive programme of clinical research and training.

For decades, as part of our ‘social contract’ with the communities with whom we work, we have provided high-quality clinical care through our hospitals in Dhaka and Matlab and at the Mirpur Treatment Centre. In 2019, our clinicians treated more than 283,000 patients, principally at the Dhaka Hospital – a 17% increase over 2018 and 80,000 more than in 2016. More than half of these patients were infants under five years of age. These activities save an estimated 80,000 lives a year.

Being intimately involved in the delivery of care ensures that our clinical researchers have a deep understanding of the key health issues facing local populations, and identify appropriate interventions with the potential to be implemented locally or in similar facilities if shown to be effective. The hospitals train doctors and nurses in clinical care, and provide a platform for them to take part in clinical research. Our clinical facilities also provide a showcase of what can be achieved in a resource-constrained environment in a low-income country.

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

We also offer paid-for clinical laboratory testing services, including X-ray, ultrasonography and gastrointestinal endoscopy, the income from which supports provision of care in our hospitals.

Every year, it costs USD 5 million to run our hospitals under normal conditions, with funds largely derived from our own resources. The impact of COVID-19 is such that our income is being reprogrammed towards our activities to support the government’s efforts to respond to COVID-19. Thus, our COVID-19 Appeal (http://covid19.icddrb.org/) is intended to raise funds to cover the cost of our hospitals. Donations help to support the doctors, nurses, support staff, in-patient and out-patient wards, intensive care unit and nutrition rehabilitation unit during this critical time.

Internationally, we provide advice to low-income countries on the set up of health facilities and also contribute to international disease control efforts in crisis situations – for example in fragile settings such as Yemen, Syria, Iraq and Somalia. In recent years, our efforts have been focused on humanitarian emergencies within Bangladesh, particularly protecting the health of forcibly displaced Myanmar nationals around Cox’s Bazar, possibly the world’s largest refugee settlement.
DHAKA HOSPITAL

- Total patients: 194,838
  - By gender: 57.4% male, 42.6% female
  - By age: 57.2% <5 years, 42.8% >5 years

MATLAB HOSPITAL

- Total patients: 68,177
  - By gender: 43.7% male, 56.3% female
  - By age: 55.4% <5 years, 44.6% >5 years

MIRPUR TREATMENT CENTRE

- Total patients: 20,536
  - By gender: 55% male, 45% female
  - By age: 40% <5 years, 60% >5 years
The Laboratory Sciences and Services Division brings together all icddr,b's research laboratories and services arms under one umbrella, providing a strategic framework for the development of laboratory sciences and services.

As well as its flagship diagnostic laboratories, the Division carries out and supports field-based and clinical research programmes and trials through its laboratory-based activities and platforms. In addition to providing essential laboratory support for projects and outbreak investigations within Bangladesh and abroad, the Division also carries out pioneering research in the areas of bacterial genetics and evolution, pathogen survival mechanisms, molecular epidemiology and diagnostic development.

All the service facilities of the Division are 100% self-sustaining and generate surplus revenues to cover operational expenses of the division and to support icddr,b’s humanitarian projects.

The Laboratory Sciences and Services Division provides diagnostic and other laboratory services to icddr,b and external clients, and contributes to icddr,b research in microbial genetics and genomics.

Dr Niyaz Ahmed
Senior Director

FORCIBLY DISPLACED MYANMAR NATIONALS

The Division has carried out important work on contamination of water supplies to forcibly displaced Myanmar nationals (see page 10).

MYCOBACTERIUM TUBERCULOSIS SURVIVAL

The Mycobacterium tuberculosis (MtB) Rv2004c protein, encoded within the DosR regulon, has been found to contribute to streptomycin resistance and survival in macrophages [1]. The DosR regulon is a suite of genes activated when MtB invades cells. E. coli expressing Rv2004c were less susceptible to streptomycin, while the MtB model organism, M. smegmatis, showed enhanced survival in macrophages when overexpressing Rv2004c.

ANTIMICROBIAL RESISTANCE

The Division is playing a key role in icddr,b’s programme of work on antimicrobial resistance (see page 13). Work has also recently been completed on a project exploring airborne transmission of resistant organisms [1]. The presence of key antibiotic-resistant bacteria is being analysed in air samples from urban residential areas and live bird markets, as well as rural households and poultry farms. Airborne particles could be an important route of transmission of antibiotic resistance, but very little is currently known about their significance.

Metagenomic work has recently been completed on surface water and sediment samples from urban and rural sites. Resistant bacteria were much more common at urban sites. The levels of gut bacteria were also higher in urban sites, suggesting that faecal contamination of urban surface water is making the greatest contribution to the presence of antibiotic genes in the environment.

Work has also begun on an antimicrobial resistance surveillance project based on whole genome sequencing. Systematically selected isolates are being sequenced to provide insight into mechanisms of resistance in key disease-causing microorganisms. The data will also be used in phylogenetic studies to explore routes of transmission in hospital and community settings.

In addition, a study has been launched to map the transmission of multidrug-resistant \textit{E. coli}, responsible for a large proportion of urinary tract infections (UTIs). Uropathogenic \textit{E. coli} also causes infections in poultry, raising the risk of foodborne transmission of disease. The project will track the transmission dynamics of uropathogenic \textit{E. coli} in Dhaka, to assess the spread of strains in community settings.

During 2019, the laboratory sciences and services platform was optimised for one-health and global antimicrobial surveillance. The Division is now set up to carry out genomic and metagenomic analyses using the latest technology.

GUILLAIN–BARRÉ SYNDROME

Two recent studies have explored genetic susceptibility to Guillain–Barré syndrome (GBS), a potential fatal autoimmune reaction often triggered by infection with \textit{Campylobacter jejuni}. Studies on one of the largest cohorts of patients in a low-income country found no association with HLA-DQB1, the most highly polymorphic immune response gene [1]. However, an allele of the Toll-like receptor-4 gene was associated with increased risk of disease (but not disease severity) [2].

Work has also recently been completed on a phase I study of a potential treatment for GBS, the humanised monoclonal antibody ANX005. ANX005 was found to be safe and well-tolerated, paving the way to a phase II study.

Our staff of over 4,000 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 and are accountable to the Board of Trustees.

**SENIOR LEADERSHIP TEAM**

*As of October 2019*

- **Professor John D Clemens**  
  Executive Director

- **Mr Syed Monjurul Islam**  
  Deputy Executive Director

- **Dr Shams El Arifeen**  
  Senior Director, Maternal and Child Health Division

- **Dr Tahmeed Ahmed**  
  Senior Director, Nutrition and Clinical Services Division

- **Professor Daniel Reidpath**  
  Senior Director, Health Systems and Population Studies Division

- **Professor Allen G Ross**  
  Senior Director, Infectious Diseases Division
OBSERVERS

Mr Nagarajan Nagarajan  
Director, Internal Oversight

Khaja Salauddin Ahmed  
Head, Regulatory and Legal Affairs

SECRETARIAT

Ms Loretta Saldanha  
Executive Assistant to the Executive Director

OBSEVERNS
icddr,b’s Board of Trustees comprises 16 health professionals and researchers representing both developed and developing countries.

The Board was created by an Ordinance of the Government of the People’s Republic of Bangladesh. Three members are nominated by the People’s Republic of the Government of Bangladesh, with the WHO and UNICEF nominating one member each. icddr,b’s Executive Director serves as the Member Secretary.

The Board operates under the icddr,b Ordinance and the accompanying Board of Trustees Bylaws. The Board of Trustees’ roles and responsibilities include fund oversight; approving and monitoring the budget; setting broad institution-wide policies; monitoring adherence to the Strategic Plan; employing, evaluating and supporting the Executive Director; maintaining the line between governance and management; and evaluating the Board’s own performance.

Chair:

Professor Maxine Anne Whittaker
Dean, College of Public Health, Medical and Veterinary Sciences and Deputy Director of the Australian Institute of Tropical Health and Medicine, James Cook University, Australia

Member Secretary:

Professor John D Clemens
Executive Director, icddr,b

Syed Monjurul Islam
Deputy Executive Director, icddr,b (Observer)

REPRESENTING THE GOVERNMENT OF BANGLADESH

Monowar Ahmed
Secretary, Economic Relations Division, Ministry of Finance

Md. Ashadul Islam
Secretary, Health Services Division, Ministry of Health & Family Welfare

Dr Abbas Bhuiya
Former Deputy Executive Director, icddr,b
**REPRESENTING UNICEF**

Dr Therese Dooley  
Senior Adviser (water, sanitation and hygiene), UNICEF Regional Office for South Asia

**REPRESENTING WHO**

Dr Sunil Kumar Bahl  
Team Leader, IVD, Immunization and Vaccine Development, WHO-SEARO, New Delhi, India

**INDEPENDENT MEMBERS**

Professor Abdullah H Baqui  
Professor, Department of International Health  
Director, International Center for Maternal and Newborn Health, Johns Hopkins Bloomberg School of Public Health, USA

Kenneth M Dye  
International Development Consultant on Governance and Accountability  
Former Auditor General of Canada

Dr Anu Kantele  
Professor, Infectious Diseases  
Helsinki University, Finland

Dr Ogutu Bernhards Ragama  
Chief Research Officer, Kenya Medical Research Institute

Dr Sara Bennett  
Professor, International Health (Primary), Health Systems Division, Center for Global Health, John Hopkins University

Nancy Y Cheng  
Assistant Auditor General, Canada

Professor Thein Thein Htay  
Former Deputy Minister for Health  
Senior Public Health Advisor, University Research Co., Myanmar

Dr G B Nair  
Former Director of National Institute of Cholera and Enteric Diseases, India, and the Translational Health Science and Technology Institute, India.

Dr Fred Binka  
Professor of Clinical Epidemiology, University of Health and Allied Sciences, Ho, Ghana
icddr,b’s overall revenue for 2019 amounted to **USD 71.98 million** compared with a total expenditure of USD 71.42 million, generating a net surplus for the year of USD 558k.

**REVENUE**

Our overall revenue for 2019 was USD 71.97m (see breakdown below) represented a decrease of USD 9k compared with 2018. Research grant income for 2019 increased by USD 1 million or 2% compared to 2018. Unrestricted total funding decreased by USD 0.5 million because of a decrease in funding from the Government of Bangladesh (GoB) (USD 246k), DFID (USD 177k) and Sida (USD 580K). However, we did receive extra funding from Global Affairs Canada (GAC) (USD 477k).

**BREAKDOWN OF REVENUES 2019**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restricted grant contributions</td>
<td>51,299,638</td>
<td>71.3%</td>
</tr>
<tr>
<td>Unrestricted grant contributions</td>
<td>8,154,102</td>
<td>11.3%</td>
</tr>
<tr>
<td>Income from laboratories</td>
<td>5,737,606</td>
<td>8.0%</td>
</tr>
<tr>
<td>Deferred income</td>
<td>3,557,194</td>
<td>4.9%</td>
</tr>
<tr>
<td>Other restricted income</td>
<td>961,870</td>
<td>1.3%</td>
</tr>
<tr>
<td>Other unrestricted income</td>
<td>2,137,438</td>
<td>3.0%</td>
</tr>
<tr>
<td>Foreign exchange (loss)</td>
<td>131,406</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

Total revenue **USD 71,979,254 (100%)**
EXPENDITURE

- Total expenditure for 2019 amounted to USD 71.42 million, representing an increase of USD 1.7 million compared to 2018. This was primarily due to the rise in staff salaries.

- The bulk of expenditure (58%) relates to staff salaries and benefits. Other key cost drivers are supplies & materials (11%), collaborative partnership costs (6%), travel & vehicle hire charges (6%), rent, communication & utilities (2.2%) and training, dissemination and staff development (2.2%).

DETAILED EXPENDITURE FOR 2019:

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>National staff</td>
<td>34,596,943</td>
</tr>
<tr>
<td>International staff</td>
<td>5,532,857</td>
</tr>
<tr>
<td>Emeritus staff</td>
<td>1,234,631</td>
</tr>
<tr>
<td>Supplies and materials</td>
<td>7,479,074</td>
</tr>
<tr>
<td>Collaborative partnership costs</td>
<td>4,014,992</td>
</tr>
<tr>
<td>Travel and vehicle hire charges</td>
<td>3,998,157</td>
</tr>
<tr>
<td>Consultancy fees</td>
<td>912,984</td>
</tr>
<tr>
<td>Rent, communication and utilities</td>
<td>1,541,466</td>
</tr>
<tr>
<td>Training, dissemination and staff development</td>
<td>1,598,872</td>
</tr>
<tr>
<td>Other operational costs</td>
<td>10,511,084</td>
</tr>
<tr>
<td><strong>Overall expenditure</strong></td>
<td><strong>71,421,060</strong></td>
</tr>
</tbody>
</table>

OTHER KEY FINANCIAL STATISTICS FOR 2019

1. At the end of the year, icddr,b had USD 69.3m in net assets.
2. Cash and cash equivalents amounted to USD 37m at the end of the year.
3. Accounts receivables (debtor) decreased by 5% as a result of increased collection from donors through rigorous monitoring and follow up.
4. Accounts payable increased by 36% overall. Vendor payable increase by 20% mainly due to increased procurement activities towards end of the year. Tax liabilities increased by 14% due to increased procurement activities.
5. Provisions increased by 17% primarily due to making provisions for project supplies, project staff costs and partially doubtful debts.
6. The current ratio (liquidity) is 1.20 which is almost same as 2018.
7. Stock inventories have increased by 10%. In terms of volume, there was a marginal increase in inventories.
8. Investments increased by 19% due to increase in Hospital and Centre endowment funds.
9. Loans and advances increased by 16% due to advance to suppliers, advances to sub-awardees as the project related activities increased, medical advances and advances against salaries.
10. The workforce decreased from 3,536 in 2018 to 3,378 in 2019 or (4.5%). The total number of scientific staff at the end of the year was 143.
11. 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) is 25%; this figure includes central management and administrative costs.

icddr,b received an unqualified (healthy) audit opinion from ACNABIN chartered accountants in respect of its financial statements for 2019.

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

### TOP 10 DONORS DURING 2019

<table>
<thead>
<tr>
<th>Donor partners</th>
<th>Restricted ('000 USD)</th>
<th>Unrestricted ('000 USD)</th>
<th>Total ('000 USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Bill &amp; Melinda Gates Foundation</td>
<td>15,721</td>
<td>15,721</td>
<td></td>
</tr>
<tr>
<td>2  US Government – United States Agency for International Development (USAID)</td>
<td>6,530</td>
<td>6,530</td>
<td></td>
</tr>
<tr>
<td>3  UK Government – Department for International Development (DFID)</td>
<td>1,465</td>
<td>3,065</td>
<td>4,530</td>
</tr>
<tr>
<td>4  US Government – Centers for Disease Control and Prevention (CDC)</td>
<td>4,201</td>
<td>4,201</td>
<td></td>
</tr>
<tr>
<td>5  Global Fund to Fight AIDS, Tuberculosis and Malaria</td>
<td>3,053</td>
<td>3,053</td>
<td></td>
</tr>
<tr>
<td>6  Global Affairs Canada</td>
<td>47</td>
<td>2,256</td>
<td>2,803</td>
</tr>
<tr>
<td>7  United Nations Development Group</td>
<td>2,722</td>
<td>2,722</td>
<td></td>
</tr>
<tr>
<td>8  US Government – National Institutes of Health (NIH)</td>
<td>2,584</td>
<td>2,584</td>
<td></td>
</tr>
<tr>
<td>9  Government of the People’s Republic of Bangladesh</td>
<td>335</td>
<td>1,708</td>
<td>2,043</td>
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<tr>
<td>10 Swedish International Development Cooperation Agency (Sida)</td>
<td>737</td>
<td>624</td>
<td>1,361</td>
</tr>
</tbody>
</table>

A complete list of donors is provided in Note 20 to the financial statements: www.icddrb.org/about-us/reports/financial-reports
CORE DONOR FUNDING

We are grateful for the core support provided by the governments of Bangladesh, Canada, Sweden and the UK.

The core donors provide funding that:

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, giving us more independence to prioritise our research agenda and to support worthwhile activities that are not funded by other donors
3. Facilitates our investment in maintaining and improving our infrastructure and research platforms 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, supply chain and facilities management, 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.
OUR DONORS IN 2019

A
Acme laboratories Ltd, Bangladesh
Advanced Chemical Industries Limited (ACI), Bangladesh
Annexon, Inc., USA
Arla Foods Amba, Denmark
Asian Development Bank
AXIS Clinicals Ltd., India

B
Bangladesh Agricultural University Research System
Bangor University, UK
Bill & Melinda Gates Foundation, USA
Bioceptive, Inc., USA
Boston Children’s Hospital, USA
Boston University, USA
BRAC, Bangladesh

C
CARE Bangladesh
CARE, USA
CDC Foundation, USA
Centers for Disease Control and Prevention, USA
Central Queensland University, Australia
Charite - Universitaetsmedizin Berlin
Chevron Bangladesh Blocks Thirteen and Fourteen, Ltd
Child Health Foundation, USA
Children’s Hospital and Research Center at Oakland, USA
Children’s Investment Fund Foundation, UK
Commission of the European Communities
Communicable Disease Threats Initiative, incorporating APLMA, Singapore
Communication Disease Control, Government of Bangladesh
Concern Worldwide, Bangladesh
CTK Biotech, Inc., USA

D
Department of Foreign Affairs, Trade and Development (DFATD), Canada
Department for International Development (DFID), UK
Department of Livestock Services, Bangladesh
Dhaka Shishu Hospital, Bangladesh
Dr Abdullah Hel Baqui
Drugs for Neglected Diseases Initiative (DNDi), Switzerland
Duke University, USA

E
Eawag, Switzerland
EcoHealth Alliance, USA
Emory University, USA
Enfants du Monde, Switzerland
Erasmus University, The Netherlands
Ethics Advance Technology Ltd, Bangladesh
European Union
Evotec International GmbH, Germany
<table>
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<tr>
<th>University of California, USA</th>
<th>UBS Optimus Foundation, Switzerland</th>
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<tr>
<td>Regents of the University of California, USA</td>
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<tr>
<td>University of Nottingham, UK</td>
<td>United Nations Children’s Fund, USA</td>
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<td>Research Foundation for the State University of New York, USA</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
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<td>University of Oxford, UK</td>
<td>United Nations Entity for Gender Equality and the Empowerment of Women</td>
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<tr>
<td>Research Triangle Institute, USA</td>
<td>United Nations Population Fund, Bangladesh</td>
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<tr>
<td>University of Saskatchewan, Canada</td>
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<tr>
<td>Rhode Island Hospital, USA</td>
<td>United States Department of Agriculture</td>
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<td>University of Alberta, Canada</td>
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<td>University of Southern California, USA</td>
<td>University of Bergen, Norway</td>
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<td>University of Stirling, UK</td>
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<td>University of Technology, Australia</td>
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<td>University of Massachusetts, USA</td>
<td>University of Newcastle upon Tyne, UK</td>
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<tr>
<td>U.S. Agency for International Development</td>
<td>University of New Mexico, USA</td>
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<tr>
<td>United States Department of Agriculture</td>
<td>University of New South Wales, Australia</td>
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<td>United Nations Children’s Fund</td>
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<td>University of Notre Dame, USA</td>
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<td>University of Pennsylvania, USA</td>
<td>WaterAid, Bangladesh</td>
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<tr>
<td>University of Saskatchewan, Canada</td>
<td>Walter and Eliza Hall Institute of Medical Research, Australia</td>
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<td>Washington University in St Louis, USA</td>
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<td>Uppsala University, Sweden</td>
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<tr>
<td>USAMC-AFRIMS, Thailand</td>
<td>Walter and Eliza Hall Institute of Medical Research, Australia</td>
</tr>
</tbody>
</table>

**OUR DONORS IN 2019**

R
Regents of the University of California, USA
Research Foundation for the State University of New York, USA
Research Triangle Institute, USA
Rhode Island Hospital, USA

S
S K Bioscience, South Korea
SAJIDA Foundation, Bangladesh
Save the Children International Inc., Dhaka, Bangladesh
Servier Affaires Medicales, France
Sinovac Biotech Co., Ltd., China
SOTER BioConsulting, Inc., USA
South African Medical Research Council, South Africa
Standard Chartered Bank, Dhaka, Bangladesh
Stanford University, USA
Stockholm University, Sweden
Stop TB/UNOPS, Switzerland
Swedish International Development Cooperation Agency
Swiss Tropical and Public Health Institute

T
Tetra Tech, Burlington, USA
Thrasher Research Fund, USA
Tokyo Kasei University and the University of Tokyo, Japan
Tufts University, USA

W
Wageningen University & Research, The Netherlands
Walter and Eliza Hall Institute of Medical Research, Australia
Washington University in St Louis, USA
Water and Sanitation for Urban Poor, UK
WaterAid, Bangladesh
Waterloo Foundation, UK
Wellcome Trust, UK
Western Sydney University, Australia
World Bank
World Health Organization, Malaysia
World Vision, Bangladesh