

ANNUAL REPORT 2020

Solving public health
problems through innovative
scientific research



icddr,b

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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 a 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.

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



Government of the People's
Republic of Bangladesh

Canada



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

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

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FINANCE

icddr,b's overall revenue for 2020 amounted to USD 64.78 million compared with a total expenditure of USD 64.11 million, generating a net surplus of USD 667,000 for the year.

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RECOGNISING OUR SUPPORTERS

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

MESSAGE FROM THE BOARD CHAIR



In many ways, 2020 was a year like no other.

The COVID-19 pandemic affected businesses and institutions across the world. For a global public health research institution like icddr,b, the pandemic presented challenges as well as opportunities.

At the onset of the pandemic, due in part to efforts to contain the spread, as well as the resulting lockdown in Dhaka, Bangladesh, the Board of Trustees and management were confronted with three priorities: the health and safety of our staff, maintaining adequate liquidity and cash flow, and the continuity of research and operations.

We took significant steps to protect the health and well-being of our people. In addition to instituting the appropriate precautionary and protective measures for those who came to work at the Dhaka campus, we also helped our staff with other measures like setting up a COVID-19 treatment facility for staff and their family members, and extending service contracts.

Throughout this challenging year, we have had many notable successes. Several of our COVID-related projects were featured in the Message from the Executive Director. I am proud to note that, during this period, we were able to continue our humanitarian work. Our hospitals continued to care for those in need. In partnership with UNICEF, we established a new COVID-19 treatment centre in Teknaf, Cox's Bazar for the displaced Rohingya people residing in Bangladesh.

Our Corporate Management Services, in particular the Information Technology Group, provided outstanding support so that staff could work remotely and the Centre could remain functional. Our staff members in the science programmes showed great dedication and professionalism, and worked often under difficult operating circumstances. They sought and received collaboration and support from project and funding partners. While some projects had to be scaled back or delayed, we were able to proceed with most of them and made great progress through the pandemic. We ended the year with remarkable scientific achievements in public health and in a good financial position.

The year 2020 also marked the 60th anniversary for icddr,b. Through innovations and research, the Centre has saved many lives in its 60-year tenure. In particular, our discovery of the Oral Rehydration Solutions (ORS), a simple and affordable treatment for diarrhoeal disease has saved tens of millions of lives in low and middle-income countries

across the world. Our research of the award-winning Oral Cholera Vaccine (OCV) helped to prevent outbreaks in as many as 14 Cholera endemic countries worldwide.

We had planned to celebrate this historic milestone at some modest events. However, we needed to forego all public gatherings due to infection risks, lockdowns and travel restrictions. Nevertheless, we thank past and present staff, collaborators and funding partners for their contribution toward the success of the Centre in its 60-year history.

After eight years of exemplary leadership as the Centre's Executive Director, Dr John D. Clemens completed his contract in early 2021. During his tenure, Dr Clemens has expanded the scientific portfolio and the Centre has received many awards for its contributions to global public health. I would like to take this opportunity to thank him for his tremendous contributions.

Finally, the Board was delighted to announce in September 2020, the appointment of Dr Tahmeed Ahmed as the incoming Executive Director. Dr Ahmed marks an important milestone and is the first Bangladeshi to assume this leadership position. He is a prominent scientist with a distinguished career in public health, specialising in nutrition. Under his leadership, we look forward to expanding and improving our scientific programmes, and to positioning the Centre as a vital contributor within the global public health community.

On behalf of the Board, I would like to thank the icddr,b leadership, all other staff, and our research and funding partners. Without your contributions, dedication, help, and support, the Centre's achievements in 2020 would not have been possible.



Nancy Y. Cheng, FCPA, FCA
Chair, Board of Trustees
November 2021

MESSAGE FROM THE EXECUTIVE DIRECTOR



The COVID-19 pandemic has reinforced the need for investing more into science and calls for greater scientific collaboration

The year 2020 has been remarkable, in the period prior to COVID-19's extraordinary impact, we were engaged extensively in our multidisciplinary research activities spanning across the country. Our research teams have been visiting communities and households and recording information for decades.

In the first quarter of 2020, we vaccinated 1.2 million residents of Dhaka and another 1 million Forcibly Displaced Myanmar Nationals (FDMNs) or Rohingya people who sought refuge in Bangladesh and their host communities with the oral cholera vaccine. But as soon as Bangladesh confirmed the first COVID-19 case on 8 March 2020, the operational dynamics changed dramatically. The country went into strict lockdown for three months. Under the challenging conditions imposed by the pandemic, researchers at icddr,b quickly turned their focus to new research areas targeted to tracking, understanding and battling COVID-19. We formed a COVID-19 response team comprising virologists, epidemiologists, clinicians, immunologists, emerging infection experts, communications experts and started holding meetings regularly.

Throughout the process, we emphasised the health and well-being of our staff, the people of Bangladesh, and the continuity of research and hospital operations. In addition, we have been providing support to the Government of Bangladesh and its partners, responding to the country's urgent needs.

One year into the pandemic, we have more than 60 diverse research projects exclusively focused on COVID-19. While we have been examining how to strengthen and improve the health system, we have also attempted to understand the transmission dynamics of COVID-19, the immune response induced by natural infection of SARS-CoV-2 or by vaccination, the role of variants, why some people are less sick than others who contracted the virus, trials of therapeutics including monoclonal antibodies, the impact of the pandemic on food security, economic loss and mental health, among many other issues. We are also conducting different COVID-19 surveillance, including wastewater surveillance, variant surveillance, and sero-surveillance.

Pursuing these research initiatives has been challenging. Since March 2020, more than 900 of our colleagues have contracted the virus. In April 2020, as more and more staff members became infected, it was clear that local health systems had inadequate preparation to manage COVID-19 patients, we implemented an unprecedented decision. We turned our day-care centre into a COVID-19 isolation ward and our staff cafeteria into a COVID-19 treatment ward equipped with high-flow oxygen, mechanical ventilators,

and all the medical equipment necessary to function as an intensive care unit. Our hospital healthcare staff, whose specialisation is treating diarrhoea/malnutrition, immediately revitalised themselves to treat COVID-19-induced complications that could affect the lung, brain, heart, liver, and kidney. The team has not only been at the forefront of COVID-19 care, but they are also sharing their knowledge and skills with other healthcare staff working at various government health facilities.

It is now evident that equitable access to safe and effective vaccines is critical to returning to normality, so it is immensely encouraging to see multiple vaccines have been already developed and administered to the mass population. But with the sheer number of unvaccinated people across the globe and the emergence of newer variants, it is implausible that we can breathe a sigh of relief anytime soon. We need more vaccines and must continue vaccine research. We have established a reputation as one of the world's leading sites for vaccine testing in a low-resource setting. Our vaccine research experience dates back to the sixties, and we have conducted more than 70 vaccine trials and helped produce evidence for the World Health Organization and global community on the use. We have had several agreements with different COVID-19 vaccine producers to conduct a phase III trial in Bangladesh. It is essential to understand how a vaccine works on the population of this country to know how much vaccines protect against infection, transmission and the disease. This work will help policymakers determine an effective vaccination strategy for the country.

icddr,b's life-saving research is only possible due to the generosity of our collaborators, supporters, and donors. Without them, we could not continue to generate affordable, easily scalable evidence and solutions that have huge potential to save lives in vulnerable low-income settings.

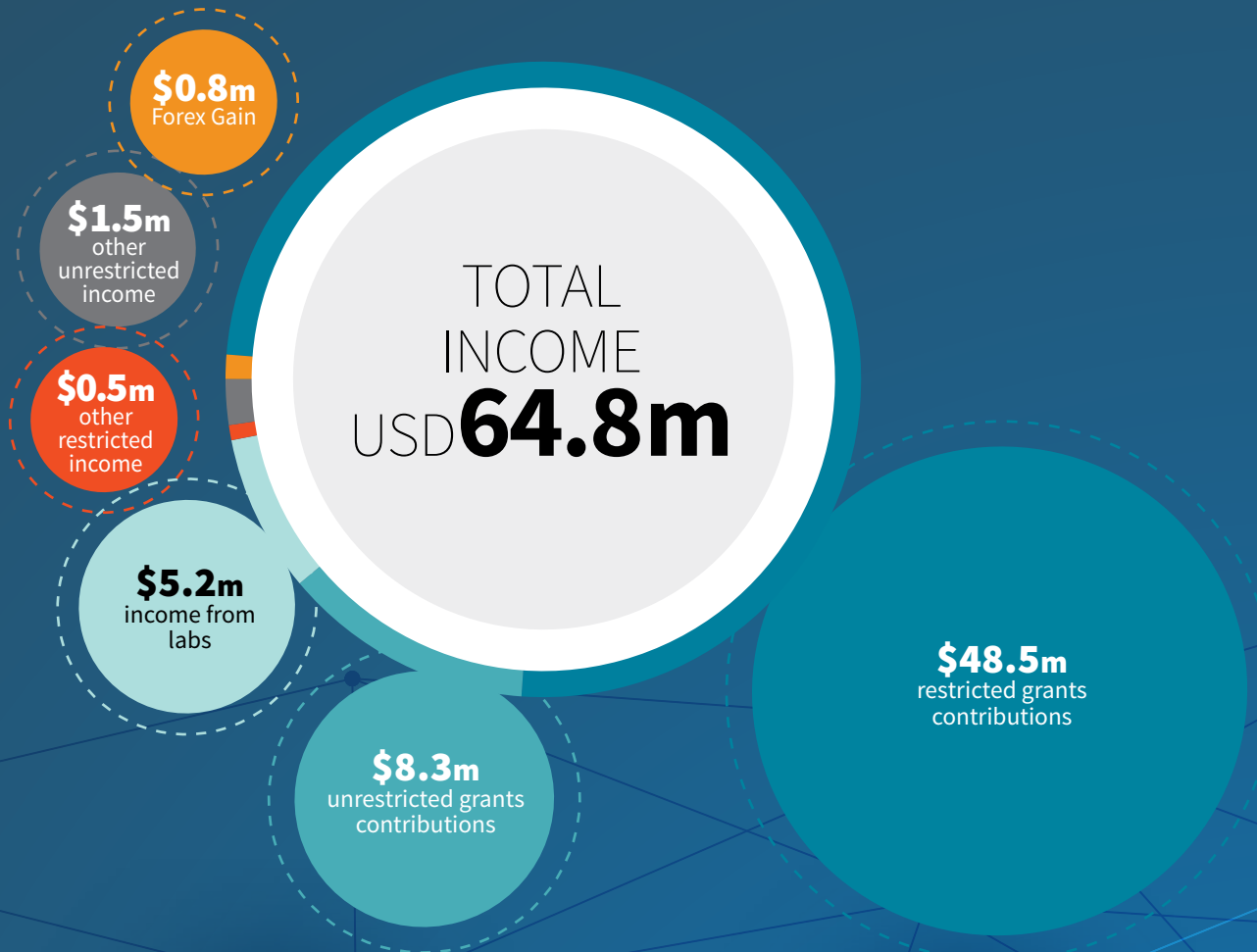
The coronavirus knows no borders, race, ethnicity and so nor do we. We have collaborated with organisations across the world, and we are open to opportunities. We believe more investment into research and greater scientific collaboration will reduce the impact and duration of the COVID-19 pandemic.



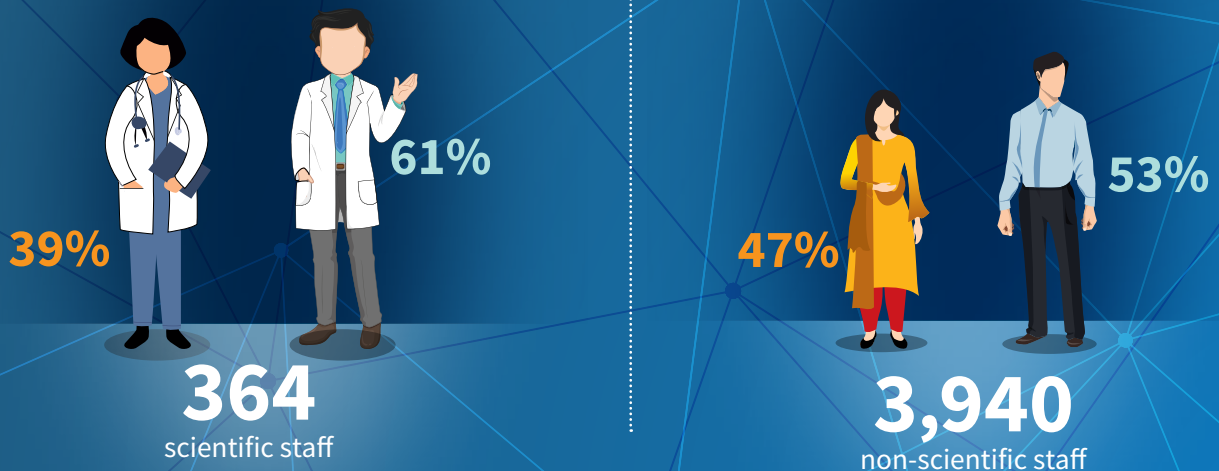
Dr Tahmeed Ahmed
Executive Director
August 2021

icddr,b IN NUMBERS 2020

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



Note: Restricted (research specific grants), Unrestricted (operation and development grants)

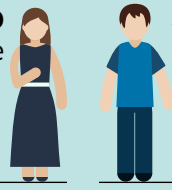


DIARRHOEAL DISEASE TREATMENT

152,024

patients treated in 2 hospitals and 1 treatment centre ^[1]

47% female **53%** male



DIAGNOSTIC CENTRE

1,397 tests offered

426,715

tests carried out



COVID-19 DIAGNOSIS (In 2020)

59,027

icddr,b Virology Lab

48,000

icddr,b Diagnostic Centre

1,813

USAID's ACTB ^[2] by GeneXpert

COVID-19 TREATMENT

C19 care in Dhaka

232

outpatient care

207

inpatient care

From 19 March 2020 to 15 April 2021, **947** staff and **1,174** family members were tested positive.

C19 care by SARI ITC^[3] in Teknaf, Cox's Bazar

50

patients (until 31 December 2020)



443

original papers published^[4]



34,455

citations from 2016-2019

132

new grants



420

ongoing projects

111

national collaborations



201

international collaborations

264

national policy review committees with icddr,b representation



274

international policy review committees with icddr,b representation

668

attendees of icddr,b training courses



262

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

70 students (63 national, 7 international) attended field experience programme

36

icddr,b staff contributing to teaching at the James P Grant School of Public Health

6

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



[1] Mirpur Treatment Centre was closed down on 26 March 2020 due to dwindling patient numbers.

[2] USAID's Alliance for Combating TB in Bangladesh

[3] Severe Acute Respiratory Infection Isolation and Treatment Centre (SARI ITC)

[4] with icddr,b scientists as authors

REMEMBERING THE GREATEST SCIENTIFIC DISCOVERIES

Celebrating six decades of Bangladesh based scientific research which saves millions of lives globally.



This year marks a significant milestone in the history of icddr,b. Sixty years ago, at the onset of a major cholera pandemic, the then South East Asian Treaty Organization (SEATO) established a small laboratory in Dhaka named Cholera Research Laboratory to be operated under the National Institutes of Health (NIH), USA. Later in 1978, this became the International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b) through a Government Ordinance followed by a World Health Organization (WHO) meeting in Geneva in 1979, which was chaired by UNDP and attended by 50 participants of 26 developing and developed countries, and agencies. A memorandum of understanding was signed by eighteen of those countries and agencies endorsing the Centre as an international entity.

With funds from the Government of USA, UK, Bangladesh and others, icddr,b has produced some stunning breakthroughs in scientific innovation, treatment, patient management and disease prevention and helped save millions of lives globally.

Here are some of icddr,b's greatest scientific discoveries:

DISCOVERY OF LIFE-SAVING ORS

icddr,b developed and carried out the first successful trial of Oral Rehydration Therapy (ORT), now known as Oral Rehydration Solution (ORS). The results were published in *The Lancet* in 1968. Within a decade, WHO, UNICEF, UNDP and other INGOs promoted the use of ORS and delivered millions of ORS sachet every year across the world.

icddr,b also discovered Labon-Gur saline in 1978 which was subsequently scaled up across the country by health workers of BRAC and other NGOs.

In Bangladesh, ORS helped reduce diarrhoeal disease mortality among children under-five from 15.1 per 1,000 to 6.0 per 1,000 live births between 1980-2015. Over the same period, similar reductions were observed in the burden of diarrhoeal diseases.

In 2007, researchers Olivier Fontaine, Paul Garner, and MK Bahn estimated that more than 50 million children have been saved by ORS between 1982 and 2007 – that is on an average two million lives a year. Based on the

estimates, the number of children saved from 1982 until 2019 could be more than 70 million.

In August 1978, *The Lancet* recognised ORS as “potentially the most important medical advance of this century.”

ENDING THE DISCRIMINATORY USE OF INJECTABLE CHOLERA VACCINE

In 1970, scientists found the only available and used whole-cell injectable cholera vaccine confers low protection. Subsequently, the 26 World Health Assembly in 1973 abolished the right of countries to require travellers from developing countries travelling to developed countries a certificate of vaccination against cholera saving billions of dollars.

REDUCING FERTILITY IN BANGLADESH AND BEYOND

In 1977, Maternal, Child Health and Family Planning interventions began in Matlab, Chandpur, Bangladesh which was soon scaled up by the Government of Bangladesh.



It resulted in a remarkable drop in fertility from 6.3 in 1975 to 2.1 in 2016 in Bangladesh after the scale-up.

The Matlab service model was later successfully replicated in Ghana and was subsequently disseminated from Ghana to neighbouring African countries.

MATERNAL AND NEONATAL TETANUS ELIMINATION

In 1980, scientists found that newborns of mothers who received a tetanus toxoid vaccine before pregnancy were 75 percent protected from neonatal tetanus. As a result of this finding, the WHO, UNICEF and partners have immunised more than 154 million women in 53 countries and helped eliminate the disease from 47 countries.

THE BEGINNING OF ORAL CHOLERA VACCINE (OCV)

In 1985, the first ever OCV trial was launched in Matlab, which eventually led to the development of easy-to-administer and affordable OCVs. This resulted the WHO to stockpile OCVs. More than 50 million doses of OCVs have been distributed in cholera endemic countries across the globe saving millions of lives. icddr,b has also facilitated the knowledge transfer to Bangladesh and the country now has an OCV produced by a local company.

NEW VIBRIO CHOLERAЕ O139 SEROGROUP DISCOVERED

In 1993, New *Vibrio cholerae* O139 Bengal was identified and later characterised. The world was warned about the emergence of a new infectious pathogen allowing preventive measures in anticipation of its spread.

GUIDELINES FOR TREATING SEVERE MALNUTRITION

In 1999, an icddr,b protocol for 'Management of Severely Malnourished Children' resulted in 50 percent reduction in case fatality. This was later published in *The Lancet*.

ZINC TREATMENT FOR DIARRHOEA

In 2002, scientists discovered that zinc treatment of diarrhoea reduces overall



mortality in young children. In 2004, zinc was recommended by the WHO and UNICEF as the only treatment to be coupled with oral rehydration salts for the treatment of all diarrhoea episodes. This has significantly helped many developing countries reduce child mortality.

INFLUENZA VACCINE SIGNIFICANTLY REDUCES ILLNESS IN INFANTS AND MOTHERS

Between 2008 and 2010, scientists found that if pregnant women were given influenza vaccine, it reduced illness by 63 percent in infants under six months and reduced respiratory infections among children and mothers by one third. It has also shown to increase newborns' birth weight. The findings resulted in WHO to recommend maternal immunisation during pregnancy with flu vaccine. The article on the findings received "Bruce Squires Award" in 2012 from the *Canadian Medical Association Journal*.

SCIENTIFIC BREAKTHROUGHS THAT RAMP UP POLIO ERADICATION EFFORT

icddr,b scientists have proved different doses and intervals of polio vaccines (bOPV, mOPV1, mOPV2 and fIPV) to be more effective than initially thought. This has resulted in WHO revising and accordingly undertaking vaccination campaigns in Pakistan, Afghanistan, Syria, Laos, India, Sri Lanka, Nepal,

Bangladesh and other polio-endemic countries. These findings also helped determine how to design the Global Polio Eradication Initiative to combat against type 2 poliovirus outbreaks. The articles published with these findings have received the Charles C. Shepard Science Award from Centers for Disease Control (CDC) in 2016 and in 2019.

ULTRA-LOW-COST CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) DEVICE FOR SEVERE PNEUMONIA

In 2015, icddr,b scientists invented an ultra-low-cost bubble-CPAP for the treatment of severe pneumonia in children, which has the potential to save thousands of infants from premature death. Large scale trials are underway in Bangladesh and in Ethiopia.

WHO has already endorsed bubble-CPAP oxygen therapy as one of the non-invasive ventilations for C19 affected children with severe pneumonia and hypoxemia.

MICROBES TO COMBAT MALNUTRITION

The prestigious journal *Science* recognised icddr,b and the Washington University, USA's research on microbes to combat malnutrition as one of the ten biggest scientific breakthroughs of 2019. This work has the potential to revolutionise the treatment of malnutrition in children in the days to come.

icddr,b's MULTIFACETED RESPONSE TO THE COVID-19 PANDEMIC

icddr,b has been actively monitoring the development of the novel coronavirus disease pandemic since late December 2019, focusing on the health and well-being of the people of Bangladesh and the continuity of research and hospital operations.

SUPPORT TO THE GOVERNMENT OF BANGLADESH

icddr,b has been devoted to tracking, understanding and combating C19 and supporting the Government of Bangladesh (GoB) with technical assistance at various levels, including participating at the C19 National Technical Advisory Committee. It has also helped Bangladesh ramp up testing and contact tracing, expanding diagnosis and testing services across the country by strengthening capacities of the staff and laboratories, undertaking C19 surveillance, strengthening infection prevention and control, strengthening hospitals and maternal, neonatal and child health services to continue providing care, providing psychological support to healthcare workers, etc.

icddr,b initiated SARS-CoV-2 variant surveillance in December 2020 in partnership with the Institute of Epidemiology, Disease Control and Research (IEDCR) and the Directorate General of Health Services (DGHS).

COVID-19 DIAGNOSIS

icddr,b has been supporting the DGHS with the COVID-19 test. Until 31 December 2020, more than 100,000 tests were carried out. Among these, 59,027 specimens received from across the country have been tested by icddr,b virology lab. Additionally, since June 2020, icddr,b diagnostic centre is offering COVID-19 test to the general public commercially and has tested 48,000 specimens in 2020. With support from the USAID and under direction of the National Tuberculosis Control Program (NTP), icddr,b has also been testing COVID-19 by the GeneXpert and has tested 1,813 specimens.

Moreover, the MoHFW has assigned icddr,b diagnostic centre to provide COVID-19 Fit-to-Fly certificates for passengers travelling abroad.

TREATMENT OF COVID-19

Bangladesh recorded its first C19 case on 8 March 2020. By the end of March, widespread media reporting on the inadequate preparation of the health systems to manage C19 patients led to an unprecedented decision by icddr,b's management to set up a C19 isolation and treatment ward primarily for its staff and suspected C19 patients at its hospital. icddr,b's day-care centre and later staff cafeteria have been transformed into C19 isolation and treatment wards. The facilitation of C19 treatment provided reassurance to employees, especially amid local reports that private ambulances were refusing to carry patients with C19 symptoms and many healthcare facilities were refusing to serve C19 patients. In subsequent months, the patient numbers grew alarmingly, as did the number of critical patients. The treatment ward had to be immediately equipped with the necessary medical equipment including high-flow



oxygen to function as an intensive care unit. The healthcare provision was broadened to cover all who have an employment contract with icddr, be it a daily wagger, contractual, or third-party service provider (security personnel and cleaners). This was further extended to cover all family members who live with an icddr, employee.

Between 19 March 2020 to 15 April 2021, 5,190 tests for C19 were carried out, resulting in 947 staff and 1,174 family members becoming positive. Of these individuals, 439 were treated under the C19 response team at icddr, Dhaka Hospital. Among them, 232 were treated at the outpatient unit, while 207 received treatment at either the isolation or the C19 ward. Among the patients who received inpatient treatment, 88 required treatment with oxygen supplementation.

icddr, with support from UNICEF Bangladesh has established a Severe Acute Respiratory Infection Isolation and Treatment Centre (SARI ITC) in Teknaf, Cox's Bazar. This has been providing health services to the affected Forcibly Displaced Myanmar Nationals (FDMNs) or Rohingya refugees and host communities since August 2020. Until 31 December 2020, more than 6,600 patients including 95 FDMN have received care for health complications; about 50 of these patients were treated for C19. The survival rate among patients requiring oxygen therapy is more than 78 percent.

COVID-19 RESEARCH AND PROJECTS

icddr, has initiated more than 30 research projects on C19 (until 31 December 2020) ranging from transmission dynamics, clinical spectrum and determinants of patients admitted to hospital, diagnostic efficiency of recombinase polymerase amplification (RPA), evaluating the safety of icddr, invented Bubble CPAP (Continuous positive airway pressure) device in C19 adults with severe pneumonia, sero-surveillance of C19, impact of stay-at-home orders on food security, economic loss and mental health; strengthening biosafety and security for managing C19 in laboratories, testing and contact tracing, monitoring of SARS-CoV-2 in bats, community transmission of C19, sewage surveillance, systemic (blood) antibody response in novel coronavirus cases of Bangladeshi participants and comparison of the antibody responses, genomic analysis, therapeutic trials.



The following sections will highlight some of these research activities. Additionally, please read icddr, b's response to C19 pandemic, which details out current activities, by visiting <https://cutt.ly/gmYdfps>

HUMANITARIAN ASSISTANCE

icddr, employees have donated cash assistance to the Prime Minister's C19 Relief Fund. Additionally, assistance was also provided to a local non-profit organisation that supports local, underprivileged communities. icddr, in partnership with the German Doctors, have extended livelihood (i.e. foodstuff) support to transgender (locally known as Hijra) and other gender and sexually diverse people.

CONTRIBUTING TO GLOBAL EFFORTS AGAINST COVID-19

SAGE MEMBERSHIP

Dr Firdausi Qadri, Senior Scientist at icddr, is one of the members at the WHO's Strategic Advisory Group of Experts on Immunization (SAGE). SAGE has been reviewing vaccines against C19

on the basis of all available evidence and recommending the WHO accordingly.

COMPARING COVID-19 VACCINES

icddr, has been selected by the Coalition for Epidemic Preparedness Innovations (CEPI) as one of five global laboratories initially selected to work together as part of the centralised network to reliably assess and compare immunological responses generated by C19 vaccine candidates.

Under this centralised laboratory initiative, the CEPI aims to measure immune responses against SARS-CoV-2 candidate vaccines in all phases of clinical trials and beyond.

STRENGTHENING LABORATORY CAPACITIES IN AFRICA AND YEMEN

We shared our technical expertise and helped strengthened biosafety and biosecurity status in laboratories and healthcare facilities of several African nations. Three sets of two-day workshops for Nigeria, Sudan, Somalia, and Libya have been conducted.

A similar capacity-building initiative was carried out for Yemen with support from IsDB.



SPOTLIGHT

The following stories highlight five areas – neonatal mortality, handwashing, cholera control, combating tuberculosis, HIV/AIDS care and prevention, FDMN health protection, and menstrual hygiene management – where we are having national and international impact.

14 STRENGTHENING SDG GUIDELINE FOR
NEONATAL MORTALITY

15 “SOAPY WATER”

15 ENDING CHOLERA – IMPLEMENTATION
OF A GLOBAL ROADMAP

16 COMBATING TUBERCULOSIS

18 HIV/AIDS CARE AND PREVENTION

20 HEALTH PROTECTION FOR THE
FORCIBLY DISPLACED

21 MENSTRUAL HYGIENE MANAGEMENT

STRENGTHENING SDG GUIDELINE FOR NEONATAL MORTALITY

icddr,b and partners contributed to revising the World Health Organization's Sustainable Development Goals target recommendations for newborn children

The Sustainable Development Goal (SDG) target 3.2 calls for ending preventable deaths of newborns and children under-five years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births. However, it did not set any intervention specific targets. To fill in the gap, the World Health Organization (WHO), UNICEF, and other global and regional partners and stakeholders developed “Every Newborn Action Plan (ENAP)” in 2014. The plan outlines and prioritises evidence-based interventions to achieve this target.

The ENAP has limitations. Among the global under-five child mortality, about 45 percent of babies die within the neonatal (0-28 days) period due to three leading causes – i) preterm and low birth weight (35%), ii) intrapartum events, including birth asphyxia (24%) and iii) infections, including pneumonia,

sepsis and meningitis (21%). Six interventions can effectively prevent deaths due to these causes. These are the administration of antenatal corticosteroid injection and kangaroo mother care (KMC) against preterm and low birthweight, early initiation of breastfeeding and resuscitation with bag-mesh for intrapartum events, and application of chlorhexidine and administration of antibiotic injection against infections. However, until these interventions are routinely monitored, tracked, measured and finetuned, it is merely impossible to achieve the optimum results from these interventions. Consequently, the ENAP action committee has outlined a set of indicators to measure the outcome of these interventions.

To this end, icddr,b, the London School of Hygiene and Tropical Medicine, UK, Ifakara Health Institute (IHI), Muhimbili University of Health and Allied Sciences

(MUHAS) in Tanzania, and UNICEF-Nepal with Lifeline in Nepal have been undertaking an observational study titled The Every Newborn – Birth Indicators Research Tracking in Hospitals (EN-BIRTH) for last four years in Bangladesh, Tanzania and Nepal. The study has validated selected newborn and maternal indicators for routine tracking of coverage and quality of facility-based care for use at district, national and global levels. It included 23,000 facility births, 840 Kangaroo mother care and 1,015 infection cases for validating indicators against five interventions; antenatal corticosteroid administration was excluded as this is not routinely practised in many countries, including where the study is taking place.

Recently, an article on the assessment of the validity of the measurement of newborn and maternal healthcare coverage in hospitals published in *The Lancet Global Health* received significant attention from the WHO. Subsequently, the WHO has revised their recommendation regarding how countries could set their targets for small and sick newborns to achieve SDG 3.2 target by 2030 based on the initial findings of this study. Dr Tedros Adhanom Ghebreyesus, Director General, WHO, has acknowledged the revision of the policy changes in his 3 September 2020 deliberation at the launch of the “Every Newborn Action Plan: 2025 Coverage Targets and Milestones” webinar.

icddr,b has been at the heart of the study from its conceptualisation, design, implementation, and necessary policy change to reduce preventable neonatal deaths and achieve SDG 3.2 target by 2030.



Day LT, Rahman QS, Rahman AE, Salim N, KC A, Ruysen H, *et al.* Assessment of the validity of the measurement of newborn and maternal health-care coverage in hospitals (EN-BIRTH): an observational study. *The Lancet Global Health*. 2020. [https://doi.org/10.1016/S2214-109X\(20\)30504-0](https://doi.org/10.1016/S2214-109X(20)30504-0).

“SOAPY WATER”

icddr,b’s soapy water made it to the WHO’s interim guideline

In late March 2020, the WHO published an interim guidance titled ‘Water, sanitation, hygiene, and waste management for SARS-CoV-2, the virus that causes C19’ intended for water and sanitation practitioners and providers, and healthcare providers who want to know more about WASH and waste risks and practices in relation to C19. The guidance was later updated in July 2020.

The interim guidance recommended commercial liquid soap or locally-made “soapy water” solution made by mixing detergent with water to be used as hand hygiene materials for communities and homes where alcohol-based hand rub or bar soap are not available. This was based on long term work undertaken by our scientists. They have demonstrated that in low-income communities, the

high cost of soap can be a barrier to regular handwashing. Soapy water – a simple mixture of 30g of powdered detergent in any 1.5L recyclable bottle – is a low-cost alternative. Scrubbing hands with soapy water followed by a water rinse is just as effective as washing with soap and water yet is much less expensive than bar soap.

Our scientists have been working with the WHO on detailed handwashing guidelines to enhance C19 prevention.

A link to the interim guidance is available at <https://www.who.int/publications/i/item/WHO-2019-nCoV-IPC-WASH-2020.4>

Amin, N. *et al.* Microbiological Evaluation of the Efficacy of Soapy Water to Clean Hands: A Randomized, Non-inferiority Field Trial. *Am J Trop Med Hyg* 2014, 91(2):415-23.

Ashraf, S. *et al.* Nonrandomized Trial of Feasibility and Acceptability of Strategies for Promotion of Soapy Water as a Handwashing Agent in Rural Bangladesh. *The American journal of tropical medicine and hygiene* 2017, 96 (2), 421-429.



Sultana F, Unicomb LE, Nizame FA, Dutta NC, Ram PK, Luby SP, Winch PJ. Acceptability and Feasibility of Sharing a Soapy Water System for Handwashing in a Low-Income Urban Community in Dhaka, Bangladesh: A Qualitative Study. *Am J Trop Med Hyg.* 2018 Aug;99(2):502-512. doi: 10.4269/ajtmh.17-0672. Epub 2018 Jun 7. PMID: 29893204; PMCID: PMC6090367.

ENDING CHOLERA – IMPLEMENTATION OF A GLOBAL ROADMAP

OCV vaccination campaign in Dhaka city

Bangladesh is one of eight cholera endemic countries in the world. Sixty-six million people are at risk of this centuries-old disease. Ahead of the cholera peak in the pre-monsoon period, under the leadership of the Communicable Disease Control (CDC) of the DGHS, we have carried out an oral cholera vaccination campaign in six areas (Adabor, Mohammadpur, Hazaribagh, Lalbagh, Darus Salam and Kamrangirchar) of Dhaka city. These areas have a high hospitalisation rate for cholera ranging

from 0.3 to 4.9 per 1,000 population. From the Global Task Force on Cholera Control (GTFCC) programme, Bangladesh received 1.2 million doses of the Euvichol oral cholera vaccine. Between 19-25 February 2020, a total of 1,199,136 people were vaccinated with a single-dose vaccine. Among the vaccinated population, 53 percent were male while 47 percent are female. Seventeen percent were children aged between 1-5 years. Vaccination of a large population in the selected urban areas of Dhaka city proved to be feasible, acceptable and achieved high coverage. However, the delivery of the second dose could not be carried out due to the C19 pandemic.

The planning for this demonstration campaign was completed by icddr,b

in collaboration with CDC, Expanded Programme on Immunization, the DGHS; the WHO, GAVI - The Vaccine Alliance and UNICEF.



COMBATING TUBERCULOSIS

Implementing the USAID's Alliance for Combating TB in Bangladesh (ACTB)

In recent years, Bangladesh has made significant progress in reducing tuberculosis (TB) prevalence. However, TB remains a major cause of illness, with 221 estimated incidences for all forms of TB per 100,000 population, claiming more than 35,000 lives annually. The recent C19 pandemic has exacerbated this situation.

Since March 2020, we implemented the USAID's flagship TB control programme, 'Alliance for Combating Tuberculosis in Bangladesh (ACTB)'. The programme strives to increase TB case detection rate to 90 percent and sustain treatment success rate to over 90 percent within the next four years. The USAID's ACTB has been supporting the National Tuberculosis Control Programme (NTP), the DGHS and the Ministry of Health and Family Welfare to accelerate their efforts to end TB through a comprehensive series of activities. These include improving

case detection through health system strengthening, mobilising resources to fill in the gaps, bringing in new tools and technology, engaging the private sector and civil society, and addressing gender as a cross-cutting issue. The activities focus on all forms of prevention, detection and treatment of tuberculosis in adults and children. It also focuses on drug-resistant (DR-TB) diagnosis and treatment.

We have partnered with one of the largest local development partners, HEED Bangladesh, to ramp up the diagnosis and management of TB cases in tea garden areas of Sylhet Division. This partnership under the USAID's ACTB has been implementing community-based interventions among tea, rubber and Punji (ethnic village) communities to identify active cases by engaging tea garden healthcare workers and local private practitioners. The tea garden healthcare workers are being trained on TB screening, diagnosis, and management. In addition, different awareness programmes have been conducted through cultural events like the POT song on TB. The partnership has successfully carried out active case identification for early TB case detection, contact investigation, and TB preventive therapy.

TB RESEARCH

A SUSTAINABLE SOCIAL ENTERPRISE MODEL (SEM)

The SEM for increased TB case detection and treatment in the private sector has operated since 2014. This study aimed to increase TB case notification from the private healthcare sector in three metropolitan cities (Dhaka, Chattogram and Sylhet) of Bangladesh. Under the SEM, more than 202,000 patients were screened in seven years, of which 27,000 were diagnosed with TB through a network of approximately 1,500 private and public healthcare facilities. Additionally, the model was incorporated into the NTP's National Strategic Plan-PPM 2016-2020 and is currently being scaled up nationwide through other NTP partners.

ASSESSMENT OF DELAY IN DIAGNOSIS AND TREATMENT INITIATION AMONG TB PATIENTS

Diagnosis and successful treatment of TB averts millions of deaths each year, yet a huge gap in detection and treatment persists. Therefore, a study to identify delays and associated factors was conducted at icddr,^b





Dhaka TB Screening and Treatment Centres (TBSTCs). Most of the presumptive patients are referred for TB testing by private practitioners.

In early 2019, in collaboration with the NTP, we introduced a digital tool, 'Janao (Report in English)' for mandatory notification of TB. Janao facilitates doctors, especially private practitioners, to notify TB cases to the government after diagnosis of the disease among private-sector patients. Available in Android, iOS and web platforms, Janao strengthened the government's 2014 declaration of TB as a mandatorily notifiable disease in Bangladesh. As a result, nearly 1,050 private providers were engaged as of December 2020, and the platform yielded more than 2,900 notifications of TB patients until December 2020.

EVALUATION OF XPERT MTB/RIF ULTRA FOR DIAGNOSIS OF TUBERCULOUS MENINGITIS

Clinical diagnosis of TB meningitis (TBM) is difficult due to its varied clinical presentations and the inability to differentiate it from other meningitis. Rapid, sensitive and accurate diagnostic tools for detecting

TBM using cerebrospinal fluid specimen are scarce. The use of Xpert MTB/RIF Ultra for detection of TBM in children and HIV negative adults have not yet been evaluated. A study is ongoing in three tertiary hospitals in Dhaka city. Study findings will help determine the accuracy and feasibility of using Xpert Ultra as an alternative tool for detecting TBM in both adults and children.

INCREASING MISSING CHILDHOOD TUBERCULOSIS PATIENT DETECTION USING XPERT MTB/RIF ULTRA ASSAY

Based on the findings of a pilot study conducted in 2018-19 on the performance of Ultra by using stool specimens for pulmonary TB detection in children (funded by the USAID's Research for Decision Makers Activity), we are implementing a large-scale study awarded by the Stop TB Partnership through TB REACH Wave 7 Initiative. In this study, we are assessing the role of Ultra in increasing both pulmonary and extra-pulmonary childhood TB (children aged 0-14 years) detection among the presumptive patients admitted in 14 selected hospitals in Dhaka city.

In addition, we are determining the role of social and behaviour change communication (SBCC) materials in increasing awareness about childhood TB and stigma associated with TB among parents/caregivers of children aged 0-14 years, especially for female children, in the catchment areas of intervention facilities.

Among hospital activities, we are enrolling presumptive childhood TB patients and collecting respiratory (either induced sputum or gastric lavage) specimens including stool samples for pulmonary and site-specific specimen for EP presumptive patients. These are then analysed using Ultra at icddr,b's mycobacteriology laboratory.

Banu S, Haque F, Ahmed S, Sultana S, Rahman MM, Khatun R, et al. (2020) Social Enterprise Model (SEM) for private sector tuberculosis screening and care in Bangladesh. *PLoS ONE* 15(11): e0241437. <https://doi.org/10.1371/journal.pone.0241437>.

Kabir, S., Rahman, S. M., Ahmed, S., Islam, M. S., Banu, R. S., Shewade, H. D., Banu, S. et al. (2020). Xpert Ultra assay on stool to diagnose pulmonary tuberculosis in children. *Clinical Infectious Diseases*. <https://doi.org/10.1093/cid/ciaa583>.

HIV/AIDS CARE AND PREVENTION

Undertaking research and evidence-based programmes that strengthen the national response for the prevention and care of HIV and AIDS

We have long-standing experience in managing evidence-based HIV prevention programmes for vulnerable and marginalised key populations (KPs) at risk of HIV through the implementation science framework. These programmes have particularly impacted the lives of gender and sexually diverse people i.e. men who have sex with men, male sex workers (MSW) and transgender women (hijra) and people who inject drugs (PWID) by providing them with targeted HIV prevention and care services. The programme's success is marked by an increase in comprehensive HIV and safe sex [1].

We have also pioneered the opioid substitution therapy (OST) programme in Bangladesh, a scientifically acclaimed biomedical intervention for curbing injection opioid drug use and the spread of HIV infection.

We conduct operational and exploratory research projects about emerging issues affecting these populations. Insights generated from these projects are used to refine the National Strategic Plan for HIV and AIDS and revolutionise HIV prevention interventions for KPs. Despite facing various challenges and delays due to the C19 pandemic, we completed the respective research projects in 2020.

UNDERSTANDING THE DYNAMICS OF THE SPREAD OF HIV INFECTION AMONG PWID

In light of the rapid increase in HIV prevalence among PWID in specific localities of Dhaka, we have explored the underlying contexts. The diversity and robustness of the ethnographic method were leveraged to understand the drug-using culture of the PWID and rigorously analyse the scopes and challenges of

the harm reduction intervention. The findings revealed several programmatic gaps of the harm reduction intervention, specifically limited efforts to cater the outreach design and implementation to the PWID's emerging drug-taking needs and complexities.

However, the study also noted that needle and syringe sharing behaviours are attributable to intrapersonal, interpersonal, and socio-structural circumstances beyond the programmatic realm. These findings served as an essential vehicle for refining national-scale harm reduction interventions for PWID.

PRIORITISING FEMALE SEX PARTNERS OF HIV-POSITIVE PWIDS

Males who inject drugs (MWID) are likely to transmit HIV via the injecting route and the sexual route, particularly to female sex partners. We conducted a mixed-methods study on female sex partners of HIV-positive MWID in Dhaka city. Findings revealed that a considerable percentage of female sex partners were HIV-positive and practice high-risk behaviours. The study also alluded to the crucial tenet that the male-focused harm reduction interventions alone cannot adequately contain the HIV epidemic; instead, the female sex partners are latently propelling the epidemic.

TACKLING THE PERVERSIVE USE OF METHAMPHETAMINE

icddr,b studies evinced the emerging use of methamphetamine (Yaba) among various groups of key populations, including gender and sexually diverse people and PWID and OST clients. A study on the former revealed that Yaba precipitated different risky sexual behaviours such as unprotected sex, violent/coercive sex and engagement with transactional sex with unknown clients. These circumstances could exacerbate HIV/STI (sexually transmitted infection) transmission. A recent study revealed the widespread use of illicit drugs among OST clients, especially Yaba, thus undermining the OST programme's core principle of preventing HIV



infection through eliminating their dependence on illicit drugs.

CARVING THE PATHWAY FOR ENHANCING TUBERCULOSIS DETECTION AND TREATMENT

Gender and sexually diverse people are particularly vulnerable to TB infection due to their low uptake of healthcare services. Moreover, passive case detection strategies which inherently exclude marginalised populations have precipitated low case notification rates.

In this context, icddr,b conducted a quasi-experimental study with the ultimate vision to enhance TB case detection and referral among this population. The study findings are likely to provide new insights for harnessing service delivery linkages with the government health system for achieving a sustainable community-based TB screening model.

A CONVENIENT, ACCESSIBLE ALTERNATIVE TO THE CONVENTIONAL HIV TESTING

A recent study found oral fluid-based HIV self-testing a highly acceptable and feasible approach for gender and sexually diverse people and their sexual partners, who were otherwise not accessible via the conventional HIV testing approach. When the results are ready, it is expected that this new modality will complement existing HIV testing services. Thus, such an initiative can substantially expand testing coverage among diverse population groups in Bangladesh.

APPLYING ICT-BASED INTERVENTIONS TO FOSTER INNOVATIVE, DIGITAL SERVICE DELIVERY

We have been implementing Information communication and technology (ICT)-based interventions (i.e., text SMS, voice SMS, mobile app, and web application) to enhance HIV prevention services and reach gender and sexually diverse people who refrain from visiting HIV centres and outreach spots. Similar approaches are implemented in the OST intervention to ensure regular treatment follow-up and retention. In 2020, a total of 280,508 text SMS and 52,593 voice SMS were delivered to the beneficiaries to improve behaviour change communication, enhance uptake of

HIV testing and other HIV prevention services. Recently, TAB-based real-time data entry has been embedded in the ICT platform for the HIV prevention intervention and OST programme.

MITIGATING COVID-19-RELATED RISKS AND CHALLENGES THROUGH INTEGRATED AND INNOVATIVE PROGRAMMATIC APPROACHES

The C19 pandemic substantially disrupted the national HIV response. icddr,b and its partner organisations experienced implementation challenges to continue services for gender and sexually diverse people and OST clients, due to national lockdown directives. This has impeded service providers' ability to attend service centres, as well as reach beneficiaries at conventional outreach spots.

In this context, service centres pursued innovations to provide essential, albeit limited-scale, services. Virtual outreach methods were prioritised for HIV prevention and OST service delivery through mobile/web apps, SMS, and telemedicine consultations. The beneficiaries were provided adequate amounts of condoms and lubricants during each outreach visit to minimise the frequency of in-person contact. HIV-positive clients were provided with sufficient supplies of antiretroviral drugs at ART centres. OST clients were provided with a maximum of 10-14 days' worth of take-home doses to reduce the frequency of clinic visits.



1. Reza, M. M. *et al.* Changes in condom use among males who have sex with males (MSM): Measuring the effect of HIV prevention programme in Dhaka city. *Plos one*, 15(7), e0236557.
2. Rahman, M *et al.* HIV-1 drug resistance and genotypes circulating among HIV-positive key populations in Bangladesh: 2016 update. *International Journal of Infectious Diseases*, 104, 150-158.
3. Khan, S. I. *et al.* The Effects of Methamphetamine Use on the Sexual Lives of Gender and Sexually Diverse People in Dhaka, Bangladesh: A Qualitative Study. *Archives of sexual behaviour*, 50(2), 479-493.
4. Sarwar, G. *et al.* Developing and testing community-based tuberculosis (TB) screening intervention to increase TB referral, case detection and knowledge among sexual minority people in urban Bangladesh: a mixed-method study protocol. *BMJ open*, 10(9), e037371.



HEALTH PROTECTION FOR THE FORCIBLY DISPLACED



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 (FDMNs) or Rohingya people arrived in the Cox's Bazar region of Bangladesh, bringing the total number of displaced people to more than a million.

Prompt action by icddr,b researchers and national and international partners led to highly successful pre-emptive use of OCV to prevent a cholera outbreak. Between Dec 2019 to Feb 2020, the sixth OCV campaign in Cox's Bazar among the host and the displaced FDMN population (children between 1-5 years of age) was carried out. One million vaccines

have been administered. However, pre-emptive vaccination of the host community in the remaining four unions of Teknaf and Ukhiya of Cox's Bazar was also not possible due to the pandemic.

An icddr,b study found that 28 percent of tube wells in refugee camps were contaminated with faecal bacteria, compared to 74 percent of stored household water sources which were contaminated. This suggested that secondary contamination poses a greater risk of infectious disease spread. Following the study, attempts were made to improve the water quality in the camps.

icddr,b has supported the government in undertaking regular diarrhoeal surveillance in 13 sentinel sites in camps and two in host communities. Every month, around 250/300 rapid diagnostic tests (RDT) are carried out, and those samples are then sent to Dhaka for a laboratory culture test.

Regular testing of water samples and diarrhoeal disease surveillance have significantly checked diarrhoeal disease outbreaks in the camps. An outbreak could create a large scale disaster.

Mahmud ZH *et al.* Occurrence of *Escherichia coli* and faecal coliforms in drinking water at source and household point-of-use in Rohingya camps, Bangladesh. *Gut Pathog.* 2019;11:52.

SEVERE ACUTE RESPIRATORY INFECTION ISOLATION AND TREATMENT CENTRE (SARI ITC)

icddr,b has been operating a 75-bed SARI ITC in at Teknaf, Cox's Bazar, since 31 August 2020 to provide C19 care to affected Rohingya refugees and host communities. UNICEF Bangladesh has been supporting this initiative.

The ITC is staffed with 155 employees that include trained doctors, nurses, medical technologists, patient care attendants, biomedical engineers, infection prevention-control officers, data, IT, and logistic officers. The facility is well-equipped with essential supplies, including PPE, medicines, central oxygen supply, cylinder oxygen, concentrators, and high flow nasal cannula. It also has a 10-bed High



Dependency Unit, Laboratory, X-ray, and ECG unit to support patient care.

All services, including diagnosis, treatment, meals for inpatients and referral to Cox's Bazar public hospital, are totally free of charge. Alongside the management of C19, treatment of chronic obstructive pulmonary disease, asthma, diarrhoea, hypertension, diabetes, pneumonia and malnutrition are also provided by the facility.

SARI ITC has completed a month-long campaign on C19 among locals and FDMN communities to raise awareness, promote mask use, maintaining personal hygiene, social distancing and the importance of testing and

seeking care when symptoms are seen. The campaign involved miking in the communities, broadcasting radio announcements and programmes on the local community Radio Naf 99.2 FM, advocacy meetings with religious and business leaders, and distributing posters and leaflets.

The SARI ITC has been actively conducting contact tracing among the patient's household members and encourages them to seek further consultation and testing if any signs and symptoms of C19 appear.

The SARI ITC has also been supporting the Teknaf Upazila Health Complex in C19 screening and C19 vaccination

campaign. The SARI ITC laboratory has been supporting the WHO in blood sample processing and setting the logistic hub of its C19 seroprevalence survey in the FDMN camps.

In November 2020, SARI ITC extended its support to local authorities in quarantining nine Bangladeshi fishermen detained for 15 days by the Myanmar border security forces and later released.

Until December 2020, SARI ITC provided care to more than 6,600 patients for different health complications, of which 95 were Rohingyas. One thousand one hundred nine were children under-five years of age.

■ MENSTRUAL HYGIENE MANAGEMENT

Innovations to promote better menstrual hygiene management

Girls in low-income countries, including Bangladesh, lack menstrual hygiene management (MHM) facilities combining products, privacy, sanitation and disposal facilities in schools. Inadequate MHM practices contribute to 30 percent of school absences among menstruating girls for an average of three days a month, and 31 percent reported menstrual problems interfered with school performance. As a result, significant attention has been paid to how menstruation affects school attendance and performance among girls.

Over 60 percent of Bangladeshi women and girls use reusable cloths as menstrual absorbents. Our scientists developed a low-cost and environment-friendly menstrual absorbent called 'Sultana-icddr,b Reusable Cloth Pad' that demonstrated an eight percent reduction in school absenteeism due to menstruation among schoolgirls in urban and rural Bangladesh within six months of the intervention. Additionally, 83 percent of the girls used and liked the pad



because it was comfortable, did not stain, was soft and reusable.

This pad is under patent consideration. It is a novel addition for menstrual hygiene management that will provide over 60 percent of women and girls with an improved solution over cloth use. The pad is made with a piece of soft and thin flannel cloth, and girls fold it to use as a menstrual hygiene product.

Our scientists have also developed and piloted a low-cost, manually powered technology called 'Washer and Dryer Bags' to facilitate the efficient washing and drying of reusable cloth menstrual pads in Bangladesh.

The findings suggest that 67 percent of the women and girls used the washer and dryer bags as it reduced drying time and the stigma associated with drying menstrual cloths openly. In addition, women and girls were willing to pay for the technology as it provided them privacy to manage their menstruation with dignity.

Sultana, Farhana *et al.* Evaluation of a menstrual hygiene management (MHM) intervention among urban and rural schools in Bangladesh: A pilot study. In 2020 Water & Health Conference, North Carolina, USA.

Link for the BBC Health Check follows: <https://www.bbc.co.uk/sounds/play/w3csy9l4?fbclid=IwAR31Jw-PkDHfWCfCOBmNqOxDcCdCqoCbDwB-ohzN9EchUC-dPxmbRZsWE3dMi4>

RESEARCH: HIGHLIGHTS

In 2020, 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 research addresses many of the key health concerns affecting Bangladesh and other countries in the global South.



24	THE IMPACT OF COVID-19 ON THE POOREST COMMUNITIES
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THE IMPACT OF COVID-19 ON THE POOREST COMMUNITIES



COVID-19 stay-at-home orders have economic and social costs for the poorest families

An icddr,b study found that families with low socioeconomic status – and particularly women – experienced

financial hardship, food insecurity, domestic violence and mental health challenges during C19 stay-at-home

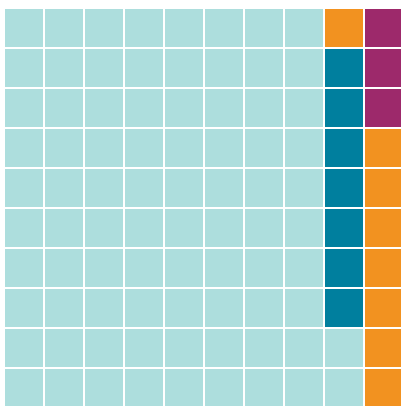
(lockdown) measures implemented in Bangladesh.

Like many countries worldwide, Bangladesh imposed stay-at-home orders to prevent the spread of C19 from late March to May 2020. Using an existing research network in Bangladesh, the study team tracked the impact of the lockdown on financial stability, food security, mental health and domestic violence in 2,424 families in Narayanganj district.

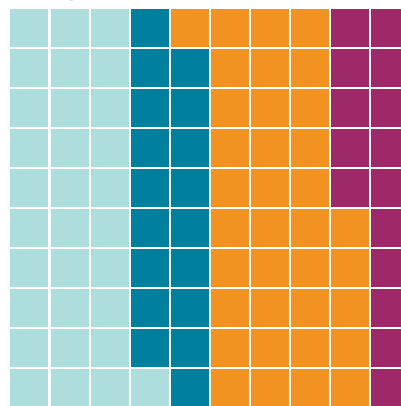
The study revealed that 96 percent of families experienced a reduction in their average monthly earnings, and 91 percent considered themselves financially unstable. During the lockdown, 47 percent of families saw their incomes drop below the international poverty line of BDT 160 (USD 1.90) per person per day, and 70 percent experienced food insecurity - with 15 percent running out of food, going hungry or missing meals.

The lockdown also had mental health impacts, with women showing an increase in depressive symptoms, and

Before Lockdown



During Lockdown



Food secure | Mild food insecurity | Moderate food insecurity | Severe food insecurity

68 percent of participants reporting that their anxiety level had increased. It is of concern that among the women who reported emotional, physical or sexual violence from their intimate partners, more than half reported that violence had increased since lockdown.

The study also highlights the need for wide-reaching welfare and other forms of financial support for families impacted by lockdown measures, not only for those on low incomes.

Crucially, social support is needed to protect women's safety, and it is essential that services against domestic violence remain accessible during the lockdown.

The marked increase in severe food insecurity in this study population shows the impact of economic pressure on food access. It also supports modelling to suggest the pandemic could have a catastrophic effect on food security and consequently on nutrition worldwide.

The findings will help Bangladesh's decision-makers and other developing countries take successful pro-poor and pro-women measures if stay-at-home orders are re-imposed.

Jena Derakhshani Hamadani *et al.* Immediate impact of stay-at-home orders to control COVID-19 transmission on socioeconomic conditions, food insecurity, mental health, and intimate partner violence in Bangladeshi women and their families: an interrupted time series. *Lancet Glob Health*, 2020 Nov;8(11):e1380-e1389. Epub 2020 Aug 25.

Determinants of food insecurity and coping strategies during COVID-19 lockdown

Another cross-sectional survey was conducted to assess the extent of food insecurity, factors associated, and coping strategies in 106 urban and 106 rural households in Bangladesh. It was found that 90 percent of households were suffering from different grades of food insecurity. Severe food insecurity was higher in urban (42 percent) than rural (15 percent) households.

The rural households with mild or moderate food insecurity adopted either financial (27 percent) or both financial and food compromised (32 percent) coping strategies. In comparison, 61 percent of urban mild or moderate food insecure households adopted both coping strategies. Similarly, nearly 90 percent of severely food insecure households

implemented both types of coping strategies.

Das S *et al.* Acute food insecurity and short-term coping strategies of urban and rural households of Bangladesh during the lockdown period of COVID-19 pandemic of 2020: report of a cross-sectional survey. *BMJ Open*. 2020 Dec 12;10(12):e043365.



COVID-19 THERAPEUTIC TRIAL



Ivermectin shows promise against COVID-19 in a Randomised Control Trial (RCT)

Since inception icddr,b has been committed to finding innovative low-cost solutions to major public health challenges. At the initial stage of the C19 pandemic (June – July), icddr,b took a bold decision to undertake a clinical trial to evaluate the safety and efficacy of Ivermectin for the treatment of confirmed mild cases of C19 in a hospital setting in Dhaka. Ivermectin is locally available, has a good safety profile, and is a low-cost drug. There were few trials of a one-day ivermectin treatment regimen at that time.

The randomised, double-blind, placebo-controlled trial evaluated orally administered Ivermectin alone (12mg once daily for five days), Ivermectin single dose (12mg) in combination with doxycycline (200mg stat doxycycline on day one followed by 100mg 12 hourly for next four days) compared with placebo among 68 hospitalised patients with C19 in Dhaka, Bangladesh. Patient distribution was 22, 23 and 23 in each

group, respectively. The participating hospitals were Mugda Medical College and Hospital, Kurmitola General Hospital, and Dhaka Medical College & Hospital.

The study demonstrated that patients in the five-day ivermectin group were 77 percent more likely to have early viral clearance on day 14 than those who received Ivermectin and doxycycline (61%) and placebo (39%). It also showed that on day three, eighteen percent of patients in the group treated with Ivermectin alone began to show viral clearance compared to Ivermectin plus doxycycline (3%) and placebo (3%), while on day seven, it stood at 50 percent, 30 percent and 13 percent respectively. The odds of improvement in clinical status with the five-day treatment course of Ivermectin versus Ivermectin and doxycycline, and placebo were also favourable, trending toward reduction of severity of infection indicated by improvement in the blood bio-markers. The C-reactive protein (CRP), Lactate

Dehydrogenase (LDH) and Ferritin levels notably dropped from the baseline to day seven in the Ivermectin alone group compared to the other two groups. The antiparasitic drug is found to be safe and has shown, at best, a modest benefit for mild C19.

On completion of icddr,b's trial of five days course of Ivermectin it received global attention. Sponsored by the Unitaid/WHO's ACT Accelerator Programme and led by the University of Liverpool, UK Senior Research Fellow Dr Andrew Hill performed a systematic review and meta-analysis focused solely on ivermectin treatment RCTs in C19. icddr,b scientist was also part of this initiative. Later on, our scientist has also collaborated with the Front Line C19 Critical Care Alliance (FLCC), USA, which was formed in March 2020; and the British Ivermectin Recommendation Development (BIRD) panel, which was established in January 2021 by Dr Tess Lawrie to explore the potential of ivermectin further.

Ahmed S *et al.* A five-day course of ivermectin for the treatment of COVID-19 may reduce the duration of illness. *Int J Infect Dis.* 2021 Feb;103:214-216. doi: 10.1016/j.ijid.2020.11.191. Epub 2020 Dec 2. PMID: 33278625; PMCID: PMC7709596.

COVID-19 ANTIBODY RESPONSE

Antibody responses after COVID-19 infection in patients who are mildly symptomatic or asymptomatic in Bangladesh

Studies on serologic responses following C19 have shown primarily in individuals who are moderately or severely symptomatic. However, there is limited data from individuals who are only mildly symptomatic or asymptomatic. This study aimed to generate the missing data and used the WHO disease severity categorisation. It measured IgG, IgA and IgM antibodies in both mildly symptomatic and asymptomatic C19 patients (RT PCR confirmed) on days one, seven, 14, and 30.

The results were then compared to those detected in pre-pandemic

samples, including healthy controls and individuals infected with other viruses commonly seen in this area. Mildly symptomatic individuals developed IgM and IgA antibody responses by day 14 after detection of infection in 74 percent and 85 percent of individuals, respectively. Furthermore, 97 percent of these individuals developed an IgG antibody response by day 14, which rose to 100 percent by day 30.

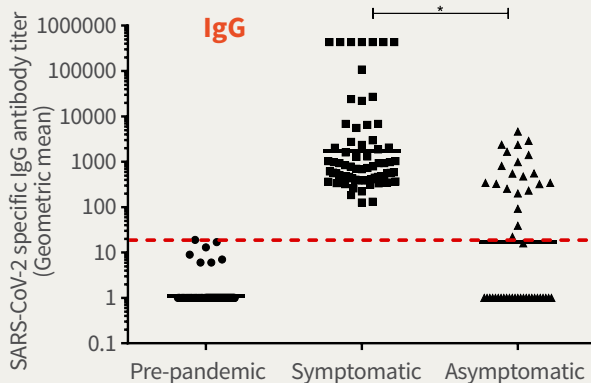
In contrast, individuals infected with SARS-CoV-2 but who remained asymptomatic developed antibody responses significantly less frequently, with only 20 percent positive for an IgA

response by day 14, 22 percent positive for IgM by day 14, and 45 percent positive for an IgG response by day 30 after detection of infection. These results indicate that patients with symptoms, even mildly symptomatic disease, develop significantly higher frequency of immune response compared to asymptomatic cases. These results will impact the modelling needed for determining herd immunity generated by natural infection or vaccination.

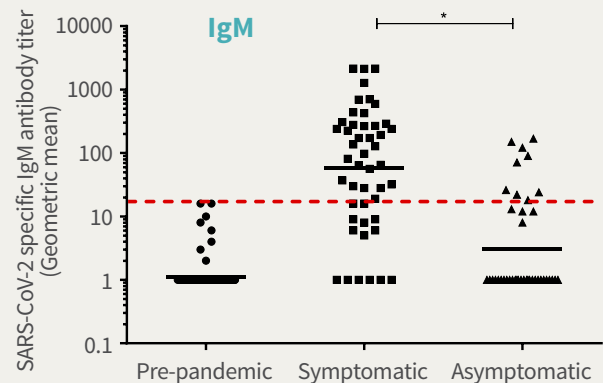
Several other studies are underway to evaluate the antibody response induced by SARS-CoV-2 infection in the country.

Tahmina Shirin, Firdausi Qadri *et al.* Antibody responses after COVID-19 infection in patients who are mildly symptomatic or asymptomatic in Bangladesh. *Int J Infect Dis.* 2020 Oct 5. PMID: PMC7534791.

SARS-CoV-2 specific antibodies in COVID-19 patients



IgG response ↑ by 1 month in-
 • 100% of those mild symptomatic
 • 45% of those asymptomatic



IgM response ↑ by 2 weeks in-
 • 72% of those mild symptomatic patients
 • 22% of those asymptomatic

DISCOVERY OF MICROBIOTA DIRECTED COMPLEMENTARY FOOD



Science recognises icddr,b and Washington University's research on gut microbes as one of the biggest scientific breakthroughs of 2019

The prestigious journal *Science* recognised the research achievement of icddr,b and Washington University, USA on microbes to combat malnutrition. Their work was a runner-up in the collection of 'Ten biggest scientific breakthroughs of 2019' in a special issue published on 19 November 2019.

The World Health Organization reported that 52 million children under five years of age are wasted (low weight for height), while 17 million are severely wasted, and 155 million are stunted (low height for age). Many countries will not be able to achieve the SDG for malnutrition.

Children suffering from malnutrition often fail to grow even after receiving enough to eat. As a result, their brains do not develop properly and remain susceptible to diseases many years after the initial episode. This is due to their gut microbes remaining in an immature state. Scientists from icddr,b and Washington

University believe this could be the cause of poor growth – and not all foods are equally effective in solving the problem.

Together, they studied the main types of bacteria present in the healthy guts of children. They also tested which sets of foods boost these important bacterial communities in animal models. In a recently concluded trial involving 68 malnourished children aged 12-18 months living in Mirpur, Dhaka, Bangladesh, the research team tested out different diets. They investigated the impact of diets on the gut microbiota, and how specific microbiota that are beneficial are affected positively.

Another key outcome of this study was the effect of diets on proteins produced in the body of the children. Consequently, three articles were published in *Science* in July 2019. The findings suggest fostering the right microbes with specific nutritional supplements including green

bananas, chickpeas, soybean and peanut flour to help the gut flora recover in these children. Larger scale clinical trials with diets prepared with these foods are now underway at icddr,b.

If the large trials support the findings, this will undoubtedly be a breakthrough discovery and will substantially address undernutrition in children in developing countries. The traditional nutrition interventions practiced in these countries may need to be revisited and improved based on the new knowledge of the role of the gut microbiota to combat malnutrition among children, thus preventing the deadly complications associated with malnutrition.

Dr Tahmeed Ahmed, Senior Director, Nutrition and Clinical Services at icddr,b and Prof Jeffrey Gordon at Washington University have been leading this research since 2014.

A. Raman *et al.* A sparse covarying unit that describes healthy and impaired human gut microbiota development, *Science*, Vol. 365, 12 July 2019

J. Gehrig *et al.* J Effects of microbiota-directed foods in gnotobiotic animals and undernourished children, *Science*, Vol. 365, 12 July 2019

E. Pennisi, Gut microbes may help malnourished children, *Science*, Vol. 365, p. 109, 12 July 2019

BLOOD PRESSURE MANAGEMENT

Study finds frontline health workers can drive effective control of blood pressure in the rural communities in Bangladesh

A multi-country research study has found promising results in controlling high blood pressure among hypertensive patients through a low-cost health intervention carried out by community health workers in rural settings of South Asia.

The multi-country Control of Blood Pressure and Risk Attenuation – Bangladesh, Pakistan, Sri Lanka (COBRA-BPS) study is a cluster randomised trial that evaluated the effectiveness of the multi-component intervention among 2,550 individuals with hypertension living in 30 rural communities in Bangladesh, Pakistan and Sri Lanka between 2016 and 2019.

In Bangladesh, the trial was implemented by icddr,b in Munshiganj and Tangail districts among 895 hypertensive individuals in close collaborations with the NCD Control Programme, DGHS, MoHFW. In the COBRA intervention areas, six Health

Assistants (HAs) measured the blood pressure of 447 study patients at homes using a digital blood pressure machine and provided education for promoting a healthy lifestyle. The HAs referred patients with uncontrolled blood pressure to selected sub-district hospitals where doctors treated patients following a treatment protocol and mobilised anti-hypertensive drugs for the patients.

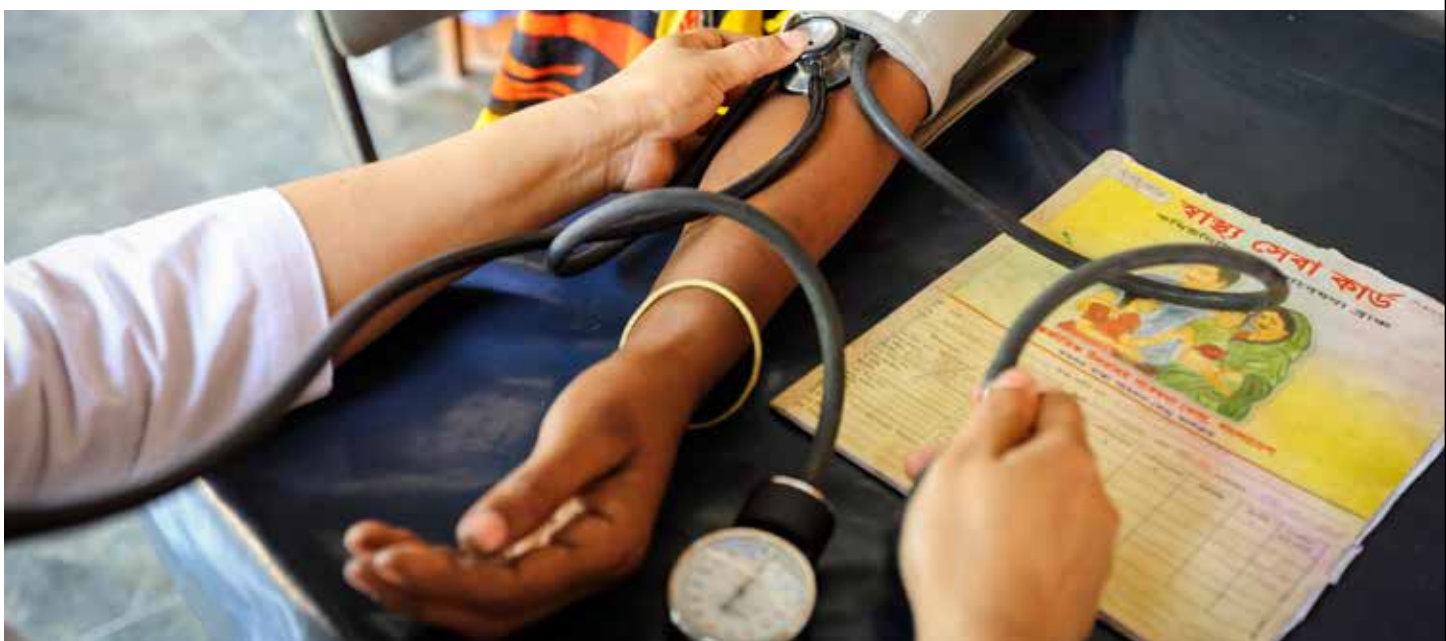
The study observed that hypertensive individuals who received COBRA care had at least 5mm Hg (millimetres of mercury) reduction in their systolic blood pressure in a year that sustained up to two years. Overall deaths due to heart attack or stroke were lower in patients receiving the intervention suggesting that COBRA intervention can be a potential solution for controlling blood pressure and preventing deaths from heart attack and stroke the leading causes of premature deaths in Bangladesh.

COBRA-BPS strategy is a service model introduced on top of the existing services provided from government rural primary healthcare facilities. Its success has demonstrated a potential pathway of quality of services for hypertension and other noncommunicable diseases in Bangladesh. Data suggests that programme delivery cost for scaling up the COBRA intervention in Bangladesh would be only BDT 51 (USD 0.60) per patient annually.

The researchers concluded that the implemented strategies in the COBRA-BPS trial have the potential to offer sustainable and low cost solutions for effective blood pressure-lowering that can be integrated in the public healthcare systems in Bangladesh and other South Asian countries, and could save thousands of lives.

This is the first multi-country trial of its kind that sets a credible example of South-South research collaboration.

Jafar TH, Gandhi M, de Silva AH, Jehan I, Naheed A, Finkelstein EA, Turner E, *et al.* (2020). A Community-Based Intervention for Managing Hypertension in Rural South Asia. *N Engl J Med*; 382: 717-26. DOI:10.1056/NEJMoa1911965.



ADOLESCENT HEALTH AND WELLBEING



The first Bangladesh Adolescent Health and Wellbeing Survey 2019-20

Bangladesh has about 36 million adolescents aged 10-19 years old – 13.7 million girls and 14 million boys - making up more than one-fifth of the total population. Investing in this large cohort of adolescents – particularly in health and wellbeing – provides an opportunity to develop a healthy labour force and increase the country's chances of achieving a demographic dividend.

The Bangladesh Adolescent Health and Wellbeing Survey 2019-20 is the first-ever national survey to provide a comprehensive picture of Bangladeshi adolescents' health and wellbeing at the national level, filling a gap of missing data. Under the authority of the National Institute of Population, Research and Training (NIPORT), icddr,^b in collaboration with MEASURE Evaluation/ Data for Impact (D4I), the University of North Carolina, conducted this national survey.

The survey involved a nationally representative sample of 72,800 households, of which 67,093 households (98%) were successfully interviewed. A

total of 4,926 ever married female (97% response rate), 7,800 unmarried female (94% response rate), and 5,523 unmarried male (85% response rate) adolescents were interviewed between 25 July 2019 and 10 January 2020.

The survey provided separate estimates for married and unmarried females and unmarried males aged 15-19 years in nine key areas: sexual and reproductive health; nutrition and food diversity; violence and harassment against adolescents; mental health; health service utilisation; connectedness to family and friends; attitude towards gender norms; access to mass media; and adolescents' participation in extracurricular activities and adolescent-focused programmes.

It revealed that one in every four households has at least one adolescent (aged between 15 and 19 years). More than 97 percent of these adolescents have attended formal education institute-school, college, or madrasa at least once. Nationally, more than 90 percent of adolescents have access to mobile phones. Seven out of ten unmarried

boys own a mobile phone. Around half of ever-married females and a quarter of unmarried girls own a cell phone. At least half of the phones are smartphones. Almost half of unmarried males and one-fifth of married and unmarried female adolescents access the internet at least once a week.

The survey also revealed that 73 percent of unmarried female adolescents and 66 percent of unmarried male adolescents wanted information on puberty and physical changes. While adolescent girls rely on books for getting information, the internet is the most availed medium of obtaining information for male adolescents.

Nationally, most female adolescents had no prior knowledge about menstruation before it occurred for the first time. Almost all (98%) of both ever married and unmarried adolescents reported using either disposable or reusable materials cleaned with water and soap/detergent during menstruation. However, hygienic menstrual practices are very low among both ever married (9%) and unmarried (12%) adolescents. Most notably, one in four ever married and unmarried in-school adolescents missed at least one day of school during their last menstruation.

The survey highlighted the need for providing adequate and timely information to adolescents regarding sexual and reproductive health (SRH). Access to a mobile phone is almost universal for adolescents, which offers an excellent opportunity to provide young people SRH information through ICT-based interventions.

Adolescents face different forms of violence and harassment, affecting other health and wellness outcomes during adolescence and beyond. Adolescents' mental health needs urgent attention as the survey found 5-15 percent of adolescents suffering from major depressive disorder, with married females experiencing depressive disorder at higher rates than their unmarried counterparts. Interventions for this vital population group should consider the unique challenges adolescents face in Bangladesh, including those exacerbated by rigid gender norms and roles.

ENVIRONMENTAL ENTERIC DYSFUNCTION

The Bangladesh Environmental Enteric Dysfunction (BEED) study comprehend the complex biological mechanism of environmental enteric dysfunction underpinning childhood malnutrition. A successful nutrition intervention was tested to improve linear growth in children and identified potential biomarkers of enteropathy.

Environmental enteric dysfunction (EED) is a small intestinal (duodenum) disorder associated with childhood growth stunting and underperforming of oral vaccines. EED is highly prevalent in communities with poor socio-economic status and is mainly characterised by sub-standard water-sanitation and hygiene practices. Unfortunately, there are no universally accepted protocols for diagnosis as well as treatment of EED.

The BEED study endeavoured to understand the complex etiopathogenesis of EED, validate non-invasive biomarkers of EED against small intestinal biopsy obtained from malnourished children who fail to thrive, and identify potential therapeutic targets for interventions to control EED as well as growth stunting.

The study was a community-based nutrition intervention study where around 6,000 people were screened and 1,575 slum-dwelling participants were enrolled in three different cohorts: stunted children aged 12–18 months, mild stunted (low height-for-age, when their height-for-age is more than two standard deviations below the WHO Child Growth Standards median children) aged 12–18 months and malnourished adults aged 18–45 years. The nutritional intervention consisted of an egg and 150 mL of milk for 90 days and one sachet of multiple micronutrient powder for 60 days. Participants who failed to respond to nutritional therapy were considered as the candidates for endoscopy and biopsy.

Biological samples were collected before and after the intervention. Histopathological scoring for EED was performed on biopsies and candidate EED biomarkers correlated with the scores and nutritional status.

The findings confirmed that EED was pervasive in the community. A statistically significant positive change in linear growth

was observed in stunted children who had received the nutrition intervention. Several novel biomarkers were identified, including tryptophan and kynurenine, alpha-1 antitrypsin, retinol-binding protein-4, stool pH, and lipocalin 2. Through this study, coeliac disease autoimmunity was reported for the first time in Bangladeshi children and malnourished adults. The analysis showed that the incidence of coeliac autoimmunity was low (0.6 percent) in malnourished slum dwellers regardless of age.

Furthermore, duodenal microbiota and proteins in stunted children with biopsy were studied, which confirmed EED. The plasma protein levels of 4,077 children were quantified, and 2,619 proteins in duodenal biopsy samples were obtained from these children. It was determined using culture-independent methods that the bacterial strains in microbiota recovered from duodenal aspirate from each child.

Fourteen bacteria in the upper part of the small intestine of children were found negatively associated with linear growth and positively associated with duodenal proteins involved in immunoinflammatory responses. It also confirmed the causal relationship with these bacteria with the pathogenesis of enteropathy in mouse model by transferring enteropathy of the small intestine in germ-free mouse that had been colonised with cultured duodenal strains obtained from children with EED.

Currently, investigators of BEED study are working with the US-based EED-biopsy consortium formed by the Bill &

Melinda Gates Foundation to develop and validate a robust EED-score that can be used in routine clinical practice.

Mahfuz M, et al. Bangladesh Environmental Enteric Dysfunction (BEED) study: Protocol for a community-based intervention study to validate non-invasive biomarkers of Environmental Enteric Dysfunction. *BMJ Open*. 2017 Aug 11;7(8):e017768.

Mahfuz M, et al. Daily Supplementation with Egg, Cow Milk, and Multiple Micronutrients Increases Linear Growth of Young Children with Short Stature. *J Nutr*. 2019 Oct 26. pii: nxz253. doi: 10.1093/jn/nxz253

Chen R, et al. Linking the duodenal microbiota to stunting in a cohort of undernourished Bangladeshi children with enteropathy. *N Engl J Med*. 2020 Jul 23;383(4):321-333. doi: 10.1056/NEJMoa1916004.

Fahim SM, et al. Evidence of gut enteropathy and factors associated with undernutrition among slum-dwelling adults in Bangladesh. *Am J Clin Nutr*. 2020 Jan 7. pii: nqz327. doi: 10.1093/ajcn/nqz327

Hossain MS, et al. Asymptomatic Duodenitis and Helicobacter pylori associated Dyspepsia in 2-Year-Old Chronic Malnourished Bangladeshi Slum-Dwelling Children: A Cross-Sectional Study. *Journal of Tropical Pediatrics* 2020; fmaa079, <https://doi.org/10.1093/tropej/fmaa079>

Fahim Sm et al. Helicobacter pylori infection is associated with fecal biomarkers of environmental enteric dysfunction but not with the nutritional status of children living in Bangladesh. *PLoS Negl Trop Dis*. 2020 Apr 23;14(4):e0008243. doi: 10.1371/journal.pntd.0008243.

Das S, et al. Changes in Retinol Binding Protein 4 Level in Undernourished Children After a Nutrition Intervention Are Positively Associated With Mother's Weight but Negatively With Mother's Height, Intake of Whole Milk, and Markers of Systemic Inflammation: Results From a Community-Based Intervention Study. *Food Nutr Bull*. 2020 Nov 23;379572120973908.

Gazi MA, et al. Plasma Kynurenine to Tryptophan Ratio Is Negatively Associated with Linear Growth of Children Living in a Slum of Bangladesh: Results from a Community-Based Intervention Study. *Am J Trop Med Hyg*. 2020 Nov 23. doi: 10.4269/ajtmh.20-0049.



PROGRAMME SUMMARIES

14 STRENGTHENING SDG GUIDELINE FOR NEONATAL MORTALITY

15 “SOAPY WATER”

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REDUCING MATERNAL, NEONATAL AND CHILD MORTALITY AND IMPROVING THE WELLBEING OF WOMEN, CHILDREN AND ADOLESCENTS



Programme lead

DR SHAMS EL ARIFEEN
Senior Director

Maternal and Child Health
Division

We develop and evaluate new interventions and carry out implementation research to enhance the coverage, quality and equity of interventions to reduce the physical and mental health burden on women, infants, children and adolescents.

Our work spans the full spectrum of research, including epidemiological studies (e.g. on indoor air pollution), basic upstream research, clinical trials (e.g. on new interventions), health systems research, and operations and implementation research. We take a life-course approach, encompassing maternal and neonatal health, child health and development as well as adolescent health and wellbeing.

The main causes of maternal, neonatal and child mortality and morbidity are now well understood, and in many cases effective interventions have been developed. A key challenge is to promote the implementation of evidence-based approaches. We actively participate in the development of national policy and rapid translation into programmes, while continuing to seek opportunities to apply the learning gained in Bangladesh to other low- and lower middle-income countries. Reducing inequities is an overarching principle guiding all our work.

Factors affecting adolescent health need to be better understood, and there is a growing recognition of the need to safeguard mental health in this population and in women.

NEWBORN MORTALITY

Newborn signal functions (NSF) are a representative shortlist of key interventions and activities that address major causes of morbidity or mortality and that are indicative of a certain type and level of care. For instance, signal functions indicative of “basic emergency obstetric care (EmOC)” could be provided by midwives at the level of a health centre, while “comprehensive EmOC” signal functions indicate a higher level of care, usually at a hospital. NSFs have been incorporated in the national monitoring checklist for newborn services, and the process of assessing the functionality of health facilities using this checklist has also been initiated.

A total of 20 newborn signal functions were identified, of which nine are primary, 13 are basic, 18 are comprehensive, and 20 are advanced. These signal functions are:

1. iron and folic acid (IFA) supplementation
2. hand wash each time before touching the baby
3. immediate drying
4. delayed umbilical cord clamping approximately 1-3 minutes after birth,

5. clean cord-cutting (clean/sterile thread)
6. a single application of chlorhexidine 7.1 percent to the umbilical cord followed by dry cord care
7. neonatal resuscitation
8. early initiation of breastfeeding within one hour
9. skin to skin care for two hours
10. tetanus toxoid
11. the suction of newborn
12. oral antibiotics for infection,
13. injectable antibiotics for infections,
14. antibiotics for premature rupture of the membrane
15. oxygen therapy,
16. injectable antibiotics for infections
17. phototherapy
18. Kangaroo mother care for preterm and low-birth-weight
19. Antenatal corticosteroid therapy (ACS) for preterm birth
20. incubator

All union and below level facilities should have these primary NSFs (1-9), while all union level facilities, all maternal and child welfare centres (MCWCs), and the majority of upazila

health complexes (UHCs) should have basic NSFs (1-13). All district hospitals, some UHCs, and some MCWCs should have comprehensive NSFs (1-18), and all medical college hospitals and specialised hospitals should have all advanced NSFs (1-20).

The study was supported by the USAID's Research for Decision Makers (RDM) Activity.

NEONATAL MORTALITY

icddr,b and partners have been undertaking an observational survey titled Every Newborn – Birth Indicators Research Tracking in Hospitals (EN-BIRTH) for last four years in Bangladesh, Tanzania and Nepal. The study selected newborn and maternal indicators for routine tracking of coverage and quality of facility-based care for use at district, national and global levels (see page 14).

IMPACT OF COVID-19 STAY-AT-HOME ORDERS

icddr,b study has found that families with low socioeconomic status – and particularly women – experienced financial hardship, food insecurity, domestic violence and mental health challenges during C19 stay-at-home (lockdown) measures in Bangladesh (see page 24).

COMPLIANCE OF PRIVATE HEALTH FACILITIES

In Bangladesh, since 1980, for-profit private health facilities have emerged as a major player on providing health care services. The Ministry of Health and Family Welfare (MohFW) recognises the contribution of private institutions in this pluralistic healthcare delivery system in the country. Unfortunately, formal accountability mechanisms for the private sector are often challenged by inadequate institutional capacity and an old regulatory framework. Consequently, the quality, effectiveness, and costs of these apparently 'better' services are not robustly and transparently evaluated.

The quality of maternal and neonatal healthcare in private sector facilities are of particular concern. Under the leadership of the Hospital and Clinic section of the DGHS, and with funding support from the USAID's RDM Activity, icddr,b assessed the licensing practices in 1,100 for-profit private healthcare facilities.

These facilities with in-patient care services were selected from a listing of all private facilities in every city corporation outside of Dhaka, four zones of Dhaka North and South City Corporations and 30 purposively selected sub-district headquarters with a high concentration of private facilities. The assessment also explored the readiness to provide maternal and newborn care services in a sub-set of about 350 facilities.

The majority (86%) of the private facilities that had ever received a license, only six percent of these facilities could show a valid license on the day of assessment. In addition, compliance with some of the licensing criteria, such as adequate human resources and availability of essential equipment, were not very promising. Substantial gaps were also found in readiness to provide maternal and newborn care services. In-depth exploration also identified several system-level and hindrances from private clinic owners to compliance and licensing practices.

The findings from the evaluation identified critical areas for intervention. It also showed that the licensing process could be used to improve public and private sector coordination and quality of care.

MATERNAL HYPERTENSION AND DIABETES

icddr,b, with support from the USAID's RDM Activity, has developed an Android

app for the Non-communicable Disease Control (NCDC) Programme of the DGHS to address the burden of non-communicable diseases (NCDs) in the population, especially among high-risk groups, including pregnant women. It is part of an initiative to automate the NCD management model, which is critical for the success of the model in identification, referral and follow up across the continuum of care.

According to the model developed by the NCDC, pregnant women of any age, and males and females aged over 40 years are identified as "at-risk population" or clients. The community health workers (CHWs) initiate contact with the clients, who are then served at different levels of healthcare facilities. Tracking the patients and services provided at each point of contact is a measure of success for the efforts.

Using the app, the CHWs visit households and identify clients who need to be examined. Then, they enrol and refer them to community clinics for screening and/or Upazila Health Complexes for diagnosis and management. The system automates the process, from identifying cases to tracking care seeking behaviour at each service delivery point and the services received at those centres.

icddr,b has been supporting the Government of Bangladesh in piloting this system in three upazilas (Baraigram, Kotchandpur and Sauria).



PREVENTING AND TREATING MATERNAL AND CHILDHOOD MALNUTRITION



Programme lead

DR TAHMEED AHMED

Senior Director

Nutrition and Clinical
Services Division

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.

IMPROVING CALCIUM STATUS OF WOMEN

Calcium is limited in the typical daily diet among the Bangladeshi population, leads to calcium deficiency. Moreover, calcium-containing foods are expensive for the general people and the high cost of calcium carbonate tablets renders calcium supplementation in Bangladesh almost impossible. Therefore, the fortification of the staple cereal – rice – is an attractive alternative.

An experimental trial to measure the fraction of calcium absorption by dual tracer calcium stable isotopes was conducted. It found significant levels (68.09 mg calcium) of absorption that circulated into the system when participants consumed 200 gm of slaked lime fortified rice.

Though the daily recommendation of calcium intake among reproductive-aged women is 1,000 mg, the mean calcium intake among Bangladeshi women is only 200 mg/day. Thus,

the true absorption of calcium found in this current study would substantially contribute to daily calcium absorption. This can also meet one-fifth of the daily recommendation of calcium if consumed three times a day. Since rice is a staple food in Bangladesh and is consumed by a vast population, it could be an innovative solution in reducing calcium deficiency in Bangladesh.

GUIDELINE FOR THE COVID-19 AFFECTED CHILDREN IN THE PAEDIATRIC INTENSIVE CARE UNIT

This is the first published international paediatric guideline for managing C19 affected children in the Paediatric Intensive Care Unit (PICU) prepared by global paediatric intensivists and clinical scientists. Fewer children than adults have been affected by the C19 pandemic. The clinical manifestations in children are distinct from those of adults. Some children particularly those with acute

or chronic comorbidities, are likely to develop a critical illness. Recently, a multisystem inflammatory syndrome (MIS-C) has been described in children, with some of these patients requiring care in the paediatric ICU.

An international collaboration was formed to review the available evidence and develop evidence-based guidelines for the maintenance of critically ill children with SARS-CoV-2 infection. Where the evidence was lacking, those gaps were replaced with consensus-based guidelines. This process has generated 44 recommendations related to paediatric C19 patients presenting with respiratory distress or failure, sepsis or septic shock, cardiopulmonary arrest, MIS-C, and those requiring adjuvant therapies.

Kache S, Chisti MJ *et al.* C19 PICU Guidelines: for high and limited resource settings. *Pediatric Research* 2020; 88: 705-716.

ADULT UNDERNUTRITION

Undernourished mothers are more likely to have adverse pregnancy events and unfavourable neonatal outcomes. Despite gradual reduction over the past couple of years, adult undernutrition is still substantial in Bangladesh. While the determinants of childhood undernutrition in the country are known, factors responsible for adult undernutrition are less well understood.

To that end, we have conducted a study to determine the factors associated with undernutrition in adults living in a resource-limited setting in Dhaka, Bangladesh. It shows that a higher number of siblings, depressive symptoms, gut enteropathy and anaemia are positively associated with undernutrition in adults. In addition, increasing age, high dietary diversity score, and handwashing practice before eating or preparing foods were protective against undernutrition among the study population.

These findings corroborate that undernutrition in adults is a complex phenomenon, which is associated with numerous physiological and sociodemographic factors, including mental health status, anaemia, and altered gut health.

Fahim SM. *et al.* Evidence of gut enteropathy and factors associated with undernutrition among slum-dwelling adults in Bangladesh. *Am J Clin Nutr.* 2020 Jan 7. pii: nqz327. doi: 10.1093/ajcn/nqz327.

FOOD INSECURITY DURING LOCKDOWN

Determinants of food insecurity and coping strategies during C19 lockdown period (see page 25).

DOMESTIC VIOLENCE, FOOD INSECURITY

Women's experience of domestic violence has adverse consequences on women's health globally and is affected by several factors. The degree of household food insecurity (HFI) is another critical indicator that influences domestic violence towards women. The prevalence of women experiencing domestic violence was 35 percent, and HFI was 86 percent. In terms of decision-making, both HFI and women's empowerment were significantly associated with women's experience of domestic violence.

Among poor households, the degree of HFI appeared to be the strongest associated factor of domestic violence. Results suggest that women's Decision Making Power (DMP) and HFI independently influence domestic violence since the associations were almost unchanged after adjusting for relevant covariates. In conclusion, behavioural change communication interventions may help to enhance DMP, but a holistic approach is required to improve food security.

Haque MA. Factors Associated with Domestic Violence in Rural Bangladesh. *J Interpers Violence.* 2020 May 27:886260520922353. doi: 10.1177/0886260520922353.

PAEDIATRIC SEPSIS DEFINITION

Current and previous definitions of sepsis in children have been developed using expert consensus but the specific criteria used to identify children with sepsis have not been rigorously evaluated. Therefore, the first systematic review was done on the definition of paediatric sepsis by global critical care medicine clinical scientists named 'Society of Critical Care Medicine's Paediatric Sepsis Definition Taskforce'.

The authors identified eligible studies by searching the following databases: MEDLINE, Embase, and the Cochrane Central Register of Controlled Trials. The authors included all randomised trials and cohort studies published between 1 January 2004 - 16 March 2020. Data extraction included information related

to study characteristics, population characteristics, clinical criteria, and outcomes. The authors have calculated the sensitivity and specificity of each criterion for predicting sepsis. The authors have also provided pooled estimates of overall hospital mortality.

The potential risk factors, clinical criteria, and illness severity scores from this systematic review which identify patients with infection who are at high risk of developing sepsis-associated organ dysfunction and/or progressing to multiple organ dysfunction or death will be used to inform the next step of research involving Paediatric Sepsis Definition Taskforce members to help attain a precise definition of paediatric sepsis both for lower middle income and high income countries.

Menon K, Chisti MJ *et al.* Pediatric Sepsis Definition—A Systematic Review Protocol by the Pediatric Sepsis Definition Taskforce. *Critical Care Explorations* 2020; 2: e0123.

ACUTE MALNUTRITION

Globally no data is available on whether the link between acute malnutrition and mortality during moderate-to-severe diarrhoea has any relation to specific infections and whether it affects a broad spectrum of enteric pathogens. Children with moderate-to-severe diarrhoea and age-matched and community-matched controls were included in this post-hoc analysis if their mid-upper arm circumference had been measured and if they were older than six months of age. Acute malnutrition was defined as mid-upper arm circumference below 12.5 cm, capturing both severe acute malnutrition (<11.5 cm) and moderate acute malnutrition (≥11.5 cm and <12.5 cm). Pathogen-specific 60-day fatality rates for all pathogens were higher among children with acute malnutrition, but no individual pathogen had a significantly larger increase in its relative association with mortality.

This is the first time the strong link between acute malnutrition and mortality during moderate-to-severe diarrhoea in children has been demonstrated as not limited to specific infections and affecting a broad spectrum of enteric pathogens.

Tickell KD, Chisti MJ. *et al.* The effect of acute malnutrition on enteric pathogens, moderate-to-severe diarrhoea, and associated mortality in the Global Enteric Multicenter Study cohort: a post-hoc analysis. *Lancet Global Health* 2020; 8: e2115-e224.

CONTROLLING ENTERIC AND RESPIRATORY INFECTIONS



Programme lead

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Senior Scientist

Infectious Diseases Division

We generate a better understanding of key disease-causing organisms and host immune responses to develop and evaluate low-cost potentially scalable preventive and therapeutic interventions.

Our work spans the full spectrum of infectious disease research, from basic laboratory sciences to field-based clinical trials, mathematical modelling, policy development and implementation.

Our outstanding laboratory, clinical and population-based research has enabled us to make major contributions to the fields of infectious disease epidemiology, immunology and microbial pathogenesis. While, we are internationally recognised for the quality of our research related to diarrhoeal diseases, including pioneering molecular-genetic studies of the cholera pathogen *Vibrio cholerae*. In addition, our clinical trial programme is conducting phase I–IV vaccine trials (e.g. for cholera, Shigella, enterotoxigenic *E. coli*, rotavirus, typhoid, hepatitis E and B viruses, human papillomavirus, respiratory syncytial virus (RSV), meningococcal conjugate vaccine, rabies and influenza) through well-established urban and rural field sites. Since the beginning of the C19 pandemic, we have extensively invested our resources into tracking, testing, and understanding this disease's pathogenesis.

We are focusing our efforts on meeting the demands of disadvantaged populations (e.g. urban slum dwellers and the rural poor) as this is where the burden of disease is greatest. We are also expanding our research portfolio on respiratory infections (e.g. influenza, RSV vaccination of mothers, and prevention with monoclonal antibodies in infants), microbiomics, diagnostics, mathematical modelling, and integrated control strategies.

We are exploring the underlying causes of both enteric and respiratory diseases and their associated host immune responses. We are also developing cost-effective vaccines and therapeutic interventions in order to prevent and treat these pathogens in LMICs. In urban slums, vaccination and treatment will be combined with WASH, nutrition and preventive therapeutics to halt disease transmission.



DR FIRDAUSI QADRI
Emeritus Scientist

Infectious Diseases Division

COVID-19 ANTIBODY RESPONSE

The study assessed the antibody responses after COVID-19 infection in patients who are mildly symptomatic or asymptomatic in Bangladesh (see page 27).

PROTECTIVE IMMUNITY TO CHOLERA

Vaccination is an important strategy to prevent cholera, but currently available vaccines provide only 3 to 5 years of protection. Understanding immune responses to cholera antigens in naturally infected individuals may elucidate which of these are key to longer-term protection seen following infection. Recently, we showed that cholera patients develop age-related immune responses against sialidase and suggest that immune responses that target sialidase may contribute to protective immunity against cholera (1). Transcutaneous vaccination

can induce both mucosal and systemic immune responses. We found that presenting Vi in a conjugate versus unconjugated form transcutaneously resulted in comparable serum IgG responses but higher serum and lamina propria lymphocyte IgA anti-Vi responses, as well as increased IgG memory responses. These results suggest that transcutaneous vaccination of a conjugate vaccine can induce systemic as well as enhanced mucosal and memory B-cell anti-polysaccharide responses (2).

Oral, inactivated cholera vaccines (OCV) result in more-limited protection. To identify characteristics of the innate immune response that may distinguish natural *V. cholerae* infection from OCV, we stimulated differentiated, macrophage-like THP-1 cells with live versus heat-inactivated *V. cholerae* with and without endogenous or exogenous cholera holotoxin. We conclude, that in humans, IL-23 promotes the differentiation of Th17 cells to T follicular helper cells, which



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Infectious Diseases Division

maintain and support long-term memory B cell generation after infection (3).

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GENETIC DIVERSITY OF SALMONELLA PARATYPHI A

The proportion of enteric fever cases caused by *Salmonella* Paratyphi A is increasing and has become a major public health concern. We have begun to introduce typhoid conjugate vaccines (TCVs) due to new strains appearing in the disease. While numerous epidemiological and genomic studies have been conducted for *S. Typhi*, there is limited data describing the genomic epidemiology of *S. Paratyphi A* especially particularly in endemic settings, such as Bangladesh.

In this study, we conducted whole genome sequencing (WGS) using Illumina HiSeq 2500 platform and sequenced 67 *S. Paratyphi A* isolated between 2008 and 2018 from enteric disease surveillance sites across Bangladesh. We performed a detailed phylogenetic analysis of these sequence data incorporating sequences from previously published global collection and observed closely related to isolates originating in Nepal, India, Pakistan, and Myanmar. The population structure was relatively homogenous across the country as we did not find any significant lineage distributions between study sites inside or outside Dhaka.

Our genomic data showed the presence of single point mutations in *gyrA* gene either at codon 83 or 87 associated with decreased fluoroquinolone susceptibility in all Bangladeshi *S. Paratyphi A* isolates.

We additionally identified the pHCM2 cryptic plasmid which was identical to *S. Typhi* plasmids circulating in Bangladesh, this has not been previously identified in any *S. Paratyphi A* strains. This study demonstrates the utility of WGS to monitor the ongoing evolution of this emerging enteric pathogen to understand both regional and global circulation patterns of this neglected emerging pathogen and will provide a framework for future genomic surveillance studies.

CRYPTOSPORIDIOSIS AND ENTEROPATHOGENS IN BANGLADESH

Cryptosporidiosis is a common cause of infectious diarrhoea in young children worldwide, significantly contributing to under-five mortality. Currently, no vaccine is available to prevent cryptosporidiosis, and little in the way of treatment. *icddr*'s cryptosporidiosis studies contribute to advancing the understanding of the impact of cryptosporidiosis on child health, malnutrition, and immunity to protection that helps lay the foundation for new treatment and prevention approaches. A pan-Cryptosporidium qPCR assay was used to identify sub-clinical and symptomatic cryptosporidiosis.

Non-diarrhoeal infection was mostly common, and 77 percent (of 750 infants) of children experienced at least one infection with *Cryptosporidium* sp. in the first two years of life. In the urban site, multiple infections were higher compared to the rural site. The most common species in urban areas was *Cryptosporidium hominis*, whereas *Cryptosporidium meleagridis* predominated in the rural areas, having similar consequences on child growth.

Genetic diversity of *Cryptosporidium hominis* infections was evaluated in slum dwelling infants in Dhaka over a two-year period to determine the rate of reinfection, seasonality and varied clinical presentations of cryptosporidiosis. This study found thirteen different *C. hominis* genotypes and seven hyper variable regions identified by whole genome sequencing. Most interestingly, cryptosporidium infections were more frequent during the monsoon (early June–late September 2015 and 2016).

Faecal immunoglobulin A directed against the *Cryptosporidium* sporozoite-expressed antigen Cp23 at 12 months of age was found to be associated with delayed time to subsequent

cryptosporidiosis to two and three years of life. This suggests a protective role of the mucosal antibody-mediated immunity in developing protective immunity to *Cryptosporidium* infection.

A cost-effective, user friendly and FDA approved - *Giardia/Cryptosporidium* QUIK CHEK®, test was reported, faecal antigen detection test was more specific than qPCR and allowed for point of care diagnosis of *Cryptosporidium* diarrhoea to overcome the hurdle of expense, laboratory setup and technical expertise.

Evaluation of *Cryptosporidium*-positive faecal by using 16S rRNA gene sequencing characterised the role of the gut microbiota in diarrhoeal cryptosporidiosis. Low abundance of *Megasphaera* was found to be associated with the diarrhoeal symptoms prior to and at the time of *Cryptosporidium* detection.

Based on increasing evidence for the development of naturally occurring immunity to *Cryptosporidium* that combined with well-described adverse effect of subclinical early childhood cryptosporidiosis, offers the hope that a cryptosporidiosis vaccine could have measurable impact on child health. *icddr*'s findings also demonstrate that renewed efforts to better understand human immune responses to *Cryptosporidium* will pave a new way in metabolomics.

Carey, M. A., Faruque, A. S. G. *et al.* *Megasphaera* in the stool microbiota is negatively associated with diarrheal cryptosporidiosis. *Clinical Infectious Diseases*, 1–10. <https://doi.org/10.1093/cid/ciab207>

Gilchrist, C. A. *et al.* Genetic diversity of cryptosporidium hominis in a bangladeshi community as revealed by whole-genome sequencing. *Journal of Infectious Diseases*, 218(2), 259–264. <https://doi.org/10.1093/infdis/jiy121>

Kabir, M., *et al.* *Giardia/cryptosporidium* quik chek assay is more specific than quantitative polymerase chain reaction for rapid point-of-care diagnosis of cryptosporidiosis in infants in Bangladesh. *Clinical Infectious Diseases*, 67(12), 1897–1903. <https://doi.org/10.1093/cid/ciy372>

Korpe, P. S. *et al.* Natural History of Cryptosporidiosis in a Longitudinal Study of Slum-Dwelling Bangladeshi Children: Association with Severe Malnutrition. *PLoS Neglected Tropical Diseases*, 10(5). <https://doi.org/10.1371/journal.pntd.0004564>

Steiner, K. L. Faruque, A. S. G. *et al.* Species of cryptosporidia causing subclinical infection associated with growth faltering in rural and Urban Bangladesh: A birth cohort study. *Clinical Infectious Diseases*, 67(9), 1347–1355. <https://doi.org/10.1093/cid/ciy310>

Steiner, K. L. *et al.* Delayed time to cryptosporidiosis in bangladeshi children is associated with greater fecal iga against two sporozoite-expressed antigens. *American Journal of Tropical Medicine and Hygiene*, 104(1), 229–232. <https://doi.org/10.4269/AJTMH.20-0657>

Steiner, K. L. *et al.* Faecal immunoglobulin a against a sporozoite antigen at 12 months is associated with delayed time to subsequent cryptosporidiosis in urban Bangladesh: A prospective cohort study. *Clinical Infectious Diseases*, 70(2), 323–326. <https://doi.org/10.1093/cid/ciz430>

DETECTING AND CONTROLLING EMERGING AND RE-EMERGING INFECTIONS



Programme lead

DR SAYERA BANU

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Infectious Diseases Division

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 Prevention (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 (IEDCR) 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.

Future priorities include developing a better understanding of antimicrobial resistance nationally, impacts of C19, 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.

ANTIBODY RESPONSE AFTER COVID-19 INFECTION

Antibody responses after C19 infection in patients who are mildly symptomatic or asymptomatic in Bangladesh (see page 27).

INFLUENZA CIRCULATION DURING COVID-19 PANDEMIC

Data from hospital-based influenza surveillance was analysed during the C19 pandemic from March to December 2020 among patients admitted with severe acute respiratory infections (SARI), defined as subjective or measured fever of $\geq 38\text{ C}^\circ$ and cough with onset within the last 10 days. Among 1,986 SARI patients, 14.3 percent were infected with SARS-CoV-2 and 8.8 percent infected with the influenza virus. Influenza virus remained undetectable during the first 14 weeks of the 20 weeks (May to September) of peak influenza circulation period in Bangladesh. Co-infection with SARS-CoV-2 and influenza virus was not very common together with the non-appearance of the influenza virus during most of the peak influenza period in Bangladesh during the C19 pandemic. It is important to keep on continuing the surveillance.

SENTINEL SURVEILLANCE FOR COVID-19 IN BANGLADESH

icddr,b, in collaboration with the IEDCR, established a hospital-based surveillance platform at three secondary level public and one tertiary level private hospitals for screening suspected C19 patients. This enabled and understanding of the C19 situation in different regions where nearby testing facilities (reverse transcription polymerase chain reaction, RT-PCR) were not available.

Surveillance staff enrolled suspected C19 patients and recorded clinical and epidemiological data, collected and transported nasopharyngeal swabs to icddr,b, Dhaka for SARS-CoV-2 test using RT-PCR. Findings were reported to the authorities over email and to patients over SMS within 36 hours. Staff followed-up all patients after 30 days for the outcome of the illness over the telephone. From June-August 2020, C19 was detected among one-third of enrolled patients and it was more common in outpatients with a peak positivity in July. Death rate among C19 cases was 2.6 percent within 30 days of enrolment. Diabetic patients were more likely to get C19 than non-diabetic patients. Death was associated with those aged over 60 years,

shortness of breath, co-morbidity, smoking history, hospital admission and seeking healthcare less than two days prior to critical illness.

TRANSMISSION DYNAMICS OF COVID-19 IN BANGLADESH

icddr,b, in collaboration with IEDCR conducted a national level survey to assess the C19 situation in Bangladesh from April 2020 to October 2020 to estimate the C19 burden and transmission dynamics. During the period, the prevalence of C19 was found to be 6.5 percent on the day of the sample collection. The prevalence of C19 cases was highest among adolescents (15-19 years) followed by the elderly (60+ years) and there was no notable difference between the prevalence of female and male population. Among the same population at the same time, it was estimated that a seroprevalence of 30.4 percent for IgG, 39.7 percent for IgM and 51.8 percent for IgG and IgM together.

SARS-COV-2 WASTEWATER-BASED EPIDEMIOLOGICAL SURVEILLANCE

Wastewater surveillance is helping scientists in more than 50 nations to monitor the spread of SARS-CoV-2 in sewage. COVID-19 infected individual sheds SARS-CoV-2 viral RNA into wastewater via faeces. The fact of viral shedding and persistent up to few weeks in faeces provides an advantage to researchers worldwide in utilising wastewater systems to monitor the viral trend and predict infection dynamics in the community.

Since September 2020, icddr,b researchers detected SARS-CoV-2 RNA in wastewater from different hospitals, sewer networks, community drains, and surface water bodies in Dhaka city. A total of 412 wastewater samples were collected and extracted by RT-qPCR for RdRp and N-genes.

Out of 412 samples, 49 percent were positive for SARS-CoV-2 RNA. The highest proportion of positive samples were from hospitals' septic tanks (60%), sewer networks (45%), and the community (45%) which includes ends of drains (74%), the centres of canals (72%), and the junctions between drains and canals (67%).

Haque R, Rahman M, Rahman MZ, Amin N, Mahmud ZH, Rahman MZ, Raqib R, Sarker P, Hossain A,



Johnston D, Akter N, Islam MT, Bhattacharya P. "Inference and Forecasting of SARS-CoV-2 Wastewater Surveillance in Bangladesh." In CUGH 2021 Virtual Conference. CUGH.

MANAGEMENT OF DENGUE OUTBREAKS

Chemical controls with the selective insecticides in the form of adulticide or larvicide are the predominant measure

to control mosquitoes in Dhaka and other parts of the country. icddr,b carried investigated insecticide resistance in *Aedes aegypti* mosquitoes in seven districts of Bangladesh including several spots in Dhaka city corporation areas. Four globally used insecticides for this study namely: permethrin, deltamethrin, bendiocarb and malathion were selected for this study.



DETECTING AND CONTROLLING EMERGING AND RE-EMERGING INFECTIONS

High levels of resistance to permethrin were observed for all *Ae. aegypti* populations in the study, with mortality ranging from 0 – 14.8 percent. Substantial resistance was observed in populations tested with higher (2x) doses of permethrin (5.1 – 44.4 percent mortality). Susceptibility to deltamethrin and malathion varied between populations. However, complete susceptibility to bendiocarb was conformed in all populations. As permethrin was the main ingredient of the insecticide used by both Dhaka North City Corporation and Dhaka South City Corporation, the information was immediately disseminated to the corresponding stakeholders.

The government relaxed the public health insecticide registration policy and allowed city corporations to switch their insecticide. City corporations started to use new insecticides (malathion and deltamethrin) which will lead to the reduction of the dengue outbreaks and deaths.

Al-Amin, H.M., *et al.*, Insecticide resistance status of *Aedes aegypti* in Bangladesh. *Parasit Vectors*, 2020. 13(1): p. 622.

GLUCOSE-6-PHOSPHATE DEHYDROGENASE (G6PD) DEFICIENCY

Glucose-6-phosphate dehydrogenase deficiency (G6PD deficiency) is a common, X-linked hereditary enzyme deficiency affecting approximately 400 million people worldwide, mainly in malaria-endemic regions. Primaquine-based radical cure is the only available treatment for the effective clearance of the vivax malaria parasites from the human host but can cause severe side effects in individuals with G6PD deficiency.

Surveillance was conducted in a multi-ethnic population in the Chittagong Hill Tracts (CHT) of Bangladesh, which carries the highest burden of malaria incidence in the country. A total of 1,002 participants from 11 major ethnicities were enrolled to assess the prevalence of G6PD deficiency by phenotype and genotype.

G6PD activity was measured by spectrophotometry. The adjusted male median (AMM) was defined as 100 percent G6PD activity and participants were categorised as G6PD deficient (<30% activity), G6PD intermediate (30%

to 70% activity) or G6PD normal (>70 percent activity).

The AMM was 7.03U/gHb. The proportions of individuals with G6PD deficiency differed significantly with ethnicity with severe G6PD deficiency present in 26 percent (26/100) of participants of the Chak ethnicity but only two percent (2/99) of those of Tripura ethnicity. Among 106 participants (32.8%) with confirmed genotype, 99 (93.4%) had the Mahidol variant (93.4% of all identified variants), the Orissa variant in six individuals (5.7% of all identified variants) and the Kalyan—Kerala variant in one individual (0.9% of all identified variants).

The high G6PDd prevalence and significant variation between ethnicities suggest the importance of routine G6PD testing to guide 8-aminoquinoline based radical in the CHT and comparable settings in the region.

Ley, B *et al.* Wide range of G6PD activities found among ethnic groups of the Chittagong Hill Tracts, Bangladesh. *PLoS Negl Trop Dis*, 2020. 14(9): p. e0008697.

NIPAH VIRUS

icddr,b has extended active surveillance activities in Bangladesh's eight-divisions, and expanded our surveillance network in 99 government and 256 private healthcare facilities through “enhanced surveillance” during Nipah season. Findings demonstrate that although interhuman transmission and morbidity/mortality indicators were stable, the number of spillovers and geographic context varied significantly over time. It is recommended that such a combination of active tracking of transmission and epidemiological indicators and systematic surveillance should be applied to other high-risk emerging pathogens to prevent future public health emergencies [1].

Surveys were conducted among 1,642 contacts of 94 Nipah virus laboratory-confirmed cases in Bangladesh to determine how contact patterns (physical and bodily fluids) changed as the disease progressed in severity. The number of contacts increased with the case's disease severity, and the highest number of contacts were detected on the day of the case's death.

Given transmission has only been observed among fatal cases of Nipah virus infection, the findings suggest

that changes in contact patterns during illness contribute to the risk of infection. This finding helps us understand the dynamics of Nipah virus transmission and variation of contacts based on the infectiousness of the host [2].

Funded by Defense Advanced Research Projects Agency (DARPA) through Johns Hopkins University and ongoing since 2018, one of the aims is to understand the epidemiology of the Nipah virus in Bangladesh. The longitudinal sites are located at Faridpur, Rangpur and Chittagong, and Nipah outbreak sites were Faridpur, Jhalkathi and Gopalganj. During 2019, we shipped 6,700 cryovials (tubes) containing 1,300 saliva swabs, 1,300 urine swabs, 1,600 serum samples and 2,500 roost urine to Rocky Mountain Laboratory of the National Institute of Health located in the USA for testing. Six bats and 11 roost urine samples tested positive for Nipah virus RNA. We have also detected two novel paramyxovirus among the archived roost urine of bats.

1. Nikolay B, Salje H, Khan AD, Sazzad HM, Satter SM, Rahman M, Doan S, Knust B, Flora MS, Luby SP, Cauchemez S. A framework to monitor changes in transmission and epidemiology of emerging pathogens: lessons from Nipah virus. *The Journal of infectious diseases*. 2020 May 1;221(Supplement_4):S363-9.

2. Lee KH, Nikolay B, Sazzad HM, Hossain MJ, Khan AD, Rahman M, Satter SM, Nichol ST, Klena JD, Pulliam JR, Kilpatrick AM. Changing Contact Patterns Over Disease Progression: Nipah Virus as a Case Study. *The Journal of infectious diseases*. 2020 Jul 6;222(3):438-42.

ANTIMICROBIAL RESISTANCE

icddr,b assessed the colonisation prevalence of three multidrug resistant organism (MDRO) in hospitals and the surrounding community: Enterobacteriales with resistance to extended-spectrum cephalosporins (ESCrE) or carbapenems (CRE) or Colistin (ColRE) and methicillin-resistant *Staphylococcus aureus* (MRSA). Stool and nasal samples were collected from adults in three hospitals and from an enumerated population within the hospitals' community catchment area.

Of 743 patients enrolled in hospitals and 768 community participants, a high prevalence of MDRO colonisation was detected respectively among hospital and community participants (ESCrE: 80% and 77%; CRE: 39% and 11%; ColRE: 14% and 14%; MRSA: 21% and 23%). The most frequently identified

Enterobacterales were *Escherichia coli* and *Klebsiella pneumoniae* for hospitals (73% and 22% respectively) and community (75% and 18% respectively). In this study, most hospital and community participants were colonised with at least one clinically important MDRO, putting them at risk for developing antibiotic resistant infections and facilitating the continued spread of MDROs in both the community and hospital.

PREVENTABLE NEONATAL DEATHS

CHAMPS is a cross-divisional initiative to determine exact cause of deaths (CoD) among under-five children and stillbirths, including, identifying the new/emerging pathogens. Data from 117 perinatal deaths (57 stillbirths and 60 early neonatal deaths) were analysed and it was determined that intrauterine hypoxia (81%) was the leading cause of stillbirths with placental complications (22%) as the main contributing factor. Other causes of stillbirth included maternal hypertension, intrauterine infection, and labour and delivery-related complications. Half of early neonatal deaths were due to preterm birth complications and 33% were due

to perinatal asphyxia. The vast majority of these deaths (92%) were preventable.

Rahman, A. et al. (2020), 'Underlying causes of perinatal deaths among cases undergoing minimally invasive tissue sampling in Bangladesh', ASTMH 2020 Annual Meeting.

PUBLIC HEALTH PERSPECTIVE ON SANITATION INVESTMENT DECISION-MAKING

icddr,b, has adopted a system modelling approach for a study site in Dhaka involving 1,500 households in a low-income area. The model comprises fate-and-transport and exposure-and-risk components, supported by the environmental sampling of key target pathogens in wet and dry seasons, and compares a range of possible sanitation investment options regarding their relative health risk.

The health effects of eight sanitation options were assessed, focusing on five target pathogens (*Shigella*, *Vibrio cholerae*, *Salmonella Typhi*, norovirus GII and *Giardia*). Comprehensive coverage of septic tanks was estimated to reduce the disease burden in disability-adjusted life years (DALYs) by 48–72 percent, while

complete coverage of communal scale anaerobic baffled reactors was estimated to reduce DALYs by 67–81 percent.

Despite these improvements, a concerning health risk persists with these systems due to effluent discharge to open drains, particularly when the systems are poorly managed. Notwithstanding variability and uncertainties in input parameters, systems modelling can be a feasible and customisable approach to consider the relative health impact of different sanitation options across various contexts and stands as a valuable tool to guide urban sanitation decision-making.

1. Amin N, Liu P, Foster T, Rahman M, Miah MR, Ahmed GB, et al. Pathogen flows from on-site sanitation systems in low-income urban neighborhoods, Dhaka: A quantitative environmental assessment. *International journal of hygiene and environmental health*. 2020;230:113619.

2. Foster T, Falletta J, Amin N, Rahman M, Liu P, Raj S, et al. Modelling faecal pathogen flows and health risks in urban Bangladesh: Implications for sanitation decision making. *International journal of hygiene and environmental health*. 2021;233:113669.

TUBERCULOSIS

Our work on Tuberculosis has been presented under Spotlight (see page 16).



ACHIEVING UNIVERSAL HEALTH COVERAGE



Programme lead (Acting)

**DR MAHBUB ELAHI
CHOWDHURY**
Scientist

Health Systems and
Population Studies Division

We contribute, not just to a local Bangladesh conversation about health systems and coverage, but also to a global understanding and conversation on how low and middle-income countries and the global South can develop a better health system.

In Bangladesh and many low-income countries, real problems exist regarding how people access health services that are effective and affordable. In many high income countries this is a problem too. Access to the health services can be limited by a range of factors including but not limited to, geography, poverty, education, gender and disability. Health is not just important for the individual. It's also important for the economy.

We have a range of research that investigates health systems. We are looking at different models for delivering, financing, and the effectiveness of health services. We look at the effects of gender, disability, morality or geographic displacement and access to health services.

We are leveraging our expertise to strengthen the urban health service delivery system (e.g. introducing ICT-based mapping of health facilities, providing evening outdoor services in public facilities), improving health financing mechanisms (e.g. adapting learning from Chakaria micro health insurance in the national health system), developing models for efficient utilisation of the health workforce, and identifying new approaches to achieve greater regulatory compliance in the private sector. We are also undertaking research on monitoring and supervision of systems for improved governance and accountability.

Our research focuses specifically on increasing service availability, improving accessibility to quality care, reducing out-of-pocket expenditure for healthcare, improving the health and social wellbeing of older people, and minimising the impact of social determinants of health. We also engage policymakers and implementers at the national and grassroots level, encouraging them to use evidence-based strategies to address health system issues. We are also developing stronger links with the global universal health coverage community.

The division has recently revitalised itself into five research groups and three initiatives.

RESEARCH GROUP: HEALTH SERVICE DELIVERY

DISTRICT HEALTH INFORMATION SYSTEM (DHIS)

Bangladesh has been using DHIS (version 2) since 2009 for capturing real-time health service utilisation data. However, routinely collected data was underused because of poor data quality and reporting. A qualitative study was conducted to understand facilitators and barriers in implementing DHIS2 to retrieve meaningful and accurate data for reproductive, maternal, newborn, child, and adolescent health (RMNCAH) services. It was found that among the facilitating factors, strong government commitment, extensive

donor support, and positive attitudes toward technology among staff are most notable.

While quality checks and feedback loops at multiple levels of data gathering points are helpful for minimising data errors. On the other hand, barriers to effective DHIS2 implementation includes lack of human resources, slow internet connectivity, frequent changes to DHIS2 versions, and maintaining both manual and electronic system side-by-side. Additionally, Data in DHIS2 remains incomplete as it does not capture data from private health facilities. Having two parallel HMIS reporting the same RMNCAH indicators threatens data quality and increases the reporting workload.

The overall insights from this study are expected to contribute to the development



**PROFESSOR DANIEL
REIDPATH**
Senior Director

Health Systems and
Population Studies Division



of effective strategies for successful DHIS2 implementation and building a responsive HMIS.

Begum T et al. Perceptions and experiences with district health information system software to collect and utilize health data in Bangladesh: a qualitative exploratory study. *BMC Health Serv Res* 2020 May 26;20(1):465. doi: 10.1186/s12913-020-05322-2.

EXCLUSIVE BREASTFEEDING (EBF)

In Bangladesh, the practice of EBF among adolescent mothers was unexplored. Scientists at icddr,b carried out a study to understand EBF practices among adolescent mothers and their determinants in both the HDSS system, areas of icddr,b service area and government service area in rural Matlab, Bangladesh. The study revealed many socio-demographic factors limit EBF practices. It also noted that the coverage of EBF among adolescent mothers in the study area was lower than the national average (42% vs. 65%). Relevant policies, programmes, and research should address the challenges regarding EBF practice among adolescents.

Rahman A et al. Trends and determinants of EBF among adolescent children born to adolescent mothers in rural Bangladesh. *Int J Environ Res Public Health* 2020;17(24):9315. doi:10.3390/ijerph17249315.

OBESITY IN YOUNG CHILDREN

While recent evidence suggests that the overall prevalence of obesity in young children in Bangladesh is low, little is known about variation in trends by sex, socioeconomic status, urbanicity, and region. A study investigated the trends among overweight children aged 24–59 months using nationally representative samples from Bangladesh Demographic and Health Surveys (BDHS) between 2004 and 2014.

There is a rising trend in overweight prevalence exclusively among girls aged 24–59 months in Bangladesh. Childhood obesity is associated with higher household education and wealth index, and the relative disparity by these factors appears to be increasing over time. These unmet inequalities should be considered while developing national public health programmes and strategies.

Shawon MSR et al. Trends in the prevalence of overweight among Bangladeshi children aged 24-59 months (2004-2014) by sex and socioeconomic status. *Int J Obes (Lond)* 2020 Mar;44(3):664-674. doi: 10.1038/s41366-019-0507-9.

RESEARCH GROUP: HEALTH ECONOMICS AND FINANCING

ECONOMIC BURDEN OF MEASLES

The study estimated the economic cost of treating measles in children under-five in Bangladesh from the caregiver, government, and societal perspectives. It revealed that a hospitalised case of measles cost USD 159 compared to USD 18 in an outpatient setting. On average, the government spent USD 22 per hospitalised case of measles in Bangladesh. Seventy-eight percent of the poorest caregivers faced catastrophic health expenditures compared to 21 percent of the richest. In 2018, 2,263 cases of measles were confirmed, totaling USD 348,073 in economic costs to Bangladeshi society, with USD 121,842 in out-of-pocket payments for households.

Improving measles vaccination coverage in areas where it is deficient (Sylhet division in our study) would likely alleviate most of this burden.

de Broucker G et al. The economic burden of measles in children under five in Bangladesh. *BMC Health Serv Res* 2020 Nov 10;20(1):1026. doi: 10.1186/s12913-020-05880-5.

ACHIEVING UNIVERSAL HEALTH COVERAGE

COST BENEFIT OF MALARIA VACCINATION

In Bangladesh 17.5 million people are at risk of endemic malaria transmission, however over 90 percent of all malaria cases are reported from Chittagong Hill Tracts (CHT) districts (Khagrachhari, Rangamati and Bandarban) making these most vulnerable districts. Accordingly, icddr,b studied the cost-effectiveness of universal childhood malaria vaccination in CHT of Bangladesh with newly developed RTS,S/AS01 malaria vaccines. It was found that introducing childhood malaria vaccination in CHT for a single birth cohort could prevent approximately 500 malaria cases and at least 30 deaths from malaria during the first year of vaccination. The cost per malaria vaccine compared to status quo is USD 2,629 and USD 2,583 from the health system and societal perspective, respectively. The study concluded that introduction of malaria vaccination in CHT region is estimated to be a cost-effective preventive intervention and would offer substantial future benefits particularly for young children vaccinated. Policies should, thus, consider the operational advantages of targeting these populations, particularly in the CHT area, with the vaccine along with other malaria control initiatives.

Sarker AR, Sultana M. Cost-effective analysis of childhood malaria vaccination in endemic hotspots of Bangladesh. *PLoS One* 2020 May 29;15(5):e0233902. doi: 10.1371/journal.pone.0233902.

HEALTH INSURANCE FOR RMG WORKERS

The employer sponsored health insurance (ESHI) scheme increased healthcare utilisation of medically trained providers by 26.1 percent among insured ready-made garment (RMG) workers compared to uninsured workers. The ESHI scheme significantly increased utilisation of medically trained providers among RMG workers. However, it has no significant effect on out of pocket (OOP) expenditure. An educational intervention seems plausible for RMG workers to improve their healthcare-seeking behaviours and thus utilisation of ESHI-designated healthcare providers while keeping OOP payments low.

Ahmed S, Sarker AR, Sultana M, et al. Do employer sponsored health insurance schemes affect the utilisation of medically trained providers and out-of-pocket payments among ready-made garment workers? A case-control study in Bangladesh. *BMJ Open* 2020;10:e030298. doi:10.1136/bmjopen-2019-030298.

HEALTH SYSTEM RESILIENCE CHECKLIST

There are 10 thematic categories identified in this study as important components of resilient health systems, these are - core health system capabilities/capacities, infrastructure/transportation, financing, barriers to care, communication/collaboration/partnerships, leadership/command, surge capacity, risk communication, workforce and infection control.

The checklist is an important first step in improving health system resilience against threats like disease outbreaks and natural disasters. However, additional research and resources will be necessary to further refine and prioritise the checklist items and to pilot the checklist with frontline health facilities. This will help ensure its feasibility and durability for the longterm within health systems strengthening and health security fields.

Meyer D, Bishai D, Ravi SJ, et al. A checklist to improve health system resilience to infectious disease outbreaks and natural hazards. *BMJ Global Health* 2020;5:e002429.

COMMUNITY SCORECARD

Engaging communities in health facility management and monitoring is an effective strategy to increase health system responsiveness. Many developing countries have used the community scorecard (CSC) to encourage community participation in health. However, the use of CSC in health in Bangladesh has been limited. In 2017, icddr,b initiated a CSC process to improve health service delivery at community clinics (CC) providing primary healthcare in rural Bangladesh. The findings suggest that CSC is a feasible and acceptable tool to engage community and healthcare providers in monitoring and managing health facilities. The findings are intended to inform programme implementers, donors and other stakeholders regarding context, mechanisms, outcomes and challenges of CSC implementation in Bangladesh and other developing countries. However, proper contextualisation, institutional capacity building and policy integration will be critical in establishing effectiveness of CSC at scale.

Mahmood SS et al. Feasibility, acceptability and initial outcome of implementing community scorecard to monitor community level public health facilities: experience from rural Bangladesh. *Int J Equity Health* 2020 Nov 2;19(1):155. doi: 10.1186/s12939-020-01265-6.

RESEARCH GROUP: URBAN HEALTH

PREGNANCY TERMINATION

The study looked at the knowledge and attitudinal factors affecting decisions to end pregnancies. It found that compared to those who did not terminate their unintended pregnancies, women who terminated their pregnancies were more knowledgeable about modern methods of termination. They have also reported lower health risks, lower costs to treat complications, fewer social/familial consequences for termination and were more likely to say that both the husband and wife were involved in the decision-making process. Both groups of women with unintended pregnancies had very high rates of contraceptive failure. Improvements in contraceptive practice can reduce the rate of unintended pregnancy and thus incidence of pregnancy termination.

Razzaque A, DaVanzo J & Ahmed S. (2020). Knowledge, Costs and Decision-Making Processes Regarding Pregnancy Termination in Matlab, Bangladesh. *J Womens Health Safety Res*, 4(2): 172-183. January 13, 2020.

BARRIERS TO PHYSICAL ACTIVITY (PA)

The current study assessed the barriers to promoting PA from the perspectives of school authorities and parents in urban Bangladesh. PA has not been prioritised at most schools for two primary reasons: 1) there was a general lack of understanding of the importance of PA; and 2) physical education classes did not contribute to grades. Outside school, lack of adequate safe open spaces undermined access to PA. Further, there were social barriers to PA including lack of parental support due to concerns about tiredness and injury and the perception that PA was detrimental to academic achievement. Many parents chose screen-based activities for children over PA. Steps should be taken to enforce existing policies that mandate effective PA for school children, and parents and teachers should be educated about the need for and benefits of PA.

Hasan AMR, Rashid M.H, Smith G, Selim MA, Rasheed S (2020) Challenges of promoting physical activity among school children in urban Bangladesh: A qualitative inquiry. *PLoS ONE* 15(3): e0230321. <https://doi.org/10.1371/journal.pone.0230321>.

CHRONIC ILLNESS AMONG ADULTS

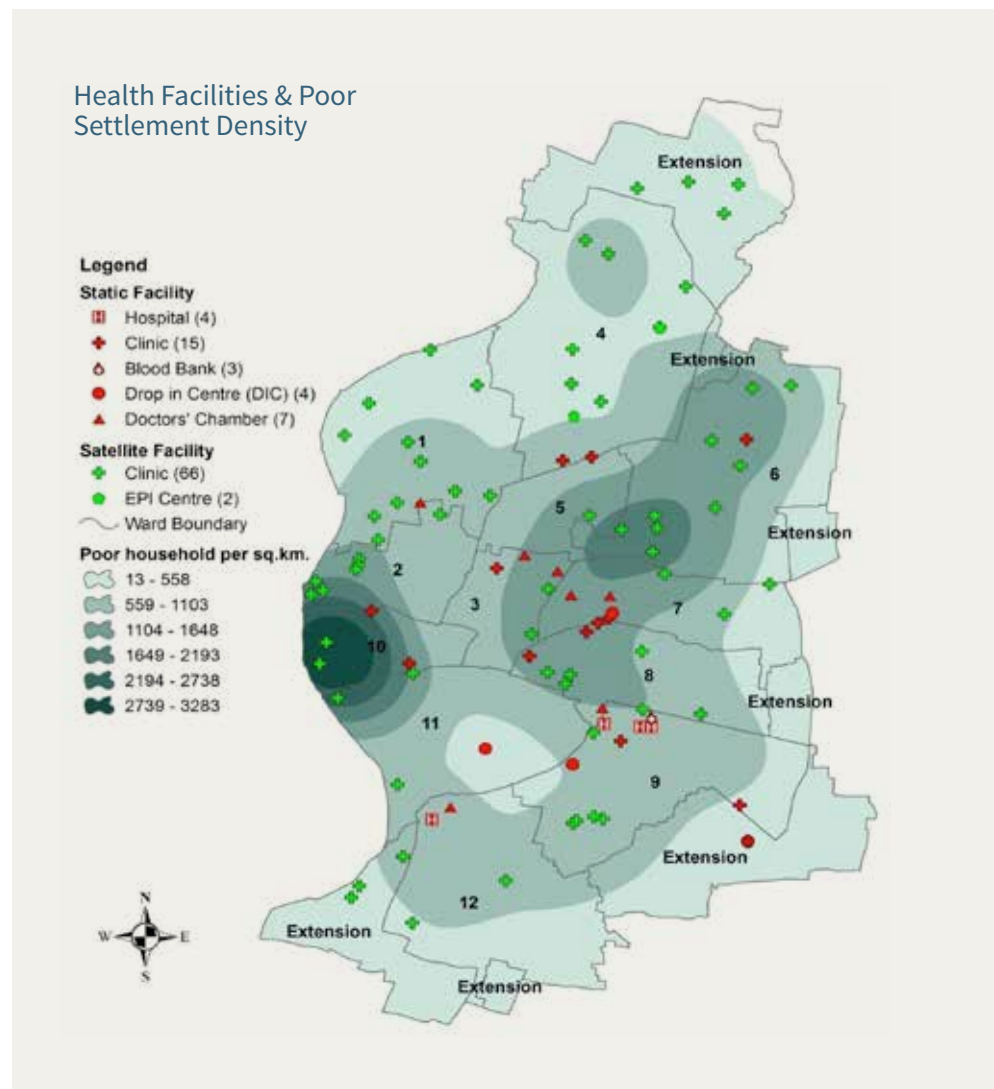
Significant differences in healthcare-seeking for chronic illness were apparent both within and between slum settlements related to sex, wealth score (the Progress of Poverty Index - PPI), and location. Women were more likely to use private clinics than men. Compared to poorer residents, those from wealthier households sought care to a greater extent in private clinics, while poorer households relied more on drug shops and public hospitals. Chronic symptoms also differed.

A greater prevalence of musculoskeletal, respiratory, digestive and neurological symptoms were reported among those with lower PPIs. The study concluded that slums are complex social and geographic entities and cannot be generalised. Priority attention should be focused on developing chronic care services that meet the needs of the working poor in terms of proximity, opening hours, quality, and cost.

Adams AM *et al.* Healthcare seeking for chronic illness among adult slum dwellers in Bangladesh: a descriptive cross-sectional study in two urban settings. *PLoS One* 2020 Jun 15;15(6):e0233635. doi: 10.1371/journal.pone.0233635.

GIS BASED CENSUS AND SURVEY OF HEALTH FACILITIES

Throughout South Asia, there is a proliferation of cities and middle-sized towns. While larger cities tend to receive greater attention in terms of national-level investments, opportunities for healthy urban development abound in smaller cities. It is vital to capture the moment where positive trajectories can be established. In Bangladesh, municipalities are growing in size and have tripled in number, especially district capitals. However, little is known about the configuration of health services to hold these systems accountable to public health goals of equity, quality, and affordability. This descriptive quantitative study uses data from a GIS-based census and survey of health facilities to identify gaps and inequities in services that need to be addressed. Findings reveal a massive private sector and a worrisome lack of primary and some critical care services. The study also reveals the value of engaging



municipal-level decision makers in mapping activities and analyses to enable responsive and efficient healthcare planning.

Hasan SM *et al.* Healthcare systems strengthening in smaller cities in Bangladesh: geospatial insights from the municipality of Dinajpur. *Health Serv Insights* 2020 Sep 3. doi:10.1177/1178632920951586 Epub ahead of print.

RESEARCH GROUP: POPULATION SCIENCE

SOCIAL DETERMINANTS OF UNDER-FIVE MORTALITY IN CHILDREN

Mortality in households with the lowest socioeconomic status (SES) was 2.2 times higher than that of children from highest SES households. Inequality in under-five mortality rate

(U5MR) at various levels of mother's education and household SES were observed in seven surveys except for 2014 and 2007. For children with birth order of two or below and preceding birth interval of three or more years, U5MR were lower than their respective counterparts. Steady linear decline in U5MR with increased household SES and birth order of two or below was observed among children of mothers with six or more years education and all education categories respectively.

No significant sex differential in U5MR was observed. Crucially, no under-five mortality was reported among urban under five children who received all basic vaccinations.

Chowdhury, Asiful & Hanifi, Manzoor & Bhuiya, Abbas. (2020). Social determinants of under-five mortality in urban Bangladesh. *Journal of Population Research*. 37. 1-19. 10.1007/s12546-019-09240-x.

ACHIEVING GENDER EQUALITY AND PROMOTING SEXUAL AND REPRODUCTIVE HEALTH AND RIGHTS



Programme lead

**DR RUCHIRA
TABASSUM NAVED**
Senior Scientist

Health Systems and
Population Studies
Division

We carry out research to address key gender-related health issues and to promote gender equality in sexual and reproductive health.

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.

DELAYING ADOLESCENT PREGNANCY

Pregnancy among adolescent girls in Bangladesh is high, with 66 percent of women under the age of 18 reporting a first birth; this issue is particularly acute in the northern region of Bangladesh, an area that is especially impoverished and where girls are at heightened risk. Using formative research, the study examined the underlying social, individual and structural factors influencing married girls’ early first birth and participation in alternative opportunities (such as education or economic pursuits) in Bangladesh.

Participants recognise the health benefits of delaying first birth, but stigma around infertility and contraceptive use, pressure from mothers-in-law and health provider bias interfere with a girl’s ability to delay childbearing. Girls’ social isolation, lack of mobility or autonomy, and inability to envision alternatives to early motherhood compound the issue; provider

bias may also prevent access to methods. While participants agree that pursuit of education and economic opportunities are important, better futures for girls do not necessarily supersede their marital obligations of childrearing and domestic chores.

Findings indicate the need for a multi-level approach to delaying early birth and stimulating girls’ participation in economic and educational pursuits. Interventions must mitigate barriers to reproductive health care; train adolescent girls on viable economic activities; and provide educational opportunities for girls. Effective programmes should also address contextual issues by including immediate members of the girls’ families, particularly the husband and mother-in-law.

Samandari, G., Sarker, B.K., Grant, C. *et al.* Understanding individual, family and community perspectives on delaying early birth among adolescent girls: findings from a formative evaluation in rural Bangladesh. *BMC Women's Health* 20, 169 (2020). <https://doi.org/10.1186/s12905-020-01044-z>



ECONOMIC COERCION AND IPV

Prior studies of the association between intimate partner violence (IPV) and depressive symptoms have typically excluded economic coercion (EC), a prevalent form of IPV worldwide. The study used structural equation models (SEM) to estimate the association of EC with depressive symptoms, with

and without adjustment for physical/psychological/sexual IPV, among women in rural Matlab, Bangladesh. Data were collected from cross-sectional surveys with married women 15-49 years, conducted between November 2018 and January 2019. The findings suggest that EC is prevalent, significantly associated with depressive symptoms, and attenuates the association of other

forms of IPV with depressive symptoms. Addressing EC with other forms of IPV may be necessary to reduce depressive symptoms in exposed women.

Zara Khan, Yuk F. Cheong, Stephanie S. Miedema, Ruchira T. Naved, Kathryn M. Yount, Women's experiences of economic coercion and depressive symptoms in Matlab, Bangladesh, *SSM - Population Health*, Volume 12, 2020, 100641, ISSN 2352-8273, <https://doi.org/10.1016/j.ssmph.2020.100641>.

EXAMINING THE HEALTH CONSEQUENCES OF AND ADAPTATION TO CLIMATE CHANGE

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.

EFFECTS OF RAINFALL ON DENGUE

The study looked at the influence of climatic variability on the occurrence of clinical dengue requiring hospitalisation in Zone-5, a high incidence area of Dhaka City Corporation (DCC), Bangladesh. It revealed that dengue is transmitted throughout the year in Zone-5 of DCC, with seasonal variation in incidence. The number of rainy days per month is significantly associated with dengue incidence in the subsequent month. The study suggests the initiation of campaigns in DCC for controlling dengue and other *Aedes* mosquito borne diseases, including Chikunguniya from the month of May each year. Bangladesh Meteorological Department (BMD) rainfall data may be used to determine campaign timing.

Rahman, Kazi Mizanur *et al.* "An Association between Rainy Days with Clinical Dengue Fever in Dhaka, Bangladesh: Findings from a Hospital Based Study." *International journal of environmental research and public health* vol. 17,24 9506. 18 Dec. 2020, doi:10.3390/ijerph17249506.

EFFECTS OF CLIMATE VARIABILITY ON MALARIA

The role of environmental conditions on the occurrence of this vector-borne parasitic disease in the region is not fully understood. The study observed significant positive association between temperature and rainfall and malaria occurrence, revealing two peaks at 19 °C and 24.5 °C for temperature and at 86 mm and 284 mm for rainfall. In sub-group analysis, women were at a much higher risk of developing malaria at increased temperatures. People over 50 years and children under 15 years were more susceptible to malaria at increased rainfall. The observed associations have policy implications.

Emeto TI *et al.* Disparities in Risks of Malaria Associated with Climatic Variability among Women, Children and Elderly in the Chittagong Hill Tracts of Bangladesh. *Int J Environ Res Public Health*. 2020 Dec 17;17(24):9469. doi: 10.3390/ijerph17249469. PMID: 33348771; PMCID: PMC7766360.



PREVENTING AND TREATING NON-COMMUNICABLE DISEASES



Programme lead

DR ALIYA NAHEED

Scientist, and Head, Initiative for Non-communicable Diseases

Health Systems and Population Studies Division

We are responding to the burden of chronic diseases in Bangladesh, documenting current care practices and health-seeking behaviours, and evaluating new interventions relevant to low-income countries, with a focus on cardiovascular disease, diabetes and mental health disorders.

Our work is contributing to scalable solutions which are cost-effective in reducing the non-communicable disease (NCD) burden in Bangladesh, and can potentially be applicable elsewhere in the global South.

NCDs are a relatively new area of icddr,b work. We have witnessed the shift from communicable to non-communicable diseases using our Matlab surveillance data, and have secured competitive grants to conduct multidisciplinary research on major NCDs (cardiovascular diseases, cancers, chronic respiratory diseases and diabetes) and common mental health disorders.

Our future work will have a particular focus on cardiovascular disease, diabetes and mental health disorders. In addition to generating a deeper understanding of disease burden and risk factors, we are developing and evaluating prevention and treatment strategies suitable for implementation in resource-poor settings (e.g. mHealth and COBRA-BPS studies for hypertension treatment, BELIEVE rural vascular health study, and National Micronutrient Survey and NCD risk). We are partnering with colleagues across icddr,b and other national institutions, and collaborating with overseas partners. We aim to develop pragmatic solutions to tackle this rapidly growing area of health concern.

COMMUNITY HEALTH WORKER-LED CARE IMPROVES BP

Study finds frontline health workers can drive effective control of blood pressure in the rural communities in Bangladesh (see page 29).

DEPRESSION AMONG MOTHERS OF CHILDREN WITH ASD

The levels of depression were assessed among mothers of children with autism spectrum disorder (ASD) attending six schools offering special educational services for children with ASD in urban Dhaka, Bangladesh. Almost one in two mothers was found to have major depression. The quality of life of these mothers was generally poor. Integrating mental health services for mothers with ASD care in children is likely to address the burden of depression among the mothers of children with ASD and improve overall quality of life.

Naheed, A *et al.* Burden of major depressive disorder and quality of life among mothers of children with autism spectrum disorder in urban Bangladesh. *Autism Research*, 13: 284-297. <https://doi.org/10.1002/aur.2227>

GESTATIONAL DIABETES MELLITUS

This study highlights the importance of contextual factors in influencing postpartum care and support for women diagnosed with gestational diabetes mellitus (GDM) in three South Asian countries (Bangladesh, India and Sri Lanka). It indicates that although provision of postpartum care is complex, a group lifestyle intervention programme is highly acceptable to women with GDM, as well as to health care professionals, at urban hospitals.

Tewari A *et al.* Feasibility of a Lifestyle Intervention Program for Prevention of Diabetes Among Women With Prior Gestational Diabetes Mellitus (LIVING Study) in South Asia: A Formative Research Study. *Front. Glob. Womens Health*. 2020 Nov 27;1:587607



CENTRAL MANAGEMENT SERVICES

Supporting research and projects during the COVID-19 pandemic



Mr Syed Monjurul Islam
Deputy Executive Director



The year 2020 commenced with a promise of a grand year-round celebration of icddr,b's sixtieth anniversary. icddr,b organised the 15th Asian Conference on Diarrhoeal Disease and Nutrition (ASCODD) between 28 January – 30 January 2020. ASCODD brought together more than 450 researchers, healthcare professionals, policymakers, and programme persons from 18 countries dedicated to improving the lives of young children and their families suffering from typhoid, cholera, malnutrition, and other enteric diseases. However, central management services (CMS) shouldered every responsibility from conceptualisation to completion of the event.

Immediately after the conference, the C19 pandemic emerged to disrupt the lives of people, communities, organisations and governments across the world. Like any other organisation, icddr,b was confounded by the twin threats of the outbreak – protecting the lives and livelihoods of its employees and at the same time, continuing its research and hospital operations.

Even though icddr,b has vast experience responding to emerging pandemics and has earned a global reputation in managing outbreaks of cholera, HIV/AIDS, and H1N1 influenza, it was challenged with the sheer scale of the threat; needing to ensure safety and well-being of its employees, and continue its essential life-saving operations at the hospitals, laboratories and research.

Meanwhile, the country went into strict lockdown in late March to curb the spread of the virus, which significantly disrupted our operations and management processes. icddr,b management led by example, making extraordinary pre-emptive decisions, even before the country reported the first death due to C19 these including implementing work from home modalities, providing staff access to necessary logistics and personal safety equipment, increasing infection prevention control measures and setting up a hospital triage, C19 testing, isolation and treatment wards. The existing day care centre was turned into an isolation ward and the cafeteria transformed into an ICU with high flow oxygen supply facilities. We fast-tracked our support services related to procurement, human resources, finance, IT, regulatory and legal affairs, and facility management to support them. We helped establish the Severe Acute Respiratory Infection Isolation and Treatment Centre (SARI ITC) in Teknaf, which offers free of charge treatment to the host population and the Rohingyas within a short period.

The CMS has ensuring timely, effective and efficient service delivery and meeting compliance. This was possible because of the workforce's high standard commitment.





Mr Jan De Waal
Director, Development and Communications

DEVELOPMENT

The Development Unit has overseen continued positive engagement with icddr,b's core donors - Foreign, Commonwealth and Development Office, UK; Global Affairs Canada, the Swedish International Development and Cooperation Agency; and the Government of Bangladesh, as well as the US Government.

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

There was an attempt several years ago to launch a donation appeal for the Dhaka and Matlab Hospitals but in the crisis environment, since C19 arrived in Bangladesh, an icddr,b C19 appeal was launched in 2020 to sustain free life-saving services for the vulnerable community of Bangladesh. The Development Unit has been communicating, pushing messages and updates, responding, and soliciting funds regularly for this appeal. Substantial commitments, as well as donations from corporations, ready-made garment manufacturers and high-net-worth individuals were received in response to the appeal.

An impressive array of visitors in 2020 included representatives from LG Electronics Singapore, PTE Ltd. Bangladesh Branch and Rotary Club of Dhaka Mavericks, Bangladesh, who visited icddr,b to support our C19 donation appeal.

We are focused on aligning with the national and global C19 responses. The Development team is continuously sharing our alignment with global initiatives with our Core Donors and their headquarters. The two biggest initiatives are CEPI and the new umbrella organisation COVAX, which includes CEPI, GAVI and the WHO. CEPI has selected icddr,b as one of five global reference laboratories for C19 vaccine evaluation. Canada, the UK and

Sweden are all supporting CEPI and COVAX and news of this development has been very well received by the core donor representatives, as this serves to validate the importance of funding icddr,b to their offices in Ottawa, London and Stockholm.

icddr,b continues to communicate and update The Conrad N. Hilton Foundation since we were awarded the Conrad N. Hilton Humanitarian Prize in 2017. icddr,b received a grant of USD 250,000 as part of the Foundation's fund to assist organisations in their C19 response. Additionally, the Hilton Foundation has approved a grant of USD 100,000 in support of our charitable mission and programmes.

COMMUNICATIONS

We have provided extensive support to the 15th Asian Conference on Diarrhoeal Disease and Nutrition (ASCODD 2020) from its inception to promotion and conclusion of the event. ASCODD brought together more than 450 researchers, healthcare professionals, policymakers and programme persons from 18 countries.

In late February 2020, we developed several C19 related communications materials to raise awareness, promote face covering and personal hygiene. These were distributed across the institutions and its offices, to local partners and stakeholders, and also shared in social media. Mainstream media also disseminated messages. The initiative has significantly contributed to increasing awareness and activism among local communities.

Bangladesh reported its first C19 case on 8 March 2020, which resulted in an exponential growth of media reports. Alarming, a significant number of reports were either spreading misinformation or contributing to C19 media fatigue. Realising these complexities, we immediately positioned icddr,b's scientists and researchers as a credible and reliable source of information based on scientific evidence. A large number of in-depth interviews (over 100) in print and electronic media, and special scientific talks via webinar were facilitated.



Several media advocacy initiatives were instigated on issues such as allowing icddr,b and other capable laboratories to test for C19, establishment of C19 committees that included scientists and public health experts and vaccine researchers. During the reporting period a special publication on icddr,b's C19 response was published highlighting icddr,b's research, treatment and humanitarian response.

Local media coverage doubled during the reporting period, more than 25 press releases and articles on research, seminars and events were disseminated resulting in extensive media coverage. Over 15 international media reports were published on icddr,b's research and initiatives in media outlets including The New York Times, BBC, CNN and The Guardian.

Exclusive media coverage was facilitated in celebration of icddr,b's sixty years anniversary.

effectively and efficiently throughout the pandemic. We also finalised the acquisition of a new ERP integrated system, Microsoft D365, with implementation expected to take 18 months, and going live in 2022.

Our cash reserves during 2020 were only reduced marginally, which allows icddr,b to manage future adverse circumstances. Full cost recovery targets have been achieved but, we continue to appreciate the support from donors, which represents a significant contribution towards meeting our central management costs. Achieving 100 percent overhead funding entirely from projects remains unachievable. Some donors will not approve our official overhead costs and generally only provide between 10 to 15 percent overhead rates, leaving a shortfall in funding core operational costs. Developing a wider portfolio of income, donor and philanthropic sources, supporting and expanding laboratory income generation, further hospital appeal funds, updating and negotiating tariffs, and appropriate recovery of costs to projects that are acceptable to all donors will help icddr,b, be more sustainable.



Mr Thomas Liam Barry
Director, Finance

FINANCE

2020 has been a challenging year in terms of managing the C19 pandemic. We went from an expected projected

deficit of over USD 3m in April 2020 towards a surplus of USD 667k at the year ending 31st December 2020. Although overall income was reduced by USD 3.7m, due to restricted activities and lockdowns we still performed very well in spite of the challenges presented by C19. Moreover, we were able to fund and subsidise all staff salaries from April to September 2020 with tremendous help from our donors and only partial use of our cash reserves. Simultaneously, cost-containment was strictly adopted to prioritise expenditure that was critical to both managing C19 and projects activities.

In addition, we achieved a successful unqualified audit report for 2020. Finance has continued to manage icddr,b resources



Mr Hugues Marie Bello
Director, Human Resources

HUMAN RESOURCES

At the beginning of the pandemic, Human Resources department formed a C19 task force which made it possible to implement business continuity measures together with those related to the

wellbeing of our staff that includes the proactive and rapid formation of medical support teams; development and implementation of C19 awareness sessions and videos; and implementation of Hazard Allowance and Risk insurance for exposed staff.



Staff health and wellbeing are of importance to us. We undertake meticulous precautions to minimise the risk of spreading C19 and help our staff manage the challenges of working remotely. HR offered programmes and initiatives ranging from salary support to staff, counselling, and health improvement services.

For icddr,b as an employer, staff flexibility has always been important to us. During the peak period of C19 in May and June, approximately 80 percent of our staff worked from home and had to adapt to their new situation quickly. Distance and virtual learning facilities helped staff and managers to navigate through these difficult times, organise themselves and coach their teams while working from home.

In addition, we continued developing our HR strategy and HR department. People are the foundations of our actions. Engaged, dedicated staff are important to icddr,b. We are committed to continuing with the deployment of our HR strategy with the flexibility necessary to adapt ourselves to business imperatives and external factors. C19 forced HR to rethink what HR does and how it is built to deliver. The way forward will require agility, we are investigating an increased digital experience and a quick move to e-HR activities and services.



Mr Mohammad Noushad Chowdhury
Director, Supply Chain and Facilities Management

SUPPLY CHAIN AND FACILITIES MANAGEMENT

Supply Chain and Facilities Management (SCFM) supports core business functions by creating an effective and efficient operating environment for icddr,b. SCFM maintains interactions with external entities to provide optimum services across all services and facilities.

During 2020, SCFM has continued to expand its service provision and optimise the quality of work undertaken to eliminate waste and minimise business disruption. All this happened in the light of the C19 pandemic where maintaining functional facilities and services was the aim for not only icddr,b but also the country.

Operationally, SCFM successfully supported divisions and units to ensure business continuity by guaranteeing a continued supply of logistics i.e. supply of imported critical health safety items like personal protective equipment, reagents, ICU equipment, ventilators, and testing kits in the context of continued global supply chain disruption as well as uninterrupted oxygen and liquid nitrogen supplies to hospitals and labs. The division ensured 24/7 service provision of essential engineering support, sustained utility services, secured work environment and a functional transport service round the clock. SCFM also worked flexibly and ensured that services to support C19 were a priority by creating a makeshift hospital from tents, converting the staff cafeteria and day care centre into temporary C19 hospitals, and constructed a negative pressure C19 test high containment facility.

Additionally, SCFM assisted the Government of Bangladesh by providing critical technical support in certification of Biosafety Cabinets of different government institutes/hospitals in collaboration with the WHO, UNICEF, USAID, CDC and ASM. SCFM also constructed a negative pressure C19 test lab in Khulna Medical College. SCFM extensively worked in the establishment of a 200-bed C19 hospital in Teknaf, Cox's Bazar which is a collaboration between UNICEF and icddr,b.

Furthermore, cost saving of USD 1.6M has been achieved. C19 test kits for employees were sourced through contacting and engaging international embassies, through which supply was secured to icddr,b. Due to this, icddr,b became a hub for all government officers, embassies, and foreign NGO partners to conduct C19 testing. As part of the contribution to the development of infrastructure for extending capacity, the construction of an external structure for the 11 storied building has been completed.

2020 was an unprecedented year. It began with many plans but as the reality of C19 set in, SCFM's priorities shifted to not just supporting an organisation in its day-to-day activities but supporting a whole system operationally. During this challenging period, the SCFM team was present on-site to operate the facility round the clock and provided a supply of uninterrupted goods and services for the organisation.



Ms Armana Ahmed
Head, Research Administration

RESEARCH ADMINISTRATION

Research Administration (RA) is the information and knowledge hub for the organisation. It supports

icddr,b's researchers in exploring research funding opportunities, submitting grant applications, facilitating the institutional review process of research projects, and assisting in publications of manuscript. Due to C19, the funding landscape has changed globally in 2020. Donors' concentration has shifted to funding C19 related research projects, resulting in a reduction of scope for funding in other areas. In such a critical scenario, RA has circulated 380 funding calls in 2020. Though the circulation was less compared to 2019 (500 nos.), the submission rate and the success rate has increased over the previous year and stood at 50 percent and 41 percent respectively in 2020. In comparison with the previous year, the number of ongoing research grants and protocols has also increased by 4percent and 7percent respectively in 2020.

In 2020, icddr,b launched the 'Mujib 100 Research Grants for Women' (Mujib 100 RGfW) in commemoration of the birth centenary of Bangladesh's Father of the Nation Bangabandhu Sheikh Mujibur Rahman and in celebration of icddr,b's 60 years of scientific brilliance. The purpose of this grant is to create a new generation of female researchers and scientists in Bangladesh. The call invited applications from female Bangladeshi citizens. Two hundred and five applications were received from internal and external applicants residing in and outside of Bangladesh. RA has served as the Secretariat and coordinated this initiative,

from document preparation to guiding the applicants, from designing the application portal to connecting external applicants with icddr,b mentors and in assisting the applicants with submission. All applications were received through an online application portal developed by icddr,b's in-house IT team.

RA plays a significant role in the publication review process in the organisation. In 2020, a Publication Clearance Form was updated to avoid plagiarism and predatory journals and conferences. The Library, which has been merged with RA, subscribed to iThenticate software for checking plagiarism. The researchers of icddr,b are now entitled to check their manuscript using iThenticate before submission to publishers. In order to streamline the publication submission process, a Flowchart of manuscript/abstract approval process has also been developed and shared with icddr,b researchers.

The Library and Information services of icddr,b, is fully equipped with modern information technology tools and is now one of the best medical libraries in Bangladesh. At the end of 2020, the most notable online databases available include the Web of Science (WoS), GIDEON (Global Infectious Diseases and Epidemiology Online Network), JSTOR, Springer Nature, Cambridge University Press, Oxford Journals and Up-to-Date. icddr,b Library has its own Institutional Knowledge Repository (IKR) using DSpace open-source software. Since 2005, icddr,b maintains this IKR to provide free online access to icddr,b publications globally, and so far, a total of 10,098 documents have been uploaded to this platform. In addition to this, icddr,b scientists were kept informed of the incoming learning resources through the weekly icddr,b bulletin and Library's New Acquisition List.



Mr Tanvir Azad Chowdhury
Head, Information Technology

INFORMATION TECHNOLOGY

To achieve efficient, effective, sustainable and productive outcomes in 2020, the Information Technology department aligned its department goals with organisational goals. IT automated 36 business processes to reduce turnaround time improving efficiency.

Implementation of a new ERP system, named Rupantor, is underway. It is a platform of Microsoft Dynamics 365. In excess of 97 percent of IT projects were completed on time and within budget. Implementation of the new Laboratory Information Management System is a key achievement of 2020.

During the C19 pandemic, IT delivered mission critical and priority automated solutions. This included Regulating Staff Attendance system, Online Appointment Management System for C19 test, Automation of Employee Voluntary Contribution for C19 through Payroll Process, Payment Gateway and Bank Transfer, Workplace Safety during C19:

Automation of Employee "Risk and Hazardous Allowance", and "Group Professional Indemnity Insurance". Throughout the pandemic, as work from home was encouraged, IT ensured technical support and accessibility of IT infrastructure was available to access from home.

To enhance information security, IT began implementation of Security Information and Event Management (SIEM). This will store, normalise and aggregate information collected from IT tools/applications and apply analytics to that data to discover trends, detect threats and vulnerabilities. This will enable the organisation to investigate any information security threats through artificial intelligence. IT has also implemented the NetFlow Analyser tool to analyse IT network traffic and behaviour to detect IT attacks and threats. During the pandemic, IT ensured that online user awareness training was available to all staff.



Mr Khaja Salauddin Ahmed
Head, Regulatory and Legal Affairs

REGULATORY AND LEGAL AFFAIRS

The Regulatory and Legal Affairs (R&LA) unit processed a plethora of legal documents in 2020, including grant agreements, collaboration agreements, sub-agreements, service agreements, material transfer agreements, and memorandums of understanding, confidentiality agreements, pre-teaming agreements, data sharing agreements, procurement-related agreements, rental agreements and amendments. This ensured that financial transactions are carried out within the appropriate legal framework. R&LA has collaborated in various cross-departmental initiatives with Human Resources (HR), Finance and Supply Chain and Facilities Management (SCFM) departments. For instance, R&LA has actively contributed to the facilitation of training and awareness sessions on code of conduct and different policies arranged by HR, the management of disciplinary proceedings by HR, awareness sessions relating to grant/contractual obligations for the stakeholders/PI Offices in collaboration with Finance, and providing oversight in the sourcing process managed by SCFM.

Expanding upon icddr,b's intellectual property (IP) capacity development initiatives, R&LA has successfully obtained the Senior Leadership Team's approval for an Intellectual Property Rights Policy Implementation Plan and taken steps to operationalise the Board and SLT's plans for IP development. Currently, there are five active patent applications that R&LA is managing, with another six in the pipeline. One copyright application has been granted, with another one expected to be approved soon. icddr,b researchers are being trained in IP awareness through seminars and training sessions facilitated by national and international government officials and keynote speakers arranged by R&LA.

PUBLICATIONS

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.

HIGH-PROFILE PUBLICATIONS IN 2020

In 2020, icddr,b researchers were authors on 443 original publications – about a 4 percent increase over 2019 – and also contributed to 150 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.



Book Chapters

3

Original Papers
443



Abstracts in Conference Proceedings

92

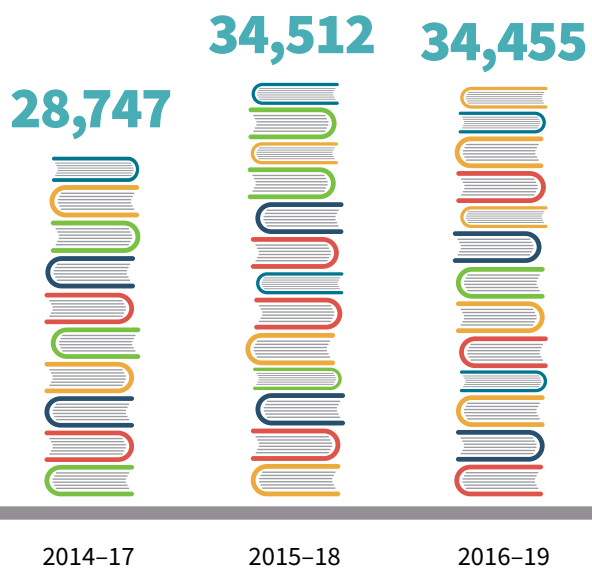
Reports/
Monographs

2

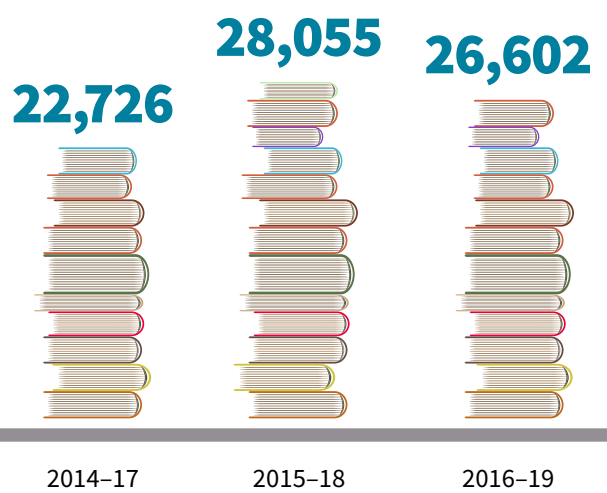


Letters,
Editorials, etc.

53



CITATIONS I: ALL PAPERS



CITATIONS II: PAPERS IN HIGH-IMPACT JOURNALS

COLLABORATIONS



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.

COLLABORATING INSTITUTIONS

BANGLADESH

- 250 Bedded TB Hospital, Shyamoli, Dhaka
- 500 Bed Mugda General Hospital
- Ad-Din Medical college Hospital (AMCH)
- Alive & Thrive, Bangladesh
- Asgar Ali Hospital
- Bangabandhu Sk. Mujib Medical University and Hospital
- Bangladesh Agricultural University
- Bangladesh Atomic Energy Commission
- Bangladesh Customs
- Bangladesh Institute of Child Health (Dhaka Shishu Hospital)
- Bangladesh Institute of Research and Rehabilitation in Diabetes Endocrine and Metabolic Disorders (BIRDEM)
- Bangladesh Livestock Research Institute (BLRI)
- Bangladesh Lung Foundation
- Bangladesh Medical College and Hospital (BMC&H)
- Bangladesh Specialized Hospital
- Bangladesh University of Engineering and Technology (BUET)
- BCSIR
- Border Guard Bangladesh (BGB)
- BRAC
- Center for Women and Child Health (CWCH)
- Central Drug Addiction Treatment Centre (CTC)
- Central Veterinary Hospital
- Centre for Communication Programs, JHU
- Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP)
- Child Health Research Foundation
- Chittagong Medical College and Hospital
- Combined Military Hospital (CMH)
- Community Based Medical College Bangladesh
- Department of Fisheries
- Department of Livestock Services (DLS)
- Dhaka Medical College and Hospital (DMCH)
- Dhaka Mohanogor Shishu Hospital
- Dhaka North City Corporation
- Dhaka Shishu Hospital
- Diabetic Association of Bangladesh (BADAS)
- Directorate General of Family Planning (DGFP)
- Directorate General of Health Services (DGHS)
- Dr. M R Khan Shishu Hospital & Institute of Child Health
- DWASA
- Enam Medical College & Hospital
- Ethics Advanced Technology Limited (EATL)
- Evercare Hospital Dhaka
- Faridpur Medical College Hospital
- Friendship
- General Hospital
- GlaxoSmithKline Bangladesh Limited
- Global Alliance for Improved Nutrition
- Global Fund Programme for People Who Inject Drugs (GFPWID)
- Good Neighbors Bangladesh
- Health Economics Unit
- HEED Bangladesh
- Ibrahim cardiac hospital and research Institute
- ideShi/CMBT (Institute for Developing Science & Health Initiatives)
- Incepta Pharmaceuticals
- Institute of Child and Mother Health (ICMH)
- Institute of Child Health & Dr. M R Khan Shishu Hospital (ICHSH)
- Institute of Epidemiology, Disease Control and Research (IEDCR)
- Institute of Public Health (IPH)
- Institute of Public Health Nutrition (IPHN)
- Khulna Medical College Hospital
- Kurmitola General Hospital (KGH)
- Labaid Specialized Hospital
- LAMB Hospital
- Marie Stopes Clinic Society (MSCS)
- Maternal & Child Health Training Institute
- Measure Evaluation
- Ministry of Health and Family Welfare
- Mohammadpur Fertility Services & Training Center
- Mymensingh Medical College and Hospital
- Narayanganj 300 Bedded Hospital



- National Centre for Hearing and Speech for Children (SAHC)
- National Heart Foundation and Research Institute
- National Heart Foundation of Bangladesh
- National Institute for Population Research and Training (NIPORT)
- National Institute of Cardiovascular Disease (NICV)
- National Institute of Diseases of Chest and Hospital (NIDCH)
- National Institute of Ear, Nose and Throat (NIENT), Bangladesh
- National Institute of Neurosciences and Hospital (NINS)
- National Malaria Elimination Program (NMEP)
- National Medical College and Hospital
- National Tuberculosis Control Programme (NTP)
- Noakhali Science and Technology University
- North South University
- Nutrition International (NI)
- Obstetrical and Gynecological Society of Bangladesh (OGSB)
- Patuakhali Science and Technology University
- Planning Commission
- R&M General Hospital
- Rajshahi Medical College and Hospital
- Save the Children
- Shaheed Suhrawardy Medical College and Hospital (ShSMCH)
- SHIMANTI
- Sir Salimullah Medical College Hospital (SSMC&H)
- Social Marketing Company (SMC)
- Sunamganj 250 bed District Sadar Hospital
- Surjer Hashi Network (SHN)
- Synesis IT
- The ACME Laboratories Ltd.
- The Salvation Army
- UChicago Research Bangladesh
- UH&FPO
- United Nations Children's Fund (UNICEF)
- United Nations Population Fund (UNFPA)

- University of Dhaka
- Universal Medical College & Hospital Ltd. (UMC&H)
- Urban Primary Health Care Project (UPHCP)
- US Embassy Dhaka
- Uttara Adhunik Medical College (UAMC&H)
- World Vision Bangladesh

AFRICA

- Armauer Hansen Research Institute (AHRI), Ethiopia
- Chris Baragwanath Hospital, South Africa
- International Institute of Tropical Agriculture, Benin
- KEMRI-Wellcome Trust Research Programme, Kenya
- Malaria Research Centre, Agogo Presbyterian Hospital, Ghana

ASIA

- Armed Forces Research Institute of Medical Science (AFRIMS), Thailand
- Banaras Hindu University, India
- Bio Farma, Indonesia

- Centre for Development Studies, India
- Chinese Center for Disease Control and Prevention, China
- Christian Medical College, Vellore, India
- Clinogent, India
- Duke-NUS Graduate Medical School Singapore, Singapore
- GlaxoSmithKline, India
- Greentech Knowledge Solutions Pvt. Ltd. (GKSPL), India
- Hiroshima University, Japan
- Institute for Human Development, India
- Institute of Medical Biology Chinese Academy of Medical Sciences, China
- Institute of Social and Economic Change, India
- Interactive Research and Development (IRD), Pakistan
- International Food Policy Research Institute (IFPRI), India
- International Vaccine Institute (IVI), Korea (South)
- Mahidol University, Thailand

- Ministry of Health and Welfare of the Korean government, Korea (South)
- Myanmar Ministry of Health & Sports, Myanmar
- National Institute of Infectious Diseases, Japan
- National University Hospital (NUH), Singapore
- 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
- Sree Chitra Tirunal Institute for Medical Science and Technology, India
- Tokyo-Kasei University, Japan
- University of Malaya, Malaysia
- University of Tokyo, Japan
- University of Tsukuba, Japan
- XIAMEN Innovax BIOTECH CO.Ltd, China

AUSTRALIA

- CSIRO
- Griffith University
- James Cook University
- Menzies School of Health Research
- The Royal Children's Hospital
- The University of Queensland
- University of Melbourne
- University of New South Wales
- University of Sydney
- University of Technology Sydney
- Western Sydney University

USA

- Albany Medical College
- Barnard College
- Bill & Melinda Gates Foundation
- Boston University School of Public Health
- Brown University
- Centers for Disease Control and Prevention
- Children's Hospital Oakland Research Institute
- Children's Hospital of Richmond at VCU
- Columbia University
- CTK Biotech Inc.
- Data for Impact (D4I)
- Duke Global Health Institute, Duke University
- EcoHealth Alliance
- Emory University
- Evolve BioSystems, Inc.
- Frederick National Laboratory for Cancer Research, Leidos Biomedical Research In
- Gynuity Health Projects
- Harvard Kennedy School
- Harvard Medical School
- Infectious Disease Research Institute
- Johns Hopkins Bloomberg School of Public Health (JHBSPPH)
- Johns Hopkins University School of Medicine
- La Jolla Institute of Immunology
- Management Sciences for Health (MSH)
- Massachusetts General Hospital (MGH)
- National Institute of Allergy and Infection Diseases (NIAID)
- Nationwide Children's Hospital
- Novavax, Inc.
- PATH Vaccine Solutions (PVS)
- PATH
- Pennsylvania State University
- PREVENT
- Pure Earth
- Rollins School of Public Health
- RTI International
- Save the Children
- Scripps Research
- Stanford University
- TechLab Inc.
- The Consortium for Conservation Medicine
- The Emmes Company, LLC
- Tufts University School of Medicine
- United States Agency for International Development (USAID)
- United States Department of Agriculture
- University at Buffalo
- University of California, Berkeley
- University of California, Davis
- University of California, Los Angeles (UCLA)
- University of California, San Diego
- University of Central Florida
- University of Chicago
- University of Colorado
- University of Florida
- University of Georgia College of Veterinary Medicine
- University of Kentucky, USA
- University of Maryland School of Medicine
- University of Maryland
- University of North Carolina (UNC)
- University of Notre Dame (UND)
- University of Pennsylvania
- University of Texas at Galveston
- University of Texas Health Sciences Center
- University of Utah
- University of Vermont
- University of Virginia Health System
- University of Virginia
- University of Washington
- Vanderbilt University
- Virginia Commonwealth University
- Warren Alpert Medical School of Brown University

- Washington State University
- Washington University School of Medicine
- Washington University
- Western Human Nutrition Research Center (WHNRC)
- Yale University

CANADA

- Salu Design
- St. Michael's Hospital
- The Hospital for Sick Children
- University of Alberta
- University of Calgary
- University of Saskatchewan
- University of Toronto

UK

- Bangor University
- Imperial College London
- Institute of Child Health
- Institute of Development Studies (IDS)
- Liverpool School of Tropical Medicine
- London School of Hygiene and Tropical Medicine (LSHTM)
- Loughborough University
- M&C Saatchi World Services
- Sheffield Hallam University
- The Children Investment Fund Foundation
- The Jenner Institute
- The Pirbright Institute
- The University of Edinburgh
- The University of Sheffield
- University College London
- University of Aberdeen
- University of Bath
- University of Cambridge
- University of Glasgow
- University of Greenwich
- University of Nottingham
- University of Oxford
- University of Portsmouth
- University of St. Andrews
- University of Stirling
- University of Warwick

EUROPE

- Antoni van Leeuwenhoek Hospital/the Netherlands Cancer Institute, Netherlands
- DNDi, Switzerland
- Drugs for Neglected Diseases initiative, Switzerland
- Eawag, Switzerland
- Erasmus MC University Medical Ctr Rotterdam, The Netherlands
- European Molecular Biology Laboratory (EMBL), Germany
- European Vaccine Initiative, Germany
- EveliQure Biotechnologies GmbH, Austria
- Fondation Mérieux, France
- Georg-August-Universität Göttingen, Germany
- Göteborg University, Sweden
- Institut Pasteur, France
- Institute of Tropical Medicine, Belgium

- International Atomic Energy Agency (IAEA), Austria
- International Maternal and Child Health Department, Sweden
- Karolinska Institute, Sweden
- KU Leuven, Belgium
- Laboratorio de Referencia de Leishmaniasis, Spain
- Laboratoire des Pathogènes Emergents, Fondation Mérieux, Lyon, France
- Max Planck Institute for Evolutionary Anthropology, Germany
- Ministry for Social Affairs and Health, Finland
- Nestle Research Center, Switzerland
- Nestle Nutrition, Switzerland
- Norwegian Institute of Public Health, Norway
- Norwegian University of Science and Technology, Norway

- Örebro University Hospital, Sweden
- REGA Institute, Belgium
- Stockholm University, Sweden
- TDR, WHO, Switzerland
- University of Basel, Switzerland
- University of Bergen, Norway
- University of Copenhagen, Denmark
- University of Gothenburg, Sweden
- University of Heidelberg, Germany
- University of Iceland, Iceland
- University of Leipzig, Germany
- Uppsala University, Sweden
- Wageningen University, Netherlands
- World Health Organization, Switzerland
- Zoetis, Spain

OTHERS

- FHI 360
- International Centre for Genetic Engineering and Biotechnology (ICGEB)
- Mycobacteriology Laboratory, Centre Pasteur du Cameroun (CPC)
- School of Pharmacy, University of Otago, New Zealand
- Stop TB Partnership

SELECTED AWARDS AND ACHIEVEMENTS

DR MEHJABIN TISHAN

Dr Mehjabin Tishan has won the MIT Solve (an initiative of the Massachusetts Institute of Technology) for her Jute cellulose-based biodegradable PPE proposal.



DR FIRDAUSI QADRI

Dr Firdausi Qadri has been awarded the 2020 L'Oréal-UNESCO For Women in Science award.



DEBASHISH BISWAS

Debashish Biswas has won the 'Best Article of the Year Award' from ASTMH for his article (doi: 10.4269/ajtmh.19-0376) published in 2019.



DR K ZAMAN

Dr K Zaman has received the prestigious Fellowship of the Royal College of Physicians of London (FRCP) from the Royal College of Physicians of Edinburgh, UK.



FARHANA SULTANA

Farhana Sultana has been awarded a grant of USD 100,000 from the Islamic Development Bank (IsDB) for her project titled “Piloting a low-cost, accessible and acceptable nutrient bar to combat micronutrient deficiency among the young menstruating women in Bangladesh”.



DR HASSAN RUSHEKH MAHMOOD

Dr Hassan Rushekh Mahmood has been awarded the IsDB call for innovation on ‘Saving Women’s Lives from Cancer’.



DR REHNUMA HAQUE

Dr Rehnuma Haque has been awarded with prestigious Fogarty GHES postdoctoral fellowship for the year 2020-2021.



Dr Sayera Banu, Dr Munirul Alam and Dr K Zaman have received the **Bangladesh Academy of Science (BAS)** Sultan Ahamed Choudhury Science and Technology **Gold Medal Award 2019**, BAS Dr MO Ghani Memorial **Gold Medal Award 2019** and BAS **Gold Medal Award 2018** in Biological Sciences (Senior Group) respectively.

TECHNICAL TRAINING UNIT

icddr,b's Technical Training Unit (TTU) works with national and international stakeholders to deliver mandated education and training services for Bangladeshi and other nationals. Over 60 years, more than 65,000 participants (researchers, physicians, laboratory personnel, public health professionals and managers, trainers, faculties and students etc.) from 87 countries have attended our training/education programmes. TTU offers participants the opportunity to learn from experts, witness the generation of critical new evidence and knowledge, and understand how low-cost interventions work in action. Across the world, thousands of health professionals consider their time at icddr,b as formative to their career.

Driven by core values and guided by icddr,b's Strategic Plan 2019-22, TTU builds skills and partnerships to ensure that research evidence has impact on national and international policies, programmes and practices for improved health. Moreover, TTU contributes enhancing skills and competencies of scientific and non-scientific staff, with a special focus on developing local research capacity, particularly for early and mid-career researchers of icddr,b. TTU's training strategy fosters collaboration with key partners including universities/institutions and donors through delivering quality and need-based education and training services with innovative approaches including synchronous and asynchronous online, and blended learning.

TECHNICAL TRAINING AND COVID-19

In April 2020, guided by senior overights of icddr,b, the TTU team developed various feasible initiatives for tackling the C19 situation. To uphold the training and education activities of icddr,b in the midst of

the pandemic, TTU transformed 12 face-to-face research capacity strengthening training courses into online delivery for icddr,b staff, national and international participants. The first online course for young researchers was delivered in May 2020 using the Zoom platform. The experience enabled improvements in the quality and completeness of subsequent delivery of online training to both internal and external participants.

TTU continued its collaboration with other units/programmes/divisions to coordinate and build C19 related capacity. For example, working closely with the Return to Project Training Sub-committee and Biosafety Office, TTU coordinated 'Bio-risk Management' Training of Trainers' workshops for the staff members of icddr,b working in field, laboratory, clinics/hospitals to resume their work ensuring safety and security of individuals and communities during the ongoing pandemic. Additionally, TTU developed an awareness-raising video on C19, handwashing both in Bengali and English.



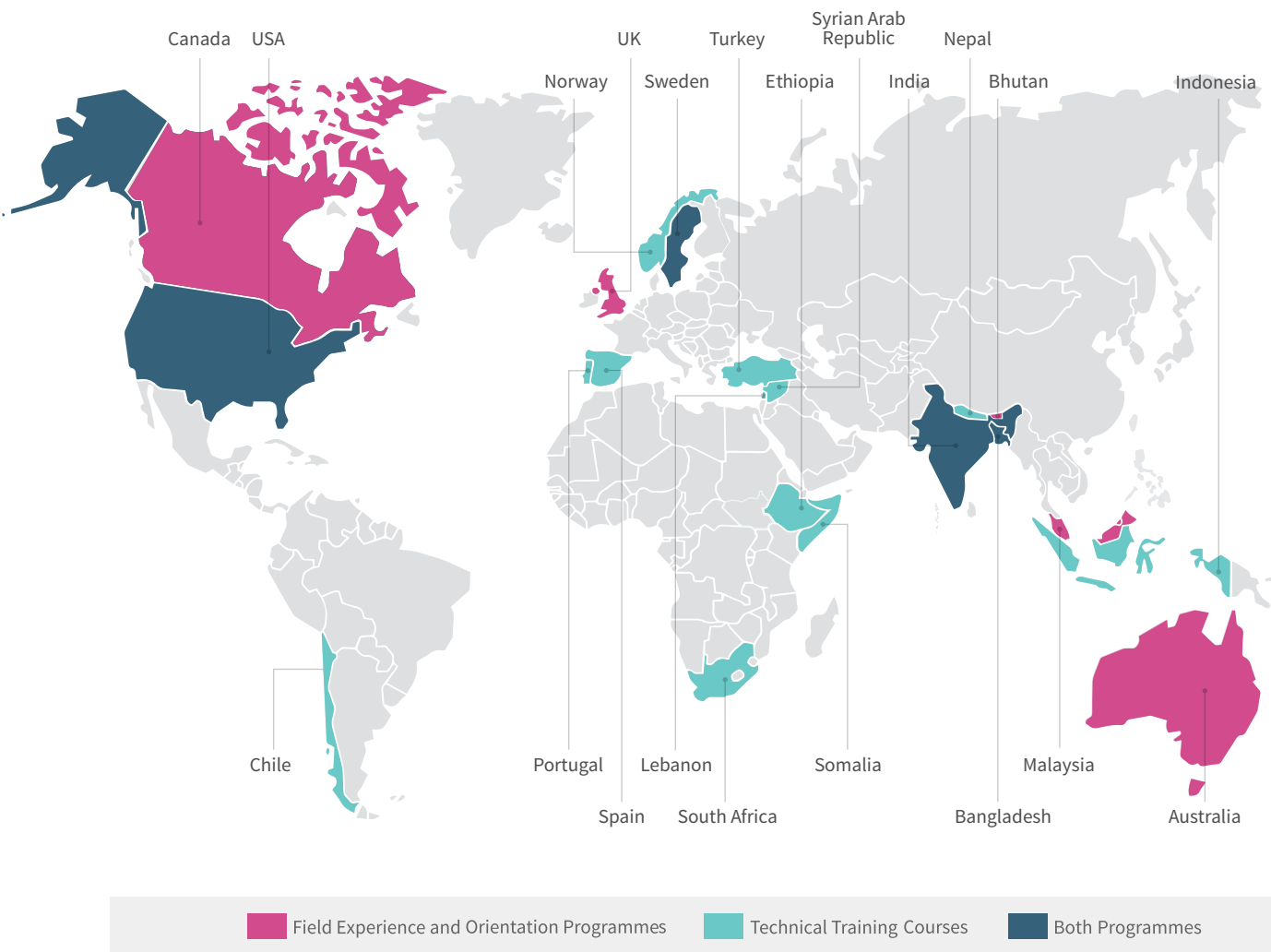
Countries represented by students attending icddr,b training courses, and field experience and orientation programmes:

FIELD EXPERIENCE AND ORIENTATION PROGRAMMES

Orientation: Bangladesh, Bhutan, India, UK, and USA
Field experience: Australia, Bangladesh, Canada, Malaysia, USA and Sweden

TECHNICAL TRAINING COURSES

Bangladesh, Chile, Ethiopia, India, Indonesia, Lebanon, Nepal, Norway, Portugal, Somalia, South Africa, Spain, Sweden, Syrian Arab Republic, Turkey, and USA



Technical Training

Internal and open courses

33 training events
668 participants

Field experience programme

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

70 students hosted:
63 national, 7 international

Orientation programme

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

6 academic training events, 4 institutes,
262 students hosted:
254 national, 8 international

INTERNAL TRAINING

Aligned with the icddr,b Strategic Plan, TTU continued to build skills and competencies of icddr,b staff with a special focus on developing capacities of young and mid-level researchers. Sida sponsored 10 technical training courses which were conducted on five prioritised areas collaborating with icddr,b's Research Administration. Two hundred and twenty-two participants (male: 115, female: 107) were trained. Besides, 10 'Bio-risk Management' Training of Trainers' workshops were conducted in collaboration with the Biosafety

Office, and 212 participants (male: 137, female: 75) were trained. In total, 20 training events were organised and 434 participants (male: 58 percent, female: 42 percent) were trained. Of them, 82 percent attended online and 18 percent attended face-to-face training.

OPEN TRAINING (FOR ALL NATIONAL AND INTERNATIONAL PARTICIPANTS)

TTU organised and conducted 13 open training courses in 2020.

A total of 234 participants (male: 107, female: 127) attended the courses of which national and international participants were 204 and 30 respectively representing 16 countries: Bangladesh, Chile, Ethiopia, India, Indonesia, Lebanon, Nepal, Norway, Portugal, Somalia, South Africa, Spain, Sweden, Syrian Arab Republic, Turkey, and USA. Of the participants, 79 percent attended online and 21 percent attended face-to-face training.



ACADEMIC TRAINING

We provide academic training to undergraduate students from different medical colleges as well as post-graduate students from public health and allied institutes on the diverse activities of icddr,b. A total of 262 students (male:117, female: 145) attended the academic training of which national and international participants were 254 and eight respectively representing five countries: Bangladesh, Bhutan, India, UK, and USA.

STUDENT SERVICES

Working alongside experienced researchers at icddr,b, 'Student Services' helps develop knowledge and skills of local and international students by offering internships and a field experience programme. A total of 70 students (male: 23, female: 47) were enrolled into the internship programme of which national and international participants were 63 and 7 respectively representing 6 countries: Australia, Bangladesh, Canada, Malaysia, Sweden and USA.

In summary, TTU hosted a total of 1,000 participants (male 499, female 501; national 955, international:45) representing 21 countries (Australia, Bangladesh, Bhutan, Canada, Chile, Ethiopia, India, Indonesia, Lebanon, Malaysia, Nepal, Norway, Portugal, Somalia, South Africa, Spain, Sweden, Syrian Arab Republic, Turkey, UK and USA) through 33 training events, and student services.



LABORATORY SCIENCES AND SERVICES

The Laboratory Sciences and Services Division (LSSD) of icddr,b discovers and innovates new tools and methods for better health of the people and provides quality lab services for research and everyday life.

The LSSD of icddr,b is a self-sustaining division and consists of research and clinical service laboratories. Its five research groups work in four research laboratories: Gut-Brain Signalling lab; Environmental lab; Laboratory of Food Safety and One health; and Molecular Genetics and Genomics research. The Clinical lab services include Clinical Biochemistry; Clinical Microbiology and AMR unit; Clinical Immunology; Molecular diagnosis; Hematopathology; and Clinical Microscopy lab. The Quality Assurance unit and Biosafety Office of the LSSD ensure quality diagnostic services and a risk-free working environment across all laboratories respectively. The Animal Facility unit of the LSSD is the only animal facility in the country certified by the National Institute of Health, USA. It supports all research laboratories across icddr,b and contributes to research and other related activities of public and private institutions and organisations in the country. The Media and Lyophilization unit of the LSSD is the pillar for quality media production for all labs in icddr,b and for external labs as well.

The unique for the country ISO 15189 and ISO 15190 accreditation of clinical lab services of LSSD generates surplus revenues to support icddr,b's humanitarian projects including its hospitals. In spite of the challenges of the C19 pandemic when the number of tests decreased compared to previous years, the clinical lab services contributed USD 1.6 million surplus revenues in 2020 to icddr,b's core and introduced 10 new diagnostic tests.

Apart from its flagship clinical lab services, the Division carries out and supports field and hospital based clinical trials as well as basic and epidemiological research. In 2020, LSSD supported 21 research projects including research projects to support the response to the C19 pandemic. We also published 40 original research papers.

426,715

Number of tests carried out

1,397

Number of tests offered

10

Number of new tests

1,659

Number of tests as part of hospital surveillance

152,893

Number of paid users

21

Number of icddr,b projects supported by LSSD



LSSD'S RESPONSE TO COVID-19 PANDEMIC

Correctly detecting C19 in patients with SARS-CoV-2 virus was imperative. In response to Bangladesh's challenge in providing quality diagnosis of SARS-CoV-2 infection, icddr,b established a unique sample collection set-up which was approved for RT-qPCR tests. The C19 corner and its lab at icddr,b was ranked first by the government health authority among the first 10 approved facilities for diagnosis of C19 patients. By the end of 2020, the C19 corner at icddr,b tested 48,000 suspected patients. New tests were initiated for faster delivery of reports for C19 providing better management of C19 patients at icddr,b hospitals and for external users.

QUALITY ASSURANCE

To ensure continuous accreditation of icddr,b's diagnostic services, the Quality Assurance (QA) unit has applied for the reaccreditation for 177 test parameters, including 23 new tests, consisting of 333 methods including C19 RT-qPCR test. To comply with the Proficiency Testing requirements, diagnostic laboratories have successfully participated in the External Quality Assurance System through the College of American Pathologists for 47 panels consisting of 262 test parameters including C19 test. QA unit has continued Quality Assurance Programmes in the laboratories using risk assessment and contingency plans for C19 pandemic.

RESEARCH AND ACTIVITIES FOR ANTIMICROBIAL RESISTANCE

LSSD is contributing to a project to address critical gaps in surveillance of antimicrobial-resistant bacteria

in human, animal and aquatic sectors in Bangladesh. Another study conducted by LSSD found that more than 75 percent of infants in rural areas of Bangladesh are colonised with multidrug-resistant *E. coli*. Furthermore, another study demonstrated the high prevalence of blaCTX-M-15 gene among extended-spectrum β -Lactamase-producing *E. coli* isolates causing extraintestinal infections in Bangladesh.

SUPPORTING FDMN POPULATION FOR BETTER LIFE

The quality of drinking water was collected and analysed from 15 forcibly displaced Myanmar nationals (FDMNs) camps in Cox's Bazar. They found that 28 percent of tube well water samples were contaminated with faecal coliforms and 11 percent were contaminated with *E. coli*. Additionally, 74 percent point-of-use water samples were contaminated with faecal coliforms while 35 percent were contaminated with *E. coli*. Moreover, a representative of 384 *E. coli* was isolated from those samples where 66 were found to be extended-spectrum β -Lactamase producers (ESBL) and 47 ESBL-*E. coli* were multidrug-resistant.

EXPLORING TREATMENT OF GUILLAIN-BARRÉ SYNDROME (GBS)

icddr,b's Gut-Brain Signalling lab has developed one of the largest cohorts of Guillain-Barré syndrome (GBS) in the world. In addition to molecular and genetic studies on GBS, the research group contributes to novel drug development for the treatment of GBS.

A phase 1b clinical trial of a novel humanised monoclonal antibody (ANX005), a C1q inhibitor, has been

completed among patients with GBS in Bangladesh, which was found to be safe and well-tolerated in patients with GBS, opening the door to further clinical stages of this trial. Amid the C19 pandemic, a phase two/phase three clinical trial of ANX005 has commenced.

ASSOCIATION BETWEEN GBS AND C19

This systematic review included 45 articles from 16 countries reporting 61 patients with SARS-CoV-2-associated GBS. Most (97.7%) articles were from high- and upper-middle-income countries. Forty-two (68.9%) of the patients were male; median (interquartile range) age was 57 (49-70) years. Reverse transcriptase polymerase chain reaction for SARS-CoV-2 was positive in 90.2 percent of patients.

One report of SARS-CoV-2-associated familial GBS was found which affected a father and daughter of a family. Albuminocytological dissociation in cerebrospinal fluid was found in 80.8 percent of patients. The majority of patients (75.5%) had a demyelinating subtype of GBS. Intravenous immunoglobulin and plasmapheresis were given to 92.7 percent and 7.3 percent of patients, respectively. Around two-thirds (65.3%) of patients had a good outcome (GBS-disability score ≤ 2) on discharge from hospital. Two patients died in hospital. SARS-CoV-2-associated GBS mostly resembles the classical presentations of GBS that respond to standard treatments. Extensive surveillance is required in low- and lower-middle-income countries to identify and report similar cases/series.

Hasan I *et al.* Guillain-Barré syndrome associated with SARS-CoV-2 infection: a systematic review and individual participant data meta-analysis. *J Peripher Nerv Syst* 2020 Oct 28. doi: 10.1111/jns.12419. Epub ahead of print.

CLINICAL SERVICES



icddr,b hospitals located in Dhaka and Matlab give free of cost treatment to patients suffering from diarrhoea and associated conditions. These establishments provide researchers a rich platform for clinical research and training.

The communities whom we serve belong to the lower socio-economic strata of the society. As part of our social commitment to Bangladesh we provide free of charge and evidence based clinical care to patients with diarrhoeal diseases and associated ailments. In 2020, our clinicians treated more than 150,000 patients, principally at the Dhaka Hospital. This figure is less than 2019 because of the effects of C19 pandemic. In 2020 the

number of under-five patients was around 64 percent, the same as seen in previous years. As a result of quick intervention and nutritional education an estimated 80,000 lives are saved annually.

In 2020, the pandemic presented new challenges for our staff and their dependants due to a scarcity of treatment facilities in the city. To support its staff, the hospital set up

a makeshift C19 treatment unit with essential ICU facilities. In 2020, a total of 715 staff, their dependants and suspected cases from the hospital were tested, received outdoor treatment, used the isolation facility, and received indoor treatment. These services were provided by the existing doctors and nurses of the hospital.

The hospitals in both Dhaka and Matlab support the clinical and other research of our doctors and scientists. This provides them the research acumen required of a scientist that results in better delivery of health services in resource constrained settings. The hospitals train doctors and nurses in management of diarrhoea and malnutrition who then disperse across the country to deliver these essential services that conform to the WHO standards.

There is round-the-year ongoing surveillance activity in the hospital that elucidates new trends of disease as well as seasonal variations. Every year, it costs USD 5 million to run our hospitals under normal conditions, with funds largely derived from our core resources. Donations help to support doctors, nurses, support staff, in-patient and out-patient wards, intensive care unit and the nutrition rehabilitation unit.

We also respond to epidemic outbreak of diarrhoea in both national and international settings where there is dearth of expertise and intervention for cholera and related diseases.

Since 2018 our efforts continue to address diarrhoeal diseases in the FDMN around Cox's Bazar where international aid efforts are concentrated.



98,220
(64.6%)

Number of children (<5 years)



152,024
Patients treated



DHAKA HOSPITAL

Total patients
97,024

By gender



58.2% **41.8%**

By age



<5 years: **68.7%** >5 years: **31.3%**

MATLAB HOSPITAL

Total patients
52,305

By gender



42.9% **57.1%**

By age



<5 years: **57.8%** >5 years: **42.2%**

MIRPUR TREATMENT CENTRE*

Total patients
2,695

By gender



55.4% **44.6%**

By age



<5 years: **49.4%** >5 years: **50.6%**

* Mirpur Treatment Centre was closed down on 26 March 2020 due to dwindling patient volumes.

A critically ill patient arrived at the emergency room

Within **15** minutes, he was transferred to ICU





Within **4**
hours,
his condition
stabilised



Within
one day
of admission, he is
in recovery



Patient
fully recovered
and released within
five days of admission.

He received
completely free-
of-charge care.



SENIOR LEADERSHIP TEAM

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 December 2020



Professor John D Clemens
Executive Director



Dr Tahmeed Ahmed
Acting Executive Director
(from 28 June 2020 until
31 January 2021)
and
Senior Director, Nutrition and
Clinical Services Division



Mr Syed Monjurul Islam
Deputy Executive Director



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



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



Professor Allen G Ross
Senior Director, Infectious
Diseases Division



Dr Dinesh Mondal
Acting Senior Director,
Laboratory Sciences and
Services Division



Mr Thomas Liam Barry
Director, Finance



Mr Hugues Marie Bello
Director, Human Resources



Mr Jan De Waal
Director, Development
and Communications



**Mr Mohammad Noushad
Chowdhury**
Director, Supply Chain and
Facilities Management



Ms Armana Ahmed
Head, Research
Administration

SECRETARIAT



Ms Loretta Saldanha
Executive Assistant to the Executive
Director

OBSERVERS



Mr Nagarajan Nagarajan
Director, Internal Oversight



Mr Khaja Salauddin Ahmed
Head, Regulatory and Legal Affairs

BOARD OF TRUSTEES

As of October 2020

icddr,b's Board of Trustees comprises 15 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 Government of Bangladesh, with the World Health Organization 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 follows the Rules of Procedure. The Board of Trustees' roles and responsibilities include fund oversight; approving and monitoring the budget; setting broad institution-wide policies, as well as 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:



Ms Nancy Y Cheng
Chair, Board of Trustees
Former Assistant Auditor General, Canada

Member Secretary:



Professor John D Clemens
Executive Director
icddr,b



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

REPRESENTING THE GOVERNMENT OF BANGLADESH



Ms Fatima Yasmin
Secretary, Economic Relations
Division, Ministry of Finance



Mr Md. Abdul Mannan
Secretary, Health Services Division
Ministry of Health and 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



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



Mr Amol Khisty
Expert, Finance & Accounting Services



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



Dr Anu Kantele
Professor, Infectious Diseases
Helsinki University, Finland



Ms Andrea J Lucard
Executive Vice President, External Relations, Medicine for Malaria Venture, Geneva, Switzerland



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



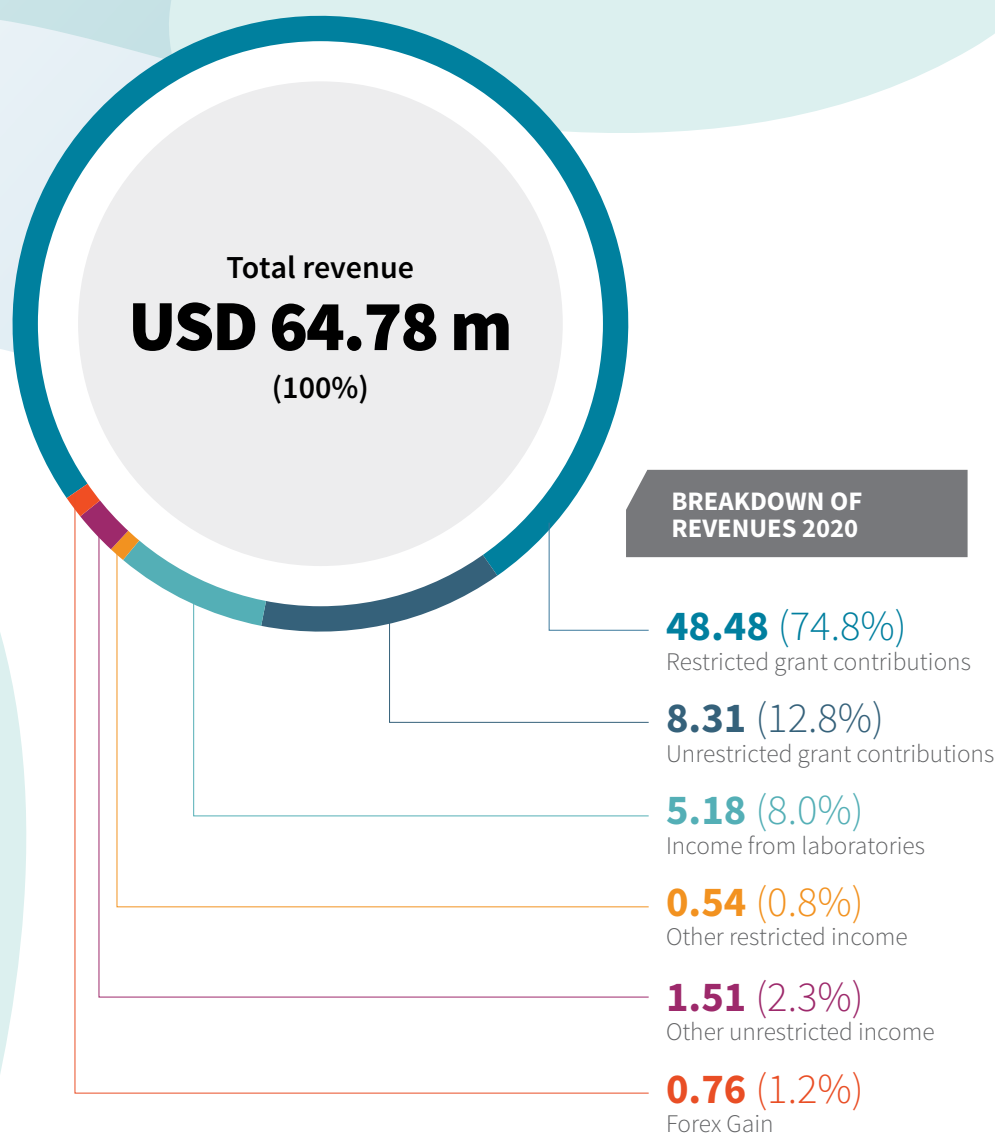
Dr Fred Binka
Professor of Clinical Epidemiology, University of Health and Allied Sciences, Ho, Ghana

FINANCE

icddr,b's overall revenue for 2020 amounted to **USD 64.78 million** compared with a total expenditure of USD 64.11 million, generating a net surplus for the year of USD 667k.

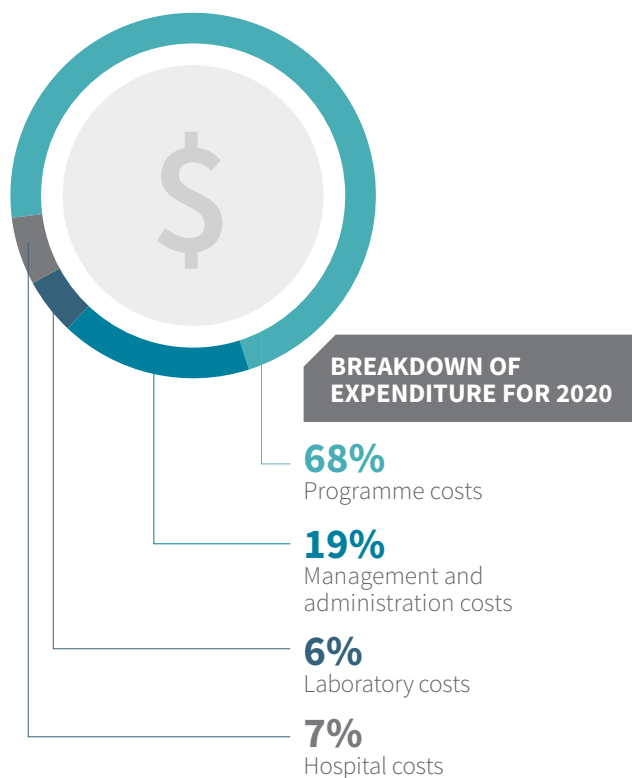
REVENUE

Our overall revenue for 2020 of USD 64.78m (see below) represented a decrease of 5 percent amounting to USD 3.7m compared with 2019. Research grant income for 2020 reduced by 5 percent equal to USD 2.8 million vs. 2019, which is mainly due to the reduction of the project activities during the C19 pandemic. Unrestricted lab income decreased by USD 560k.



EXPENDITURE

- Overall expenditure for 2020 was USD 64.11 million, representing a decrease of 6 percent equivalent to USD 3.7 million compared with 2019, as a result of C19 restrictions and cost containment initiatives.
- The bulk of total expenditure (67.7%) relates to staff salaries and benefits. Other key costs are; supplies and materials (11.5%), collaborative partnership costs (4%), travel and vehicle hire charges (3.5%), rent, communication and utilities (2.4%) and training, dissemination and staff development (1.2%).



DETAILED EXPENDITURE FOR 2020: (in USD millions)

National staff	USD 36.88
International staff	USD 5.31
Emeritus staff	USD 1.23
Supplies and materials	USD 7.36
Collaborative partnership costs	USD 2.56
Travel and vehicle hire charges	USD 2.22
Consultancy fees	USD 0.62
Rent, communication and utilities	USD 1.53
Training, dissemination and staff development	USD 0.79
Other operational costs	USD 5.63

OTHER KEY FINANCIAL STATISTICS FOR 2020

1. At the end of the year, icddr,b had USD 38m in net assets, which reduced further as a result of leasehold land changes.
2. Cash and cash equivalents amounted to USD 36.4m at the end of the year.
3. Accounts receivables (debtors) increased by 36 percent. The main reason is due to delay in payments by different donors such as EU for USD 750k, Concern Worldwide for USD 194k, WHO for USD 443k, University of Bergen for USD 579k etc.
4. Accounts payables increased by 11 percent overall, mainly due to the late implementation of project activities in 2020, as most of the activities resumed in the fourth quarter of 2020.
5. Provisions reduced by 6 percent due to reduced project activities in 2020 compared with 2019, as a result, fewer provisions were made.
6. The current ratio (liquidity) is 1.20 which is the same as 2019.
7. Stock inventories have increased by 32 percent amounting to USD 112k, mainly due to lab supplies relating to COVID-19.
8. Investments increased by 13 percent due to an increase in the market value of the Endowment funds from USD 14.2m to USD 16m.
9. Loans and advances increased by 3 percent due to “Advances to suppliers and others” by USD 100k, paid mainly for LC procurements.
10. Indirect costs (expenses that are not readily identified with a particular grant, contract, project function or activity, but are necessary for the organisation’s general operations) rate is now 28 percent; this figure includes central management and administrative costs.

icddr,b received an unqualified (healthy) audit opinion of its financial statements for 2020 from A. Qasem & Co. Chartered Accountants.

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

RECOGNISING OUR SUPPORTERS

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

TOP 10 DONORS DURING 2020

	Donor partners	Restricted (USD)	Unrestricted (USD)	Total (USD)
1	Bill & Melinda Gates Foundation	3,963,217	-	3,963,217
2	US Government – United States Agency for International Development (USAID)	2,647,778	-	2,647,778
3	United Nations Development Group (UNDG)	1,663,422	-	1,663,422
4	Foreign, Commonwealth & Development Office (FCDO)	739,812	835,891	1,575,703
5	Global Affairs Canada (GAC)	390,716	1,109,719	1,500,435
6	US Government – Centers for Disease Control and Prevention (CDC)	1,460,926	-	1,460,926
7	US Government – National Institutes of Health (NIH)	780,120	-	780,120
8	Government of the People’s Republic of Bangladesh (GoB)	107,119	616,900	724,019
9	The Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM)	559,125	-	559,125
10	The Swedish International Development Cooperation Agency (Sida)	545,835	-	545,835

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, 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.



Canada



ANNUAL REPORT 2020



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