



# Health management during COVID-19 pandemic—contribution of women health informaticians, medical physicists and veterinarians from Bangladesh and Malaysia during the world crisis

Chai Hong Yeong<sup>1</sup> · Hasin Anupama Azhari<sup>2,3</sup> · Sharmin Parveen<sup>4</sup> · Nasrin Sultana Juyena<sup>5</sup> · Nasreen Nahar<sup>6</sup> · Md. Aminul Islam<sup>4</sup> · Sunil Mysore Kempegowda<sup>7</sup> · Nupur Karmaker<sup>2</sup> · Tabassum Mumtaz<sup>8</sup> · Magdalena Stoeva<sup>9</sup>

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## Abstract

This article aims to highlight some of the contributions from Bangladeshi and Malaysian women scientists in the fields of health informatics, medical physics and biomedical engineering, and veterinary science in combating the COVID-19 world crisis. The status of COVID-19 situations in Bangladesh and Malaysia in respect to global scenario, some relevant government policies, lessons learnt from previous pandemics, socio-economic impacts of COVID-19, the impact on healthcare system and health management approaches taken by individual/institutional research group led by women scientists during the COVID-19 pandemic have been discussed and demonstrated in this article. These promising activities and initiatives will eventually motivate other women in science and extend their roles from laboratory to society in more aspects.

**Keywords** COVID-19 · Contribution · Biomedical engineering · Health informatics · Health management · Medical physics · Veterinary · Women scientists

## 1 Introduction

The world is currently facing an unprecedented crisis due to the novel Coronavirus Disease 2019 (COVID-19). It has caused more than a million deaths globally after the first confirmed case was reported from Wuhan City of Hubei Province in China on 31 December 2019. The whole world observed and was literally shut down for several months due to RNA virus known as the SARS-CoV-2 virus. Because of

the uncontrolled and rapid spread of the virus worldwide, the world health organization (WHO) declared it a global pandemic on 11 March 2020 [1]. Not only many people have lost their lives, the effects of this catastrophe include financial, psychological, physical and relational challenges all over the world. As shown in Fig. 1, as of 10 November 2020, COVID-19 has claimed more than 1,261,075 lives from 50,676,072 confirmed cases worldwide, recorded since January 2020 (World Health Organization, 2020) [2]. America has the highest confirmed cases, followed by

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✉ Hasin Anupama Azhari  
lahasananupama@gmail.com

<sup>1</sup> Faculty of Health and Medical Science, School of Medicine, Taylor's University, 47500 Subang Jaya, Malaysia

<sup>2</sup> Department of Medical Physics and Biomedical Engineering (MPBME), Gono Bishwabidyalay (University), Savar, Dhaka, Bangladesh

<sup>3</sup> South Asia Centre for Medical Physics and Cancer Research, Savar, Dhaka, Bangladesh

<sup>4</sup> Department of Health Informatics, Bangladesh University of Health Sciences, Dhaka, Bangladesh

<sup>5</sup> Department of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh

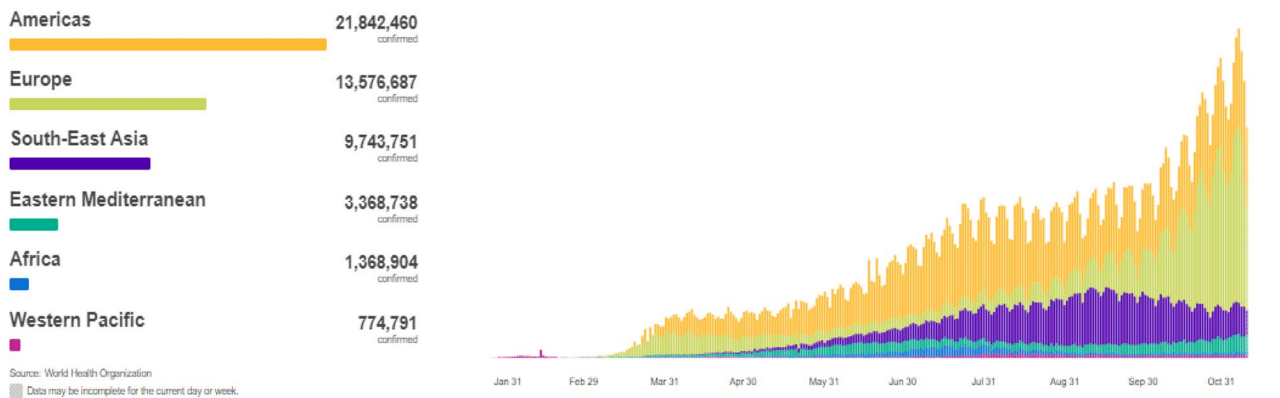
<sup>6</sup> Department of Reproductive and Child Health, Bangladesh University of Health Sciences, Dhaka, Bangladesh

<sup>7</sup> CloudTechInfo Pty Ltd, 608 Harris St, Ultimo, Sydney, New South Wales 2007, Australia

<sup>8</sup> Institute of Food and Radiation Biology, Bangladesh Atomic Energy Commission, Dhaka 1207, Bangladesh

<sup>9</sup> Medical Imaging Department, Medical University, Plovdiv, Bulgaria

## Situation by WHO Region



**Fig. 1** Situation of COVID-19 by WHO as of 10 November 2020 [2]

Europe, South-East Asia, Eastern Mediterranean, Africa and the Western Pacific.

Even after a year of the first outbreak, the death toll has surpassed 1.5 million people, and the global economy has been severely affected [3]. Many countries are suffering a second or third wave while waiting helplessly for vaccines to become available. The rapid spread of COVID-19 to about 220 countries is revealing how the CORONA pandemic has impacted our social, economic, mental, educational, and professional life. Meanwhile, researchers around the globe are probing into new vaccines, medicine, accurate and faster detection technology; making safety tools for general and frontline workers etc. However, the COVID-19 pandemic has become a global issue that cannot be effectively addressed by only one or two scientific areas of people. As mentioned by WHO's Director General, in the global response to COVID-19, massive effort from every profession is needed to produce the best outcome and to keep the world safe. For example, the recent book edited by K Ng and M Stoeva, gives a very good overview on the activities of medical physics professionals globally as they continue to support the frontline professionals in radiology, nuclear medicine, and radiation oncology during critical times [3].

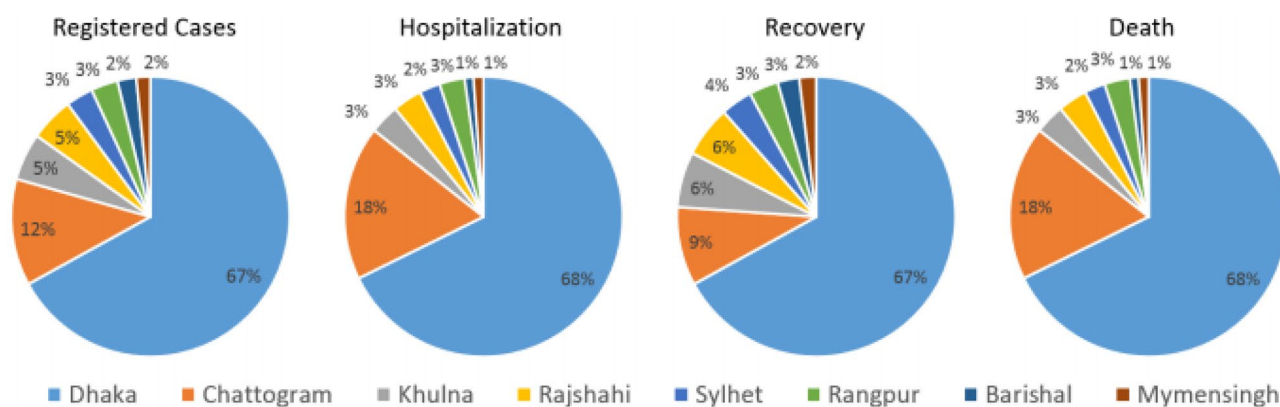
Taking this into account, our paper has centered on four major areas: medical physics, biomedical engineering, health informatics, and veterinary medicine due to their highly influential, specialty contribution in this situation. Although they are not frontline providers like doctors, nurses and volunteer; they have been contributing a lot behind the scenes with their problem-solving skills.

In this article, we have described examples of contribution from Bangladeshi and Malaysian Women scientists in different fields in identifying the challenges on human and animal health in this COVID-19 pandemic. The pandemic state, 2020 of Bangladesh and Malaysia in respect to the

world situation, lessons learnt from previous pandemics, socio-economic impacts of COVID-19 are also described successively in this paper.

Bangladesh reported its first confirmed COVID-19 case on 8 March 2020 and recorded the first death of COVID-19 on 18 March, 2020 [4]. Between 8 March and 09 November 2020, according to the directorate general of health services (DGHS) Press Release, there were 421,921 COVID-19 confirmed cases by reverse transcription polymerase chain reaction (rt-PCR) tests, including 6092 related deaths (case fatality rate 1.76%) [5]. COVID-19 pandemic has drastically disrupted every aspect of human life. Health systems around the world are jeopardized with increasing demands for care of people with COVID-19. It has further intensified by stigma, misperception and restrictions on movement that mess up the health care services [2]. The whole world is still learning from COVID-19; Bangladesh is not an exception. As part of the response to the COVID-19 pandemic, the country went for complete lockdown from 23 March to 30 May 2020 [6] and prepared some necessary steps to spread awareness to keep this syndrome away from them. The government has been reintegrating social distancing and quarantine for all. The government announced closing down of all schools and educational institutions in the country from 18 March 2020 till 19 December 2020 in Bangladesh. Figure 2 shows the proportional distribution of COVID-19 cases, hospitalization, recovery and death in Bangladesh by division from 8 March to 9 November 2020 [7].

In Malaysia, the total confirmed cases of COVID-19, as of 11 November 2020, was 42,050 and the total number of death was 300 [8]. The federal government of Malaysia has taken an early preventive measure against COVID-19 after WHO declared the situation as a pandemic. Malaysia implemented the first phase of movement control order (MCO), commonly referred to in local and international media as a national "lockdown", on 18 to 31 March 2020 [9].



**Fig. 2** Distribution of COVID-19 cases, hospitalization, recovery and death situation in Bangladesh as of 10 November 2020

The MCO was extended three times until 12 May 2020 to give time to the healthcare personnel battling the COVID-19 outbreak, apart from preventing the virus from spreading again and to avoid another increase of cases if the MCO was lifted too early. On 4 May 2020, the Malaysian government eased the lockdown restrictions under a “conditional MCO” (CMCO) until 9 June 2020. During CMCO, most business sectors were allowed to operate except sports centers and social activities. Interstate travel was not allowed except for work purposes and to return home after being stranded in the hometowns or elsewhere. The number of COVID-19 confirmed cases had reduced drastically since the implementation of the MCO and CMCO. Hence, the Prime Minister of Malaysia announced the Recovery phase of MCO (RMCO) from 10 June to 31 August 2020 and was later extended to 31 December 2020. Under the RMCO, a range of businesses and activities have been allowed to resume operations. However, every individual is required to follow the Standard Operation Procedures (SOPs) as stated by the government, e.g. applying social distancing, wearing face masks, registration of personal info and body temperature at every business/activity check-in counter, etc.

### 1.1 Looking into the past: what have we learnt from the previous pandemics

Animals, plants, and all living systems intrinsically linked that obviation of perils and the mitigation of effects of crises that originate at the interface between humans, animals, and their environments can only amend health and wellbeing. Pandemics are not a new experience of the human race. Looking over the past 600 years, world has witnessed several outbreaks caused by bacteria and viruses claiming millions of lives. The deadliest pandemic “Black Death or plague” during 1347 to 1351, resulted in the deaths of up to 75–200 million [10]. Over centuries, human history recorded pandemics such as Plague (1720), Cholera (occurred six times

between 1817 and 1923 and seventh pandemic began in 1961), Spanish Flu (1918), and the latest is the corona virus (2020). While plague and cholera were caused by bacteria, COVID 19 or SARS-COV-2 is a virus belongs to the genus *Coronaviridae*. It has the same transmission criteria as severe acute respiratory syndrome (SARS) and the middle east respiratory syndrome (MERS). The virus first made its debut in the Chinese city of Wuhan in December 2019 and has spread rapidly around the world till date. Without a host it cannot live, but once inside the cells, the viral enzymes take over those enzymes of the host cells and begin making copies of the viral genetic instructions. The new copies of the viral genetic instructions are packaged inside the new protein coats to make new viruses. Ideally, it will continue to spread until the invention of vaccine or acquirement of herd immunity.

From avian influenza to SARS to swine flu to MERS to Ebola, the past decade has witnessed one zoonotic disease outbreak after another. International travel, globalization of trade, untrammled urbanization, population explosion, agricultural intensification, and ecosystem destruction- all these factors dominantly increase the risk for both the emergence and the rapid spread of zoonotic pathogens. However, with rapid advancements in research in science, technology, engineering and mathematics (STEM); as the history represents, mankind make improvements and find solutions to many of the challenges like natural outbreaks, climate change and natural disasters, disease, sanitation, housing and food security.

### 1.2 Impacts of COVID-19 pandemic on education, global co-operation and technological developments

As the COVID-19 pandemic has continued to cross both national and international borders, it has affected people regardless of nationality, gender, level of education, income,

etc. The Global Education Coalition launched by UNESCO reported that more than 1.5 billion students and youth across the planet are or have been affected by school and university closures due to the COVID-19 pandemic [11]. At least in 188 countries, all levels of education, primary secondary and tertiary is closed, which disrupted their smooth flow of learning and receiving continuous education. School closures widen learning inequalities and hurt vulnerable children and youth disproportionately. To meet these challenges, the government and educational authorities in most countries switched to digital technology. Needless to say, this digital system has slowly reduced the disparity between the educational systems globally and preventing the hamper of the student's efficiency of the knowledge. Again, academic institutions worldwide need to be leveraged as the current educational system is centuries-old, lecture-based approaches to teaching, entrenched institutional biases, and outmoded classrooms. COVID-19 acts as a catalyst to find an innovative solution in all educational institutions worldwide in a short period of time.

Developed countries have opened educational institutions and are able to maintain social distancing and other hygienic practices. Nearly 200 million primary and secondary students in China started their new semesters via the Internet in 2020, which is considered as the largest simultaneous online learning exercise in human history by The World Bank [12]. Several other Asian countries including Indonesia and India have also offered online learning alternatives during the pandemic, shifted at least parts of their education systems online, or used other mediums such as television. However, a densely populated country like Bangladesh, it is really difficult to maintain strict hygienic rules and health protocols in schools. On the other hand, most of the teachers are not familiar with e-learning and are not trained to conduct online classes. Moreover, lower bandwidth in remote areas, less trained resources, little preparation makes the poor output of education and become not conducive to sustained growth. The necessity of both the computer and/or mobile phone for

more than one child put the low-income family into tremendous pressure.

The COVID-19 pandemic turned out to be a wake-up call for multilateralism. As per advice from the WHO that all countries should work together in overcoming this crisis, the United Nations has mobilized global cooperation in science-based COVID-19 responses. As a result, multiple meetings have been conducted in small and large scales within the south asian association for regional cooperation (SAARC) countries, G7 as well as G20 leaders (Fig. 3) [13–15]. National leaders came together through a video conference and joined their hands to chalk out a common strategy to fight against the deadly COVID-19 in each region. Prime Minister of Bangladesh, Sheikh Hasina urged all the SAARC leaders to set up a regional institution to fight public health threat [16]. In addition, the Prime Minister of India, Mr. Narendra Modi proposed to set up an emergency COVID-19 fund for the SAARC nations, and India has contributed \$10 million US dollar to the fund [17].

In the context of Covid-19, technology turned out as a savior especially during the lockdown and minimized the physical exposure due to daily activities. Examples such as online shopping, internet banking, cash transfer via the Automated Teller Machines (ATMs), telecommunication, online staff operation, online investment, digital security, etc. have enabled most people to stay at home and prevent further spreading of the virus.

The need for technology based digital health is greater than ever before. COVID-19 has exposed the critical need to adopt devices, platforms and services to support individuals at every level of care. artificial intelligence (AI) plays an important role in this regard. For example, a popular mobile app developed in South Korea known as “Corona 100 m”, will instantly alert the users when they come within 100 m of a location visited by an infected person [18]. The app enables users to conveniently avoid potentially high risk areas without checking the travel histories of those infected. By using health information



**Fig. 3** Global co-operation- meeting between Leaders of G7, SAARC countries and G20 leaders during COVID-19 pandemic [13–15]



technology integrated with strong health-care infrastructure; Taiwan has developed a dedicated Smart Card that enables real-time access to a patient's health records with a real-time alert system that is linked with immigration data [19].

In the subsequent sections (Sects. 2, 3, 4, 5), we will elaborate some health management activities conducted by women led research groups in the fields of health informatics, medical physics and biomedical engineering, and veterinary science in Bangladesh and Malaysia. Section 2 will show how a group of health informaticians have been able to provide solutions to Remote care for Maternal and Child health using telemedicine, Health apps for Data management & analytics and electronic medical record to accelerate the digital transformation of healthcare during COVID-19 pandemic. Sections 3, 4 will deal with the contribution of medical physicists in Malaysia and Bangladesh, respectively. Lastly, the live-stock management approaches undertaken by Veterinarians in Bangladesh will be highlighted in Sect. 5.

## 2 Contributions of health informaticians at Bangladesh University of Health Sciences (BUHS), Bangladesh

The use of information technology in health has been growing faster in recent time. Health care, management, policy and planning all depend on having good information to make decisions. In order to maintain physical distance and health instructions of COVID-19, health informatics can allow us to provide continuous care through telehealth/telemedicine/telecare, m-Health, electronic medical record (EMR), ICU care management system, computerized physician order entry (CPOE) system, robotic surgery, etc. Health informatics can play a leading role to solve so many challenges during COVID-19.

The traditional healthcare systems in Bangladesh are highly concentrated in hospitals and clinics, but in situations like COVID-19 pandemic, people prefer to receive health services at their own residences as much as possible. In the face of COVID-19, many healthcare providers turned to remote patient monitoring and virtual visits to continue caring for vulnerable patients while minimizing the risk of virus transmission and reducing the strain on scarce hospital resources. We are still hopeful that sooner or later, the threat from COVID-19 will go away. However, it reinforces the research group at Bangladesh university of health sciences (BUHS) to rethink the major reform of the existing care delivery system in maternal and child health services. The aim is to bring healthcare to the door-steps of patients.

## 2.1 Disruptions of sexual and reproductive healthcare (SRH) services from COVID-19 pandemic- outcome and impact

COVID-19 has, without a doubt, exposed the weaknesses of the health care sector to a greater extent. Many countries have graved deficiencies of doctors, nurses and medical staffs. Doctor to patient ratio in Bangladesh is 5.26 per 10,000 people [20]. Moreover, hospitals and clinics are afraid of admitting the non-COVID-19 patients. A lot of treatments and follow-up cases of chronic patients were postponed; some running hospitals were also unwilling to take in-patients with the fear that they might be contaminated with the virus. Pregnant women are one of the vulnerable groups as many women are fear of visiting the clinics/hospitals and due to COVID-19, their routine follow-ups and medications are delayed. Life-saving immunization programs are highly affected too. The uptake of maternal and newborn health services has been reduced by approximately 19% [21]. As shown in Fig. 4 essential maternal health services such as antenatal care (ANC) visits and postnatal check-ups in health facilities have also declined extensively, and deliveries in facilities declined by 21% for the period of January to March 2020, compared with October to December 2019.

The same report [21] also predicts that in Bangladesh, more than 28,000 children under the age of five might die in the next six months as an indirect result of the pandemic if there is more decrease in health services. Moreover, gender violence has also increased significantly during the COVID-19 pandemic. Table 1 below summarizes some of the main disruptions occurred in Sexual and Reproductive Healthcare (SRH) services due to the COVID-19 outbreak and its anticipated outcome and impact [22–31].

## 2.2 Proposed telemedicine model for Bangladesh

Telemedicine stands out as a very powerful tool that is driving the exciting digital transformation of Health care.

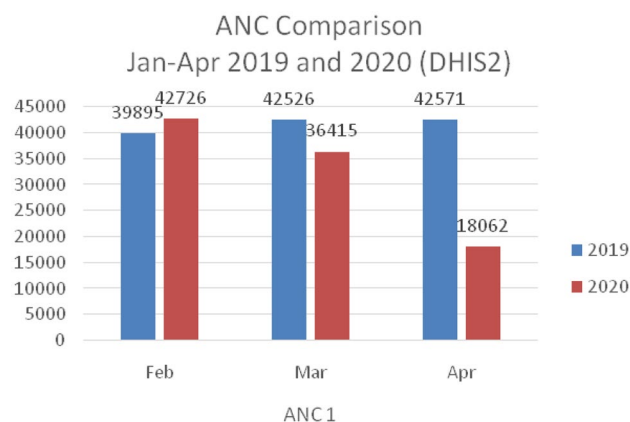


Fig. 4 ANC Comparison Jan–Apr 2019 and 2020 in Bangladesh

**Table 1** Disruption of sexual and reproductive healthcare (SRH) services resulting from COVID-19 pandemic [22–31]

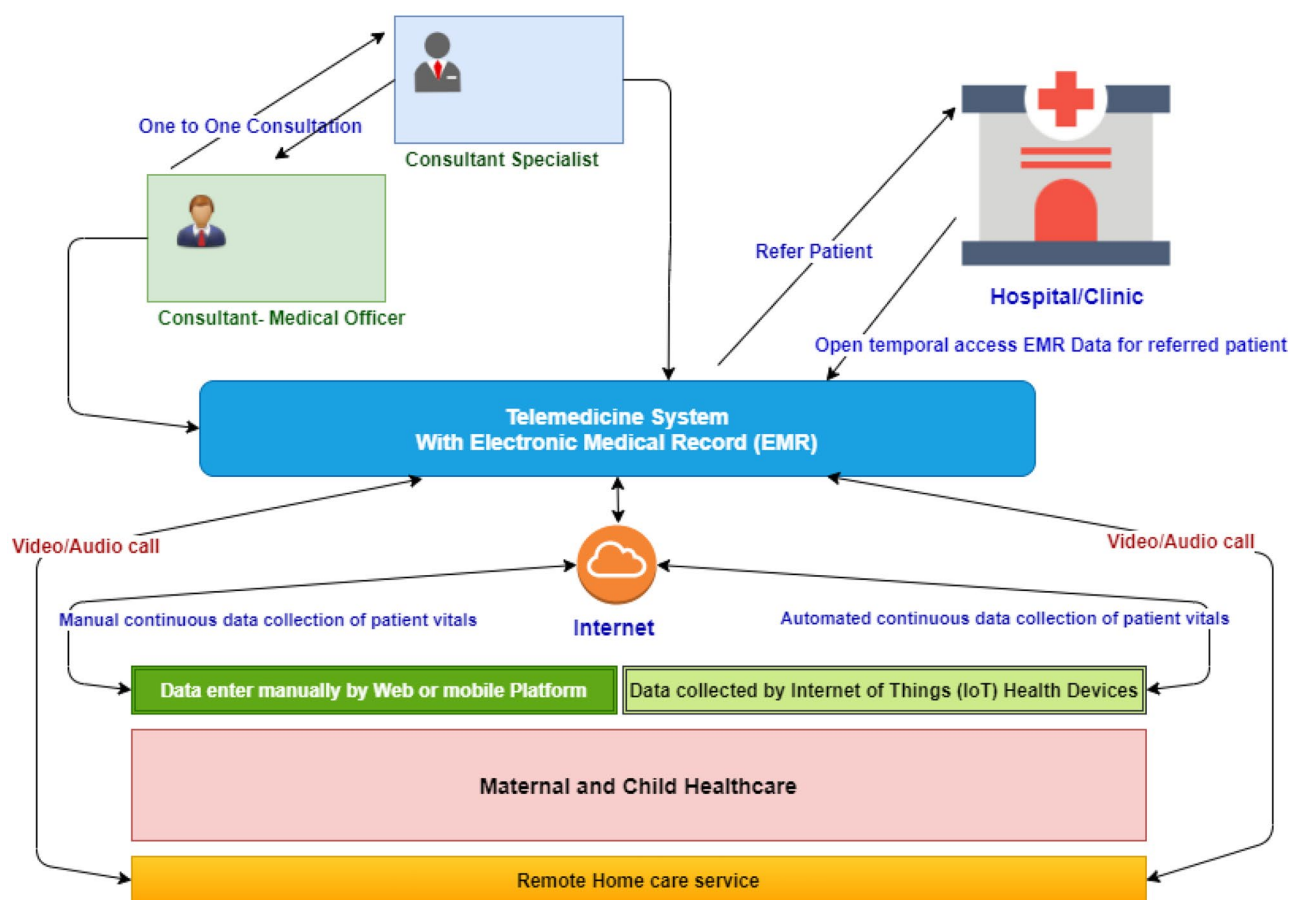
Sl Nos.	Disruption in essential SRH care/ Lifestyle	Outcome	Impacts
1.	Decline in service coverage of essential pregnancy-related care	a) Women may experience major obstetric complications without care: <ul style="list-style-type: none"> <li>• Post- Partum Hemorrhage/Severe bleeding</li> <li>• Pre-eclampsia/Eclampsia</li> <li>• Infection/Sepsis</li> <li>• Genital prolapse</li> <li>• Fistula</li> </ul> b) Home delivery will be increased c) Adolescent also may experience major obstetric complications without care	<ul style="list-style-type: none"> <li>• Maternal death including adolescent mother and maternal morbidities</li> <li>• Fetal/newborn death</li> </ul>
2.	Decline in antenatal care	a) Maternal malnutrition b) Gestational diabetes mellitus (GDM) and its complications c) Intra uterine growth retardation (IUGR) d) Intra uterine death/still birth e) Low birth weight	<ul style="list-style-type: none"> <li>• Maternal death and maternal morbidities</li> <li>• Fetal/newborn death</li> </ul>
3.	Decline in service coverage of essential newborn care	a) Newborns may experience major complications without care: <ul style="list-style-type: none"> <li>• Birth asphyxia/respiratory distress syndrome</li> <li>• Convulsion</li> <li>• Infection</li> <li>• Acute respiratory tract infections(ARI) like pneumonia</li> <li>• Diarrhoea</li> </ul> b) Child Malnutrition	Newborn and child deaths and morbidities
4.	Decline in use of short- and long-acting reversible contraceptives	a) Unintended pregnancies b) Unmet need for modern contraceptives	Over population
5.	Shift in abortions from safe to unsafe	a) Unsafe abortions	• Maternal death and maternal morbidities
6.	Reduced access to service for gender-based violence	Decline in response to reports of gender-based violence	• Increased insecurity and chronic distress

Despite the bold promise of telemedicine to improve healthcare, much remain unknown about whether and how this will be fulfilled. COVID-19 pandemic has clarified the potential usefulness of telemedicine for care. However, there are some challenging limitations for identification of patient's actual situation remotely such as BP, pulse, O<sub>2</sub> level, ECG, and RBS etc. There is a gap, which needs to mitigate and need to facilitate the telemedicine system to fit with the business model and adaptation of both patient and facility providers. A pregnancy-related services including at-home monitoring, virtual prenatal and postnatal visits and mental health care, can be provided through telemedicine. Remote monitoring has emerged as a new and powerful modality that can greatly improve the mother and child care delivery whilst protecting healthcare workers during a pandemic. Internet of Things (IoT), smart sensors and wearables have augmented the healthcare system enabling remote monitoring, disease tracking, early diagnosis and treatments. Wearable devices have the functionality to automatically record and transmit information, such as heart rate, blood glucose, lung function, gait, posture control, tremors, physical activity or sleep patterns. Home monitoring devices for older people or people with dementia detect changes in normal activities

such as falls. IoT gains knowledge about the environment, user's activities and situation which has become possible by embedded sensors in it. Implementation of smart sensors transformed IoT devices into an intelligent one. Data gathered by these sensors can then be analyzed to find hidden patterns and predict medical diagnosis or medical condition. Figure 5 shows our proposed architecture of IoT and EMR based Telemedicine system, which can provide remote care for maternal and child health.

The proposed architecture of the telemedicine system in Fig 5 will be empowered by the medical officers and specialists. Usually medical officers will attend to the patient's call, if the patient's condition demands a specialist, then they will direct the patient to a specialist. Both resources will be available simultaneously. If patients can afford IoT health devices, then they will buy and setup the devices at their premises. These devices will feed data automatically to the central telemedicine EMR database.

On the other hand, there will be a web-based or a mobile platform where patients can enter vitals manually. Therefore, both models will be opened for the patient. Maternal and Child patients require frequent visits/treatments. Telemedicine using advanced technology could significantly



**Fig. 5** The architecture of proposed IoT and EMR based telemedicine system for MCH

improve their healthcare service delivery. The patient will get medication and medical consultation any time they require. They will be able to give feedback, as well. This telemedicine model will be a paradigm shift for traditional telemedicine system. For that, telemedicine should be set up keeping the context and legal aspects in mind. Our proposed telemedicine model has been designed keeping those features in consideration. Following are the salient features of our proposed model:

- Set up a telemedicine website portal for Bangladesh.
- The website to be mobile friendly and intuitive to use by the common man.
- Eligible medical professionals will be to register after validating their credentials.
- To avail telehealth, the patient must register if it is the first time or login subsequently.
- Patients must have the option to search for their ailment or browse the services.
- The telehealth facility or available telehealth professionals listed as per patient geolocation.

- Patients may choose the facility or health professional they prefer.
- Price catalogue to be displayed for the patient to choose the treatment as well as the health professional.
- All the treatment provided, i.e., the conversation, documents, treatment, etc. to be digitally stored.
- The access to the patient record to be role based e.g. doctor, patient, etc.
- Option to rate the service and also if the previous rating exists to be displayed.
- Data collected can be used to analyze the current service, determine the pattern of disease and predict future ailment.

### 2.3 COVID-19 data entry, reporting, management, analysis and training

For evidence-based policymaking, we need our own data and research. But obtaining current and credible information in a timely fashion is a key challenge for healthcare professionals. During COVID-19 pandemic Department

**Fig. 6** The volunteers team consists of (from left to right) a mechanical engineering lecturer (Dr. Hui Leng Choo), a biochemistry postdoc fellow (Dr. Wong Yin How), a chemical engineering lecturer (Dr. Anis Suhaila Shuib), a medical physicist (Assoc. Prof. Dr. Chai Hong Yeong) and a lab technician (Mr Ahmad Hassan Bin Mohd Som) from Taylor's University, Malaysia



of Health Informatics, Bangladesh University of Health Sciences is actively involved with COVID data entry, data reporting, data monitoring, management & analytics, giving training in COVID lab in Management Information System (MIS) department of Directorate General of Health Services (DGHS). They are still working in different centers of the country.

### 3 Contribution of medical physicists and biomedical engineers at Taylor's University, Malaysia

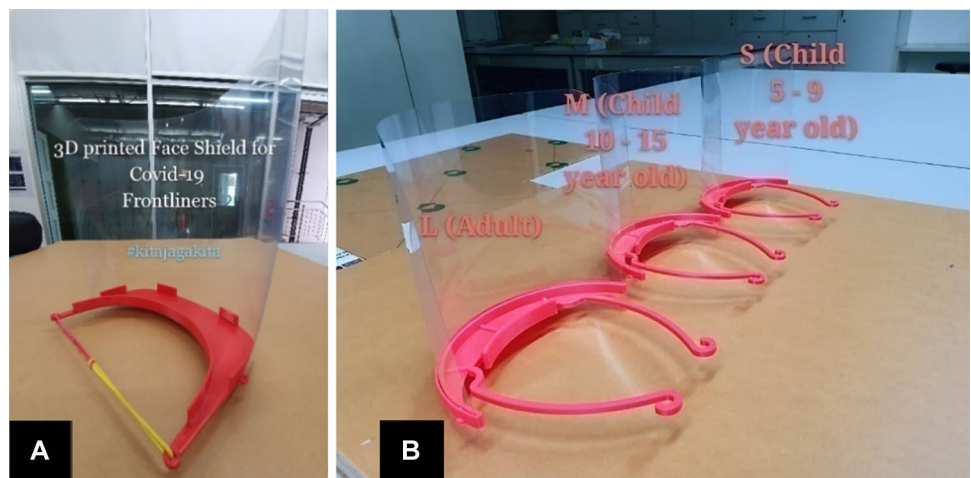
During the COVID-19 pandemic, many countries have faced critical shortage of personal protective equipment (PPE) such as 3-ply surgical masks, face shields, protective gowns,

etc. among the front liners due to the restriction of import/export activities and border control. Many healthcare staffs would need to prepare their own PPE, such as face shields, from raw materials. Therefore, a team of volunteers (Fig. 6) led by a woman medical physicist in Malaysia, has decided to produce face shields using 3D printing technology available at the Taylor's University to support the front liners.

The team worked round the clock to produce and deliver 3D printed face shields to hospitals in dire need. They used open-source face shield designs (Fig. 7A credits to Budmen.com [32]) and Thingiverse (credits to Arkham Designs [33]) with some modifications to suit the local scenarios. The face shields met the following criteria:

- Fast printing time. It took about 40 min to print a high quality (0.3 mm layer height) face shield frame. There

**Fig. 7** **A** The first version (credits to Budmen.com) and **B** Improved version (credits to Arkham Designs) of the 3D printed face shields





were twelve 3D printers in the lab, hence the team was able to produce 12 face shields in every 40 min.

- Environmental friendly. The face shield frame was printed using polylactic acid (PLA) filament, a degradable material made of corn starch.
- Minimal consumables. The improved version of the face shield (Fig. 7B) does not require any consumables (e.g. glue, rubber band, holes puncher, etc.) except the A4 plastic sheet.
- Easy assembly. The transparent A4 plastic sheet can be easily installed and removed from the frame without using any tools. This could save time for the front liners to focus on their important tasks.
- Reusable. The face shield frame can be reused after proper disinfection using > 70% isopropyl alcohol (IPA) after each use. The face shield should be used as a personal protective tool and should not be shared.
- Full top coverage. The face shield was designed to meet the requirements for full top protection to prevent splashes/droplets from the top.
- Lightweight and comfortable to wear. The full face shield weighs about 25 g. It is flexible and comfortable to wear even without the foam.

The project was initially funded by the university as a corporate social responsibility (CSR) activity, but it later on received an overwhelming response from the society, and many charity organizations and individuals started to offer their contributions either in the form of monetary or services. Due to the increased demand of face shields throughout the nation, the team then joined a decentralized production platform initiated by a local education foundation, Taylor's Mureka Maker space under the Biji-Biji Initiative [34]. The decentralized production platform allows for numerous partners to join together in a network of communication and collaboration, whereby all members are able to leverage from each other's resources, knowledge, expertise and tools to provide a timely supply of PPE to the COVID-19 front liners in the country. The platform has successfully gathered 68 production sites and engaged more than 85 volunteers to supply PPE including face shields, isolation chambers, non-woven scrubs set, boot and hood covers to 117 hospitals/clinics nationwide. This initiative is run based on a volunteering basis, and the donation was received from

the public crowd funding. The local media has described this initiative as a communal effort towards aiding the COVID-19 front liners. To date, the foundation has supplied more than 20300 face shields, 1495 aerochambers, 56 isolation box, etc. to the COVID-19 front liners in the country [35].

## 4 Contribution of medical physicists and biomedical engineers, Bangladesh

This section focuses on the research activities of Gono Biswabidyalay (University), Gonoshasthaya Kendra (GK) and organizations such as AFOMP, SCMPPCR, ALO-BT in response to corona crisis. Gono University is the pioneer university for Medical Physics and Biomedical Engineering education program in Bangladesh, whereas GK is one of the oldest non-governmental, non-profit, and national level organizations providing community and institutional services in the fields of healthcare, women empowerment, disaster management, education, agriculture, and basic rights-based advocacy for almost half a century in the country.


In Sect. 4.1, the activities of research team at Department of Medical Physics and Biomedical Engineering (MPBME) at Gono University will be highlighted. Team's effort in liaising with DGHS, Ministry of Health on raising mass awareness and exchanging information on COVID-19 and the societal role in arranging different webinar programs and promotional activities with AFOMP, SCMPPCR in COVID crisis will be detailed in the subsequent Sects. (4.2, 4.3, 4.4).

### 4.1 Medical physics and biomedical engineering (MPBME), Gono Biswabidyalay (University)

Graduate students having BSc in BME from the department of department of medical physics and biomedical engineering (MPBME) started working in the GK to prepare the COVID-19 dedicated unit and also associated with designing and installation of oxygen system in the hospital. They also worked in other pharmaceutical lab and were involved in activities such as COVID-19 detection kits production, lab installation, lab safety, HVAC system, maintenance and quality control etc. (Fig. 8).

**Fig. 8** Activities of Gonoshasthaya Kendra with MPBME students of Gono University






**Asia - Oceania Federation of Medical Physics**

**President**  
Prof Dr. Arie Changtong  
Universitas Indonesia  
Jl. Sekeloa Selatan 1 No. 1  
Jakarta 12510, Indonesia  
Telp. 62-21-57171000  
Fax 62-21-57171001  
Email: arie@afomp.org


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Prof Dr. Iwan Samsi  
Universitas Indonesia  
Jl. Sekeloa Selatan 1 No. 1  
Jakarta 12510, Indonesia  
Telp. 62-21-57171000  
Fax 62-21-57171001  
Email: iwan@afomp.org

**Secretary General**  
Dr. Agus Setiawan  
Universitas Indonesia  
Jl. Sekeloa Selatan 1 No. 1  
Jakarta 12510, Indonesia  
Telp. 62-21-57171000  
Fax 62-21-57171001  
Email: agus@afomp.org

**Emergent**  
Dr. Eddy Sherry  
Universitas Indonesia  
Jl. Sekeloa Selatan 1 No. 1  
Jakarta 12510, Indonesia  
Telp. 62-21-57171000  
Fax 62-21-57171001  
Email: eddy@afomp.org




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Chair of ETC, Asia-Oceania Federation of Organizations for Medical Physics (AFOMP)  
Edited and approved by AFOMP ECOM


The Disease caused by severe acute respiratory syndrome coronavirus 2, SARS-CoV-2, has been named as Coronavirus Disease 2019 (COVID-19) by the World Health Organization (WHO). It was declared a Public Health Emergency of International Concern on 11th January 2020, and elevated to a



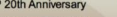
Step 1 Hand hygiene



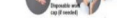
Step 2 Put on mask




Step 3 Protective eyewear




Step 4 down disposable gown



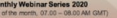
Step 5 Waterproof boots



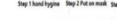
Step 6 Disposable rubber gloves



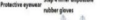
Step 7 Disinfecting




Step 8 Decontamination



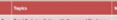
Step 9 Decontamination




Step 10 Decontamination




Step 11 Decontamination



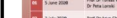
Step 12 Decontamination



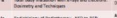
Step 13 Decontamination




Step 14 Decontamination




Step 15 Decontamination



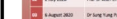
Step 16 Decontamination



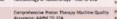
Step 17 Decontamination




Step 18 Decontamination




Step 19 Decontamination



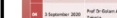
Step 20 Decontamination



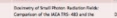
Step 21 Decontamination



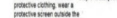
Step 22 Decontamination




Step 23 Decontamination




Step 24 Decontamination



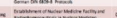
Step 25 Decontamination



Step 26 Decontamination




Step 27 Decontamination




Step 28 Decontamination



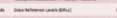
Step 29 Decontamination




Step 30 Decontamination



Step 31 Decontamination



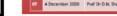
Step 32 Decontamination



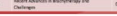
Step 33 Decontamination




Step 34 Decontamination




Step 35 Decontamination




Step 36 Decontamination




Step 37 Decontamination




Step 38 Decontamination




Step 39 Decontamination




Step 40 Decontamination




Step 41 Decontamination




Step 42 Decontamination



Step 43 Decontamination



Step 44 Decontamination



Step 45 Decontamination



**Fig. 11** Awareness leaflet in the Bengali language provided by WHO (left) Relief distribution leaflet (middle) and activities during CORONA pandemic (right)



of work, cannot manage even their daily food, etc. Regarding this, relief distribution program has been arranged and targeted for the needy people for two months (Fig. 11). In parallel, research is going on with national and international students on COVID-19 using AI.

## 5 Contribution of veterinarian scientists in COVID-19 research, Bangladesh

Mankind relies on livestock and poultry for a secure supply of milk, meat and eggs. Veterinarians care for the production of food animals to ensure their welfare and good health, as well as food safety. Thus, veterinary profession contributes to human health improvement by promoting scientific and comparative medical research, avoiding and combating zoonotic diseases, and enhancing the health of the environment and the habitats [36]. Veterinarians form an integral part of the health community around the world. In addition to activities related to animal health and welfare, they play a key role in the prevention and management of diseases, including those that are transmitted to humans, and in ensuring food safety for the populations [37].

Research team at department of surgery and obstetrics, faculty of veterinary science, Bangladesh Agricultural University has made an online survey on the quarantine quality in different parts of Bangladesh and made a prediction trend on COVID-19 pandemic in Bangladesh. Their study also showed that the main disruptions occurred in sexual and reproductive healthcare (SRH) on animal health due to the COVID-19 outbreak are: interruption in animal's feed-nutritive supply chain and declination of field veterinary health services. As a result, the number of sick animals due to lack of nutrition increased; the amount of milk production is greatly reduced. Several emergency diseases like ruminal acidosis, septicemia, dystocia, Pneumonia etc. predominate and the herd health management became disrupted. Ultimately, it increased mental distress and impacted on the animal owners as he/she suffers economic loss due to unwanted culling of these otherwise valuable animals. The number of death increases as the outbreak intensifies.

'One Health Bangladesh'—a multidisciplinary platform dealing with health threats at human-animal—environmental interface; arranged a series of webinars in response to the COVID-19 pandemic. They were able to bring attention to the fact that the complexity of COVID-19 can only be tackled if veterinarians from all around the country can work together and struggled hard with their research for solving health challenges of animals due to COVID-19.

For instance, with the spread of COVID-19, there was an increased demand for testing, diagnosis, and treatment, causing a shortage of medical resources. Reverse transcription polymerase chain reaction (RT-PCR) was used as the definitive test for diagnosing COVID-19, at the beginning of pandemic. However, RT-PCR's limited sensitivity and the shortage of testing kits in epidemic areas increased the screening burden, and many infected people could not be isolated immediately. Vet professionals played significant role in terms of expanding the number of testing laboratory for COVID detection throughout the country.

Following services/initiatives have been undertaken by veterinarians in Bangladesh for the control and management of COVID-19.

- i. Veterinarians have shown their commitments to support the work of human health authorities. Female veterinarians along with their male counterparts of the Bangladesh Livestock Research Institute (BLRI) [38] and chittagong veterinary and animal sciences university (CVASU) [39] have used their experience, expertise and provide labs to test human samples, supporting the diagnostic capacity of human health services of the Ministry of Health and Family Welfare of Bangladesh (Fig. 12).
- ii. Many veterinary clinics and department of livestock service (DLS), Bangladesh has been donating essential tools such as personal protective equipment and ventilators to the hospitals in need. Department of Microbiology and Hygiene, Faculty of Veterinary Sciences of Bangladesh Agricultural University (BAU) and CVASU provided rt-PCR equipment to Mymensingh Medical College (MMC) and Chattogram Medical College (CMC), respectively, to test samples of COVID-19 suspects in Mymensingh and



### Volunteer Veterinary Scientists in COVID-19 RT-PCR lab of BLRI



Dr. Md. Giasuddin Dr. M. Abdus Samad Dr. M. Habibur Rahman Dr. Md Shariful islam Dr. Ruhina Begum

### Volunteer Veterinary Scientists in COVID-19 RT-PCR lab of CVASU



Dr. Md. Sirzul Islam Veterinary Pathologist Dr. Sabiha Jarin Tasnim Veterinary Surgeon Dr. Pronesh Datta Vet. Epidemiologist Dr. Jahan Ara Veterinary Public health specialist Dr. Tanvir Ahmed Nijami Veterinary Microbiologist

**Fig. 12** Veterinarians supporting the diagnostic capacity of human health services of the ministry of health and family welfare of Bangladesh

Chattogram regions [40, 41]. Veterinary professors, scientists have also been volunteering in hospitals and laboratories to test COVID-19 (Fig. 12).

- iii. In the public health response, veterinary scientists have been helping to monitor the disease in humans and to support the research.
- iv. Not only in public health, is the veterinarian's role in ensuring the integrity of our food supply and the livelihood of our farmer's also essential and economic viability. Veterinarians of DLS are helping and counseling livestock farmers to raise animals safely, not only protecting their livelihoods but also a necessary source of food at a time of potential scarcity (Fig. 13).

## 6 Recommendations/ways forward

Human, animal, agriculture and technology are all interconnected. If any one of these is disrupted, then others will be automatically affected. Therefore, concerted efforts from all disciplines are a must in tackling COVID-19. Taking this into account, we would like to recommend the following measures for creating awareness, strategizing preparedness, and strengthening prevention against the current and future pandemics or epidemics:

- i. *Coordination with public health expertise and other professionals at the policy level:* the unparalleled complexity of COVID-19 pandemic and the uncer-



**Fig. 13** Contribution of the veterinary professionals in Bangladesh



tainties surrounding it demands new and innovative approaches to address it; these will only be achieved by cross-sectoral cooperation and a multidisciplinary “whole-of-society” approach to minimize the impact of rapidly spreading viruses like the coronavirus. It is important to involve expertise of health informaticians, medical physicists and Veterinarians at the policy level to ensure proper planning, design, implementation and oversight of veterinary health programs, and to ensure adequate integration and collaboration with the public health programs.

- ii. *Implementation of One Health*: as long as humanity converts nature into a large-scale agriculture, kills ecosystems, increases contact between wild animals and humans, and continues to grow, epidemics such as COVID-19 will continue to threaten the global economy and human life. Genomic sequencing of SARS-CoV, MERS-CoV (middle eastern respiratory coronavirus syndrome), and SARS-CoV-2 showed that these viruses originated in bats, used palm civets and dromedary camels as intermediate hosts respectively, with human as terminal hosts. Moreover, the intermediate hosts of SARS-CoV-2 are expected to be the unknown wild animals sold on the seafood market [42]. Animals act as a crucial source of many infectious or emerging disease of the human. That is why, in the concept of “One Health”, human beings, animals and ecosystems are bound by health, and this concept has been strongly recommended to implement in Bangladesh.
- iii. *Diplomacy for Science, Science for Diplomacy*: science diplomacy is the use of research exchanges between nations to tackle the shared challenges for building constructive, knowledge-based international partnerships [43]. Many of the defining challenges that we are facing like fighting against climate change and diseases, food security, poverty reduction and nuclear disarmament are multinational, might be the result of globalization. No country can solve those problems on its own. Foreign approaches and policies must be adapted to a world of increasing scientific and technical complexity. We need international cooperation in scientific arenas (science diplomacy) to improve international relations between countries in conducting diplomatic research.
- iv. *Implementation of strategies to prepare our generation for risk management*: surprisingly, the very common words such as “lockdown, social distancing, and sanitization” are found unfamiliar among the public in Bangladesh. The risk management system must be included in curricula starting from the elementary level to tertiary education.

## 7 Conclusions

COVID-19 pandemic is affecting everyone on the earth, and it requires global collaborative efforts to minimize its impact. Scientists are now working round the clock to understand the virus and its evolution, to develop interventions, and to enhance capacity to respond to this human health crisis. Till now, rapid case identification and subsequent isolation and strict maintenance of social distancing as control measures have been practicing to reduce the chance of onward chains of transmission of COVID-19. More interestingly, the significant role of women scientists and health professionals in providing global health has become more prominent than ever.

This report gives some recommendations from Medical Physicists, Biomedical Engineers, Health Informaticians and Veterinarians who are contributing in tackling COVID-19 in their respective field in Bangladesh and Malaysia which can act as a stimulant for the coming generations.

While their research activities and active participation can ensure front liners’ safety; raising public awareness and applying safety measures (wearing masks, sanitizing hands etc.) will disable the spread of this deadly virus. Nevertheless, their representation in health management and leadership wisdom and strategies can be replicated to lead other team of scientists of the other parts of the world towards safety and prosperity.

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