

PERSPECTIVES AND DEBATES

Tackling the COVID-19 pandemic: The Bangladesh perspective

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Abstract

An outbreak of a COVID-19 pandemic disease, caused by a novel coronavirus SARS-CoV-2, has posed a serious threat to global human health. Bangladesh has also come under the attack of this viral disease. Here, we aimed to describe the responses of Bangladesh to tackle the COVID-19, particularly on how Bangladesh is dealing with this novel viral disease with its limited resources. The first case of a COVID-19 patient was detected in Bangladesh on March 8, 2020. Since then, a total of 263,503 people are officially reported as COVID-19 infected with 3,471 deaths until August 11, 2020. To combat the COVID-19, the government has taken various steps *viz.* diagnosis of the suspected cases, quarantine of doubted people and isolation of infected patients, local or regional lockdown, closure of all government and private offices, increase public awareness and enforce social distancing, *etc.* Moreover, to address the socio-economic situations, the government announced several financial stimulus packages of about USD 11.90 billion. However, the government got 3 months since the disease was first reported in China, but the country failed in making proper strategies including contact tracing, introducing antibody/antigen-based rapid detection kit, and also failed to make multi-disciplinary team to combat this disease. Further, limited testing facilities and inadequate treatment service along with public unawareness are the major challenges for Bangladesh to tackle this situation effectively. Along with the government, personal awareness and assistance of non-government organizations, private organizations, researchers, doctors, industrialists, and international organizations are firmly required to mitigate this highly contagious disease.

Introduction

A cluster of patients of pneumonia with unknown etiology was first reported in the Wuhan city of Hubei Province in China in December 2019.¹⁻³ The initial symptoms were fever, cough, dyspnea, myalgia or fatigue, headache, hemoptysis, diarrhea and acute respiratory distress syndrome (ARDS).^{4,5} After a few days, Chinese health authorities confirmed that those cases were associated with infection by a novel coronavirus.³ Eventually, the Chinese Centre for Disease Control and Prevention (CCDC) has identified the causative agent from throat swab samples on January 7, 2020, and named the pathogen as Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2).⁶ SARS-CoV-2 is classified under the genus Betacoronavirus of the family *Coronaviridae* under the order *Nidovirales*. It is a non-segmented, enveloped, positive sense RNA virus.⁷ On the other side, the World Health Organization (WHO) named this disease as a coronavirus disease-19 (COVID-19).⁶

The WHO has declared this ongoing outbreak of COVID-19 as a Public Health Emergency of International Concern on January 30, 2020.⁶ According to WHO, the countries with vulnerable health systems are at higher risk. As of August 11, 2020, the disease has infected at least 20417,377 people and has resulted in at least 742,311 deaths globally.⁸ The emergency committee of WHO has announced that the spread of COVID-19 could be discontinued by trace, early detection, isolation, and prompt treatment.⁶ To date, more than 213 countries or territories have confirmed the occurrence of COVID-19 including Bangladesh.⁸ Bangladesh is one of the most vulnerable countries due to high population density (ca. 170 million people in 147,570 km²), poor health care systems, poverty, and the weak economy. In recent years, Bangladesh's economy has been growing well with a GDP

Significance for public health

A novel coronavirus, named SARS-CoV-2, causes COVID-19 disease. This has emerged as a serious threat to human health and economy of the whole world. Bangladesh is one of the densely populated countries in the world, which also has come under attack of COVID-19. The first case of COVID-19 patient was detected in Bangladesh on March 8, 2020. Since then, a total of 30,205 people are officially reported as COVID-19 infected with 432 deaths. This lethal COVID-19 drastically hit the economy of Bangladesh, with 170 million of inhabitants. The local and regional lockdown has already suspended almost all economic activities. However, limited health care service facilities of the country along with public unawareness are the major problems for Bangladesh to tackle this situation effectively. Of note, a large number of low-income workers, day-laborers need to go outside to earn daily income for their livelihood that causes mass transmission. Moreover, many hospitals, some doctors, nurses and other health officials are reluctant to provide treatment to COVID-19 patients and also non-COVID-19 patients. This report described the responses of Bangladesh to tackle the dreadful COVID-19 and discussed prevailing challenges, and how to mitigate this highly contagious disease with limited resources.

growth rate of more than 7.5%, however, about 20% of the population is poor. Nevertheless, because of the rapid spread of the COVID-19, Bangladesh's economy has already started taking a big hit. The nationwide shutdown has already suspended almost all economic activities except agriculture which forced thousands of employments at risk. International trade orders, especially in ready-made garments industries, are being greatly canceled. While the richest, developed and the most powerful countries of the world have been struggling to fight against the COVID-19, failing to provide the necessary support and medical treatment to their patients. Although increase in agricultural sectors in last four decades is phenomenal and the country is nearly food secured, the ongoing COVID-19 poses a serious threat to the supply chain, marketing and production in agriculture. On the other hand, Bangladesh has only 5.3 doctors per 10,000 people, 0.3 nurses per 1,000 people, 0.87 hospital beds per 1,000 people, 0.72 ICU beds and 1.1 ventilators per 100,000 people. The country has relatively very limited health service facilities in comparison to other COVID-19 affected countries that might be one of the possible reasons for comparatively lower recovery rate (57.67%) of COVID-19 patients in Bangladesh.⁹ Bangladesh has never faced a situation like this before. In fact, health care systems of Bangladesh were not prepared to face this pandemic outbreak. COVID-19 is not only a public health concern or medical issue but also it requires a multidisciplinary planning and approach. Molecular diagnostic procedure against any infectious disease is very limited in Bangladesh. Therefore, tackling this newly introduced disease requires comprehensive planning and approaches including the medical, virological and epidemiological interventions. It is now a worrying question how is Bangladesh responding and tackling the pandemic COVID-19 with its relatively poor health management systems. Several opinion papers have been published on different countries regarding the outbreak of COVID-19.^{10,11} The present perspective report aimed to focus how is a resource-poor country Bangladesh tackling this fearsome disease by adopting steps and stimulus packages.

Situation of COVID-19 in Bangladesh

On March 8, 2020, three cases of pandemic COVID-19 were confirmed by the Institute of Epidemiology, Disease Control and Research (IEDCR) for the first time in Bangladesh.¹² Till August 11, 2020, a total of 263,503 COVID-19 patients were officially reported with 3,471 deaths in Bangladesh.^{8,13} COVID-19 patients were found in all 64 districts of the country; however, Dhaka, Narayanganj, Gazipur and Chattogram have been mostly affected (Figure 1).¹³ Dhaka is the capital city of Bangladesh, and one of the fastest growing cities of the world. It supports more than 15 million people in less than 325 square kilometres of area that makes it one of the most densely populated megacities.¹⁴ Moreover, most of the industries of the country such as textiles, tanneries, fertilizer plants, pharmaceuticals companies, cement factories, pulp and paper industries, and most of the government and non-government offices are located in these major cities, which might be one of the possible reasons for higher prevalence of this disease in these areas.

The number of tests per day by real-time RT-PCR is still very low compared to the demand. Possibility for detection of positive cases will be increased when more people will be tested for COVID-19. The lower number of positive cases and deaths might be attributed to the lower test of samples in comparison to other developed countries (Figure 2A). These results indicate that a large number of infected patients are remained undetected, which

accelerate transmission of the disease in the society. Notably, about 20.46% people have been found positive for COVID-19 from total number of people tested (detection rate) in Bangladesh, which is the second highest in comparison to that in both drastically affected countries and neighbour countries (Figure 2B). USA, Brazil, Russia, Italy, Spain, India, and Pakistan recorded 7.91%, 23.19%, 2.90%, 3.43%, 5%, 9.21% and 13.17% COVID-19 positive people, respectively in comparison to the total number of tests conducted (Figure 2B).⁸

Bangladesh experienced a sharp rising of positive cases these days, as the country started conducting doing more tests since the fourth week of first detection. But Bangladesh recorded lower recovery rate in comparison to the neighbour country. As of August 11, 2020, the percentage of recovered patients (recovery rate) in Bangladesh is 57.67% whereas death rate is 1.32% (Figure 3A). However, situation is better in terms of recovery of COVID-19 patients in other countries, for example, Brazil, Russia, Italy, India and Pakistan have been witnessing 70.53%, 78.34%, 80.59%, 70.35%, and 91.60% recovery rate, respectively.⁸ The lower recovery rate might be attributed partly to the limited health service facilities in Bangladesh which has already been reported in the previous study.⁹ Again, a large number of population of Bangladesh faces double burden of diseases: non-communicable diseases like diabetes, cardiovascular diseases, hypertension, stroke, malnutrition, chronic respiratory diseases and cancer, and communicable diseases like tuberculosis, tetanus, malaria, measles, rubella, leprosy and so on.¹⁵

In Bangladesh, young professionals, and working people have so far been mostly infected with COVID-19. Specifically, IEDCR reported that 68% of COVID-19 positive cases were observed in people aged between 21 to 50 years (Figure 3B). On the other side, infected patients aged >50 years constituted 21% of the total infected people. The children and youths aged <20 years comprised 11% of total infected cases (Figure 3B).¹³ There is a similarity of the age distribution of COVID-19 positive patients between Bangladesh and India, but differs with that of the USA and Italy where it has been broken out more drastically. In India, 75.09% of the confirmed patients were less than 50 years old. The working-

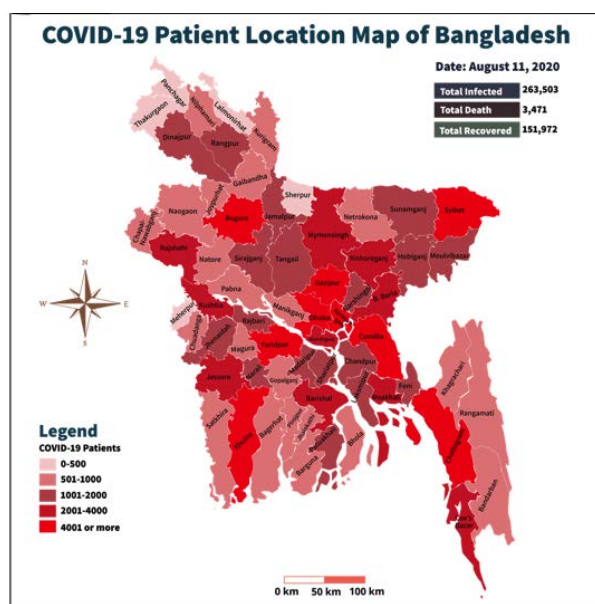


Figure 1. COVID-19 infected patient's location map of Bangladesh. People from 64 districts have already been infected with COVID-19.

age population was infected mostly so far in India. On the other hand, only 27.2% people aged between 19 to 50 years have been infected with COVID-19 in Italy. In the USA, COVID-19 infected people, aged over 50 years old, accounted for 50.63%.¹⁶

The reason(s) why young and working people have been mostly affected by COVID-19 in Bangladesh is not known. However, young people may be little bit careless regarding COVID-19 and working-age people need to go outside to work for maintaining their daily life, which might contribute for getting infection in those people.

Responses of Bangladesh to tackle COVID-19

Almost every country is following aggressive non-therapeutic measures to control the spread of pandemic COVID-19. Bangladesh also has followed the same way. To combat COVID-19, the government of Bangladesh has taken some major steps such as i) the formation of a national COVID-19 response committee headed by the Minister for Health; ii) cancellation of the grand inauguration ceremony of the father of the Nation Bangabandhu

Table 1. The financial packages announced by the Prime Minister of Bangladesh to tackle the socio-economic losses caused by the lethal COVID-19.

Package n.1. Key information	
Package 1	<ul style="list-style-type: none"> i) To provide working capital facilities for the affected industries and service sector organizations, a loan facility of approximately USD 3,529 million created to provide working capital in the short term through the bank system. ii) On the basis of bank-client relationship, the working capital loan is to be given to the respective industries/businesses organization by the commercial banks from their own funds. The interest rate of this loan will be 9%. Half of the interest on the loan is paid by the borrower and the rest of the half will be paid by government.
Package 2	<ul style="list-style-type: none"> i) Providing Working Capital Benefits to Small (Cottage Industries) and Medium Enterprises: A loan facility of approximately USD 2,353 million will be created to provide working capital in the short term through the bank system. ii) On the basis of bank-client relations, commercial banks will lend the working capital to concerned small and medium enterprises with their own funds. The interest rate of this loan will also be 9%. 4% loan will be paid by small and medium enterprises and the remaining 5% will be paid by the government to the concerned bank.
Package 3	<ul style="list-style-type: none"> i) Extending the Benefits of Export Development Fund (EDF) initiated Bangladesh Bank: Under the Block to Block LC, the current size of the EDF will be increased from USD 3.5 billion to USD 5 billion to increase the import of raw materials. ii) As a result, an additional approximately USD 1,500 million will be added to the EDF fund, equivalent to USD 1.5 billion. The current interest rate for the EDF will be reduced from LIBOR (The London Inter-Bank Offered Rate) + 1.5% (which is actually 2.73%) to 2%.
Package 4	Bangladesh Bank will launch a new loan facility of approximately USD 589 million named Pre-shipment Credit Refinance Scheme. The interest rate of this loan will be 7%.
Package 5	<p>The Prime Minister has already announced an emergency incentive package of approximately USD 589 million to pay the salaries/allowances of workers and employees of export-oriented industries.</p> <ul style="list-style-type: none"> i) The government of Bangladesh has announced a new stimulus package of approximately USD 589 million to provide financial support to the farmers in rural areas for boosting agricultural production facing the fallout of COVID-19. This package titled 'Special Incentive Re-financing Scheme for Agriculture Sector' is allocated for ensuring smooth flow of capital for non-crop agriculture sub-sectors dependent on working capital, including seasonal fruit and flower cultivation, fisheries, poultry, dairy and livestock. ii) To meet the country's food demand, different initiatives, including stimulus packages and approximately USD 1060 million has been allocated for boosting crop production amid the outbreak of COVID-19. iii) Approximately USD 15 million for rehabilitation of farmers, while approximately USD 6 million for the farmers affected by natural disaster and cooperatives agriculture, and approximately USD 9 million for expansion of new crops and agriculture technology have been allocated. iv) For distributing machineries and seeds among farmers as agriculture assistance approximately USD 23.5 million has been allocated. Approximately USD 4.1 million has been allocated for buying Aus crop seeds and fertilizers, while approximately USD 4.25 million for irrigation. v) To mitigate the possible shortage of laborers during the harvesting period of boro crop amid COVID-19 outbreak, 180 combined harvesters and 137 reapers has been allocated for the farmers of the haor regions on emergency basis. vi) The government has allocated additional approximately USD 12 million for mechanization of agriculture sector. vii) Nearly 800 combined harvesters and 400 reapers from this amount will be distributed among farmers soon.
For Agricultural sector	
For the doctors, nurses and health workers	<ul style="list-style-type: none"> i) The government has announced a package of approximately USD 12 million for special honorarium for the doctors, nurses and health ii) Approximately USD 88.25 million for health insurance and life insurance.
For non-resident Bangladeshis	The government has announced a stimulus package of approximately USD 236 million for the program to generate employments through several banks for non-resident Bangladeshi people.
For social safety	<ul style="list-style-type: none"> i) Approximately USD 294.5 million for free distribution of food materials to the needy people. ii) Approximately USD 29.5 million for selling rice at 'Rice for TK. 10 per KG (approx. 12 cents/kg rice)' program iii) Approximately USD 148 million for distributing cash among the target-based communities. iv) Approximately USD 96 million for expanding the coverage of allowance program. v) Approximately USD 250.6 million for building houses for the homeless people.

Sheikh Mujibur Rahman's birth centenary celebration programs; iii) closure of all government and private offices; iv) closure of all educational institutions of the country v) ban of all public gathering and transportation services; vi) suspension of all domestic and international flights; vii) deployment of the law enforcement agencies including army and police to ensure that people maintain social distancing and to motivate the people; viii) cancellation of celebration of Bangla New Year on April 14; ix) cancellation of celebration program of the 50th Independence Day; x) operating the 'Rice for TK. 10 per KG (approx. 12 cents/kg rice)' program for the needy people throughout the country; and xi) extension of social safety net to the poor and distressed people of the society. An addition, civil society, philanthropists and richer people of the society are generously supporting the poor community of the society by offering foods and money.¹⁷⁻²¹ The government has also declared several stimulus packages of the total amount of approximately USD 11.90 billion for the business industries including small and medium enterprises, cottage industries; for doctors, nurses, homeless people and social safety, and for the agricultural sector to ensure food and nutritional security of the country (Table 1).^{20,22-24} The diagnostic approach of COVID-19 patients in Bangladesh is of total instability and lack of coordination, and therefore proper solution was not found in last five months since outbreak of this disease. The health care management system of Bangladesh is not perfect, which has lots of weaknesses and problems. When a health emergency of an immense proportion like that of COVID-19 pandemic gripped the country, it seems that the health system management has lost its way. Most of the time, the health sector policymakers were talking about all kind of preparations being already taken to tackle the pandemic COVID-19. However, the lack of coordination among various departments of the government and the absence of proper direction are very evident on the ground.²⁵ Consequently, the Government has failed to restrict the travelers to enter into the country from the COVID-19 affected countries on time.¹⁰ While the government of Bangladesh needed to establish proper measures to identify people infected with COVID-19, various departments, including those at various airports, were completely disorganized. Only three thermal scanners were mounted in Dhaka international airports, and one in Sylhet and another one in Chittagong international airports to screen a large number of inbound passengers.²⁶ No disinfection activities were performed and no samples were collected from passenger's body for performing confirmatory diagnostic tests.

Initially, the government of Bangladesh has declared the enforcement of lockdown for 10 days. After completing the initial lockdown, thousands of service holders, garments workers and other factory workers started heading back from home residences (mostly villages) to major cities, e.g., Dhaka, Narayanganj, Gajipur, and Chattogram, ignoring the risk of spreading of COVID-19. Later, the government declared extensions of the nationwide lockdown and these people coming from different areas of the country started to head back to their home residences.¹⁰ Notably, when most of the people, including the owners of shops and shopping malls were not in favor of reopening their business, the government permitted 'limited' restart of business.²⁵ Government also allowed migration of thousands of people during Eid festival from COVID-19 hotspots like Dhaka to all over the countries, without maintaining social distance. Collectively, the government has failed to maintain proper lockdown due to the lack of coordination between different authorities and groups.¹⁰ Some corrupt officials of the health ministry embezzled money in the name of buying personal protection equipment (PPE) and standard masks.²⁷ Of note, more than a dozen of Bangladeshi health service

providers were arrested on charges of selling thousands of fake COVID-19 negative certificates.²⁸

Major challenges of COVID-19 in Bangladesh

Though the government has taken some essential steps, many challenges are still remained to be addressed to effectively tackle this fearsome disease. The major challenges for addressing the COVID-19 in Bangladesh are briefly described as follows.

A limited number of tests

As there is no effective treatment against COVID-19, this is very important to follow test, trace and treatment policies to tackle this highly contagious disease. It is crucial to diagnose the disease at the earliest stage so that immediate contact tracing, isolation of the patient and quarantine of the person(s), who have the possibility to come in contact with the patient, could be ensured. Less than ten thousand daily test capacity is very low in a country of 170 million of population. Until August 11, 2020, Bangladesh has tested only 7,812 samples per million people whereas Russia has tested 212,414 samples (Figure 2A).⁸ Thus, it is believed that most of the people having COVID-19 were left undetected due to the lower number of tests. But after increasing the number of tests, the number of positive cases is growing high very rapidly in Bangladesh. An extremely limited number of tests is increasing the chances of leaving a higher number of COVID-19 cases undetected in Bangladesh. It is highly recommended to increase the number of tests for suspected and asymptomatic people as soon as possible. Besides this, all identified and suspected cases must be quarantined and treatment should be provided if needed. The government must need to include all research institutes, universities, and other organizations that have the laboratory facility to increase the number of tests for diagnosing COVID-19. Rapid test protocol is yet to be used in Bangladesh for diagnostic purpose of COVID-19. Thus, Bangladesh urgently needs to introduce effective rapid tests such as antigen/antibody-based test protocols to satisfy the skyrocketing demand not only for diagnosis of COVID-19 but also for seroprevalence study to tackle this socially spread fatal disease in a sustainable manner. To tackle this situation, convenient, effective, and specific rapid test methods should be urgently introduced.

Lack of safety equipment

There is inadequate supply of personal protection equipment (PPE), standard masks, and hand gloves to the health service providers, which is one of the major constraints in providing treatment facilities. A significant lack of safety equipment is fueling the concern for frontline health service providers like doctors and nurses. Some corrupt officials of health ministry were involved in importing low quality protective equipments.²⁷ Some factories were also involved in producing cheap and poor quality antiseptic liquids, face masks, hand gloves and PPE all over Bangladesh. These low quality healthcare products are now posing great risk to public health amid the ongoing pandemic COVID-19.²⁹ A large number of doctors, nurses, and persons of law enforcing agencies have already diagnosed as COVID-19 patients in the country. Of note, until August 11, 2020, approximately 92 doctors have been died of this disease in Bangladesh.³⁰ Collectively, the limitation of PPE and inadequate test facilities of real-time RT-PCR are the big challenges for Bangladesh. The government has to make available more test facilities and import high quality of these protective gears immediately.

Lack of skilled human resources

The use of real-time RT-PCR-based-assay to diagnose COVID-19 requires skilled human resources and sophisticated laboratory facilities. To avoid contamination, false-negative results and risks of biological hazards, the government is not allowing all hospitals, and organizations to perform the test. A large number of graduates have been producing annually in the field of biochemistry, molecular biology, microbiology, biotechnology etc. from different universities in Bangladesh. Those graduates can be specially trained to carry out the diagnosis of COVID-19. However,

government has failed in making strategy to use these skilled graduates. A national panel of virologists, biotechnologists and molecular biologists should be formed, trained and employed for the diagnosis of COVID-19.

Limited treatment facilities

The diagnosis and treatment facilities of COVID-19 in Bangladesh are very limited. Bangladesh has eight hospital beds per 10,000 people, whereas the USA has 29 beds per 10,000 people and China has 42. Moreover, the government health department of

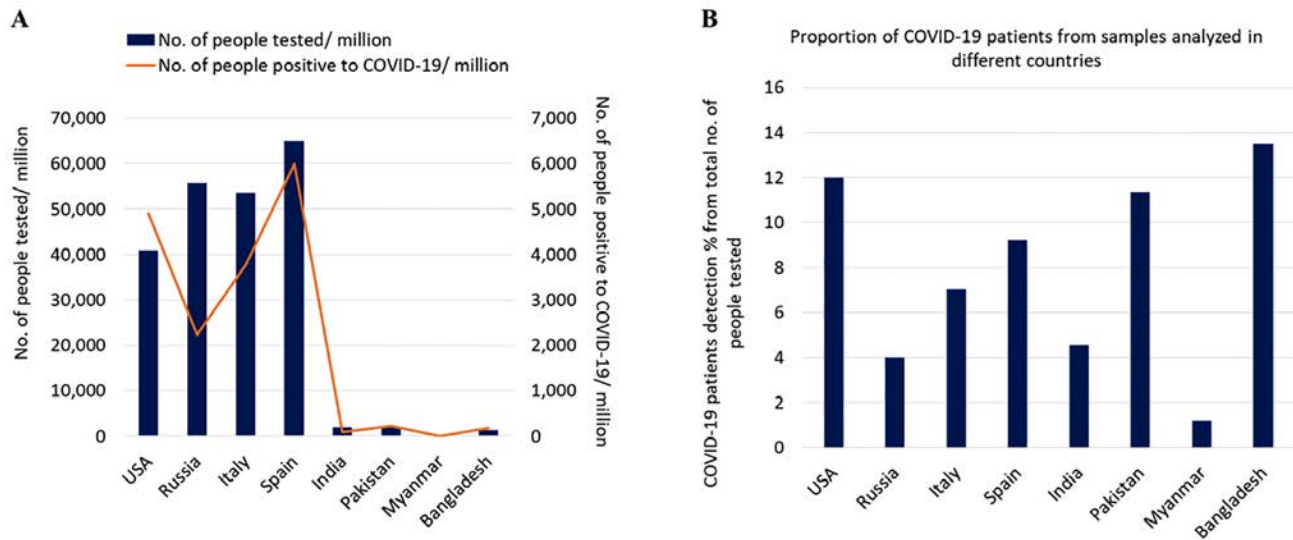


Figure 2. A) Trends in diagnosis of COVID-19 positive cases with number of people tested. Until August 11, 2020, Bangladesh has completed 7,812 tests per million people with 1,598 positive cases per million people. On the other hand, USA, Russia, Italy, Spain and Pakistan has completed large number of test and got increased number of positive cases. The data show that possibility for detection of positive cases is increased when more people are tested for COVID-19. B) The proportion of COVID-19 positive patients detected from total number of people tested in different countries including Bangladesh. The results show that the detection rate of COVID-19 positive cases is the second highest in Bangladesh.

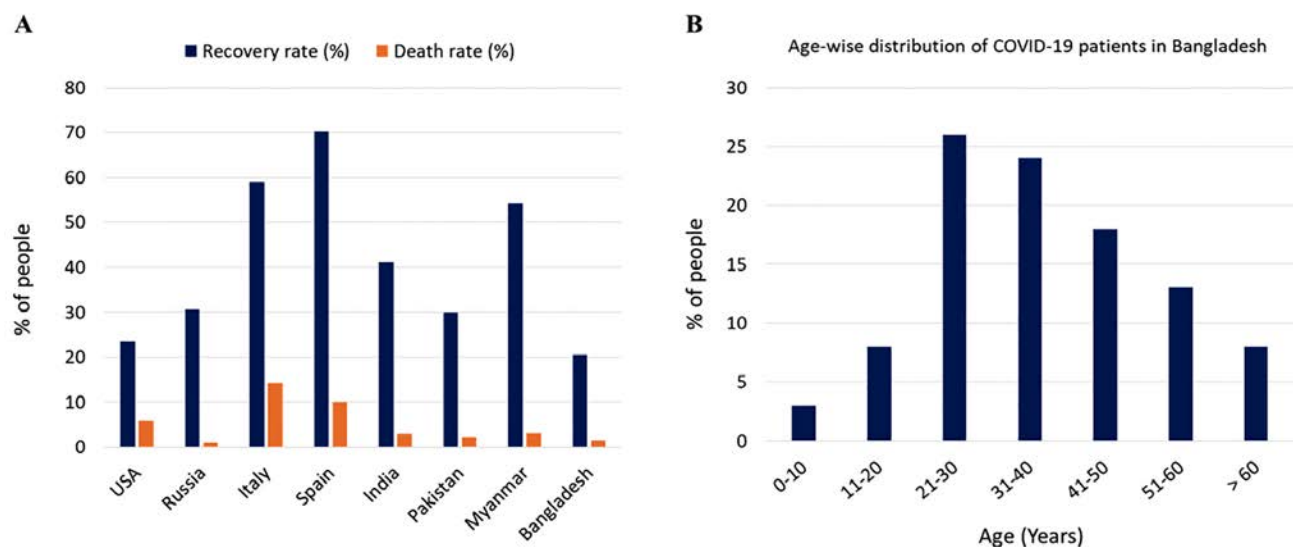


Figure 3. A) The recovery and death rate of COVID-19 patients in some selected countries including Bangladesh. The result reveals that the recovery rate in Bangladesh is lower than that compared to other countries, even though death rate is very low. B) Age-wise distribution of COVID-19 patients in Bangladesh. The result shows that people aged between 21-50 years are likely to have COVID-19 infection under Bangladesh situation.

Bangladesh has only 432 ICU beds in total, only 110 of which are placed outside the capital city, Dhaka. The private healthcare sector has additional 737 ICU beds and this is for a population of 170 million.^{9,31} The government has to prepare special hospitals as soon as possible with a sufficient number of ICU beds. Currently, almost all private hospitals and healthcare systems are not accepting any COVID-19 patients. The government should take necessary steps to engage these private organizations to the national mission of combating the COVID-19.

In addition to the above-mentioned challenges, the country does not have enough ventilator machines to provide respiratory support to critical COVID-19 patients. Right now, only 1,769 ventilators are available in Bangladesh that means an average of one ventilator available for every 93,273 persons.⁹ Also, most of the intensive care beds and ventilators of the country are installed at hospitals in major cities, mostly in Dhaka, which means that people from the remote areas will not be able to get those facilities when they will fall in critical condition. Along with the government, other industrialists and civil societies should to come forward to arrange ICU beds, mechanical ventilators and to import these instruments at the earliest period of time. The government should declare this importation as tax-free.

The private sector of health service department of Bangladesh usually treat a large number of patients everyday both in their indoor and outdoor sections. However, they stopped to deliver their all medical services not only for COVID-19 patients but also for non COVID-19 patients. Of note, some large and leading private hospitals also kept themselves away from the ongoing health emergency.²⁵ Recently, some private entities have come forward amid the ongoing health emergency. Bashundhara group, country's leading private organization has allowed to use the Bashundhara Convention Centre to build a 2000-unit hospital which will also have 71 Intensive Care Units (ICU). Likewise, Akij Group has also decided to set up a 301-bed hospital in the Tejgaon area.

Limited number of health service provider

Another big problem in Bangladesh is the fewer number of doctors and nurses in comparison to other countries. Bangladesh has 5 doctors on average per 10,000 people, whereas this number in Italy is 41 doctors.²⁴ Moreover, many hospitals, some doctors, nurses and other health officials were showing unwillingness to provide treatment for the COVID-19 patients which is unethical and unprofessional from hospital authorities and the doctors as well. They are scared of getting infected as they do not have sufficient protective equipment. In this situation, secondary and tertiary waves of the infection may result in major outbreak which could lead to a huge disaster for the country. To encourage health professionals, the government has declared incentives and health insurance for the doctor, nurses and other frontline workers involved in fighting against the COVID-19. To increase the number of health workers, the government should arrange a quick training for the community health workers who can provide support COVID-19 patients in the remote areas. Recently, the Health Ministry of Bangladesh has appointed 2,000 doctors and 6,000 nurses to fight against the pandemic COVID-19.³²

Community transmission

The COVID-19 is an extremely contagious disease. When the exact source of infection is not clearly identified, it is called community transmission. Many positive cases have been reported already where the infected person neither came from abroad nor any family members have returned from abroad, which suggests that community transmission has taken place. The number of new infected patients and deaths are increasing geometrically. Print, electronic and social

media have published a series of the report about suspicious deaths of patients with COVID-19 symptoms. Some of the death cases were recorded at the COVID-19 isolation centers at hospitals at the district level. In due courses, others were denied for providing treatment, even though no tests were performed to confirm the contagion. Test facilities for the COVID-19 diagnosis were mostly centralized to only the IEDCR in the capital city Dhaka for a long time, although patients with suspicious symptoms of COVID-19 were reported throughout the country. However, the government is now arranging the COVID-19 test facilities laboratory at district level, mainly based on the government medical colleges and some research institutes in Bangladesh. Obviously, the number of the test capacities must be increased across the country. In addition, number of test laboratories should be made available in different areas of the country and all the suspected cases of COVID-19 need to be tested immediately. Microbiology, virology, molecular biology, biotechnology and biochemistry laboratories in the universities and medical colleges across the country should be transformed quickly into COVID-19 diagnostic laboratory to confirm the contagion.

Lack of research fund

The universities of Bangladesh have inadequate fund for molecular research, which is reflected on the lower amount of scientific papers published every year in the international open access scientific journals. Due to inadequate facilities including limited modern laboratory equipments, Bangladeshi researchers could not work intensively on this important issue of COVID-19. It is important to note that the developed countries have been investing billions of dollars for research on COVID-19 and other infectious diseases, Bangladeshi researchers depend only on limited resources. Therefore, it is essential to allocate adequate funds from government and non-government sources to perform more research and study about the ongoing COVID-19 and other fatal diseases in Bangladesh.

Large number of vulnerable and disadvantaged people

In Bangladesh, 20% people are poor. Some of them live from hand to mouth. Due to lockdown and staying home, they are now in a vulnerable situation. Special attention has to be paid to protect these vulnerable groups or individuals. They are basically elder people and the disadvantaged, including day-laborers, patients with comorbidities who have a higher risk of getting infected. The elder people are more susceptible because of their low immunity to fight against the disease and therefore, they need more intensive care-based treatment which would require an increased number of ventilators. Some disadvantaged groups, day-laborers are also vulnerable and may cause mass transmission as they need to go outside to earn their daily food items. Again, working-aged people need to go outside to work for maintaining their daily life, which might contribute to getting the infection in those people. Through providing essential support such as daily needs, food, and relief to these groups of disadvantaged people at this crucial time may reduce their sufferings and also reduce their chance of getting infected and infecting others. At this point, the government has to monitor the safety net program very strictly otherwise, there is a chance of misuse of those relief items by immoral local leaders.

Lack of public awareness

As specific drugs and vaccines have not yet been released to prevent or treat COVID-19, strict lockdown of vulnerable places, maintaining social distancing and practicing of cough etiquettes such as by covering coughs and sneezes with disposable tissues or clean clothes by every person are critical to tackle this highly contagious disease. Maintaining social distancing is a very difficult

task in a highly populated country like Bangladesh. In Bangladesh, there is no educational program or subjects on public awareness at any level of education including elementary level. However, to combat the dreadful COVID-19, the government has opened a new cell to raise public awareness and to prevent propaganda among people about the fatal effect of COVID-19.³³ Mass media including television media, the Community radios and newspaper are broadcasting several program daily about COVID-19 in different formats like- news, Public Service Announcement (PSA), radio spots, radio talks, magazine, drama, jingles, interview and expert opinions etc.³⁴ Furthermore, campaigns for increasing public awareness explaining the causes, symptoms, and effects of COVID-19 are being carried out across social media.³⁵ But many people are not so much conscious about the fatal effect of COVID-19. Young people may be a little bit careless regarding COVID-19. This is why, they are infected at higher rate in Bangladesh. Along with the government's step, every person should try himself to keep distancing with others, washing hands, not to go outside without any important reason. Special measures should be taken by the print and electronic media by engaging celebrities to promote public awareness to the fatality of the COVID-19 and social distancing.

Large number of Rohingya refugees

A big burden of Bangladesh is to save more than one million Rohingya refugees from the rapidly spreading COVID-19, who are living in the confined conditions in Cox's Bazar district.³⁶ The number of ventilators in Cox's Bazar is very limited where around 3.3 million people are living.³⁶ If severe community transfer will happen there, many lives will be lost. The number of tests, ventilators and special attention regarding this issue has to be increased at the earliest period of time.

Effects on economy of the country

Bangladesh economy has been improving with GDP growth rate 6-8% in last decade. The present outbreak of COVID-19 poses a serious threat to the growing economy of the country in various ways. Due to sudden disruption in textile and garments manufacturing industries, trades and business of deferent sectors, tourism, supply and marketing channels of the agricultural produces, agricultural production, and unemployment of a huge number of people, the economy of the country is under a serious threat. The government has already declared some stimulus packages for the industrial sector to provide financial support and to boost up the threatened economy.^{20,22-24}

Effects on agricultural sector

Bangladesh is an agrarian country. Although agriculture contributes 14% to the GDP, nearly 70% of the population directly or indirectly depends on agriculture. The COVID-19 interrupted badly the supply chain and marketing of perishable vegetables, fruits, poultry and dairy products. As a result, both producers and consumers are affected. Bangladesh immediate needs to get supports from the deployed army and police forces to reinstate these supply chain and marketing channels. Currently, local *boro* rice harvesting season in low lying areas (*haor* in Bangla) were going on which were under the threat of flash flood. The *haor* areas are a big basket for rice crops in the country. But due to the outbreak of COVID-19, there was a possible chance of the shortage of laborers in the *haor* area. The government has made special arrangement to allow laborers from other districts to move to the *haor* areas for rice harvesting. Meanwhile, the government has arranged a good number of the harvester and other facilities to harvest the

boro rice before the flash flood inundate the areas. To give good price to the farmers, government should purchase rice, wheat and other food crops and store them in for future food security. After the outbreak of COVID-19 in Bangladesh, some people started to disseminate false propaganda through social networks that coronavirus causing COVID-19 in humans may transmit from the live-stock and poultry and their products (meat, milk, and egg). In fact, this meat, milk, and egg are essential to humans for boosting up their immunity which might play pivotal roles in fighting against COVID-19. Due to the disruption of supply chain and change in the mind of consumers, the price of milk, meat, and eggs has drastically been decreased. It should be noted that approximately 20% of the people of Bangladesh directly or indirectly rely on the live-stock and poultry sectors for their livelihoods. The government needs to increase public awareness through television, social media, print, and electronic media to eat more meat, fish, and eggs for becoming people healthy which is very important to fight against the COVID-19. Recently, the government has announced a new stimulus package of approximately USD 589 million to provide financial support only to the farmers and some other stimulus packages for boosting crop production.^{22,23} The distribution of this stimulus funds to the right farmers in the right time is obviously a challenging task. The government has also declared to arrange health checkups, sanitary equipment, vehicles for transportation, resident for the farmers who are willing to go to *haor* area from harvesting of the *boro* rice crop. This is definitely a right decision and implementation of this decision would help the country to ensure food security.

The overall current situation of Bangladesh illustrated in above sections clearly reflects that Bangladesh has to overcome huge challenges to tackle the fatal COVID-19 epidemic in the country. Although the effects of environment on dissemination and severity of COVID-19 infection is not clear yet, the current rate of infection and death cases in a tropical delta Bangladesh is low compared to any temperate European and American countries. Further studies on the effect of temperature, humidity, sunlight and other environmental and demographic factors should be investigated to understand the nature of infections.

Conclusion

The COVID-19 poses a serious health and economic problem in a resource-poor highly dense populated country, Bangladesh. The government of Bangladesh has taken many initiatives such as diagnosis of suspected cases, quarantine of doubted people and isolation of infected patients, local or regional lockdown, increasing public awareness and social distancing to combat the COVID-19. Furthermore, the government has announced many financial stimulus packages for industries, agricultural production, and daily workers. However, lack of facilities for testing required number of suspected samples, scarcity of diagnostic kits, insufficient PPE, ICU, and ventilators in the hospitals, limited number of health workers along with public unawareness are the major challenges for this developing nation for combating the COVID-19. Therefore, the government should take the necessary actions to address these challenges and ensure public health. At the same time, the government also needs to use rapid detection kit for diagnostic purpose and import PPE, ventilators, and ICU beds on an urgent basis to fight against lethal COVID-19. Furthermore, the government should order mandatory lockdown in vulnerable places. The government also needs to allocate sufficient research funds to conduct research on COVID-19. Moreover, it is needed to circulate the news and instruction continuously regarding COVID-

19 to increase public awareness. Along with the government, people also must need to maintain social distancing, personal awareness, personal hygiene, self-quarantine condition and to obey the rules of the country and WHO as well.

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