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Complete List of Authors:	Biswas, Raaj Kishore; University of New South Wales, Transport and Road Safety (TARS) Research Centre, School of Aviation Huq, Samin ; Child Health Research Foundation Afiaz, Awan ; Dhaka University Khan, Hafiz; University of West London College of Nursing Midwifery and Healthcare, Public Health
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Short title: COVID-19 preparedness in Bangladesh

Raaj Kishore Biswas

Transport and Road Safety (TARS) Research Centre, School of Aviation, University of New South Wales, Australia

RaajKishore.Biswas@student.unsw.edu.au

Samin Huq

Child Health Research Foundation, Dhaka, Bangladesh

samin.huq@eleve.ehesp.fr

Awan Afiaz

Institute of Statistical Research and Training, University of Dhaka, Dhaka, Bangladesh

aafiaz@isrt.ac.bd

Hafiz T.A. Khan

The Graduate School, University of West London, England, UK

hafiz.khan@uwl.ac.uk

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Contributor statement

RK Biswas conceptualised the study, formulated the model, coded the maps, synthesised the analysis plan, and drafted the manuscript. S Huq structured the manuscript, conducted literature review, and drafted the manuscript. A Afiaz compiled the data, coded the maps, finalized the model, and drafted the manuscript. HTA Khan critically reviewed the manuscript. The final manuscript was read and approved by all the authors.

A systematic assessment on COVID-19 preparedness and transition strategy in Bangladesh

Raaj Kishore Biswas (corresponding author)[a]

[a] *Transport and Road Safety (TARS) Research Centre, School of Aviation, University of New South Wales, Sydney, Australia*
RaajKishore.Biswas@student.unsw.edu.au

Abstract

Rationale, aims and objectives: The COVID-19 pandemic of 2020 has overpowered the most advanced health systems worldwide with thousands of daily deaths. The current study conducted a situation analysis on the pandemic preparedness of Bangladesh and provided recommendations on the transition to the new reality and gradual restoration of normalcy.

Method: A complex adaptive system (CAS) framework was theorized based on four structural dimensions obtained from the crisis and complexity theory to help evaluate the health system of Bangladesh. Data sourced from published reports from the government, non-governmental organizations and mainstream media up to 15 June 2020 were used to conduct a qualitative analysis and visualize the spatial distribution of countrywide COVID-19 cases.

Results: The findings suggested that Bangladesh severely lacked the preparedness to tackle the spread of COVID-19 with both short- and long-term implications for health, the economy, and good governance. Absence of planning and coordination, disproportionate resource allocations, challenged infrastructure, adherence to bureaucratic delay, lack of synchronized risk communication, failing leadership of concerned authorities and incoherent decision-making have led to a precarious situation that will have dire ramifications causing many uncertainties in the coming days.

Conclusions: Implementation of response protocols addressing the needs of the community and the stakeholders from the central level is urgently needed. The development of mechanisms for dynamic decision-making based on regular feedback and long-term planning for a smooth transition between the new reality and normalcy should also be urgently addressed in Bangladesh.

Keywords: Situational assessment, Health system, Crisis theory, Complexity theory, SARS-COV-2, Pandemic, LMIC

Introduction

The outbreak of the 2019 novel coronavirus (COVID-19) has challenged existing health systems and national preparedness strategies on the outbreak of pandemics worldwide. COVID-19 has surpassed the magnitude of two epidemics in last two decades: severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV).[1,2] General discussion about the pandemic up until June, 2020 has focused on the experiences of China, USA and Europe. Low- and middle-income countries (LMICs) such as Bangladesh started to experience the early onslaught of COVID-19 in early March 2020 with severe consequences in the offing.[3] To help address this gap, this study evaluated the health system of Bangladesh and its pandemic preparedness approach by means of a complex adaptive system (CAS) framework.

Following the introduction of International Health Regulations (IHR) in 2005 endorsed by 196 countries, national level efforts were called for to strengthen health systems to help prevent the spread of infectious diseases on an international scale without disrupting international traffic and trade.[4] However, in LMICs, political resolve, insufficient resources and technical limitations have challenged the implementation of these recommendations.[5,6] Furthermore, the support from high-income countries towards LMICs has not been encouraging.[7,8] It was also recommended that policy implementation for all LMICs as a single body would not be practical in unprecedented circumstances, as is evident from the ongoing COVID-19 pandemic that demands country specific assessments.[9]

Bangladesh is an over-populated LMIC that has seen strong growth over the last decade in its export-based economy and improvements in multiple public health indicators.[10,11,12] Despite the goodwill from local and international non-governmental organizations, the existing health system is already stretched with only 7.4 skilled workers per 10,000 population.[13,14] The dawn of the COVID-19 crisis has positioned the whole system into a unique paradigm by challenging health, the economy, and law and order.

There has not been a formal evaluation on the preparedness of the Bangladesh health system for coping with pandemics or substantial analysis on the health system as a whole. A critical assessment is therefore needed in order to better prepare for the ongoing challenge and future pandemics. The objective of this study is to theorize a complex adaptive system (CAS) framework to evaluate the health system during a pandemic and assess the steps taken so far by Bangladesh

for tackling the COVID-19 crisis up to 15 June 2020.

For the purpose of discussing the preparedness and systematic transmission of Bangladesh during the COVID-19 crisis, the study applied the CAS framework. The parameters of the CAS and sources of data based on relevant theories were detailed in the next section (Methods) followed by a discussion on the agents, internal and external environments that impact the performance of the health system of Bangladesh during the pandemic. Before conclusion, a set of recommendations derived from the quantitative synthesis were listed, which would assist policymakers and relevant institutions to conduct a better transition from current crisis to normalcy.

Methods

The complex adaptive system (CAS) framework was used to assess the health system preparedness of Bangladesh since the performance is based on multiple dimensions of crisis theory and complexity theory. Crisis theory is characterizes the idea that unresolved or inevitable conflict will change the existing paradigm and typical problem-solving mechanisms would not be efficient.[15,16] Due to the resulting disorganization from the crisis, interventions are applied to help the system to adapt and recover in the shortest possible time.[17] This theory was applied to explain the management of a recent country-specific epidemic such as SARS in Singapore.[18]

Complexity theory was proposed to explore the individual, organizational and systemic behaviours of a social phenomenon.[19,20] Using complexity theory, complex and emerging health issues such as pandemics or epidemics can be elucidated.[21] Health systems can be non-linear and often unpredictable during a pandemic[22] and since complexity theory has been used in the literature for disease outbreaks,[23] several aspects of this theory were applicable in the context of COVID-19.

Four major dimensions were extracted from the crisis and complexity theories to encompass the preparedness of the Bangladesh health system for COVID-19 (Figure 1) and, based on these four dimensions, the CAS framework was assembled. The CAS framework is a continuing self-organization that uses a bottom-up approach based on multiple agents of a system to emerge a whole pattern based on both internal and external environment.[24,25] The CAS is regularly applied to explain the interdependencies among health system agents and their consequences in multiple spheres (macro, meso, micro and nano).[26] In this study, each of the four dimensions were

explored using the four concepts of the CAS framework: agents, emergence, internal and external environments, to elucidate the Bangladesh health system (Figure 1).

Data were sourced from reports published by the Bangladesh Directorate General of Health Services (DGHS) and World Health Organization (WHO) for instance, among others, as well as media articles up to 15 June 2020 for the situation analysis. Regular press briefings and data released by the Institute of Epidemiology, Disease Control and Research (IEDCR), the official source of COVID-19 information in Bangladesh, were collected and analysed. These include daily data on the number of tests, positive cases, deaths, recoveries and case locations as well as data on medical inventories specially supplied for COVID-19 preparation. The spatial mapping on district wise COVID-19 transmission was formulated using *R* (version 3.5.0).

Results and Discussion

1. Immediate response to crisis

National level preparedness and coordination

Previous pandemics related to the coronavirus have provided examples of healthcare workers being infected due to occupational exposure and demonstrate the importance of timely sharing of accurate information and proactive collaboration in generating an effective response.[27] Reinforcement of the IHR guidelines[28] has allowed effective management of crises through evaluation of risk communication strategies using information from risk assessments minimizing mass anarchy.[29]

Coordination and accountability are vital elements in forming an effective response to events such as COVID-19. Therefore, such mechanisms need to channel the implementation of evidence based decision-making at central level for its contextualization to the needs at local level. Coordination also requires the incorporation of feedback from communities addressing their concerns that may be causing emotional distress and the development of effective relationships at local level.[18]

As part of its COVID-19 response, Bangladesh has established a number of committees at all levels comprising of decision-makers, administration, law and order, information, local & international organizations and various components of the health system.[30] A technical committee was formed at central level comprising healthcare stakeholders for the purpose of evaluating activities in the plan through a review process and for recommending resource mobilization.

The role of committees at local level is limited to the implementation of the plan devised at central level. According to Stacey (2003)[20] on the understanding of complex systems, the

committee failed to include sector specialists (including public health experts) focusing on the respective service and information delivery relevant to the COVID-19 response. Such a scenario can contribute to a lower rate of information flow as well as prompt limited impact due to a lower level of diversity and differentials in risk perceptiveness between the various levels.

The status quo differentials between local and national interests might also affect the generation of any response due to the unavailability of feedback loops among the parts of the system based on these committees.[31] The differentials between local and national levels can affect the degree of accountability in these systems that are not specified in measured terms regarding the trend of the disease spread.

Assessing the overall scenario and conducting strategic planning

A total of 90,619 cases and 1209 deaths with a recovery rate of 20.6% have been reported until 15 June 2020 due to COVID-19 from the 519,503 tests conducted across 60 testing centres indicating an attack rate of 532.1/million people and case fatality rate of 1.33% in Bangladesh.[32] IEDCR estimates suggest that 53% of cases belong to the 21-40 years age group with 70% of cases being males.[33] Half of the centres are located in Dhaka (the capital) with those outside the city sited in scattered locations, not more than 3 centres other than Dhaka (excluding Dhaka city) (6), Chattogram (8), Rajshahi divisions (5). This situation can possibly lead to overloading of the test centres in Dhaka that can, in turn, contribute towards issues of timeliness of reporting of the number of cases as well as the quality of the test samples obtained.

Due to the lack of an effective health information system that would have contributed towards enhanced surveillance ensuring effective planning and monitoring of disease spread, government was forced to undertake stringent measures without meticulous assessment of the magnitude of disease due to data unavailability. As of 15 June 2020, the Dhaka city bears the major burden of COVID-19 cases (2859.6 per million). However, the virus has managed to spread to other neighbouring districts of Munshiganj (876.4 per million), Naryanganj (852.4 per million) as well as other major cities such as Cox's Bazar (494.9 per million), Chattogram (408.7 per million).[34] Such level of caseload is also evident on the case doubling rate of Dhaka, Naryanganj, Munshiganj, Cox's Bazar, Munishiganj within the range of 6-8 days. Even in other district, alarms are ringing as the case doubling rate in Feni and Noakhali is only 5 days.[35] However, the situation became quite difficult to control in the light of suspension of trade and other economic activities, the country has

been divided into multiple zones 45 areas in Dhaka city and 11 in Chattogram for adhering strict control.[36] These indicate that community transmission is observed in Bangladesh and is shown in Figure 2.

Although a protocol has been designed,[30] its implementation and accuracy require assessment. Reports from WHO dated 20 April 2020 suggest that the discrepancy between the reported number of tests and the number of people tested indicates multiple testing of the same patient.[34] There is no available data on the quality control around the handling of the samples and is therefore another issue to explore in addition to the diagnostic characteristics of the tests available for the identification of the disease.

Deployment of inadequate resources at key periods has led to a deterioration of the scenario. A total of 718,921 people arrived in Bangladesh via air, land and seaports from 8 March 2020, when the first case was identified, up to 15 June 2020. Airport screening of such high numbers overwhelmed a pool of only 7 doctors, 10 nurses and 20 staff also operating without separate booths for passengers arriving from high-risk countries.[37] This situation heightens the possibility that passengers with virus symptoms travelling to the country in the early days of the pandemic were missed.

As part of the COVID-19 preparedness and response plan, 565 medical teams with isolated units in 493 upazila and separate outpatient departments for patients having respiratory tract infections at 443 upazila have been established as of 15 June 2020.[32] While all this looks good on paper, a disproportionate allocation of resources was widespread. For example, despite there being a higher case burden in Dhaka (2859.6/million) and in the neighbouring districts such as Narayanganj (852.4/million) and Munshiganj (876.4/million), as of 15 June 2020, all of them have a lower number of isolation beds than Sylhet (N = 481) that has 166.5 cases per million people.[32] A similar imbalance was observed in the formulation of medical teams. A total of 889 physicians and 738 nurses were involved in the designated COVID-19 response medical teams but only 185 medical technologists and 504 support staff were included. A large number of teams consisted of only physicians and nurses, excluding other key personnel leading to an inadequate proportion of available healthcare workers, disorganization, and increased exposure.

As of June 15, 2020, a total of 1.3 million PPEs, 3.14 million mask, 562,439 gloves have stocked.[38] There is a huge shortage of supplies in those facilities located in areas with a higher case burden, especially the N-95 masks. These masks are being highly distributed in districts like

Dinajpur (354) and Moulvibazar (388) but Narayanganj had only 10 of the N-95 masks despite having a much higher case burden.[39]

The quality of the supplied resources has been extensively questioned. News reports indicate a debacle with the quality of 20,600 of the N-95 masks where the supplier organization has sought exemption from punishment for providing below quality masks after packaging them with N-95 marking.[40] These inadequacies played a part in the lead up to the health facility lockdowns as health workers were infected and services were halted as a result.[41,42]

Bottlenecks and barriers for preparedness

An effective response coordinating multilevel stakeholder activities during a pandemic could improve the healthcare infrastructure and contribute to a resilient healthcare system. A resilient healthcare system is expected to absorb the shock and adept to dynamic needs while maintaining the existing level of healthcare accessibility.[43]

Bangladesh activated a 6-level plan from preparedness to mitigation using the Infectious Disease (Prevention, Control and Elimination) Act 2018 as the guiding document detailing the containment activities for the progressive development of COVID-19.[30] Early initiatives like quarantining arrivals from high-risk countries was hampered by crowd reactions to the appalling conditions at the quarantine sites that forced the government to allow home quarantine for new arrivals.[44] Other bottlenecks included the non-adherence to home quarantine and non-compliance with social gatherings as evident from the Gaibandha district where 2 US returnees with confirmed COVID-19 status went to a wedding ceremony that had 500 attendees[45] along with mass religious gatherings in the Lakshmipur district.[46]

RT-PCR is an advanced molecular testing procedure with costs ranging from 54-100 Euros per test. In a country where the public healthcare expenditure is heavily donor dependent (60%), it will be difficult for the government to fund mass testing countrywide. Poverty played a role in lock down failure in Bangladesh when 370 ready-made garments (RMG) factories failed to pay their workers by the 16 April deadline, which affected the livelihoods of these workers[47] and prompted them to arrange protests risking community transmission. RMG sectors appeared to have no rescue packages to cover the salaries of workers in case of a pandemic emergency and immediately sought government assistance for paying them. This has caused an understandable if undesirable panic among RMG workers even among those in the big factories.

The panic created by factory owners trying to resume work on 12 April 2020 with the decision then retracted the night before saw mass migration from rural to urban areas risking further transmission.[48] Furthermore, the fiasco created on the provision of false treatment and fabricated testing result lead to a trust issue on the private sector service delivery making the process rather complicated in the context of the fragmented public health infrastructure including international visa denials.[49,50,51]

Risk communication is a vital bottleneck for response and preparedness in a pandemic. This kind of communication includes understanding public perceptions and promptly addressing misinformation. Even though the protocol[30] mentions that a knowledge, attitude and practice survey had been conducted during the preparedness phase, there are no reports of such a survey having been completed. The shortage of drugs such as hydroxychloroquine created an artificial scarcity, media hype created through vaccine and other promising candidate downplaying the risk,[52,53] and refusal to have routine check-ups due to a perceived fear of the spread of COVID-19 are embodiments of weak risk communication strategies.

There are 7.4 skilled health workers per 10,000 population in Bangladesh that accentuates the difficulty in monitoring COVID-19 cases effectively.[54] While several countries resorted to recruiting healthcare workers from their reserve or retired professionals,[55] the Bangladesh Government is still in the process of recruiting 2,000 physicians and 6,000 nurses in order to make up for staff shortages that demonstrates bureaucratic delay.[56] Other preparedness bottlenecks involve the equitable distribution of intensive care units (ICUs), limited access in the context of out-of-pocket expenditures, healthcare equipment including the availability of ventilators, protective equipment, and availability of essential medicines due to the halt in movement and trade.

Information to the public

Dissemination of correct information to concerned stakeholders is vital during a pandemic. It addresses the dimension of awareness in the healthcare access theory using mainstream and social media while maintaining order and safety.[57,58] Timeliness and transparency in disseminating information have been shown to reduce panic and anxiety and helped in effectively engaging citizens with their social responsibilities during the 2003 SARS pandemic.[59]

Public communication measures in Bangladesh during the COVID-19 outbreak were unsatisfactory. The authorities constantly downplayed the magnitude of the threat posed by the virus

outbreak in the media along with the government's capacity for tackling such a crisis despite different claims in media reports.[60,61] These failings caused complacency among the people and sowed the seeds of confusion and distrust of authority.

Although the official protocol states that risk communication strategies have been discussed at length,[30] these measures have hardly been put into practice. The plan to counter the spread of misinformation was derelict[60] and focused on and issuing reminders and threats against the entities (individuals, media outlets) that spoke out against those in the government.[62,63]

The response plan included developing preventive appropriate message packages for different audiences based on key demographic characteristics and revolved around working with key stakeholders to build their capacity for awareness and health promotion through participatory interventions. However, no systematically established community information and feedback mechanisms have been made available leaving the government in the dark about how the adopted control measures are functioning in the society that may have considerable implications for future planning and decision-making. Lack of accountability and transparency has led to the suspension of medical professionals at a time when they are most needed.[64]

2. Mobilizing resources and addressing novelty

New problem - new structure

The current health system and the underlying healthcare infrastructure in Bangladesh are both considerably neglected and underdeveloped.[65] In recent times, the health system has struggled to deal with a recurring seasonal dengue outbreak that has been occurring regularly and increasing in severity since the turn of the century.[66,67] A review of the healthcare system in Bangladesh[68] revealed that non-transparent and corrupt practices, as well as ineffective oversight mechanisms, failed to uphold the safety of citizens and left them vulnerable to malpractice within the system.[65] These scenarios have been observed during the early onset of the COVID-19 outbreak.

Like many other countries, the COVID-19 outbreak has posed an unprecedented strain on the health system of Bangladesh. While the average health expenditure in south Asian countries and LMICs was 3.46% and 5.39% of GDP respectively,[69] the recent fiscal budget in Bangladesh has increased allocation to the health sector for the year 2019-2020 to a meagre 1.02%.[70] This translates to a weak health system and infrastructure that is unlikely to attain the WHO benchmark 1.3 or be capable of sustaining any financing mechanism ensuring there are enough funds for a timely

response to public health emergencies, or conform to the IHR guidelines.[28]

In a country of more than 16 million people, there are 49 ventilators at government facilities ([32] last updated: 26 April 2020) and limited number of ICUs countrywide with no quality control mechanism.[71,72] These findings expose the urgent need for an updated health system framework that can address the aspects of access and mobilization of necessary resources in accordance with the current pandemic situation.

A pandemic scenario demands an improved efficiency in decision-making by devising necessary protocols that enable quick responses. This is fundamental to the process of strategising an effective call-to-action in any epidemic or pandemic requiring on the spot decisions and informed actions including effective mobilization of resources.[73] Bangladesh had time to prepare for the pandemic with the country's first case identified on 8 March 2020, over a month after WHO's declaration of a public health emergency of international concern.[74] Unfortunately, the authority's reluctance from the outset and persistence with typical bureaucratic procedures yielded weak preparedness.

Contextualizing the health system

It is expected that preparation of the health system would contextualize the new demands in the existing framework. Part of these preparations would involve setting up testing centres, dedicating disease-specific specialized health facilities and engaging with the context-specific needs of professional bodies. All these are possible in Bangladesh but the capabilities of the test centres/health facilities during this crisis and the goodwill of the highly politicized professional associations could be questionable.[75,76,77]

Previous responses from Bangladesh during health crises are not encouraging. For example, during the Nipah virus (NiV) in 2004, patient caregiving practices were poor and hospitals were not equipped to handle contamination.[78] Due to overcrowding, health facilities are often subjected to nosocomial due to inadequate isolation units, bed space, sinks, waste management, and general hygiene practices.[79] During the 2004 crisis, many health facilities had been reluctant to treat patients who showed virus-like symptoms, often leaving them untreated and resulting in multiple deaths.[80] The current infrastructure could hardly address the burden of a pandemic of the size of COVID-19.

The lack of preparation for the COVID-19 crisis was evident within the first month (March 2020). This included the closing of entire health complexes as health workers were COVID-19

positive,[81] suspension of doctors due to their alleged unwillingness to treat patients,[82] physicians served with a 'show cause' for speaking out regarding lack of protective equipment,[63] and confession of faulty equipment already distributed to doctors that all serve to illustrate the severe lack of preparation by DGHS and mistrial incoordination that resulted in a failure to address stakeholder concerns.[40] Health workers in Bangladesh made up 12% of all the COVID-19 cases (at least 350 out of 2948 recorded positive cases) as of 11am on 21 April 2020[83] despite a lengthy preparedness and response plan that shows the weakness in policy implementation.

Mobilizing community engagements

An important aspect of crisis management is the mobilization of local community level efforts including distribution of resources and handling mass panic. A well-articulated plan was required to ensure that food relief reached those in need and emergency services continued without disruption ensuring a successful lockdown. To manage unnecessary panic or rumours, central communication needed to reach to the root or local level to assure the unprivileged sections of society that the lockdown would not lead to starvation and they would receive adequate treatment.

Despite the worldwide lockdown and WHO's constant advice on social distancing and lockdowns, these decisions in Bangladesh were taken late and disregarded how the new normal would work. For example, the entire transport system was closed without any measures put in place to enable emergency workers to travel. Even after six weeks from the first identification of a COVID-19 patient (8 March to 15 June), the inadequate distribution of PPEs was being reported[84] in spite of government data showing there were adequate stocks.[61]

The Infectious Disease Act[85] should, on paper, have served the purpose of enabling appropriate dissemination of information and controlling any panic. However, emergency measures were delayed as lack of transparency at the Health ministry led to confusion.[86,87] Panic was further fuelled when the government accused healthcare workers of negligence in discharging their duties, that they had a weak mentality and claimed they would be replaced by foreign workers.[88] All these presented mixed messages to the community, where infection of COVID-19 was equated to confirming death in rural areas. Consequently, people were averse to testing and many fled from quarantine risking greater community transmission.[89]

3. Non-linearity

Decision dynamics

Any pandemic provides a unique scenario with intricate and rapid mechanisms. The current organizational approach that focuses on maximizing outputs often fails to recognize the interactivity between the components of a complex system.[90] This is an important realization in the context of planning an effective response during a pandemic. Such an approach provides encouragement for innovation and synergised operation by accepting the non-linearity of a complex system and permits creative solutions to sudden and challenging problems.[91]

The idea of pre-emptive listing of the barriers to devising an appropriate response to the pandemic might not be exhaustive as more unexpected problems are likely to reveal themselves over the course of the pandemic. The leadership needs to make proper use of the intellectual capital available while discussing creative control measures and putting them into practice.[90] Coordination with international organizations, such as the WHO, UN and World Bank is essential in procuring necessary funds for LMICs and implementation of international guidelines.

Bangladesh came short in putting emergency procedures into practice. The initial safety measures to be implemented at the airports were severely lacking even after the WHO had declared the COVID-19 outbreak a world health emergency.[92,93,94] However, this situation did not improve until the government was forced to ban almost all domestic and international flights from 28 March onwards after imposing a partial ban on 21 March.[37,95]

During the month of April, the second month of the crisis, the authorities failed to stop large gatherings taking place at Brahmanbaria and Barguna districts.[96,97] Lack of coordination across ministries and institutions, weak leadership and an inability to mobilize responses to unexpected events has put Bangladesh in a precarious situation amid the COVID-19 pandemic.

Leadership

It is to be expected that the health department would make prompt decisions efficiently during public emergencies. Often new ideas and fresh energy are required if the typical system fails. For example, China changed leadership in Hubei Province during the Wuhan outbreak[98] and the Netherlands made an opposition leader the temporary health minister to cover the crisis.[99] These moves were intended to restore public confidence and display political goodwill.

Bangladesh was ill-prepared for COVID-19. The same system that failed to meet regular

healthcare demands was put to a sterner test. This resulted in utilization of only one test centre in the first 3 weeks of the crisis (8 - 25 March 2020) that was only able to test 0.3% of those who raised a concern over their status.[3] Even the expansion of the test centres was sluggish indicating an inadequate laboratory infrastructure and slow dissemination of test kits.[100,101,102]

Lack of coordination among departments in the Bangladesh government could be a result of poor leadership. While the Health Minister failed to maintain composure, there were multiple irresponsible statements coming from other ministers including that Bangladesh would be capable of building hospitals in six days like in Wuhan, and downplaying COVID-19 as a non-deadly disease that did not help the greater cause.[60] These random, irresponsible dialogues equate to a loss of faith in the leadership and often give birth to fabricated news.

Typical political stances can block the possibility and potential of fresh ideas. While the Prime Minster proposed a 31-point directive in early April 2020, none of the points were fully implemented.[103] The planning stage of these proposals, just like the National Preparedness and Response Plan for COVID-19 and the infectious disease law, remained on paper due to absence of targeted assessment to address the burden properly alongside the feasibility for its successful implementation. These stereotypical politics and the fatigued health system are hardly in a position to put up a fight against the COVID-19 pandemic.

4. Designing an escape plan

Normalizing the new reality

The current situation with COVID-19 will make it difficult to resume normal service in the country straight away. The increased transmission risk of COVID-19 in any congested working space minimizes opportunities for social distancing. Capacity building and legislature mechanism need to be the building blocks for preparing the health system for resumption of normal services in a progressive way.

Bangladesh, however, is not showing signs of deviating from its traditional infrastructure development process despite the pandemic. A meagre increment of 0.63% of the total budget is to be allocated to the health sector that is aimed at building a 1000-bed super specialized ward, a one-point check-up centre and a cancer building at Bangabandhu Sheikh Mujib Medical University.[104] A private-public partnership was used to set up testing kiosks in Dhaka in April, but these low-quality facilities could actually put health workers at increased risk.[47]

Economic growth is expected to be a trade-off for the lockdown to contain the ongoing spread. The cancellation of orders for the RMG sector amounted to USD 3 billion, as of 3 April 2020.[105] It has been reported an estimated loss of BDT 33 billion every day during the shutdown.[106] Restricted movements can contribute to the economic cycle affecting those with limited earnings as well as large industries dependent on day labourers.

In order to address the impact on the economy, the government has rolled out an incentive package of around BDT 950 billion. Around USD 589 million are allocated with a 2% service charge for the payment of all RMG workers for a duration of 3 months.[105] The Ministry of Health along with partners have planned a project of more than 30 million USD for a 9-month duration in order to address the bottlenecks of the health system.[30] Despite such packages, multiple attempts have been made to open the industries again, particularly RMGs, that threatens the disease containment objective of this short-term bail out.

Systematic transition mechanism

Although the initial transition in Bangladesh was disjointed, lessons from that time can be used for cautioned opening. A second wave or more of the COVID-19 pandemic might not be affordable for the already hit economy.[107] Positive steps were taken to keep the economy going such as mobilizing community efforts for Boro-rice cultivation that not only addressed concerns due to an early flash flood, but also contributed towards temporary employment opportunities along with food shortages. A constant monitoring of these small-scale gatherings would provide indicators for the transition steps.[108] In order to implement the response mechanism effectively, more tests would be required and meticulous contact tracing system should be developed along with testing infrastructures that would utilize existing university laboratories.

It is expected that population-based risk assessments will be conducted routinely in order to isolate those at higher risk of contracting the virus. Classification of disease risk in terms of infection spread and exposure level covering all population groups will facilitate the issue of accountability and data-driven decision-making.[109] The availability of newer quarantine centres through conversion of existing facilities would need to be functional for some time in the event of any transition to normal services. Leadership and effective governance through coordination between the societal building blocks is pivotal for ensuring a smooth transition.

Recommendations

The countries with the best performances during the COVID-19 pandemic, such as South Korea, provided a subsidy for living costs to individuals in isolation. Germany, Mexico and Chile provided funds through health insurance mechanisms to those that met the case definitions of the respective countries for COVID-19 or were referred by a doctor.[55]

A vaccine or a drug for treating COVID-19 has yet to be developed so disease management and accurate diagnosis are crucial factors in the context of this virus. An effective pipeline needs to be established for the provision of kits, PPEs and stocks for intensive care units as well as essential medicine addressing the continuum in terms of supply and quality control. Experience from France, China, Sri Lanka and Japan has shown the benefits of makeshift but sustainable health facilities to tackle an increased number of patients.[55] Bangladesh could take note from their quarantine strategies, lockdown policies and integrity in leadership to better handle the pandemic.

A protocol should be put in place for a smoother and sustainable transition between the lockdown period and normality. A pre-defined procedure on steps from lock down to cautioned opening should be documented and followed. For example, New Zealand have set a four-level risk assessment system or United Kingdom's five levels corona virus alert, which are allowing them to gradually return to normalcy.[110] A robust information system providing access to disease prognosis harnessing the power of informatics and telemedicine can be utilized to ensure adequate follow up and risk assessment on the diagnosed cases.[111] The summary of the recommendations is listed in Table 1.

Feedback mechanisms at the local level should be developed for a better understanding of priorities and be needs specific to the local context. The practice of social distancing needs to be strictly followed until the emergence of proper vaccines and extensive monitoring on inflation and control over artificial crises on trade and resources are required.[107] Meticulous understanding of the available evidence base is necessary to dispel the spread of misinformation and thus creating a cohesive environment for developing contextual and widespread evidence-based sustainable decision making.

Conclusion

The aim of this study was to evaluate the existing health structure in Bangladesh and its response in the early periods of the COVID-19 pandemic (March-June 2020). The results show that Bangladesh is not COVID ready due to complacency from its leaders at the beginning coupled with inadequate testing that has led to a scenario where decisions are not evidence-based but rather based instead on intuition and experience. While protocols or reports developed by the government indicated substantial planning, the field level response was insufficient to implement them. A change in health leadership, coordination with professional bodies enabling multi-sectorial partnerships and appropriate utilization of existing resources might be a plausible short-term solution. For a long-term transition process to achieve normalcy, awareness on health literacy, close monitoring, data-driven decision making and coordinated efforts from all relevant stakeholders are paramount.

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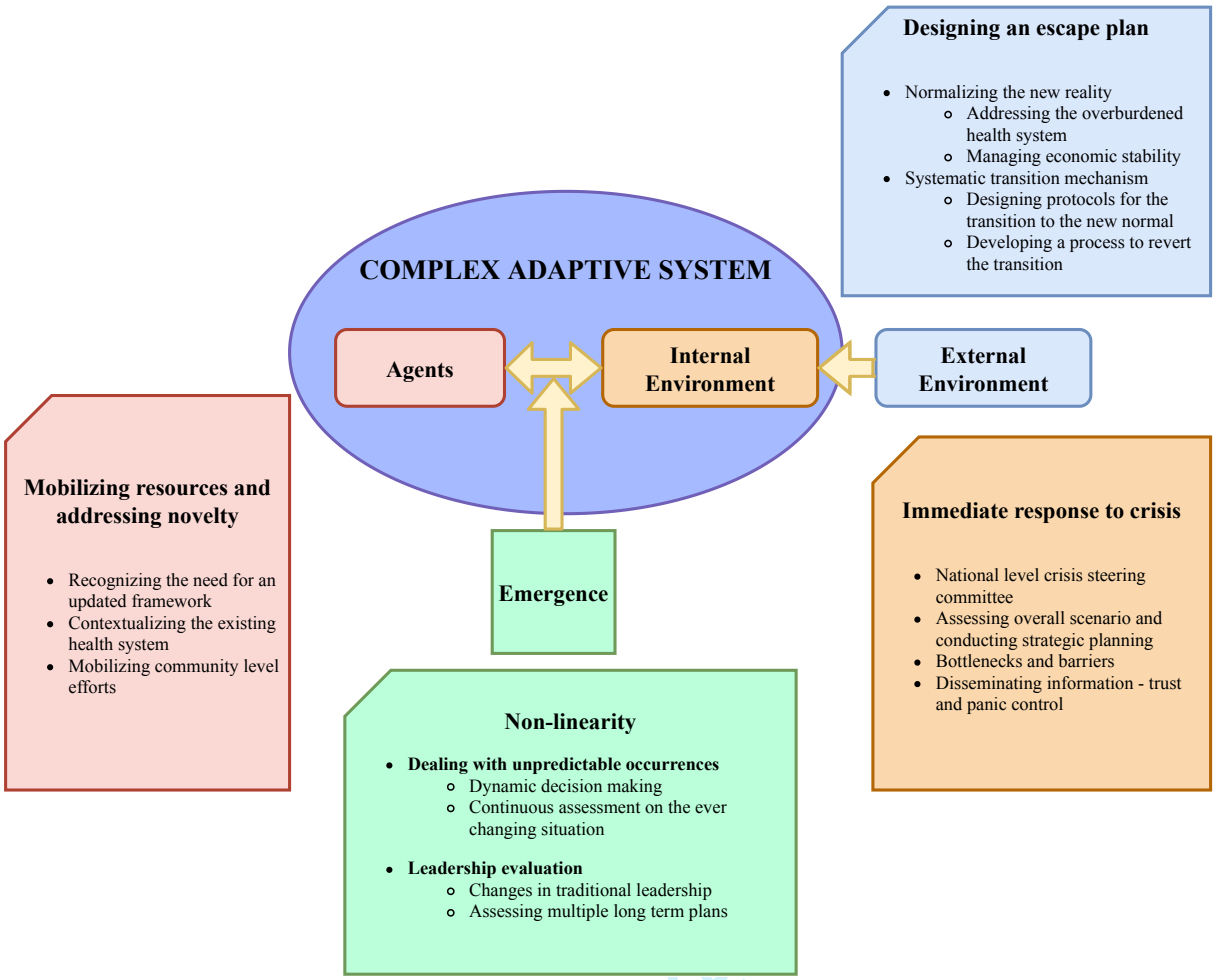
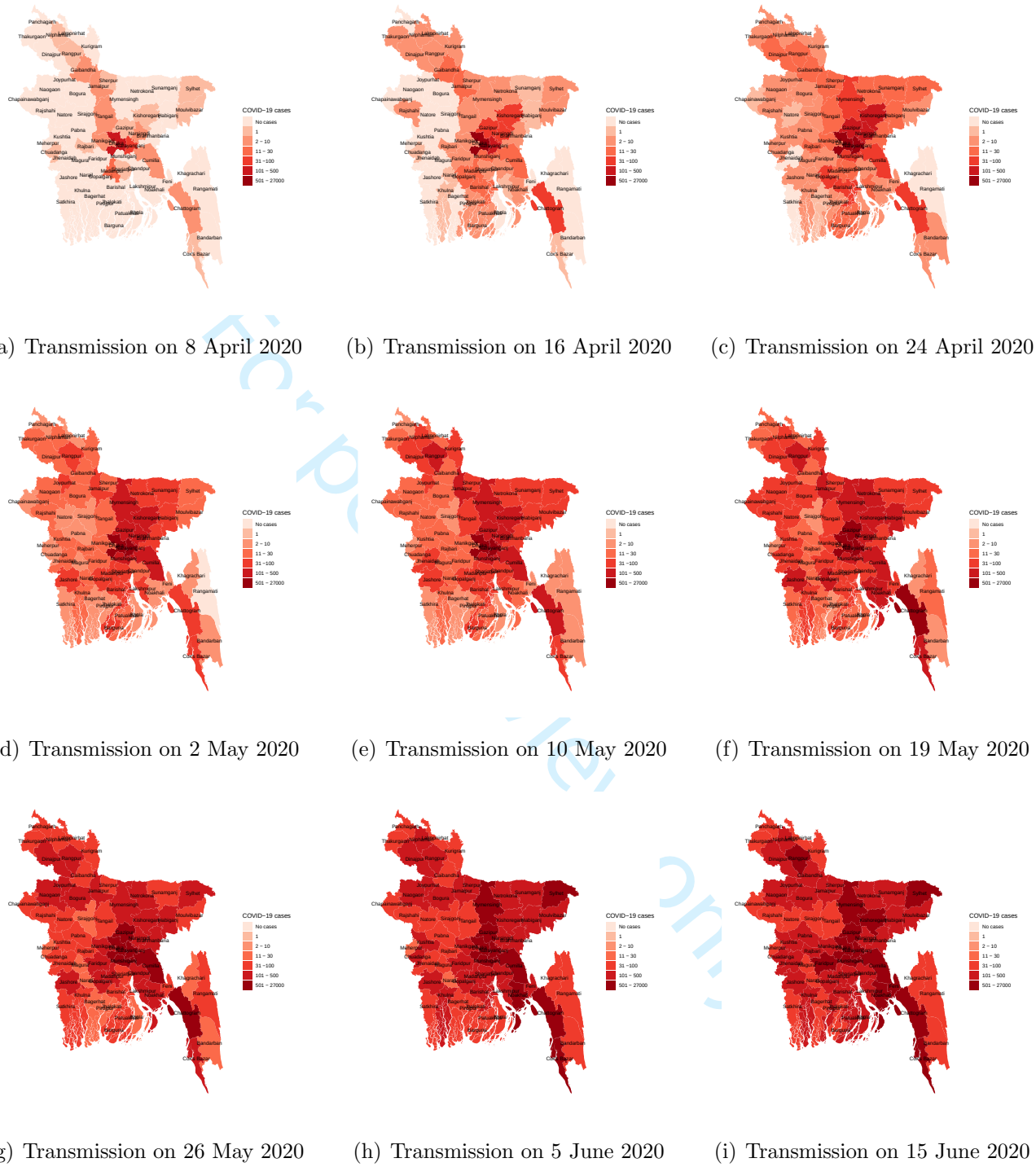


Figure 1: The complex adaptive system (CAS) framework complemented by crisis and complexity theory to ascertain the COVID-19 preparedness of Bangladesh health system



(a) Transmission on 8 April 2020 (b) Transmission on 16 April 2020 (c) Transmission on 24 April 2020

(d) Transmission on 2 May 2020 (e) Transmission on 10 May 2020 (f) Transmission on 19 May 2020

(g) Transmission on 26 May 2020 (h) Transmission on 5 June 2020 (i) Transmission on 15 June 2020

Figure 2: District-wise transmission of COVID-19 in Bangladesh from 8 April to 15 June 2020

25 July 2020

Dr Mathew Mercuri
Editor in Chief
Journal of Evaluation in Clinical Practice

RE: Decision on Manuscript ID JECP-2020-0430

Dear editor,

Thank you for proving us the opportunity to revise the manuscript entitled "A systematic assessment on COVID-19 preparedness and transition strategy in Bangladesh" for publication in the *Journal of Evaluation in Clinical Practice*.

We have addressed the reviewers' comments in our responses and incorporated the related changes into the original manuscript through a revision. For convenience, the reviewers' comments are highlighted in blue and our responses are highlighted in black font.

The primary changes made in the revised version of the manuscript include:

1. A new theoretical framework - The complex adaptive system (CAS).
2. New figures for maps have been recoded to include more recent information from 8 April to 15 June 2020.
3. A summary table of recommendations has been added for an easy one-glance overview.

In addition to the above, all authors have read and revised the manuscript. Some minor changes throughout the revised version of the manuscript are made, mostly to improve clarity of expressions.

We would like to thank you and reviewers for the valuable feedback and suggestions.

Sincerely,
Authors

A systematic assessment on COVID-19 preparedness and transition strategy in Bangladesh

(Manuscript ID: JECP-2020-0430)

Reviewer #1

Reviewer's comment

1. This is a highly relevant paper for the journal. The paper is well written and the writer should be congratulated on the focus they have put into this research. The COVID-19 pandemic is an unknown quantity and I think the paper would be relevant to different stakeholders (e.g. academics, policymakers, non-government organisations).
I think the geographical illustrations (transmission rates) the authors have provided are excellent.

Authors' response

Thank you. We believe it is important for Bangladesh to have its health system assessed in light of the current pandemic to address the weaknesses and to improve in future.

Please note that we have changed the graphical illustrations. Previously we mapped the infection transmission from 8 April to 28 April. We have updated the maps and now addressing the changes from 8 April to 15 June.

Reviewer's comment

4. I have one recommendation for this paper, which I, as a reviewer, believe would make the paper even stronger. My recommendation is that the author includes a signpost statement in the introduction, i.e. how is the paper structured and what is the underlying argument.

Authors' response

Thank you for the suggestion. We have added the following paragraph at the end of Introduction (line 61-67 of page 3 of the revised manuscript) to address the signpost statement,

"*For the purpose of discussing the preparedness and systematic transmission of Bangladesh during the COVID-19 crisis, the study applied the CAS framework. The parameters of the CAS and sources of data based on relevant theories were detailed in the next section (Methods) followed by a discussion on the agents, internal and external environments that impact the performance of the health system of Bangladesh during the pandemic. Before conclusion, a set of recommendations derived from the quantitative synthesis were listed, which would assist policymakers and relevant institutions to conduct a better transition from current crisis to normalcy.*"

Reviewer #2

Reviewer's comment

1. An analysis of a COVID pandemic in a LMIC like Bangladesh is most important for the field, and the authors are commended for their effort. However, the current manuscript is majorly deficient in its current form as it lacks a clear focus (the latter part is woolly and doesn't really connect to the main issues raised in the early parts), and lacks a clear anchoring in a conceptual space.

Authors' response

Thank you. For a better anchoring and to address the signpost statements, we have included the following at the end of Introduction (line 61-67 of page 3 of the revised manuscript),

"*For the purpose of discussing the preparedness and systematic transmission of Bangladesh during the COVID-19 crisis, the study applied the CAS framework. The parameters of the CAS and sources of data based on relevant theories were detailed in the next section (Methods) followed by a discussion on the agents, internal and external environments that impact the performance of the health system of Bangladesh during the pandemic. Before conclusion, a set of recommendations derived from the quantitative synthesis were listed, which would assist policymakers and relevant institutions to conduct a better transition from current crisis to normalcy.*"

Furthermore, to tie the later part of the manuscript with the main theme of the paper (evaluating health system's preparedness and current performance), multiple changes has been brought in each segment of 'Results and Discussion'. Each section was tied with the objective of the paper.

Reviewer's comment

2. For a re-write I would suggest to anchor the paper in a complexity/complex adaptive systems framework (many examples have been published in this journal) as much of the analysis is referring to it (note the table referring to the methodology was missing). I further suggest to create a figure that shows the interdependencies and their consequences (largely failures) so a reader can get a "one glance overview" of the complexities inherent in the Bangladesh health and political system interactions.

Authors' response

Thank you for suggesting it. We believe that complex systems framework would be a better suit than logic model in our paper. Thus, we have made the following changes and included a new diagram (Figure 1) to replace Table 1. We have made the following changes in Methods section,

"*The complex adaptive system (CAS) framework was used to assess the health system preparedness of Bangladesh since the performance is based on multiple dimensions of crisis theory and complexity theory..*" (line 69-70 in page 3).

"*Four major dimensions were extracted from the crisis and complexity theories to encompass the preparedness of the Bangladesh health system for COVID-19 (Figure~1) and, based on these four dimensions, the CAS framework was assembled. The CAS framework is a continuing self-organization that uses a bottom-up approach based on multiple agents of a system to emerge a whole pattern based on both internal and external environment.*[24,25] *The CAS is regularly applied to explain the interdependencies among health system agents and their consequences in multiple spheres (macro, meso, micro and nano).*[25] *In this study, each of the four dimensions were explored using the four concepts of the CAS framework: agents, emergence, internal and external environments, to elucidate the Bangladesh health system and its response mechanism to the COVID-19 pandemic (Figure 1).*" (page 82-90 in page 3).

For "one glance overview", we have created a summary Table (Table 1) was added in the recommendation section which listed the suggestions based on the four dimensions. Please refer to line 432 in page 15 and the attached Table.

Reviewer's comment

3. The text needs to be tightened up a lot, the conclusions need to be consistent with your findings, and the paper is unnecessarily long and markedly over-referenced with unimportant/outdated references but key references to the current complexity health systems literature missing.

Authors' response

Thank you. We have conducted a full revision of the paper. Given our work was a systematic assessment, we needed to provide a large amount of evidence which lead to a high number of references. However, we have rechecked the reference list and only 3 out the 104 references were older than 2000. All three were related to theoretical framework. Half of our references were from 2020.

To address your concern, we have replaced few references and tightened the findings throughout.

A systematic assessment on COVID-19 preparedness and transition strategy in Bangladesh

Raaj Kishore Biswas (corresponding author)[a]

[a]*Transport and Road Safety (TARS) Research Centre, School of Aviation, University of New South Wales, Sydney, Australia*

RaajKishore.Biswas@student.unsw.edu.au

Abstract

Rationale, aims and objectives: The COVID-19 pandemic of 2020 has overpowered the most advanced health systems worldwide with thousands of daily deaths ~~daily~~. The current study conducted a situation analysis on the pandemic preparedness of Bangladesh and provided recommendations on the transition to the new reality and gradual restoration of normalcy.

Method: A complex adaptive system (CAS) framework ~~logic model~~ was theorized based on four structural dimensions obtained from ~~both~~ the crisis and complexity theory to help evaluate the health system of Bangladesh. Data sourced from published reports from the government, non-governmental organizations and mainstream media up to ~~28 April~~15 June 2020 were used to conduct a qualitative analysis and visualize the spatial distribution of countrywide COVID-19 cases.

Results: The findings suggested that Bangladesh severely lacked the preparedness to tackle the spread of COVID-19 with both short- and long-term implications for health, the economy, and good governance. Absence of planning and coordination, disproportionate resource allocations, challenged infrastructure, adherence to bureaucratic delay, lack of synchronized risk communication, failing leadership of concerned authorities and incoherent decision-making have led to a precarious situation that will have dire ramifications causing many uncertainties in the coming days.

Conclusions: Implementation of response protocols addressing the needs of the community and the stakeholders from the central level is urgently needed. The development of mechanisms for dynamic decision-making based on regular feedback and long-term planning for a smooth transition between the new reality and normalcy should also be urgently addressed in Bangladesh.

COVID-19 preparedness of Bangladesh

Keywords: Situational assessment, Health system, Crisis theory, Complexity theory, SARS-COV-2, Pandemic, LMIC

Introduction

The outbreak of the 2019 novel coronavirus (COVID-19) has challenged existing health systems and national preparedness strategies on the outbreak of pandemics worldwide. COVID-19 has surpassed the magnitude of two epidemics in last two decades: severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERSCoV).[1,2] General discussion ~~up to now~~ about the pandemic up until June, 2020 has focused on the experiences of China, USA and Europe. Low- and middle-income countries (LMICs) such as Bangladesh started to experience the early onslaught of COVID-19 in early March 2020 with severe consequences in the offing.[3] To help address this gap, this study evaluated the health system of Bangladesh and its pandemic preparedness approach by means of a complex adaptive system (CAS) framework~~logic model~~.

Following the introduction of International Health Regulations (IHR) in 2005 endorsed by 196 countries, national level efforts were called for to strengthen health systems to help prevent the spread of infectious diseases on an international scale without disrupting international traffic and trade.[4] However, in LMICs, political resolve, insufficient resources and technical limitations have challenged the implementation of these recommendations.[5,6] Furthermore, the support from high-income countries towards LMICs has not been encouraging.[7,8] It was also recommended that policy implementation for all LMICs as a single body would not be practical in unprecedented circumstances, as is evident from the ongoing COVID-19 pandemic that demands country specific assessments.[9]

Bangladesh is an over-populated LMIC that has seen strong growth over the last decade in its export-based economy and improvements in multiple public health indicators.[10,11,12] Despite the goodwill from local and international non-governmental organizations, the existing health system is already stretched with only 7.4 skilled workers per 10,000 population.[13,14] The dawn of the COVID-19 crisis has positioned the whole system into a unique paradigm by challenging health, the economy and law and order.

COVID-19 preparedness of Bangladesh

There has not been a formal evaluation on the preparedness of the Bangladesh health system for coping with pandemics or substantial analysis on the health system as a whole. A critical assessment is therefore needed in order to better prepare for the ongoing challenge and future pandemics.~~any kind of future challenge.~~ The objective of this study is to theorize a complex adaptive system (CAS) framework ~~logic model~~ to evaluate ~~frame~~ the health system during a pandemic and assess the steps taken so far by Bangladesh for tackling the COVID-19 crisis up to ~~28 April~~15 June 2020.

For the purpose of discussing the preparedness and systematic transmission of Bangladesh during the COVID-19 crisis, the study applied the CAS framework. The parameters of the CAS and sources of data based on relevant theories were detailed in the next section (Methods) followed by a discussion on the agents, internal and external environments that impact the performance of the health system of Bangladesh during the pandemic. Before conclusion, a set of recommendations derived from the quantitative synthesis were listed, which would assist policymakers and relevant institutions to conduct a better transition from current crisis to normalcy.

Methods

The complex adaptive system (CAS) framework was used to assess the health system preparedness of Bangladesh ~~as well as~~ since ~~its~~the performance is based on multiple dimensions of crisis theory and complexity theory. Crisis theory characterizes~~is based on~~ the idea that unresolved or inevitable conflict will change the existing paradigm and typical problem-solving mechanisms would not be efficient~~useful~~.[15,16] Due to the resulting disorganization from the crisis, interventions are applied to help the system to adapt and recover in the shortest possible time.[17] This theory was applied to ~~could~~ explain the management of a recent country-specific epidemic such as SARS in Singapore.[18]

Complexity theory was proposed to explore the individual, organizational and systemic ~~be~~ behaviours of a social phenomenon.[19,20] Using complexity theory, complex and emerging health issues such as pandemics or epidemics can be elucidated.[21] Health systems can be non-linear and often unpredictable during a pandemic[22] and since complexity theory has been used in the

literature for disease outbreaks,[23] several aspects of this theory were applicable~~seemed to be useful~~ in the context of COVID-19.

Four major dimensions were extracted from the crisis and complexity theories to encompass the preparedness of the Bangladesh health system for COVID-19 (Figure 1) and, based on these four dimensions, ~~a logic model~~the CAS framework was assembled. The CAS framework is a continuing self-organization that uses a bottom-up approach based on multiple agents of a system to emerge a whole pattern based on both internal and external environment.[24,25] The CAS is regularly applied to explain the interdependencies among health system agents and their consequences in multiple spheres (macro, meso, micro and nano).[26] ~~Logic models are typically used in public health to~~

~~map a chain of causality to evaluate a system.[24,25,26]~~ In this study, each of the four dimensions were explored using ~~different~~ the four concepts of the ~~logic~~ CAS framework:~~model~~ agents, emergence, internal and external environments, to elucidate ~~on~~ the Bangladesh health system~~. This model is presented in Table 1~~ and its response mechanism to the COVID-19 pandemic (Figure 1).

Data were sourced from reports published by the Bangladesh Directorate General of Health Services (DGHS) and World Health Organization (WHO) for instance, among others, as well as media articles up to 15 June ~~28 April~~ 2020 for the situation analysis. Regular press briefings and data released by the Institute of Epidemiology, Disease Control and Research (IEDCR), the official source of COVID-19 information in Bangladesh, were collected and analysed. These include daily data on the number of tests, positive cases, deaths, recoveries and case locations as well as data on medical inventories specially supplied for COVID-19 preparation. The spatial mapping on district wise COVID-19 transmission ~~spared~~ was formulated using *R* (version 3.5.0).

Results and Discussion

1. Immediate response to crisis

National level preparedness and coordination

Previous pandemics related to the coronavirus have provided examples of healthcare workers being infected due to occupational exposure and demonstrate the importance of timely sharing of accurate information and proactive collaboration in generating an effective response.[27] Reinforcement of the IHR guidelines[28] has allowed effective management of crises through

evaluation of risk communication strategies using information from risk assessments minimizing mass anarchy.[29]

Coordination and accountability are vital elements in forming an effective response to events such as COVID-19. Therefore, such mechanisms need to channel the implementation of ~~evidencebased~~evidence based decision-making at central level for its contextualization to the needs at local level. Coordination also requires the incorporation of feedback from communities addressing their concerns that may be causing emotional distress and the development of effective relationships at local level.[18]

As part of its COVID-19 response, Bangladesh has established a number of committees at all levels comprising of decision-makers, administration, law and order, information, local & international organizations and various components of the health system.[30] A technical committee was formed at central level comprising healthcare stakeholders for the purpose of evaluating activities in the plan through a review process and for recommending resource mobilization.

The role of committees at local level is limited to the implementation of the plan devised at central level. According to Stacey (2003)[20] on the understanding of complex systems, the committee failed to include sector specialists (including public health experts) focusing on the respective service and information delivery relevant to the COVID-19 response. Such a scenario can contribute to a lower rate of information flow as well as prompt limited impact due to a lower level of diversity and differentials in risk perceptiveness between the various levels.

The status quo differentials between local and national interests might also affect the generation of any response due to the unavailability of feedback loops among the parts of the system based on these committees.[31] The differentials between local and national levels can affect the degree of accountability in these systems that are not specified in measured terms regarding the trend of the disease spread.

Assessing the overall scenario and conducting strategic planning

A total of 90,619 cases and 1209 deaths with a recovery rate of 20.6% have been reported till June 15, 2020 due to COVID-19 from the 519,503 tests conducted across 60 testing centres indicating an attack rate of 532.1/million people and case fatality rate of 1.33% in Bangladesh. [32] ~~(WHO, 2020) As of 24 April 2020, a total of 4,689 cases and 131 deaths have been confirmed due to COVID-19 from 39,776 tests conducted across 21 test centres.[32]~~ IEDCR estimates suggest that

~~46~~53% of cases belong to the 21-40 years age group with ~~68~~70% of cases being males.[33] ~~Nearly~~ H~~h~~alf of the centres are located in Dhaka (the capital) with those outside the city sited in scattered locations, not more than 3 centres other than Dhaka (excluding Dhaka city) (6), Chittagong (8) , Rajshahi divisions (5). This situation can possibly lead to overloading of the test centres in Dhaka that can, in turn, contribute towards issues of timeliness of reporting of the number of cases as well as the quality of the test samples obtained.

Due to the lack of an effective health information system that would have contributed towards enhanced surveillance ensuring effective planning and monitoring of disease spread, the government was forced to undertake stringent measures without meticulous assessment of the magnitude of disease due to data unavailability. As of June 15, 2020, the Dhaka city bears the major burden of COVID-19 cases (2859.6 per million). However, the virus has managed to spread to other neighbouring districts of Munshiganj (876.4 per million), Naryanganj (852.4 per million) as well as other major cities such as Cox's Bazar (494.9 per million), Chittagong (408.7 per million). Such level of caseload is also evident on the case doubling rate of Dhaka, Naryanganj, Munshiganj, Cox's Bazar, Munishiganj within the range of 6-8 days. Even in other district, alarms are ringing as the case doubling rate in Feni and Noakhali is only 5 days~~.~~ ~~As of 20 April 2020, cases of the virus have been concentrated in Dhaka~~

~~(1,014 per million) and its neighbouring districts of Narayanganj (386 per million) and Gazipur (173 per million), with a fair presence in 57 out of a total of 64 districts.[34] This situation has led to a complete lockdown of 332 upazilas (sub-districts) based in 41 districts and a partial lockdown in 22 upazilas based in 19 other districts.~~[35] However, the situational become quite difficult to control in the light of suspension of trade and other economic activities, the country has been divided into multiple zones 45 areas in Dhaka city and 11 in Chattogram for adhering strict control~~.~~. [36] This information indicates there is community transmission in the country and is shown in Figure 1.

Although a protocol has been designed,[30] its implementation and accuracy require assessment. Reports from WHO dated 20 April 2020 suggest that the discrepancy between the reported number of tests and the number of people tested indicates multiple testing of the same patient.[34] There is no available data on the quality control around the handling of the samples and is therefore another issue to explore in addition to the diagnostic characteristics of the tests available for the identification of the disease.

COVID-19 preparedness of Bangladesh

Deployment of inadequate resources at key periods has led to a deterioration of the scenario. A total of ~~161,788~~718,921 people arrived in Bangladesh via air, land and seaports from 8 March 2020, when the first case was identified, up to 24 April 2020. Airport screening of such high numbers overwhelmed a pool of only 7 doctors, 10 nurses and 20 staff also operating without separate booths for passengers arriving from high-risk countries.[36] This situation heightens the possibility that passengers with virus symptoms travelling to the country in the early days of the pandemic were missed.

As part of the COVID-19 preparedness and response plan, ~~507~~ 565 medical teams with isolated units in ~~468~~ 493 upazila and separate outpatient departments for patients having respiratory tract infections at ~~414~~ 443 upazila have been established as of 24 April 2020.[32] While all this looks good on paper, a disproportionate allocation of resources was widespread. For example, despite there being a higher case burden in Dhaka (2859.6~~226~~) and in the neighbouring districts such as Narayanganj(~~130~~852.4) and ~~Gazipur (35)~~ Munshiganj (876.4), as of ~~24 April 2020~~15 June 2020, all of them have a lower number of isolation beds than Sylhet (481) that has ~~three~~ 166.5 cases per million people.[32] A similar imbalance was observed in the formulation of medical teams. A total of ~~622~~ 889 physicians and ~~560~~ 738 nurses were involved in the designated COVID-19 response medical teams but only 185~~31~~ medical technologists and 504~~314~~ support staff were included. A large number of teams consisted of only physicians and nurses, excluding other key personnel leading to an inadequate proportion of available healthcare workers, disorganization, and increased exposure.

~~There is no overall dearth of logistic supplies for tackling COVID-19. PPE Kits were distributed to 87.8% of the facilities while the availability of facemasks (89.5%), shields (90.4%), and sanitizers (82.7%) represents a good picture on paper~~. Earlier reports suggested shortage of items ~~In respect of facemasks,~~ there is a huge shortage of supplies in those facilities located in areas with a higher case burden, especially the N-95 masks. These masks are being highly distributed in districts like Dinajpur (354) and Moulvibazar (388) but Narayanganj had only 10 of the N-95 masks despite having a much higher case burden.[37]

As of June 15, 2020, a total of 1.3 million PPEs, 3.14 million mask, 562,439 gloves have stocked. The quality of the supplied resources has been extensively questioned. News reports indicate a debacle with the quality of 20,600 of the N-95 masks where the supplier organization has sought

exemption from punishment for providing below quality masks after packaging them with N-95 marking.[38] ~~T~~ here exists a shortage of surgical masks in the most affected districts as well. The number of available masks in Dhaka (2356) and Narayanganj (4692) was surprisingly low with respect to Cox's Bazar (52802) and Rangamati (3213), all of which have a much lower number or no cases as yet.

PPE distribution is higher (67494) in all the divisional health facilities, however, there remains a low supply in the most affected Narayanganj and Gazipur districts when compared to other districts such as Jashore, Cox's Bazar and Pabna.[37] These inadequacies played a part in the lead up to the health facility lockdowns as health workers were infected and services were halted as a result.[39,40]

Bottlenecks and barriers for preparedness

An effective response coordinating multilevel stakeholder activities during a pandemic could improve the healthcare infrastructure and contribute to a resilient healthcare system. A resilient healthcare system is expected to absorb the shock and ~~adept~~ adapt to dynamic needs while maintaining the existing level of healthcare accessibility.[41]

Bangladesh activated a 6-level plan from preparedness to mitigation using the Infectious Disease (Prevention, Control and Elimination) Act 2018 as the guiding document detailing the containment activities for the progressive development of COVID-19.[30] Early initiatives like quarantining arrivals from high-risk countries was hampered by crowd reactions to the appalling conditions at the quarantine sites that forced the government to allow home quarantine for new arrivals.[42] Other bottlenecks included the non-adherence to home quarantine and non-compliance with social gatherings as evident from the Gaibandha district where 2 US returnees with confirmed COVID-19 status went to a wedding ceremony that had 500 attendees[43] along with mass religious gatherings in the Lakshmipur district.[44]

RT-PCR is an advanced molecular testing procedure with costs ranging from 54-100 Euros per test. In a country where the public healthcare expenditure is heavily donor dependent (60%), it will be difficult for the government to fund mass testing countrywide. Poverty played a role in lock down failure in Bangladesh when 370 ready-made garments (RMG) factories failed to pay their workers by the 16 April deadline, which affected the livelihoods of these workers[45] and prompted

them to arrange protests risking community transmission. RMG sectors appeared to have no rescue packages to cover the salaries of workers in case of a pandemic emergency and immediately sought government assistance for paying them. This has caused an understandable if undesirable panic among RMG workers even among those in the big factories. Furthermore, the fiasco created on the provision of false treatment and testing result created mass issues on trust on the private sector service delivery making the process rather complicated in the context of the fragmented public health infrastructure. The panic created by factory owners trying to resume work on 12 April 2020 with the decision then retracted the night before saw mass migration from rural to urban areas risking further transmission.[46]

Risk communication is a vital bottleneck for response and preparedness in a pandemic. This kind of communication includes understanding public perceptions and promptly addressing misinformation. Even though the protocol[30] mentions that a knowledge, attitude and practice survey had been conducted during the preparedness phase, there are no reports of such a survey having been completed. The shortage of drugs such as hydroxychloroquine created an artificial scarcity, media hype created through vaccine and other promising candidate downplaying the risk, [52, 53] and refusal to have routine check-ups due to a perceived fear of the spread of COVID-19 are embodiments of weak risk communication strategies.

There are 7.4 skilled health workers per 10,000 population in Bangladesh that accentuates the difficulty in monitoring COVID-19 cases effectively.[47] While several countries resorted to recruiting healthcare workers from their reserve or retired professionals,[48] the Bangladesh Government is still in the process of recruiting 2,000 physicians and 6,000 nurses in order to make up for staff shortages that demonstrates bureaucratic delay.[49] Other preparedness bottlenecks involve the equitable distribution of intensive care units (ICUs), limited access in the context of out-of-pocket expenditures, healthcare equipment including the availability of ventilators, protective equipment, and availability of essential medicines due to the halt in movement and trade.

Information to the public

Dissemination of correct information to concerned stakeholders is vital during a pandemic. It addresses the dimension of awareness in the healthcare access theory using mainstream and social

media while maintaining order and safety.[50,51] Timeliness and transparency in disseminating information have been shown to reduce panic and anxiety and helped in effectively engaging citizens with their social responsibilities during the 2003 SARS pandemic.[52]

Public communication measures in Bangladesh during the COVID-19 outbreak were unsatisfactory. The authorities constantly downplayed the magnitude of the threat posed by the virus outbreak in the media along with the government's capacity for tackling such a crisis despite differ-

ent claims in media reports.[53,54] These failings caused complacency among the people and sowed the seeds of confusion and distrust of authority.

Although the official protocol states that risk communication strategies have been discussed at length,[30] these measures have hardly been put into practice. The plan to counter the spread of misinformation was derelict[53] and focused on and issuing reminders and threats against the entities (individuals, media outlets) that spoke out against those in the government.[55,56]

The response plan included developing preventive appropriate message packages for different audiences based on key demographic characteristics and revolved around working with key stakeholders to build their capacity for awareness and health promotion through participatory interventions. However, no systematically established community information and feedback mechanisms have been made available leaving the government in the dark about how the adopted control measures are functioning in the society that may have considerable implications for future planning and decision-making. Lack of accountability and transparency has led to the suspension of medical professionals at a time when they are most needed.[57]

2. Mobilizing resources and addressing novelty

New problem - new structure

The current health system and the underlying healthcare infrastructure in Bangladesh are both considerably neglected and underdeveloped.[58] In recent times, the health system has struggled to deal with a recurring seasonal dengue outbreak that has been occurring regularly and increasing in severity since the turn of the century.[59,60] A review of the healthcare system in Bangladesh[61] revealed that non-transparent and corrupt practices, as well as ineffective oversight mechanisms,

failed to uphold the safety of citizens and left them vulnerable to malpractice within the system.[58] These scenarios have been observed during the early onset of the COVID-19 outbreak.

Like many other countries, the COVID-19 outbreak has posed an unprecedented strain on the health system of Bangladesh. While the average health expenditure in south Asian countries and LMICs was 3.46% and 5.39% of GDP respectively,[62] the recent fiscal budget in Bangladesh has increased allocation to the health sector for the year 2019-2020 to a meagre 1.02%.[63] This translates to a weak health system and infrastructure that is unlikely to attain the WHO benchmark 1.3 or be capable of sustaining any financing mechanism ensuring there are enough funds for a timely response to public health emergencies, or conform to the IHR guidelines.[28]

~~Disparities in the distribution and mobilization of medical accessories were also observed. According to the,[32] there are nearly 6 million gloves in storage (as of 18 April 2020), with more than 1.91 million of them in Dhaka district and 1.86 million of them at only one facility - Dhaka Medical College~~. In a country of more than 16 million people, there are 49 ventilators at government facilities ([32] last updated: 26 April 2020) and limited number of ICUs countrywide with no quality control mechanism.[64,65] These findings expose the urgent need for an updated health system framework that can address the aspects of access and mobilization of necessary resources in accordance with the current pandemic situation.

A pandemic scenario demands an improved efficiency in decision-making by devising necessary protocols that enable quick responses. This is fundamental to the process of strategising an effective call-to-action in any epidemic or pandemic requiring on the spot decisions and informed actions including effective mobilization of resources.[66] Bangladesh had time to prepare for the pandemic with the country's first case identified on 8 March 2020, over a month after WHO's declaration of a public health emergency of international concern.[67] Unfortunately, the authority's reluctance from the outset and persistence with typical bureaucratic procedures yielded weak preparedness.

Contextualizing the health system

It is expected that preparation of the health system would contextualize the new demands in the existing framework. Part of these preparations would involve setting up testing centres, dedicating disease-specific specialized health facilities and engaging with the context-specific

needs of professional bodies. All these are possible in Bangladesh but the capabilities of the test centres/health facilities during this crisis and the goodwill of the highly politicized professional associations could
be questionable.[68,69,70]

Previous responses from Bangladesh during health crises are not encouraging. For example, during the Nipah virus (NiV) in 2004, patient caregiving practices were poor and hospitals were not equipped to handle contamination.[71] Due to overcrowding, health facilities are often subjected to nosocomial due to inadequate isolation units, bed space, sinks, waste management, and general hygiene practices.[72] During the 2004 crisis, many health facilities had been reluctant to treat patients who showed virus-like symptoms, often leaving them untreated and resulting in multiple deaths.[73] The current infrastructure could hardly address the burden of a pandemic of the size of COVID-19.

The lack of preparation for the COVID-19 crisis was evident within the first month (March 2020). This included the closing of entire health complexes as health workers were COVID-19 positive,[74] suspension of doctors due to their alleged unwillingness to treat patients,[75] physicians served with a 'show cause' for speaking out regarding lack of protective equipment,[56] and confession of faulty equipment already distributed to doctors that all serve to illustrate the severe lack of preparation by DGHS and mistrial incoordination that resulted in a failure to address stakeholder concerns.[38] Health workers in Bangladesh made up 12% of all the COVID-19 cases (at least 350 out of 2948 recorded positive cases) as of 11am on 21 April 2020[76] despite a lengthy preparedness and response plan that shows the weakness in policy implementation.

Mobilizing community engagements

An important aspect of crisis management is the mobilization of local community level efforts including distribution of resources and handling mass panic. A well-articulated plan was required to ensure that food relief reached those in need and emergency services continued without disruption ensuring a successful lockdown. To manage unnecessary panic or rumours, central communication needed to reach to the root or local level to assure the unprivileged sections of society that the lockdown would not lead to starvation and they would receive adequate treatment.

COVID-19 preparedness of Bangladesh

Despite the worldwide lockdown and WHO's constant advice on social distancing and lockdowns, these decisions in Bangladesh were taken late and disregarded how the new normal would work. For example, the entire transport system was closed without any measures put in place to enable emergency workers to travel. ~~Moreover, personal protective equipment (PPE), facemasks and other necessary items did not reach even the main hospitals in Dhaka, let alone those located in the peripheries despite constant assurances from the authorities.~~[77] Even after six weeks from the first identification of a COVID-19 patient (8 March to 24 April), the inadequate distribution of PPEs was being reported[78] in spite of government data showing there were adequate stocks.[54]

The Infectious Disease Act[79] should, on paper, have served the purpose of enabling appropriate dissemination of information and controllingled any panic. However, emergency measures were delayed

as lack of transparency at the Health ministry led to confusion.[80,81] Panic was further fuelled when the government accused healthcare workers of negligence in discharging their duties, that they had a weak mentality and claimed they would be replaced by foreign workers.[82] All these presented mixed messages to the community, where infection of COVID-19 was equated to confirming death in rural areas. Consequently, people were averse to testing and many fled from quarantine risking greater community transmission.[83]

3. Non-linearity

Decision dynamics

Any pandemic provides a unique scenario with intricate and rapid mechanisms. The current organizational approach that focuses on maximizing outputs often fails to recognize the interactivity between the components of a complex system.[84] This is an important realization in the context of planning an effective response during a pandemic. Such an approach provides encouragement for innovation and synergised operation by accepting the non-linearity of a complex system and permits creative solutions to sudden and challenging problems.[85]

The idea of pre-emptive listing of the barriers to devising an appropriate response to the pandemic might not be exhaustive as more unexpected problems are likely to reveal themselves over the course of the pandemic. The leadership needs to make proper use of the intellectual capital

available while discussing creative control measures and putting them into practice.[84] Coordination with international organizations, such as the WHO, UN and World Bank is essential in procuring necessary funds for LMICs and implementation of international guidelines.

Bangladesh came short in putting emergency procedures into practice. The initial safety measures to be implemented at the airports were severely lacking even after the WHO had declared

the COVID-19 outbreak a world health emergency.[86,87,88] However, this situation did not improve until the government was forced to ban almost all domestic and international flights from 28 March onwards after imposing a partial ban on 21 March.[36,89]

During the month of April, the second month of the crisis, the authorities failed to stop large gatherings taking place at Brahmanbaria and Barguna districts.[90,91] Lack of coordination across ministries and institutions, weak leadership and an inability to mobilize responses to unexpected events has put Bangladesh in a precarious situation amid the COVID-19 pandemic.

Leadership

It is to be expected that the health department would make prompt decisions efficiently during public emergencies. Often new ideas and fresh energy are required if the typical system fails. For example, China changed leadership in Hubei Province during the Wuhan outbreak[92] and the Netherlands made an opposition leader the temporary health minister to cover the crisis.[93] These moves were intended to restore public confidence and display political goodwill.

Bangladesh was ill-prepared for COVID-19. The same system that failed to meet regular healthcare demands was put to a sterner test. This resulted in utilization of only one test centre in the first 3 weeks of the crisis (8 - 25 March 2020) that was only able to test 0.3% of those who raised a concern over their status.[3] Even the expansion of the test centres was sluggish indicating an inadequate laboratory infrastructure and slow dissemination of test kits.[94,95,96]

Lack of coordination among departments in the Bangladesh government could be a result of poor leadership. While the Health Minister failed to maintain composure, there were multiple irresponsible statements coming from other ministers including that Bangladesh would be capable of building hospitals in six days like in Wuhan, and downplaying COVID-19 as a non-deadly disease

that did not help the greater cause.[53] These random, irresponsible dialogues equate to a loss of faith in the leadership and often give birth to fabricated news.

Typical political stances can block the possibility and potential of fresh ideas. While the Prime Minister proposed a 31-point directive in early April 2020, none of the points were fully implemented.[97] The planning stage of these proposals, just like the National Preparedness and Response Plan for COVID-19 and the infectious disease law, remained on paper due to absence of targeted assessment to address the burden properly alongside the feasibility for its successful implementation. These stereotypical politics and the fatigued health system are hardly ~~in a position~~able to put up a fight against the COVID-19 pandemic.

4. Designing an escape plan

Normalizing the new reality

The current situation with COVID-19 will make it difficult to resume normal service in the country straight away. The increased transmission risk of COVID-19 in any congested working space minimizes opportunities for social distancing. Capacity building and legislature mechanism need to be the building blocks for preparing the health system for resumption of normal services in a progressive way.

Bangladesh, however, is not showing signs of deviating from its traditional infrastructure development process despite the pandemic. A meagre increment of 0.63% of the total budget is to be allocated to the health sector that is aimed at building a 1000-bed super specialized ward, a one-point check-up centre and a cancer building at Bangabandhu Sheikh Mujib Medical University.[98] A private-public partnership was used to set up testing kiosks in Dhaka in April, but these low-quality facilities could actually put health workers at increased risk.[45]

Economic growth is expected to be a trade-off for the lockdown to contain the ongoing spread. The cancellation of orders for the RMG sector amounted to USD 3 billion, as of 3 April 2020.[99] It has been reported an estimated loss of BDT 33 billion every day during the shutdown[100] . Restricted movements can contribute to the economic cycle affecting those with limited earnings as well as large industries dependent on day labourers.

In order to address the impact on the economy, the government has rolled out an incentive package of around BDT 950 billion. Around USD 589 million are allocated with a 2% service charge

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for the payment of all RMG workers for a duration of 3 months.[99] The Ministry of Health along with partners have planned a project of more than 30 million USD for a 9-month duration in order to address the bottlenecks of the health system.[30] Despite such packages, multiple attempts have been made to open the industries again, particularly RMGs, that threatens the disease containment objective of this short-term bail out.

Systematic transition mechanism

Although the initial transition in Bangladesh was disjointed, lessons from that time can be used for cautioned opening. A second wave or more of the COVID-19 pandemic might not be affordable for the already hit economy. Positive steps were taken to keep the economy going such as mobilizing community efforts for Boro-rice cultivation that not only addressed concerns due to an early flash flood, but also contributed towards temporary employment opportunities along with food shortages. A constant monitoring of these small-scale gatherings would provide indicators for the transition steps.[101] In order to implement the response mechanism effectively, more tests would be required and meticulous contact tracing system should be developed along with testing infrastructures that would utilize existing university laboratories.

It is expected that population-based risk assessments will be conducted routinely in order to isolate those at higher risk of contracting the virus. Classification of disease risk in terms of infection spread and exposure level covering all population groups will facilitate the issue of accountability and data-driven decision-making.[102] The availability of newer quarantine centres through conversion of existing facilities would need to be functional for some time in the event of any transition to normal services. Leadership and effective governance through coordination between the societal building blocks is pivotal for ensuring a smooth transition.

Recommendations

The countries with the best performances during the COVID-19 pandemic, such as South Korea, provided a subsidy for living costs to individuals in isolation. Germany, Mexico and Chile provided funds through health insurance mechanisms to those that met the case definitions of the respective countries for COVID-19 or were referred by a doctor.[48]

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A vaccine or a drug for treating COVID-19 has yet to be developed so disease management and accurate diagnosis are crucial factors in the context of this virus. An effective pipeline needs to be established for the provision of kits, PPEs and stocks for intensive care units as well as essential medicine addressing the continuum in terms of supply. Experience from France, China and Japan has shown the benefits of makeshift but sustainable health facilities to tackle an increased number of

Patients.[48] Bangladesh could take note from their quarantine strategies, lockdown policies and integrity in leadership to better handle the pandemic.

A protocol should be put in place for a smoother and sustainable transition between the lockdown period and normality. A pre-defined procedure on steps from lock down to cautioned opening should be documented and followed. For example, New Zealand have set a four-level risk assessment system or United Kingdom's five levels corona virus alert, which are allowing them to gradually return to normalcy.103 A robust information system providing access to disease prognosis harnessing the power of informatics and telemedicine can be utilized to ensure adequate follow up and risk assessment on the diagnosed cases.104 The summary of the recommendations is listed in Table 1.

Feedback mechanisms at the local level should be developed for a better understanding of priorities and be needs specific to the local context. The practice of social distancing needs to be strictly followed until the emergence of proper vaccines and extensive monitoring on inflation and control over artificial crises on trade and resources are required. Meticulous understanding of the available evidence base is necessary to dispel the spread of misinformation and thus creating a cohesive environment for developing contextual and widespread evidence-based sustainable decision making.

Conclusion

The aim of this study was to evaluate the existing health structure in Bangladesh and its response in the early periods ~~first six weeks~~ of the COVID-19 pandemic (March-~~April~~ June 2020). The results show that Bangladesh is not COVID ready due to complacency from its leaders at the beginning coupled with inadequate testing that has led to a scenario where decisions are not evidence-based but rather based instead on intuition and experience. While protocols or reports developed by the government indicated substantial planning, the field level response was insufficient to implement them. A change in health leadership, coordination with professional bodies enabling multi-sectorial partnerships and appropriate utilization of existing resources might be a plausible short-term solution. For a long-term transition process to achieve normalcy, ~~worldwide successful examples could be followed.~~awareness on health literacy, close monitoring, data-driven decision making and coordinated efforts from all relevant stakeholders is paramount.

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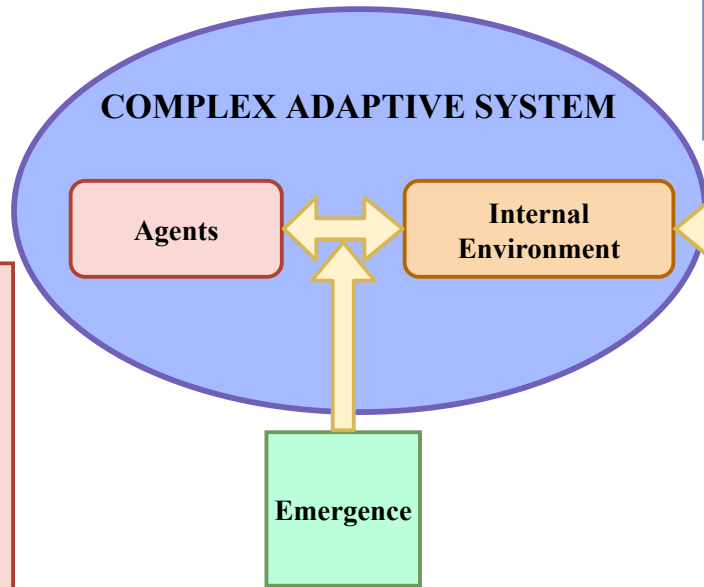
Table 1: Summary of recommendations for addressing the pandemic in Bangladesh

Dimensions	Strategies	Output	Impacts	Outcomes
1. Immediate response to crisis	a. Coordination among ministries b. Forming national emergency committee c. Assembling local committees	a. National emergency committee to steer local committees b. Local committee to coordinate community preparation c. Developing a feedback mechanism for context-specific changes	a. All parties to be aware of their duties b. Flexibility in decision making	a. Short time crisis aversion and transition to the new normal b. Effective delivery of mass information
	a. Data management and quality assurance b. Protocol design and implementation c. Enactment of the Infectious Disease Law d. Effective Health Information System	a. Protocols reflecting real-time data analysis b Disseminating protocols c. Assessment on lock downs and disease spread	a. Appropriate distribution of responsibilities b. Evidence based decision on disease spread c. Enactment of lock downs	

	a. Identifying road blocks and pre-emptive strategies b. Multisectoral workforce involvement c. Sustained financing	a. Listing possible barriers and designing counter measures b. Enhanced surveillance c. Skilled workforce development	a. Minimize damage through pre-emptive measures b. Incorporating feedback from local clientele c. Resilience through IHR embedding d. Constraint reduction on service delivery	
	a. Liaising with stakeholders b. Enacting a media cell as news dispersion platform c. Monitoring misinformation	a. Engagement with the civil society and professional associations b. Media coordination c. Disseminating correct information	a. Public awareness on social responsibilities and control measures b. Panic minimization	
2. Mobilizing resources and addressing novelty	a. Minimizing bureaucratic delays b. Activating emergency protocols	a. Faster decision making b. Mobilization of necessary goods and enactment of new policies	a. Administrative delays avoided b. Strengthening production to service connection	a. Essential workers continue services throughout pandemic b. Community to adjust to the new normal with relative ease
	a. Co-ordination between professional associations and the lead emergency committee b. Ensuring all relevant stakeholders are prepared to deal with new uncertainties	Improving existing structure for an effective response	a. Protection of essential workers during pandemic b. Appropriate distribution of necessities	

	a. Appropriate distribution of resources b. Maintaining the law and order	a. Allowing emergency services to function b. Continuous aid assurance and appropriate distribution of resources	a. No scarcity of resources at the community level b. Curbing sudden panic stricken activities	
3. Non-linearity	a. Dynamic decision making b. Continuous assessment on the ever changing situation	a. Utilization of global research. b. Coordinating with international organizations and neighbouring nations	Addressing changes based on real-time, fundamental research	Execution of plans with appropriate leadership and addressing the long-term effects
	a. Changes in traditional leadership b. Assessing multiple long term plans	a. Fresh ideas to energize the traditional system b. Devising multiple backup plans for various post-pandemic scenarios	a. Greater confidence in the community b. Displaying political goodwill c. Utilization of revised plans	
4. Designing an escape plan	a. Addressing the overburdened health system b. Managing economic stability	a. Balancing between health system burden and economic sustainability b. Injection of economic rescue packages	Economic security at community level	Allowing a smooth transition between the paradigms
	a. Designing protocols for the transition to the new normal b. Developing a process to revert the transition	a. The gradual transition to the new normal b. Systematic restoration of previous normality	a. Transition to the new normal b. Employing primary transition experience to the restoration process	



Designing an escape plan

- Normalizing the new reality
  - Addressing the overburdened health system
  - Managing economic stability
- Systematic transition mechanism
  - Designing protocols for the transition to the new normal
  - Developing a process to revert the transition

Mobilizing resources and addressing novelty

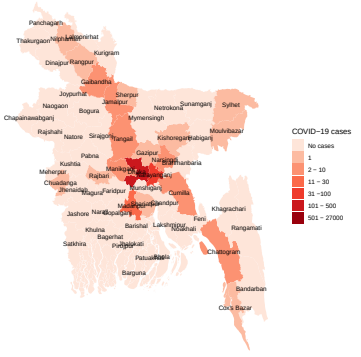
- Recognizing the need for an updated framework
- Contextualizing the existing health system
- Mobilizing community level efforts

Immediate response to crisis

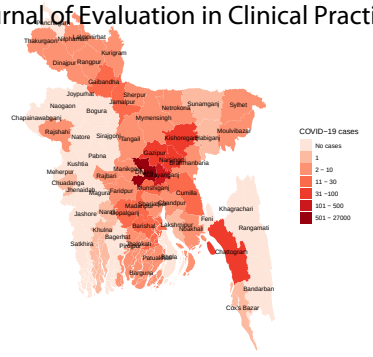
- National level crisis steering committee
- Assessing overall scenario and conducting strategic planning
- Bottlenecks and barriers
- Disseminating information - trust and panic control

Non-linearity

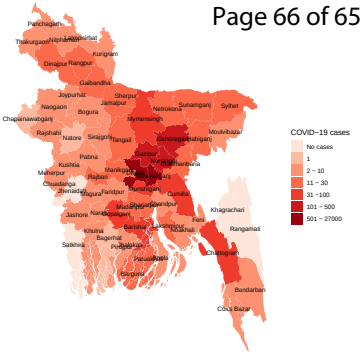
- **Dealing with unpredictable occurrences**
  - Dynamic decision making
  - Continuous assessment on the ever changing situation
- **Leadership evaluation**
  - Changes in traditional leadership
  - Assessing multiple long term plans



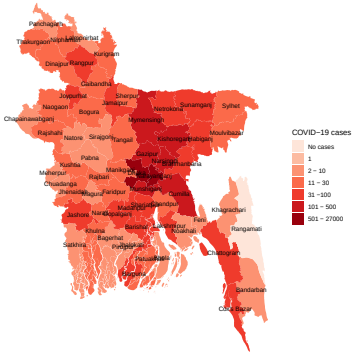
(a) Transmission on 8 April 2020



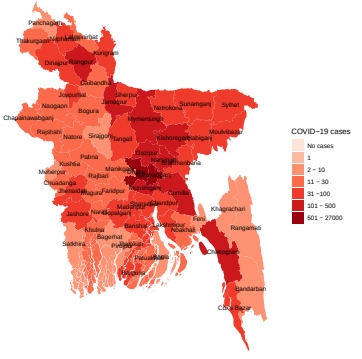
(b) Transmission on 16 April 2020



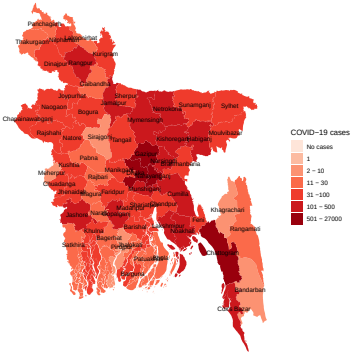
(c) Transmission on 24 April 2020



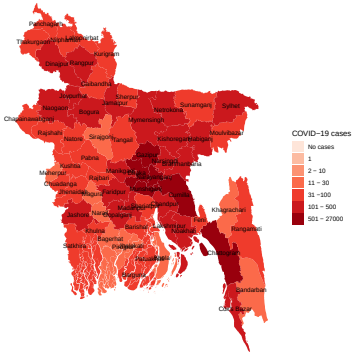
(d) Transmission on 2 May 2020



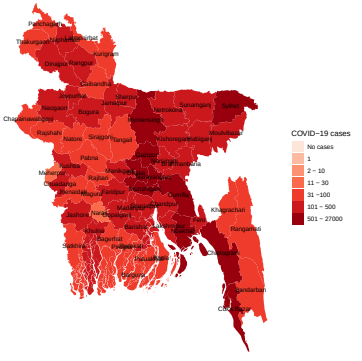
(e) Transmission on 10 May 2020



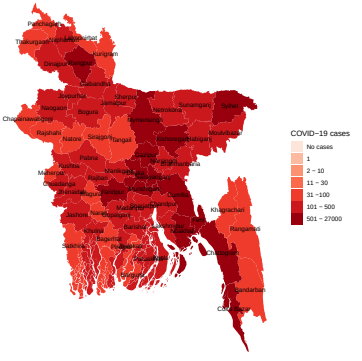
(f) Transmission on 19 May 2020



(g) Transmission on 26 May 2020



(h) Transmission on 5 June 2020



(i) Transmission on 15 June 2020