Onset, Transmission, Impact, and Management of COVID-19 Epidemic at Early Stage in SAARC Countries

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Abstract

The impact of the COVID-19 outbreak had devastating consequences globally with 20,675,770 affected and 749,061 dead. Despite different measures to restrict transmission, the death toll continues to rise. The SAARC group of countries comprising eight nations—Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka, where 23.75% of the world population reside, implemented containment measures at different stages of the outbreak with varying consequences. In this review, we examined the onset and transmission of the virus in each country at an early stage and critically appraised their response with respect to their medical facilities for diagnosis and management. We found that countries that succeeded to contain the spread of COVID-19 were able to do so by prioritizing non-pharmaceutical interventions (e.g. early and stricter lockdowns). Currently, the epicentre of COVID-19 appears to be shifting to India (the largest SAARC nation), the death toll is likely to steeply increase if effective and aggressive measures are not taken urgently. The authors believe that authorities of each of the SAARC countries should act decisively and cooperatively as a matter of urgency increasing the regional collaboration in an eloquent and durative way.

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Introduction

Since the first reported case of 'pneumonia' in Wuhan city of Hubei Province in China in December 2019 [1], it took only a couple of months before the novel coronavirus disease (COVID-19) was declared a pandemic by the World Health Organization (WHO) [2]. The causative virus, Severe Acute Respiratory Coronavirus-2 (SARS-CoV-2) or nCoV-19, is the seventh coronavirus known to infect humans [3] . Andersen et al. (2020) suggested that the virus might use an intermediary host (Malayan pangolins) of high population density after jumping from the reservoir bat (*Rhinolophus affinis*) for acquiring the optimized SARS-CoV-2 RBD (Receptor-binding domain) region and polybasic cleavage sites through the natural selection process, or the selection process could occur in humans following the zoonotic transfer [4].

Considering the clinical aspects of the virus, the most common symptoms patients experience at the onset of COVID-19 illness are fever, cough, and fatigue, while other symptoms may include sputum production, headache, haemoptysis, diarrhoea, dyspnoea, and lymphopenia [5]. What makes the virus deadly is the ability to transmit from human to human through casual contact by droplet, fomite, and direct contact routes, whereas recent studies have also indicated possible airborne, fecal, and intrauterine transmission leading to an increase in the cases worldwide with no direct treatment available yet where many researches are going on [6]. As of 10^{th} May 2020, 3.99 million COVID-19 cases have been confirmed in more than 213 countries and territories, with 2,78,941 deaths [3,7–9]. At the initial stage, China was the epicenter which was changed to Italy, UK, and later to the USA while the South Asian and African countries came later in the epidemic timeline [10–13]. Remarkably, Africa's lower mortality rate (11,652 deaths among 494,380 cases as of 7th July, 2020) can be linked with younger population structure, climate, and other possible confounding factors although comorbidities may influence disease severity in future [14–17].

Strikingly, the wave of pandemic hit SAARC (South Asian Association for Regional Cooperation) countries (Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka) relatively later than Europe and America [7,18–20]. The SAARC is a special group of countries constituting about $\frac{1}{4}$ of the world's total population with similar socio-economic-geo-political contexts [21]. The population densities of Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka and Afghanistan are 1265/km^2, 20/km^2, 464/km^2, 1802/km^2, 203/km^2, 287/km^2, 341/km^2 and 60/km^2, consecutively [22]. SAARC countries hold significant value in the world map with respect to trade, economy, defense, culture, entertainment, outsourcing workforce, manufacturing, and services [23–25]. Geographic variables such as population density play a crucial role in epidemics study [26], and investigations on infectious diseases demonstrated its effect on the magnitude of the outbreak and disease spreading [27,28]. In the case of South Asia, preventable infectious diseases are a major cause of death and disabilities [29]. Although the COVID-19 cases are increasing rapidly compared with other regions, the SAARC countries are less prepared against COVID-19 pandemic due to poverty, poor medical infrastructure and medical care facilities, as well as the lowest number of physicians per capita (less than 1) [30].

Unlike the rest of highly affected regions such as European and American, SAARC countries had gained the

upper hand to take the advantage of delimiting the initial entry into the countries and later the community transmission where all countries have also started taking actions to fight against the rapid spread of COVID-19 [31]. Besides, climate, genetic make-up, age structure, BCG vaccination might account for differences in the pandemic's spread [32,33]. Each government of these countries has taken different measures, such as complete lockdown, social distancing, advising to use mask and hand-wash, testing as much as possible, supplying PPE (personal protective equipment) for the health workers, nurses and doctors, and other control strategies, which have direct and indirect impacts on the epidemiology of COVID-19 [34–36].

Previously, the case studies, current scenario, government implications, and mathematical model based control strategy were reported from each SAARC country [7,13,37–42]. Those publications have not described all the necessary information regarding the overall scenario, reasons behind success/failure, and future directions for each of the countries, for example, we have very little concrete knowledge on the COVID-19 situation of Maldives [42]. Moreover, a comparative review with comprehensive visualization of related data will bring out significant pieces of information that may help in future implications to tackle pandemic, or at least reduce its lash on any country.

In this review, we describe the early pandemic scenario of COVID-19 in SAARC countries as a story-line - starting from the disease onset focusing on patient zero, the initial and community transmission, and the ambiguity regarding case fatality rate, how effectively different country manage and contain disease through diagnosis (testing), health care facilities, and effective treatment. Also, the effective interventions and policies implied jointly after a long time by the SAARC platform was worth mentioning here. For specific criteria based comparative analyses of SAARC countries such as total reported case and death, mobility data report of Google, we employed R statistical platform to visualize the results in a reader-friendly way. Finally, this review focuses on the comparison of onset and transmission of COVID-19 as well as the initial responses and preparation of countries, future directions declared and progressive measures focused by the government until 10th May, 2020.

The Disease Onset of COVID-19 in SAARC countries

Patient Zero

Since the initial outbreak in Wuhan, SARS-CoV-2 has now spread to more than 213 countries, including the SAARC countries [43]. The first COVID-19 case was confirmed in Nepal among the SAARC countries on 24 January. And shortly after Nepal, Sri Lanka and India also confirmed the countries' first cases in January 2020. The patient zero of each of these three countries was reported to come from China.

Later, in February, Afghanistan and Pakistan reported their first confirmed cases. Interestingly, both cases had a history of visiting Iran recently. On the other hand, foreign nationals were the first COVID-19 positive cases in Bhutan and Maldives detected on 6 and 7 March 2020 respectively (**table 1**). Lastly, on 8 March, Bangladesh confirmed their first three cases, two of whom came from Italy, while the third-case was subjected to the intra-familial transmission of COVID-19.

Table 1: Patient zero and their information of each of the SAARC countries

Country	First report	Demographic characteristics	Travel History	Outcome (Death/ recovery)	References
Nepal	24 January	32 year age, male	China	Recovered (after 13 days)	[44]
Sri Lanka	27 January	44 year age, female (Chinese national)	Hubei, China	Recovered	[39]

India (Kerala)	30 January	age and gender unknown (student of Wuhan University)	Wuhan, China	Recovered	[45,46]
Afghanistan (Herath)	24 February	35 year age, male	Qom, Iran	Recovered	[47]
Pakistan	26 February	One case (student of University of Karachi, age/gender unknown)	Iran	Recovered	[37]
Bhutan	6 March	76 year Male (US national)	From USA through India	evacuated to United States on 13 March	[38]
Maldives	7 March	2 foreign nationals	Direct contact with Italian tourists who came to Maldives	Was under medical treatment and isolation and recovered	[48]
Bangladesh	8 March	3 cases, aged between 20-35, 2 males, 1 female	Both males were from Italy. The female patient has a family member from Italy.	Was under medical treatment and monitoring in a hospital and recovered	[13]

Transmission of COVID-19 in SAARC countries

As of 10^{th} May 2020, a total of 3.99 million COVID-19 cases have been confirmed around the world. Among the SAARC countries, India is showing the highest prevalence of COVID-19 cases followed by Pakistan, Bangladesh, Afghanistan, Maldives, Sri Lanka, Nepal and Bhutan (**Figure 1A**). As of 10^{th} May 2020, a total of 2,78,941 people died of COVID-19 throughout the world and India had the highest number of deaths among the SAARC countries as well followed by Pakistan, Bangladesh, Afghanistan, Sri Lanka, Maldives and Nepal [49]. Among SAARC countries, Bhutan is yet to encounter any death related to COVID-19 (**Figure 1B**). However, to date, only Bangladesh is in the community transmission phase, while all other SAARC countries except for Bhutan are in the clusters of cases phase and Bhutan is having sporadic cases according to WHO [50]. But the number of cases in SAARC countries might be an underestimated picture of COVID-19 cases due to the limited testing facilities and resources. Due to the unavailability of published data or complete databases, the demographic aspects of COVID-19 cases in these countries could not be compared among all SAARC countries. However, similar to global data, a higher prevalence of COVID-19 among the males compared to females was observed so far in Bangladesh (72% vs 28%), Nepal (84% vs 16%) and Pakistan (70% vs 30%), while the opposite scenario was evident in Bhutan (44.3% male vs 55.7% females) [51–53]. Besides, COVID-19 showed an age-stratified mortality rate, while the highest infection rates were reported among 25-54 years (53.08%) and 21-50 years (64.3%) age groups of individuals from Pakistan and Bangladesh, respectively.

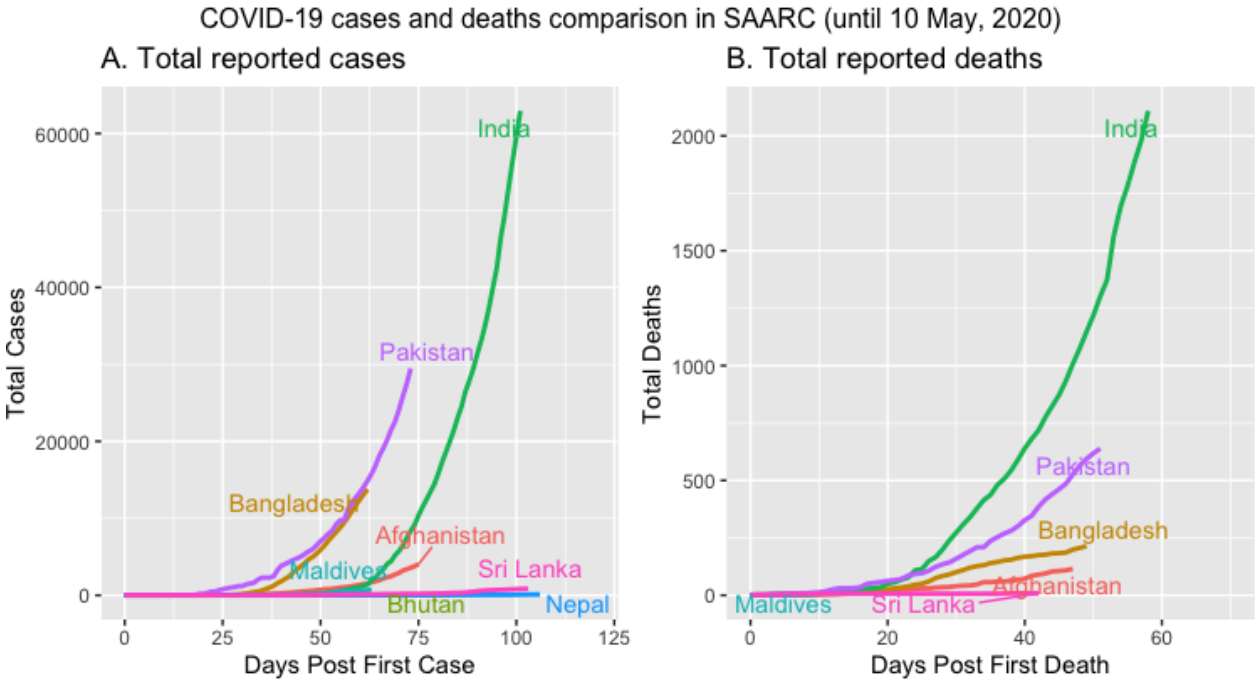

Figure 1: *(A) Total number of confirmed COVID-19 cases since the 100th confirmed case throughout the world and green colored lines are the SAARC countries. The figure shows that India, Pakistan and Bangladesh are in the trend of doubling almost every 5 days, followed by Afghanistan and Maldives, Sri Lanka with the trend of doubling every 10 days. The numbers of cases in Nepal and Bhutan are still lower compared to other SAARC countries. (B) The total numbers of deaths in SAARC countries show that India has the highest number of deaths and Bhutan is yet to record any death cases related to COVID-19 [49].*

Ambiguity in the Case Fatality Rate in SAARC Countries

Since the origin of the COVID-19 outbreak in China, the death toll has kept climbing which even yielded the dramatic trajectory in countries like the USA, Russia, Brazil and Spain [54]. Despite the limitations of testing facilities and reagents, increasing numbers of COVID-19 cases are also being detected in SAARC countries along with the increasing death reports. Apart from the standard method, Ghani et al. (2005) estimated the case fatality ratio (CFR) of SARS using a simple method (deaths/(deaths + recovered), which was used alongside the standard method (deaths/(confirmed cases)). Apart from CFR, another model to estimate the excess COVID-19 related mortality to individualise risk prediction across underlying conditions [55]. In the case of India, the CFR for each day calculated based on the formula, deaths at day.x / cases at day.x-{T} (where T = average time period from case confirmation to death) was available in the worldometer database. Based on the detailed dataset along with day-to-day basis CFR according to the World Health Organization (WHO) which is available only for India among SAARC countries, the CFR calculated for India is 4.38% as of July 06, 2020. However, this value was around 20% on average at the initial stage (April-May) [56]. Testing suspected cases at a limited scale might contribute to the high mortality rate in India, Bangladesh, Pakistan, Sri Lanka, and Afghanistan.

While co-morbidity has been found to influence the mortality rate, the precise data were not available for most of the SAARC countries (not open accessed) to estimate the association for these countries. However, daily newspaper reports and other online information predicted a high ratio of death cases related to pre-existing disease factors. But the lessons learned from previous SARS pandemic in 2003 suggest that simple

estimates for the novel, emerging infectious diseases can often be misleading. Because the fatality rate for SARS was estimated 4% (or as low as 3%) at the initial stage which later changed to 9.6%, while for COVID-19, the initial mortality rate of 1.1% in Wuhan, China has already been wronged in Italy where the rate was as high as 7.5%.

Disease Management and Containment Strategies

Diagnosis of COVID-19 and Diagnostic facilities in SAARC countries

All SAARC countries except India have been performing laboratory assays for SARS-CoV-2 detection based on WHO recommended guidelines. The real-time reverse transcriptase PCR (RT-PCR) is considered the reference standard for definitive COVID-19 diagnosis [57], [58], which is being also practised in all the SAARC countries except for only two countries (India and Bhutan) [59,60]. These countries use antibody-based rapid tests for COVID-19 detection along with RT-PCR based tests. For RT-PCR, the standard approach is to collect the respiratory specimens (Upper or lower) from the patients and to use SARS-CoV-2 specific primers and probes to check for the presence of the virus by RT-PCR. But considering the limitations of resources and facilities, the current practice is taking samples from the patients who are suspected as COVID-19 positive, based on the empirical diagnosis along with a travel history in the affected countries or having close contact with the confirmed cases in most of the SAARC countries [58,61,62]. Furthermore, there are limitations of the test itself, high false negative results, that could potentially underestimate the number of cases in these countries. So, in addition to fewer people being tested, there were also false negatives, both of which could partly explain why SAARC countries reported far fewer cases than European and other countries. The testing procedure, testing facilities and current testing center numbers are shown in table 2.

Despite the highest number of tests performed in India which was 1,610,788 as of 10^{th} May, the highest test capacity per million is 1659.446 in the Maldives. In the case of test centers, the highest and the lowest number of testing centers were found respectively in India and Maldives **(table 2)** .

Table 2: *COVID-19 tests and testing facilities in SAARC countries as of May 10, 2020*

Country or Territory	**Test method**	**Specimen**	**Total Tests Performed**	**Test per million**	**Number of Test Centers**
Bangladesh	RT-PCR	Upper airway specimens: Oropharyngeal swabs, nasal swabs, nasopharyngeal secretions Lower airway specimens sputum, bronchoalveolar lavage fluid, airway secretions	1,22,657	95.276	36

India	RT-PCR, Antibody-based TrueNat Test CBNAAT Test	Nasal/throat swab, sputum, nasopharyngeal swab, bronchoalveolar lavage (BAL) or endotracheal aspirate for RT-PCR; Blood/serum/plasma for Ab based detection	1,610,788	51.272	502 Real-Time RT PCR for COVID-19: 411 TrueNat Test : 56 CBNAAT Test : 35
Nepal	RT-PCR	Nasal/throat swab	16898	4.599	14
Pakistan	RT-PCR	nasopharyngeal or oropharyngeal swab	283,517	145.234	33
Maldives	RT-PCR	Lower respiratory specimens (sputum, endotracheal aspirate, or BAL fluid)* URT samples (nasopharyngeal aspirate or combined oropharyngeal and nasopharyngeal swabs)	8,537	1659.446	2
Afghanistan	RT-PCR	nasopharyngeal or oropharyngeal swab	15,560	120.401	10
Bhutan	RT-PCR Rapid Test	nasopharyngeal or oropharyngeal swab Blood/serum/plasma for Ab based detection	11,655 (2,477 RT-PCR tests, 9,178 Rapid tests)	14.256	64

Sri Lanka	RT-PCR	Symptoms based selection of specimen: nasopharyngeal or oropharyngeal swabs for mild symptoms; endotracheal aspirate or bronchoalveolar lavage for severe symptoms	36,596	40.582	17

Medical Facility and Treatment Strategies

Differential severity of COVID-19 is evident among patients primarily depending on age and underlying comorbidity [63]. So, WHO has declared 6 clinical syndromes of COVID-19: 1) Mild illness (Influenza like illness-ILI), 2) Pneumonia, 3) Severe pneumonia, 4) Acute respiratory distress syndrome (ARDS), 5) Sepsis, 6) Septic shock. While most of the cases were reported to have mild pneumonia-like symptoms, 14% cases became severe and even 5% were critical with respiratory failure, septic shock, and/or multiple organ dysfunction or failure (7). Even the severe/critical cases need medical care in hospital settings for a significantly longer time compared to ordinary patients (8). So, the prevalence of severity in SAARC countries may vary from the existing global data depending on the existing health care facilities, which is challenging the health care system around the world. And the overburdened health care system in the countries with vulnerable economics is in crisis in the present time and the SAARC countries are also included in this list.

Most of the SAARC countries fall into the lower-middle to medium income group. According to the World Bank Country and Lending Groups 2020, Bhutan, Bangladesh, India, Pakistan, Nepal and Sri Lanka are in lower-middle income countries and Afghanistan is in low-income groups, although the Maldives is considered as upper-middle income countries [64]. However, the health care system is directly dependent on the economy of the country. Analysis by WHO showed that Hospital bed capacity and Physician density exhibit a strong correlation with the income status of countries [65]. Also, the 'Inpatient bed capacity' indicator meaning hospital bed per 1000 people is crucial during such an outbreak of COVID-19 to assess the health facility infrastructure of a country. While WHO recommended the standard of 5 beds per 1,000 population in any country, none of the SAARC countries fulfills the recommended standard [66]. Besides, in low and lower-middle income countries like Afghanistan, Bangladesh, India and Pakistan have hospital bed density far below the standard**(Table 3)** . Although the recent data were not available for the countries, this number may have increased in the last decade. But the question remains if these low-income countries of SAARC have increased their inpatient bed capacity enough to catch up the demand amid the pandemic. However, each country has prepared some additional beds for isolation of affected COVID-19 patients. In Bangladesh, there are around 6,085 (as of 10 May) isolation beds in 7 divisions, while Pakistan has a total of 2,942 (as of 5 Apr, source: National Institute of Health, Islamic Republic of Pakistan. List of Hospitals Province-wise with Isolation Facilities. Islamic Republic of Pakistan; 2020 p. 1-5) isolation beds for their seven provinces [67]. Nepal has a total of 3209 (as of 10 May, source: NEOC, Ministry of Home Affairs and Provincial Health Directorate, Date: 27th Baisakh 2077 (9th May 2020)) isolation beds. India has arranged the highest number of isolation beds of 152,403 (as of 4 April), while it will still be challenging for a country with such a huge population **(Table 3)**[68].

Besides, critical care bed capacity is still a serious problem for all the SAARC countries. Although a recent study showed that South Asia has an estimated 0.7-2.8 critical care beds per 100 000 population, the striking heterogeneity in the number of critical care beds is visible among different countries **(Table 3)**[69].

Not hospital beds are the only limitations to get worried about in these countries, but medical equipment like ventilators has also become a dire concern for the countries threatening the feasibility of medical care for COVID-19 patients. Because the severe cases having breathing difficulties like severe pneumonia, ARDS etc. require urgent care of breathing treatments or oxygen therapy using ventilators. Currently, Bangladesh having a total population size of 157,826,578 has only 1250 ventilators (as of Apr) [70]. Pakistan has only 2200 (as of Apr) ventilators for a total population of 204,924,861, while India, one of the most densely populated countries of South Asia with a total population size of 1,281,935,911, has only 19,398 (as of 1 May) ventilators [71,72].

On the other hand, the protective gears for health care professionals are in high demand in the present world. While the crisis of personal protective equipment (PPE)—gloves, face masks, air-purifying respirators, goggles, face shields, respirators, and gowns etc. is being noticed worldwide, even including the countries of high nominal GDP such as USA, United Kingdom etc., SAARC countries with poor/medium income are not exceptional [73,74]. Although the data of PPE distributed/ available have not been found for all the countries, reports from Bangladesh (21,21,285- as of 10 May), India (21.32 lakh- as of 9 May [75]), Nepal (9158- as of Apr, source: NEOC, Ministry of Home Affairs and Provincial Health Directorate, 26th Chaitra 2076 (8th April 2020).) and Pakistan (16,700- as of Apr) [51,71,75] showed that the available PPE or the budget for PPE is far below the demand. An increase in PPE supply in response to this new demand will require a large increase in PPE manufacturing, a process that will take time many health care systems do not have, given the rapid increase in COVID-19 patients. Besides, quality validation of those PPE should also be considered and monitored carefully. So, the ultimate lack of PPE is increasing the risk of health care workers getting infected. Besides, reports of getting infected or even death due to COVID-19 among the doctors, nurses, or other health care workers have already been noticed [76]. Proper supply and management of PPE might mitigate this occupational hazard [77–79]. While the physician density per 1000 population is below 1 for all countries but the Maldives, even below 0.5 in Afghanistan, Bangladesh and Bhutan, striking or losing health care professionals to COVID-19 is worsening the countries' health care system more vulnerable **(Table 3)** [80]. So, the morbidity or mortality rate might not be the same in the near future in these countries as found at this initial stage.

Table 3: *Capacity of inpatient beds, critical care beds, physician in SAARC countries based on the available data*

Entity	**Total Population Size (2020)** [81]	**Hospital beds / 1000$_{(Year)}$** [82]	**Critical Care Beds** [69]	**Critical Care Beds/100,000 Population**	**Physician density$_{(Year)}$** [83]
Afghanistan	38,928,346	0.5 $_{(2015)}$		-	0.3 $_{(2016)}$
Bangladesh	164,689,383	0.8 $_{(2015)}$	1,174	0.7	0.472 $_{(2015)}$
Bhutan	771,608	1.7 $_{(2012)}$		-	0.381 $_{(2017)}$
India	1,380,004,385	0.53 $_{(2017)}$	29,997	3.7	0.758 $_{(2016)}$
Maldives	540,544	4.3 $_{(2009)}$		-	1.04 $_{(2016)}$
Nepal	29,136,808	0.3 $_{(2012)}$	815	NA	0.65 $_{(2017)}$
Pakistan	220,892,340	0.6 $_{(2014)}$	3,142	2.5	0.98 $_{(2015)}$
Sri Lanka	21,413,249	3.6 $_{(2012)}$	519	0.6	0.96 $_{(2017)}$

Now, Focusing on the treatment strategy, each SAARC country has developed its protocol for sample collection, detection, isolation, case definition, treatment according to syndromes and stage, burial for death patients, which are available on the government portal sites in detail. These strategies are mainly based on the clinical guidelines of COVID-19 management provided by WHO. However, WHO recommended patient criteria have been revised in some countries **(Table 4)** for case management according to countries' capabilities and facilities.

Although, there is no specific therapy to treat COVID-19 to date, the adapted existing therapeutic agents,

such as lopinavir/ritonavir, remdesivir, favipiravir, interferon, ribavirin, tocilizumab and sarilumab are found promising so far [84,85]. Each SAARC country is giving priority to different types of antiviral treatment based on their investigation and counselling **(Table 4)** .

Table 4: Categorization of COVID-19 cases with treatment strategies followed by the countries

Entity	**Categories of COVID-19 Cases**	**Drugs used**	**Govt. document references**
Afghanistan		Ceftriaxone 1 g (vial) every 12 h for 7 days, oseltamivir 75 mg (tablets) every 12 h for 30 days, and terbutaline 10 mg (tablets) every 12 h for 7 days. [47]	
Bangladesh	Mild- Influenza like illness (ILI), Moderate- Pneumonia (CRB 65 score 0), Severe- Severe Pneumonia, Sepsis, Critical- ARDS, Septic shock (b)	Chloroquine with a dose of 500mg BID for 7 days and Hydroxychloroquine: (400mg-BID-D1 and 200 mg –TID-D2-D10) for pulmonary syndrome without hypoxia, Favipiravir [86]	Disease Control Division Directorate General of Health Services. National Guidelines on Clinical Management of Coronavirus Disease 2019 (Covid-19). Dhaka: Ministry of Health & Family Welfare, Government of the People's Republic of Bangladesh; 2020 p. 14.
Bhutan	Uncomplicated illness- Nonspecific viral infection of URT (cough, nasal congestion, sore throat, malaise, headache with or without fever)	Oseltamivir for 5 days	Clinical management protocol for COVID-19 confirmed cases, Royal Government of Bhutan, Ministry of Health. 3rd Edition, 15th March 2020 p. 1-2
	Mild Pneumonia- pneumonia, not severe pneumonia with cough/difficulty breathing,	Ceftriaxone for 7 days, Doxycycline 200mg oral stat and 100mg BD for 7 days and Oseltamivir 75mg BD for 5 days.	
	Severe Pneumonia / ARDS/ Sepsis/ septic shock- fever, suspected respiratory infection, severe respiratory distress, sepsis.	Both antibiotics (Piperacillin tazobactam or Meropenem) and antivirals (Lopinavir 400mg/ ritonavir 100mg twice daily for 10 days, Oseltamivir for 5 days, Chloroquine 500mg twice daily for 5 days)	

India	Uncomplicated illness	Oseltamivir for 5 days	Revised Guidelines on Clinical Management of COVID – 19. India: Directorate General of Health Services (EMR Division), Ministry of Health & Family Welfare, Government of India; 2020 p. 2-15.
	Mild pneumonia	Ceftriaxone for 7 days, Doxycycline 200mg oral stat and 100mg BD for 7 days and Oseltamivir 75mg BD for 5 days	
	Severe pneumonia ARDS Sepsis septic shock	Both antibiotics (Piperacillin tazobactam or Meropenem) and antivirals (Lopinavir 400mg/ ritonavir 100mg twice daily for 10 days, Oseltamivir for 5 days, Choloroquine 500mg twice daily for 5 days) [87]	
Maldives	Mild disease Moderate Severe disease	Oseltamivir, lopinavir and ritonavir [88]	Health Protection Agency. COVID-19 Quick Reference Guidelines. Ministry of Health, Maldives; 2020 p. 37-39.
Nepal	Mild	Antipyretics for fever	Depart of Health Services. COVID Clinical Management Guideline. Ministry of Health and Population, Government of Nepal; 2020 p. 2-3.
	Severe	Empirical antimicrobials suggested but no specific drug was named by the ministry	

Pakistan	Mild or asymptomatic,	Supportive care only including acetaminophen for fever, oral hydration in case of diarrhea and antihistamines for rhinorrhea.	Definitions, Criteria for Testing, Admission and Management of Patients with Suspected/ Confirmed COVID-19. Ministry of National Health Services, Government of Pakistan; 2020 p. 3.
	Moderate and Severe or critical	Chloroquine 500 mg BD for 10 days and Hydroxychloroquine sulfate 200 mg, three times per day for 10 days [89]	
Sri Lanka	Mild	Antipyretics for fever with supportive therapy	Provisional Clinical Practice Guidelines on COVID-19 suspected and confirmed patients. Epidemiology Unit, Ministry of Health Sri Lanka; 2020 p. 11.
	Moderate Severe (Critical)	Neuraminidase inhibitors suggested as initial empiric therapy if there is concern that the patient might have influenza pneumonia	

Different Forms of Containment Strategies to Tackle COVID-19 in SAARC Countries

Non-pharmaceutical Containment Strategies

The world has come to standstill due to the current COVID-19 pandemic affecting 213 countries, while vaccines or effective treatments are yet to be available [90]. So, considering the global health risk, the importance of non-pharmaceutical containment strategies cannot be denied. Besides, the previous experiences with the Influenza pandemic showed that non-pharmaceutical interventions are especially crucial for underdeveloped countries, which include these South Asian countries [91]. Based on country preparedness capacity, WHO categorized SAARC countries in level 3 denoting developed capacity ([?]60%), except for Pakistan and Afghanistan which are still in level 2 (limited capacity of [?]40%) indicating the vulnerable health system (WHO n.d.). However, as of 20^{th} May 2020, WHO classified the mode of transmission as clusters of cases for these countries excluding Bhutan and Nepal, which are in the phase of sporadic cases, although limitations of testing facilities might underestimate the real situation [92]. That is why containment strategy is more crucial for these countries than ever not to reach the community transmission stage.

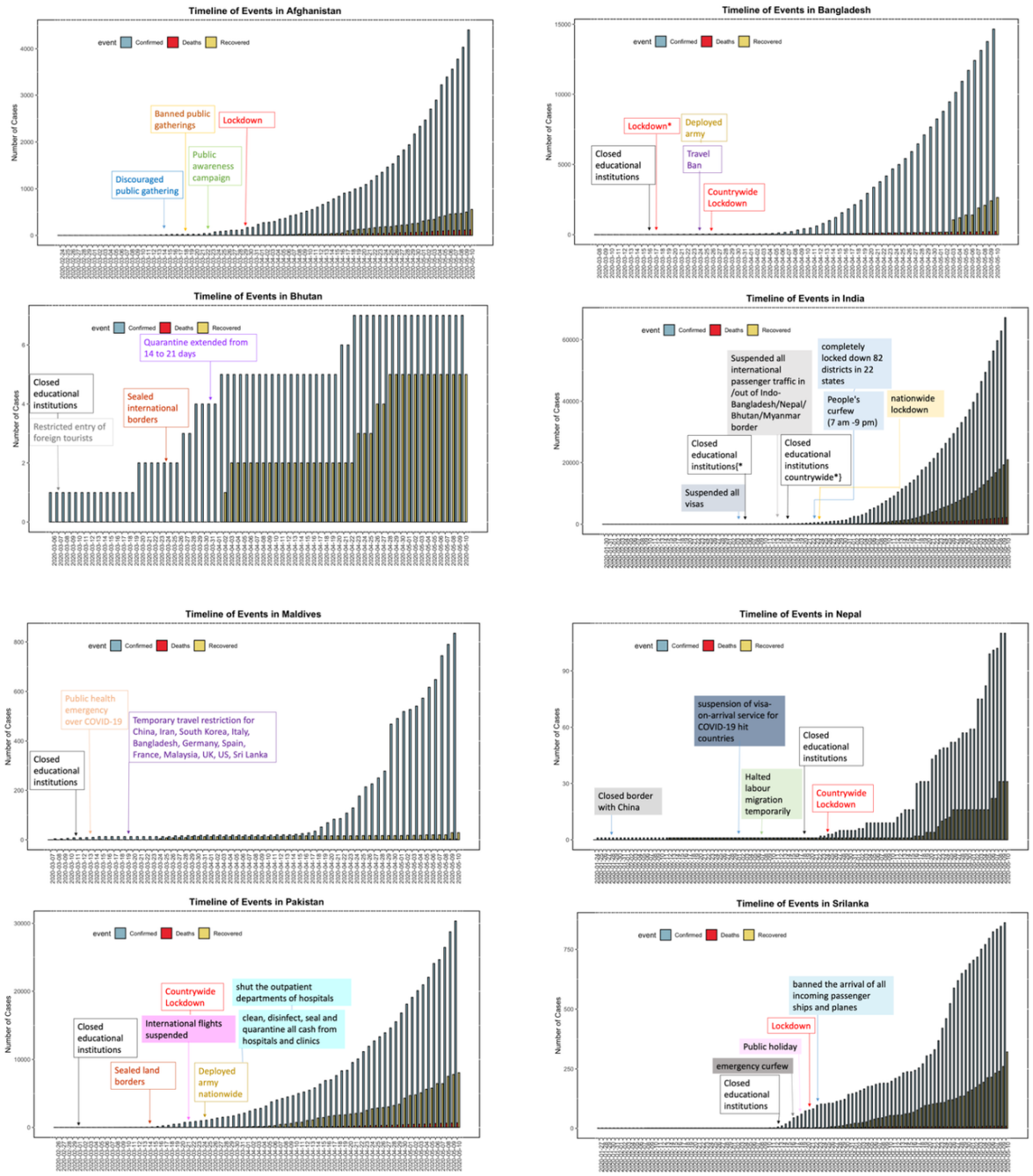

Figure 2: *Timeline of events in SAARC countries and the intervention strategies taken (source: Worldometer).*

Several modeling assessments showed that the effect of limiting travel could be instrumental to limit the spread of the coronavirus worldwide. One study showed that the initial travel ban in Wuhan was effective in limiting the cases observed worldwide and effectively reduced international cases. They showed that travel restriction to COVID-19 affected areas will have a modest effect and will lead to mitigation of the epidemic [93]. Besides, to contain the global spread of the outbreak, border control measures such as airport screening

and travel restrictions have been implemented in several countries [94]. The SAARC countries have also taken the mitigation policies on international and national travel, as well as airport screening, voluntary or mandated quarantines or isolation, lockdowns, closure of educational institutions, travel restrictions and cancellation of public events etc. (**Figure 2**). On the other hand, different educational institutions are kept closed in Bhutan, Bangladesh, India, Sri Lanka, and Pakistan. This decision is praiseworthy considering the transmission potential of public gathering from these institutions. However, considering the apparently low rate of COVID-19 infection among children, school closure might not play the major role which was observed in controlling influenza A pandemic [95]. But the higher rate of paucisymptomatic cases among children surely indicates the significance of this decision in curbing the dissemination of COVID-19 [96]. Even 80% of the COVID-19 cases are asymptomatic or minimally symptomatic and reported primarily among the young aged population of colleges and universities [97].

Mobility Reduction as a Form of Containment Strategy

Travel restriction is assumed to reduce the importations of COVID-19 from China at a significant level (from 779 to 230) [93]. In response to public health officials for useful aggregated, anonymized insights of human mobility based on products like Google Maps, Google Inc. published community mobility reports broken by country/states [98,99]. These data are from users of these products who have turned on the location history settings. The reported data among countries were compiled to show percent changes from baseline mobility in several categories, i.e. retail & recreation, grocery & pharmacy, parks, transit stations, workplaces, and residential. The data represents a comparison of baseline mobility data from February 23 for each country. Based on the Google Covid-19 community mobility reports, it appears that Afghanistan has a minimum reduction of mobility and a lower increase in residential from its baseline. In terms of indoor activity, percentage-mobility increased in all countries at a similar level except for Afghanistan. Bangladesh, India, Nepal, Pakistan, and Sri Lanka had a higher reduction in outdoor mobility. However, for Bangladesh and Pakistan, mobility in the parks did not reduce that much (around 10-25%) compared to other SAARC countries except Afghanistan. Also, in all categories, Sri Lanka has a consistently higher reduction in mobility. However, this report represents a fraction of the population in all countries who have access to the internet and are the users of smart-phones, so this trend should be used with caution since this does not represent the overall mobility trend in the country across all demographics of population (Figure 3). Also, the location accuracy and the understanding of categorized places vary from region to region. The effect of mobility reduction was also observed in the air quality index (based on particulate matter size 2.5 micrometers, also known as AQI PM2.5). Except for the Bhutan and Maldives, all countries in SAARC have daily records of PM2.5 (as reported in airnow.gov) which has been visualized in figure 4 from early 2020 until May 10 for all cities for which the data is available in SAARC. Afghanistan, Bangladesh, and Sri Lanka showed an increase of AQI PM2.5 value in early 2020 that peaked in mid February, and then consistently declined until May. In all other countries, a continuous decrease has been observed in these five months. Since a large proportion of PM2.5 can be attributed to traffic vehicle's gas and industrial burning of fuels, this general decline of AQI data indirectly shows an effect of lockdown in these countries.

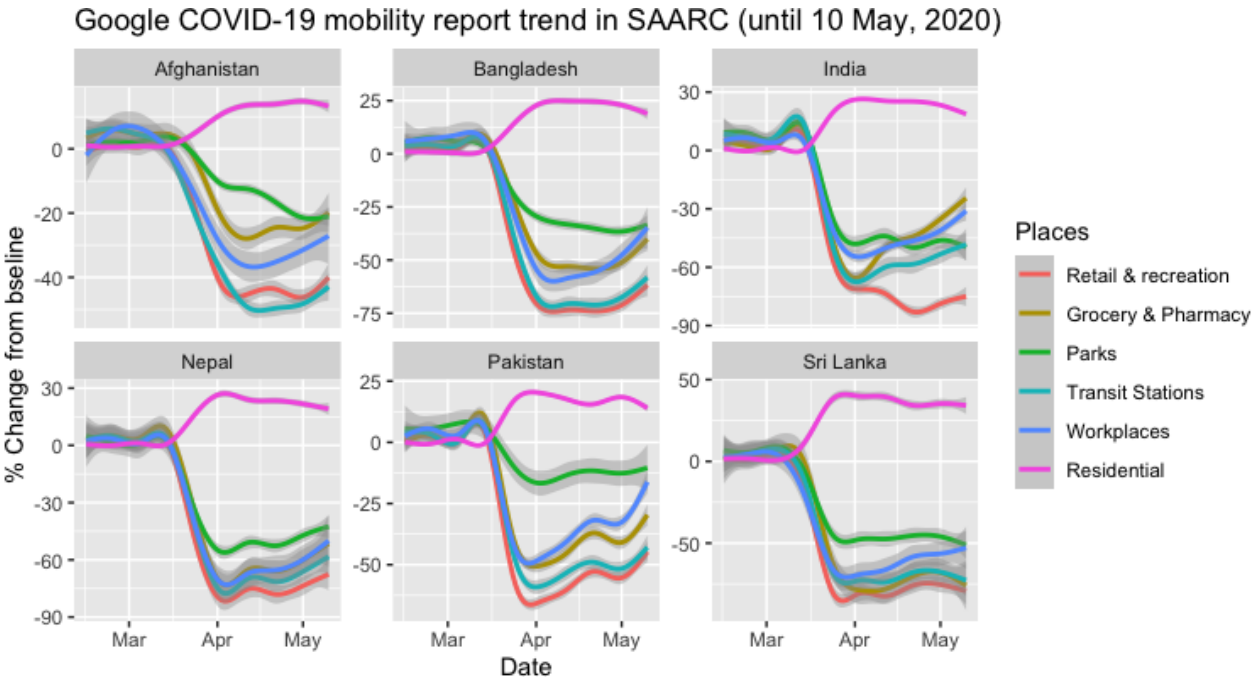

Figure 3: *Summary of mobility data reported by Google. The data generated based on Google Maps, Google Inc. published community mobility reports. The timeline illustrates the change in human mobility in response to the measurements of social distancing compared to baseline. The data has been smoothed using the locally weighted scatterplot smoothing (LOWESS) method.*

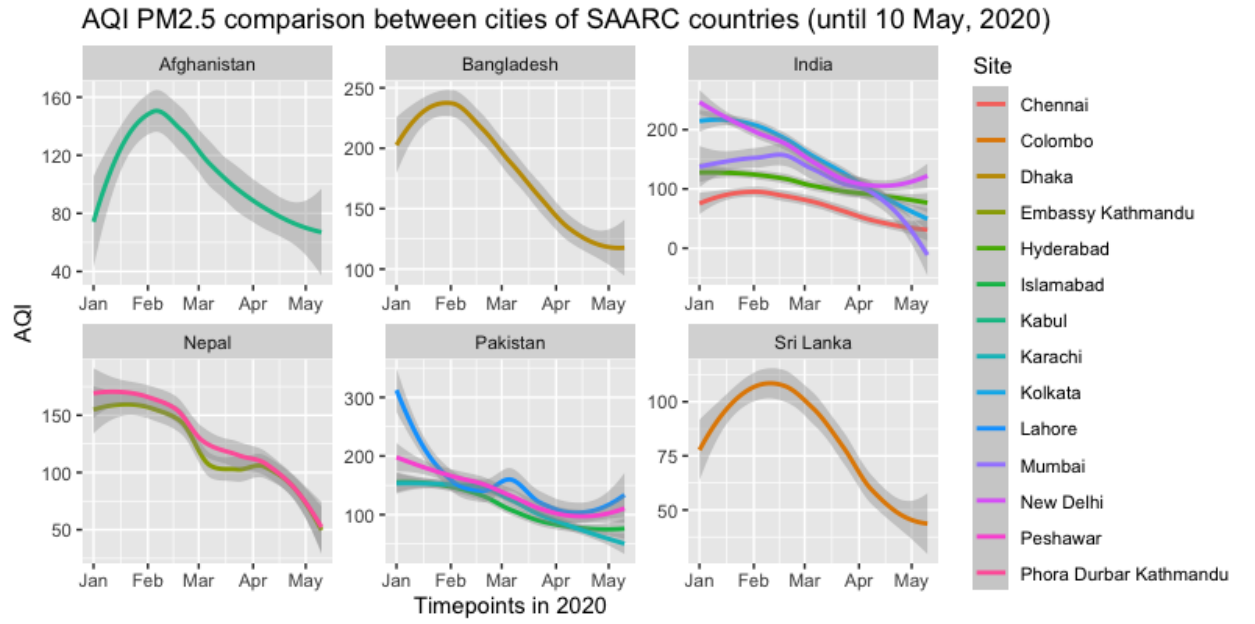

Figure 4: *AQI PM2.5 changes across SAARC countries indicates a reduction of particle emission due to COVID-19 containment measurement as well as a positive environmental outcome in the cities. The data has been smoothed using the locally weighted scatterplot smoothing (LOWESS) method.*

Improved Detection and Isolation as Containment Strategy

The improved detection and isolation of the confirmed cases are supposed to have a greater impact on curbing the dissemination of COVID-19 compared to travel restriction [100]. But contact tracing is challenging for the SAARC countries, which is of greater impact on curbing the transmission, specifically in the early stages. According to a model-based estimation, at least 70% will have to be traced successfully to control the transmission of such high transmissible viruses as SARS-CoV-2 [100]. But limitations of resources and preparedness in this region arise the question of the feasibility of contact tracing and their extent. Besides, even if this is included in the action plans of some countries like Bangladesh [101], only limited reports of implementation have been noticed from either of the countries.

So, ensuring social distance is crucial for intervening transmission of this highly transmissible SARS-CoV-2, while awareness campaigns were held to make people aware of maintaining social distance. Even armed forces were deployed in countries like Bangladesh and Pakistan (Figure 2). But draconian lockdowns or social distancing in the context of the fragile economic condition of the majority of the population in this region rather seems to be an infringement of human dignity. So, given limited diagnostic facilities and national resources, SAARC countries may need to revise their action plan to combat this outbreak.

Interventions and Policies Taken Through SAARC Platform to Combat COVID-19

The necessity of mutually combating the COVID-19 outbreak in the Southeast Asian region is evident during the current coronavirus pandemic. On March 15, the Indian Prime Minister Narendra Modi called on a video conference with the eight-member countries of the only intergovernmental group spanning in the entire south east Asian region, the South Asia Association for Regional Cooperation (SAARC) to explore ways to resolve the threats raised by the coronavirus in one of the most densely populated areas in the globe [102].

The Video Conference of the SAARC Leaders was attended by H. E. Mohammad Ashraf Ghani, President of the Islamic Republic of Afghanistan; H. E. Sheikh Hasina, Prime Minister of the People's Republic of Bangladesh; H. E. Dr. Lotay Tshering, Prime Minister of the Royal Government of Bhutan; H. E. Narendra Modi, Prime Minister of the Republic of India; H. E. Ibrahim Mohamed Solih, President of the Republic of Maldives; Rt. Hon. KP Sharma Oli, Prime Minister of the Federal Democratic Republic of Nepal; H. E. Dr. Zafar Mirza, special health adviser of Prime Minister Imran Khan of the Islamic Republic of Pakistan; and H. E. Gotabaya Rajapaksa, President of the Democratic Socialist Republic of Sri Lanka ("Press Release-The Leaders of the Member States of the South Asian Association for Regional Cooperation (SAARC) held a Video Conference on 15 March 2020 to discuss measures to contain the spread of COVID-19 in the region. ," 2020).

Together, the eight members of the South Asian Association for Regional Cooperation (SAARC) (with the exception of Pakistan) have contributed $18.3 million to 'SAARC' Emergency Response Fund for COVID-19. Leaders have met for the second time over a video-conference on March 26 to discuss creating an integrated surveillance portal and coordination of research [103].

India first announced to provide USD $10 million to the fund and Bangladesh has announced to provide USD $1.5 million (Press Trust of India, 2020b). Sri Lanka pledged USD $5 million in contribution to the SAARC' Emergency Response Fund for COVID-19 [104]. Nepal has pledged USD $1 million while Bhutan has pledged USD $100,000 [105]. Afghanistan and Maldives said they will be contributing USD $1 million and USD $2,00,000, respectively, to the 'SAARC' Emergency Response Fund for COVID-19 [106].

The national leaders also proposed collective ways to combat the pandemic. For instance, Afghanistan suggested adopting a shared telemedicine framework to provide health care to remote areas. The Maldives called for closer cooperation among national health emergency agencies and a long-term economic recovery

plan for the region. The Prime Minister of Bangladesh expressed her interest to share its abilities and experiences with SAARC member countries to conquer the outbreak and proposed to establish an institute in Bangladesh to counter any challenges to human health throughout the South Asian community [107]. Pakistan offered to hold a SAARC health ministers' video-conference to enhance cooperation and proposed establishing a working group of national authorities to exchange information and data in real time. Sri Lanka reiterated the need to work together, create social awareness, and have one central depository to disseminate information (Fruman & Kau, 2020). Prime Minister Lotay Tshering from Bhutan encouraged all SAARC member states to seek unity. He also emphasized the significance of combined efforts among south Asian nations in sharing medical facilities [108].

Discussion and Conclusion

Sharing a common regional space laid the base of SAARC to work for the crises of its member countries by increasing regional cooperation and integrity. Correspondingly, the common parameters of these countries like geographical conditions, meteorological aspects and the population perspective put the SAARC countries on a common platform to combat COVID-19. The significance of this collaborative approach of combating strategy by sharing experiences and abilities to support the health sector and to recover the economical growth was also the highlight of the video conferences held by the leaders of its member states. So, this comparative review evaluated different aspects of COVID-19 in these countries beginning from the first patients detected in each country to comprehend the origin of the outbreak and the immediate response of each country to the action plans devised so far.

Although the airport screening followed by mandated quarantine of the individuals coming from abroad or later closing borders with affected countries especially China were implied almost at the beginning of this year in each of the countries, the first identified cases in countries had the history of traveling China, Iran and Italy. The transmission status of SAARC showed that some countries were better in controlling the transmission compared to other countries resulting in a lower number of cases and deaths. Besides, the medical facilities were crucial in controlling the transmission and case numbers, while the high-income countries like the Maldives and Sri Lanka had better medical facilities including a comparatively higher number of hospital beds per 1000 and physician density possibly leading to the lower death and infection rate in those countries. Conversely, the middle-income countries like Nepal and Bhutan showed quite an efficiency in containing COVID-19. Specifically, Bhutan, despite being landlocked between the world's most populous nations, India and China, the latter where the virus originated, has done exceptionally well with no reported COVID-19 related death case. Many Bhutanese students returned home from highly infected countries ahead of national lockdown and that was matched with Bhutan's potential exposure, to COVID-19, by the high risk of the virus spreading within borders due to sharing border with China. Besides, the country has a shortage of doctors along with ICU and laboratory experts which posed greater threat and outpouring concerns. But Bhutan was fast in its reaction and planning, which led to contact tracing and testing of individuals coming in contact with the first identified cases, although wide scale lockdown was avoided. Eventually, the evidence-based approach of testing, effective quarantine and border control made Bhutan an outlier in the fight against COVID-19 among SAARC countries by successful clinical management with limited resources and preventing the overburdening of the hospital patients.

On the other hand, the rise in case of numbers due to lack of preparation to tackle such pandemic was not uncommon in the SAARC countries. But it was equally true that the economically unprivileged majority of the population along with high population density made maintaining social distance and lockdown challenging in countries like Bangladesh, Afghanistan and Pakistan. Besides, using less commonly understood terms of nonpharmaceutical interventions like lockdown and quarantine was reported to hamper the understanding of the common people in Bangladesh implementing more difficult [109]. The lack of previous experience of such pandemic in these countries might also have partially contributed to this less prepared state and the

lack of farsightedness [110].

However, as of 10th May, the number of deaths per million people is lower in SAARC countries compared to the rest of the world. Besides, the number of confirmed cases strikingly deviated from the predicted models even though the social distancing was not maintained as strictly as in other developed countries with minimal resources challenging the implementation of the necessary mitigation measures [13,111,112]. Although this might show a sign of success, different studies performing statistical analyses found that less number of tests performed in the SAARC countries could be a major cause behind this phenomenon [113–115]. On this note, the number of false negative tests due to manifolds lacking in the health systems, sample transportation, and molecular experience might be impediment towards a precise result [116,117]. Besides, the RT-PCR assay cannot always give accurate results. On the other hand, fear of being socially stigmatized and marginalized was evident, which might have interrupted the medical attention-seeking decision in this pandemic as it did during the previous outbreaks[118,119]. Besides, the death surveillance systems in SAARC countries may not be well equipped to reliably ascertain COVID-19 deaths. The demographic properties such as median age of the population might also have played a role, like Africa, the continent with the lowest median age (18) in the world, has the lowest number of recorded COVID-19 deaths, compared to other regions. Likewise, Italy has the highest median age (45.5) of its population in Europe and had the worst COVID-19 hit, while the SAARC countries have the population age distribution being more skewed to the young population with a median age varying between 18.90 to 32.8 [120,121]. During the summer period, relatively warm temperature, humidity and UV index might have also contributed to the slow progression of the infection. Moreover, less population density in rural areas, longer daylight exposed immunity, certain food habits, and fresh air circulations and ventilation perhaps contribute to restricting the infection, or at least the fatality, up to a certain level in SAARC countries[111].

However, based on the current review, it is evident that the countries that were better able to constrain COVID-19, did implement non-pharmaceutical interventions perfectly with proper management rather than a unique approach of treatment. So, to the best of our understanding, the quarantine steps that should have been taken immediately in the highest risk region after the identification of the first case for better containment. The government needs to work with public health colleagues to ensure that population-based interventions — including social distancing, quarantine, and isolation actions should have been taken promptly and prudently in order to flatten the epidemic curve. Besides, further investments need to be made for increasing treatment facilities and research to develop vaccines directed for this region. The healthcare professionals who are working in the foremost stage should get proper training as well as equipment including PPE. Most importantly, the learning and experiences from this pandemic should be considered as a ground for devising proper and prompt plans to combat future pandemics in SAARC countries.

Authors' Contribution

MUSS, ASMRUA, NNR, MK and MKSS participated in primary drafting of the manuscript. MUSS, MK, MHI, AR and AK collected and analysed data. MUSS, ASRU and NNR prepared the final draft which was critically reviewed by RSMS, MAK, MAM, AR and AK. MUSS, AR and AK designed and supervised the whole study.

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Competing interest statement

The authors declare no conflict of interest.

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