JIDC | THE JOURNAL OF INFECTION IN DEVELOPING COUNTRIES

Coronavirus Pandemic

A comprehensive design for prevention and management of COVID-19 in a tertiary medical institution in Bangladesh

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Abstract

Introduction: Containment of the further spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection and reducing fatality due to coronavirus disease 19 (COVID-19) represent a pressing challenge to global health services. Here, we present a management blueprint for both the containment of SARS-CoV-2 and treatment of COVID-19 through a comprehensive approach.

Methodology: A cohort of 130 consecutive patients identified as positive for SARS-CoV-2 by testing of nasal swab by polymerase chain reaction were managed at a peripheral city of Bangladesh between 1 April and 31 May, 2020. Based on their clinical status, 64 of them were initially selected for isolation (Isolation Group) and 66 recommended for hospitalization (Hospital Group) as per the direction of the "Central COVID-19 Control" Center. Both groups of patients were allocated to receive standard of care management and oxygen inhalation, and intensive care unit management as and when necessary. Based on the conditions of the COVID-19 patients, there was an active system of patients being transferred from the "Isolation Group" to "Hospital Group" and *vice versa*.

Results: Twelve patients of the "Isolation Group" were transferred to the hospital, as they exhibited symptoms of deterioration. Four patients of the "Hospital Group" died during the observation period of two months in the intensive care unit. However, there has been no fatality among the patients of the "Isolation Group".

Conclusions: The concept of "Isolation" and "Hospital Management" with the participation of the community seems to be an effective management strategy for COVID-19 in developing countries.

Key words: SARS-CoV-2; COVID-19; Bangladesh; central control room; prevention and therapy; integrated approach.

J Infect Dev Ctries 2022; 16(8):1252-1257. doi:10.3855/jidc.13729

(Received 20 August 2020 – Accepted 11 March 2021)

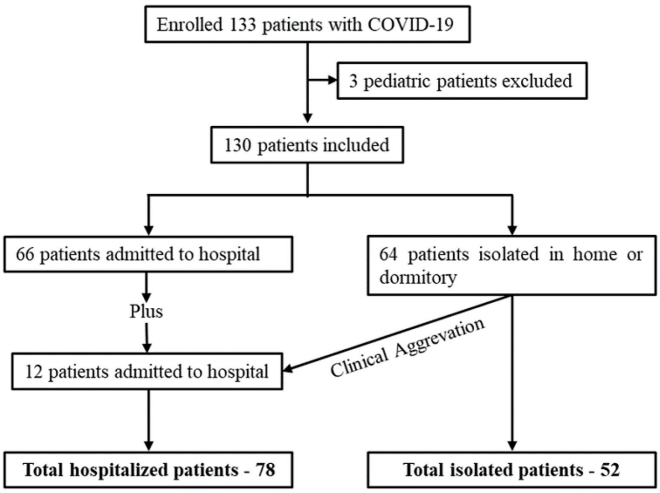
Introduction

On 31 December 2019, a cluster of pneumonia cases of unknown origin was reported in China. These cases were later identified as having been caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1,2]. Eventually, SARS-CoV-2-induced disease was designated as coronavirus disease 2019 (COVID-19) and declared to be a pandemic by the World Health Organization (WHO) on 11 March 2020. As of 7 August 2020, about 20 million cases of COVID-19 and around 0.8 million COVID-19-related deaths have been reported globally [3]. SARS-CoV-2 virus is highly infectious, and the infection is characterized by diverse types of epidemiological features, virologic characteristics, clinical presentations, and complications [4]. On the one hand, COVID-19 patients

may be completely asymptomatic or may have mild flu-like symptoms; on the other, SARS-CoV-2 may cause severe complications like respiratory distress and pneumonia [5,6]. Recent investigations show that SARS-CoV-2 infection may be related to the development of serious damages to various vital organs, in addition to the bronchial and pulmonary systems [7-9]. In view of all these evolving insights about SARS-CoV-2/COVID-19, globally, the primary challenge faced by health professionals and policy makers constitutes reducing the propagation of SARS-CoV-2 infection and proper management of COVID-19 patients. Bangladesh, a South Asian country of 164 million people, is a developing and resource-constrained and has encountered more than 270,000 patients with COVID-19 from 8 March 2020, with more than 3,500 deaths as of 10 August 2020 [10]. The numbers of both confirmed cases and deaths reveal a rising trend. To contain the spread of SARS-CoV-2, different public health measures have been adopted in Bangladesh, including: (i) lock-down of cities and localities at local and national levels, (ii) closure of institutions and business facilities, (iii) reduction of congregation of people in industrial belts, and other national and international approaches. On the technical side, the numbers of testing and diagnosis by PCR methodology have increased.

Under these circumstances, the primary objective of this study is to assess whether the propagation of SARS-CoV-2 infection and treatment of COVID-19 patients can be addressed simultaneously in a comprehensive manner. The study has been carried out at Mymensingh, 150 km from Dhaka, the capital of Bangladesh. To achieve this goal, we took advantage of the working strategy of the "Central COVID-19 Management Center", a venture of the Government of Bangladesh, mostly using the existing health care delivery systems.

Figure 1. Diagram showing the management strategy of 130 SARS-CoV-2 patients.



Methodology

General

This retrospective study is observational and assessed how containment of SARS-CoV-2 infection and management of COVID-19 patients can be accomplished simultaneously. The strategy and the activities of the respective branches of service delivery were approved by the Government of Bangladesh and optimized by Mymensingh Medical College Hospital, Mymensingh, Bangladesh. The Ethics Committee of the hospital permitted the study. Informed consent was also obtained from the patients.

Study Design

A total 130 adult SARS-CoV-2-positive patients (confirmed by polymerase chain reaction--PCR- of nasal swab) attending "Central COVID-19 Management Center" of Mymensingh were enrolled in the study. The study was conducted between 1 April and 31 May 2020. Patients enrolled up to 31 May 2020 were finally analyzed.

The patients were selected for entry into either the Isolation Group or the Hospitalized Group with their oral and informed consent, based on their clinical condition. Initially, 64 SARS-CoV-2-positive patients were enrolled in the "Isolation Group" and the remaining 66 SARS-CoV-2-psoitive patients were admitted to SK hospital (COVID-19-earmarked unit of Mymensingh Medical College Hospital) as the "Hospitalized Group". After the commencement of the study, 12 SARS-CoV-2-positive patients of the "Isolation Group" were transferred to the hospital, as they showed progressive diseases and severe illness, increasing the total patients in the "Hospitalized Group" to 78 (Figure 1). Although mutual transfer of patients between "Isolation Group" and "Hospitalized Group" took place as and when necessary as a part of preventive and therapeutic strategy, the comparative analysis of different symptoms and signs was done between 78 patients of the "Hospitalized group" (66 initial members plus 12 transferred from the Isolation Group) and 52 Patients of the "Isolation Group (64 patients initial minus 12 moved to the "Hospitalized Group") (Figure 1).

The patients of the "Isolation Group" were advised to be under isolation for two weeks. The nature of isolation was variable; some were recommended home isolation, while others were managed at dormitories and

government isolation centers. All the patients of the "Hospitalized Group" were admitted to the hospital. Patients of both the groups were properly monitored using various approaches like direct observation and tele-medicine. All of them received standard of care (SoC) as and when necessary, including anti-pyretic drugs for reducing fever, antihistamines for alleviating cough and Azithromycin (500 mg/day). Azithromycin was selected for its antiviral and anti-inflammatory properties and its wide use in COVID-19 patients with profound safety and moderate efficacy [11-13]. Further, patients of the "Hospitalized Group" received oxygen and management at the intensive care unit (ICU) as per the decision of the attending physicians. The criteria for discharge were negativity of SARS-CoV-2 in two consecutive testings three days apart and improvement of presenting symptoms.

Assessment of various parameters

The diagnosis of SARS-CoV-2 and assessment of all parameters of generalized markers and specific illnesses were accomplished by the standard methodology of the Medical College Hospital of Mymensingh. These included estimations of complete blood count, checking for liver and kidney functions, assessment of C-reactive protein, X-ray chest, computed tomography, and other investigations necessitated by the patients' condition.

Statistical analysis

The data have been shown as mean and standard deviation, as well as median and range. Categorical variables are shown as frequencies and percentages and continuous variables as mean-standard deviation (median and range). The continuous variables were analyzed with the ANOVA F-test and categorical variables with the chi-square test. All calculations were performed using SAS, version 9.4 (Cary, NC, USA). A p value of less than 0.05 (two-tailed) was regarded as statistically significant.

Results

The patients of the "Isolation Group" and "Hospitalized Group" complained of cough, headache,

Table 1. Profiles of SARS-CoV-2-positive patients. Data of Age, Body temperature, Heart rate, Respiratory rate, and Oxygen saturation are shown as mean - standard deviation (median and range). Other values are number and parenthesis indicates % of the group.

Variables		Total patients	Hospital patients	Isolation patients	*p* value
Number of patients		130	78	52	
Characteristics of patients					
Age, years		37.18 - 10.11 (35; 18–70)	37.32 - 11.39 (35; 21–70)	36.98 - 7.92 (35; 18–55)	0.481
Age group	18 – 50	122 (94)	72 (92)	50 (96)	0.209
	≥ 51	8 (6)	6 (8)	2(4)	0.024
Gender	Female	62 (48)	29 (37)	33 (64)	
	Male	68 (52)	49 (63)	19 (37)	
Comorbidities and preexisting conditions					
Hypertension		17 (13)	11 (14)	6 (12)	
Diabetes Mellitus		18 (14)	14 (18)	4 (8)	
Chronic obstructive pulmonary disease		8 (6)	6 (8)	2 (4)	
Hyperlipidemia		8 (6)	7 (9)	1 (2)	
Asthma		13 (10)	12 (15)	1 (2)	
Inhaler using		13 (10)	12 (15)	1 (2)	
Currently smoking		24 (19)	20 (26)	4 (8)	
Exposure to COVID-19 patients		61 (45)	28 (36)	33 (64)	
Presenting symptoms					
Cough		92 (71)	62 (80)	30 (58)	
Headache		53 (41)	29 (37)	24 (46)	
Sore throat		24 (19)	21 (27)	3 (6)	
Breathing difficulty		31 (24)	27 (35)	4 (8)	
Loose motion		13 (10)	12 (15)	1 (2)	
Anosmia		9 (7)	7 (9)	2 (4)	
Body temperature – °C		100.2-1.6 (101; 98–103)	100.8-1.5 (101; 98–103)	99.4-1.6 (99; 98–103)	0.000
≤ 37.4		53 (41)	21 (27)	32 (62)	0.009
≥ 37.5		77 (59)	49 (74)	26 (50)	0.134
Heart rate – beats/min		91 - 7 (94; 70–99)	92 - 6 (94; 75–99)	89 - 9 (93; 70–99)	0.006
Respiratory rate – breaths/min		24 - 3 (24; 18–31)	25 - 3 (25; 20–31)	24 - 2 (24; 18–31)	0.002
Oxygen saturation – %		97 - 3 (98; 81–100)	96 -4 (97; 81–100)	98 - 2 (98; 96–100)	0.000
≤ 94		11 (6)	11 (10)	0 (0)	

sore throat, breathing difficulty, and anosmia in different degrees. Further, some patients of both the groups had a history of previous illnesses like hypertension, diabetes mellitus, chronic obstructive pulmonary disease, asthma, and hyperlipidemia. About 20% of the patients were smokers. The presenting symptoms and pre-existing diseases were seen in both the groups; however, these were more frequent and aggravated in patients of the "Hospitalized Group", compared to the "Isolation Group" (Table 1).

There was a predominance of male patients in the "Hospitalized Group", whereas females were more among the patients of the "Isolation Group". History of contact with SARS-CoV-2 patients was found mostly among patients of the "Isolation Group" (63%) (Table1).

The duration of hospital stays varied highly, with some patients discharged from hospital after a day following admission, mainly due to a fatal outcome. One patient died after one day, two patients after two days and one after four days. Similar diversities were seen regarding the hospital stay of the surviving patients. Nineteen patients were discharged within 10 days of admission and forty-five patients after 20 days, while two patients had to remain in hospital for more than 30 days. Twenty patients exhibited improvement in their symptoms and remained almost disease-free, but negativity of SARS-CoV-2 required comparatively longer. Body temperature, heart rate, and respiratory rate were significantly higher among patients of the "Hospitalized Group", vis-à-vis those of the "Isolated Group" (Table 1). The levels of oxygen saturation were also lower in the hospitalized patients, the minimum being 81%. Most of the hospitalized patients required oxygen therapy (76%).

The management strategy of the patients is shown in Table 2. The Hospitalized patients were treated with antipyretic drugs, antihistamines and antibiotics. Oxygen inhalation was recommended by the attending physician. Some patients were also moved to ICU for better management.

Discussion

People of both developed and developing countries have been equally affected by SARS-CoV-2. The disease originated in China, with many of its neighboring countries encountering thousands cases of COVID-19 by February and March 2020. By that time, substantial numbers of patients were found in the Islamic Republic of Iran, followed by the spread of the COVID-19 pandemic in Europe and then USA. At present, COVID-19 patients have been detected in 215 countries.

All countries have adopted systems for containment of SARS-CoV-2 and treatment of COVID-19 patients, depending on their individual resources and limitations. While hospital-based therapy with the usage of antiviral drugs has been adopted in Europe and USA [14,15], countries like Japan have placed utmost importance on tracing of infection at community levels and management of patients at the hospital, with emphasis on lung function cases [16].

At the center of this management system, the Central Control Room for COVID-19 played the most crucial role. Suspected patients were subjected to the PCR method using nasal swab for confirmation. The physicians and health professionals in charge of the Central Control Room advised the SARS-CoV-2-positive patients about the nature of the management strategy. Internal migration of patients between "Isolation Center" and "Hospital Admission" groups

Table 2. Treatments for and the clinical outcomes of patients with COVID-19. Data of Amount of oxygen inhaled, SARS-CoV-2 positivity to negativity, Duration of ICU stay, and Duration of hospital stay are shown as mean - standard deviation (median and range). Other values are number and in parenthesis indicates percentage of the group.

Variables	Total patients (n = 130)	Hospital patients (n = 78)	Isolation patients (n = 52)
Diagnosis and treatments			
Antipyretic drug	80 (62)	61 (78)	19 (37)
Antihistamine drug	92 (71)	62 (80)	30 (58)
Antibiotic (azithromycin)	130 (100)	78 (100)	52 (100)
Oxygen inhalation	59 (45)	59 (76)	
Amount of oxygen inhaled – Litter/minute		3.6 - 2.2 (3; 1–12)	
Intensive care unit (ICU)	8 (6)	8 (10)	
Duration of ICU stay – day		3.0 - 1.6 (3; 1–6)	
Duration of hospital stay – day	13.3 - 6.5 (13; 1–37)	13.3 - 6.5 (13; 1–37)	
Clinical outcomes– no (%)			
Remained in hospital or isolation	10 (8)	6 (8)	4 (8)
Discharged	116 (89)	68 (87)	48 (92)
Died	4 (3)	4 (5)	0 (0)

remained as part of this integrated management strategy.

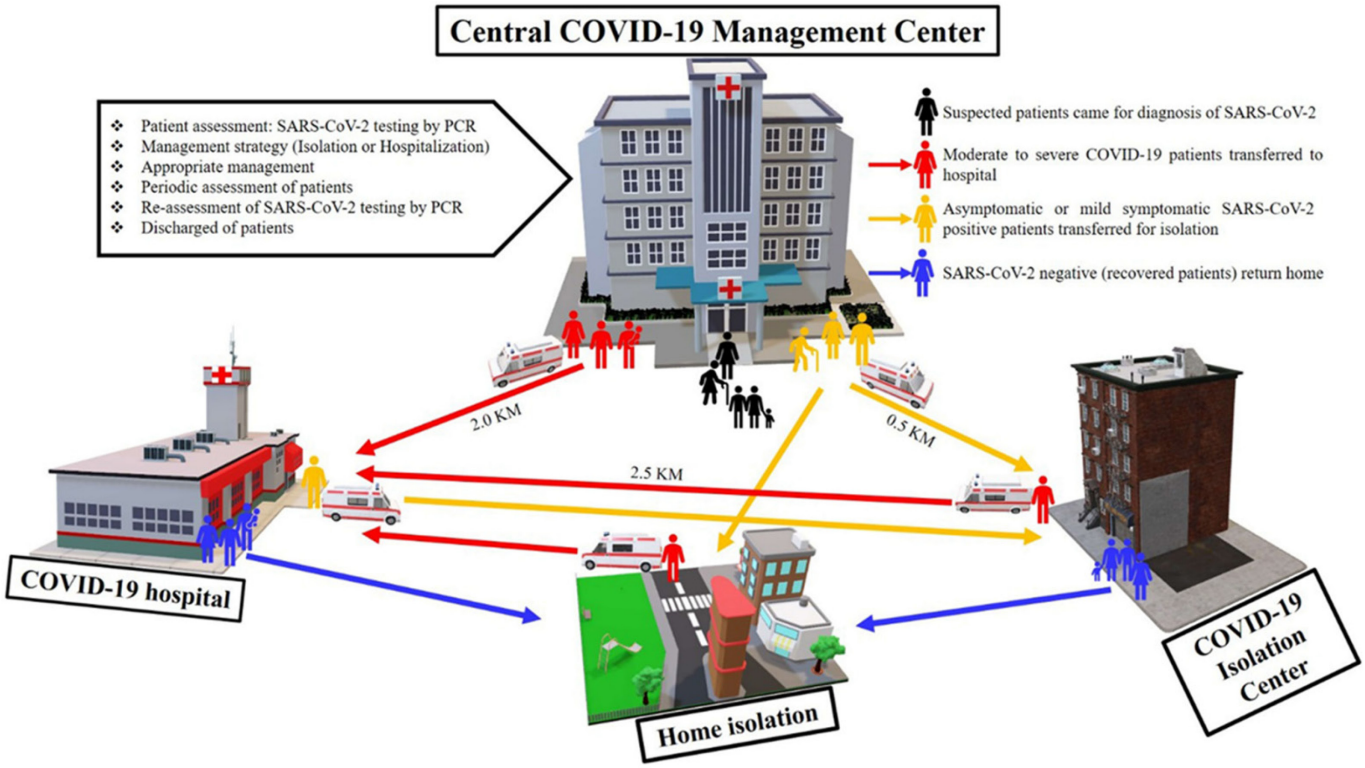
An assessment of the overall outcome of this management strategy reveals that four out of 130 patients with COVID-19 expired, all of them in the ICU and all members of the "Hospitalized Group". As of 10 August 2020, about 260,000 Bangladeshis have been found to be positive for SARS-CoV-2, 3,500 of whom have died [10]. Although the case fatality rate in our set-up is higher than the general rate, this may be acceptable, as considerable numbers of severe cases, including patients requiring ICU accommodation, formed part of this study. Moreover, compared to the fatality rates of Western countries and Europe, the rate in Bangladesh is extremely low [16-18]. The causes underlying the high mortality of Western countries and low mortality of Bangladeshi patients are not comparable, as there are limited insights about the viral genome and viral mutations and host immunity among countries of these regions. Also, the nature of pathogenesis of SARS-CoV-2 is still poorly understood and there remain diverse opinions regarding the pathogenic potentiality of the virus in different regions. Further, several protective factors of the host may be relevant to this conception.

However, this is a practical approach for Bangladesh and possibly for many developing countries that share similar socio-economic conditions. The most notable contribution of this study is its design for providing both preventive and therapeutic measures simultaneously (Figure 2). The overall data indicate that with proper diagnosis, subsequent isolation, requisite hospitalization, periodic checkup and assessment, final evaluation of negativity of SARS-CoV-2 can be ensured, as shown in Figure 2.

The isolation unit and the hospital that admitted COVID-19 patients were of small to moderate size. The isolation center was capable of hosting 80 patients and the COVID-19 unit of the hospital had only 77 beds with seven ICU facilities. Due to proper coordination and constant transfer of patients between the Isolation Unit and Hospital, at the peak of admission, we were able keep about one-third of the hospital beds free for tackling any emergency. Further, only four of the seven ICU beds were occupied at their most congested time. Currently, the numbers of COVID-19 patients are on the rise in Bangladesh, India and other Asian and Latin American countries. The present model of patient management may be relevant in those areas as well.

The present study has several limitations. The sample size is small and there has been no control group with other management strategy, which was not possible during the pandemic in Bangladesh.

Figure 2. An activity diagram of the Central COVID-19 Management Center.



Conclusions

COVID-19 has emerged in epidemic proportions in Bangladesh, a country with 164 million people, 285,201 confirmed Covid patients and 3,781 deaths (as of 20 August 2020). The study conducted in Bangladesh with a comprehensive approach of prevention and management of COVID-19 is objective-oriented and may be relevant in other developing countries of similar social, economic and cultural backgrounds.

Acknowledgements

We would like to thank Masud Rabbani for his technical support.

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Conflict of interests: No conflict of interests is declared.