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RESEARCH PAPER

Service Availability and Readiness Assessment of COVID-19 Disease Management at Different Tiers of Health Service Delivery in Bangladesh

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Abstract

Background: The world is passing through a hard time due to the highly infectious COVID-19 pandemic. Like other countries in the world, the Bangladesh government has taken various preventive measures. As part of this, the availability and readiness of different health facilities is crucial.

Objective: The study aimed to assess availability and readiness based on logistics, workforce, clinical management, and IPC.

Methods: A cross-sectional quantitative study was conducted from August 20 to September 30, 2021, which comprised a health facility survey with a sample of 210. The health facilities included all three tiers of hospitals, covering 24 districts of eight divisions. All COVID-19 dedicated hospitals were included in this survey. The questionnaire consisted of a standard checklist developed by WHO, DGHS, and CDC.

Results: The overall scores for ICU, HDU, and ventilation service were 76.8%, 87.5%, and 85.7%, respectively, but they were almost missing in Upazila health complex and below the average in non-dedicated hospitals. All (100%) secondary and tertiary level hospitals had a 24-hour staffed emergency unit, with dedicated hospitals outperforming non-dedicated hospitals (99.2% vs 98.7%). Above 90% of hospitals in different tiers had hand hygiene supplies and respiratory hygiene supplies for staff and patients, 98% of the primary level hospitals displayed instructions on hand and respiratory hygiene practices. On the other hand, 94.9% of secondary level hospitals had clearly identified and separated COVID-19 isolation areas from non-COVID-19 areas; 82.1% of secondary level hospitals had service providers (MOs) who used PPE; 97.4% had routine cleaning and disinfection of ambulances done according to IPC guidelines; and 64.1% had staff of laboratory, laundry, food services, and waste management teams who used appropriate PPE. Secondary level hospitals had a better availability of PPE compared to primary and tertiary level hospitals, which consisted of protective gowns (87.8%), disposable latex gloves (examination) (92.5%), goggles, protective (82.9%), face shields (72.5%), respirator masks (N95 or FFP2) (75.0%), and masks, medical/surgical (97.6%) available for all health service providers. Almost 26.2% facility have PCR testing lab and almost all (96.7%) the facilities have specimen collection system in their facility.

Conclusion: The service availability and readiness regarding COVID-19 among different tiers of health facilities in Bangladesh are not adequate. We need more support for disease detection capacities through provision of technical expertise, laboratory equipment and increase capacity of the secondary and primary health care tier along with national capacity for covid-19 testing.

Keywords: COVID-19, Service availability, Readiness, Health facility, Bangladesh

Introduction

The coronavirus disease 2019 (COVID-19) pandemic caused by a novel coronavirus (2019-nCoV) originated in Wuhan, Hubei province, China at the end of 2019, which has gained intense attention globally.[1,2] COVID-19 is a highly transmittable viral infection caused by a novel strain of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[3] The World Health Organization (WHO) revealed the appearance of the novel coronavirus (2019-nCoV) on January 30, 2020, as a Public Health Emergency of International Concern (PHEIC) because of the mysterious character of the coronavirus (SARS CoV-2), frequent mutation, and

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ability of getting back with new strength.[4] In Bangladesh, the first case of COVID-19 was officially recorded on March 8, 2020,[5] and since then the total number of confirmed cases spiked swiftly and approximately 1,969,361 cases have been confirmed with a death toll of 29,145 till date.[6]

So, dealing with this virus was undoubtedly a daunting task for most countries in the world, including Bangladesh. Initially, the country adopted several non-therapeutic measures in the absence of vaccine and treatment to flatten the curve of the infection and death rates, which included (a) declaring a mass lockdown and a public holiday (started from 26 March and ended on 31 June); (b) risk zone-based lockdowns (started from 9 June); (c) limited working hours (started from 31 May); and (d) maintaining social isolation protocol and restricting population movement through travel bans (started from 26 March and ended on 31 May).[7,8] However, during the first few months of the COVID-19 pandemic in Bangladesh, there were disruptions in health service delivery across the country; limited availability of isolation facilities; and apparent inadequate preparedness of hospitals to respond to the outbreak.[5]

Pandemic preparedness, be it related to the health system or readiness assessment, is fundamental for country-level response to COVID-19 addressed by WHO guidelines and assessing the readiness of health facilities is a vital element of epidemic preparedness. Despite widespread concerns about the vulnerability of low-income nations' health systems, Bangladesh has minimal facility-level assessments of critical care capability like many other low-income developing countries. Thus, research on service availability and preparedness related to COVID-19 has significant public health policy implications, as preparedness is the key to navigating any public health crisis.[9] A study conducted in Bangladesh shows that the country severely lacked pandemic preparedness in its health and governance systems. This study reported that lack of preparedness was due to the "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."[10] had increased the country's epidemiologic vulnerability.

However, no study directly accessed the readiness of hospitals to respond to the COVID-19 pandemic on a national scale. Inadequate readiness of hospitals to respond to the COVID-19 pandemic may lead to inadvertent exposure of healthcare workers, poor outcomes among hospitalized patients, and disruption of routine delivery of essential health services. Therefore, this study assessed the service availability and readiness of different tiers of health facilities for COVID-19 response as per the national preparedness plan and explored the performance of both the public health system in terms of public health response, psychosocial support, quality of care, IPC, and clinical care services. The study helped to generate evidence on the gaps in preparation and management of COVID-19 that will guide the government to prepare for subsequent waves of the pandemic and respond accordingly.

Methods

Study design and setting: A cross-sectional quantitative study was conducted from August 20 to September 30, 2021, which comprised a health facility survey with a sample of 210. The health facilities included all three types of hospitals, covering 24 districts of eight divisions. All COVID-19 dedicated hospitals were included in this survey. Multistage sampling design was adopted for facility survey. The sample health facilities were taken by three health tiers (primary 98, secondary 42, and tertiary 70), nature of COVID-19 service (dedicated 133 and non-dedicated 77), and divisions (see Table 1).

The government health facility is categorized into three tiers, namely primary, secondary and tertiary. Though private clinic and hospital were not graded as per health service tier, this study categorized private clinic and hospitals having inpatients service and surgical facility as secondary tier facility and medical college hospitals and specialized hospitals as tertiary tier hospitals.

Data collection procedure: A total of 210 health facilities agreed to participate in the study. Information on hospital characteristics, such as availability of beds, isolation units, intensive care units (ICU), ventilators, and a specialist COVID-19-related health workforce, was obtained using a structured questionnaire. Data on hospital readiness was obtained using a modified WHO COVID-19 hospital readiness checklist (interim version February 2020).

Table I: The distribution of health facility by division

Division	Heath facility tiers			Covid-19 Service facility		Total
	Primary	Secondary	Tertiary	Dedicated	Non-Dedicated	
Barisal	8	2	1	3	8	11
Chattogram	21	13	4	29	9	**38**
Dhaka	19	18	46	56	27	**83**
Khulna	17	3	3	8	15	**23**
Mymensingh	9	0	1	3	7	**10**
Rajshahi	12	2	3	12	5	**17**
Rangpur	9	1	4	8	6	**14**
Sylhet	5	1	8	14	0	**14**
Overall	**98**	**42**	**70**	**133**	**77**	**210**

Study instruments: For data collection a standardized tool was developed after an extensive review of the previous articles and a checklist and standard questionnaire were developed for assessment of health facility. These were first prepared in English and then translated into Bengali before deployment in the field. Once translated, the questionnaires/guidelines were pre-tested to gather feedback about understandability, timing and consistency of the questions. The checklist and questionnaire were pre-tested in one of the COVID-19 treatment centers and this health facility was excluded from participating in the survey. All guidelines were finalized after necessary modifications based on the findings from the pretest and feedback from technical committee of BMRC. The questionnaire was a structured questionnaire that included COVID-19 service availability, COVID-19 service readiness and PHC service specific readiness of the facility. Rapid Hospital Readiness checklist, National Health Facility Preparedness & Readiness Rapid Assessment Checklist for COVID-19 in Bangladesh, and Facility Readiness Assessment for Corona Virus Disease 2019 (COVID-19): Infection Prevention and Control Considerations in Non-US Healthcare Settings were adopted to meet WHO standard for facility assessment questionnaire.

Ethical Approval: The study was approved by the National Ethical Review Committee (NERC) of the Bangladesh Medical Research Council (BMRC). Participation in this survey was entirely voluntary, and no incentives were provided to the health facility authority.

Statistical analysis: A data analysis strategy was prepared in alignment with the research objectives and expected outcomes. Data from each center was entered, cleaned, aggregated, and analyzed using Microsoft Excel software. Research teams in each hospital ensured that all responses in the checklist and questionnaire were answered before data entry to avoid missing data. The quantitative analysis was conducted using SPSS version 25 software. Responses were separated to facilitate comparative analysis by facility type for the facility assessment survey. Descriptive statistics were computed for continuous variables and presented using the median (range), while frequencies and proportions were generated for categorical variables. Results were presented using tables and charts. We considered a p-value of 0.05 or lower to indicate a statistically significant difference.

Results

A total of 210 facilities were selected of which 98 at primary, 42 secondary and 70 tertiary levels hospitals from 8 Divisions of the country. Public & private health care facilities as well as COVID dedicated & non-dedicated facilities were included in the study. Among 210 facilities, 133 were COVID-19 dedicated hospitals and 77 were non-dedicated hospitals.

Provision of COVID-19 services: All (100%) secondary and tertiary level hospitals had a 24-hour staffed emergency unit, with dedicated hospitals outperforming non-dedicated hospitals (99.2% vs 98.7%) (see Table 2). However, 84.6% of tertiary hospitals had ambulance service, which was lower than primary and secondary

level hospitals. Among the hospital tiers, radiology and imaging services were found lower in primary health care facilities compared to secondary and tertiary levels. Statistically significant differences in services were found among different tiers of hospitals in terms of radiology and imaging facilities, isolation centers, HDU beds, ICU and ventilation. On the other hand, ICU and ventilation services were found to be significantly different in the case of dedicated and non-dedicated hospitals. Also, inpatient (indoor) service, emergency service, and provision of essential drugs were available in facilities that provided dedicated services for COVID-19.

Overall, 36.5% of the total beds were allocated for COVID-19 services, and in the case of ICU beds, HDU beds, ICU equivalent high flow nasal canola beds, and central oxygen beds, the percentages of allocated facilities were 69.7%, 81.1%, 49.3%, and 47.8%, respectively (see Table 3). If we consider the allocation of hospital resources in terms of hospital tiers overall, secondary hospitals hold the highest place. In terms of ICU beds, tertiary hospitals allocated about 64% of the available capacity. Secondary hospitals allocated 85.6% and 95.5% of the available ICU and HDU beds for COVID-19 health facilities. However, in the case of HDU beds and ICU equivalent high flow nasal canola beds, non-dedicated hospitals were allocated more facilities than dedicated hospitals.

Available equipment: Almost all equipment in tertiary level hospitals were functional in more than 95% of cases, but this is not the case in primary and secondary level hospitals (see Table 4); in primary level hospitals, X-ray, portable X-ray, and portable ultrasonogram machines were not functional in nearly 50% of cases. More than 90% of dedicated and non-dedicated hospitals had operational Patient Monitoring

Table II: Service provision by health care tier, hospital management, and COVID-19 Service.

Service Type	Service Component	Hospital Tier			Nature of Hospital Service		Overall
		Primary (n=98)	Secondary (n=42)	Tertiary (n=70)	Dedicated (n=133)	Non-dedicated (n=77)	
		Percentage (%)					
24-hour service	24 hour staffed emergency unit	99.0	100.0	100.0	99.2	98.7	99.5
	Ambulance service	94.9	100.0	84.6	96.2	93.5	95.2
	Provision of essential drugs	99.0	100.0	98.6	99.2	98.7	99.0
	Accessible Treatment (Referral)	96.9	95.2	91.4	94.7	94.8	94.8
	Lab facility (pathology)	91.8	100.0	98.6	95.5	96.1	95.7
	Radiology and imaging facility *	74.5	97.6	98.6	90.2	81.8	87.1
COVID-19 specific service	Service point for COVID-19 patient	98.0	97.6	97.1	98.5	96.1	97.6
	Isolation center *	72.4	97.6	95.7	88.7	79.2	85.2
	HDU bed a *	-	61.9	85.7	79.4	60.0	76.8
	ICU a, *,¥	-	71.4	97.1	91.8	60.0	87.5
	Ventilation a, *,¥	-	71.4	94.3	89.7	60.0	85.7
	Oxygen supply system b	100.0	100.0	100.0	100.0	100.0	100.0
	Health education & counseling for COVID-19	99.0	97.6	97.1	97.7	98.7	98.1

Note: [a] *Primary level healthcare (UHC, n=98) excluded as it does not have mandate to have HDU, ICU, and Ventilation Services;* [b] *Oxygen supply system: Central line or Oxygen cylinder.*

* Significant (p-value <0.05) for Hospital Tier; ¥ Significant (p-value <0.05) for Nature of Hospital Service

Table III: Percentage of bed capacity of the facility allocated for COVID-19 services

	Allocated beds for COVID-19 services				
	COVID-19 declared bed	*ICU bed*	*HDU bed*	*ICU equivalent High flow nasal canola bed*	*Central oxygen bed*
	Percentage				
Hospital Tier					
Primary (n=98)	37.1		100.0	75.0	70.59
Secondary (n=42)	46.2	85.6	95.5	94.6	56.50
Tertiary (n=70)	34.0	63.3	72.0	39.3	43.78
Nature of Hospital Service					
COVID-19 dedicated (n=133)	38.5	73.6	82.0	49.1	49.18
Non-dedicated (n=77)	24.4	37.3	86.7	75.0	31.70
Overall (n=210)	**36.5**	**69.7**	**81.1**	**49.3**	**47.48**

Table IV: Functional equipment's of the facility by hospital type, hospital tier and nature of hospital service

Equipment type		Hospital tier			Nature of hospital service	
		Primary [n=98]	*Secondary [n=42]*	*Tertiary [n=70]*	*Dedicated [n=133]*	*Non dedicated [n=77]*
		percentage				
Patient Monitoring	Pulse oximeters	95.4	97.1	97.9	96.3	97.1
	Digital thermometer *,¥	95.3	99.8	99.3	97.2	98.7
	Electronic drop counter *,¥	90.0	97.4	99.3	98.9	90.0
	Suction devices	92.7	96.7	97.4	96.9	91.8
	Resuscitator*,¥	100.0	99.5	97.9	98.3	100.0
Diagnosis equipment	X-Ray*,¥	52.5	74.9	90.9	77.8	56.8
	Portable X-ray*,¥	52.4	89.6	89.9	84.9	85.0
	ECG*	72.8	87.1	93.7	85.7	77.5
	Ultrasonogram*,¥	58.6	86.8	91.5	85.4	61.2
	Portable Ultrasonogram*,¥	50.0	93.3	99.6	95.8	85.7
	CT scan*,¥	100.0	95.0	91.2	93.3	85.0
	Biochemistry analyzer*,¥	73.9	92.3	96.2	93.7	73.1
Case management	Ventilator for ICU*,¥	-	95.4	97.3	96.4	100.0
	Non-invasive ventilator (HFNC) *,¥	100.0	94.2	95.1	95.7	91.7
	Oxygen concentrator*	95.3	99.2	98.6	97.5	96.1
	Filled oxygen cylinder	97.8	95.9	98.2	97.5	97.5
	Nasal oxygen cannula*,¥	97.9	97.9	98.3	98.2	97.8
	Bag valve mask	98.0	99.2	99.3	98.9	98.2

Note: * Significant (p-value <0.05) for Hospital Tier; ¥ Significant (p-value <0.05) for Nature of Hospital Service

and Case Management equipment. In terms of patient monitoring equipment, significant differences were found in availability among hospital tiers and nature of hospital service, except for pulse oximeters and suction devices, whereas significant differences were found in diagnostic equipment among hospital tiers and nature of hospital service.

Readiness of clinical management for COVID-19: Most of the hospitals (above 90%), irrespective of primary, secondary, and tertiary level hospitals, had the National COVID-19 Case Management Guideline at their workplace, monitored all vital signs for the admitted patients, and had the practice of maintaining national protocols for patient admission, referral, and discharge of SARI patients (see Table 5). It has been found that the availability of liquefied oxygen systems [oxygen cylinders] and oxygen manifold systems was very low in primary hospitals compared to the other tiers, which were 65.3% and 19.4%, respectively. An oxygen manifold system was found in most of the tertiary level hospitals (74.3%), whereas the lowest was found in primary level hospitals. Moreover, a significant difference was found in the availability of oxygen manifold systems in terms of hospital tier and nature of hospital service. Although mental and psychosocial counseling were considered the most important services during the pandemic, secondary hospitals provided mental and psychosocial counseling to 61.9% of admitted patients, which was the lowest percentage compared to other tiers. It is also found that most hospitals (above 80%) in terms of different tiers and COVID-19 services provided nutritious foods for their admitted patients.

Triage and first contact at health facility: Above 90% of hospitals in different tiers had hand hygiene supplies and respiratory hygiene supplies for staff and patients (see Table 6). The table also reveals that the majority of tertiary hospitals had designated separate areas for individuals having flu-like symptoms, whereas only 74.5% and 71.4% of primary and secondary hospitals had these types of facilities. It was also found that among different service components, hospitals in all the three tiers incurred the lowest percentages for maintaining 3ft interval reception and general-waiting rooms for patients, and the percentages were 32.7% and 33.7% for primary hospitals; 38.1% and 35.7% for secondary hospitals; and 57.1% and 58.6% for tertiary hospitals. These

Table V: Readiness of clinical management for COVID-19 by hospital tier, hospital types and nature of hospital service

Clinical management	Hospital Tier			Nature of hospital service		Overall
	Primary (n=98)	Secondary (n=42)	Tertiary (n=70)	Dedicated (n=133)	Non-dedicated (n=77)	
	Percentage					
National COVID-19 Case Management Guideline	93.9	92.9	97.1	96.2	92.2	94.8
Liquefied Oxygen System [Oxygen cylinder] *	65.3	71.4	85.7	75.2	70.1	73.3
Oxygen Manifold system *,¥	19.4	54.8	74.3	58.6	20.8	44.8
Patient admission, referral, and discharge of SARI patients are done by following national protocols	99.0	97.6	98.6	99.2	97.4	98.6
Mental and psychosocial counseling received by admitted patient	70.4	61.9	78.6	69.2	75.3	71.4
All vital signs monitored for the admitted patients	95.9	97.6	100.0	97.7	97.4	97.6
Nutritious foods for the admitted patients	88.8	88.1	88.6	91.0	84.4	88.6

Note: * Significant (p-value <0.05) for Hospital Tier; ¥ Significant (p-value <0.05) for Nature of Hospital Service

Table VI: Triage and first contact at health facility by hospital tier, type, and nature of hospital service

Treatment of critical patients (Triage)	Hospital Tier			Nature of Hospital Service		Overall (n= 210)
	Primary (n=98)	Secondary (n=42)	Tertiary (n=70)	Dedicated (n=133)	Non-dedicated (n=77)	
	Percentage (%)					
Signage and flow chart (Bangla) of triage at the reception counter ¥	78.6	81.0	77.1	73.7	87.0	78.6
Availability of screening questionnaires according to the updated case definition with Health Service Provider	81.6	88.1	81.4	82.7	83.1	82.9
Hand hygiene supplies	100.0	97.6	98.6	98.5	100.0	99.0
Respiratory hygiene supplies for staff and patients	92.9	97.6	98.6	95.5	96.1	95.7
3ft interval maintained in General- Waiting room for patients	33.7	35.7	58.6	49.6	29.9	42.4
3ft interval maintained in reception for patients *,¥	32.7	38.1	57.1	50.4	27.3	41.9
Tele-triage system for triage patients before they arrive at the hospital *,¥	96.9	88.1	88.6	90.2	96.1	92.4
Designated separate area for individual having flu like symptom	74.5	71.4	91.4	79.7	79.2	79.5
Availability of Social and Behavioral Change Communication (SBCC) materials for COVID-19 *	95.9	88.1	90.0	91.7	93.5	92.4
Practice any communication measure to aware general people on COVID-19	99.0	83.3	92.9	91.0	98.7	93.8

Note: * Significant (p-value <0.05) for Hospital Tier; ¥ Significant (p-value <0.05) for Nature of Hospital Service

differences were statistically significant. Above 90% of hospitals, irrespective of dedicated or non-dedicated, had hand hygiene supplies, respiratory hygiene supplies for staff and patients, a tele-triage system for triaging patients before they arrive at the hospital, the availability of Social and Behavioral Change Communication (SBCC) materials for COVID-19 and practiced any communication measure to make general people aware of COVID-19. Approximately 83% to 80% of hospitals, whether dedicated or non-dedicated, had screening questionnaires available in accordance with the updated case definition with health service provider and designated separate area for individuals experiencing flu-like symptoms. It was also found that the 3ft interval was less maintained in the general-waiting room and reception for patients by non-dedicated hospitals (29.9% and 27.3%, respectively) compared to dedicated hospitals (49.6% and 50.4%, respectively). That difference was statistically significant.

Infection Prevention and Control (IPC) management: Considering the status of IPC practice in hospitals, overall, at the tertiary level, the status of IPC practice is better compared to the primary and secondary level hospitals **(see Table 7).** However, 97.9% of the primary level hospitals displayed instructions on hand and respiratory hygiene practices for patients and visitors. 74% of the primary level hospitals' staff of laboratory, laundry, food services, and waste management teams used appropriate PPE, which is greater than secondary level hospitals, and this difference was statistically significant. On the other hand, 94.9% of secondary level hospitals had clearly identified and separated COVID-19 isolation areas from non-COVID-19 areas; 82.1% of secondary level hospitals had service providers (MOs) who used PPE; 97.4% had routine cleaning and disinfection of ambulances done according to IPC guidelines; and 64.1% had staff of laboratory, laundry, food services, and waste management teams who used appropriate PPE; these percentages indicate that secondary level hospitals performed better than tertiary hospitals.

Most dedicated hospitals provided better services compared to non-dedicated hospitals. However, 90.1% of the dedicated hospitals provided a 1-meter distance between beds of suspected COVID-19 patients and maintained hand hygiene stations at all points of care (96.2%), which was slightly lower than non-dedicated hospitals. Dedicated hospitals had better preparation for IPC management in all components except the designated IPC focal point/person in the facility component. In the case of dedicated hospitals, 88.7%

Table VII: IPC management at different health facility

Types of services	Hospital tier			Nature of hospital service		Overall (N=210)
	Primary [n=98]	Secondary [n=42]	Tertiary [n=70]	Dedicated [n=133]	Non dedicated [n=77]	
	Percentage					
Screening of all patients and visitors at a dedicated entrance *,¥	27.1	43.6	66.7	51.9	28.8	43.6
Distancing of at least 1 meter between patients and visitors in waiting rooms and wards *,¥	32.3	46.2	62.3	53.4	30.1	45.1
Displaying instructions on hand and respiratory hygiene practices for patients and visitors	97.9	92.3	97.1	96.2	97.3	96.6
Screening and triage of patients for suspected COVID-19 using up-to-date guidelines	97.9	94.9	100.0	98.5	97.3	98.0
COVID-19 isolation areas clearly identified and divided from non-COVID-19 areas	92.7	94.9	98.6	96.2	93.2	95.1
Is a 1meter distance between beds of suspected COVID-19 patients maintained?	87.5	92.3	94.2	90.1	91.8	90.7
Designated staff entrance for screening *,¥	33.3	46.2	73.9	57.3	35.6	49.5
Hand hygiene stations at all points of care	95.8	94.9	98.6	96.2	97.3	96.6
Use of PPE by Service providers (MOs) *	83.3	82.1	95.7	87.8	86.3	87.3
Are routine cleaning and disinfection of ambulances done as per IPC guideline? *,¥	81.3	97.4	97.1	93.1	83.6	89.7
Are staffs of laboratory, laundry, food services, waste management team follow IPC guidelines? *,¥	74.0	92.3	87.0	84.7	76.7	81.9
Are staffs of laboratory, laundry, food services, waste management team use appropriate PPE? *,¥	58.3	64.1	84.1	71.8	61.6	68.1
Does the facility disposes used PPE safely?	99.0	92.9	91.4	93.2	98.7	95.2

Note: * Significant (p-value <0.05) for Hospital Tier; ¥ Significant (p-value <0.05) for Nature of Hospital Service

formed an IPC committee, 98.5% took measures for a COVID-19 safe environment, and 96.2% had IPC guidelines for COVID-19.

Availability of PPE: According to the availability of PPE on the day of data collection, secondary level hospitals had a better availability of PPE compared to primary and tertiary level hospitals. At the secondary level, hospitals had protective gowns (87.8%), disposable latex gloves (examination) (92.5%), goggles, protective (82.9%), face shields (72.5%), respirator masks (N95 or FFP2) (75.0%), and masks, medical/surgical (97.6%) available for all health service providers (see **Table 8)**. A statistically significant difference was found across hospital tiers in terms of goggles, protective face shields, and respirator masks (N95 or FFP2).

Availability of COVID-19 detection facility: All the primary level hospitals had specimen collection facility, which was greater compared to secondary and tertiary level hospitals (see Table 9). Around one-quarter (26.2%) facility had PCR testing lab and almost all (96.7%) the facility had specimen collection system in their facility. However, in terms of PCR testing, tertiary level hospitals had greater availability compared to primary and secondary level hospitals. In terms of COVID-19 dedicated service, PCR testing facility was very low in non-dedicated hospitals (7.8%) than COVID-19 dedicated hospital (36.8%). In divisional consideration, hospitals of all the divisions had specimen collection facility with an exception in Chattogram and Dhaka divisions in which around 94% hospitals had specimen collection facility but there were huge differences in PCR testing facility that was highest in hospitals in Dhaka (47.0%) division whereas Barisal, Mymensingh, Rangpur and Sylhet divisions had only one PCR machine each.

The Facilities collecting specimen needed adequate extraction kits including other safety measures for maintaining laboratory standard that are vital for test

Table VIII: Availability of PPE at Facility

PPE	Availability status	Hospital tier			Overall (N=210)
		Primary [n=98]	Secondary [n=42]	Tertiary [n=70]	
		Percentage			
Gown, protective	For all health service providers	64.9	87.8	74.3	72.6
	For limited health service providers	28.9	7.3	22.9	22.6
	Not available today	6.2	4.9	2.9	4.8
Disposable latex gloves (examination)	For all health service providers	64.9	92.5	80.0	75.0
	For limited health service providers	29.9	2.5	15.7	19.7
	Not available today	5.2	5.0	4.3	4.8
Goggles, protective *	For all health service providers	53.1	82.9	60.0	61.1
	For limited health service providers	38.5	9.8	34.3	31.3
	Not available today	8.3	7.3	5.7	7.2
Face shield*	For all health service providers	48.5	72.5	64.3	58.2
	For limited health service providers	36.1	17.5	30.0	30.3
	Not available today	15.5	10.0	5.7	11.1
Respirator masks (N95 or FFP2) *	For all health service providers	46.1	75.0	58.6	53.8
	For limited health service providers	31.5	15.0	35.7	28.4
	Not available today	22.5	10.0	4.3	13.0
Mask, medical/ surgical	For all health service providers	83.5	97.6	95.7	90.4
	For limited health service providers	13.4	2.4	2.9	7.7
	Not available today	3.1	0.0	1.4	1.9

Note: * Significant (p-value <0.05) for Hospital Tier; ¥ Significant (p-value <0.05) for Nature of Hospital Service

accuracy. For proper diagnosis, in addition to extraction kit, viral transport medium with swab and boxes for transport are equally important. If the specimen is not transported with appropriate temperature the chances of getting false, result may increase. More than 95% hospitals had extraction kit but boxes for transport was available in only 90.6% hospitals (see Figure 1).

Table IX: Availability of COVID-19 detection facility, by hospital category, hospital tier, hospital type, nature of hospital service and division

Types of hospitals	COVID-19 detection facility	
	Specimen Collection	PCR Test *,¥
	Percentage	
Hospital Tier		
Primary (n=98)	100.0	3.1
Secondary (n=42)	88.1	16.7
Tertiary (n=70)	97.1	64.3
Nature of Hospital Service		
COVID-19 dedicated (n=133)	95.5	36.8
Non-dedicated (n=77)	98.7	7.8
Division		
Barisal (n=11)	100.0	9.1
Chattogram (n=38)	94.7	13.2
Dhaka (n=83)	94.0	47.0
Khulna (n=23)	100.0	17.4
Mymensingh (n=23)	100.0	10.0
Rajshahi (n=10)	100.0	17.6
Rangpur (n=17)	100.0	7.1
Sylhet (n=14)	100.0	7.1
Overall (n=210)	**96.7**	**26.2**

Note: * Significant (p-value <0.05) for Hospital Tier; ¥ Significant (p-value <0.05) for Nature of Hospital

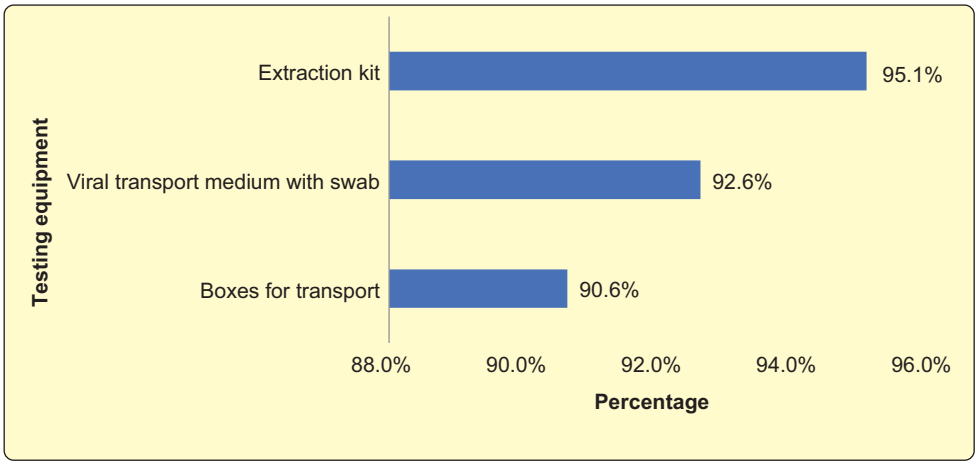

Figure 1: Availability of specimen collection (base, n =203)

Discussion

Our study findings have revealed the availability and readiness of services as well as finding gaps in infrastructure, equipment, human resources, processes, and procedures related to COVID-19 response among primary, secondary, and tertiary health facilities in Bangladesh. The present study found that almost all (100%) secondary and tertiary level hospitals had staffed emergency units, and dedicated hospitals had better provision of this service compared to non-dedicated hospitals. This finding is not surprising since COVID-19 dedicated hospitals are entitled to provide basic COVID-19 services in Bangladesh, such as isolation centers, HDU beds, ICUs, and ventilation. The DGHS MIS data shows that by the end of December 2020, almost 30 COVID-19 dedicated hospitals with 10,510 general beds and 582 ICU beds were ready for service of COVID-19 patients. Given that 80% of all COVID-19 positive patients do not require hospital care, primary care doctors can provide medical advice to patients who are under lockdown or quarantine to help them and their families manage symptoms from home, and to help them determine if and when going to a hospital is absolutely necessary.[11]

Bangladesh has a long list of successes in health in the last few decades. However, the ratio of doctors, nurses, and hospital beds is very low by WHO standards; even it is lower than neighboring countries like India, Sri Lanka, Nepal, and Bhutan; the doctor-patient ratio is only 6.73 and the nurse-patient ratio is only 3.06 to every 10,000 population. Bangladesh continues to face a shortage of 90,000 doctors, 273,000 nurses, and 455,000 technologists, according to WHO recommendations.[12] Medical facilities, such as beds, intensive care units, and ventilators, are far fewer than the required amount in both government and private hospitals.[13] There are some 1,11,413 MBBS doctors and dentists registered with the Bangladesh Medical and Dental Council (BMDC) and the doctor-patient ratio is 1.29 doctors for every 10,000 population, according to a health bulletin. As of March 31, 2019, Bangladesh has a total of 56,733 registered nurses and midwives working in different positions, including nursing superintendent, deputy nursing superintendents, nursing supervisors, senior staff nurses, and staff nurses, who are employed at different government, private, and army institutions, and NGOs.[14] Moreover, medical facilities are concentrated in urban areas that create a healthcare divide depriving rural areas.[15,16] Amid such a situation, the COVID-19 pandemic reveals many loopholes in the healthcare system that can be summarized under three themes: 1) ineffective governance and increased corruption; 2) insufficient healthcare facilities; and 3) inadequate public health communication.[13]

The training related data shows that 5100 doctors and 1700 nurses were trained on COVID-19 management and IPC.[17] With all this progress, there have been a lot of unprecedented challenges that have placed enormous strain on many health systems, regardless of geography and income level. In most low-resourced countries, like Bangladesh, healthcare systems suffer from severe shortages of financing, low equity, poor quality, and are poorly prepared to meet the challenges of the current COVID-19 pandemic. Furthermore, several research, government documents, and newspapers identified significant gaps in logistics and supplies such as the availability of skilled manpower, infrastructure, equipment, diagnosis facility, medicine, infection control equipment, identification and isolation, waste management system, and other human resources in dealing with the pandemic.[5]

The present study found that secondary level hospitals had a better availability of PPE such as protective gowns, disposable latex gloves (examination), goggles, protective face shields, respirator masks (N95 or FFP2), and masks, medical or surgical, compared to primary and tertiary level hospitals. The health care facilities in Bangladesh had a huge shortage of adequate personal protective equipment (PPE) — like masks, gloves, and gowns — as a result of health workers getting exposed to COVID-19.[18] It has also been discovered that the availability of PCR testing facilities in non-dedicated hospitals (7.8%) is significantly lower than in COVID-19 dedicated hospitals (36.8%). In divisional consideration, hospitals in all the divisions have specimen collection facilities, with an exception in the Chattogram and Dhaka divisions, in which around 94% of hospitals have specimen collection facilities. Along with this, 163 centers for COVID-19 detection testing, including 114 RT PCR labs, were prepared, whereas 2000 doctors and 4,000 nurses were recruited, and 2,654 supporting staff were procured through outsourcing.[19] Bangladesh has a severe shortage of COVID-19 testing kits. The government of Bangladesh has about 100 thousand testing kits in stock, and nearly 20 thousand have been distributed to different testing facilities around the country.[7] Because of these criticisms, the Bangladeshi government expanded its testing numbers (20) and as of July 7, 2020, the total number of testing centers has increased to 74.[21]

Conclusions

The study results revealed that the government of Bangladesh has taken quick decision and actions in response to COVID-19 pandemic and many of them worked tremendously for controlling the pandemic but there was no harmony for readiness of the tertiary, secondary and primary. It also illustrates the gaps in coordination, clinical case management, IPC and governance for management of COVID-19 pandemic in Bangladesh. It is concluded from the study results that in spite of preparation for rapid pandemic control through dedicated hospital and clinic, clinical management of COVID-19 is hampered due to lack of adequate human resources, inadequate testing facility, adequate infrastructure facility for respiratory service at peri-urban and rural level. The study findings provide the most recent and comprehensive evidence base results on the status of readiness of different tier health facilities and availability services for management of COVID-19.

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