

## Brief Research Article

# COVID-19-Hospitalized Patients in Karnataka: Survival and Stay Characteristics

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## Summary

The information on the clinical course of coronavirus disease 2019 (COVID-19) and its correlates which are essential to assess the hospital care needs of the population are currently limited. We investigated the factors associated with hospital stay and death for COVID-19 patients for the entire state of Karnataka, India. A retrospective-cohort analysis was conducted on 445 COVID-19 patients that were reported in the publicly available media-bulletin from March 9, 2020, to April 23, 2020, for the Karnataka state. This fixed cohort was followed till 14 days (May 8, 2020) for definitive outcomes (death/discharge). The median length of hospital stay was 17 days (interquartile range: 15–20) for COVID-19 patients. Having severe disease at the time of admission (adjusted-hazard-ratio: 9.3 (3.2–27.3);  $P < 0.001$ ) and being aged  $\geq 60$  years (adjusted-hazard-ratio: 11.9 (3.5–40.6);  $P < 0.001$ ) were the significant predictors of COVID-19 mortality. By moving beyond descriptive (which provide only crude information) to survival analyses, information on the local hospital-related characteristics will be crucial to model bed-occupancy demands for contingency planning during COVID-19 pandemic.

**Key words:** Bed occupancy, COVID-19, fixed cohort, hospitalization, Kaplan–Meier analysis, length of hospital stay, severe acute respiratory illness, survival

## INTRODUCTION

Coronavirus disease 2019 (COVID-19) pandemic poses a great challenge to health-care organizations and economies worldwide. As on April 23, 2020, 213 countries/territories worldwide have been affected with COVID-19 with 2,549,632 confirmed cases and 175,825 deaths.<sup>[1]</sup> At the same time, India had recorded 21,700 confirmed cases and 686 deaths.<sup>[2]</sup> As of now, there is abundant information on the descriptive statistics (confirmed cases, active cases, and death) of COVID-19 in India which provide only crude information. With the progression of global pandemic of COVID-19, the information on the duration of hospital stay and the survival of patients may be helpful in the planning of allocation of medical resources, improving treatment outcomes, and designing effective interventions.<sup>[3]</sup> However, such information for COVID-19 have not been well described in the Indian context.

With this in background, we aimed to investigate the factors associated with hospital stay and death among COVID-19 patients for the entire state of Karnataka, India. By moving beyond conventional descriptive statistics to the

survival analysis, we believe that such state-derived data on the survival and length of stay for COVID-19 will become crucial to assess the needs for health system strengthening and preparedness.

## MATERIALS AND METHODS

We conducted a retrospective cohort analysis using the record review of daily media bulletin published by the Department of Health and Family Welfare, Government of Karnataka (GoK). The media bulletin is available for general public in the official website of GoK.<sup>[4]</sup> Karnataka is a southern state in India with

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a population of 6,10,95,297 (5% of total population of India) spread across 30 districts.<sup>[5]</sup>

### Building the cohort

The cohort for our retrospective analysis included all the COVID-19-positive cases that were published in the GoK media bulletin from March 9, 2020, (first-case reporting) to April 23, 2020. Data from the media bulletin were extracted using the data abstraction form and entered into the spreadsheet which formed our cohort database. The data abstraction form was developed and standardized based on the data available from the media bulletin and expert inputs. The data abstraction form included the variables on Patient\_Id, Sex, Age, Place of hospital admission, exposure history, signs and symptoms, date of test-positivity, details, and date of outcome. Severe Acute Respiratory Illness (SARI) and Influenza-like Illness (ILI) reported in the media bulletin were defined as per the guidelines of Ministry of Health and Family Welfare, Government of India. Our fixed-cohort was followed till 14 days (May 8, 2020) for definitive outcomes (death/discharge). Those patients without definitive outcome till May 8, 2020, were right censored.

The study used the data that are available for general public, and hence, no ethical approval was sought. All the analyses were unlinked and anonymous. We also refrained from reporting any sensitive information related to COVID-19 pandemic in the state of Karnataka.

### Data analysis

Descriptive statistics were computed for demographic and clinical characteristics. The Mann-Whitney U-test was used to compare the differences in the length of hospital stay between the various groups of patients with definitive outcomes. Kaplan-Meier method was used to estimate the survival probability of COVID-19 patients at 7, 14, and 21 days. The risk factors associated with COVID-19 mortality were

assessed through the Cox-proportional hazard regression modeling using time taken for the occurrence of death as the main outcome.<sup>[6]</sup>  $P < 0.05$  was considered as statistically significant. All analyses were performed using STATA 16.1 software (StataCorp 2019, College Station, TX, USA).

## RESULTS

Of the total 445 patients of our cohort across the entire state of Karnataka, 390 (87.6%) had definitive outcomes till May 8, 2020. Majority of the patients were male (70.8%) and belonged to the age group of 21–40 years (48.3%). About 4.3% (19/445), 14.8% (66/445), and 80.0% (356/445) had experienced definitive outcome at 7, 14, and 21 days, respectively. The median number of days between the hospital admission (unpublished data) and test positivity is one with interquartile range (IQR) between 0 and 2 days.

Among those with definitive outcomes, nearly 6% had SARI at the time of admission [Table 1]. The case fatality rate was 5.1% (20/390), and the recovery rate was 94.9% (370/390). Following the test-positivity, the median length of stay among COVID-19 patients with definitive outcomes was 17 days (IQR: 15–20). COVID-19 cases with SARI at the time of admission and those with no travel history had significantly lower length of hospital stay as compared to their counterparts. There was no difference in the length of hospital stay by gender and age [Table 1]. Among those without definitive outcomes (55/445), the length of stay in the hospital following test-positivity ranged from 16 to 39 days.

The Kaplan-Meier analysis showed an overall survival rate of 95.7% at 7 days and 95.5% at 14 days. The survival probability at 21 days remained the same as 14 days. COVID-19 cases who were  $\geq 60$  years and who have presented with SARI had significantly higher risk of mortality when compared to the counterparts. However, the risk of mortality did not differ much

**Table 1: Characteristics of coronavirus disease 2019 cases by length of hospital stay, Karnataka**

Variable	Frequency	Length of Hospital Stay in days Median (IQR)	Mann-Whitney U-test	
			Z*	P
Sex				
Male	279 (71.5)	17 (15-20)	-1.58	0.113
Female	111 (28.5)	18 (15-21)		
Age (years)				
<60	325 (83.3)	17 (15-20)	1.39	0.164
≥60	65 (16.7)	17 (13-21)		
Travel history				
Absent	267 (68.5)	17 (15-20)	-2.94	0.003
Present	123 (31.5)	18 (15-21)		
Severity of symptoms <sup>†</sup>				
SARI	30 (7.7)	15.3 (3-17)	-4.11	<0.001
Others	360 (92.3)	17.5 (15-20)		
Overall <sup>‡</sup>	390 (100)	17 (15-20)		

\*Z is the normal approximation of Mann-Whitney U-test. Higher the Z value nearer to P value to 1, <sup>†</sup>SARI; others included influenza such as illness and contacts with or without symptoms., <sup>‡</sup>Overall included only those with definitive outcomes. SARI: Severe Acute Respiratory Illness, IQR: Interquartile range

among male and female COVID-19 patient. Having SARI at the time of admission (adjusted hazard-ratio: 9.3 (3.2–27.3);  $P < 0.001$ ) and being aged  $\geq 60$  years (adjusted hazard-ratio: 11.9 (3.5–40.6);  $P < 0.001$ ) were the significant predictors of mortality among COVID-19 patients [Table 2]. Age had confounding effect on the severity of symptoms and survival as Model-1 and Model-2 were compared.

## DISCUSSION

The present study is the first attempt to investigate the characteristics and correlates of hospital stay and mortality among COVID-19 for an entire state of India. It provides the valuable insights on the morbidity and mortality parameters influencing the hospital resources and needs. The study findings have the implications for health system strengthening to efficiently handle the emerging COVID-19 cases, especially during the lockdown relaxations.

Karnataka reported the first COVID-19 death for India on March 13, 2020.<sup>[4]</sup> The overall case fatality rate for our cohort with definitive outcome was 5.1%, and this was higher than the overall national figure (3.4%) as on May 8, 2020.<sup>[2]</sup> This is because some of the cases reported at the national level were still hospitalized and have not experienced any definitive outcomes.

COVID-19 patients who are  $\geq 60$  years and those with serious illness (SARI) at the time of admission were found to have poor prognosis, whereas gender had no effect on the mortality. This implies local areas and districts with more vulnerable elderly populations irrespective of the gender may require more attention and additional medical resource allocations. Thus, the requirements for hospital resources should account for elderly population in their catchment area. More importantly, the study emphasizes the need for protecting the highly vulnerable elderly population from the highly mobile younger population

with a high prevalence of COVID-19 (reverse quarantine).<sup>[7]</sup> The findings also necessitate the need for the early detection and management of COVID-19, especially among the elderly to prevent SARI for the better prognosis. This also emphasizes the need to address the stigma associated with the reporting of COVID-19 symptoms to the health facility for early detection.

The median length of stay reported in the present study was 17 days. This was higher than that reported from China (14-days) and outside China (5-days), especially when we account for time between hospital-admission and test-positivity.<sup>[8]</sup> This may be explained by the differences in early detection, severity, admission and discharge criteria, and different timing within the pandemic.<sup>[8]</sup> Nonetheless, this information on the length of hospital stay will be crucial to model bed occupancy demands for contingency planning.<sup>[9]</sup>

As far as we know, this is the first study to report on the survival of COVID-19 patient from the entire state cohort that had highest number of patients with definitive outcomes. Although there are some case series, many patients in those series remained hospitalized at the time of publication. Systematic data collection, a cohort with large data on definitive outcome and robust analyses of survival characteristics providing valid estimates on hospital stay and survival were the strength of the study.

Parsimonious modeling due to availability of limited variables from media-bulletin was one of our limitations. Refined analyses and better insights could have been possible if more nuanced information on symptoms, comorbidities, etc., were made available for public-health research. Measurement biases in our study are unlikely as the variables extracted from the media bulletin undergo an extensive quality check before its publication. Although a complete picture can be obtained at the end of epidemic, the preliminary evidences from this study will be sufficient to inform differential and coordinated state-specific response for health resource planning and

**Table 2: Predictors of mortality among coronavirus disease 2019 cases in Karnataka using multivariate cox-proportional hazard regression**

Variables	Univariate model		Multivariate Model 1*		Multivariate Model 2*		Multivariate Model 3*	
	Unadjusted hazard ratio (95% CI)	P	Adjusted hazard ratio (95% CI)	P	Adjusted hazard ratio (95% CI)	P	Adjusted hazard ratio (95% CI)	P
Sex								
Male	Reference		Reference		Reference		Reference	
Female	1.3 (0.5-3.3)	0.567	1.3 (0.5-3.2)	0.589	0.8 (0.3-2.0)	0.58	0.8 (0.3-1.9)	0.579
Severity of symptoms								
No SARI	Reference		Reference		Reference		Reference	
With SARI	28.0 (11.2-70.5)	<0.001	27.9 (11.1-70.3)	<0.001	10.2 (3.7-27.7)	<0.001	9.3 (3.2-27.3)	<0.001
Age (years)								
<60	Reference				Reference		Reference	
$\geq 60$	24.5 (8.2-73.5)	<0.001	-	-	11.3 (3.4-37.6)	<0.001	11.9 (3.5-40.6)	<0.001
Travel history								
Absent	Reference				-		Reference	
Present	0.6 (0.2-1.9)	0.419	-	-	-	-	0.8 (0.2-2.5)	0.667

\*Model 1 included sex and severity of symptoms as predictors; Model 2 included sex, severity of symptoms, and age as predictors; Model 3 included sex, severity of symptoms, age, and travel history as predictors. SARI: Severe Acute Respiratory Illness, CI: Confidence interval

resource allocation. Notwithstanding these limitations, the present study is an attempt to derive the meaningful information from the publicly available data for public health action.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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