Original Article

Predictors of Hospital Length of Stay among Hospitalized Older Patients with COVID-19

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Abstract

Background: Older patients are particularly vulnerable to COVID-19 health consequences. The rapid and widespread COVID-19 pandemic resulted in a considerable shortage in the delivery of healthcare services, including hospital beds, which more evidently affected older adults. This study aimed to estimate the hospital length of stay for older COVID-19 patients and its associated factors. **Patients and methods:** This are a retrospective analysis of hospital database of older adult patients who were hospitalized in the Geriatric Medicine isolation Hospital, Ain Shams University Hospitals, Cairo, Egypt for COVID-19. The patient's medical files were revised, and the patients' data concerning history, clinical assessment, laboratory investigations, and length of hospital stay were extracted. **Results:** This study included 301 patients who were hospitalized with COVID-19. The patient's length of hospital stay (LOS) ranged from 1 to 37 days, with a median (interquartile range) of 9 (4 - 13) and a mean of 9.79 ± 6.74. Patients with previous cerebrovascular stroke had significantly longer hospital stays (p=0.034). Similarly, patients with COPD had significantly longer hospital stays (p=0.005). Also, a statistically significant longer LOS was found in COVID-19 patients who were presented with headaches (p=0.034). A statistically significant negative correlation was found between the LOS and each of the haemoglobin levels (p=0.01) and lymphocytic count (p=0.003). While a statistically significant positive correlation was found between the LOS and each of total leukocyte count (p=0.001), neutrophilic count (p=0.005), and blood urea nitrogen (p=0.011). **Conclusion:** Pre-existing chronic obstructive pulmonary disease (COPD) and stroke, presenting with headaches, anaemia, Leucocytosis, lymphopenia, and neutrophilia, are associated with prolonged hospital stays, and could be identified as early indicators of a prolonged hospital stay.
KEYWORDS: COVID-19, older adults, length of hospital stay, predictors.

INTRODUCTION:

Since mid-December 2019, the coronavirus disease (COVID-19), caused by the newly erupted severe acute respiratory syndrome coronavirus 2 (SARS-CoV2), has impacted human health worldwide. The

disease started in China and spread worldwide as a pandemic [1].

COVID-19 is primarily a respiratory illness. It has a systemic affection with diverse health burdens that require the collaboration of nearly all healthcare specialties [2].

Older patients are particularly vulnerable to COVID-19's health consequences. Immunosenescence, which is the disruption of innate and acquired immunity, is an established feature of ageing that can affect the outcome of COVID-19 in older people [3]. Inflammaging, which is the continuous release of inflammatory mediators in the elderly, ciliary function impairment, and ciliary ultrastructural anomalies may impact the efficient clearance of SARS-CoV-2 particles, and all are contributing factors to the ageing-associated poor outcomes of the disease [3].

COVID-19 consequences have severely impacted older adults since the start of the pandemic. The majority of COVID-19-related deaths (80%), according to the Centers for Disease Control and Prevention (CDC), occurred in older adults over 65 years [4]. In addition, the rapid and widespread of COVID-19 pandemic resulted in a considerable shortage in the delivery of healthcare services, including hospital beds [5-9],

which more evidently affected older adults [10].

Therefore, it is important to determine baseline criteria and factors that affect LOS since the shortage of hospital beds may critically affect saving the lives of some patients over others [11]. Currently, there are scarce Egyptian studies assessing COVID-19-related hospital LOS. Thus, this study aimed to estimate the length of hospital stays for elderly COVID-19 patients and factors associated to it.

PATIENTS AND METHODS:

This is a retrospective analysis of hospital database of older adult patients with COVID-19, who were admitted to Geriatric medicine isolation Hospital, in Ain Shams University Hospitals, Cairo, Egypt, from the end of December 2020 to mid-June 2021. The study was approved by the institutional research ethical committee and was conducted according to the Declaration of Helsinki.

The study included older patients, fifty years and above, who were admitted to the isolation hospital with COVID-19. Diagnosis of COVID-19 was confirmed by real-time polymerase chain reaction (RT-PCR). Patients with prior advanced end-organ failure or malignancy, were excluded. Patients with missing relevant

data were also excluded. Informed consent was waivered, as data was anonymously collected from medical files. The patient's medical files were revised and the patients' data concerning history, clinical assessment, laboratory investigations, and length of hospital stay were extracted.

Study outcomes

The study outcomes were the prediction of the length of hospital stay in older patients admitted to Geriatric Medicine isolation Hospital, with COVID-19.

Statistical analysis

The collected data was revised, coded, and analysed using the statistical software SPSS (IBM Corp., Armonk, NY, USA), version 28. The Numerical data were expressed as mean, standard deviation, median, and interquartile range (IQR) according to the normality of the data. Categorical values were presented as frequencies and percentages. The independent t-test, or Mann-Whitney test, was used to compare numerical data, and the chi-square test, or Fisher's exact test, was used to compare categorical data as appropriate.

RESULTS:

This study included 301 patients hospitalized for COVID-19 at our institution. The patients' mean age was 68.96 ± 8.98 years.

Females constituted 55.5% of the patients (n=167). Most frequent presentations were; cough with 218 patients (72.4%), dyspnea in 201 patients (66.8%), anosmia in 169 patients (56.1%), and headache in 163 patients (54.2%). The patient's length of hospital stay ranged from 1 to 37 days, with a median (IQR) of 9 (4–13) and a mean of 9.79 ±6.74 days.

Results showed that patients with stroke had a significantly longer hospital stay, with a median of 10 days compared to 8 days in those without stroke (p=0.034). Also, patients with COPD had significantly longer hospital stay, with a median of 12 days compared to 8 days in non-COPD patients (p=0.005) (Table 1). Regarding the presenting symptoms in COVID-19 patients, a significantly higher length of hospital stay was found in those who presented with headache (p=0.034) (Table 2).

No statistically significant correlation was found between age and LOS (p=0.0602).

Analysis of the laboratory data in COVID-19 patients revealed a statistically significant negative correlation between the length of hospital stay and each of haemoglobin level (p=0.01) and lymphocytic count (p=0.003). Also, a statistically significant positive correlation was found between the length of hospital stay and each of total leucocyte count (p=0.001), neutrophilic

count (p=0.005), and blood urea nitrogen (p=0.011) (Table 3).

DISCUSSION:

It has been shown that older patients with COVID-19 have severe clinical behavior and are more likely to progress toward ARDS [12]. Adults over 65 are more susceptible to the pandemic's effects and have a greater chance of developing severe conditions, with a subsequent longer hospital stay and poor outcome [13].

The precise estimation of LOS would help to understand the impact of COVID-19 on hospital capacity and the approximate bed requirements. In this study, the median hospital LOS was 9 days, and the mean was 9.79 days. This is close to the data of Rosenthal et al. [14], Teich et al. [15], and Oksuz et al. [16], who reported mean LOS of 9.89, 9, and 9.1 days, respectively, in older adults with COVID-19.

However, widely variable ranges were also reported and documented in the meta-analysis of Alimohamadi et al. [17] and were found to range from 4 to 56 days. This variation is likely attributable to the difference in baseline patients' characteristics and disease severity.

This retrospective analysis of Peng et al. [18] that encompassed a cohort of 123 individuals who had been diagnosed with severe COVID-19 and aimed to compare the clinical characteristics of younger and older patients. Notably, the study's findings revealed that elderly patients had a longer duration of illness prior to being admitted to the hospital in comparison to their younger counterparts. Moreover, older patients also experienced an extended length of hospital stay. These findings substantiate the clinical significance of assessing the predictors of longer stay in elderly patients.

Multiple organs, including the kidney, heart, lungs, brain, and blood, are susceptible to COVID-19. Thus, it may result in the failure of multiple organs [19], which may prolong the hospital stay. To determine the predictors of LOS, we should consider indicators from a variety of patients' characteristics.

The present study demonstrated that presence of old cerebrovascular stroke was significantly associated with LOS prolongation. Likewise, the study of Alwafi et al. observed that pre-existing cerebrovascular events carry a high risk of a longer hospital stay [20]. The baseline presence of COPD was also found as a predictor of increased LOS in our study. Similar data were described previously in the work done by Alwafi et al. and Alqahtani et al. [20,21]. The association between COPD and a prolonged LOS is explainable, given these patients' impaired

lung functions and associated comorbid conditions [22]. In addition, a higher incidence and severity of hypoxia could lead to a poorer outcome that might prolong the LOS [23].

This study showed that patients presented with headache had significantly prolonged LOS. A plausible explanation is that headaches are one of the neurological symptoms reported in infected individuals. Patients experiencing neurological symptoms may require specialized care and monitoring, leading to a longer hospital stay. Also, patients who present with headaches alongside COVID-19 may have underlying health conditions that complicate their recovery and necessitate prolonged hospitalization [24].

The current work revealed that LOS prolongation was associated with presence of anemia, leukocytosis, lymphopenia, and neutrophilia. A plausible explanation is that the severe infection and long bedridden states lead to the dysregulation of cascade system homeostasis by inflammatory cytokine activation [25]. In congruence with our results, the meta-analysis of Wu et al. (2020) reported a significant association of leukocytosis with the poor outcome of COVID-19 [23]. Similarly, Urra et al. (2020) reported that patients with neutrophilia had a poor disease prognosis [26]. Neutrophilia and lymphopenia were found to be associated with more severe diseases in the study of Elshazli et al. (2020) [27]. Our study was substantiated by Bellmann-Weiler et al. [28] and Alwafi et al. [20], who described anemia, Leucocytosis, neutrophilia, and lymphopenia to predict a long hospital stay.

A typical biomarker for renal function and hypovolemia is blood urea nitrogen, which results from the metabolism of protein [29]. This study revealed a significantly positive correlation between LOS and BUN levels (p = 0.011). Similarly, many studies have linked COVID-19 patients' long hospitalizations to increased BUN levels [20,30-32].

Despite the concern about the current status of COVID-19 as a pandemic and its potential impact on the relevance of our study, we believe that our study still holds significant value for several reasons. First, even though COVID-19 might not be classified as a pandemic anymore, it is important to recognize that the virus and its effects are far from being completely eliminated. There are still cases and potential for resurgences, and understanding the factors influencing the length of hospital stays for elderly patients remains pertinent in managing the healthcare resources effectively. Second, the insights gained from our study

can continue to inform healthcare providers, policymakers, and researchers about strategies to optimize hospital stays and resource allocation. Hospitals and healthcare systems can utilize this information to enhance patient care, streamline resource utilization, and make evidence-based decisions. Additionally, the factors associated with hospital stays identified in our study might have relevance beyond the context of a pandemic. Understanding how various factors impact the length of hospital stays in a specific demographic (elderly patients) could potentially apply to other infectious diseases, respiratory illnesses, or healthcare settings. The present study had some limitation including the retrospective design, the relatively small sample size, the absence of electronic medical records for full data and the future prospects such as using artificial intelligence for better prediction of LOS and outcomes. However, the results of the present work provide data that would help with the early stratification of such a particularly vulnerable group of patients to enable a proper triage of COVID-19 patients.

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CONCLUSION:

Older adults hospitalized with COVID-19 had a LOS of 1-37 days. Pre-existing COPD and stroke, presenting with headaches, and suffering anemia, leukocytosis, lymphopenia, and/or neutrophilia, could be identified as associated factors that can be used to suspect prolonged hospital stay in COVID-19 older adults' patients.

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Table 1: Patients hospital length of stay in relation to sex and co-morbidities.

		Length of hospital stay in days	Mann Whitney test		
		Median (IQR)	z	p-Value	Sig.
Sex	Male	9 (5 -13)	-1.332	0.183	NS
	Female	8 (4 - 13)			
Congestive HF	No	8 (4 - 13)	-0.901	0.368	NS
	Yes	10 (5 - 15)			
Stroke	No	8 (4 - 13)	-2.123	0.034*	**S**
	Yes	10 (8 - 15)			
DM	No	9 (4 - 13)	-0.679	0.497	NS
	Yes	8 (4 - 12)			
Hypertension	No	8 (4 - 12)	-1.667	0.096	NS
	Yes	9 (5 - 14)			
ISHD	No	8.5 (4 - 13)	-0.615	0.538	NS
	Yes	9 (5 - 15)			
CKD	No	9 (4 - 13)	-0.524	0.600	NS
	Yes	8 (5 - 15)			
Chronic Liver disease	No	8 (4 - 13)	-0.939	0.348	NS
	Yes	9 (7 - 14)			

			z	p	Sig.
COPD	No	8 (4 - 12)	-2.821	0.005*	**S**
	Yes	12 (8 - 17)			
Bronchial Asthma	No	9 (4 - 13)	-0.363	0.717	NS
	Yes	9.5 (5 - 15)			
Dementia	No	9 (5 - 13)	-1.464	0.143	NS
	Yes	6.5 (4 - 12)			

z: Mann-Whitney test.

COPD: Chronic Pulmonary Obstructive Pulmonary Disease, CKD: Chronic Kidney Disease, ISHD: Ischemic Heart Disease, DM: Diabetes, HF: Heart Failure.

Table 2: Patients hospital length of stay in relation to clinical presentation.

		Length of hospital stay in days	Mann Whitney test		
		Median (IQR)	z	p-Value	Sig.
Cough	No	9 (4 - 13)	-0.062	0.950	NS
	Yes	9 (4.5 - 13)			
Dyspnea	No	9 (5 - 13)	-0.875	0.381	NS
	Yes	8 (4 - 12)			
Fever	No	8 (5 - 13)	-0.191	0.849	NS
	Yes	10 (4 - 13)			
Myalgia	No	8 (4 - 13)	-1.618	0.106	NS
	Yes	10 (5 - 13)			
Diarrhea	No	8 (4 - 13)	-0.444	0.657	NS
	Yes	9 (5 - 13)			
Headache	No	8 (4 - 12)	-2.118	0.034*	**S**
	Yes	10 (5 - 13)			
Delirium	No	9 (5 - 13)	-0.967	0.334	NS
	Yes	8 (4 - 12)			
Evidence of thrombosis	No	9 (5 - 13)	-1.240	0.215	NS
	Yes	7.5 (3 - 13)			
Functional decline	No	8 (4.5 - 13.5)	-0.196	0.845	NS
	Yes	9 (4 - 13)			
Anosmia	No	7.5 (4 - 12)	-1.453	0.146	NS
	Yes	9 (5 - 13)			
Anorexia	No	8 (4 - 13)	-1.244	0.214	NS
	Yes	10 (5 - 13)			

z: Mann-Whitney test.

Table 3: Correlation between patients hospital length of stay and laboratory parameters.

	Length of hospital stay in days		
	Spearman's rho	p-Value	Sig.
Age	-0.030	0.602	NS
Hb level	-0.148	0.010	**S**
Leucocytic count	0.195	0.001	**S**
Lymphocytic count	-0.171	0.003	**S**
Platelet count	-0.012	0.843	NS
Neutrophilic count	0.161	0.005	**S**
Serum ferritin	0.033	0.597	NS
D-dimer	-0.008	0.895	NS
CRP	-0.093	0.116	NS
LDH	0.034	0.598	NS
Serum creatinine	-0.072	0.210	NS
BUN	0.146	0.011	**S**
ALT	-0.023	0.690	NS
AST	-0.026	0.654	NS
Na+	-0.023	0.690	NS
Procalcitonin	-0.073	0.335	NS

HB: Hemoglobin level, CRP: C-Reactive Protein; LDH: Lactate Dehydrogenase; BUN: Blood Urea Nitrogen; AST: Aspartam Transaminase; ALT: Alanine transaminase; Na: Sodium.