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Factors associated with prolonged length of hospital stay among COVID-19 cases admitted to the largest treatment center in Eastern Ethiopia

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Abstract

Introduction: The hospital admissions load and how long each patient will stay in the hospital should be known to prevent the overwhelming of the health system during coronavirus disease 2019 era. Even though the length of hospital stay could vary due to different factors, the factors that affect the stay are not well characterized yet, particularly in the resource-limited settings. Knowing the time spent by the coronavirus disease 2019 patients in the hospital and its associated factors are important to prioritize mobilizing resources, such as beds, pharmacological and non-pharmacological supplies, and health personnel. Therefore, this study was intended to determine the median and identify factors associated with the length of hospital stay among coronavirus disease 2019 cases.

Methods: A facility-based cross-sectional study design was implemented on 394 randomly selected hospitalized patients. Epidata Version 3.1 software was used for data entry, and further analysis was done using Stata version 14.2 software. Frequencies, median with interquartile range, and chi-square test were performed. A logistic regression model was used to identify the association between outcome and explanatory variables. The statistical significance was declared at *p*-value of less than 0.05 at 95% confidence interval.

Results: The analysis was done for a total of 394 cases admitted for coronavirus disease 2019. The median age of the study participants was 40 years with interquartile range of 28–60 years. The median length of hospital stay was 12 days with the interquartile range of 8–17 days. The patients presented with shortness of breathing (AOR = 2.74, 95% confidence interval: 1.33–5.66), incident organ failure (AOR = 3.65, 95% confidence interval: 1.15–11.58), increased leukocyte count (AOR = 0.95; 95% confidence interval: 0.91–0.99), and blood urea nitrogen (AOR = 0.98, 95% confidence interval: 0.97–0.99) had a significant association with prolonged hospital stay.

Conclusion: This study demonstrated that the proportion of patients stayed above the median hospital stay of the total patients was 185 (46.9%) with the median length of 12 (interquartile range = 8–17) days. Patients presented with difficulty of breathing, had incident organ failure, had decreased leukocyte, and blood urea nitrogen level should be estimated to stay longer in the hospital. Hence, patients with prolonged hospital length of stay associating factors should be expected to consume more pharmacological and non-pharmacological resources during hospital care receiving.

Keywords
Hospital length of stay, factors, coronavirus, SARS-CoV-2, Ethiopia

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Introduction

The coronavirus disease 2019 (COVID-19) pandemic has negatively impacted the globe causing loss of human life and also imposed a burden to the healthcare system. Healthcare systems are being challenged by the surge of COVID-19 cases as it spreads throughout the world.[1–5] As experienced in most of the European countries where their health systems

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are well established and well equipped, a rampant increase in COVID-19 cases seeking admission that caused overwhelming of healthcare services.[6] This increases a serious tension over the possible impact on resource-limited health setups in low- and middle-income nations. Information about hospital bed demand, adequacy of staff, or medical supplies-related requirements provides an input for planning and proactive preparation.[6,7] Forecasting demand for patient care involves estimating the volume of patients requiring hospital admissions and how long each person will stay in the hospital. Coronavirus cases present with different levels of clinical stages. Patient's hospital stay could vary from general ward care to high dependency units with oxygen support to intensive care units where the patients may be intubated for mechanical ventilation.[7,8]

Average hospital stay period for admitted COVID-19 cases varies across countries. For instance, meta-analysis study that included 52 studies revealed the average time of hospital stay from China was 14 days and 5 days outside of China.[9] Average hospital length of stay is affected by age, seriousness of illness, patient to healthcare workers ratio, hospital size, and treatment outcome at discharge.[9,10] The length of stay is likely to rely on the extent of the care required and the geographic variation due to differences in COVID-19 care guidelines.[9]

In countries, such as Ethiopia, where the bed to population ratio and staff to patient ratio are significantly low, evidences about length of stay in the hospital are helpful for anticipating the need and allocation of scarce resources to those who are in need. However, to date, there is dearth of literatures on the mean hospital stay and its determinants among COVID-19 patients in Ethiopia. Hence, this study was intended to determine the median and identify factors associated with length of hospital stay among COVID-19 cases, with the demographic characteristics of COVID-19 cases, underlying comorbidities and other factors among COVID-19 cases admitted in Hiwot Fana Specialized Comprehensive Hospital, Eastern Ethiopia.

Materials and methods

Study setting, period, and design

A facility-based cross-sectional study design was implemented in Harari region, Ethiopia. The region is found 522 km away from the capital city of Ethiopia (Addis Ababa) due east. In the region there are two public hospitals (Hiwot Fana Specialized University Hospital and Jogul general Hospital), one Federal Police Hospital, one Fistula center, private hospitals, and eight health centers. Hiwot Fana Specialized University Hospital is tertiary referral and teaching hospital in eastern part of Ethiopia. The hospital receives referrals from Harari region, Eastern Oromia, Somali region, and Dire Dawa City administration. During this pandemic, the hospital is among 10 treatment centers designated by the Ethiopian government to manage the COVID-19 cases in Eastern Ethiopia. Therefore, the hospital has been serving as COVID-19 treatment center in the eastern part of Ethiopia, where it serves more than 6 million populations in the catchment areas.

Study population and eligibility criteria

The source of population was COVID-19-infected people who admitted to Hiwot Fana Hospital, and the study population was COVID-19 cases admitted to Hiwot Fana Hospital from 10 August 2020 to 10 August 2021.

Sample size calculation and sampling procedure

The sample size was determined using single population since there was no prior information about the proportion (p) of prolonged hospital stay in the study setting. Thus, 50% proportion was taken with the estimation of type I error of 0.05 with 95% level of confidence. The sample size was estimated to be 384. Then after, 5% of the sample size was added by considering the likelihood of medical chart incompleteness for the variable of interest. Finally, the sample was determined to be 403.

Measurements and variables in the study

Prolonged length of hospital stay was considered as an outcome variable in the study. It was dichotomized (yes/no) based on the median value of length of hospital stay. The patients who stayed in the hospital beyond or equal to median length of stay rendered as "prolonged," while the patients who spent in the hospital less than the median length of hospital stay rendered "not prolonged."

The explanatory variables are sociodemographic characteristics, such as sex, age, marital status, occupation, residence, clinical factors, such as comorbid conditions (hypertension, diabetes, cardiovascular disease, kidney diseases, lung diseases, asthma, cancer, and liver diseases), COVID-19 clinical characteristics, COVID-19 clinical stage, use of ventilators, COVID-19 clinical management, cough, fever headache, discharge status, and laboratory findings. In addition, risky behavioral predictors, such as history of alcohol and current smoking status, were considered.

COVID-19 case was diagnosed as the case having a SARS-COV-2 positive result from swabs obtained from oropharyngeal using reverse transcriptase polymerase chain reaction (RT-PCR). The radiological and imaging investigations were used based on the clinical decision-making of physicians. The length of hospital stay was measured as the total number of days that patients spent in the hospital wards from the date of admission to the date of hospital discharge/death.[11]

Clinical stages of COVID-19 are defined as follows:[12] ***an asymptomatic COVID-19 case is defined as a*** person

who tested positive for SARS-CoV-2 using a PCR but who have no symptoms that are consistent with COVID-19. ***Mild Illness*** *of COVID-19 case is* people who have any of the various SARS-COV-2 signs and symptoms of COVID-19 except shortness of breath, dyspnea, and abnormal chest imaging. ***Moderate Illness*** *of COVID-19 case* is people with the evidence of lower respiratory disease during clinical assessment or imaging and who have oxygen saturation (SpO_2) ⩾ 94% on room air at sea level. ***Severe Illness*** *of COVID-19 case is people* who have $SpO_2 < 94\%$ on room air at sea level, a ratio of arterial partial pressure of oxygen to fraction of inspired oxygen (PaO_2/FiO_2) < 300 mmHg, respiratory frequency > 30 breaths/min, or lung infiltrates > 50%. ***Critical Illness*** *of COVID-19 case is people* who have respiratory failure, septic shock, and/or multiple organ dysfunctions.

Data collection tools and procedures

Data collection checklist was prepared by the researchers after conducting literatures review of relevant studies.[9,13,14] The checklist comprised sociodemographic characteristics, clinical factors, laboratory findings, and behavioral factors. Data were retrospectively extracted from the patients' medical records by five BSc health professionals. Two public health professionals supervised the data collection. Before data collection, they took 2 days of training on the objective and relevance. Before actual data collection, 5% of the sample size was pre-tested on the patients admitted before 10 August 2020 at Hiwot Fana Specialized University Hospital. The collected data were checked for consistency and double entered to assure the data quality.

Statistical analysis

The data were coded, recoded, and entered into Epidata Version 3.1 and analyzed by Stata Version 14. Descriptive statistics, such as frequency, percentage, mean with standard deviation, and median with interquartile range (IQR), were performed to characterize the study participants. Chi-square assumption was checked before statistical modeling. For each predictor variables, bivariable binary logistic regressions were fitted. The variables that had a *p*-value of less than 0.25 in the bivariable were candidate for multivariable logistic regressions model to examine their effects after adjusting for potential confounders. In the multivariable logistic regressions, predictor variables were presented using adjusted odds ratios (AORs) at 95% confidence intervals (CIs). Finally, the statistical significance was declared at *p*-value of less than 0.05.

Ethical statement

The Institutional Health Research Ethical Review Committee (IHRERC) of the College of Health and Medical Sciences of Haramaya University reviewed and approved the study protocol. As the study used secondary data, obtaining informed consent for this study was waived by the Ethical Review Committee ((Ref.no. IHRERC/018/2021). No personal identifiers, such as names, addresses, and any private information were collected. Data were handled confidentially during all phases of research activities using anonymous medical registration numbers as identification.

Table 1. Sociodemographic characteristics of COVID-19 patients in Hiwot Fana Specialized University Hospital COVID-19 treatment center, Harar, Ethiopia.

Variable	Category	Frequency	%
Sex	Male	244	61.9
	Female	150	38.1
Age of the patients (years)	Median	40 (IQR = 28–60)	
Employment status	Employed	208	52.8
	Unemployed	186	47.2
Region of residence	Harari region	225	57.1
	Oromia region	160	40.6
	Others	9	2.3
Marital status	Single	61	15.5
	Married	295	74.9
	Others	38	9.6
Current smoking status	Yes	137	65.2
	No	257	34.8
Alcohol drinking status	Yes	90	22.8
	No	304	77.2
Medication history	Yes	165	41.9
	No	229	58.1

IQR: interquartile range.

Results

Sociodemographic characteristics

Data of 403 patients who were admitted between 2020 and 2021 were collected, and records of 9 patients were excluded because their date of admission and date of discharged were not well registered. The final analysis was done on 394 patients with a response rate of 97.76%. Majority of the study participants were male 244 (61.9%). The study subjects' median age was 40 years with an IQR of 28–60 years Table 1.

COVID-19 cases clinical presentations

Of the total study participants, 307 (77.9%) and 116 (29.4%) experience cough and fever, respectively. Majority, 248 (62.9), of the study participants develop difficulty of breathing. Besides, the median temperature, respiratory rate, and SpO_2 with the IQR were 36.9 (IQR = 36.2–37.8), 28 (IQR = 24–40), 89 (IQR = 75–95), respectively, as shown in Table 2.

Table 2. Clinical, risky behavioral characteristics of COVID-19 patients in Hiwot Fana Specialized University Hospital COVID-19 treatment center, Harar, Ethiopia.

Variables	Category	Frequency	%
Cough	Yes	307	77.9
	No	87	22.1
Fever	Yes	116	29.4
	No	278	70.5
Difficulty of breathing	Yes	248	62.9
	No	146	37.1
Temperature (°C)	Median	36.9 9 (IQR = 36.2–37.8)	
Respiratory rate	Median	28 (IQR = 24–40)	
Heart rate	Median	102 (IQR = 88–119)	
SpO_2	Median	89 (IQR = 75–95	
Presenting with comorbidities	Yes	211	53.6
	No	183	46.4
Did the patient take dexamethasone?	Yes	74	18.8
	No	320	81.2
COVID-19 clinical stages	Mild	117	29.8
	Moderate	133	33.8
	Severe	58	14.8
	Critical	85	21.6
Did the patient put on mechanical ventilation?	Yes	44	11.2
	No	350	88.8
Discharge status of the patient	Died	100	25.4
	Survived	294	74.6
Laboratory findings among COVID-19 patients			
Creatinine	Median	0.91 (0.7–1.4)	
Blood urea nitrogen	Median	52 (36–62)	
Lymphocyte count	Median	15.43 (8.1–27.8)	
Neutrophil count	Median	80 (65.1–88.9)	
Leukocyte count	Median	8.8 (5.98–13.4)	
Hemoglobin count	Median	12.9 (10.9–14.6)	
Platelet count	Median	278 (201–364)	
Alanine transaminase, U/L	Median	42 (28–62.1)	
Aspartate transaminase, U/L	Median	49 (34–68)	
Erythrocyte sedimentation rate (ESR)	Median	14 (10–40)	

SpO_2: oxygen saturation: COVID-19: coronavirus disease 2019: IQR: interquartile range,

Factors associated with prolonged hospital stay

The median days of length of hospital stay was 12 days with the IQR of 8–17 days. The patients presented with shortness of breathing, incident organ failure, increased leukocyte count, and blood urea nitrogen (BUN) level had significant association with prolonged hospital stay. The odds of having a prolonged hospital stay (versus non-prolonged stay) among the patients with shortness of breathing were 2.74 times as much as that among those without the condition (AOR = 2.74, 95% CI: 1.33–5.66). COVID-19 patients who were diagnosed to have at least one of organ failure had a prolonged hospital stay 3.65 times more likely than patients who had no organ failure (AOR = 3.65, 95% CI: 1.15–11.58). A unit increase in the leukocyte count corresponded to a 5% decrease in the odds of having a prolonged stay (AOR = 0.95; 95% CI: 0.91–0.99). Odds of having an increased BUN level by one unit decrease hospital stay by 2% (AOR = 0.98, 95% CI: 0.97–0.99), Table 3.

Discussions

This study demonstrated that the median length of hospital stay was 12 days with the IQR of 8–17 days. This finding is higher than the finding from Saudi Arabia (6 days),[15] for patients not admitted to ICU in the United States (6 days),[12] and 16.4 days in the Indiana,[16] 9 days in France,[17] 7 days in Peru,[18] 8.5 days in Mediterranean,[19] and 6 days in London.[20] However, the finding was lower than the length of stay reported from China[10] (median = 19 days; (IQR): 14–23 days). The variation of hospital length of stay is expected to vary because of different reasons. These could be the type of health facilities setups across the world. For instance, the center that accommodates both critical and mild case may

Table 3. Factors associated with prolonged hospital stay among COVID-19 patients Hiwot Fana Specialized University Hospital COVID-19 treatment center, Harar, Ethiopia.

Variables	Prolonged hospital stay		COR (95% CI)	AOR (95% CI)
Employment status	Yes	No		
Unemployment	98	110	1	1
Employment status	87	99	0.98 (0.66–1.46)	1.35 (0.72–2.53)
Current smoking status				
Yes	75	62	1.6 (1.06–2.45)	1.74 (0.78–3.88)
No	110	147	1	1
Cough on admission				
Yes	153	154	1.7 (1.04–2.78)	1.40 (0.65–3.00)
No	32	55	1	1
Fever on admission				
Yes	78	38	3.28 (2.07–5.17)	1.88 (0.93–3.81)
No	107	178	1	1
Difficulty of breathing				
Yes	144	104	3.54 (2.28–5.50)	2.74 (1.33–5.66)
No	41	105	1	1
COVID-19 clinical stages				
Mild	30	87	0.15 (0.08–0.28)	0.52 (0.13–1.98)
Moderate	61	72	0.37 (0.21–0.66)	0.66 (0.22–2.01)
Severe	35	23	0.67 (0.33–1.35)	0.96 (0.34–2.70)
Critical	59	26	1	1
Comorbidities on admission				
Yes	117	94	2.1 (1.4–3.15)	0.77 (0.38–1.57)
No	68	115	1	1
Having organ failure				
Yes	42	5	11.98 (4.62–31.03)	3.65 (1.15–11.58)
No	143	204	1	1
Creatinine level			1.22 (0.98–1.53)	1.07 (0.91–1.26)
Lymphocyte count			0.97 (0.95–0.98)	0.98 (0.96–1.02)
Neutrophil count			0.98 (0.97–0.99)	0.99 (0.97–1.01)
Leukocyte count			0.91 (0.88–0.95)	0.95 (0.91–0.99)
Platelet count			0.99 (0.98–1.00)	0.99 (0.98–1.01)
Blood urea nitrogen			0.98 (0.97–0.99)	0.98 (0.97–0.99)
Hemoglobin count (g/dL)			1.6 (1.11–2.49)	1.56 (0.91–2.69)

g/dl: gram per deciliter, COR: crude odds ratio, AOR: adjusted odds ratio, CI: confidence interval.

face different length of stay due to the clinical outcome variations and the treatment they demand. In addition, there could be differences of admission and discharging criteria, and resources exist to manage the patients. Moreover, other sociodemographic characteristics, such as age, could cause the variation of hospital stay from patients to patients.[21]

Clinical characteristics manifested on admission could reveal the organ affected by the competing disease. In this study, patients who presented with difficulty of breathing stayed in the hospital longer than the patients who presented with other than shortness of breathing. Thus, the study conducted in French supported this study that presenting with dyspnea may elongate the time to discharge.[17] These type of patients might have complication related to respiratory problems,[22] such as hypoxia, and presented with lung opacity, consolidations, and effusions that affect respiratory system.[14,23–26]

COVID-19 patients who were diagnosed to have at least one of organ failure had a prolonged hospital stay 3.65 times more likely than patients who had no organ failure. The patients who presented with comorbidities, such as hypertension, diabetes, cardiovascular, and lung disease, stayed in the hospital longer than patients who had no comorbidities on admission.[27,28] This finding is aligned with the finding from Wuhan, China.[14] Organ failures could be high among risky group of patients. For instance, presenting with comorbidities, being aged, smoker, and drinking alcohol may exacerbate the probability of developing organ failure. The causes of organ failure and organ failure itself should be treated even if the patient recovered from COVID-19. Therefore, the additional management that is received by the patient to tackle the negative impact of organ failure and its underlying causes could take more time than the patients did not have.

The leukocyte count increment decreases hospital length of stay by 0.95 among COVID-19 patients. Studies showed that leukocytosis is a biomarker of COVID-19 severity clinical stages.[29–31] This could be indirectly due to increment of leukocyte aggravates the clinical outcome of the patient that results in shortening of length of stay by ending up the stay with death. Odds of having an increased BUN level by one unit decreases hospital stay by 2%. The study suggested that the increment of BUN demonstrates the severity of COVID-19 clinical stages.[32] BUN is one of the indices that may predict the patients at high risk of in-hospital mortality. Thus, an increment of BUN could increase the risk of dying from COVID-19.[20,33] Thus, this finding can be justified by the fact that increment of serum BUN predicts the severe clinical stages which may result the shortening of patient's hospital stay due to death. The limitation of this study could be the dichotomizing of continuous variable, such as length of hospital stay. The admission and discharge criteria across the world could bring a difficulty of comparing the finding with other studies conducted in another COVID-19 admitting settings.

Conclusion

This study demonstrated that the proportion of patients stayed above the median hospital stay of the total patients was 185 (46.9%) with the median length of 12 (IQR = 8–17) days. Patients who presented with difficulty of breathing, developed organ failure, and had a decreased leukocyte count and BUN level should be expected to stay longer in the hospital. Hence, patients with prolonged hospital length of stay associating factors should be expected to consume more pharmacological and non-pharmacological resources during hospital care receiving.

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Author contributions

A.B. was involved in the conception, designing, and analyzing the data; B.T.M., G.M.A., A.A, B.N., and Y.D. were involved in drafting and editing the article. Finally, all of the authors read and approved the article before submitting to the journal for publication.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

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Informed consent

Informed consent for this study was waived by the Institutional Health Research Ethical Review Committee (IHRERC) of the College of Health and Medical Sciences of Haramaya University (Reference No. IHRERC/018/2021).

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Supplemental material

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