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## Comparison of the Treatment Cost of COVID-19 and Non-COVID-19 Patients in the Intensive Care Unit

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### ABSTRACT

**Objective:** This study aimed to compare the cost of treating coronavirus disease 2019 (COVID-19) and non-COVID-19 patients in our intensive care unit (ICU).

**Materials and Methods:** Patient data such as age, gender, comorbidities, radiological findings, treatments received, length of stay in the ICU, polymerase chain reaction (PCR) test result, and invoice issued at the time of discharge were recorded. The patients were divided into two groups, including patients being treated for COVID-19 (Group 1) and those being treated for other diseases (non-COVID-19) (Group 2). The chi-square test ( $\chi^2$ ) was used to compare categorical variables. Continuous variables were compared using the Mann–Whitney U test. Spearman's correlation coefficient was used to determine the correlation between treatment cost and variables. A p-value of  $<0.05$  was considered statistically significant.

**Results:** A positive moderate statistically significant correlation was found between treatment cost and length of stay in the ICU ( $r=0.68$ ;  $p<0.001$ ).

**Conclusion:** The present study showed that the treatment cost increases with a prolonged length of stay in the ICU. In addition, it was shown that it is more expensive to treat COVID-19 patients.

**Keywords:** COVID-19, cost, intensive care unit

### INTRODUCTION

The novel coronavirus 2019 is an RNA virus from the coronavirus family that causes coronavirus disease 2019 (COVID-19), which originated in the city of Wuhan, China, and has led to an ongoing pandemic (1). It is associated with atypical symptoms similar to influenza. There is currently no vaccine or specific treatment for COVID-19. The mortality rates range from 2% to 7% (2). In addition, approximately 5% of COVID-19 cases require intensive care hospitalization (3).

The COVID-19 pandemic has also affected the economy (4, 5). Workplaces were temporarily closed, and some people lost their jobs due to the pandemic (6). Bartsch et al. (7) predicted that the median medical cost of a patient hospitalized due to COVID-19 would be \$14,366.

A review of the literature has shown that no study has investigated the cost of hospitalization for COVID-19 treatment.

Therefore, we aimed to compare the cost of treating COVID-19 and non-COVID-19 patients in our intensive care unit (ICU).

### MATERIALS and METHODS

#### Study area and study population

This retrospective study was conducted after obtaining approval from the local ethics committee (Ankara City Hospital, E1-20-916) and Ministry of Health. In addition, it was conducted in compliance with the Helsinki Declaration. We included patients who were treated in our ICU between March 11, 2019, and June 11, 2019. Patient data were retrieved from the hospital operating system. Criteria such as low saturation, change of consciousness, need for intubation and mechanical ventilation, and application of resuscitation were used in the admission of patients to intensive care. Data such as age, gender, comorbidities, symptoms of the patients when they were taken into the ICU, radiological findings, treatments received (fluid, vasopressor, hydroxychloroquine, antiviral therapy, azithromycin), length of stay in the ICU, polymerase chain reaction (PCR) test result, and invoice issued at the time of discharge were recorded. The inclusion criteria were patients being followed up at the ICU of Yenimahalle Training and Research Hospital between the specified dates and who were older than 18 years. The exclusion criteria were patients younger than 18 years.

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The patients were divided into two groups, including patients being treated for COVID-19 (Group 1) and those being treated for other diseases (sepsis, arthroplasty, diabetic ketoacidosis, chronic obstructive pulmonary disease, respiratory failure, etc.) (non-COVID-19) (Group 2). We compared the demographic characteristics and treatment costs between both groups.

Later, patients with COVID-19 were divided into two groups, including patients who died and those who were discharged, and their demographic characteristics and cost were compared.

### Statistical Analysis

Statistical analysis was performed using SPSS for Windows version 23 software. Qualitative data were expressed as percentage (%) and number (n). The distribution of continuous variables was evaluated using the Kolmogorov–Smirnov test. Quantitative data were expressed as median (interquartile range). The chi-square test ( $\chi^2$ ) was used to compare categorical variables. Continuous variables were compared using the Mann–Whitney U test. Spearman's correlation coefficient was used to investigate the correlation between patient treatment cost and other variables. A p-value of <0.05 was considered statistically significant. The power of the study was determined as 0.95.

## RESULTS

### All Patients

A total of 129 patients were treated in the ICU between the specified dates. The treatment cost of all patients hospitalized in the ICU was determined to be 18,219.57 (24,698.24) ₺. A positive moderate statistically significant correlation was found between treatment cost and length of stay in the ICU ( $r=0.681$ ;  $p<0.001$ ). There was no statistically significant correlation between treatment cost and other variables ( $p>0.05$ ).

The patients were divided into two groups, including patients being treated for COVID-19 (Group 1) and those being treated for other diseases (non-COVID-19) (Group 2) (Table 1). No statistically significant difference was noted between the groups in terms of median age and gender ( $p>0.05$ ). On the other hand, there was a statistically significant difference between the groups in terms of median cost and length of stay ( $p<0.05$ ). Both the median cost and length of stay were higher in Group 1 ( $p<0.05$ ). Moreover, a statistically significant difference was noted between the groups in terms of mortality rate ( $p<0.05$ ) (Table 1).

### COVID-19 Patients

The COVID-19 patients are summarized in Table 2. The median age of the patients who died was higher ( $p=0.02$ ), while the length of stay in the ICU of the discharged patients was longer ( $p<0.05$ ) (Table 2). The dyspnea rate was higher in patients who died ( $p<0.05$ ). The other characteristics of the patients were similar (Table 2). The most common symptom among COVID-19 patients was dyspnea (66.1%). The median cost was significantly higher in those treated with plasma and tocilizumab than those without ( $p<0.05$ ). We did not find a significant relationship between other treatments and treatment costs ( $p>0.05$ ) (Table 3). Furthermore, COVID-19 patients were divided into two subgroups, including patients who died and those

**Table 1.** Characteristics of patients according to groups

Variable	Group 1	Group 2	p
Age [median (IQR)]	67.50 (25)	73.00 (19)	0.07
Gender (n) (male/female)	39/32	30/28	0.72
Comorbidity			
DM (yes/no)	12/59	9/49	0.83
HT (yes/no)	12/49	19/39	0.83
COPD (yes/no)	12/59	12/46	0.58
Cost (₺) [median (IQR)]	28,136.93 (29,911.8)	11,049.50 (15,886.7)	<0.001
Length of stay (day)	11.50 (11)	7.50 (12)	0.018
Mortality	33/71	12/58	0.02

DM: Diabetes mellitus; HT: Hypertension; COPD: Chronic obstructive pulmonary disease; ₺: TRY; IQR: Interquartile range; Group 1: COVID-19 patients; Group 2: Other patients

**Table 2.** Characteristics of patients with COVID-19

Variable	Discharged (n=38)	Died (n=33)	p
Age [median (IQR)]	63 (23)	73 (19)	0.02
Cost (₺) [median (IQR)]	27,146.31 (34,869.5)	30,152.95 (26,404.9)	0.81
PCR (n) (positive/negative)	19/19	15/18	0.72
Gender (n) (male/female)	18/20	21/12	0.16
Comorbidity (yes/no)	22/16	26/7	0.06
Comorbidity [n (%)]			
DM	6 (15.7)	6 (18.8)	1.0
HT	6 (15.7)	6 (18.8)	1.0
COPD	6 (15.7)	6 (18.8)	1.0
Symptom [n (%)]			
Fever	25 (65.7)	18 (54.5)	0.46
Dyspnea	21 (55.2)	26 (78.7)	0.03
Cough	11 (28.9)	5 (15.1)	0.25
Thorax CT [n (%)]			
Ground-glass	35 (92.1)	29 (87.8)	0.697
Treatment [n (%)]			
Antiviral	34 (89.4)	33 (100)	0.11
Hydroxychloroquine	38 (100)	30 (90.9)	0.09
Azithromycin	35 (92.1)	29 (87.8)	0.69
Plasma	12 (31.5)	7 (21.2)	0.42
Tocilizumab	0	2 (6.06)	–
Length of stay (day) [median (IQR)]	12.5(14)	10(11)	0.002

DM: Diabetes mellitus; HT: Hypertension; COPD: Chronic obstructive pulmonary disease; ₺: TRY; IQR: Interquartile range

who were discharged. The median age of patients who died was 73 years (19), and that of patients who were discharged was 63 years (23).

**Table 3.** Cost of COVID-19 according to variable

Variable [cost (₺)]	Yes		No		p
	Cost (₺)	Median (IQR)	Cost (₺)	Median (IQR)	
Comorbidity	26,807.13	21,591.2	30,287.48	34,749.9	0.274
DM	33,885.41	29,057.9	26,203.05	30,661.5	0.063
HT	27,146.31	26,103.3	28,405.19	31,991.6	0.931
COPD	23,480.49	19,116.1	30,152.95	31,236.0	0.172
Treatment					
Favipiravir	28,591.67	30,510.2	25,292.99	27,877.1	0.318
Hydroxychloroquine	28,136.93	30,680.3	3507.00		0.074
Azithromycin	30,617.37	30,733.3	30,152.95	35,575.1	0.407
Tocilizumab	118,709.66		27,381.72	28,642.2	0.029*
Plasma	41,801.98	54,705.8	24,038.48	23,287.4	0.001*
MV	30,287.48	21,311.1	24,038.48	33,384.6	0.118
NMV	27,389.79	27,385.8	30,152.95	34,150.8	0.915
Mortality	30,152.95	26,404.9	27,146.31	34,869.5	0.811

DM: Diabetes mellitus; HT: Hypertension; COPD: Chronic obstructive pulmonary disease; ₺: TRY; IQR: Interquartile range; MV: Mechanical ventilation; NMV: Noninvasive mechanical ventilation; \*: Significantly

## DISCUSSION

It has been reported that the median age of patients with COVID-19 in intensive care was between 51 and 69 years in the literature (3, 8–15). The median age was 67.50 years in the present study with COVID-19 patients. Our results are consistent with the literature. We believe that patients in the ICU are at older ages since the elderly have poor body resistance and are vulnerable to diseases. The median age of the patients who died was greater (Table 2). A statistically significant difference was observed between age and mortality in COVID-19 patients. The increase in mortality in patients with advanced age may be attributed to the weakening of body resistance and increased immobility with age. Since patients' reserve is low, the mortality rates increase.

It has been reported in the literature that most of the patients hospitalized in the ICU due to COVID-19 were men (3, 8–12). In the present study, 54.9% of hospitalized patients were male COVID-19 patients. Our results are consistent with the literature. In the present study, no significant difference was observed between gender and mortality. The disease progressed with similar mortality rates in both genders.

The comorbidities of the patients who were discharged and those who died were similar (Table 2). The length of stay in intensive care has been reported as 9–12 days (3, 8, 9, 13). The median length of stay of our patients with COVID-19 in the ICU was 11.5 days. Our results are consistent with the literature.

A statistically significant difference was noted between the groups in terms of mortality rate. The mortality rates of our patients with COVID-19 were higher. No publications on this subject were found in the literature. The fact that most of our non-COVID-19 patients were hospitalized in intensive care for postoperative observation may be the reason for this situation. It has been reported that the median rate of mortality of patients with COVID-19 in intensive

care was between 0% and 84.6% (3, 9–14). The mortality rate of our patients with COVID-19 was 46.5%. These differences in intensive care mortality may be due to the differences in the economic status of the countries, differences in the intensive care capacity, and different times of the studies.

A review of the literature has shown that no study has been conducted to investigate the costs of ICU services provided to patients with COVID-19. The total cost of all patients hospitalized in the ICU was calculated to be 18,219.57 (24,698.24) ₺. A positive moderate statistically significant correlation was found between treatment cost and length of stay in the ICU ( $r=0.681$ ;  $p<0.001$ ). The longer the patients' stay in the ICU, the higher the treatment costs.

The results of the present study showed that the median cost of patients was 28,136.93 (29,911.8) ₺ in Group 1 and 11,049.50 (15,886.7) ₺ in Group 2 and it was more expensive to treat COVID-19 patients. Factors such as the treatments applied and the length of stay in the ICU may be effective in the higher cost in patients with COVID-19.

The median length of stay of patients who were treated in the ICU for COVID-19 was 11.50 days (11), and COVID-19 patients had a longer length of stay in the ICU than the non-COVID-19 patients. Due to the article that has been added to the Social Security Institution (SSI) Health Implementation Notification, a standard treatment fee has been determined for patients receiving treatment in the hospital for COVID-19 (15). The fees specified in this notification are as follows: 370.99 ₺ for primary intensive care, 788.36 ₺ for secondary intensive care, 1,485 ₺ for bed fee, and 1,124.35 ₺ for pandemic care service in tertiary intensive care. The most important factor determining the number of patient bills is the length of stay in the ICU. In the present study, the length of stay in the ICU ranged from 1 to 47 days. A statistically significant difference was noted between the groups in terms of length of stay (Table

1). We think that the costs of our patients in Group 1 were higher because they stayed longer in the intensive care.

We did not find any study in the literature about the effect of plasma treatment on COVID-19 cost. Plasma treatment unit cost in our country is 1,318.07 ₺ (SUT). We applied plasma therapy to 19 patients. Moreover, we did not find any study in the literature about the effect of tocilizumab treatment on COVID-19 cost. Tocilizumab treatment unit cost in our country is 2,671.25 ₺ (SUT). We applied tocilizumab therapy to two patients. We could not find a significant relationship between other treatments and costs. We think that specific treatments that are newly developed and/or require technology may increase the cost.

## CONCLUSION

In conclusion, the present study showed that treatment costs increase with a prolonged length of stay in the ICU and it is more expensive to treat COVID-19 patients than non-COVID-19 patients in the ICU.

### Limitations of the Study

Since this was a retrospective study, detailed laboratory data of the patients could not have been accessed. Since the laboratory data are incomplete, scores such as the APACHE II score of the patients could not be calculated. Another limitation was that the cost calculation was based only on the invoice issued to the SSI, and hospital operations, salaries, and depreciation were not reflected in the costs.

Since COVID-19 is a new disease that does not yet have a clear treatment protocol and there are no randomized controlled trials available, there may be other factors that may affect the reliability of cost analysis.

**Ethics Committee Approval:** The Ankara City Hospital Clinical Research Ethics Committee granted approval for this study (date: 02.09.2020, number: E1-20-916).

**Informed Consent:** Written informed consent was obtained from patients who participated in this study.

**Peer-review:** Externally peer-reviewed.

**Conflict of Interest:** The author have no conflict of interest to declare.

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