Clinical and Experimental Health Sciences

Comparative Analysis of Service Costs In Intensive Care Unit, Length of Stay and Mortality Rate Before and During the COVID 19 Pandemic

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ABSTRACT

Objective: The aim of the present study was to compare the average length of stay, mortality rates and service costs in intensive care unit provided to patients during October-November-December 2019 (pre-pandemic), with the average length of stay, mortality rates and service costs in intensive care unit during October-November-December 2020 (pandemic).

Methods: This was a retrospective cross-sectional comparative, single-center study. The demographic data (age, gender), average length of stay, mortality and hospital costs of intensive care patients during October-November-December 2019 (pre-pandemic) were compared using the hospital records with the same data of patients in the same intensive care unit during October-November-December 2020 (pandemic), and the factors affecting the cost were investigated.

Results: Of the 437 patients included in the study, 233 were hospitalized in pre-pandemic period and 204 in pandemic period. Pre-pandemic period mean age was 65.04 ± 17.0, and pandemic period mean age was 68.07 ± 15.1 years. The majority of the cases in both periods were male (57.9% and 63.2%). Length of stay, cost and mortality rates were significantly higher in the pandemic group (p: 0.000). There was a significant positive correlation between length of stay and cost (p: 0.000).

Conclusion: It was found that intensive care costs increased considerably during the COVID 19 period, along with the increases in the length of stay and mortality rates. Advanced age and increase in length of stay were found to be correlated with mortality, but only length of stay was correlated with cost.

Keywords: COVID – 19, Length Of Stay, ICU Cost, Mortality

1. INTRODUCTION

Coronavirus disease 2019 (COVID-19) has affected every continent in the world and is considered the biggest infectious disease outbreak of the 21st century, with over 125,507,698 cases and 2,755,212 deaths as of March 27, 2021. (1)

The COVID-19 pandemic is observed to have a detrimental impact on global health systems and affect every aspect of human and economic life. A major concern with the COVID-19 pandemic is the high financial burden on healthcare systems. To fully understand the economic burden of COVID-19 and assist decision makers in planning future investments in COVID-19 prevention and treatment strategies, specific data describing the healthcare costs of hospitalized COVID-19 patients is needed. A cohort study in Saudi Arabia reported that the average healthcare cost of COVID 19 patients admitted to the intensive care unit (ICU) per patient was $ 21,178.21 ± 14,839.38. This cost was higher in patients undergoing mechanical ventilation. (2) Similarly, Wang et al. reported the estimation of average medical cost for COVID-19 patients to be $ 6,500 in their modeling studies. (3)

However, to the best of our knowledge there is no study investigating how much these costs have changed compared to a year ago, neither in the world nor in our country. The present study aimed to compare the length of stay (LOS), mortality rates and costs between patients in the intensive care unit during the last quarter of 2019 and the same period of 2020.

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2. METHODS

The study was planned as a retrospective cross-sectional comparative study. The study was initiated after obtaining the approval of the Clinical Research Ethics Committee of S.B.U Kocaeli Derince Research And Training Hospital (Ethics committee approval number: 2021/14). (ClinicalTrials.gov ID: NCT04748614)

From the electronic records of our hospital, the demographic data (age, gender), the average length of stay, mortality rates and hospital costs of the patients who were admitted to the intensive care unit during October-November-December 2019 (pre-pandemic) were compared with the demographic data (age, gender), the average length of stay, mortality rates and hospital costs of the patients who were admitted to the intensive care unit during October-November-December 2020 (pandemic), and the factors affecting the costs were investigated.

Since the first COVID 19 case in our country was detected on March 11, 2020, the last quarter of 2019 was determined as the Pre-Pandemic period.

The primary objective of this study was to compare the healthcare costs of ICU patients before the COVID 19 outbreak (Pre-Pandemic) and during the Pandemic.

Secondary objective was to compare these two periods in terms of length of stay and mortality rates, and to determine the factors affecting the costs.

2.1. Statistical Analysis

The results were presented for categorical variables as numbers and percentages, for continuous variables as mean ± standard deviation. Comparison of the categorical variables between groups was done using Chi-square or Fisher exact test. The normality of distribution for continuous variables was confirmed with the Kolmogorov–Smirnov test. For comparison of continuous variables between two groups, the Student's t-test or Mann-Whitney U test was used depending on whether the statistical hypotheses were fulfilled or not. To evaluate the correlations between measurements, Pearson's correlation coefficient was used. p value of 0.05 was considered statistically significant for all tests. Statistical analysis was performed using the IBM SPSS ver. 22 package software (IBM Software, New York, United States).

3. RESULTS

A total of 448 patients were screened in this study comparing patients in intensive care in the last quarter of 2019 and the last quarter of 2020. 11 of these patients (3 pre-pandemic; 8 pandemic) were excluded from the analysis because cost information was not available. Of the 437 patients included in the study, 233 were hospitalized in the pre-pandemic period and 204 in the pandemic period. Pre-pandemic period mean age was 65.04 ± 17.0; pandemic period mean age was 68.07 ± 15.1 years. Although there was no statistical difference in terms of gender, the majority of the cases were male (57.9% and 63.2%) in both periods. LOS, cost (average, daily, per patient) and mortality rates were significantly higher in the pandemic group (p: 0.000) (Table 1, Figure 1).

Table 1: *Comparative Analysis of Groups*

	Pre-pandemic	pandemic	P
n (437)	233	204	
Age (year)	65.04 ± 17.0	68.07 ± 15.1	0.051
Sex (f/m)(n)	98/135	75/129	0.281
LOS (day) (1-99 day)	6.1 ± 9,2	8.8 ± 9,8	0.003*
Cost (Turkish Liras (TL))	14.703 ± 15.019	26.967 ± 21.295	0.000*
Cost per patient (TL)	63	132	0.000*
Daily cost (TL)	2.410 ± 1.632	3.064 ± 2.172	0.000*
Discharge (n)	156 (% 67,0)	71 (% 34,8)	0.000*
Death (n)	77 (% 33,0)	133 (% 65,2)	

Chi-Square Tests(LOS: length of stay*

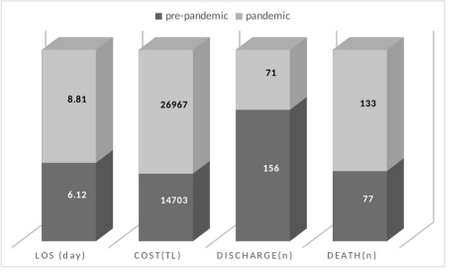

Figure 1. *Comparative Analysis of Groups*

When the factors affecting the cost were examined, there was a significant positive correlation between length of stay and cost (p: 0.000). It was observed that as age and length of stay increased, mortality increased, but they were not correlated with cost (Table 2).

CONSORT 2010 Flow Diagram

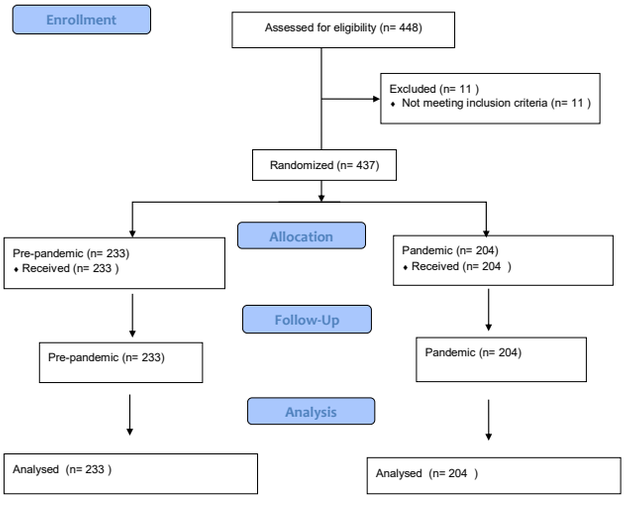

Figure 2: *CONSORT 2010 Flow Diagram*

Table 2. *Correlation of Cost, Age, LOS And Mortality Between Groups:*

			Cost	Age	LOS	DEATH
Pre-Pandemıc	Cost (TL) (14.703 ± 15.019)	Pearson Cor.	1	-,088	**,576****	,049
N:233		Sig.		,181	**,000**	,453
	Age (Year) (65.04 ± 17.0)	Pearson Cor.	-,088	1	,025	**,206****
		Sig.	,181		,706	**,002**
	LOS (Day) (6.1 ± 9,2)	Pearson Cor.	**,576****	,025	1	,195**
		Sig.	**,000**	,706		,003
	Death [77 (% 33,0)]	Pearson Cor.	,049	**,206****	**,195****	1
		Sig.	,453	**,002**	**,003**	
Pandemic	Cost (TL) (26.967 ± 21.295)	Pearson Cor.	1	-,118	**,773****	-,054
N:204		Sig.		,092	**,000**	,444
	Age (Year) (68.07 ± 15.1)	Pearson Cor.	-,118	1	-,038	**,217****
		Sig.	,092		,591	**,002**
	LOS (Day) (8.8 ± 9,8)	Pearson Cor.	**,773****	-,038	1	-,038
		Sig.	**,000**	,591		,585
	Death [133 (% 65,2)]	Pearson Cor.	-,054	**,217****	-,038	1
		Sig.	,444	**,002**	,585	

***. Correlation is significant at the 0.01 level (2-tailed). LOS: lenght of stay; TL: Turkish Liras*
*** pearson correlation levels:*
0.01 – 0.29 low correlation
0.30 – 0.70 moderate relationship
0.71 – 0.99 high level correlation

4. DISCUSSION

In this study, where pre-COVID 19 intensive care costs and COVID 19 period intensive care costs were compared, it has been determined that, during the COVID 19 period, the costs of hospitalization increased considerably, along with the increases in length of stay and mortality rate. While advanced age and increase in length of stay were correlated with mortality, only length of stay was correlated with cost.

Patient characteristics, clinical outcomes, and resource use of hospitalized COVID-19 patients have been described in several US studies. (4-6) However, limited data are available describing direct healthcare costs associated with hospital resource use among hospitalized COVID-19 patients. (7) A study in Saudi Arabia (2) determined a cost of $ 21,178.21 ± 14,839.38 per patient among those admitted to the ICU, and a study in USA (7) stated that this cost increased up to $ 54,402. Similarly, a simulation study by Sarah et al. (8) determined the cost of a patient requiring hospitalization as $ 14,366. While the cost analysis results of our study were in line with the literature (TL 26,967 ± 21,295), they were additionally compared with the pre-pandemic values, and it was observed that the cost increased almost two-fold compared to the pre-pandemic period (pre-pandemic: TL 14,703 ± 15,019 and pandemic: TL 26,967 ± 21,295). This situation highlights the scale of resources required to manage COVID-19 cases.

It has been shown in various studies that the mean age of patients in intensive care due to COVID 19 is high. A study by Fusco et al. (7) reported median (mean) age as 63 (61) years, among hospitalized COVID-19 patients (N = 173,942). Similarly, Haase et al. (9) found that average age was 68 (59-75). In the present study, mean age in the pandemic period was 68.07 ± 15.1. Although it increased compared to the pre-pandemic period, this increase was not statistically significant. In addition, our study determined that, advanced age was correlated with increased mortality, which was in line with the literature(7), but not correlated with increased costs. This situation is not in line with the literature because according to Sarah et al., the cost increases as the age increases. (8) We believe that this difference is due to the fact that the mentioned publication is based on a simulation software, and that our study has been a single-center study and included only intensive care patients.

In our study, there was no difference between the genders in the comparison of the two periods, however it was observed that the male gender was at risk in terms of admission to intensive care (pre-pandemic: 57.9% and pandemic: 63.2%). Our findings are in line with the literature. (2, 7, 9, 10)

It is anticipated that, the length of stay will increase during the pandemic period because the treatment and complications of COVID 19 disease are not yet fully elucidated. However, previous studies comparing patients who were followed up in the hospital wards and who were admitted to intensive care,

reported that median length of stay was 4 days for patients who were not admitted to ICU and did not undergo invasive mechanical ventilation (IMV), while it increased to 15 days for patients who were admitted to ICU or underwent IMV.(7) It also followed a course that increased with age (≥50 years: 6 days). (7) In a study by Khan et al. the median LOS was 7.93 days, and the maximum LOS was 43 days. (2) Unlike these studies, our study includes LOS values before and during the pandemic and is in line with the literature with LOS values of 6.1 ± 9.2 days for the pre-pandemic period, and LOS values of 8.8 ± 9.8 days during the pandemic period. In addition to the literature, cost was found to be correlated with the increase in LOS.

COVID 19 patients in intensive care unit have an increased risk of mortality. Mortality rates ranging from 0% to 84.6% can be found in the literature (11); however, this review found the ICU mortality rate as 35.5% (31.3-39.9%) as a result of quantitative analysis of all these studies. This study also stated that the highest mortality rate was in the Middle East when viewed on a regional basis. (61.9% (52.5–70.5%)). In our study, mortality rate was 65% in the pandemic period in parallel with the literature, but a two-fold increase in mortality was found compared to the pre-pandemic period. In addition, in line with the literature, mortality was correlated with age (7), but no correlation was found between increased mortality and cost.

The results of this study should be interpreted in the context of various limitations. First, the study data only represent the ICU inpatient environment and focused directly on medical costs, therefore the full clinical and healthcare economic burden of patients hospitalized for COVID-19 such as the indirect costs incurred by patients due to hospitalization for COVID-19 (for example, employment income losses, family travel expenses, childcare costs, etc.); are largely unknown and not evaluated in this study. In addition, as the significant proportion of hospitalized COVID 19 patients are transferred to other care facilities and those who are discharged home may require additional care outside of the inpatient setting, additional studies need to be conducted in other care settings. Second, the scarcity of critical supplies can increase costs, as suppliers can increase prices (for example, hospitals pay up to fifteen times the normal price for personal protective equipment and medical supplies). Third, our analysis does not include impacts such as indirect medical costs, or reduced income due to reductions in elective procedures, or potential cost increases resulting from worse disease outcomes due to delays in preventive care and diagnosis.

Although this is a single-centre study, it provides valuable information regarding economic burden of COVID 19 patients, who were admitted to the ICU due to COVID 19, on hospitals. The findings of our study provide the first insights regarding the economic burden on hospitals with regard to providing healthcare to COVID-19 patients hospitalized in Turkey. Such cost data will be useful as input for future studies assessing the economic burden of healthcare services for COVID 19 pandemic in Turkey, and for developing cost-effectiveness models to evaluate the potential impacts of COVID 19 prevention and treatment efforts.

5. CONCLUSION

In our study comparing pre-pandemic and pandemic periods, all three values of patients in intensive care during pandemic, length of stay, hospital costs, and mortality rates increased by almost two-fold compared to the pre-pandemic period**.** The findings of this study support the need for urgent implementation of effective interventions, including safe and effective vaccines.

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Ethical considerations: The study was initiated after obtaining the approval of the Clinical Research Ethics Committee of S.B.U Kocaeli Derince Research And Training Hospital (Ethics committee approval number: 2021/14). (ClinicalTrials.gov ID: NCT04748614)

Conflicts of interest: None

Authorship statement: IK, MYK: Conceptualization, Methodology, Data curation, Writing – Original draft preparation, Visualization, Investigation, Supervision, Reviewing and Editing,

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