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The Association Between Emergency Severity Index Triage Score and Clinical Outcomes in Patients with COVID-19

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ABSTRACT

Correct, accurate, and organized triage is one of the key factors in rapidly categorizing COVID-19 patients. Further research on the triage outcomes and prioritization of limited resources seems necessary. Therefore, the present study was performed to determine the relationship between the triage with the ESI and the outcomes of COVID-19 patients. This descriptive-analytical study was conducted on 1046 records of patient with COVID-19, in March 2019 and 2020.The highest and lowest frequency of triage was related to level 3 (54.2%) and level 1 (6.3%) triage, respectively. The Spo2 level in more than half of the patients (56.6%) was less than 93%. The maximum mortality rate (95.5%) was observed in patients with level 1 triage. Also, patients with levels 1 and 3 triage required intubation, and there was a statistically significant relationship between the triage level, the SpO2 level, and the intubation rate (p <0.001). The present study's results showed a correlation between the triage level and the variables of age, SpO2 level, intubation, and disease outcome. The findings can be used to create an accurate and efficient triage system for similar pandemics.

Keywords: Triage; Emergency Severity Index (ESI); Clinical Outcomes; COVID-19

Introduction

Severe acute respiratory syndrome coronavirus (SARS2-CoV-2) was identified as the pathogen of the new coronavirus 2019 (COVID-19) pandemic, which started in December 2019 in Wuhan, China [1]. COVID-19 has infected more than 180 million people and killed more than 4 million patients [1, 2]. Also, in Iran, more than 3 million people have been infected, and this disease has killed more than 80,000 patients. In Lorestan province of Iran, more than 120,000 people have been infected, and about 2,000 people have been killed by COVID-19 disease [3]. So, considering the high costs of medical care and limitations in facilities, equipment, and human resources, it is important to prioritize COVID-19 patients to receive the required medical care and services [4], and the correct, accurate, and organized triage is necessary [1,5].

Patients generally attend the emergency room and go through the triage process [6]. There is no universal consensus or no fixed rules on how patients should be triaged as a dynamic process. Among the triage systems in the world, the triage systems of Australia, Canada, Manchester, and the Emergency Intensity Index (ESI) are the most accepted [4,7]. The late 1990s and early 2000s, the five-

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level triage system was created and introduced [8,9]. ESI is the triage system in most hospitals and for suspected patients with infectious diseases like COVID-19 worldwide and in Iran [10,11]. However, in this regard, it should be noted that overcrowding in the triage unit causes confusion, chaos, and an increase in cross-contamination between patients and staff [12].

So far, few studies have been conducted on the triage of patients with COVID-19. Due to the constantly changing nature of the disease, examining and reviewing the triage process will help us better manage patient treatment and care, control the disease, and develop new health protocols. Formulating a preoperative program for managing patients with COVID-19 has been considered a challenge in health care [13, 14].

In practice, however, the relationship between the triage level and the clinical outcome of COVID-19 patients' needs to be clarified. In this regard, the researcher's observations indicate that in many emergency units, the patient's condition has been perceived to be good, while the patient has died within a few hours. So, it seems that congestion, inaccuracy, and complexity of COVID-19 disease in the emergency department, on the one hand, and the fear of disease and confusion among patients and treatment staff, on the other hand, may cause nurses to miscalculate the correct triage level. Therefore, one criterion that can determine the correct triage level of COVID-19 patients in the emergency department is patients' clinical outcome and condition at the time of discharge from the hospital so that the obtained results can be used in the medical care program [15]. Therefore, the present study was designed and performed to determine the relationship between ESI triage and the outcomes of patients with COVID-19.

Materials and Methods

This descriptive-analytical study was conducted on 1046 hospital records of COVID-19 patients referred to the emergency department of Shahid Rahimi with symptoms of COVID-19 and pulmonary involvement between March 2019 and March 2020. After obtaining the code of ethics from the university's ethics committee (IR.LUMS.REC.1400.114), the necessary coordination was made with the hospital officials regarding reviewing the patient's records. For this purpose, first, a list of patients who met the inclusion criteria was created from the MCMC system, and their record numbers were extracted. Then, by referring to the HIS, the selected medical records were reviewed to extract and register the necessary information. Inclusion criteria for patients whose medical records were used in this study were being admitted with COVID-19, SPO2 level of less than or equal to 93, chills and diarrhea, and is diagnosed based on clinical, laboratory, or CT scan tests approved by an infectious disease specialist, the triage level ranged from 1 to 3. The patient records' telephone numbers were also registered for the follow-up. Data collection tools used in this study included a researcher-made demographic information checklist, which contained questions about the triage level, length of hospital stay, patient's conditions (death, discharge, or recovery), admission to intensive care unit and SPO2 level, age, and gender. Data were entered into SPSS software version 25 to be analyzed. Descriptive statistics, central indices, dispersion of quantitative variables, frequency, and percentage of qualitative variables were also used to describe the data. The chi-square test was used to compare the qualitative data. In order to investigate the relationship between quantitative variables, logistic regression analysis was used. A significance level of less than 0.5 was considered for all tests.

Results

The mean age of patients with COVID-19 was 58 years, and 50.2% were female. Most female patients were housewives (76.2%), and 40.7% of the male patients were self-employed. Moreover, the results showed that 0.2% had been affected by COVID-19 for the second time. The highest prevalence of COVID-19

was among patients with high blood pressure (22.7%) and diabetes (18.1%), and the lowest prevalence was among patients with chronic blood diseases (%3). The highest frequency of triage level was related to level 3 (n=567, 54.2%), and the lowest frequency was related to level 1 (n=66, 6.3%). The SPO2 level in 56.6% of patients was less than 93%, and 95.4% did not need intubation. Meanwhile, 97.4% of the patients were discharged from the hospital and fully recovered, while 11.9% were hospitalized in the intensive care unit.

The highest frequency of triage level was related to level 3 triage in over 60-year-old patients (n=252, 50.4%). The frequency of triage level was different in different age groups, and this difference was statistically significant (P = 0.001). Also, there was a difference at level 2 and 3 triages between the female and male genders, so the frequency of the female gender was higher. In contrast, this difference was not statistically significant (P = 0.95). The highest frequency of level 3 triage for men (n=282) and women (285) was 54.1% and 54.3%, respectively. The highest frequency of level 3 triage was observed in patients with an education level lower than a bachelor's degree. A difference was also observed at level 3 triage between patients with bachelor's and master's degrees and those with lower education levels, but this difference was not statistically significant (P = 0.17).

The studied patients had no significant relationship between triage level and underlying disease. Most patients with and without underlying disease were at level 3 triage (267 vs. 343). The frequency of patients with different triage levels was higher for patients without underlying disease than those with underlying disease.

The results showed that the highest length of hospital stay was related to patients at level 3 triage (8.03± 5.48), and the lowest mean length of hospital stay was related to patients at level 2 triage (7.79±9.86). There was also no statistically significant relationship between the triage level and the length of hospital stay (P =0.88).

Results of Table 1 indicate that the SPO2 level for patients at level 2 triage was the highest, and for patients at level 1 triage was the lowest. There was also a statistically direct relationship between the triage level and SPO2 level (P <0.001).

To investigate the relationship between ESI triage level and Spo2 level used logistic regression; patients with level 1 triage were at higher risk of complication compared to patients with level 3 (OR=5.76 95% CI: 2.43-13.66) and level 2 triage (OR=11.00 95% CI: 4.68-25.87). Also, the Spo2 level in patients with level 1 triage was lower than 93%. After adjusting the variables of gender, age, and education level, patients at level 1 triage were at higher risk of less than 93% Spo2 (OR=5.72 95%CI: 2.13-40.60) compared to patients at level 3 triage. Patients at level 2 triage also were at higher risk of less than 93% Spo2 than those at level 3 triage (OR=10.81 95%CI: 4.25-56.61).

Table 2 shows the relationship between the ESI triage level and the intubation status of COVID-19 patients. The intubation chance in patients at level 1 triage was higher than in patients at other triage levels. Also, triage level and Intubation chance had a statistically direct relationship.

Table 1: The relationship between ESI triage level and Spo2 level in patients with COVID-19admitted to Shahid Rahimi Hospital in Khorramabad

Variable		Number	Spo2 value Mean (SD)	P- value*
Triage level	Level1	66	80.87±11.69	<0.001
	Level2	413	90.94±5.04	
	Level3	567	90.91±5.94	

Table 2: The relationship between ESI triage level and Intubation chance in patients with COVID-19 admitted to Shahid Rahimi Hospital in Khorramabad

Variable		Intubation chance		P- value*
		No Frequency (%)	Yes Frequency (%)	
Triage level	Level1	50(75.8)	16(24.2)	<0.001
	Level2	400(96.9)	13(3.1)	
	Level3	548(96.6)	19(3.4)	

Table 3: The relationship between ESI triage level and clinical outcomes of patients with COVID-19

Variable		**Clinical outcomes**		**P- value***
		Discharge Frequency (%)	**Death Frequency (%)**	
Triage level	Level1	3(4.5)	63(95.5)	<0.001
	Level2	387(93.7)	26(6.3)	
	Level3	524(92.4)	43(7.6)	

Logistic regression investigated the relationship between ESI triage level and intubation status in COVID-19 patients. The chance of intubation in patients at level 1 triage was significantly higher than in patients at level 3 triage (OR=10.82 95%Ci: 5.01-23.40). Patients at level 2 triage were also at higher risk of intubation than those at level 3 triage. There was a difference between patients at level 2 and 3 triages regarding intubation, but this difference was not statistically significant. After adjusting the variables of gender, age, and education level, patients at level 1 triage were at higher risk of intubation than patients at level 3 triage (OR=7.16 95%CI: 3.14-16.34). There was no significant difference between level 2 and level 3 triage regarding intubation (OR=0.92 95%CI: 0.42-2.02).

Table 3 shows the relationship between ESI triage level and clinical outcomes of COVID-19 patients. The mortality rate in patients at level 1 triage was higher than in patients at other triage levels, and there was a direct relationship between the triage level and patient status.

Univariate logistic regression was used to investigate the relationship between ESI triage level and clinical outcome in COVID-19 patients. Compared to patients at level 3 triage, patients at level 1 triage were at higher risk of mortality rate (OR=255.91, 95%CI: 77.14-848.98). However, no significant difference was observed between patients at level 2 triage and patients at level 3 triage regarding the risk of death. After adjusting the variables of age, sex, and education level, patients at level 1 triage were at higher risk of death than patients at level 3 triage (OR=259.72 95%CI: 75.80-889.83). No significant difference was observed between patients at level 2 triage and patients at level 3 triage in terms of the risk of death (OR=0.77-95%CI: 0.46-1.28).

Table 4 shows that the highest frequency of hospitalization in the intensive care unit was related to patients at level 1 triage, and the highest frequency in other units was related to patients at level 3 triage. There was also a significant relationship between the triage level and the hospitalization of COVID-19 patients in the intensive care units and other wards.

Univariate logistic regression was used to investigate the relationship between ESI triage level and hospitalization in the intensive units among COVID-19 patients. Compared to patients at level 3 triage, patients at level 1 triage were significantly more hospitalized in the intensive units (OR=7.24 95% CI: 3.97-13.22). Also, the chance of being hospitalized in the intensive units for patients at level 2 triage was significantly higher than that of patients at level 3 triage (OR=2.39 95%CI: 1.30-57.65).

Table 4: The relationship between ESI triage level and Hospitalized in the ICU in patients with COVID-19

Variable		Hospitalized in the unit		Total Frequency (%)	Test statistic	P-value*
		Intensive Care Frequency (%)	Other Frequency (%)			
Triage level	Level 1	23(34.8)	43(65.2)	66(100)		
	Level 2	62(15)	351(85)	413(100)	77.50	<0.001
	Level 3	39(6.9)	528(93.1)	567(100)		

After adjusting the variables of gender, age, and education, patients at level 1 triage were significantly more hospitalized in the intensive units than patients at level 3 triage (OR=6.51 95%CI: 3.53-12.02). Also, the chance of being hospitalized in the intensive unit for patients at level 2 triage was significantly higher than those at level 3 triage (OR=2.32 95%CI: 1.52-3.55).

Discussion

The present study's findings showed that the highest and lowest lengths of hospital stay in the ICU were related to patients at level 3 and level 2 triages, respectively. Also, in terms of hospitalization in different units, the highest length of stay in the intensive care unit was related to patients at level 2 triage. However, the highest length of stay in isolated units and other wards was related to patients at level 1 triage. The findings also showed that patients at level 2 triage had the highest oxygen saturation level, and those at level 1 triage had the lowest. Patients at level 1 and 2 triages were at higher risk of less than 93% Spo2 level than patients at level 3 triages. Results of this study showed that patients at level 1 triage were at higher risk of intubation than patients at level 3 triage. The findings indicated that the number of deaths for patients at level 1 triage was higher than in patients at other triage levels.

Our findings also showed that the highest frequency of hospitalization in the intensive care unit was observed in patients at level 1 triage, and the highest frequency of hospitalization in other units was observed in patients at level 3 triage. A significant relationship was also observed between the triage level and hospitalization in intensive care units or other wards. Hence, patients at level 1 triage were more likely to be hospitalized in the intensive care unit than patients at level 3 triage. The chance of admission to the intensive care unit for patients at level 2 triage was also higher than that of patients at level 3 triage.

In general, it can be said that the triage of Covid-19 patients at level 1 was done accurately by the ESI index, so that, as expected, patients at level 1 had the highest frequency of hospitalization in the intensive care unit had the highest risk of Spo2 level of less than 93%, and also had the highest risk of intubation and death. However, some challenges could be observed regarding the triage of patients at levels 2 and 3 triages. Although the relationship between the triage level and length of hospital stay in ICU was insignificant, patients at level 2 triage had the most extended stay in ICU. Also, the oxygen saturation level in patients at level 3 triage was lower than in patients at level 2 triage. Finally, the number of deaths in patients at level 3 triage was higher than in patients at level 2 triage. Nevertheless, no significant difference between patients at levels 2 and 3 triages regarding intubation and death was observed. It can be concluded that patients who should have been triaged at level 3 were incorrectly triaged at level 2.

Also, according to these findings, it can be acknowledged that a higher number of deaths in patients at level 3 triage compared to level 2 triage can indicate an error in triaging patients so that patients were assigned to a lower level of triage, which led to the worsening of patient's conditions. As observed, patients at level 3 triage had lower oxygen saturation levels than those at level 2 triage. This could be because patients at level 3 triage could have been exposed to more intubation than patients at level 2 triage. Also, as mentioned earlier, the length of hospital stay in ICU for patients at level 3 triage was longer than patients at level 2

triage. Grossman et al. stated that assigning high-risk patients to the lower triage level may be due to the nurses' neglect of high-risk patients and also misinterpretation of vital signs [16].

Another reason for incorrectly assigning patients to correct triage levels could be silent hypoxia (17). Meanwhile, the underlying mechanism of silent hypoxia in COVID-19 patients has not been adequately determined. Silent hypoxia is defined as a condition in which a person has a lower oxygen saturation level than expected (~ 50–80% saturation, while the predicted saturation level is 95% or higher). However, the person does not experience respiration problems (18).

Usually, increased respiratory rate (tachypnea) is seen in patients with normal hypoxia, but it is not often seen in patients with silent hypoxia. Therefore, it may cause rapid harm to patients (19). When COVID-19 is diagnosed, silent hypoxia should be immediately assessed and ruled out by pulse oximeter, blood gas analysis, respiratory and heart rate monitoring, or other methods (18).

In addition, various studies have examined the relationship between risk factors and the severity of COVID-19 disease, which is in line with the present study's findings. Among these risk factors, age and clinical symptoms such as hypoxemia have been independently associated with the mortality rate while predicting the chance of hospitalization (19-21). Older age and decreased arterial blood oxygen saturation (22) can be predictors of hospitalization in the ICU, which is consistent with the present study. Thus, a significant application of this research is the necessity to develop a triage scoring system for patients with acute respiratory conditions, such as COVID-19.

Conclusion

The present study showed that age, arterial oxygen saturation, intubation, disease outcome (death, discharge, and transfer to other units), and admission to the ICU were correlated to triage level. The assignment of patients to level 1 triage as the acute group had been correctly implemented, but more care should be taken in assigning patients to level 2 and 3 triages. Patients should be monitored more closely after categorization based on their clinical condition. Also, more studies on the accuracy of ESI triage are suggested. This study can be a basis for further research to create an accurate and efficient triage system in pandemics similar to Covid-19.

Conflict of Interests

Authors declare that they do not have any conflict interests.

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