Analysis of Sequential Organ Failure Assessment (SOFA) Score Profile in Relation to Length of Stay and Patient Outcome in the ICU of Abdul Moeloek Regional General Hospital

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Keywords: ICU, Length of Stay, Mortality, Sepsis, SOFA Score.

Abstract: Sepsis is a severe dysfunction of the body's organs triggered by the immune system's imbalance in reaction to an infection. The Sequential Organ Failure Assessment (SOFA) score is utilized to evaluate the organ failure linked to sepsis. An increase in the SOFA score is associated with worse patient outcomes or higher mortality rates. This study seeks to analyze the correlation between SOFA scores, length of stay, and mortality in sepsis patients. The study subjects are sepsis patients treated in the Intensive Care Unit (ICU) of Dr. H. Abdul Moeloek Regional General Hospital. The research was conducted from May to October 2023. This study is a prospective cohort analytical observational research conducted at Dr. H. Abdul Moeloek Regional General Hospital and the University of Lampung between May and October 2023. A total of 137 patients were involved during a span of three months, with 89 patients chosen as subjects for this study, while 48 patients were excluded because of incomplete data. The Spearman Correlation normality test displayed a correlation between the SOFA score and Length of Stay with a significance value of 0.367. Since this value is >0.05, H0 is accepted, and H1 is rejected. The Spearman Correlation normality test indicated a correlation between the SOFA score and the patients' final condition with a significance value of 0.000. As this value is <0.05, H0 is rejected, and H1 is accepted. The correlation coefficient of 0.097 indicates a very weak level of association between the SOFA score and Length of Stay, suggesting no significant correlation between the two variables. However, a correlation coefficient of 0.592 denotes a moderately robust level of association between the SOFA score and the Patients' Final Condition, highlighting a correlation between the two variables.

1 INTRODUCTION

Sepsis is a health issue prevalent in society characterized by a severe clinical infection syndrome marked by cardinal inflammatory signs such as leukocyte accumulation, vasodilation, and increased microvascular permeability occurring in tissues far from the source of infection (Darwis & Probosuseno, 2019).

According to the WHO (2017), there were 48.9 million reported cases with 11 million deaths associated with sepsis, contributing for 20% of all deaths worldwide. Each year, sepsis causes 6 million deaths and has been designated as a global health priority by the WHO. Sepsis cases rank among the top ten causes of death in the United States (Marik & Taeb, 2011).

A study conducted in 2009 across 16 Asian countries, including Indonesia, stated that the incidence of severe sepsis and septic shock in ICU wards was 10.9%, with a corresponding mortality rate of 44 percent. Another study at RSCM Jakarta in 2012, spanning one month, it was found that among 84 intensive care cases, there were 23 instances of severe sepsis and septic shock, resulting in a mortality rate of 47.8 percent (Kemenkes, 2017).

Based on data retrieved from patient medical records at RSUP Dr. Sardjito Yogyakarta in 2016, the incidence of sepsis in internal disease inpatient wards amounted to 704 cases (17.06%) out of the total number of treated patients, with 431 (61.22%) deaths among diagnosed sepsis patients. In 2017, there was a decrease in sepsis incidence to 454 cases (9.71%) out of the total number of treated patients, with 278

Wahyuni, A., Sidharti, L. and Kusumaningrum, D.
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DOI: 10.5220/0013668100003873

In *Proceedings of the 1st International Conference on Medical Science and Health (ICOMESH 2023)*, pages 203-207
ISBN: 978-989-758-740-5

(61.23%) deaths among diagnosed sepsis patients (Darwis & Probosuseno, 2019).

Assessment systems for organ damage and failure can be monitored using ICU illness scores such as APACHE II, SAPS II, and the SOFA score to assess the severity of the disease (Dirgantoro, 2018). The APACHE II scoring system itself has several limitations due to selection bias, lead time bias, and the difficulty in determining the primary diagnosis leading patients into the ICU, requiring a higher cost due to multiple laboratory variables tested and a lengther time to obtain results. Whereas the SAPS II system, although the first system to use statistical modeling techniques, is difficult to establish considering data must be collected within one hour after the patient enters the ICU (Sugiman, 2011).

In sepsis, organ dysfunction can be recognized by a sudden increase of at least 2 points in the overall SOFA score because of an infection. Each organ has a value ranging from 0 (normal function) to 4 (very abnormal), resulting in a maximum total score of 24 (Seymour et al., 2016). The researchers chose the SOFA score because it's not a one-time assessment; it can be evaluated periodically, observing score increases or decreases. The SOFA score isn't just calculated upon patient admission but also every 24 hours. Parameters in the SOFA score are deemed ideal for depicting organ dysfunction (Singer et al., 2016). Moreover, the SOFA score attributes values to individual organ systems depending on one or multiple variables, fewer than other ICU severity assessment systems like APACHE II and SAPS II (Dirgantoro, 2018).

Identifying sepsis before significant organ failure occurs poses a challenge to all medical professionals. For primary care doctors, detecting potentially septic patients among many individuals presenting with uncomplicated infections, as well as those not progressing to sepsis, requires specific skills (Tavare & Oflyn, 2017). The lack of diagnostic tools is a major obstacle in the early management of sepsis. This is compounded by the fact that sepsis presents as a heterogeneous set of symptoms without a gold standard for diagnosis (Mclymont & Glover, 2016).

2 METHODS

2.1 Research Design

This research is an analytical observational research using a prospective cohort study approach. It was carried out at RSUD Dr. H. Abdul Moeloek and University of Lampung from Mei to October 2023.

2.2 Sample Research

The subjects of this study were individuals admitted to the ICU at Dr. H. Abdul Moeloek Regional General Hospital who met the study criteria. Inclusion criteria for this research were patients aged ≥18 years diagnosed with either sepsis or septic shock. Exclusion criteria included patients discharged without the approval of the attending physician or upon their own request, and patients with a SOFA score <2 assessed based on serum creatinine concentration, platelet count, and Glasgow Coma Scale (GCS) within 24 hours following the diagnosis of sepsis. A total of 137 patients were identified over three months, with 89 patients included as subjects in this study, while 48 patients were excluded due to incomplete patient data.

2.3 Data Analysis Research

In this research, the data was performed on the data using SPSS version 22.0. Spearman's test was utilized for numerical data to evaluate the distribution of the data. Descriptive data were reported as the mean and standard deviation (SD) for normally distributed data or as the median and interquartile range for data that did not follow a normal distribution. Bivariate analysis was conducted to compare variable differences between subjects who experienced improvement and those who deceased.

3 RESULTS

The SOFA score is one of the scoring systems commonly used to depict organ failure or dysfunction, typically measured in patients undergoing treatment in the intensive care unit. The influence distribution factor are presented in the table 1.

Table 1: Distribution Frequency of Patients Age.

Data Criteria	Patients Age
N	89
Minimun	18
Maximum	94
Mean	56.49

Based on the research data provided, it's evident that the ICU at Dr. H. Abdul Moeloek Regional General Hospital had a total of 89 patients as research subjects. The patients' ages displayed a considerable range, spanning from a minimum of 18 years to a maximum of 94 years. The average age of patients treated in the ICU is approximately 56.49 years. These results depict the diversity of ages among patients requiring intensive care in this hospital.

Table 2: Distribution Frequency of Patients Gender.

Data Criteria	Patients Gender
Men	42
Women	47
Total	89

Based on the research data provided, it is observed that in the ICU of Dr. H. Abdul Moeloek Regional General Hospital, out of a total of 89 research subjects, there were 42 male patients and 47 female patients. These results depict an insignificant difference between the number of male and female patients.

Table 3: Distribution Frequency of Primer Diagnoses.

Data Criteria	Primer Diagnoses
Neurological Disorders	19
Cardiovascular System	15
Respiration System	1
Gastrointestinal System	2
Endocrine Disorders	4
Infection	1
Postoperative Management	25
Liver Disorders	3
Kidney Disorders	6
Malignancy	8
Sensory Sytem	2
Hematological Disorders	2
Reproduction System	1
Total	89

Based on the distribution of primary diagnoses, it was found that out of the total 89 research subjects, the three most common primary diagnoses were patients undergoing postoperative care, neurological system disorders, followed by cardiovascular system issues. Patients undergoing postoperative care included those after a laparotomy. The most prevalent neurological diseases were patients with brain hemorrhage and stroke. As for cardiovascular diseases, the most frequently encountered were patients with heart failure and coronary artery disease.

Table 4: Distribution Frequency of Number of Comorbidities.

Data Criteria	Number of Comorbidities
0	17
1	21
2	18
3	7
4	18
5	4
6	4
Total	89

Based on the distribution of data on the number of patient comorbidities, it was found that the majority of patients undergoing treatment in the ICU at Dr. H. Abdul Moeloek Regional General Hospital had comorbidities, varying from a minimum of 1 to a maximum of 6 comorbidities. Patients without comorbidities amounted to 17 individuals. The presence of comorbidities in patients, whether acquired before or during their treatment, becomes a factor that worsens the patient's condition and poses a higher risk of mortality. The most commonly found comorbidities were electrolyte imbalance and infections.

Table 5: Distribution Frequency of SOFA Score.

Data Criteria	SOFA Score
N	89
Minimum	3
Maximum	14
Mean	7.44

Based on table 5, the Sequential Organ Failure Assessment (SOFA) Score among patients varied between a minimum score of 3 and a maximum score of 14. The mean SOFA score was around 7.44. A higher SOFA score indicates a greater severity of organ dysfunction experienced by the patient.

Table 6: Distribution Frequency of Length Hospitalization.

Data Criteria	Length Hospitalization
N	89
Minimum	0
Maximum	25
Mean	5.61

According to table 6, the length of stay varied between 0 days as the minimum and 25 days as the maximum. The average length of stay in this ICU was approximately 5.61 days. The varied length of stay from 0 to 25 days reflects the diversity in patient conditions, with some patients possibly requiring shorter treatment durations while others may need lengther care.

Table 7: Distribution Frequency of Final Condition.

Final Condition	Frequency	Percentage (%)
Life	12	13.5
Dead	77	86.5
Total	89	100

Based on the above table 4, out of the total 89 patients who were subjects of the study, approximately 13.5% of them successfully recovered and survived after undergoing treatment in the ICU. The most notable data is that around 86.5% of patients experienced death during or after ICU treatment.

Table 8: SOFA Score Normality Test Results with Length of Hospitalization.

Variable	P-Value
SOFA	0.008
Length Hospitalization	0.000

Based on the normality test using Kolmogorov-Smirnov in the table above, it is known that the probability values (p-values) or Asymp. Sig. (2-tailed) for the variables SOFA Score and Length of Stay are 0.008 and 0.000, respectively. As the probability values are smaller than the significance level of 0.05, it indicates that the normality assumption is not met. Therefore, the correlation test between SOFA Score and Length of Stay will be conducted using Spearman Correlation.

Table 9: Correlation Test Results of SOFA Score with Length of Hospitalization.

Variable	Person (r)	P-Value
SOFA	0.097	0.367
Length Hospitalization		

From the table 9, it is revealed that concerning the relationship between the SOFA Score and Length of Stay yielded a significance value of 0.367. Since this value is >0.05, H0 is accepted, and H1 is rejected, indicating no relationship between the SOFA Score and Length of Stay. With a correlation coefficient of 0.097, it signifies a very low level of association (correlation) between the SOFA Score and Length of Stay.

Table 10: SOFA Score Normality Test Results with Patient's Final Condition.

Variable	P-Value
SOFA	0.008
Final Condition	0.000

Based on the normality test using Kolmogorov-Smirnov in the table above, it is noted that the probability values (p-values) or Asymp. Sig. (2-tailed) for the variables SOFA Score and Patient Outcome are 0.008 and 0.000, respectively. As the probability values are smaller than the significance level of 0.05, it indicates that the normality assumption is not met. Therefore, the correlation test between the SOFA Score and Patient Outcome will be conducted using Spearman Correlation.

Table 11: Correlation Test Results of SOFA Score with Patient's Final Condition.

Variable	Pearson (r)	P-Value
SOFA	0.592	0.000
Kondisi Akhir Pasien		

From the table 11, it's clear that in relation to the connection between the SOFA Score and the patient's outcome, a significance value of 0.000 was obtained. As this value is <0.05, H0 is declined, and H1 is acknowledged, signifying an association between the SOFA Score and the Patient's Outcome. With a correlation coefficient of 0.592, it signifies a moderately strong level of association (correlation) between the SOFA Score and the Patient's Outcome. As the correlation coefficient is positive, it indicates a direct relationship between the two variables. Therefore, it can be concluded that as the SOFA Score increases, the patient's outcome deteriorates.

4 DISCUSSION

The SOFA score is a reliable scoring method utilized to illustrate organ failure or dysfunction, typically measured in patients undergoing intensive care unit (ICU) treatment. However, based on the findings of this research, there was no correlation found between the SOFA score and the duration of stay. The correlation test revealed a weak correlation between these two variables. Factors influencing ICU patient length of stay include age, primary diagnosis, and the patient's initial condition upon admission. In this study, the subjects encompassed all patients receiving ICU care, resulting in diverse patient ages and primary diagnoses, hence no significant relationships were found due to the variability in patient backgrounds. This highlights the need for more specific research in subsequent studies.

The SOFA score serves as an indication of the quantity and severity of organ dysfunction in ICU patients. A higher SOFA score indicates increased organ dysfunction severity, elevating the risk of mortality (Sari et al., 2021). SOFA score

measurements indicated that the majority of patients with a fatal outcome experienced multi-organ dysfunction, notably in the respiratory system, as observed from PaO2/FiO2 data. Patients experiencing respiratory distress exhibited decreased lung compliance and hypoxemia, leading to inadequate oxygen reaching body tissues.

Another indicator of multi-organ dysfunction seen in SOFA score measurements is the neurological system through a decrease in the Glasgow Coma Scale (GCS), signifying reduced patient consciousness levels. This serves as an indication of potential brain injury worsening due to infection, masses, or other inflammatory processes. The cardiovascular system is also assessable via the SOFA score, with Mean Arterial Pressure (MAP) as an indicator. The initial MAP target for patients receiving vasopressor therapy is 65 mmHg to achieve optimal tissue perfusion. Prolengthed hypotension is associated with increased patient mortality risk.

Serum creatinine levels serve as an indicator for monitoring kidney function and are included in SOFA score evaluations. Patients with acute kidney injury exhibit increased serum creatinine levels, indicating weakened filtration and elimination over several hours to days. Elevated serum creatinine levels correlate with worse patient outcomes.

The research findings indicate a connection between the SOFA score and the final condition of ICU patients. Correlation tests showed that higher SOFA scores correspond to an increased risk of the patient's final condition worsening. This aligns with previous studies where a SOFA score ≥7 had a mortality rate of 72.6% (Sari et al., 2021). Iskandar and Siska (2020) mentioned that individuals having a SOFA score of ≥7 faced a mortality risk 2.8 times higher than those with a SOFA score of <7. Other studies, such as Bale et al. (2013), also highlighted the use of the SOFA score as a predictor of the patient's final condition.

5 CONCLUSION

The SOFA score does not have a significant relationship with the length of stay of patients undergoing intensive care treatment in the ICU at RSUD Dr. H. Abdul Moeloek. However, the SOFA score does have a significant relationship with patient mortality, thus serving as a reasonably good predictor in predicting the patient's final condition.

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