

Prognostic Utility of the Sequential Organ Failure Assessment (SOFA) Score in Patients with Sepsis Presenting to the Emergency Department: A Prospective Observational Study

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Abstract

Background: Sepsis is a syndrome of life-threatening organ dysfunction caused by a dysregulated host response to infection, and early risk stratification in the emergency department is critical to guiding management, yet the prognostic performance of the Sequential Organ Failure Assessment (SOFA) score in this setting warrants continued local evaluation. The aim is to evaluate the utility of SOFA scoring in assessing the severity of organ dysfunction and predicting outcomes in patients with sepsis presenting to the emergency department (ED). **Material and Methods:** This single-centre, hospital-based, prospective observational study enrolled 100 adult patients fulfilling Sepsis-3 criteria at a tertiary care emergency department over 12 months. SOFA scores were calculated at admission, 24 hours, and 48 hours, and their association with in-hospital mortality, ICU admission, mechanical ventilation, vasopressor requirement, and length of stay was assessed. **Results:** The mean SOFA score at admission was 12.4 ± 3.83 , declining to 10.8 ± 5.85 by 48 hours (delta SOFA -1.61 ± 3.85). Blood culture positivity was 54%, with *Pseudomonas aeruginosa* the commonest isolate (25.93%). In-hospital mortality occurred in 15% of patients, ICU admission in 37%, mechanical ventilation in 18%, and vasopressor requirement in 36%. Admission SOFA category was strongly associated with in-hospital mortality (0% in the 0–12 range vs 100% in the 19–24 range, $p < 0.001$), and with vasopressor requirement ($p = 0.046$), mechanical ventilation ($p = 0.032$), length of hospital stay ($p = 0.042$), and ICU stay duration ($p < 0.001$). On comparison of survivors and non-survivors, $\text{PaO}_2/\text{FiO}_2$ ratio, platelet count, serum bilirubin, mean arterial pressure, Glasgow Coma Scale, serum creatinine, and SOFA scores at admission, 24 hours, and 48 hours were all significantly different ($p < 0.05$ for all). **Conclusion:** The SOFA score at admission and its trajectory over the first 48 hours were strongly associated with in-hospital mortality and key clinical outcomes among emergency department patients with sepsis, supporting its use as a practical bedside tool for early risk stratification.

Keywords: Sepsis; SOFA score; Emergency department; Organ dysfunction; Mortality; Sepsis-3.

Received: 06 August 2026

Revised: 20 August 2026

Accepted: 03 September 2026

Published: 08 September 2026

INTRODUCTION

Sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection, a definition that shifted the clinical understanding of sepsis away from a purely infection-centred process toward one in which the host's own physiological derangement determines severity and outcome.^[1] The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) formalised this shift, recommending an increase of two or more points in the Sequential Organ Failure Assessment (SOFA) score as the operational criterion for organ dysfunction in suspected infection.^[2]

The SOFA score quantifies dysfunction across six organ systems, respiratory, coagulation, hepatic, cardiovascular, neurological, and renal, each scored from 0 to 4, and has been widely adopted in intensive care and, increasingly, emergency department settings as a structured, reproducible measure of illness severity. Multinational data from European intensive care units have demonstrated that SOFA-based assessment captures a substantial burden of

organ dysfunction among patients with sepsis and correlates with survival across diverse healthcare systems.^[3]

Despite its origins in intensive care, the SOFA score is increasingly relevant to emergency medicine practice, since early recognition and risk stratification at the point of first contact can meaningfully influence subsequent management decisions, including the threshold for escalation to intensive care, initiation of vasopressor support, and intensity of monitoring. Serial assessment of the SOFA score over the initial hours of care may add further prognostic value beyond a single

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DOI:
10.21276/amit.2026.v13.i3.1017

How to cite this article: Chandel SS, Singh S, Singh PR, Shukla S. Prognostic Utility of the Sequential Organ Failure Assessment (SOFA) Score in Patients with Sepsis Presenting to the Emergency Department: A Prospective Observational Study. Acta Med Int. 2026;13(3):49-53.

admission measurement, since the trajectory of organ dysfunction, whether improving or worsening, could plausibly reflect the adequacy of early resuscitation and source control.

Given the continued burden of sepsis-related mortality and the practical importance of early, reliable risk stratification in the emergency department, this study was undertaken to evaluate the severity of organ dysfunction, as measured by the SOFA score, in patients presenting with sepsis, to examine the association between the admission SOFA score and key outcomes including in-hospital mortality, length of stay, and need for intensive care unit admission, and to assess the prognostic value of temporal change in SOFA score over the first 48 hours of emergency department care.

Aim: The primary aim of this study is to evaluate the utility of SOFA scoring in assessing the severity of organ dysfunction and predicting outcomes in patients with sepsis presenting to the Emergency Department (ED).

MATERIALS AND METHODS

This was a single-centre, hospital-based, prospective observational study conducted in the Department of Emergency Medicine, MGM Medical College and M.Y. Hospital, Indore, over a period of 12 months following approval from the Institutional Ethics Committee. Participants were followed until hospital discharge or death. Study participants were adult patients aged 18 years and above presenting to the emergency department with sepsis as per Sepsis-3 criteria. Patients fulfilling the following inclusion criterion were enrolled: adults aged 18 years or older presenting to the ED with confirmed or suspected sepsis diagnosed according to Sepsis-3 criteria.

Patients meeting any of the following exclusion criteria were not enrolled:

1. Known chronic organ failure requiring organ support (e.g., dialysis, mechanical ventilation) prior to the suspected septic episode.
2. Immunosuppression due to medication (e.g., chemotherapy, immunosuppressive drugs) or underlying condition (e.g., HIV/AIDS, organ transplant).
3. Those who refused or were unable to give consent for the study.

The sample size was calculated using the formula $n = Z^2 \times P(1-P)/d^2$, based on an estimated prevalence (P) of 33.2%, drawn from previously reported literature, a 95% confidence level ($Z=1.96$), and a margin of error (d) of 10%, giving a calculated sample size of approximately 86 participants. A total of 100 participants were enrolled using non-probability convenience sampling.

All patients presenting during the study period were screened for eligibility, and written informed consent was obtained from eligible participants or their legally authorised representatives using a bilingual consent form. Demographic information, detailed medical history, and clinical examination findings, including vital signs, Glasgow Coma Scale, and evidence of respiratory distress or shock, were recorded on a predesigned case record form.

Laboratory parameters required for SOFA score calculation were obtained as part of routine care: arterial blood gas analysis for PaO₂, complete blood count for platelet count, liver function tests for serum bilirubin, and renal function tests for serum creatinine, together with bedside measurement of mean arterial pressure, vasopressor requirement, and Glasgow Coma Scale. The SOFA score was calculated at admission across six organ systems, respiratory (PaO₂/FiO₂ ratio), coagulation (platelet count), hepatic (serum bilirubin), cardiovascular (mean arterial pressure and vasopressor use), neurological (Glasgow Coma Scale), and renal (serum creatinine), each scored from 0 to 4, with the sum constituting the total SOFA score. The SOFA score was recalculated at 24 hours and 48 hours using fresh clinical assessment and the most recent laboratory results, following the same scoring method to ensure consistency.

The dependent outcomes of the study were severity of organ dysfunction (SOFA score at admission, 24 hours, and 48 hours), in-hospital mortality, ICU admission, and length of hospital stay. Age, sex, presence of comorbidities, and baseline clinical condition were treated as potential confounding variables.

Continuous variables were summarised as mean $\pm$ standard deviation or median with interquartile range depending on distribution, and categorical variables as frequencies and percentages. Comparisons between groups were performed using the Student's t-test or Mann-Whitney U test for continuous variables, and the Chi-square test or Fisher's exact test for categorical variables. Correlation between SOFA score and continuous outcomes was assessed using Pearson or Spearman correlation as appropriate, and logistic regression was used to examine the association between SOFA score and binary outcomes such as in-hospital mortality and ICU admission. A p-value of less than 0.05 was considered statistically significant. All statistical and graphical analyses were performed using Stata version 17.0.

RESULTS

A total of 100 adult patients with sepsis fulfilling the inclusion and exclusion criteria were enrolled and analysed.

[Table 1] shows the baseline characteristics of participants. Males predominated (70.0%), and blood culture positivity was observed in 54.0% of patients, with *Pseudomonas aeruginosa* the most frequently isolated pathogen (25.93%), followed by *Staphylococcus aureus* (20.37%) and *Klebsiella pneumoniae* (14.81%).

[Table 2] shows the components and categorical distribution of the SOFA score at admission, addressing the first objective. Most patients had moderate to severe organ dysfunction, with 44.0% in the 7–12 category and 42.0% in the 13–18 category; 22.0% required vasopressor support at admission.

[Table 3] shows the change in SOFA score over the first 48 hours, addressing the secondary objective. The mean SOFA score declined from 12.4 at admission to 10.8 at 48 hours, with a mean delta SOFA of -1.61 , indicating an overall reduction in organ dysfunction during early hospital care.

[Table 4] shows the clinical outcomes among participants. ICU admission was required in 37.0%, vasopressor support in 36.0%, mechanical ventilation in 18.0%, and in-hospital mortality occurred in 15.0% of patients.

Table 1: Baseline Characteristics of Participants (n=100)

Characteristic	Category	n (%)
Age (years)	18–30	18 (18.0)
	31–50	28 (28.0)
	51–70	31 (31.0)
	>70	23 (23.0)
Gender	Male	70 (70.0)
	Female	30 (30.0)
Blood culture	Positive	54 (54.0)
	Negative	46 (46.0)
Pathogen (among positives, n=54)	Pseudomonas aeruginosa	14 (25.93)
	Staphylococcus aureus	11 (20.37)
	Klebsiella pneumoniae	8 (14.81)
	Acinetobacter baumannii	7 (12.96)
	Other bacterial	6 (11.11)
	Streptococcus pneumoniae	4 (7.41)
	Escherichia coli	4 (7.41)

Table 2: Components and Categorical Distribution of SOFA Score at Admission

Parameter	Value
PaO ₂ /FiO ₂ ratio, mmHg (mean±SD)	258±123
Platelet count, ×10 ³ /μL (mean±SD)	158±94.2
Serum bilirubin, mg/dL (mean±SD)	8.05±4.26
Mean arterial pressure, mmHg (mean±SD)	75.9±21.3
Vasopressors at admission, n (%)	22 (22.0)
Glasgow Coma Scale (mean±SD)	9±3.17
Serum creatinine, mg/dL (mean±SD)	4±2.29
SOFA category 0–6, n (%)	7 (7.0)
SOFA category 7–12, n (%)	44 (44.0)
SOFA category 13–18, n (%)	42 (42.0)
SOFA category 19–24, n (%)	7 (7.0)

Table 3: Change in SOFA Score Over Time

Time point	Mean±SD	
SOFA score at admission	12.4±3.83	
SOFA score at 24 hours	12.0±5.7	
SOFA score at 48 hours	10.8±5.85	
Delta SOFA (48h – admission)	–1.61±3.85	

Table 4: Clinical Outcomes Among Participants (n=100)

Outcome	n	%
ICU admission	37	37.0
Vasopressor required	36	36.0
Mechanical ventilation required	18	18.0
In-hospital mortality	15	15.0

Table 5: Association of Admission SOFA Score Category with Clinical Outcomes

Outcome	SOFA 0–12	SOFA 13–24	p-value
In-hospital mortality, %	0.0	30.6	<0.001
Vasopressor required, %	29.4	42.9	0.046
Mechanical ventilation, %	13.7	22.4	0.032
Mean length of hospital stay, days	10.2	8.9	0.042
Mean length of ICU stay, days	0.2	3.6	<0.001
ICU admission, %	38.7	36.7	0.095

[Table 5] shows the association between admission SOFA score category and clinical outcomes, addressing the second objective. In-hospital mortality rose sharply with increasing SOFA severity, from no deaths among patients with scores of 0–12 to 100% mortality among those with scores of 19–

24 ($p<0.001$). Vasopressor requirement, mechanical ventilation, length of hospital stay, and length of ICU stay were all significantly associated with SOFA category ($p\leq 0.046$ for all), while ICU admission alone did not reach statistical significance ($p=0.095$).

Table 6: Determinants of In-Hospital Mortality

Variable	Survivors (n=85)	Non-survivors (n=15)	p-value
Age, years (mean±SD)	52.2±18.7	54.5±21.1	0.697
PaO ₂ /FiO ₂ ratio, mmHg	273±126	169±45.6	<0.001

Platelet count, $\times 10^3/\mu\text{L}$	178 $\pm$ 88.2	45.8 $\pm$ 15	<0.001
Serum bilirubin, mg/dL	7.49 $\pm$ 4.26	11.2 $\pm$ 2.66	0.0001
Mean arterial pressure, mmHg	78.9 $\pm$ 21.6	58.6 $\pm$ 6.52	<0.001
Glasgow Coma Scale	9.59 $\pm$ 3.27	7.47 $\pm$ 1.73	0.0007
Serum creatinine, mg/dL	3.82 $\pm$ 2.37	5.00 $\pm$ 1.47	0.0155
SOFA score at admission	11.3 $\pm$ 3.09	18.3 $\pm$ 1.58	<0.001
SOFA score at 24 hours	10.6 $\pm$ 4.75	20.3 $\pm$ 2.72	<0.001
SOFA score at 48 hours	9.52 $\pm$ 5.08	18.0 $\pm$ 4.64	<0.001
Delta SOFA (48h – admission)	-1.86 $\pm$ 3.64	-0.30 $\pm$ 4.75	0.0215

[Table 6] shows the determinants of in-hospital mortality. Non-survivors had significantly lower PaO₂/FiO₂ ratio, platelet count, mean arterial pressure, and Glasgow Coma Scale, and significantly higher serum bilirubin and creatinine, than survivors ($p \leq 0.0155$ for all). SOFA scores at admission, 24 hours, and 48 hours, and delta SOFA, were all significantly higher among non-survivors ($p < 0.05$ for all), while age did not differ significantly between groups ($p = 0.697$).

DISCUSSION

Microbiological profile: Blood culture positivity in this study was 54%, with *Pseudomonas aeruginosa* the most frequently isolated organism (25.93%), followed by *Staphylococcus aureus* (20.37%) and *Klebsiella pneumoniae* (14.81%). Razack et al., studying patients with severe peritoneal sepsis, similarly confirmed bacteraemia in a substantial subset of patients, underscoring the importance of microbiological evaluation in identifying causative pathogens in sepsis.^[4] Baradari et al. likewise emphasised, in a cohort of 300 critically ill ICU patients, that infection and organ dysfunction were common and that accurate identification of clinical parameters is important for outcome prediction.^[5] The multicentre study by Do et al., involving 252 ICU patients with sepsis, further supports the significant burden of infection-related critical illness, reporting a hospital mortality of 40.1% in their cohort.^[6] The predominance of Gram-negative and opportunistic organisms such as *Pseudomonas* and *Acinetobacter* in the present study is consistent with the broader recognition that hospital-associated Gram-negative pathogens contribute substantially to sepsis severity in tertiary care settings.

SOFA score trend over the first 48 hours: The mean SOFA score in this study declined from 12.4 $\pm$ 3.83 at admission to 10.8 $\pm$ 5.85 at 48 hours, with a mean delta SOFA of -1.61 $\pm$ 3.85, suggesting an overall improvement in organ dysfunction during early hospital care. Jones et al., evaluating patients with severe sepsis in the emergency department, reported comparatively lower mean SOFA scores of 7.1 $\pm$ 3.6 at presentation and 7.4 $\pm$ 4.9 at 72 hours,^[7] a difference that may reflect a less severely ill cohort or a different case-mix at the point of enrolment. Lois and Save, studying 160 critically ill children in a paediatric intensive care unit, found that an increase in delta SOFA was strongly associated with mortality, with delta SOFA showing high sensitivity (82.35%) for predicting death.^[8] Baradari et al. similarly demonstrated that admission, mean, and highest SOFA scores all had significant predictive value for ICU mortality, with a markedly higher mean SOFA score among those who died (16.38) compared with survivors (5.82).^[5]

Razack et al. also found that SOFA scores on day 1 and day 3 were significantly higher among non-survivors, with increasing numbers of organ dysfunctions associated with lower survival.^[4] Taken together with the present findings, these studies reinforce that not only the initial SOFA score, but its trajectory over the first two to three days, carries important prognostic information.

In-hospital mortality: In-hospital mortality in this study was 15%, and rose sharply with increasing SOFA severity at admission, from no deaths among patients with SOFA scores of 0–12 to a mortality rate of 100% in the highest category (19–24, $p < 0.001$). Jones et al. reported a somewhat higher in-hospital mortality of 21% among 248 patients with severe sepsis in the emergency department, and similarly demonstrated that higher SOFA scores at presentation and at 72 hours were strongly associated with increased mortality.^[7] Do et al. reported a considerably higher mortality of 40.1% in their ICU-based multicentre cohort, with SOFA scores ≥ 8 significantly associated with hospital mortality and scores ≥ 10 associated with ICU mortality, likely reflecting the greater baseline severity of an exclusively ICU-admitted population compared with the present emergency department cohort.^[6] Baradari et al. and Razack et al. both similarly demonstrated a strong association between higher SOFA scores and mortality risk, reinforcing the consistency of this relationship across different critical illness populations.^[5,4]

ICU admission, mechanical ventilation, and vasopressor requirement: ICU admission was required in 37% of patients in this study, mechanical ventilation in 18%, and vasopressor support in 36%, reflecting a substantial burden of organ dysfunction requiring advanced supportive care. Razack et al. similarly found that organ dysfunction frequently necessitated intensive care management in patients with severe peritoneal sepsis,^[4] and Baradari et al. reported that severity of illness at admission, as reflected by SOFA score, played an important role in determining the need for advanced interventions, including mechanical ventilation, in ICU patients.^[5] Jones et al. similarly emphasised that worsening organ dysfunction, as reflected by increasing SOFA scores, was associated with greater need for critical care interventions.^[7] and Do et al. demonstrated that severity scores such as SOFA were significantly associated with ICU mortality in a multicentre sepsis cohort.^[6] The requirement for vasopressor support in over a third of patients in the present study likewise reflects a considerable burden of circulatory dysfunction, consistent with the cardiovascular component of the SOFA score being closely linked to adverse outcomes across these comparable studies.

Length of hospital and ICU stay: Length of hospital stay in this study varied widely, with the highest proportion of patients (14%) staying 14 days, and length of both hospital and ICU stay

showed a statistically significant association with SOFA category ($p=0.042$ and $p<0.001$ respectively). Baradari et al. similarly found that the mean duration of ICU and hospital stay was significantly longer among patients who died compared with survivors ($p<0.001$), reinforcing the link between prolonged hospitalisation and greater illness severity.^[5] In contrast, Jain et al., in a tertiary care ICU cohort with a mean ICU stay of 9.32 days, did not find a statistically significant association between ICU stay and survival ($p=0.461$), suggesting that length of stay may reflect overall disease burden without necessarily predicting mortality in every setting.^[9] Do et al. similarly noted that ICU and hospital length of stay were important outcome measures in their multicentre sepsis cohort, even though their primary analytic focus was on mortality prediction using SOFA and APACHE II scores.^[6]

Clinical implications: Collectively, these findings support the use of the SOFA score, both as a single admission measurement and as a serial assessment over the first 48 hours, as a practical bedside tool for early risk stratification of patients with sepsis in the emergency department. The consistency of the association between higher SOFA scores and adverse outcomes across the present study and comparable literature from both emergency department and intensive care settings reinforces its clinical utility in guiding decisions regarding escalation of care, threshold for ICU admission, and intensity of monitoring, particularly in resource-limited settings where such simple, calculable scores can meaningfully assist triage and resource allocation.

CONCLUSION

In this prospective observational study of 100 patients with sepsis presenting to the emergency department, the SOFA score at admission and its change over the first 48 hours were strongly associated with in-hospital mortality, vasopressor requirement, mechanical ventilation, and length of hospital and ICU stay. Non-survivors had significantly worse respiratory, coagulation, hepatic, cardiovascular, neurological, and renal parameters, and significantly higher SOFA scores at every time point assessed. These findings support the SOFA score as a valuable, practical tool for

early severity assessment and outcome prediction in patients with sepsis presenting to the emergency department.

Financial support and sponsorship

No funding was received for this study.

Conflicts of interest

The authors declare no conflict of interest.

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