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Original

Comparative Evaluation of SOFA and SAPS-3 scores for Predicting ICU Mortality in Sepsis Patients: A Prospective Observational Study from South India

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ABSTRACT

Background: Sepsis is a life-threatening state resulting from an ineffective biological host response to infection resulting in organ dysfunction with high mortality, especially in intensive care unit (ICU) settings. Despite progress in its management, early prognosis of sepsis remains difficult. Severity scoring systems have been developed to assess disease severity and predict outcomes, including the Sequential Organ Failure Assessment (SOFA) score and the Simplified Acute Physiology Score-3 (SAPS-3). This study sought to evaluate and compare the prognostic utility of SOFA and SAPS-3 scores in predicting ICU mortality in patients with sepsis at a tertiary care center in South India.

Methods: A prospective observational study was performed on 316 adult patients who were admitted to the medical intensive care unit with a confirmed or probable diagnosis of sepsis based on the criteria of Sepsis-3 definition. SOFA and SAPS-3 scores were determined using the relevant worst clinical and laboratory parameters recorded within the first 24 hours of ICU admission. Follow-up continued through discharge or death. Statistical analysis included chi-square tests, binomial logistic regression for predictor variables, and Receiver Operating Characteristic (ROC) curve to ascertain the predictive accuracy of each scoring system.

Results: Of the 316 sepsis patients enrolled, ICU mortality was 56%, with non-survivors being significantly older and having higher rates of ventilation and inotrope use ($p < 0.05$). All severity scores were significantly elevated among non-survivors ($p < 0.001$). ROC analysis demonstrated that SOFA (AUC = 0.832) and SAPS-3 (AUC = 0.819) had excellent discriminative ability for predicting ICU mortality, outperforming OASIS (AUC = 0.779) and LODS (AUC = 0.722). Thus, SOFA and SAPS-3 emerged as the most reliable prognostic tools for outcome prediction in sepsis patients in South Indian ICUs.

Conclusion: The prognostic value of SOFA and SAPS-3 scores for predicting ICU mortality among patients with sepsis was excellent. SOFA also had slightly more discriminative ability than SAPS-3, making it a useful and trusted tool for predicting outcomes early and guiding clinical decisions in critical care.

Keywords:
Simplified Acute Physiology Score III (SAPS III) and sequential organ failure assessment (SOFA)score, ICU, Mortality

1. INTRODUCTION

Sepsis is a serious clinical syndrome due to an out-of-control host response to infection, resulting in life-threatening organ dysfunction and a high rate of mortality (1). Today, despite major strides in diagnosis and treatment, sepsis remains one of the leading causes of death in ICUs around the world, with approximately a 25–30% mortality (2).

Therefore, early recognition of and accurate assessment of illness severity is paramount to management and improved patient outcomes (3).

The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) identified sepsis as organ dysfunction defined as an increase of ≥2 points in the Sequential Organ Failure Assessment (SOFA) score (1). The SOFA score was developed by the European Society of Intensive Care Medicine to objectively quantify dysfunction across six organ systems—respiratory, cardiovascular, hepatic, coagulation, renal, and neurological (4,5). The use of serial SOFA scores is a reliable predictor of morbidity and mortality in critically ill patients (6,7).

Concurrently, the Simplified Acute Physiology Score (SAPS) was created to provide an overall severity assessment that could be applied to a variety of ICU populations. The evolution of SAPS II, published in 1993, was based predominantly upon cohorts from Europe and North America, limiting its representation of other parts of the world (8). Subsequent to SAPS II, the SAPS-3 model was developed to address some contextual limitations by including global data points and refreshing the predictive variables of age, PLOS prior to ICU admission, Glasgow Coma Scale, temperature, creatinine, bilirubin, platelets, heart rate, blood pressure, and oxygenation. This enhanced model allows for the more accurate estimation of mortality probability at ICU admission and is particularly useful for benchmarking and quality assessment (8,9).

While SOFA is still the mainstay for sepsis diagnosis and monitoring, SAPS-3 offers a wider physiological context that includes both acute and chronic variables that influence mortality. Studies have compared these two systems and suggest that SAPS-3 may have better discriminative accuracy for mortality than SOFA, especially in heterogeneous ICU populations (10,11). However, there is no data to validate the performance of these advanced scoring systems in the Indian context remain scarce, despite contextual differences in patient population, healthcare infrastructure, and burden of diseas.

This study therefore aims to compare the predictive accuracy of SOFA and SAPS-3 scores for ICU mortality in patients with sepsis treated at a tertiary care hospital in South India. Establishing predictive validity for this population may improve risk prediction, resource allocation, and patient outcomes.

2. MATERIALS AND METHODS

Study Design and Setting

This was a prospective observational study carried out at the Department of Medicine, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu, India. The study was conducted over an eight-month period from October 2023 to June 2024. The hospital is a tertiary-care facility that has a well-established multidisciplinary intensive care unit (ICU) where patients are admitted for a variety of critical illnesses, including sepsis. The research ethics board granted ethical approval for the study study before initiation. All participants, or their legally authorized representatives, provided written informed consent before enrollment.

Study Population

A total of 316 consecutive adult patients admitted to the medical critical care wards with a confirmed or probable diagnosis of sepsis, as defined by the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3), were included in the study. Patients were enrolled consecutively after fulfilling the inclusion and exclusion criteria to minimize selection bias.

Inclusion Criteria

Adults aged ≥ 18 years. Patients admitted to the medical ICU with a confirmed or probable diagnosis of sepsis as per Sepsis-3 guidelines, characterized by infection with acute organ dysfunction (increase in SOFA score ≥ 2 points). Patients with a well-defined clinical outcome (discharge or in-hospital mortality).

Exclusion Criteria

Patients unwilling to participate or those whose relatives declined consent. Patients admitted for conditions other than sepsis (e.g., trauma, poisoning, postoperative non-infectious cases). Patients with ICU stay less than 24 hours, as adequate data for scoring systems could not be obtained.

Sample Size Calculation

The minimum sample size was calculated based on the formula:

$$n=4pq/d2$$

where p = 20.4% (expected sepsis mortality rate from previous studies) and q = 1 – p = 79.6%. With a 95% confidence interval and allowable error d = 4%, the estimated sample size was 316 patients.

This number was sufficient to provide adequate power for statistical comparison of the predictive performance of the selected scoring systems.

Scoring Systems

All patients were diagnosed and categorized based on the Sepsis-3 criteria. Organ dysfunction was defined by an increase of ≥ 2 points in the Sequential Organ Failure Assessment (SOFA) score. The following scoring systems were calculated for each patient within the first 24 hours of ICU admission, using the worst recorded values for each physiological or biochemical variable:

1. SOFA (Sequential Organ Failure Assessment): A total of six organ systems—respiratory, cardiovascular, renal, hepatic, hematologic, and central nervous system—were reviewed and individual organ dysfunction scores from 0 to 4 were assigned to each organ system based on the degree of dysfunction. The total score (0–24) reflects the overall severity of organ failure.

2. SAPS-3 (Simplified Acute Physiology Score 3): This score includes information available before ICU admission (demographics, comorbidities, admission type) and physiological information (vital signs, laboratory values, including bilirubin, creatinine, platelets, pH, and oxygenation indices). We calculated predicted hospital mortality using the SAPS-3 equation for each patient.

Additional scores such as **OASIS** (Oxford Acute Severity of Illness Score) and **LODS** (Logistic Organ Dysfunction System) were also calculated in the larger comparative analysis, however, this study primarily focuses on the performance of SOFA and SAPS-3 for predicting in sepsis patients.

Data Collection

A systematic proforma was employed to gather information on demographics, clinical characteristics, and laboratory results for all participants. The following data were documented: Age, sex, and comorbidities (e.g., diabetes, hypertension, CKD, COPD). Vital signs at the time of admission (heart rate, respiratory rate, mean arterial pressure, temperature, SpO_2). Laboratory values: total leucocyte count, hemoglobin, platelet count, liver function tests (bilirubin, AST/ALT), renal parameters (urea, creatinine), arterial blood gas (pH, PaO_2/FiO_2), and serum albumin. Clinical outcome: Mortality in the ICU or survival (discharged alive). Each patient 's progress was monitored prospectively until either hospital discharge or death.

Outcome Variables

The primary outcome variable was ICU mortality, defined as death during the index ICU admission. Secondary outcomes were predicted mortality based on each scoring system, length of ICU stay, and need for organ support (e.g.mechanical ventilation, vasopressors, renal replacement therapy).

Statistical Analysis

The data were collected using Microsoft Excel and analyzed with SPSS version 26.0 (IBM Corp., Armonk, NY). Continuous variables were reported as mean ± standard deviation (SD) or median [interquartile range (IQR)], and categorical variables were reported as frequency and percentage. We used the Student's t-test or Mann–Whitney U test for continuous variables and the Chi-square test for categorical variables to compare survivors and non-survivors. The predictive accuracy of the SOFA and SAPS-3 for ICU mortality was assessed using Receiver Operating Characteristic (ROC) curve analysis. Area Under the Curve (AUC) was calculated for both scoring systems and a larger AUC reflected enhanced discriminative ability, while optimal cutoff points were determined using Youden's index. Calibration of each model was assessed by the Hosmer–Lemeshow goodness-of-fit test. We conducted multivariate logistic regression analysis using SAPS-3 and SOFA scores, age, sex, and comorbidities, in order to identify independent predictors of ICU mortality. Statistical significance was defined as $p < 0.05$.

3. RESULTS

This prospective observational study enrolled 316 patients who were admitted to the medical intensive care unit (ICU) with a confirmed or probable diagnosis of sepsis. A total of 139 (44%) survived and 177 (56%) died. Table 1 describes the demographic, clinical, and laboratory characteristics of survivors and non-survivors.

Table 1 summarizes the baseline characteristics of 316 sepsis patients, comparing survivors and non-survivors. Non-survivors were significantly older ($p = 0.021$) and had higher rates of mechanical ventilation and inotrope use ($p < 0.05$). Diabetes and coronary artery disease were more prevalent among non-survivors ($p = 0.020$ and $p = 0.033$,

respectively). All severity scores - SOFA, SAPS-3, OASIS, and LODS - were significantly higher in non-survivors ($p < 0.001$), indicating greater disease severity and organ dysfunction in this group.

Table 1. Baseline characteristics of survivors and non-survivors among sepsis patients

Variable	Survivors (n = 139)	Non-survivors (n = 177)	Total (n = 316)	P-value
Age (years)	53.2 ± 14.9	56.8 ± 12.5	55.2 ± 13.7	0.021 *
Male (%)	68 (48.9)	89 (50.3)	157 (49.7)	0.810
Ventilation (%)	64 (46.0)	102 (57.6)	166 (52.5)	0.041 *
Inotropes (%)	12 (8.6)	100 (56.6)	112 (35.4)	<0.001*
Comorbidities				
Diabetes	74 (53.2)	117 (66.1)	191 (60.4)	0.020 *
Hypertension	60 (43.2)	91 (51.4)	151(47.8)	0.145
CAD	5 (18.0)	50 (28.2)	75(23.7)	0.033 *
Renal failure	25 (18.0)	37 (20.9)	62(19.2)	0.517
SOFA	6.4 ± 2.5	9.9 ± 2.8	8.3 ± 3.2	<0.001*
SAPS-3	62.7 ± 9.4	74.4 ± 9.8	69.2 ± 11.3	<0.001*
OASIS	36.9 ± 4.9	42.1 ± 5.6	39.8 ± 5.9	<0.001*
LODS	5.9 ± 1.9	7.5 ± 2.1	6.9 ± 2.1	<0.001*

$p < 0.05$ indicates statistical significance (95% CI).

Comparison of baseline demographic and clinical characteristics Table 1 between survivors and non-survivors among the study population (n = 316).

Figure 1 indicates that non-survivors were significantly older than survivors (56.8 ± 12.5 vs 53.2 ± 14.9 years, $p = 0.021$). The requirement for mechanical ventilation ($p = 0.041$) and supportive inotrope ($p < 0.001$) was significantly higher among non-survivors. Diabetes and coronary artery disease (CAD) were also more prevalent in the non-survivor group. Furthermore, all four severity scores (SOFA, SAPS-3, OASIS, and LODS) were significantly higher among non-survivors, indicating greater illness severity and poorer prognosis ($p < 0.001$ for all).

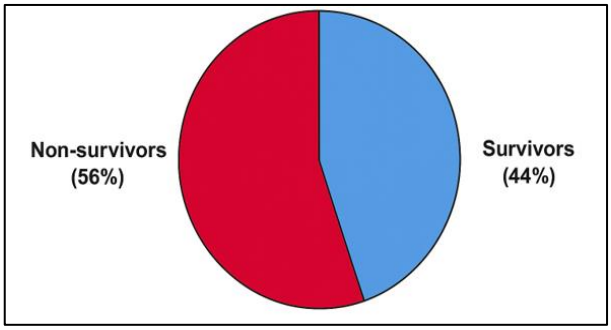

Figure 1. Outcome distribution among sepsis patients (n = 316)

Binomial Logistic Regression Analysis

Multivariable logistic regression analysis was performed to identify independent predictors of ICU mortality.

Age and male gender were significantly associated with mortality (AOR = 2.98, 95% CI 1.16–5.82, p = 0.003; and AOR = 2.26, 95% CI 1.18–4.31, p = 0.013, respectively).

The need for mechanical ventilation (AOR = 4.63, $p < 0.001$) and inotrope use (AOR = 18.53, $p < 0.001$) emerged as strong independent predictors of mortality. Among comorbidities, diabetes (AOR = 4.63, p = 0.028) and CAD (AOR = 2.27, p = 0.002) were significant predictors, whereas hypertension and renal failure were not.

On univariate analysis **Figure 2** increasing age, male sex, requirement of ventilation and inotropic support, diabetes, and coronary artery disease (CAD) were significantly associated with mortality ($p < 0.05$). Multivariate analysis further identified age (AOR = 2.98; $p = 0.003$), male gender (AOR = 2.26; $p = 0.013$), ventilation (AOR = 4.63; $p < 0.001$), inotropic support (AOR = 18.53; $p < 0.001$), diabetes (AOR = 4.63; $p = 0.028$), and CAD (AOR

= 2.27; p = 0.002) as independent predictors of mortality among critically ill sepsis patients.

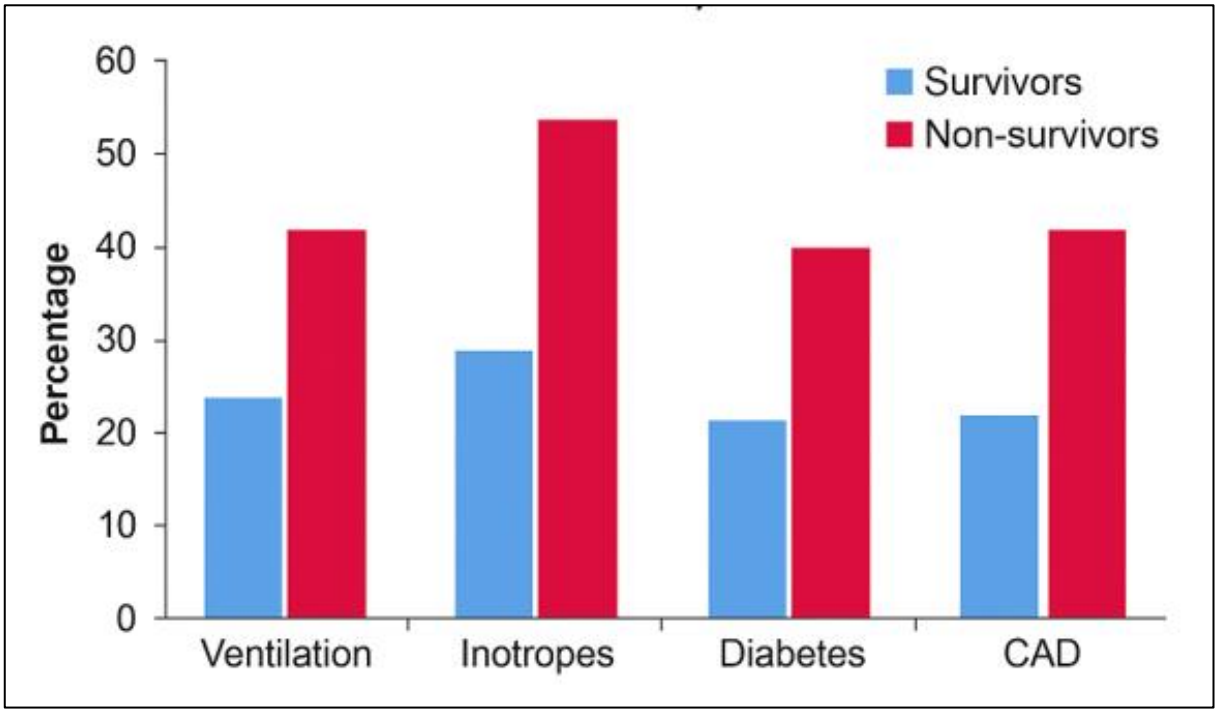

Figure 2. Baseline characteristics

Predictive Performance of Scoring Systems

Receiver Operating Characteristic (ROC) analysis was performed to evaluate the discriminative ability of the four scoring systems (SOFA, SAPS-3, OASIS, and LODS) in predicting ICU mortality.

The SOFA score demonstrated the highest predictive performance with an AUC = 0.832 ($p < 0.001$), followed closely by SAPS-3 (AUC = 0.819, $p = 0.001$).

The OASIS score showed a good predictive value (AUC = 0.779, $p = 0.004$), while LODS had the lowest but still statistically significant predictive ability (AUC = 0.722, $p = 0.002$).

These findings suggest that both SOFA and SAPS-3 scoring systems outperform OASIS and LODS in discriminating survivors from non-survivors among sepsis patients in the ICU.

Table 2. Receiver Operating Characteristic (ROC) curve comparison of scoring systems

Scoring System	AUC	P-value
SOFA	0.832	<0.001*
SAPS-3	0.819	0.001*
OASIS	0.779	0.004*
LODS	0.722	0.002*

Comparison Table 2 of predictive performance of severity scoring systems for mortality among sepsis patients.

Among the four scoring systems **figure 3** evaluated, the SOFA score demonstrated the highest predictive accuracy for mortality with an AUC of 0.832 ($p < 0.001$), followed closely by SAPS-3 (AUC = 0.819, $p = 0.001$). The OASIS (AUC = 0.779) and LODS (AUC = 0.722) scores also showed statistically significant predictive ability, though comparatively lower than SOFA and SAPS-3.

4. DISCUSSION

In this prospective observational study of 316 adult sepsis patients admitted to a tertiary-care ICU in South India, we found that both the Sequential Organ Failure Assessment (SOFA) score and the Simplified Acute Physiology Score-3 (SAPS-3) demonstrated excellent prognostic performance for ICU mortality, with AUCs of 0.832 and 0.819 respectively. Both scores significantly discriminated between survivors and non-survivors ($p < 0.001$). These findings support the utility of both scoring systems for early prognostication in sepsis, and affirm that in our cohort, SOFA had a slight edge over SAPS-3 in discrimination.

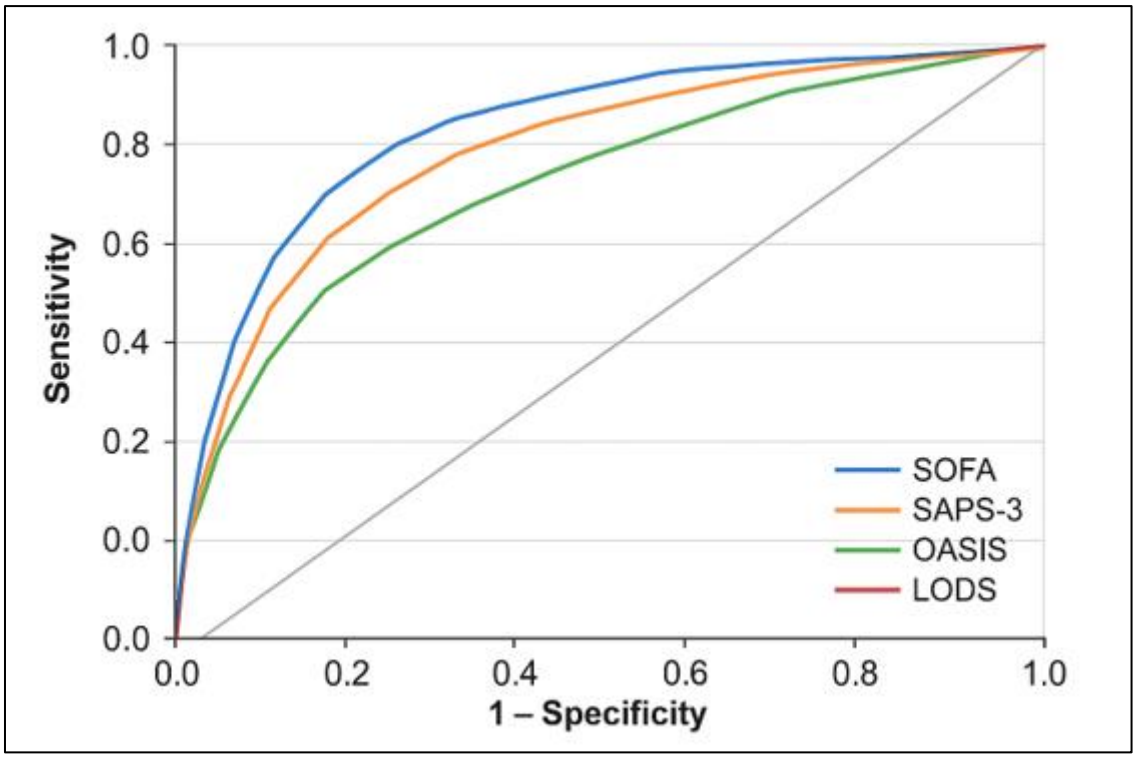

Figure 3. ROC Curves

Our results are congruent with prior literature showing a strong association between SOFA scores and mortality in sepsis. For example, Udy AA et al., a large multicenter ICU study found that an increase in SOFA score of ≥2 points within 24 h was a better discriminator of in-hospital mortality than the older SIRS or qSOFA criteria (AUROC ~0.753) in critically ill patients with suspected infection (12). Moreover, Ferreira FL et al., studies analysing SOFA in sepsis have confirmed that higher first-day or maximum SOFA scores correlate closely with mortality: for example, scores above 11 predicted very high mortality (7). Our mean SOFA values among non-survivors (9.9 ± 2.8) and survivors (6.4 ± 2.5) align well with this pattern.

With respect to SAPS-3, comparative data are somewhat more limited in sepsis-specific populations. Some studies (e.g., comparing SAPS-3 and SOFA) found SAPS-3 to outperform SOFA, particularly in sepsis cohorts: for example, one literature reported Zhu Y et al., SAPS-3 discrimination superior to SOFA for 28-day mortality in sepsis patients (13). In our study the difference between SOFA and SAPS-3 was modest but consistent in favour of SOFA. The moderately higher AUC for SOFA may reflect its simplicity, focus on organ dysfunction (rather than physiology and comorbidities), and better calibration in our population. Indeed, studies of Do SN et al., SOFA in diverse settings (including low- and middle-income countries) support its robust prognostic significance (14).

Beyond discrimination, our regression analyses also identified key independent predictors of mortality: increasing age, male gender, requirement for mechanical ventilation, use of inotropes, presence of diabetes mellitus, and coronary artery disease. These factors are well-known risk markers in sepsis literature. The high odds ratio of inotropic support (AOR ≈18.5) underscores the very high risk associated with early haemodynamic instability in sepsis. The fact that both SOFA and SAPS-3 were significantly higher in non-survivors highlights that the severity of organ dysfunction (captured by the scoring systems) together with comorbidity and acute interventions determine outcome.

However, there are important limitations and considerations. Our study is single-centre and observational, which may limit generalisability. The performance of scoring systems can vary by population, case-mix, local ICU practices and available resources; calibration (i.e., how predicted mortality aligns with observed mortality) was not formally reported in our manuscript and merits further work. Some previous studies emphasise that although discrimination (AUC) can be good, calibration may be suboptimal (9). Also, we calculated the scores based on the worst values

within the first 24 hours; we did not evaluate dynamic changes (for example delta-SOFA) which some studies suggest may improve prognostic prediction further (15). Furthermore, although we compared four scoring systems, our primary focus here is SOFA vs SAPS-3; the results for OASIS and LODS are secondary and thus warrant cautious interpretation.

Another limitation is that we did not evaluate longer-term outcomes beyond ICU discharge (e.g., hospital mortality, 28-day or 90-day mortality) which might differ. In other studies, the performance of scoring systems can decline when extended beyond ICU stay(14). Also, given the observational design, we cannot comment on whether using these scores to guide management would improve outcomes — that would require interventional or prospective application studies.

Nevertheless, the strengths of our study include a reasonably large sample size (n=316) from a tertiary care centre in South India, prospective data collection, use of standardized definitions (Sepsis-3), and application of multiple scoring systems enabling head-to-head comparison in a local context. This contributes to the relatively scarce literature from Indian ICUs on sepsis severity scoring and prognostication.

5. CONCLUSION

In summary, our results indicate that both SOFA and SAPS-3 are effective tools for early mortality prediction in sepsis patients admitted to ICU. Given the marginal difference in discrimination but practical advantages of SOFA (simplicity, organ-dysfunction focus), it may be the preferred option in resource-constrained settings, while SAPS-3 remains a strong alternative when full data are available. Future research could focus on external validation in other Indian ICUs, assessment of calibration in our population, exploration of dynamic scoring (e.g., change in SOFA over time), and evaluation of whether implementation of scoring-guided pathways improves patient outcomes and resource use.

6. CONFLICT OF INTEREST AND FUNDING

There were no conflicts of interest declared by the investigators. The study received no external funding or sponsorship.

7. REFERENCES

1. Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA. 2016 Feb 23;315(8):801–10.
2. Liu V, Escobar GJ, Greene JD, Soule J, Whippy A, Angus DC, et al. Hospital deaths in patients with sepsis from 2 independent cohorts. JAMA. 2014 July 2;312(1):90–2.
3. Severity scoring systems in the critically ill | BJA Education | Oxford Academic [Internet]. [cited 2025 Oct 27]. Available from: https://academic.oup.com/bjaed/article-abstract/8/5/181/268370
4. The SOFA (Sepsis-related Organ Failure Assessment) score to describe organ dysfunction/failure | Intensive Care Medicine [Internet]. [cited 2025 Oct 27]. Available from: https://link.springer.com/article/10.1007/BF01709751
5. Vincent JL, de Mendonca A, Cantraine F, Moreno R, Takala J, Suter PM, et al. Use of the SOFA score to assess the incidence of organ dysfunction/failure in intensive care units: Results of a multicenter, prospective study. Critical Care Medicine. 1998 Nov;26(11):1793.
6. Vincent JL, Ferreira F, Moreno R. Scoring systems for assessing organ dysfunction and survival. Crit Care Clin. 2000 Apr;16(2):353–66.
7. Ferreira FL, Bota DP, Bross A, Mélot C, Vincent JL. Serial Evaluation of the SOFA Score to Predict Outcome in Critically Ill Patients. JAMA. 2001 Oct 10;286(14):1754–8.
8. The importance of technology for achieving superior outcomes from intensive care | Intensive Care Medicine [Internet]. [cited 2025 Oct 27]. Available from: https://link.springer.com/article/10.1007/BF01709743
9. Knaus WA, Zimmerman JE, Wagner DP, Draper EA, Lawrence DE. APACHE-acute physiology and chronic health evaluation: a physiologically based classification system. Crit Care Med. 1981 Aug;9(8):591–7.
10. Comparison of qSOFA score, SOFA score, and SIRS criteria for the prediction of infection and mortality among surgical intermediate and intensive care patients | World Journal of Emergency Surgery | Full Text [Internet]. [cited 2025 Oct 27]. Available from: https://wjes.biomedcentral.com/articles/10.1186/s13017-020-00343
11. Hamsen U, Lefering R, Fisahn C, Schildhauer TA, Waydhas C. Workload and severity of illness of patients on intensive care units with available intermediate care units: a multicenter

cohort study. Minerva Anestesiol. 2018 Aug;84(8):938–45.
12. Raith EP, Udy AA, Bailey M, McGloughlin S, MacIsaac C, Bellomo R, et al. Prognostic Accuracy of the SOFA Score, SIRS Criteria, and qSOFA Score for In-Hospital Mortality Among Adults With Suspected Infection Admitted to the Intensive Care Unit. JAMA. 2017 Jan 17;317(3):290–300.
13. Zhu Y, Zhang R, Ye X, Liu H, Wei J. SAPS III is superior to SOFA for predicting 28-day mortality in sepsis patients based on Sepsis 3.0 criteria. International Journal of Infectious Diseases. 2022 Jan;114:135–41.
14. Do SN, Dao CX, Nguyen TA, Nguyen MH, Pham DT, Nguyen NT, et al. Sequential Organ Failure Assessment (SOFA) Score for predicting mortality in patients with sepsis in Vietnamese intensive care units: a multicentre, cross-sectional study. BMJ Open. 2023 Mar 14;13(3):e064870.
15. The early change of SOFA score as a prognostic marker of 28-day sepsis mortality: analysis through a derivation and a validation cohort | Critical Care | Full Text [Internet]. [cited 2025 Oct 27]. Available from: https://ccforum.biomedcentral.com/articles/10.1186/s13054-019-2665-5