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ORIGINAL RESEARCH

# Can CALLY score predict mortality and ICU stay in elderly patients with sepsis?

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## Abstract

**Background**: Sepsis remains a leading cause of mortality, and accurate, early identification of high-risk sepsis patients is essential in elderly adults. Scoring systems, such as Quick Sequential Organ Failure Assessment (qSOFA) and Systemic Inflammatory Response Syndrome (SIRS), are widely used but have limitations in predicting outcomes in elderly patients. The CRP-albumin-lymphocyte (CALLY) score is a potential alternative, but its role in predicting mortality and Intensive Care Unit (ICU) admission in older sepsis patients is limited. **Methods**: This retrospective cohort study included patients aged 65 years and older admitted with sepsis to a tertiary hospital covering the years 2021 to 2023. Demographic data, qSOFA, SIRS, and CALLY scores, length of hospital and ICU stay, and mortality outcomes were collected. Statistical analyses were conducted using *t*-tests and chi-square tests, with a significance threshold set at $p < 0.05$. **Results**: The study included 150 patients, with a mean age of 81.1 ± 8.3 years. 50 patients (33.3%) died, and 42 patients (28.0%) required ICU admission. Patients who died had significantly higher qSOFA and SIRS scores, but lower CALLY scores compared to survivors. ICU length of stay ranged from 1 to 34 days, with a mean of 10.6 ± 8.4 days. ICU admission rates were higher in patients who died ($p < 0.001$), but length of stay did not differ significantly between survivors and nonsurvivors ($p = 0.129$). Although CALLY scores did not significantly differ between ICU and non-ICU groups, qSOFA scores were higher in those admitted to the ICU ($p = 0.006$). **Conclusions**: The qSOFA score effectively predicted ICU admission and mortality in older sepsis patients, but its reliability may be compromised in those with cognitive decline. The CALLY score demonstrated potential as an adjunct tool for mortality prediction. Further research is necessary to develop and validate new scoring systems for sepsis assessment in elderly patients.

**Keywords**
Sepsis; Emergency department; Old patients; CALLY score

## 1. Background

Sepsis is a life-threatening organ dysfunction resulting from the host's irregular response to infection. Despite early diagnosis, early antibiotic administration, and advancements in treatment, 15%–25% of patients do not survive. The mortality rates rise to 30%–40% as patients progress toward septic shock [1]. For this reason, early diagnosis and early treatment are important to help patients avoid progressing to shock, and therefore mortality [2]. Emergency departments are frequently overwhelmed by crowding, which significantly delays both timely diagnosis and effective treatment of sepsis [3]. Consequently, there is a pressing need for a practical and rapid diagnostic tool that can facilitate early recognition of septic patients in such congested environments. When evaluating sepsis, many scoring systems are used, and the purpose of these scoring systems is to make an early diagnosis, assess severity, and predict mortality. There have been concerns in recent discussions that criteria in scoring systems might not adequately capture the early signs of sepsis in the geriatric population, potentially resulting in missed or delayed interventions [4].

The Sequential Organ Failure Assessment (SOFA) score is a standardized tool for assessing organ failure and short-term mortality, especially in sepsis [2]. Although practical, this score exhibits limitations in elderly individuals, since it ignores essential geriatric factors such as frailty, cognitive decline, and multimorbidity. Also, in elderly patients, Systemic Inflammatory Response Syndrome (SIRS) criteria, such as fever and tachycardia, are often blunted—fever may be absent or tachycardia might be masked by beta blockers [5, 6]. A study revealed that scoring methods like Mortality in Emergency Department Sepsis (MEDS), Predisposition, Insult, Response, Organ dysfunction (PIRO), and Quick Sequential Organ Failure Assessment (qSOFA) were inadequate in predicting prognosis in elderly individuals with sepsis [7]. These findings indicate that existing scoring tools may inadequately assess mortality risk in elderly people, underscoring the necessity for novel methodologies that incorporate age-specific clinical factors. Without clear protocols, there is a risk of misclassification, which may lead to either underestimation or overestimation of sepsis severity in older patients [8]. Therefore, alternative scoring systems may be needed to predict outcomes more accurately in older patients with sepsis.

Researchers have recently developed a parameter called the CRP-albumin-lymphocyte (CALLY) index, which includes C-Reactive Protein (CRP), serum albumin level, and lymphocyte count. The CALLY index has mostly been used in studies on patients with malignancies [9], but considering the parameters of this score, it might be convenient to use the CALLY score to predict mortality in sepsis patients. For instance, Cui and colleagues revealed a close relationship between CRP levels and poor prognosis in sepsis patients [10]. In addition, hypoalbuminemia has a strong predictive value for poor prognosis [11], and lymphopenia is seen as a marker of compromised immunity and negative outcomes in patients with sepsis [12]. In sepsis patients, however, current data on the use of the CALLY index are limited. The aim of the study was, therefore, to investigate and compare the effects of qSOFA, SIRS, and CALLY scores on the length of stay and mortality of older patients admitted to the emergency department (ED).

## 2. Methods

### 2.1 Study design and participants

This was a retrospective cohort study comprising patients aged 65 years and above who were hospitalized at the ED of Istanbul Prof. Dr. Süleyman Yalçın City Hospital with a sepsis diagnosis between 01 January 2021 and 31 December 2023. Sepsis was diagnosed by clinical assessment as well as positive confirmation of blood cultures. Ethical approval for this study was secured from the Non-Interventional Clinical Research Ethics Committee of Istanbul Medipol University on 28 June 2024, with approval number E-10840098-202.3.02-3871. This study was conducted and reported in accordance with the Transparent Reporting of a multivariable prediction model for Individual Prognosis or Diagnosis guideline.

We documented demographic data (age, sex), parameters from the qSOFA, SIRS, and CALLY indices, in addition to the duration of hospital and intensive care unit (ICU) admissions and mortality status of patients diagnosed with sepsis in the ED. All predictor variables including blood tests which enables us to assess used indices were obtained at the time of initial ED presentation as a hospital policy especially in older adults. The prediction model was developed using these values, and no imputation was applied.

Inclusion criteria for the study required that patients be at least 65 years of age and admitted to either the hospital ward or the ICU with a diagnosis of sepsis. Exclusion criteria included patients who were transferred to an external facility and individuals diagnosed with nephrotic syndrome, active malignancy, or liver failure, as these illnesses potentially obscure the study outcomes due to their correlation with low serum albumin levels. The latter conditions were determined using the International Classification of Diseases codes and hospital data set. In addition, patients who received cardiopulmonary resuscitation upon arrival of the ED were also excluded.

The SIRS score is a scoring system established in 1992 by the American College of Chest Physicians and the Society of Critical Care Medicine as a fundamental component of sepsis diagnosis. To declare SIRS, a minimum of two of the following four criteria must be met: fever or hypothermia: $>38$ °C or $<36$ °C, heart rate above 90 beats per minute, respiration rate surpassing 20 breaths per minute or Partial pressure of arterial carbon dioxide ($PaCO_2$) below 32 mmHg, white blood cell count greater than 12,000/$mm^3$ or less than 4000/$mm^3$ with over 10% band form neutrophils. Patients with a score of 2 or above were determined positive for SIRS in the study.

For qSOFA score each parameter counted is valued at 1 point. The parameters include systolic blood pressure $\leq$100 mmHg, Glasgow Coma Scale $\leq$13, and respiratory rate $\geq$22/minute. Patients with a score of 2 or above were determined positive for qSOFA in the study.

The CALLY score comprises CRP, serum albumin levels, and total lymphocyte count, which indicate the body's inflammatory status relative to nutritional and immune system health. The CALLY index is computed with the following equation.

$$CALLY = \frac{Albumin\ (g/L)\ \times\ Lymphocyte\ count\ (1000/\mu L)}{CRP\ (mg/dL)}$$

Previous studies about the CALLY score do not identify a precise cut-off number for this metric. We determined the optimal cutoff value for CALLY using the Youden Index in the Receiver Operating Characteristic (ROC) curve analysis. The identified cutoff value was 2. The mortality curve is shown in Fig. 1.

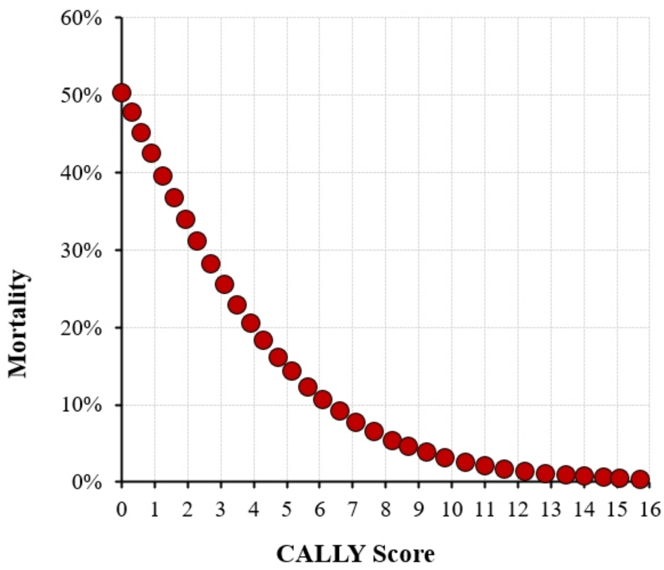


**FIGURE 1. Mortality curve of CALLY score for determination of cut-off value.** CALLY: C-Reactive Protein-albumin-lymphocyte.

## 2.2 Statistical methods

Descriptive statistics for the data included mean, standard deviation, median, minimum, maximum, frequency, and percentage values. The distribution of variables was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. For the analysis of independent continuous variables with a normal distribution, the independent samples *t*-test was used; for independent continuous variables that did not follow a normal distribution, the Mann-Whitney U test was employed. The chi-square test was applied to analyze categorical independent variables. The effect size and cut-off value were determined using ROC curve analysis. The effect size was further investigated using univariate and multivariate logistic regression analyses. All statistical analyses were performed using SPSS version 28.0 (IBM Corp., Armonk, NY, USA). Statistical significance was set at $p < 0.05$.

# 3. Results

A total of 502 patients with a clinical diagnosis of sepsis were initially identified, of whom 160 (31.9%) were under 65 years of age and 342 (68.1%) were 65 years or older. Of these patients, 136 (27.1%) were referred to other facilities, and 46 (9.2%) were excluded due to incomplete data or a history of comorbidities potentially affecting the CALLY score or having had cardiopulmonary resuscitation. Consequently, 150 (29.9%) patients were included in the final analysis. The patients in the study were aged between 66 and 99 years, with a computed average age of 81.5 years (mean $\pm$ standard deviation: 81.1 $\pm$ 8.3). In the analyzed cohort, 82 patients were female (54.7%) and 68 were male (45.3%). The clinical and demographic parameters of patients were given in Table 1.

Upon assessment using the CALLY score, 46 patients (30.7%) had a score $\leq$2, whereas 104 patients (69.3%) had a score >2. The qSOFA score varied from 0 to 3, with a mean value of 2.1 $\pm$ 0.9. In 31 patients (20.7%), the qSOFA score was $\leq$1, whereas in 119 patients (79.3%) it exceeded 1. The SIRS score varied from 0 to 4, with a mean value of 2.3 $\pm$ 1.0. In 33 patients (22.0%), the SIRS score was $\leq$1, whereas in 117 patients (78.0%) it exceeded 1. In the study, the cut-off value for the CALLY score was established as 2 based on statistical analyses. In 46 patients (30.7%), the value was $\leq$2, whereas in 104 patients (69.3%) it was >2.

Among the 150 patients analyzed, 100 patients (66.7%) survived, and 50 patients (33.3%) did not. Those who died exhibited a significantly lower CALLY score ($p < 0.001$), yet had significantly higher qSOFA and SIRS scores ($p = 0.003$) compared with those who survived (see Tables 2 and 3). Fig. 2 shows the performances of each score based on mortality.

Forty-two patients (28.0%) were admitted to the ICU. The patients' ICU length of stay (LOS) ranged from 1.0 to 34.0 days, with a median of 7.5 days and a mean $\pm$ standard deviation of 10.6 $\pm$ 8.4 days. The hospital LOS ranged from 1.0 to 52.0 days, with a median of 8.0 days and a mean $\pm$ standard deviation of 11.0 $\pm$ 9.5 days. The ICU admission rate was significantly higher ($p < 0.01$) in patients who did not survive than in those who did. However, the hospital (*p*: 0.129) and ICU LOS did not show a significant difference (*p*: 0.639) between survivors and nonsurvivors.

We observed no significant difference in the CALLY score between those admitted to the ICU and those not (*p*: 0.608). By contrast, the qSOFA score was significantly higher in the ICU admission group (*p*: 0.006), as shown in Table 4. Although CALLY and SIRS scores showed no discriminatory ability for ICU admission (Area Under Curve (AUC): 0.527 (0.423–0.631) and AUC: 0.554 [0.447–0.660], respectively), the qSOFA score demonstrated a weak discriminatory ability (AUC: 0.636 (0.542–0.730)) (Fig. 3).

# 4. Discussion

Sepsis incidence typically peaks in patients in their sixth decade of life. In a retrospective study conducted by Angus *et al.* [13] which analyzed more than six million patients, the annual incidence of sepsis was reported as three per 1000 whereas in patients aged 85 years and older, it rises to 26.2 per 1000. The data obtained from another study indicated that age is an independent risk factor for both the development and fatal course of sepsis [14]. In this study, the age range of patients monitored for sepsis was between 66 and 99 years, with a mean age of 81 years. In the current study age was not found to have a significant effect on mortality. In elderly individuals, the immune system fails to generate a rapid and effective immune response against threats, and the immune response in patients over 65 years of age is similar [15]. As all patients included in the study were over 65 years of age, the lack of effect of age on mortality may be attributed to changes in immune reactions among older patients.

Various sepsis scoring systems have been established to assess disease severity and predict mortality, including the SIRS, SOFA, qSOFA, the National Early Warning Score, and the Modified Early Warning Score. Nonetheless, these techniques often exhibit only limited to moderate precision in stratifying risk and forecasting death outcomes in elderly individuals with sepsis [16]. In the present study, qSOFA and SIRS scores were found to be higher in patients who died. A previous study reported that in-hospital mortality was significantly higher in patients with positive qSOFA scores. Specifically, the in-hospital mortality rates for patients meeting zero, one, two, or three qSOFA criteria were reported as 0%, 7%, 18%, and 45%, respectively [17]. Also the study by Churpek *et al.* [18] demonstrated that qSOFA outperformed SIRS in predicting in-hospital mortality. The findings of the present study further support the notion that qSOFA is a more accurate predictor of in-hospital mortality than SIRS. The CALLY score, a novel prognostic biomarker, was first introduced by Müller *et al.* [19] in 2021 to predict survival outcomes in patients with hepatocellular carcinoma. Several studies have investigated the use of the CALLY score with oncologic patients; however, research on its impact on mortality in sepsis patients remains limited [20, 21]. One of the few studies in the literature, a retrospective, single-center observational study, demonstrated that the CALLY score could serve as an independent risk factor for both 30-day and 60-day mortality in sepsis patients [14]. The present study observed a low CALLY score to be predictive of high mortality in old sepsis patients, and its combination with qSOFA added a high value to predicting mortality. How-

**TABLE 1. Demographic and clinical characteristics of study patients.**

| | Min–Max | Median | Mean ± SD/n (%) |
|---|---|---|---|
| Age (yr) | 66.0–99.0 | 81.5 | 81.1 ± 8.3 |
| Gender | | | |
| Female | | | 82 (54.7%) |
| Male | | | 68 (45.3%) |
| SIRS | | | |
| Temperature (Celsius) | 36.0–39.0 | 36.0 | 36.7 ± 1.0 |
| $PaCO_2$ (mmHg) | 18.0–77.0 | 36.0 | 36.9 ± 8.0 |
| Respiratory Rate per min | 14.0–44.0 | 26.0 | 26.3 ± 6.1 |
| White Blood Cells ($\times 10^3/\mu L$) | 0.1–59.0 | 13.7 | 14.9 ± 10.2 |
| Pulse per min | 60.0–167.0 | 102.5 | 101.0 ± 20.7 |
| qSOFA | | | |
| Systolic Blood Pressure (mmHg) | 50.0–200.0 | 99.0 | 108.6 ± 30.8 |
| Glasgow Coma Scale | 3.0–15.0 | 14.0 | 12.2 ± 3.7 |
| Tachypnea | 14.0–44.0 | 26.0 | 26.3 ± 6.1 |
| CALLY | | | |
| C-Reactive Protein (mg/L) | 3.0–542.0 | 156.0 | 182.3 ± 111.6 |
| Albumin (g/L) | 13.0–42.0 | 29.0 | 28.9 ± 6.6 |
| Lymphocyte ($\times 10^3/\mu L$) | 0.1–4.3 | 0.8 | 1.0 ± 0.8 |
| CALLY Score | 0.1–160.0 | 1.4 | 6.5 ± 22.0 |
| $\leq 2$ | | | 46 (30.7%) |
| $>2$ | | | 104 (69.3%) |
| qSOFA Score | 0.0–3.0 | 2.0 | 2.1 ± 0.9 |
| $\leq 1$ | | | 31 (20.7%) |
| $>1$ | | | 119 (79.3%) |
| SIRS Score | 0.0–4.0 | 2.0 | 2.3 ± 1.0 |
| $\leq 1$ | | | 33 (22.0%) |
| $>1$ | | | 117 (78.0%) |
| CALLY/qSOFA/SIRS Score | | | |
| (−) | | | 83 (55.3%) |
| (+) | | | 67 (44.7%) |
| Intensive Care Unit Admission | | | |
| (−) | | | 108 (72.0%) |
| (+) | | | 42 (28.0%) |
| Intensive Care Unit Stay (d) | 1.0–34.0 | 7.5 | 10.6 ± 8.4 |
| Hospitalization in the Ward | | | |
| (−) | | | 49 (32.7%) |
| (+) | | | 101 (67.3%) |
| Length of Stay in the Ward (d) | 1.0–52.0 | 8.0 | 11.0 ± 9.5 |
| Mortality | | | |
| (−) | | | 100 (66.7%) |
| (+) | | | 50 (33.3%) |

*SIRS: Systemic Inflammatory Response Syndrome; qSOFA: Quick Sequential Organ Failure Assessment; CALLY: C-reactive protein-Albumin-Lymphocyte Index; $PaCO_2$: Partial pressure of arterial carbon dioxide; SD: Standard Deviation; Min–Max: Minimum–Maximum.*

**TABLE 2. The impact of CALLY, qSOFA, and SIRS scores on mortality.**

| | Mortality (−) (n = 100) | | Mortality (+) (n = 50) | | $p$ |
|---|---|---|---|---|---|
| | Mean ± SD/n (%) | Median | Mean ± SD/n (%) | Median | |
| CALLY Score | 9.1 ± 26.6 | 1.6 | 1.4 ± 1.5 | 1.1 | $<0.001^{m}$ |
| ≤2 | 59 (59.0%) | | 45 (90.0%) | | $<0.001^{\chi^2}$ |
| >2 | 41 (41.0%) | | 5 (10.0%) | | |
| qSOFA Score | 1.8 ± 0.9 | 2.0 | 2.7 ± 0.6 | 3.0 | $<0.001^{m}$ |
| ≤1 | 29 (29.0%) | | 2 (4.0%) | | $<0.001^{\chi^2}$ |
| >1 | 71 (71.0%) | | 48 (96.0%) | | |
| SIRS Score | 2.2 ± 1.0 | 2.0 | 2.6 ± 0.9 | 3.0 | $0.003^{m}$ |
| ≤1 | 27 (27.0%) | | 6 (12.0%) | | $0.037^{\chi^2}$ |
| >1 | 73 (73.0%) | | 44 (88.0%) | | |

*$^{m}$: Mann-Whitney U test; $^{\chi^2}$: Chi-square test. CALLY: C-reactive protein-Albumin-Lymphocyte Index; qSOFA: Quick Sequential Organ Failure Assessment; SIRS: Systemic Inflammatory Response Syndrome; SD: Standard Deviation.*

**TABLE 3. Logistic regression modeling of the impact of CALLY, qSOFA, and SIRS Scores on mortality.**

| | Univariate Model | | | Multivariate Model | | |
|---|---|---|---|---|---|---|
| | OR | 95% CI | $p$ | OR | 95% CI | $p$ |
| CALLY Score | 0.704 | 0.546–0.908 | 0.007 | 0.738 | 0.579–0.941 | 0.014 |
| qSOFA Score | 5.612 | 2.906–10.839 | <0.001 | 5.350 | 2.747–10.418 | <0.001 |
| SIRS Score | 1.661 | 1.141–2.418 | 0.008 | | | |

*CALLY: C-reactive protein-Albumin-Lymphocyte Index; qSOFA: Quick Sequential Organ Failure Assessment; OR: Odds Ratio; CI: Confidence Interval.*

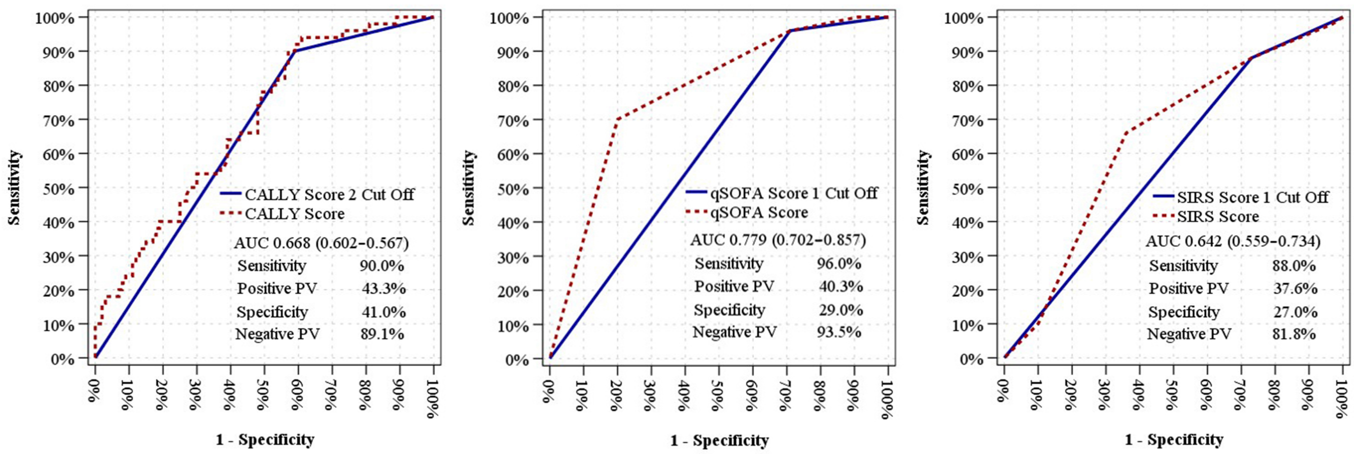


**FIGURE 2. The performance metrics of diagnostic tests used in the study on mortality.** CALLY: C-Reactive Protein-albumin-lymphocyte; SIRS: Systemic Inflammatory Response Syndrome; AUC: Area Under Curve; PV: Predictive Value.

**TABLE 4. The Impact of qSOFA, CALLY, and SIRS Scores on ICU Admission.**

| | ICU admission (−) (n = 108) | | ICU admission (+) (n = 42) | | $p$ |
|---|---|---|---|---|---|
| | Mean ± SD | Median | Mean ± SD | Median | |
| CALLY Score | 5.7 ± 20.6 | 1.3 | 8.7 ± 25.4 | 1.5 | $0.608^{m}$ |
| qSOFA Score | 2.0 ± 0.9 | 2.0 | 2.4 ± 0.6 | 2.5 | $0.006^{m}$ |
| SIRS Score | 2.3 ± 1.0 | 2.0 | 2.5 ± 1.1 | 3.0 | $0.284^{m}$ |

*$^{m}$: Mann-Whitney U test. CALLY: C-reactive protein-Albumin-Lymphocyte Index; qSOFA: Quick Sequential Organ Failure Assessment; ICU: intensive care unit; SD: Standard Deviation.*

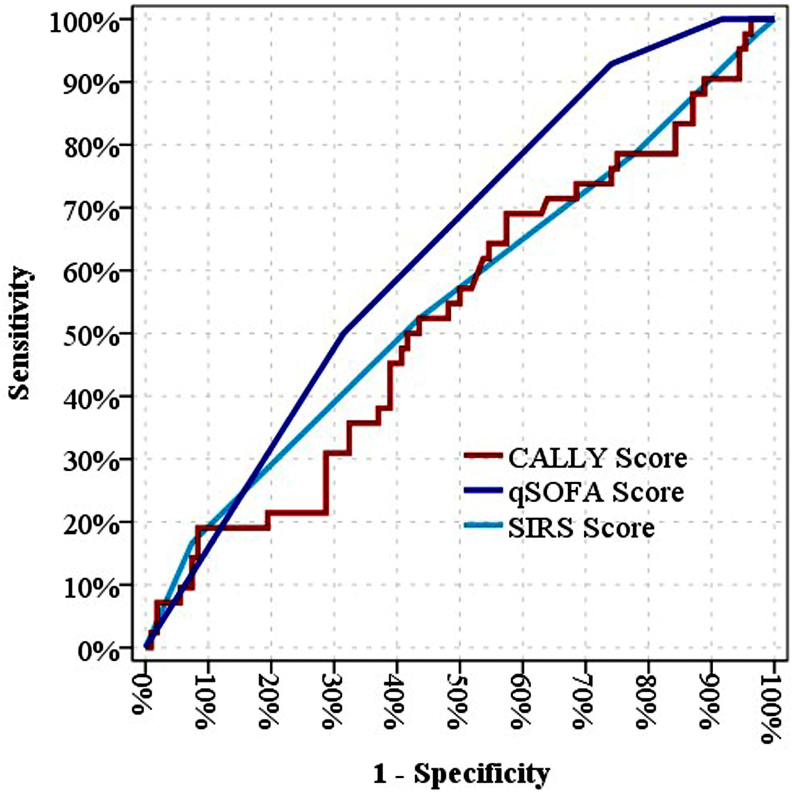


**FIGURE 3. The sensitivity and specificity of scores in terms of prediction of ICU admission.** CALLY: C-reactive protein-Albumin-Lymphocyte Index; qSOFA: Quick Sequential Organ Failure Assessment; SIRS: Systemic Inflammatory Response Syndrome.

ever, CALLY score was not predictive of ICU admission in the present cohort, suggesting that a marker associated with mortality may not necessarily serve as a reliable indicator of intensive care requirement. On the contrary, qSOFA predicted admission to the ICU, and its application reflects an important role for hemodynamic and respiratory instability in predicting a demand for the ICU, consistent with other studies [18]. Since the study population consisted exclusively of elderly patients, the usual inflammatory markers and systemic response criteria may not have accurately captured the severity of illness or the need for ICU admission.

As emergency clinicians often employ scoring systems for early identification and risk stratification of sepsis, it is crucial to acknowledge the limits of these instruments. These scoring tools fall broadly into two categories: (1) functional assessment and tools utilizing biomarkers or (2) objective clinical assessments such as arterial hypotension. Functional scoring tools, including qSOFA, target acute physiologic abnormalities, but can be confounded by transient fluctuations in a patient's state. By contrast, tools utilizing laboratory markers such as SOFA, SIRS, and CALLY may provide objective, quantitative information about the progression of sepsis. Whereas SOFA and SIRS assess organ function and systemic markers of inflammation, CALLY specifically considers markers such as lymphocyte count, CRP levels, and albumin, all of which have a direct bearing on immune function, inflammation, and nutrition. For this reason, CALLY might be particularly beneficial in older adults, in whom nutritional and immune function can have a significant implication on disease progression. Several studies have demonstrated that serum albumin concentrations have a strong correlation with both nutritional and inflammatory markers and with prognosis in septic patients [22, 23]. According to Jiang *et al*. [24], both increased lymphocyte apoptosis and decreased lymphocyte counts were independent risk indicators for 28-day mortality. Also, prolonged lymphopenia has been identified as a major risk factor for sepsis-related mortality in elderly adult patients in a retrospective study conducted in Spain [25]. Given that low albumin levels and lymphopenia are associated with poor prognosis, particularly in the elderly patient population, the CALLY score might be considered a valuable tool for enhancing clinical assessment.

In the study qSOFA showed the highest sensitivity in distinguishing between survivors and nonsurvivors whereas SIRS exhibited the lowest sensitivity. Conversely, CALLY showed the highest specificity and SIRS the lowest. The 2021 Surviving Sepsis Campaign recommendations do not endorse any early warning score as a sole independent tool for the identification of sepsis. In this context, although these techniques may assist in preliminary evaluation, they must be incorporated within a comprehensive diagnostic framework that encompasses clinical judgment and ongoing monitoring. Consequently, although the CALLY score may provide additional prognostic insights, particularly for older patients, it should not be regarded as an independent triage instrument and is most effective when incorporated with comprehensive clinical evaluations. The findings in current study suggest that combining qSOFA and CALLY may enhance prognostication in sepsis management. Given CALLY's high specificity, its integration into clinical practice may enable more precise mortality risk assessment, facilitating more meticulous and targeted patient management.

## 5. Limitations

As the study was retrospective, it was not possible to directly observe patients' detailed physical examinations. Moreover, since the study was conducted at a single center, patients only received the standard treatments and health care services available at the institution. Within this patient population, we evaluated the impact of various scoring systems on mortality and ICU admission among sepsis patients. Potential shortcomings or errors in the hospital's standard sepsis protocols may have contributed to higher-than-expected mortality rates; however, given that this research took place in a tertiary university hospital, it is anticipated that any such effect was minimal or negligible.

The fact that all predictors were acquired at the time of ED admission is one of the study's limitations. Although this method mimics actual procedures in suspected sepsis cases, it ignores clinical or laboratory changes that take place later in the ED stay or during the ICU disposition.

Since these scores depend on physiological and laboratory parameters that are not readily available in the ED dataset, this study was unable to directly compare with ICU-based mortality prediction models like SOFA, Acute Physiology and Chronic Health Evaluation, Simplified Acute Physiology Score, or Mortality Probability Model. Furthermore, the retrospective design prevented us from doing formal calibration analysis. Our model showed an acceptable discriminatory performance, and future prospective studies with larger datasets are required to evaluate the model's calibration and allow for comparison with established scores.

Additionally, only patients who were admitted with a clinical diagnosis of sepsis were enrolled. Patients who were misdiagnosed in the ED and subsequently diagnosed with sepsis on the wards were excluded. Therefore, it is possible that some sepsis cases were missed. Nevertheless, considering the institution's strong technical resources and the involvement of an experienced, academically trained team, it is believed that the limitation exerted minimal influence on the findings.

## 6. Conclusions

Among patients presenting to the ED with sepsis requiring hospital admission, the use of the CALLY score enables prediction of mortality, exhibiting higher positive predictive value and specificity relative to other scoring systems. It should be noted, however, that the sensitivity of the CALLY score is lower than that of qSOFA in this population. Based on the results of current study and a review of the existing literature, the utility of the SIRS score appears to be limited. Future research should seek to standardize the clinical application of the CALLY score, optimize its cut-off values, and validate its prognostic utility further.

### AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

### AUTHOR CONTRIBUTIONS

BA and ABÇ—were responsible for data acquisition and analysis. GAS and ABÇ—contributed to data interpretation. KE and GAS—drafted the manuscript and provided revisions. All authors contributed to the conception and design of the work. All authors have approved the submitted version of the manuscript and have agreed to be personally accountable for their own contributions. They have also committed to ensuring that any questions related to the accuracy or integrity of any part of the work, even those in which they were not directly involved, are appropriately investigated, resolved, and documented in the literature.

### ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval of this study was secured from the Non-Interventional Clinical Research Ethics Committee of Istanbul Medipol University. Ethical approval was secured on 28 June 2024, with approval number E-10840098-202.3.02-3871. The requirement for informed consent was waived by the Non-Interventional Clinical Research Ethics Committee of Istanbul Medipol University.

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### CONFLICT OF INTEREST

The authors declare no conflict of interest.

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