

Comparison of SOFA Score, SIRS, qSOFA, and qSOFA + L Criteria in the Diagnosis and Prognosis of Sepsis

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ABSTRACT

Objective: Sepsis has been defined as a life-threatening organ dysfunction that develops as a result of impaired host response to infection. This study aimed to investigate sequential organ failure assessment (SOFA) score, systemic inflammatory response syndrome (SIRS), quick SOFA (qSOFA), and qSOFA + lactate criteria (qSOFA+L) in the diagnosis and prognosis of sepsis.

Materials and Methods: A retrospective study was performed that included all patients diagnosed with sepsis between January 1, 2013 and December 31, 2017 in Izmir Tepecik Training and Research Hospital Infectious Diseases and Clinical Microbiology Clinic.

Results: A total of 976 patients diagnosed with sepsis (mean age 72.5 ± 13.7 years, 52.7% women) over five years were included in this study. Of all patients admitted to the emergency department and diagnosed with sepsis, 37.4% (n=365) were hospitalized and 52.3% (n=191) of these patients died. Emergency department mortality was 12.5% (n=122). The mortality rate was higher in patients with qSOFA and qSOFA+L criteria ≥ 2 in the emergency department. There was no statistically significant difference in terms of SIRS, qSOFA, or qSOFA+L criteria among patients who died in the hospital. The SOFA score (area under receiver operator characteristic curve, $AUC=0.89$) was highly discriminative in predicting sepsis. When the SOFA score was >11 , its sensitivity and negative predictive values were both 100%. The SOFA score ($AUC=0.75$ and 0.72 , respectively) was also highly discriminative in predicting emergency and in-hospital mortality. When the SOFA score was >11 , the sensitivity and specificity of predicting emergency department mortality were 63.5% and 78.8%, respectively. The sensitivity was 65.8% and the specificity was 75.5% when describing in-hospital mortality for SOFA scores >9 .

Conclusion: The SOFA score was highly sensitive and predictive in the diagnosis of sepsis. The SOFA score had a high discriminative ability to predict emergency and in-hospital mortality.

Keywords: Sepsis, scoring system, systemic inflammatory response syndrome, sequential organ failure assessment

Introduction

Sepsis is one of the oldest and most difficult syndromes in the history of medicine. Despite the emergence of modern antibiotics, germ theory cannot fully explain the pathogenesis of sepsis, and why so many patients die after the causative pathogen has been eradicated. Therefore, researchers posit that the host response was effective in the pathogenesis of sepsis, not the microbes, and subsequently, a fitting definition of sepsis was developed by international consensus [1].

The Third International Consensus Definitions for Sepsis and Septic Shock in 2016 defined sepsis as life-threatening organ dysfunction that develops as a result of an impaired host response to infection. The sequential organ failure assessment (SOFA) is a scoring system used for clinical evaluation purposes; a score of 2 or more is associated with an in-hospital mortality risk over 10%. Septic shock is a subset of sepsis that progresses with deep circulatory, cellular, and metabolic abnormalities with higher mortality risk. Patients with septic shock need vasopressors to achieve an average arterial pressure of 65 mm Hg or more, and in the absence of hypovolemia, serum lactate levels exceed 2 mmol/L; the in-hospital mortality rate in these patients is over 40% [2].

Cite this article as: Kilinc Toker A, Kose S, Turken M. Comparison of SOFA Score, SIRS, qSOFA, and qSOFA + L Criteria in the Diagnosis and Prognosis of Sepsis. *Eurasian J Med* 2021; 53(1): 40-7.

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Received: April 20, 2020
Accepted: June 3, 2020

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DOI 10.5152/eurasianjmed.2021.20081



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The quick SOFA (qSOFA) can be used to inform sepsis-induced prognosis in adult patients with suspicious infections in nonhospital, emergency, or general hospital conditions. A positive qSOFA score involves having a respiratory rate of 22 or more per minute, altered mental state, or systolic blood pressure of, or below, 100 mm Hg [2]. However, the systemic inflammatory response syndrome (SIRS) criteria are superior to qSOFA for the clinical diagnosis of sepsis, and qSOFA is superior to SIRS for predicting in-hospital mortality [3].

In this study, we investigated the predictive capacity of the SOFA score, SIRS, qSOFA, and qSOFA + lactate criteria (qSOFA+L) criteria in the diagnosis and prognosis of sepsis.

Definitions

Infection: An inflammatory response to the invasion of microorganisms into sterile host tissue.

Bacteremia: The presence of live bacteria in the blood, diagnosed by blood culture.

SIRS: The first attempt to standardize sepsis terminology was made in 1991 at the American Chest Diseases Association/Society of Critical Care Medicine (SCCM) Consensus Conference. Sepsis is conceptually defined as a systemic inflammatory response to the presence of infection [4-6]. SIRS is diagnosed by the presence of at least two of the following four SIRS criteria:

1. body temperature > 38°C or < 36°C,
2. heart rate > 90 beats/min,
3. respiratory rate > 20 breaths/min or $\text{PaCO}_2 < 32$ mm Hg,
4. leukocyte count over $12,000\text{mm}^{-3}$ or under $4,000\text{mm}^{-3}$ or immature band/neutrophil ratio exceeds 10%.

Sepsis-1 (1991): Clinical manifestation of an infection with SIRS is defined as sepsis.

Severe sepsis: The presence of symptoms of organ disorder, hypoperfusion, or hypotension with sepsis.

Sepsis-2 (2001): Although the sepsis-1 definition remains valid, some additions were made to better define sepsis. Sepsis criteria were expanded as follows:

1. **General signs and symptoms:** fever, hypothermia, tachycardia, tachypnea, altered mental state, marked edema or positive fluid balance, hyperglycemia in the absence of diabetes, etc.
2. **Inflammatory findings:** leukocytosis or leukopenia, C-reactive protein (CRP), procalcitonin elevation, etc.
3. **Hemodynamic signs and symptoms:** hypotension (systolic blood pressure < 90 mm Hg and mean arterial pressure < 70 mm Hg), $\text{SvO}_2 > 70\%$, etc.
4. **Organ dysfunction signs and symptoms:** arterial hypoxia, acute oliguria, increased creatinine, coagulation abnormalities, thrombocytopenia, hyperbilirubinemia, etc.
5. **Tissue perfusion disorder signs and symptoms:** increased lactate (> 2 mmol/L), decreased capillary refill, etc.

Sepsis-3 (2016): In the Third International Consensus report published in 2016, the SCCM and the European Society of Intensive Care Medicine defined sepsis as life-threatening organ dysfunction that develops as a result of impaired host response to infection. In addition to the proven infection, a score of 2 or more points on the SOFA (organ dysfunction) is required for the diagnosis of sepsis. The SIRS-criteria-based test and the definition of severe sepsis (above) were abandoned in this consensus [2].

Septic shock (a subset of sepsis with higher mortality): Patients with septic shock need vasopressors to achieve average arterial pressure of 65 mm Hg or more, and in the absence of hypovolemia, serum lactate level exceeds 2 mmol/L. In-hospital mortality rates among these patients are over 40% [2].

SOFA: The SOFA score identifies organ failure in six systems and assigns 0–4 points for each system. It was created in 1996 by consensus [7] (Table 1).

qSOFA criteria: qSOFA criteria determine sepsis-induced prognosis in adult patients with suspicious infections in nonhospital, emergency, or general hospital conditions. A positive qSOFA score requires at least two of the following criteria: respiratory rate ≥ 22 breaths/min or more,

altered mental state, or systolic blood pressure under 100 mm Hg [2] (Table 1).

Materials and Methods

This retrospective study included data collected between January 1, 2013 and December 31, 2017 at the Izmir Tepecik Training and Research Hospital Infectious Diseases and Clinical Microbiology Clinic. Approval from the local ethics committee was obtained prior to initiating the study. (Approval No. 1/1, Approval date: 31/03/2018) Because of the retrospective study design, written informed consent was not obtained.

All the study participants were diagnosed with sepsis by an infectious disease and clinical microbiology specialist who came to the emergency department.

Statistical Analysis

In the statistical analyses, categorical data were summarized as frequencies and percentages, and continuous data were summarized as mean \pm standard deviation or median values (minimum–maximum) depending on the distribution of the data. For continuous variables that were normally distributed, independent sample *t*-tests were used in the comparison of the two groups, while analysis of variance was used for comparisons among more than two groups. For variables that were not normally distributed, the nonparametric Mann–Whitney *U* test was used for two-group comparisons and the Kruskal–Wallis test was used to compare more than two groups. In addition, Spearman and Pearson correlation coefficients were used to control for the relationship between continuous variables. Normality controls for the continuous measurements were assessed with the Shapiro–Wilk test. Receiver operator characteristic (ROC) analyses of SIRS, SOFA, qSOFA, and qSOFA+L criteria were performed. In addition, the ROC curves of the parameters were compared. For the descriptive statistics, the area under ROC curve (AUC) value, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratio (LR^+), negative likelihood ratio (LR^-), and 95% confidence interval values are given. $P < 0.05$ was considered statistically significant.

Results

This study included a total of 976 patients who were admitted to the emergency department during the five-year study period and diagnosed with sepsis by an infectious disease and clinical microbiology specialist. Of those, 52.7% ($n=514$) were female and 47.3% ($n=462$) were male. Their mean age was 72.5 ± 13.7 years. The

Main Points

- The important feature of our study was that SOFA score, SIRS, qSOFA, and qSOFA+L criteria were compared in both ICU patients and emergency department patients in the diagnosis of sepsis and prognosis.
- Despite the limitations described above, we found that the diagnostic and prognostic value of the SOFA score was more valuable than that of other scores.
- We have also found that the qSOFA criterion may be suitable for emergency department.

Table 1. Sequential [Sepsis-Related] Organ Failure Assessment (SOFA) score

Score	0	1	2	3	4
Sysyem					
Respiratory PaO ₂ / FiO ₂ , mmHg (kPa)	≥400 (53.3)	<400 (53.3)	<300 (40)	<200 (26.7) with respiratory support	<100 (13.3) with respiratory support
Coagulation					
Platelet count × 10 ³ / μL	≥ 150	< 150	< 100	< 50	< 20
Liver					
Bilirubin, mg / dL	<1.2	1.2-1.9	2.0-5.9	6.0-11.9	>12.0
Cardiovascular	MAP * ≥70 mm Hg	MAP <70 mm Hg	Dopamine <5 or dobutamine (all doses)	Dopamine 5.1-15 or epinephrine ≤0.1 or norepinephrine ≤0.1	Dopamine >15 veya epinephrine >0.1 veya norepinephrine >0.1
Central Nervous System					
Glaskow Coma Scale	15	13-14	10-12	6-9	< 6
Renal					
Creatine, mg/dL	<1.2	1.2-1.9	2.0-3.4	3.5-4.9	>5.0
Urine Output				< 500	< 200

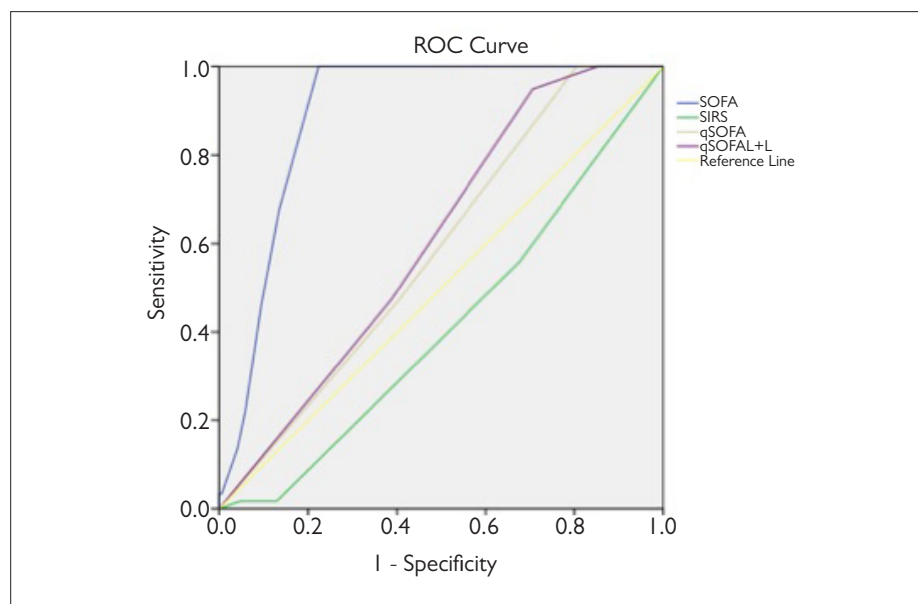
Catecholamine doses should be given at least one hour, μg / kg / min.
*MAP= DBP + 1/3 (SBP – DBP)

Table 2. qSOFA (Quick SOFA) criterion

Score	0 point	1 point
Respiratory rate > 22 / min		
Yes		
No		
Altered mental status		
Yes		
No		
Systolic blood pressure ≤ 100 mmHg		
Yes		
No		

mean age of the female patients was 72.6±14 years, and the mean age of the male patients was 72.3±13.3 years. The most common comorbidity was chronic kidney disease (CKD) at 18.9% (n=184). The demographic characteristics of the patients are shown in Table 2.

Overall, 37.4% (n=365) of all patients admitted to the emergency department and diagnosed with sepsis were hospitalized and 52.3% (n=191) of these patients died. Emergency department mortality was 12.5% (n=122). The median length of hospital stay was 137.5 h. The most common source of infection was the respiratory system (24.5%, n=239), followed by the urinary system (23.8%, n=232). The source of infection could not be determined in 31.1% (n=323) of the patients. Gram-negative bacillus (22.7% and 51%, respectively) was observed in the cultures of emergency cysts (n=396) and urine (n=414). The clinical and

**Figure 1.** ROC analysis curves for SOFA score, SIRS, qSOFA and qSOFA + L criteria in the diagnosis of sepsis

laboratory features of the patients are shown in Tables 2 and 3.

There was a statistically significant difference between patients who died in the emergency department and those who survived in terms of qSOFA and qSOFA+L criteria ($P<0.05$). The mortality rate was higher in patients with qSOFA and qSOFA+L criteria ≥ 2 (Table 4). There was no statistically significant difference between the patients who died in the hospital and those who survived in terms of SIRS, qSOFA, and qSOFA+L criteria ($P>0.05$) (Table 4).

There was a statistically significant difference in the SOFA scores of patients who died in the emergency department and those who survived ($P<0.001$). Patients who died had a higher SOFA score than patients who lived (Table 5).

ROC Curve Analysis

According to the results of the ROC analysis of continuous measurements, the ability of SOFA score, SIRS, qSOFA, and qSOFA+L criteria to predict sepsis was statistically significant ($P<0.0001$, 0.048, 0.0004, and 0.0001, respectively). The SOFA score (AUC=0.89) had a distinctively high ability to predict sepsis

Table 3. Demographic and clinical features of patients

Variable		
Age (Mean \pm SD) (min.-max.)	72.5 \pm 13.7 (18-106)	
Gender	n (%)	
Female	514 (52.7)	
Male	462 (47.3)	
Comorbidities	n (%)	
Diabetes	59 (6.0)	
CKD	184 (18.9)	
COPD	30 (3.1)	
CHF	82 (8.4)	
SVD	60 (6.1)	
Malignancy	118 (12.1)	
Hematological malignancy *	16 (1.6)	
Other**	61 (6.3)	
Emergency service outcome	n (%)	
Admission	365 (37.4)	
Referred	471 (48.3)	
Refuse treatment	18 (1.8)	
Death	122 (12.5)	
Hospital service outcome	n (%)	
Still admitted	7 (1.9)	
Discharged	157 (43)	
Referred	6 (1.6)	
Refuse treatment	4 (1.1)	
Death	191 (52.3)	
The length of hospital stay (hours) Median (IQR) (min.-max.)	137.5 \pm (260.5) (0.03- 3509)	
Source of infection	n (%)	
Respiratory	239 (24.5)	
Urinary	232 (23.8)	
Gastrointestinal	132 (13.5)	
Other***	50 (5.1)	
Unknown	323 (31.1)	
Microorganisms growing in Blood culture	n (%)	
Gram-negative bacilli	90 (22.7)	
Gram-positive cocci	73 (18.4)	
Contamination	51 (12.9)	
No reproduction	182 (46)	
Total	396(100)	
Microorganisms growing in Urine culture	n (%)	
Gram-negative bacilli	211 (51)	
Gram-positive cocci	31 (7.5)	
Gram-negative bacilli and gram-positive cocci	5 (1.2)	
Contamination	45 (10.9)	
No reproduction	122 (29.5)	
Total	414(100)	
	n	Ort. \pm SD (min.-max.)
SIRS	526	1.75 \pm 0.67 (0-4)
SOFA	378	9.9 \pm 3.1 (2-22)
qSOFA	499	2.04 \pm 0.78 (0-3)
qSOFA+Laktat	499	2.79 \pm 1.06 (0-4)
* = Non-hodgkin lymphoma, myelodysplastic syndrome, multiple myeloma, acute & conical myeloid leukemia, chronic lymphocytic leukemia		
** = Alzheimer's disease, epilepsy, liver cirrhosis, chronic disease anemia, coronary artery disease, heart rhythm disorders, thyroid function disorders		
*** = Cellulitis, wound infection, encephalitis, meningitis		

($P<0.0001$). When the SOFA score was >11 , its sensitivity was 100%, specificity was 79%, PPV was 57.8%, NPV was 100%, LR^+ was 4.78, and LR^- was 0 (Table 6; Figure 1).

According to the results of the ROC analysis in terms of emergency department mortality, the ability to predict SOFA score, qSOFA, and qSOFA+L criteria was found to be statistically significant ($P<0.0001$, 0.009, and 0.006, respectively). The ability of the SIRS-criteria-based test to predict emergency department mortality was not statistically significant ($P=0.303$). The SOFA score (AUC=0.75) had a high distinctive ability to predict emergency department mortality ($P<0.0001$). When the SOFA score was >11 , its sensitivity was 63.5%, specificity was 78.8%, PPV was 46.6%, NPV was 88.2%, LR^+ was 3, and LR^- was 0.46. When the qSOFA score was >1 , sensitivity was 81.7% and specificity was 28.6% (Table 6; Figure 2).

According to the results of ROC analysis, the ability to predict in-hospital sepsis-related mortality was statistically significant for the SOFA score, while SIRS, qSOFA, and qSOFA+L criteria were not significant ($P<0.0001$, 0.329, 0.950, and 0.999, respectively). The SOFA score (AUC=0.72) had a high distinctive ability to predict in-hospital mortality ($p<0.0001$). When the SOFA score was >9 , its sensitivity was 65.8%, specificity was 75.5%, PPV was 81.8%, NPV was 56.9%, LR^+ was 2.69, and LR^- was 0.45 (Table 6; Figure 3).

Discussion

Several studies have already compared the diagnostic criteria for sepsis in emergency departments and intensive care units (ICUs). Those that primarily consider mortality were generally performed in ICU patients [8, 9]. Our study is novel because it compared the predictive capacity of SIRS, qSOFA, qSOFA +L, and SOFA score in both the diagnosis and prognosis of patients admitted to the emergency department with sepsis.

In our study, patients who died in the emergency department and in the hospital had higher SOFA scores than those who survived. Mortality rates were higher in the emergency department for patients with qSOFA and qSOFA+L criteria ≥ 2 . There was no statistically significant difference between the patients who died and those who survived in the hospital in terms of SIRS, qSOFA, and qSOFA+L criteria. The SOFA (AUC=0.89) had a high distinctive ability to predict sepsis. When the SOFA score was >11 , sensitivity and NPV were both 100%. The SOFA score (AUC=0.75 and 0.72,

Table 4. Laboratory features of patients

Variable	n	Median (IQR) (min.-max.)
Lactate (mmol/L)	828	2.91 (3.6) (0-27)
White blood cell count ($\times 10^3/\mu\text{L}$)	859	15.9 (12.1) (0.1-270)
Neutrophil count ($\times 10^3/\mu\text{L}$)	832	13.85 (11.5) (0-257)
Creatine (mg/dL)	948	2.3 (2.2) (0.3-16)
Urea (mg/dL)	948	106 (107) (5-731)
Total bilirubin (mg/dL)	842	1 (1.1) (0.1-30.4)
pH (Blood Gas)	843	7.38 (0.17) (6.66-7.68)
pCO ₂ (Blood Gas) (mmHg)	840	32.3 (13.5) (3.4-103.7)
Variable	n	Mean \pm SD (min.-max.)
Platelet count ($\times 10^3/\mu\text{L}$)	854	237.5 \pm 145.5 (4-1053)
Mean platelet volume (fL)	833	9.1 \pm 1.5 (5-16)
Hemoglobin (g/dL)	855	11.2 \pm 2.6 (3.3-18.8)
Base excess (Blood Gas) (mmol/L)	824	-6.4 \pm 7.6 (-31.9-21.2)
HCO ₃ (Blood Gas) (mEq/L)	128	17.4 \pm 6.8 (2.5-41.1)

Table 5. SIRS, qSOFA and qSOFA + L criteria of patients in terms of emergency and hospital mortality

Variable		n (%) Death	n (%) Survive	P
Emergency service mortality	SIRS (n=526)			
	<2	30 (17.9)	138 (82.1)	0.285
	≥ 2	51 (14.2)	307 (85.8)	
	qSOFA (n=499)			
	<2	21 (16)	110 (84)	0.026
	≥ 2	94 (25.5)	274 (74.5)	
Hospital mortality	qSOFA+L (n=499)			
	<2	11 (12.8)	75 (87.2)	0.013
	≥ 2	104 (25.2)	309 (74.8)	
	SIRS (n=199)			
	<2	32 (53.3)	28 (46.7)	0.700
	≥ 2	70 (50.4)	69 (49.6)	
	qSOFA (n=170)			
	<2	26 (51)	25 (49)	0.058
	≥ 2	79 (66.4)	40 (33.6)	
	qSOFA+L (n=170)			
	<2	16 (48.5)	17 (51.5)	0.080
	≥ 2	89 (65)	48 (35)	

Table 6. SOFA scores of patients in terms of emergency and hospital mortality

Variable	n (Mean \pm SD) Death	n (Mean \pm SD) Survive	p
Emergency service mortality			
SOFA score (n= 378)	85 (11.95 \pm 2.82)	293 (9.32 \pm 2.98)	< 0.001
Hospital mortality			
SOFA score (n= 131)	82 (10.5 \pm 3.29)	49 (8.04 \pm 2.52)	< 0.001

respectively) was highly distinctive in predicting emergency and in-hospital mortality. When the SOFA score was >11 , the sensitivity was 63.5% and the specificity was 78.8% in determining the emergency department mortality. When the SOFA score was >9 , the sensitivity was 65.8% and the specificity was 75.5% in determining the in-hospital mortality. When the qSOFA criteria score was >1 , the sensitivity was 81.7% and the specificity was 28.6% in determining the emergency department mortality. In terms of the ability to predict emergency department mortality, the SIRS-criteria-based test was not statistically significant. SIRS, qSOFA, and qSOFA+L criteria were not significant, while the SOFA score was highly distinctive in predicting in-hospital mortality.

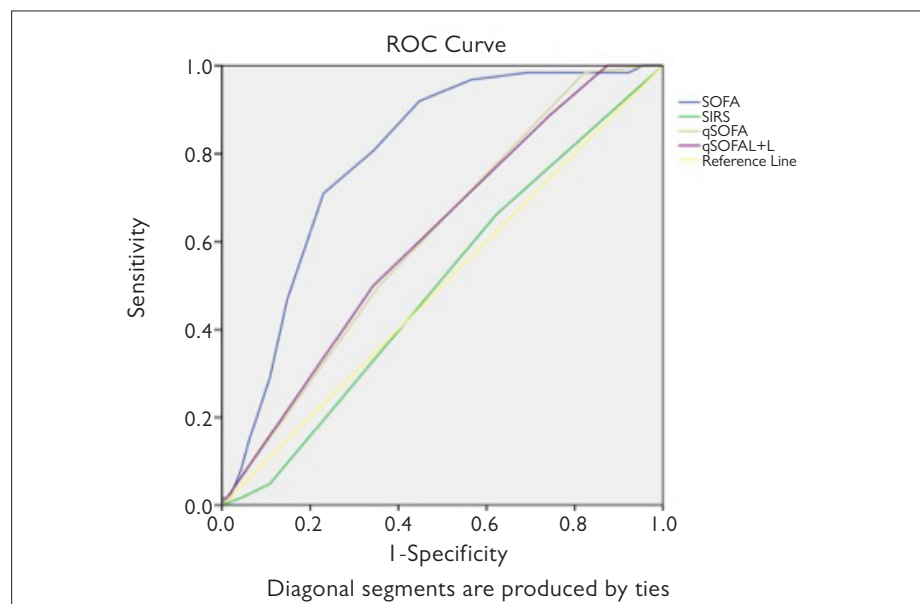
Over 20 years ago, sepsis was described as a combination of an infection and SIRS. However, research has since shown that sepsis is not only a proinflammatory condition but also a convergence of early anti-inflammatory responses. SIRS has been criticized for a long time, as it covers even mild conditions (e.g., influenza) without any organ dysfunction. In 2015, Churpek and colleagues showed that almost half of adult patients met at least once, often two SIRS criteria during their hospital stay [10]. Kaukonen et al. [11] showed that approximately 12% of adult ICU patients with infections and at least one organ disorder are negative according to the SIRS-criteria-based test, and their mortality rates are high. These results indicate that the SIRS-criteria-based test is not suitable for screening at-risk patients and does not accurately reflect the risk of mortality/organ dysfunction.

Risk factors for sepsis include advanced age, comorbidity (e.g., diabetes, kidney failure, respiratory failure, etc.), infection source, infection location (e.g., nosocomial), and the patient's ward (e.g., ICU, emergency department, etc.). Severe sepsis is especially common among elderly patients, and more than half of the patients with sepsis are over 65 years old. Furthermore, the majority of sepsis cases involve at least one chronic disease. Severe sepsis is more likely to develop in patients with Chronic obstructive pulmonary disease (COPD), malignancy, CKD, and diabetes [12, 13]. A total of 976 patients diagnosed with sepsis during a five-year period were included in our study. The mean age was 72.5 years, and 52.7% (n=514) of the patients were women. The most common comorbidity was CKD, which affected 18.9% (n=184) of all patients.

Sepsis is the greatest financial burden for hospitals and the leading cause of death in non-coronary ICU cases, contributing to 30–50%

Table 7. ROC analysis results for SOFA score, SIRS, qSOFA and qSOFA + L criteria

		Cut-off	AUC (p)	Sensitivite (% 95 CI)	Spesifite (% 95 CI)	PPV (% 95 CI)	NPV (%95 CI)	+ LR (%95 CI)	- LR (%95 CI)
Diagnosis of Sepsis	SOFA	>11	0.893 (<0.0001)	100 (94.6-100)	79.06 (73.3-84.1)	57.8	100	4.78	0
	SIRS	>1	0.414 (0.048)	55.93 (42.4-68.8)	32.75 (25.7-40.3)	22.3 (18.2-26.9)	68.2 (60.75-5)	0.83 (0.65-1.07)	1.35 (0.94-1.93)
	qSOFA	>1	0.617 (0.0004)	91.04 (81.5-96.6)	31.76 (25.8-38.2)	27.7 (25.5-30.2)	92.5 (84.9-96.4)	1.33 (1.2-1.5)	0.28 (0.1-0.6)
	qSOFA+L	>2	0.638 (<0.0001)	86.57 (76-93.7)	40.77 (34.4-47.4)	29.6 (26.7-32.6)	91.3 (84.9-95.2)	1.46 (1.3-1.7)	0.33 (0.2-0.6)
Emergency service mortality	SOFA	>11	0.754 (<0.0001)	63.53 (2.4-73.7)	78.84 (73.7- 83.4)	46.6 (39.9-53.4)	88.2 (84.8-90.8)	3 (2.3-3.9)	0.46 (0.3-0.6)
	SIRS	>1	0.464 (0.303)	62.96 (51.5-73.4)	31.01 (26.7-35.5)	14.25 (12.2-16.5)	82.14 (77-86.3)	0.91 (0.7-1)	1.19 (0.8-1.6)
	qSOFA	>1	0.573 (0.009)	81.74 (73.5-88.3)	28.65 (24.3-33.5)	25.5 (23.6-27.6)	84 (77.5-88.8)	1.15 (1-1.3)	0.64 (0.4-1)
	qSOFA+L	>3	0.577 (0.006)	38.26 (29.4-47.8)	72.14 (67.4-76.6)	29.1 (23.7-35.3)	79.6 (76.9-82)	1.37 (1-1.8)	0.86 (0.7-1)
Hospital mortality	SOFA	>9	0.726 (<0.0001)	65.85 (54.6-76)	75.51 (61.1-86.7)	81.8 (72.9-88.3)	56.9 (48.5-65)	2.69 (1.6-4.5)	0.45 (0.3-0.6)
	SIRS	>1	0.460 (0.329)	68.63 (58.6-77.4)	28.87 (20.1-38.9)	50.36 (45.8-54.9)	46.67 (36.4-57.2)	0.96 (0.8-1)	1.09 (0.7-1.6)
	qSOFA	>1	0.503 (0.950)	75.24 (65.8-83.1)	38.46 (26.6-51.3)	66.39 (61.2-71.1)	49.02 (37.9-60.2)	1.22 (0.9-1.5)	0.64 (0.4-1)
	qSOFA+L	>1	0.500 (0.999)	84.76 (76.4-91)	26.15 (16-38.5)	64.96 (61-68.6)	51.52 (36.6-66.1)	1.15 (0.9-1.3)	0.58 (0.3-1)

**Figure 2.** ROC analysis curves for SOFA score, SIRS, qSOFA and qSOFA + L criteria in terms of emergency mortality

of all in-hospital deaths [9]. In accordance with the literature, in our study, the mortality rate in patients admitted to the emergency department with sepsis was 12.5%, and the mortality rate of the sepsis patients hospitalized was 52.3%. In addition, in our study, the median value of the hospital stay was 137.5 h.

There are multiple causative pathogens in the etiology of sepsis. However, the factor responsible could not be isolated in 30–50% of the cases, depending on the study. With the prevalent use of antibiotics, gram-negative bacteria have increasingly become a factor in sepsis. Recently, an increase has been

observed in gram-positive bacteria, especially in cases of staphylococcal sepsis [14]. In our study, the most frequently detected causative agent was gram-negative bacilli, followed by gram-positive cocci. In addition, the most common source of infection was the respiratory system, followed by the urinary system. In our study, the source of infection could not be determined in 31.1% of patients, which is in line with the literature.

A 2016 international prospective cohort study compared the old and new sepsis criteria and found that the accuracy of the qSOFA criteria was higher than both the SIRS-criteria- and the severe sepsis-criteria-based tests in predicting in-hospital mortality [15]. In a retrospective large cohort study in patients admitted to ICUs in Australia and New Zealand in 2017 with primary diagnoses associated with infection, SOFA scores over 2 had higher prognostic accuracy for in-hospital mortality than SIRS or qSOFA criteria [16]. Both of these studies support the Sepsis-3 recommendations to use the qSOFA criteria in non-ICU patients and the full SOFA score in ICU patients to effectively identify high-risk individuals among potentially infected patients. In our study, the SOFA had a high distinctive ability in the diagnosis of sepsis.

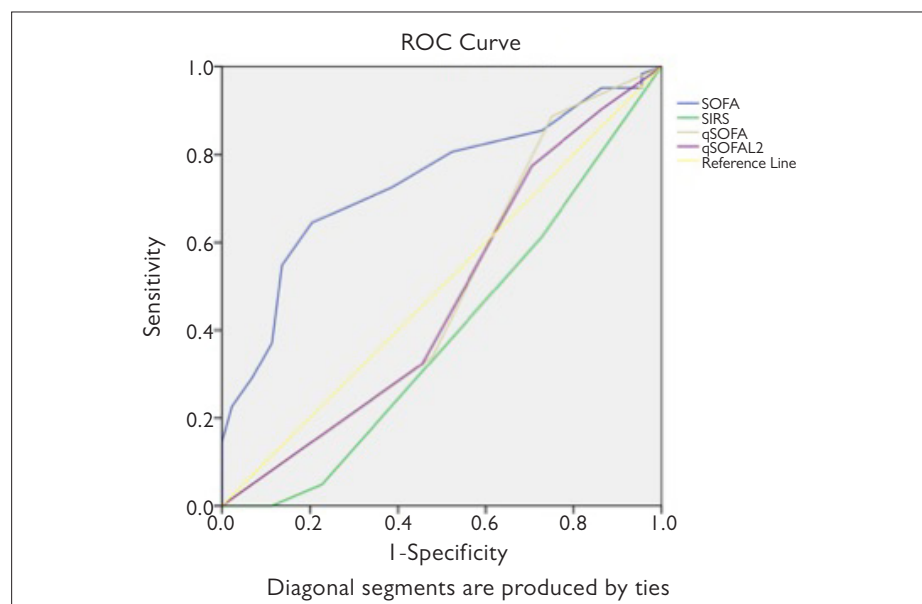


Figure 3. ROC analysis curves for SOFA score, SIRS, qSOFA and qSOFA + L criteria in terms of hospital mortality

Abandoning the SIRS-criteria-based test and focusing on the qSOFA criteria, the SOFA is a major concern owing to the possibility of delaying early diagnosis and treatment [17,18]. Despite its weaknesses, the SIRS-criteria-based test is helpful in the early detection of an infection and in preventing progression to organ dysfunction. Quality improvement studies worldwide have relied on the SIRS-sepsis structure for years [19-21]. The use of the SIRS-criteria-based test is credited with contributing to the decrease in sepsis-related mortality seen over the past 20 years [22-24].

Another potential weakness of the new sepsis definitions is that they are based on the SOFA score. The SOFA was created primarily for research purposes in ICUs in 1996. As scoring systems such as SOFA are not easy to memorize, their clinical use is generally limited. Many components of the SOFA (e.g., $\text{PaO}_2/\text{FiO}_2$ ratio and vasopressor requirement) are specific to the ICU or not routinely administered initially in septic patients (e.g., the Glasgow Coma Scale). However, the initial treatment of many septic patients begins in the emergency department or hospital services [25,26].

The Sepsis-3 consensus definitions should not be interpreted as replacing the SIRS criteria with qSOFA. In previous definitions, the SIRS-criteria-based test has been a prerequisite for the diagnosis of sepsis, but this is not the case with the qSOFA. The qSOFA score is presented only as an additional clinical criterion in identifying suspected infection patients at risk of a poor outcome and informing early intervention choices [9]. In a recent cohort study of suspect-

ed emergency department patients, qSOFA had a high specificity for predicting organ dysfunction (96.1%) but with low sensitivity (29.7%), while SIRS was less specific (61.1%) but more sensitive (72.3%) [27].

In a prospective large study of ICU patients in 16 countries, SOFA scores greater than 15 were associated with a 90% mortality rate [28]. In a prospective study conducted in another ICU, the first increase occurred in the SOFA score for 96 h; regardless of baseline score, the mortality rate was at least 50% as the score increased, and 27–35% when remained unchanged, and less than 27% when decreased [29]. In addition, the SOFA has been validated and administered in various ICU patient groups, including medical, surgical, and heart and burn patients [30]. Although, in our study, the SIRS-criteria-based test was not statistically significant in terms of its ability to predict emergency department mortality, the qSOFA criteria and the SOFA score were significant. SIRS, qSOFA, and qSOFA+L criteria were not significant, while the SOFA score was highly distinctive in predicting in-hospital mortality.

This study has several limitations. The first limitation of our study is its retrospective nature. The second limitation, the current status of the patients who came to the emergency department and transferred, is not known. In addition, since many seriously infected patients are sent to our hospital, our mortality rate is high. The third limitation of this study is a single center, so the results may not be representative. Therefore, multicenter prospective studies are needed.

In conclusion, as a result, in our study, the SOFA score had a high sensitivity and negative prediction in the diagnosis of sepsis. In the emergency department and in-hospital mortality estimations, the SOFA was again highly capable. However, the qSOFA score had higher sensitivity in the emergency department mortality estimate than the SOFA score, but less specific. In terms of the ability to predict emergency department mortality, the SIRS-criteria-based test was not significant. SIRS, qSOFA, and qSOFA+L criteria were not significant in predicting in-hospital mortality.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Izmir Tepecik Training and Research Hospital (Approval Date: 31/03/2018; Approval Number: 1/1).

Informed Consent: N/A

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - A.K.T.; Design - A.K.T., M.T.; Supervision - Ş.K.; Resources - A.K.T.; Materials - A.K.T.; Data Collection and/or Processing - A.K.T., M.T.; Analysis and/or Interpretation - A.K.T., M.T.; Literature Search - A.K.T.; Writing Manuscript - A.K.T., M.T.; Critical Review - Ş.K.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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