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Comparison of scoring systems of sepsis for predicting 28-day mortality in Egyptian ICU sepsis patients based on sepsis 3 criteria

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ABSTRACT

Background: Sepsis has emerged as a major global public health concern. The purpose of this study was to determine the risk factors associated with the incidence of death among 5 common models (SOFA, APACHE II, LODS, SAPS II, and SAPS III) and reevaluate their discrimination in predicting the 28-day mortality of ICU Egyptian patients. **Methods**: A prospective cohort study was carried out from July 2023 to August 2024 on 100 ICU patients who were diagnosed with sepsis either at admission or later. The study was carried out in various ICUs, including the medical and surgical ICUs of Tanta University Hospitals. The 28-day mortality outcome was documented, and the various mortality scores were calculated. **Results**: The mortality rate was 61%, and the most common infections among nonsurvivors were intraabdominal (27.2%) and respiratory tract (23%). GCS, SBP, TLC, platelets, PH, bicarbonate, Fio2, AST, total bilirubin, PT, creatinine, urine output, serum lactate, procalcitonin, mechanical ventilation, and need for vasoactive therapy were significant predictors for sepsis outcomes ($p < 0.005$). Additionally, models for predicting mortality that were significant ($p < 0.005$) included SOFA, APACHE II, LODS, SAPS II, and SAPS III. At a cutoff of >4, the SOFA score demonstrated the highest AUC of 0.850 with sensitivity (86.89) and specificity (66.67). The SAPS III score was an independent predictor of the 28-day mortality rate among patients with ICU sepsis in multivariate regression analysis. **Conclusion**: Combining the SOFA and SAPS III scores is expected to improve overall outcomes, lower expenses, and improve prognosis in ICUs.

Introduction

Severe organ failure caused by a dysregulated host response to infection is known as sepsis and is one of the most difficult global health problems [1]. Although sepsis mortality rates have decreased because of improvements in treatment approaches, they remain incredibly high, particularly in low- and middle-income nations [2,3].

According to the most recent data on global sepsis incidence and mortality estimates, sepsis is the cause of 48.9 million cases and 11.0 million deaths worldwide annually, accounting for 20% of all fatalities [3], especially in the first 28 days after onset. The 28-day mortality interval is a conventional timescale for assessing the effectiveness of sepsis therapy and forecasting results and is frequently used in clinical trials [4].

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In ICUs, many scoring systems have been developed and used frequently to determine illness severity, forecast mortality and morbidity, and gauge treatment effectiveness [5]. The Acute Physiology and Chronic Health Assessment Score (APACHE-II) [6], Simplified Acute Physiology Score II, III (SAPS-II, III) [7, 8], sequential organ failure assessment (SOFA) [9], and logistic organ dysfunction score (LODS) [10], are the most dependable scoring techniques.

Because severity scores mainly aim to quantify organ malfunction rather than forecast the outcome. No equivalent equation has been established for mortality prediction. Therefore, severity scores should be used to determine the risk of mortality based on data collected upon admission or during the first 24 hours in ICU is essential [11]. Furthermore, prediction models calibration and discrimination accuracy diminish with time, thus, it is necessary to reassess their performance [12].

By improving the accuracy of mortality prediction within the critical 28-day window, clinicians can better target interventions and determine the appropriate level of care, potentially leading to improved survival rates and more efficient use of ICU resources. This is especially crucial in an era where healthcare systems are often overwhelmed by the rising number of sepsis cases. So, in this study, we aimed to assess the discrimination of SOFA, APACHE II, LODS, SAPS II, and SAPS III models for predicting 28-day mortality in ICU Egyptian patients with sepsis based on Sepsis-3 criteria to develop accurate and timely prognostic tools to help clinicians identify patients at high risk of death early in the disease process.

Materials and methods

Study design and population

This was a prospective cohort study included 100 critically ill ICU patients diagnosed with sepsis according to the Sepsis 3.0 criteria (Diagnostic criteria for sepsis according to Sepsis 3.0 include a patient with a suspected infection and a SOFA score ≥2) [1], either on admission or acquired later, in different ICUs, including medical and surgical ICUs at Tanta University Hospital, Egypt, from July 2023 to August 2024. The study was approved by the Ethical Committee of the Faculty of Medicine, Tanta University (code: 36264 MS200/6/23). It was conducted according to the revised declaration of Helsinki, and written informed consent was obtained from the caregivers of all participants. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement is a set of recommendations to improve the reporting of observational studies.

Pregnant women, patients with hospital stays of less than 24 hours, patients with cardiac arrest within 6 h prior to 1 h after ICU admission, patients whose caregivers refused to include them in this study, and patients under the age of 18 were excluded. Hospitalization and treatment of patients followed normal protocols, including crystalloids, vasopressors, and broad-spectrum antibiotics, as recommended by the Surviving Sepsis Campaign [13].

The patients were divided into two groups based on the outcome: (group 1) alive up to 28 days after ICU admission (survivors), and (group 2) dead within 28 days from ICU admission (non-survivors). Therefore, 28-day mortality was used as the mortality measure when dividing patients.

Data collection

A thorough general and systemic clinical examination, history of the last antibiotic use, and demographic information (age, gender, and cause of sepsis) were performed. A complete blood picture (CBC), daily arterial blood gases (ABGs) analysis, liver and renal function tests, serum lactate, and serum procalcitonin were among the laboratory tests conducted. Within the first 24 hours of ICU admission, the Glasgow Coma Score (GCS), SOFA, APACHE-II, LODS, SAPS-II, and SAPS-III scores, as well as the corresponding predictive mortality rates, were computed for each scoring model. The physiological criteria for classifying patients into multiple organ dysfunction syndrome (MOD), septic shock, and severe sepsis were developed, along with the concept of systemic inflammatory response syndrome (SIRS) [1].

When appropriate, a microbiological sample culture was conducted based on the suspected site, and pathogenic organisms were noted. Data on 28-day mortality after ICU admission, the need for vasoactive therapy, and the need for mechanical ventilation (MV).

Statistical analysis of data

Version 20.0 of the IBM SPSS software suite was used to feed data into the computer and analyze it. (IBM Corp., Armonk, NY) Numbers and percentages were used to describe qualitative data. The distribution normality was confirmed using the Shapiro-Wilk test. The range (minimum and

maximum), mean, standard deviation, median, and interquartile range (IQR) were used to characterize quantitative data. The 5% level was used to assess the significance of the results. For categorical variables, the chi-square test was employed; where ≥ 20% of the cells had an anticipated count of 5, the chi-square was corrected using Fisher's exact test. Quantitative variables that were regularly distributed were analyzed using the student T-test. Quantitative variables with anomalous distributions were examined using the Mann–Whitney test. To evaluate the predictive value of the various scores for in-hospital mortality, receiver operating characteristic (ROC) curves were created, and the area under the ROC curves was computed. In addition, positive and negative predictive values, sensitivity, and specificity were calculated. The logistic regression model's goodness-of-fit was evaluated using the Hosmer and Lemeshow Test, which compares expected and actual values, particularly for binary outcomes like success or failure or the presence or absence of disease.

Results

Table 1 shows that heart rate, FIO2, TLC, total bilirubin, AST, mechanical ventilation, procalcitonin, serum lactate, and the need for vasoactive therapy were significantly higher in non-survivors ($p<0.05$). Furthermore, systolic blood pressure, platelets, PH, and bicarbonate ($p<0.05$) were significantly lower among non-survivors. However, age, gender, temperature, respiratory rate, PaO2, and history of last antibiotic intake were not significantly different between the two groups ($p > 0.05$). All studied severity scores and their estimated mortality rates (SOFA, SAPS III, SAPS II, LODS, APACHE II) were significantly higher in the non-survivor group ($p<0.05$).

According to the history of the last antibiotic intake, among our sepsis patients, we recorded 23 with no history of antibiotics, 25 with a history of second and third generation cephalosporins, 9 cases of fourth generation cephalosporins, 7 cases of linezolid, 6 cases of carbapenems, 5 cases of amoxicillin clavulanic, 4 cases of teicoplanin, 2 instances of vancomycin, 2 cases of doxycycline, and 17 cases of combined antibiotic intake of any two of the following (carbapenems, linezolid, metronidazole, 2nd, 3rd generation cephalosporins).

Table 2 illustrates the distribution of sepsis cases according to causes and outcomes; the most common cause of sepsis mortality was intraabdominal infection (27.9%). It was followed closely by lower respiratory tract infections (23.0%) and skin infections (23.0%). Regarding intra-abdominal infection, there were 6 intra-abdominal abscess, 5 cases of infected malignant tumors, 4 cases of perforated viscus, 3 cases of spontaneous bacterial peritonitis, 2 cases of necrotic pancreatitis, 2 cases of abdominal trauma, 1 case of ruptured appendix and peritonitis, 1 case of intestinal obstruction, and 1 case of complicated umbilical hernia.

The data show that skin infections represent 16 cases (16.0%) divided into 6 cases of diabetic foot, 3 cases of infected advanced bed sores, 3 cases of infected wounds, 1 case of infected deep burn, 1 case of necrotizing fasciitis, 1 case of surgical site skin infection, and 1 case of infected wet gangrenous limb, with a notable 23.0% mortality among total mortality cases, which was statistically significant ($p = 0.018$). The remaining categories did not show significant differences in outcomes. Regarding the others, they represented (9%) of total mortality and included 7 cases of unknown cause, 1 case of leptospirosis, and 1 case of brucellosis.

Only 63 cultures were obtained from our study patients, including 14 blood cultures and 49 cultures from suspected infection sites, such as peritoneal fluid, pleural fluid, endotracheal tubes, bed sore swabs, diabetic foot swabs, urine, sputum, and pus samples. Mixed-organism cultures accounted for (30%) of the cases. The remaining isolates included *Staphylococcus aureus* (12.7%), *Pseudomonas aeruginosa* (11.1%), *Escherichia coli* (11.1%), *Klebsiella* species (11.1%), *Proteus* species (8%), *Staphylococcus epidermidis* (6.3%), *Streptococci* (4.8%), and *Candida* species (4.8%). The most common mixed bacteria in our study were *Klebsiella* species with Staph. Aureus or *Staph. Epidermidis* or *E. coli*, followed by *E. coli* and *gram-positive diplococci*. However, there were 15 cultures of no growth.

In Table 3, all models were statistically significant predictors of mortality ($p < 0.001$). Firstly, the SOFA score demonstrated the highest AUC of 0.850 (95% CI: 0.775–0.924), with a cut-off value of >4, providing a sensitivity of 86.89% and a specificity of 66.67%. Second, the SAPS and SAPS II models, at cut-off values >65 and >38, respectively, showed AUC values of 0.805 (95% CI: 0.719–0.891) and 0.790 (95% CI: 0.700–0.879),

respectively, with sensitivities of 80.33% and 78.69%, specificities of 64.10% and 61.54%.

Table 4 shows that the univariate analysis identifies several variables that are significantly associated with mortality risk, including GCS (p=0.030), procalcitonin (p=0.004), bicarbonate (p=0.001), TLC (p=0.026), pH (p=0.005), FIO2 (p=0.018), platelet count (p=0.018), serum lactate (p<0.001), mechanical ventilation (p=0.059), need for vasoactive therapy (p<0.001), systolic blood pressure (p=0.003), and severity scores (SOFA, SAPS III, SAPS II, LODS, APACHE II, (p<0.001) for all. Notably, septic shock (p<0.001) and sepsis (p<0.001) also showed significant associations. In the multivariate analysis, only the predictive role of the SAPS III score continued to be significant (OR = 1.075, 95% CI: 1.002 – 1.153, p = 0.045), whereas other factors lost their significance after adjusting for other variables.

Table 1. Characteristics of the two studied groups.

Variables	**Total (n = 100)**	**Fate after 28 days of follow up**		**U**	**p**
		Non-survivors (n = 61)	**Survivor (n = 39)**		
Age (years)	58.0(43.0 – 70.0)	60.0(50.0 – 68.0)	51.0(33.5 – 70.0)	U= 982.000	0.142
Gender					
Male [n (%)]	62 (62%)	39 (63.9%)	23 (59.0%)	χ^2= 0.248	0.618
Female [n (%)]	38 (38%)	22 (36.1%)	16 (41.0%)		
Temperature (°C)	38.26 ± 0.74	38.29 ± 0.76	38.22 ± 0.71	t= 0.436	0.664
Heart rate (bpm)	98.0 (90.0 – 110.0)	102.0 (91.0 – 120.0)	93.0 (88.50 – 100.0)	U= 897.500*	0.039*
Systolic blood pressure (mmHg)	90.0 (80.0 – 100.0)	80.0 (70.0 – 90.0)	90.0 (90.0 – 110.0)	U= 657.500*	<0.001*
Respiratory rate (breath/min)	22.29 ± 4.75	22.21 ± 5.17	22.41 ± 4.06	t= 0.201	0.841
GCS	12.41 ± 2.76	11.92 ± 2.69	13.18 ± 2.72	t= 2.279*	0.025*
Partial pressure of oxygen (PaO2) (mm Hg)	95.0 (77.10 – 135.5)	97.0 (77.0 – 136.0)	95.0 (80.50 – 114.0)	U=1178.500	0.941
FIO2 (%)	33.0 (21.0 – 40.0)	40.0 (21.0 – 40.0)	21.0 (21.0 – 37.50)	U= 788.500*	0.002*
TLC (10^3/cmm)	16.95 (13.20 – 20.0)	17.80 (14.0 – 20.70)	14.70(12.45 –18.65)	U= 877.000*	0.027*
Platelet(10^3/cmm)	198.0(110.5 –277.5)	177.0(101.0 –261.0)	227.0(170.0 –313.5)	U= 853.000*	0.018*
Total Bilirubin (mg/dl)	1.10 (0.80 – 2.20)	1.30 (0.90 – 3.80)	1.0 (0.70 – 1.30)	U= 875.500*	0.026*
AST(U/L)	41.0 (21.50 – 90.50)	57.0 (23.0 – 115.0)	32.0 (18.50 – 54.0)	U= 839.500*	0.013*
Procalcitonin(ng/ml)	3.70 (1.95 – 9.40)	6.10 (2.50 – 13.0)	2.10 (1.49 – 3.60)	U= 578.000*	<0.001*
Serum lactate(mg/dl)	25.21 ± 10.98	29.02 ± 10.73	19.24 ± 8.50	t= 4.809*	<0.001*
Blood PH	7.35 (7.30 – 7.42)	7.34 (7.28 – 7.41)	7.37 (7.34 – 7.44)	U= 787.50*	0.004*
Bicarbonate (mEq/L)	18.10 (15.90 – 20.0)	17.0 (15.0 – 19.0)	19.90(18.30 –21.95)	U= 559.000*	<0.001*
Mechanical ventilation including CPAP during current ICU admission	45 (45%)	35 (57.4%)	10 (25.6%)	χ^2=9.681*	0.002*
History of Last antibiotic intake	76 (76.0%)	45 (73.8%)	31 (79.5%)	χ^2=0.426	0.514
Need for vasoactive therapy	39 (39%)	35 (57.4%)	4 (10.3%)	χ^2=22.204*	<0.001*
SOFA Mortality Rate (%)	6.0 (4.0 – 9.0) 21.50 (20.20 – 33.30)	7.0 (6.0 – 10.0) 21.50 (21.50 – 50.0)	4.0 (2.0 – 5.50) 20.20 (6.40 – 20.85)	U= 358.000* U= 386.000*	<0.001* <0.001*
SAPS III Mortality Rate (%)	70.89 ± 16.31 56.50 (35.30 – 75.30)	77.51 ± 15.20 67.50 (50.40 – 82.0)	60.54 ± 12.17 31.50 (17.40 –57.50)	t= 5.870* U= 389.000*	<0.001* <0.001*
SAPS II Mortality Rate (%)	43.75 ± 14.46 29.55 (16.70 – 49.55)	49.16 ± 13.57 43.80 (26.60 – 61.90)	35.28 ± 11.55 16.70 (7.75 – 28.50)	t= 5.280* U= 492.500*	<0.001* <0.001*
LODS Mortality Rate (%)	7.0 (5.0 – 9.0) 38.20 (21.10 – 58.70)	8.0 (6.0 – 10.0) 48.40 (28.90 – 67.60)	5.0 (4.0 – 7.0) 21.10 (15.0 – 38.20)	U= 37.500* U= 543.000*	<0.001* <0.002*
APACHE II Mortality Rate (%)	14.26 ± 6.45 15.0 (8.0 – 25.0)	16.41 ± 6.57 15.0 (12.0 – 25.0)	10.90 ± 4.62 12.0 (7.0 – 15.0)	t= 4.567* U= 752.000*	<0.001* <0.001*

χ^2: Chi square test, FET: Fisher Exact test, U: Mann Whitney test, t: Student t-test, p: p value, *: Statistically significant at $p \leq 0.05$

Table 2. Comparison between the two studied groups according to cause of sepsis.

Cause of sepsis	Total (n = 100)		Fate after 28 days of follow up				c^2	p
			Nonsurvivors (n = 61)		Survivors (n = 39)			
	No.	%	No.	%	No.	%		
Biliary tract infection	5	5.0	2	3.3	3	7.7	0.976	^{FE}p=0.375
Genitourinary infection	9	9.0	4	6.6	5	12.8	1.139	^{FE}p=0.306
I.V catheter related infection	4	4.0	1	1.6	3	7.7	2.270	^{FE}p=0.296
Intraabdominal infection	25	25.0	17	27.9	8	20.5	0.687	0.407
Intracranial infection	3	3.0	1	1.6	2	5.1	0.995	^{FE}p=0.559
Lower respiratory tract infection	23	23.0	14	23.0	9	23.1	0.0	0.988
Musculoskeletal infection	2	2.0	2	3.3	0	0.0	1.305	^{FE}p=0.519
Mesenteric vein occlusion, infected gangrenous bowl	1	1.0	0	0.0	1	2.6	1.580	^{FE}p=0.390
Complicated inguinal hernia	1	1.0	1	1.6	0	.0	0.646	^{FE}p=1.000
Primary bacteremia	2	2.0	1	1.6	1	2.6	0.104	^{FE}p=1.000
Skin infection	16	16.0	14	23.0	2	5.1	5.623*	0.018*
Others	9	9.0	4	6.6	5	12.8	1.139	^{FE}p=0.306

χ^2: Chi square test, FET: Fisher Exact test, p: p value, *: Statistically significant at $p \leq 0.05$

Table 3. Comparison of Roc curve of the models for predicting 28-day mortality in ICU patients with sepsis.

	AUC	p	95% C. I	Cut off#	Sensitivity	Specificity	PPV	NPV
SOFA	0.850	<0.001*	0.775 – 0.924	>4#	86.89	66.67	80.3	76.5
SAPS III	0.805	<0.001*	0.719 – 0.891	>65	80.33	64.10	77.8	67.6
SAPS II	0.790	<0.001*	0.700 – 0.879	>38	78.69	61.54	76.2	64.9
LODS	0.774	<0.001*	0.680 – 0.868	>6#	70.49	71.79	79.6	60.9
APACHE II	0.760	<0.001*	0.664 – 0.855	>12	73.77	66.67	77.6	61.9

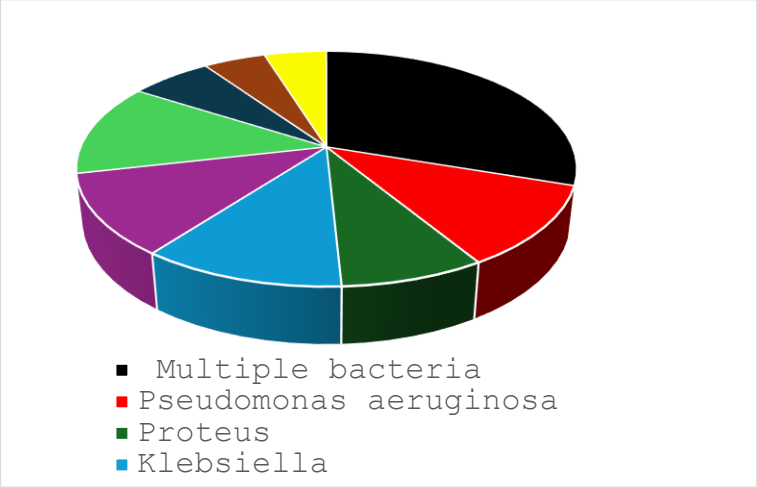
AUC: Area Under a Curve, p value: Probability value, CI: Confidence Intervals, NPV: Negative predictive value, PPV: Positive predictive value, *: Statistically significant at $p \leq 0.05$, #Cut off was chosen according to Youden index

Table 4. Univariate and multivariate Logistic regression analysis for the parameters affecting mortality.

	Univariate		**#Multivariate**	
	p	**OR (LL – UL 95% C. I)**	**p**	**OR (LL – UL 95% C.I)**
GCS	**0.030***	0.823(0.689 – 0.982)	**0.330**	0.861 (0.636 – 1.164)
Procalcitonin	**0.004***	1.149(1.046 – 1.262)	**0.094**	1.113 (0.982 – 1.262)
Bicarbonate	**0.001***	0.799(0.700 – 0.911)	**0.426**	0.920 (0.749 – 1.130)
TLC	**0.026***	1.085(1.010 – 1.167)	**0.758**	1.017 (0.916 – 1.129)
PH	**0.005***	0.001(0.0 – 0.128)	**0.852**	1.101 (0.400 – 3.033)
FIO_2 (%)	**0.018***	1.049(1.008 – 1.092)	**0.299**	1.020 (0.983 – 1.058)
Platelet	**0.018***	0.995(0.991 – 0.999)	**0.615**	0.998 (0.991 – 1.005)
Total Bilirubin	**0.110**	1.104 (0.978 – 1.246)		
AST	**0.064**	1.006 (1.0 – 1.012)		
Serum lactate (mg/dl)	**<0.001***	1.111(1.054 – 1.170)	**0.116**	1.074 (0.982 – 1.174)
Mechanical ventilation	**0.059**	3.574 (0.955 – 13.385)		
Need for vasoactive therapy	**<0.001***	11.779 (3.721 – 37.283)	**0.341**	0.060 (0.000 – 19.585)
Systolic blood pressure	**0.003***	0.964 (0.941 – 0.987)	**0.517**	0.987 (0.949 – 1.027)
SOFA	**<0.001***	1.777 (1.401 – 2.253)	**0.300**	1.282 (0.801 – 2.051)
SAPS III	**<0.001***	1.094 (1.051 – 1.138)	**0.045***	1.075 (1.002 – 1.153)
SAPS II	**<0.001***	1.102 (1.053 – 1.154)	**0.430**	0.963 (0.878 – 1.057)
LODS	**<0.001***	1.614 (1.287 – 2.024)	**0.684**	0.911 (0.583 – 1.425)
APACHE II	**<0.001***	1.194 (1.091 – 1.307)	**0.955**	1.005 (0.842 – 1.200)
SIRS				
SIRS	**0.999**	NA		
Sepsis	**<0.001***	0.192 (0.080 – 0.461)	**0.401**	2.230 (0.343 – 14.514)
MOD	**0.999**	NA		
Septic shock	**<0.001***	14.143 (3.929 – 50.914)	**0.126**	102.364 (0.272–38556.83)
Severe sepsis	**0.649**	0.627(0.085 – 4.646)		

OR: Odd`s ratio, C.I: Confidence interval, LL: Lower limit, UL: Upper Limit #: All variables with p<0.05 was included in the multivariate
*: Statistically significant at $p \leq 0.05$, Hosmer and Lemeshow Test= χ^2 =8.397(0.396)

Figure 1. Spectrum of causative pathogens among studied ICU patients.



Discussion

Up to the 28-day follow-up, 61% of the observed fatality rates in this investigation were recorded. This agrees with the findings of Elbaih et al., who found that the mortality rate of patients with ICU sepsis up to 28 days was 67.2% [15]. In comparison with our study, a lower death rate of 40.7% was reported by Ren et al. [16]. The differences in sepsis and septic shock death rates worldwide are reflected in these discrepancies. The fatality rates of sepsis and septic shock in high-income countries (HICs) are 15%–25% and 30%–40%, respectively. The mortality rates of sepsis and septic shock, on the other hand, exceed 40% and 50% in low- and middle-income countries (LMICs), respectively. This is due to several factors, including lack of healthcare access, higher occurrence of infections, and rise in antibiotic resistance. This highlights the urgent need for early intervention, especially in LMICs [17].

In our study, patient ages ranged from 19 to 86 years (median, 58.0 years). The non-survivors were slightly older (50–68 years) than the survivors (33.5-70.0 years), but the difference between the two groups was not significant ($p = 0.142$). Consistent with our results, Kari et al. conducted a prospective cohort study on 292 patients with sepsis and found that age ranged from 18 to 93 years, with a mean age of 50.98 ± 17.75 years. The mean age was 53.50 ± 17.50 for those who died and 50.05 ± 17.80 for survivors, showing no significant age difference in outcomes ($p = 0.0143$) [18].

Although there was not a significant difference in gender between survivors and the deceased ($p = 0.618$), our study found a male-dominated gender distribution (62%) and a greater male mortality rate (63.9%). This is in line with Kari et al. who found no significant difference in death rates ($p = 0.542$) despite their finding that males represented 64.4% of the population and 69.2% of non-survivors [18]. In contrast, Thompson et al. found a significantly higher mortality rate in male patients with sepsis than in females (25.3% vs. 22.5%, p 0.001) [19]. Variations in sample size, biological factors, comorbidities, infection sites, and possible gender biases in assessment and care could all contribute to the reported variances in mortality outcomes according to gender. These disparities may be linked, for example, to the higher prevalence of chronic obstructive pulmonary disease and earlier development of cardiac disease in males [20].

Our study found that the primary causes of sepsis-related mortality were intra-abdominal infections, which accounted for (27.9%) of cases, followed by lower respiratory tract infections (23%), and skin infections also (23%). These findings are consistent with those of Chou et al., who reported that the leading causes of sepsis-related mortality were intra-abdominal infections (30.6%), lower respiratory tract infections (27.7%), and skin infections (15.4%) [21]. Skin infections were the third most common cause of sepsis mortality in our cohort (16%) and showed a significant difference between the groups ($p = 0.018$). Pulido-Pérez et al. reported that skin and soft tissue infections were the fourth most common cause of sepsis, with 28% of these patients requiring ICU admission and an 8% mortality rate [22]. Furthermore, Leisman et al. identified surgical site infections as the fifth leading cause of sepsis [23]. In contrast, Jeganathan et al. found the highest mortality for sepsis from multiple or unknown sources, with the lowest mortality for abdominal, genitourinary, or skin/soft tissue infections [24], likely due to variations in study location and comorbidities [25]. In our study, diabetes mellitus (29% of comorbidities) contributed to higher rates of diabetic foot gangrene, infected bed sores, and surgical site infections, highlighting the need for preventive measures like preoperative antibiotics and patient preparation [26].

Among our ICU sepsis patients, univariate regression analysis showed that the following factors were significant predictors of mortality ($p < 0.05$): GCS, systolic blood pressure, platelet count, blood PH, and bicarbonate, procalcitonin, serum lactate, total leucocyte count (TLC), fraction of inspired oxygen (FIO2), need to MV, and vasopressor need, severity scores (SOFA, SAPS III, SAPS II, LODS, and APACHE II). Nevertheless, SAPS III score was found to be a key independent predictor of 28-day mortality among patients with ICU sepsis in the multivariate regression analysis ($p = 0.045$). Our findings are supported by the results of Zhu et al. which are consistent with our own [27]. Furthermore, SAPS III score was the strongest predictor of intra-ICU and intrahospital mortality, as reported by Falcão et al. [28]. In contrast to our results, Tekin et al. observed that the SOFA score had the strongest predictive value for death among ICU sepsis patients over a 28-day follow-up, out of the models they evaluated (SOFA, APACHE II, LODS, and SAPS II) [29]. Furthermore, Zhang et al.

demonstrated that the LODS score was superior to the SOFA score in forecasting 28-day mortality in patients with septic infection who presented with urinary tract infections, pneumonia, bacteremia, and abdominal infections [30]. Several variables, including the infection site, patient comorbidities, study design, diagnostic criteria, and cutoff values, may contribute to the variation in prognostic accuracy among scores.

Conclusions

During the 28-day follow-up, procalcitonin, serum lactate, vasopressor use, and mechanical ventilation were the main predictors of mortality among patients with sepsis in the ICUs. The SAPS III score was the most effective predictor of 28-day mortality, whereas the SOFA score was the most sensitive and reliable measure. Therefore, SAPS 3 and SOFA Scores, according to our study, are considered good tools to use in ICUs to improve outcomes and prognosis, especially in countries with limited resources.

Conflict of interest

Non decalred

Financial disclosure

Non declared

Data availability

The data that support the findings of this study are available from the corresponding author upon request.

Authors' contribution

Aliaa Abotaleb, principal investor, led data collection; Dr. Osama Negm conceptualized and designed the study and the research; Dr. Sameh Abdelkhalik led the analysis of data and interpretation of results; and Dr. Shimaa El-Sharawy designed the study, prepared the draft of the manuscript and reviewed the manuscript

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