CCI JOURNAL CRITICAL CARE INNOVATIONS

ORIGINAL ARTICLE

Crit. Care Innov. 2021; 4(4):9-18

Sequential organ failure assessment and modified early warning score system versus quick SOFA score to predict the length of hospital stay in sepsis patients – accuracy scoring study.

Gopala Krishna [1] - A,B,C,E,F,I,M,N,O. ORCID www.orcid.org/0000-0003-3125-1016
Siva Kumar [1] - A,B,C,E,F,I,M,N,O. ORCID www.orcid.org/0000-0003-4170-9940
Ravi Sankar [1] - A,B,C,E,I,K,M,N,O. ORCID www.orcid.org/0000-0001-5951-328X
Kondle Raghu [1] - A,B,E,J,K,N,O. ORCID www.orcid.org/0000-0001-8713-8640
Vemula Sathynarayana [1] - A,C,E,N,O. ORCID www.orcid.org/0000-0002-5590-2824
Pasupuleti Siripriya [1] - A,C,E,N,O. ORCID www.orcid.org/0000-0002-1237-7126

[1] *Department of Emergency Medicine, Narayana Medical College and Hospital, Nellore. Andhra Pradesh, India.*

Address for correspondence:
Siva Kumar, MD - Department of Emergency Medicine, Narayana Medical College and Hospital, Nellore. Andhra Pradesh, India. Chintareddy Palem, Nellore, Andhra Pradesh 524003, Indie;
Tel: +91 861 231 7968; E-mail: svkmr450@gmail.com

ISSN 2545-2533
Received: 27.10.2021
Accepted: 20.11.2021
Published: 31.12.2021

Author Contributions (CRediT Taxonomy):

Conceptualization - **A**
Data Curation - **B**
Formal Analysis - **C**
Funding Acquisition - **D**
Investigation - **E**
Methodology - **F**
Project Administration - **G**
Resources - **H**
Software - **I**
Supervision - **J**
Validation - **K**
Visualization - **L**
Writing (Draft Preparation) - **M**
Writing (Review & Editing) – **N**
Approved the final version - **O**

ABSTRACT

INTRODUCTION: Sepsis is a global healthcare challenge, and accurate scores are required to identify and stratify patients' risk. The current study aimed to compare the prognostic accuracy of quick SOFA (qSOFA) with comparison to SOFA and MEWS scores in order to identify the length of hospital stay and outcomes among patients with sepsis who presented to emergency department (EMD).

MATERIAL AND METHODS: Between July and November 2018, 77 adult patients with sepsis were treated at EMD. The area under the receiver operating characteristic curve (AUROC) of quick SOFA (qSOFA), SOFA, and MEWS scores was used to compare prognostic accuracy for the outcome of hospital mortality and length of stay.

RESULTS: The majority of patients (68%) were over the age of 50. Systemic Hypertension is the most common comorbid condition, accounting for 38.9% (n=30). Pneumonia is the most common diagnosis in 27.3 percent of cases (n=21). Patients required vasoactive support in 45.5 percent (n=35) of cases, and ventilator support in 50.6 percent (n=39) of cases. Mortality was observed in 34.1 percent (n=27) of the cases. Patients on vasopressor and ventilator support have a higher mortality rate [8(19%) vs. 21(50%)]. The mortality rate in patients with a qSOFA score of 3 is 71.4 percent. Patients with a SOFA score of >15 had higher mortality rate. The mortality rate in patients with MEWS score > 5 is 48.9%. A qSOFA score of 3 is associated with an increased risk of death, and the majority died in less than three days. Because of increased mortality, most patients with a SOFA score of 7 have a length of stay of 3 days. Most patients with a Mews score of 5 or higher have a length of stay of 3 days due to mortality. The AUC value for qSOFA is 0.721, the AUC value for SOFA is 0.714, and the AUC value for MEWS is 0.693, indicating that qSOFA is more sensitive in predicting the outcome than SOFA and MEWS.

CONCLUSIONS: In all prediction scores, qSOFA outperformed than SOFA and MEWS in terms of hospital mortality and length of hospital stay. qSOFA is a simple, rapid bedside tool that does not require laboratory parameters and can be used to predict the prognosis of patients with sepsis in the EMD.

KEY WORDS: Sepsis, prognostic accuracy, SOFA score, qSOFA score, MEWS score.

INTRODUCTION

In all prediction scores, qSOFA outperformed SOFA and MEWS in terms of hospital mortality and length of hospital stay. qSOFA is a simple, quick bedside tool that does not require laboratory parameters and can be used to predict p. Sepsis is a global health problem with high mortality and morbidity[1]. It progresses quickly to a critical stage, and failure to identify and treat it results in a fatal outcome [2]. It's one of the most common life-threatening conditions seen in the emergency room. Sepsis is caused by a combination of pathological, physiological, and biochemical abnormalities that occur as a result of infection caused by any pathological event [3,4].

There are numerous clinical scoring systems available today to assess disease severity and prognosis [6]. SOFA, APACHE, MEDS, LODS, MEWS, and so on are examples. Because laboratory investigations are time-consuming, the Sepsis 3 task force has introduced a new scoring system, qSOFA [7], which is a simple and rapid bedside tool that can be performed on patients with suspected infection by medical professionals. They recommend the qSOFA score for patients who are at high risk of developing sepsis outside of the ICU, and the SOFA score for patients who are in the ICU [5,8].

The ideal sepsis detection and patient outcome prognostication scoring system is still unknown. The purpose of this study was to determine the utility of qSOFA in comparison to SOFA and MEWS for early prognosis of patients with sepsis who presented to the Department of Emergency Medicine, Narayana Medical College, Nellore. We hypothesised that there were significant differences between these scores, which could have an impact on score performance across different hospitalised populations.

MATERIAL AND METHODS

Study design - The current study is a prospective study of atraumatic patients admitted to Narayana Medical College and Hospital's Emergency Department in Nellore District, Andhra Pradesh. The research was carried out in the Emergency Department of Narayana Medical College And Hospital, Nellore, from November 2018 to October 2020. 77 patients of both sexes over the age of 18 were included, as were patients with clinical or laboratory values suggestive of sepsis. Patients under the age of 18, patients with recent surgery, trauma, or burns, or a known case of cardiac illness or pregnancy, malnutrition, malignancy, or transplant recipients were excluded. The electronic health record was used to extract patient demographic data, vital signs, laboratory values, orders (e.g., medications, cultures, oxygen therapy, vasopressors), hospital mortality data, and ICU and hospital length of stay (LOS). The qSOFA, SOFA, and MEWS scores of each patient were calculated at the time of admission using physiological and laboratory parameters recorded within the 24 hours preceding and following admission [9,10]. The primary outcome was the prognostic accuracy of individual hospital mortality scores. The secondary outcome was LOS greater than 3 days and overall hospital LOS greater than 7 days following study inclusion. Statistical analysis: Patient characteristics are presented as a percentage, mean standard deviation, and median and

interquartile range (IQR) for normally distributed variables, and median and interquartile range (IQR) for non-normally distributed variables. The Student's t-test was used to compare continuous variables. The chi-square test was used to compare dichotomous variables. The area under the receiver operating characteristic curve (AUROC) for each score was used to assess comparative prognostic accuracy for outcomes. When the p value was less than 0.05, the association between the variables was considered statistically significant. SPSS version 22.0 was used for statistical analysis (SPSS Inc, IL, US).

Ethical Approval - This study was approved by the Institutional ethics committee of Allied hospital (Faisalabad Medical University) with approved no. AHF-379-FMU-04/15. Informed consent was taken from the patients.

RESULTS

Fifty (64.9 percent) of the seventy-seven patients admitted are male, while 27 (35.1 percent) are female. Patients were divided into four age groups: 30yrs, 31-40yrs, 41-50yrs, and >50yrs, with 5 (6.50%), 3 (3.90%), 16 (20.80%), and 53 (68.80%), respectively. The patients were clinically examined and diagnosed after appropriate investigations. Out of 77 patients, 21 (27.3 percent) had pneumonia, 11 (14.3 percent) had urosepsis, 9 (11.7 percent) had acute gastroenteritis, 5 (6.5 percent) had septic encephalopathy, and the rest had cellulitis, cholecystitis, pyelonephritis, viral hepatitis, etc. (Figure 1). Forty two (54.5%) patients were managed without vasoactive support, and 35 (45.5%) patients were managed with vasoactive support. In the study, 34.1 percent (n=27) are non-survivors. There were 8 (19%) and 19 (54%), respectively, non-survivors in patients who did not receive Vasoactive support.

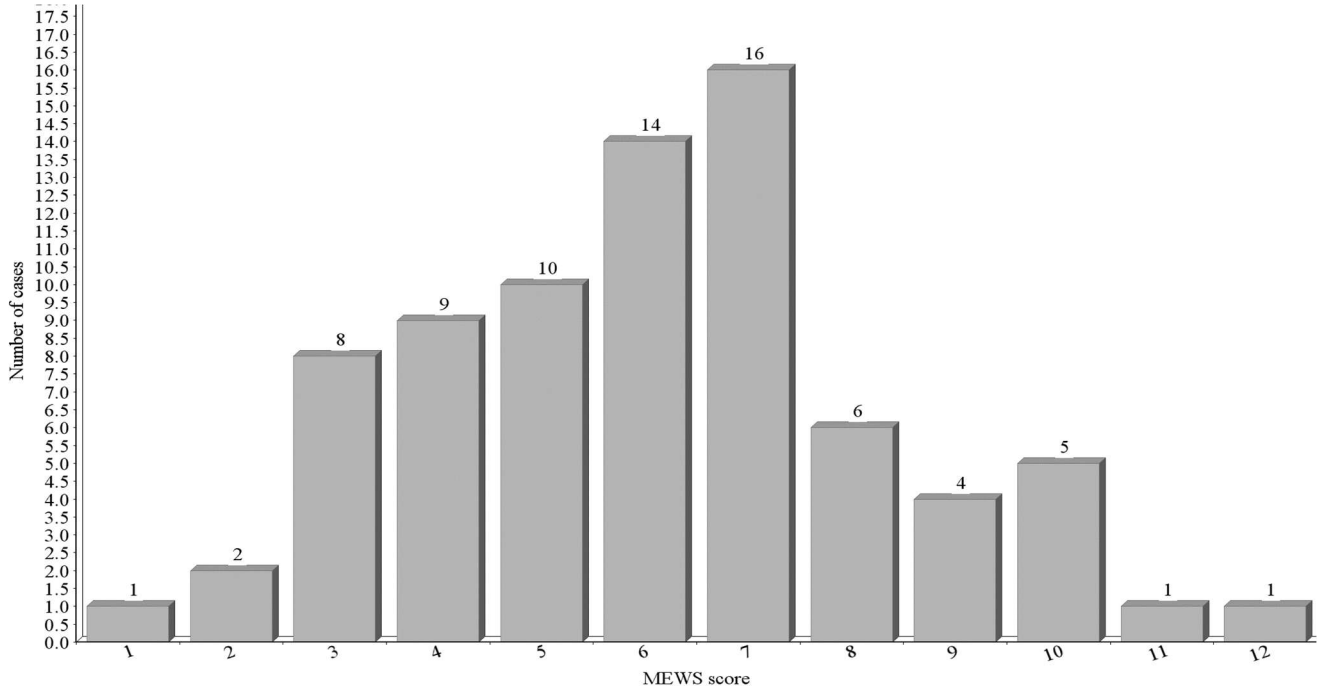

Figure 1. Frequency of distribution vs MEWS.

Out of 77 patients, 35 (45.5%) were kept without ventilator support, while 42 (54.5%) were kept with ventilator support. In patients who were kept without and with ventilator support, there were 6 (17%) and 21 (50%) non-survivors, respectively. Thirty-seven (48%) of the 77 patients are hypertensive. There were 8 (20%) and 19 (51%), respectively, non-survivors in non-hypertensives and hypertensives. In total, 77 patients have a qSOFA score of 1, 44 (57%) have a score of 2, and 21 (27%) have a score of 3. For a qSOFA score of 1, 10(83%) are survivors and 2(17%) are non-survivors; for a score of 2, 34(77%) are survivors and 10(23%) are non-survivors; and for a score of 3, 6(29%) are survivors and 15(71%) are non-survivors (Table 1).

Table 1. Association between qSOFA and outcome.

			Outcome		Total
			Alive	Death	
qSOFA_SCR:	1	Count	10	2	12
		% within qSOFA_SCR	83.3%	16.7%	100%
		% within Outcome	20.0%	7.4%	15.6%
	2	Count	34	10	44
		% within qSOFA_SCR	77.3%	22.7%	100%
		% within Outcome	68.0%	37.0%	57.1%
	3	Count	6	15	21
		% within qSOFA_SCR	28.6%	71.4%	100%
		% within Outcome	12.0%	55.6%	27.3%
Total:		Count	50	27	77
		% within qSOFA_SCR	64.9%	35.1%	100%
		% within Outcome	100%	100%	100%

Out of 77 cases, 38 (49.3 percent) have a SOFA Score of 0-6, 32 (41.5 percent) have a SOFA Score of 7-12, 6 (7.8 percent) have a SOFA Score of 13-14, and 1 (1.3 percent) have a SOFA Score of 15 or higher. For a SOFA Score of 0-6, 30(78.9 percent) are survivors, and 8(21.05 percent) are non-survivors; for 7-12, 19(59.37 percent) are survivors, and 13(40.6 percent) are non-survivors; for 13-14, 2(33.3 percent) are survivors, and 4 (66.67 percent) are non-survivors; and for score 15-24, 1 (100 percent) case of non-survivor. MEWS Score: Out of 77 total cases, 30 (39 percent) have a score of 0-5 and 47 (61 percent) have a score of >5. There were 5 (17%) non-survivors with a MEWS score of 0-5 and 23 (49%) with a MEWS score of >5 (Figure 1). A qSOFA score of 3 is associated with an increased risk of death, and the majority died in less than three days. Because of increased mortality, most patients with a SOFA score of 7 have a length of stay of 3 days (Table 2).

Table 2. Scores vs length of stay.

SCORE	Length of Stay ≤ 3 DAYS	Length of Stay >3 DAYS
qSOFA Score & Length of Stay		
1	4	8
2	13	31
3	12	9
SOFA Score & Length of Stay		
0-6	13	25
7-12	13	19
13-14	2	4
≥15	1	0
MEWS & Outcome		
0-5	9	21
>5	20	27

Most patients with a Mews score of 5 or higher have a length of stay of 3 days due to mortality. In a comparison of qSOFA, SOFA, and MEWS in patients with sepsis, qSOFA was found to be more sensitive than SOFA and MEWS (Figure 2, 3, 4).

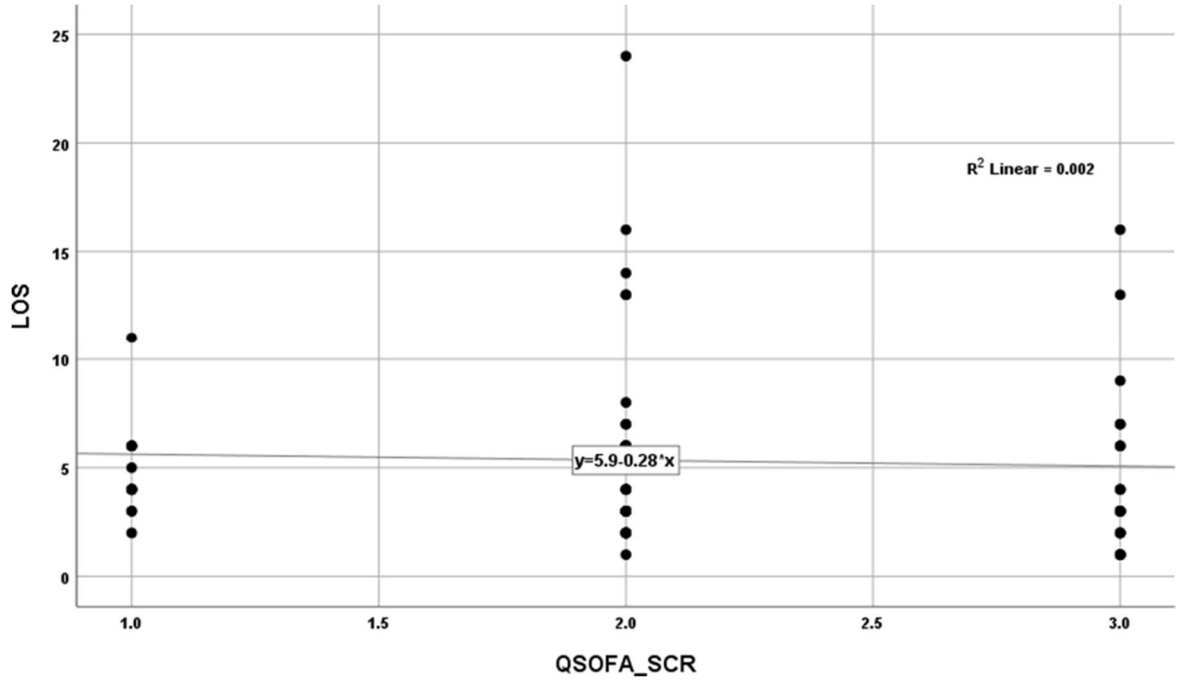

Figure 2. Length of stay of patients in relation to qSOFA score.

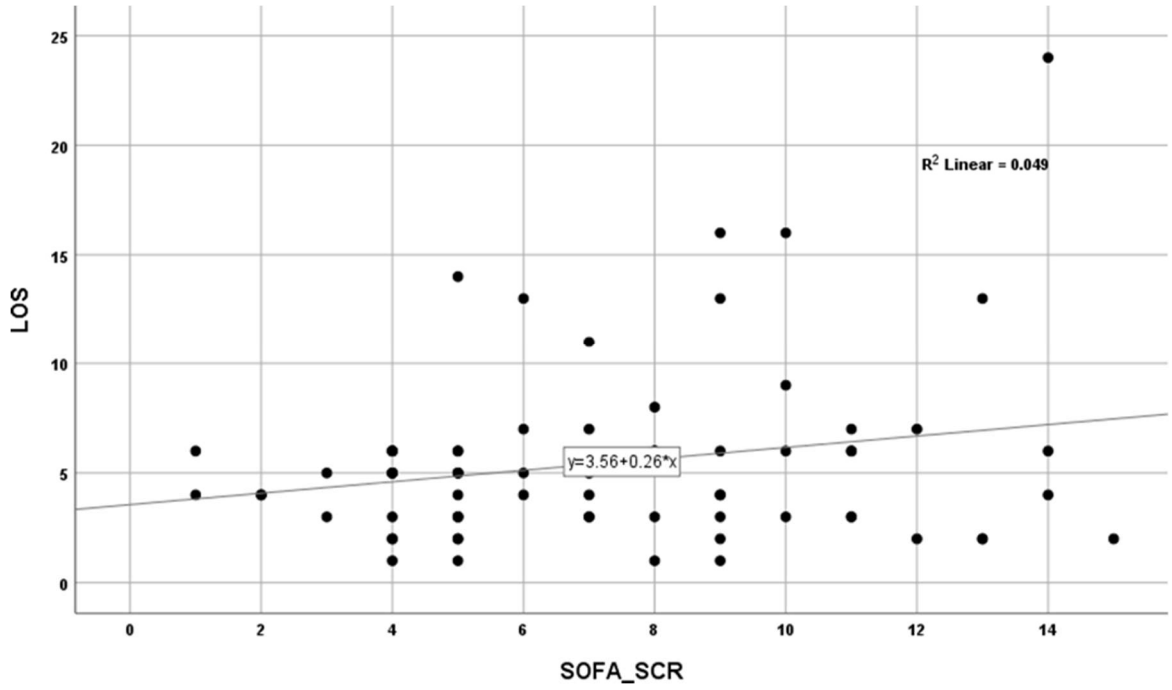

Figure 3. Length of stay of patients in relation to SOFA score.

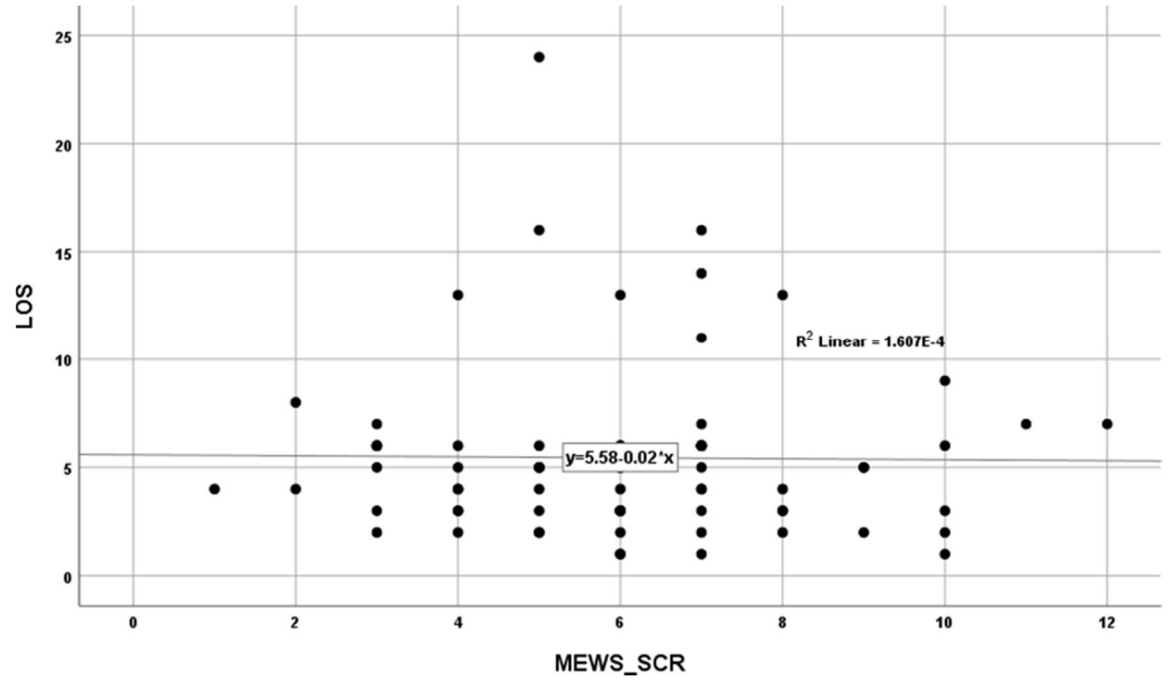

Figure 4. Length of stay of patients in relation to MEWS.

The AUC value for qSOFA is 0.721, SOFA's AUC value is 0.714, and MEWS's AUC value is 0.693, indicating that qSOFA has higher significant sensitivity in predicting the outcome. (Table 3) (Figure 5).

 doi: 10.32114/CCI.2021.4.4.9.18

Table 3. Statistical analysis of qSOFA, SOFA, MEWS in sepsis patients.
Area under curve (AUC) For qSOFA, SOFA and MEWS

Test Result Variable(s)	Area	Std. Error	P-value	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
qSOFA_SCR	0.721	0.065	0.002	0.593	0.848
SOFA_SCR	0.714	0.065	0.003	0.587	0.840
MEWS_SCR	0.693	0.061	0.007	0.573	0.813

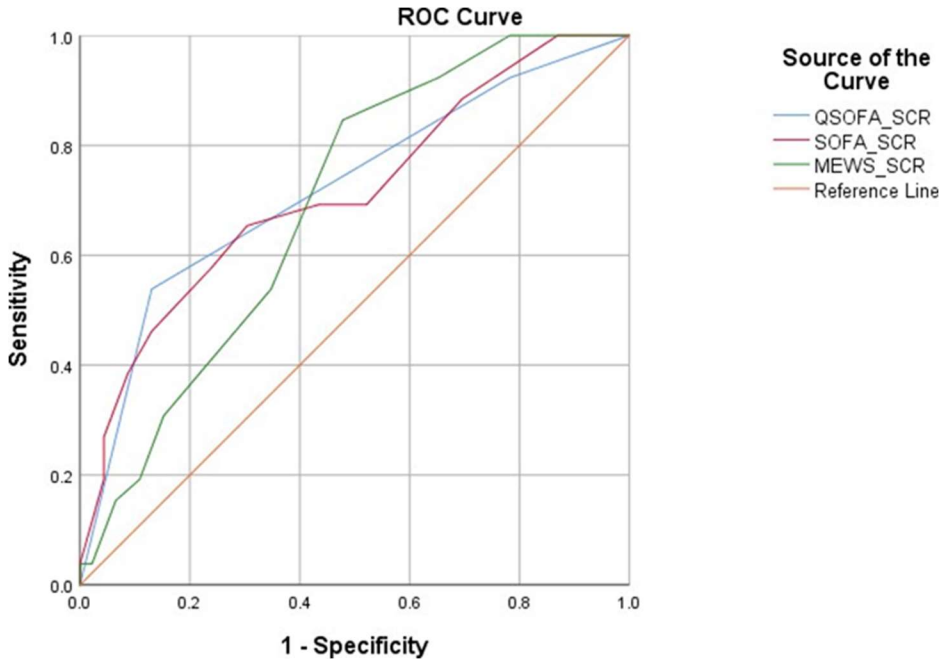

Figure 5. ROC curve for sepsis (qSOFA, SOFA, MEWS).

DISCUSSION

Males (64.9 percent) were more commonly affected than females in the current study. Males (51%) were affected more than females in Goulden R et al., and females (53%) were affected more than males in Singer et al. In the current study, people over the age of 50 (68.8%) were the most commonly affected. Similarly to our study, Vanderwoude et al. found that 62.3 % of patients were over the age of 50 [10-12].

In the current study, respiratory tract infection (29.9%) was the most common diagnosis, followed by urosepsis (14.3%) and gastrointestinal disease (18.2%). In comparison to Goulden R et al., respiratory tract infection (29%) and Eamon P. Raith et al., respiratory tract infection (28%) is the most common diagnosis, which is consistent with the current study [13].

Survivors (65.9%) are the outcome in our study, whereas survivors (85%) are the outcome in Goulden R et al. and 81.3 percent are the survivors in Eamon P. Raith. In our study, 45.5 percent of patients required vasoactive support, whereas M A Baig et al.[14] required 49.9 percent. In our current study, 50.6 percent of patients required ventilator support, whereas M A Baig et al. required ventilator support in 48.3 percent of patients. In our current study, 38.9 percent of patients have hypertension, 37.6 percent have diabetes mellitus, and 31.1 percent have no comorbidities. When compared to Kavous Shahsavarinia et al., 32.1 percent of patients have hypertension, followed by 27.1 percent who have CAD, and 22.1 percent who have diabetes [1]. As shown in the table, 57.1 percent of patients in our current study have a qSOFA score of 2, and the mortality rate is 37 percent, followed by 55.6 percent mortality in a qSOFA score 3, and the patients are 27.3 percent. In comparison to Said et al., 37.1 percent of patients have a qSOFA score of 1 and a mortality rate of 12%, while 35 percent of patients have a qSOFA score of 1 and a mortality rate of 35% [15]. In our current study, 49.3 percent of patients had a SOFA score of 0-6, while 41.5 percent had a SOFA score of 7-12. In comparison to M.A. Baig et al., 50.4 percent of patients have a SOFA score of 7-12, while 40.7 percent have a SOFA score of 0-6. Similarly to our study, Said et al. found that 68.6 percent of patients have a SOFA score of 0-6, with 26.4 percent having a SOFA score of 7-12 [16].

In our current study, 61 percent of patients had a MEWS score of 5 or higher, with a mortality rate of 29.8 percent, and 38.9 percent of patients had a MEWS score of 0-5, with a mortality rate of 6.4 percent.
In our current study, 16.8 percent of patients with qSOFA score 2 have a length of stay of 3 days, while 40.2 percent of patients with qSOFA score 2 have a length of stay of 3 days. In addition, 16.8 percent of patients with a SOFA score of 0-6 had a length of stay of 3 days. The average length of stay for patients with a SOFA score of 0-6 is 3 days. In our current study, 25.9% of patients with a MEWS score of >5 have a length of stay of 3 days, and 29.8% of patients with a MEWS score of >5 have a length of stay of >3 days. In our current study, qSOFA outperformed SOFA and MEWS. In contrast to our study and Valeria Caramello et al., SOFA is more accurate than qSOFA in Eamon P. Raith et al. and Said et al. Valeria Caramello et al.[16] identified AUC values of 0.758, 0.725, and 0.61 for qSOFA, SOFA, and MEWS, respectively. Similar to our study, qSOFA is more accurate than SOFA and MEWS.

CONCLUSIONS

In the current study, 64.9 percent of participants are survivors, while 34.1 percent are non-survivors. The mortality rate in patients with a qSOFA score of 3 is 71.4 percent. Patients with a SOFA score of 15 or higher have a 100% chance of dying. The mortality rate in patients with MEWS greater than 5 is 48.9%. The AUC values for qSOFA, SOFA, and MEWS are all statistically significant. Sepsis is one of the most common life-threatening conditions that present to the Emergency Department; early stratification, rapid and aggressive management reduces mortality and hospital stay. In comparison to SOFA and MEWS, the qSOFA score is a promising tool for prognosis and mortality prediction. qSOFA is a simple, rapid bedside tool that does not require laboratory parameters and can be used to predict the prognosis of patients with sepsis in the emergency department.

SUPPLEMENTARY INFORMATION

Funding: *This research received no external funding.*
Institutional Review Statement: *The study was conducted according to the guidelines of the Declaration of Helsinki.*
Informed Consent Statement: *Informed consent was obtained from all subjects involved in the study.*
Data Availability Statement: *The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.*
Conflicts of Interest: *The authors declare no conflicts of interest.*
Acknowledgment: *The authors would like to thank the emergency department staff as well as Narayana Medical College and Hospital for providing the material.*

REFERENCES

[1] Shahsavarinia K, Moharramzadeh P, Arvanagi RJ, Mahmoodpoor A. qSOFA score for prediction of sepsis outcome in emergency department. Pak J Med Sci. 2020; 36(4): 668-672.
doi: https://doi.org/10.12669/pjms.36.4.2031

[2] Fleischmann C, Scherag A, Adhikari NK, Hartog CS, Tsaganos T, Schlattmann P, et al. Assessment of Global Incidence and Mortality of Hospital-treated Sepsis. Current Estimates and Limitations. Am J Respir Crit Care Med. 2016; 193(3): 259–272..
doi: https://doi.org/10.1164/rccm.201504-0781OC

[3] Lichtman JH, Leifheit-Limson EC, Jones SB, Wang Y, Goldstein LB: 30- Day risk-standardized mortality and readmission rates after ischemic stroke in critical access hospitals. Stroke. 2012; 43(10): 2741-2747.
doi: https://doi.org/10.1161/STROKEAHA.112.665646

[4] Yealy DM, Huang DT, Delaney A, Knight M, Randolph AG, Daniels R, et al. Recognizing and managing sepsis: what needs to be done? BMC Med. 2015; 13(98).
doi: https://doi.org/10.1186/s12916-015-0335-2

[5] Seymour CW, Gesten F, Prescott HC, Friedrich ME, Iwashyna TJ, Phillips GS, et al. Time to Treatment and Mortality during Mandated Emergency Care for Sepsis. N Engl J Med. 2017; 376: 2235–2244.
doi: https://doi.org/10.1056/NEJMoa1703058

[6] Jones AE, Fitch MT, Kline JA. Operational performance of validated physiologic scoring systems for predicting in-hospital mortality among critically ill emergency department patients. Crit Care Med. 2005; 33(5): 974–978.
doi: https://doi.org/10.1097/01.ccm.0000162495.03291.c2

[7] Tintinalli JE, Stapczynski JS, Ma OJ, Cline DM, Meckler GD. Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 8th edition. McGraw-Hill Education: Medical, 2015.

[8] 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. Working group on "sepsis-related problems" of the European Society of Intensive Care Medicine. Crit Care Med. 1998; 26(11): 1793–1800.
doi: https://doi.org/10.1097/00003246-199811000-00016

[9] Prytherch DR, Smith GB, Schmidt PE, Featherstone PI. ViEWS - Towards a national early warning score for detecting adult inpatient deterioration. Resuscitation. 2010; 81(8): 932–937.
doi: https://doi.org/10.1016/j.resuscitation.2010.04.014

[10] 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; 315(8): 801–810.
doi: https://doi.org/10.1001/jama.2016.0287

[11] Goulden R, Hoyle MC, Monis J, Railton D, Riley V, Martin P, et al.. qSOFA, SIRS and NEWS for predicting inhospital mortality and ICU admission in emergency admissions treated as sepsis. Emerg Med J. 2018; 35(6): 345-349.
doi: https://doi.org/10.1136/emermed-2017-207120

[12] Van der Woude S W, van Doormaal FF, Hutten BA, Nellen FJ, Holleman F. Classifying sepsis patients in the emergency department using SIRS, qSOFA or MEWS. Neth J Med; 2018: 76(4): 158-166.

[13] Raith EP, Udy AA, Bailey M, McGloughlin S, MacIsaac C, Bellomo R, et al. Prognostic accuracy of the SOFA ccore, SIRS criteria, and qSOFA score for in-hospital mortality among adults with suspected infection admitted to the intensive care unit. JAMA. 2017; 317(3): 290-300.
doi: https://doi.org/10.1001/jama.2016.20328

[14] Baig MA, Sheikh S, Hussain E, Bakhtawar S, Subhan Khan M, Mujtaba S, et al.. Comparison of qSOFA and SOFA score for predicting mortality in severe sepsis and septic shock patients in the emergency department of a low middle income country. Turk J Emerg Med. 2018; 18(4): 148-151.
doi: https://doi.org/10.1016/j.tjem.2018.08.002

[15] Said MA, Wangari-Waweru S, Mung'ayi V, Shah R. Comparison of the Sequential Organ Failure Assessment (SOFA) and Quick SOFA Scores in predicting in-Hospital Mortality among Adult Critical Care Patients with Suspected Infection. Int J Crit Care Emerg Med 2019; 5: 084.
doi: https://doi.org/10.23937/2474-3674/1510084

[16] Caramello V, Beux V, De Salve AV, Macciotta A, Ricceri F, Boccuzzi A. Comparison of different prognostic scores for risk stratification in septic patients arriving to the Emergency Department. Ital J Med. 2020; 14(2): 79-87.
doi: https://doi.org/10.4081/itjm.2020.1232