

Comparison of National Early Warning Score (NEWS) & Sepsis Patient Evaluation in the Emergency Department (SPEED) for The Early Identification of Sepsis in the Emergency Department

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Abstract:

Background: Sepsis, a multifaceted syndrome initiated by infection, is defined by pathophysiological and biochemical disturbances.

Aims and Objectives: Evaluate the comparative capabilities of the National Early Warning Score (NEWS) and the Sepsis Patient Evaluation in the Emergency Department (SPEED) to identify patients at risk of in-hospital mortality and other adverse outcomes as **Primary (main) outcome:** Mortality during the 30-day follow-up & **secondary outcomes:** Hospital admission, ICU/HDU admission or readmission in the emergency department ED in Assiut & Suez canal Universities.

Patients and Methods: This prospective observational analytical cross-sectional study was conducted on 120 patients who entered the ER.

Result: The Total NEWS score had higher sensitivity (76%) than the total SPEED score. There is no difference between the total NEWS and SPEED scores in specificity for the mortality prediction. Area under the curve (AUC) of the total NEWS score was higher than the total SPEED score in predicting mortality.

Conclusion: The SPEED score predicts 30-day mortality in septic patients. It is simple, useful, and accurate, and its predictive value is comparable to that of other scoring systems. The NEWS was immediately available as it does not require laboratories. However, scoring the NEWS may be more suitable for computerized assessment.

Keywords: National Early Warning Score (NEWS); Sepsis Patient Evaluation in the Emergency Department (SPEED), The Early Identification of Sepsis; Emergency Department.

Introduction:

Numerous medical diseases necessitate a prompt response to provide optimal patient outcomes. Examples encompass sepsis, myocardial infarction (MI), significant trauma, ruptured abdominal aortic aneurysm, and ruptured ectopic pregnancy. The clinical diagnosis of some diseases is often complex.⁽¹⁾

Sepsis is characterized by the presence of suspected or confirmed infection, indications of systemic inflammation, and

organ failure. Septic shock is characterized by sepsis necessitating vasopressor administration following sufficient resuscitation, accompanied by high lactate levels.⁽²⁾

Sepsis, defined by the Society of Critical Care Medicine (SCCM) Sepsis-3 criteria, is a life-threatening organ dysfunction caused by a dysregulated host response to infection. Sepsis and septic shock are major contributors to global mortality. Sepsis and septic shock are medical crises necessitating prompt examination and care; early detection

and therapy initiation enhance outcomes for sepsis patients. Early administration of antimicrobial medication is a highly effective intervention that reduces in-hospital mortality in sepsis patients. ⁽³⁾

Various scoring systems, grounded in clinical and laboratory data, are formulated to predict short-term mortality in patients with severe sepsis and septic shock. ⁽²⁾

I. The National Early Warning Score (NEWS):

NEWS is a verified track-and-trigger early warning score system utilized to identify the danger of deterioration. The scoring system comprises six fundamental physiological parameters: respiration rate, oxygen saturation, temperature, systolic blood pressure (SBP), pulse rate, and level of awareness. ⁽⁴⁾

It signifies that a high NEWS score isn't a diagnosis but a systematic indicator that a patient requires immediate clinical evaluation. ⁽⁵⁾

An assigned score between 0 and 3, with higher scores denoting a more significant departure from the normal range. ⁽⁶⁾

II - The sepsis patient evaluation in the emergency department (SPEED):

Another scoring system assesses the existence of an immunosuppressive condition. ⁽⁷⁾ Hypotension (SBP < 90 mmHg), hypothermia (body temperature < 36.0°C), hypoxemia (pulse oximetry < 90%), low hematocrit (hematocrit < 0.38), acidosis (blood pH < 7.35), increased blood lactate (> 2.4 mmol/L), and pneumonia as the cause of infection. ⁽⁴⁾ Then the Speed⁽⁸⁾ is evaluated in four grades.

The factors utilized in the SPEED score can be readily and uniformly acquired in an ER setting: patient characteristics, vital signs, and laboratory findings. ⁽⁹⁾

There is a simplified method, termed the quick Sepsis-Related Organ Failure Assessment (qSOFA), that serves as a simplified bedside tool to help clinicians identify patients who may be at greater risk of dying from sepsis. It consists of only three components, each one point. A score of ≥ 2 points signifies the presence of organ dysfunction. (Respiratory rate $\geq 22/\text{min}$,

alteration in mental status, SBP ≤ 100 mmHg. ⁽¹⁰⁾

Patients and Methods:

Study Type: A prospective observational analytical cross-section.

Study Setting: patient entrance to ED at Assiut & Suez Universities hospitals from March/2022 to June/2024, following the approval of the Research Ethics Committee of the Faculty of Medicine, Assiut University (IRB local approval number 17101765). The trial was registered on ClinicalTrials.gov under the identification number NCT05107297.

Study Subjects :

- Inclusion criteria: Patients of both genders are aged 18 - 80.
- Exclusion criteria: Patient or relative refusal, aged below 18 years.
- Sample Size Calculation: Using G*Power 3 software⁽¹¹⁾, the sample size calculation was done. A calculated minimum sample of 120 septic patients admitted to the ER fulfilling at least two criteria for qSOFA will be needed to detect an effect size of 0.2 (HR ranged between 1.5 and 1.8 in the multivariate Cox Hazard Proportion Regression for 30-day mortality in septic patients), with an error probability of 0.05 and 90% power on a one-tailed test.

Methods:

All patients were subjected to:

1) Full history (Hx) taking:

- **Personal Hx:** age, sex, occupation, phone number, residence.
- **Complaint & its duration**
- **Present & past Hx:** recent infection, chronic illnesses as
- **Hypertension(HTN)** {(SBP) ≥ 140 mmHg and/or their diastolic blood pressure (DBP) ≥ 90 mmHg following repeated examination}
- **Chronic Kidney Disease(CKD)** {present for >3 months: either GFR < 60 ml/min/1.73 m² or markers of kidney damage, including albuminuria}
- **Diabetes Mellitus(DM)** {Hemoglobin A1c levels $\geq 6.5\%$, the fasting blood glucose test level ≥ 126 , Random ≥ 200 .

- Ischemic heart disease(IHD)& autoimmune diseases.

2) Physical examination:

1.Vital Signs Assessment:

- **Temperature:** Fever $> 38^{\circ}\text{C}$ or hypothermia $< 36^{\circ}\text{C}$.
- **Heart Rate:** Tachycardia > 100 beats/minute or bradycardia < 60 beats/minute.
- **Respiratory Rate:** Tachypnea > 20 breaths/minute) or a significant increase from baseline.
- **Oxygen saturation:** Normal range above 92 and 88-92 in COPD patients, air or supplemental oxygen at the time of SpO2 measurement.
- **Blood Pressure:** Hypotension (SBP < 90 mmHg or a decrease of 40mmHg from baseline) is a late sign of sepsis.

2.Rapid Neurological Evaluation:

- **Mental Status:** Level of consciousness by the Glasgow Coma Scale.
- **Pupillary Response:** Pupil size & reactivity to light.

- **Motor Function:** Motor strength, coordination, Weakness, or focal deficits.

3.Systemic Evaluation:

- **Cardiovascular:** For signs of inadequate tissue perfusion.
- **Respiratory:** For signs of respiratory distress and auscultation of lung fields for abnormal breath sounds.
- **Peripheral Vascular:** Evaluation of peripheral perfusion.
- **Limbs Evaluation:** Checking for signs of localized infection.

4.LAB investigation:

1- Routine:

- Complete Blood Picture (CBC).
- Renal Function Test.
- Liver Test Profile.
- Lactate.

2- ABG.

- pH.
- Partial Pressure of Oxygen (PaO2).
- Partial Pressure of Carbon Dioxide (PaCO2).
- Bicarbonate (HCO3-).
- Oxygen Saturation (SaO2).

Procedures:

- **Both scores apply to randomized patients coming to the ED** after fulfilling at least two criteria for the **qSOFA score**

1) **First:** Initial vital signs upon arrival at ED triage to evaluate the NEWS score.

PHYSIOLOGICAL PARAMETERS	3	2	1	0	1	2	3
Respiration Rate	≤ 8		9 - 11	12 - 20		21 - 24	≥ 25
Oxygen Saturations	≤ 91	92 - 93	94 - 95	≥ 96			
Any Supplemental Oxygen		Yes		No			
Temperature	≤ 35.0		35.1 - 36.0	36.1 - 38.0	38.1 - 39.0	≥ 39.1	
Systolic BP	≤ 90	91 - 100	101 - 110	111 - 219			≥ 220
Heart Rate	≤ 40		41 - 50	51 - 90	91 - 110	111 - 130	≥ 131
Level of Consciousness				A			V, P, or U

Figure (1): The original NEWS scoring system⁽¹²⁾

An assigned score between 0 and 3, with higher scores denoting a more significant departure from the normal range. ⁽⁶⁾

- **Low risk:** is between 1 and 4, the ward nurse assesses them to determine how often they need to be monitored or if their care needs to be escalated.

- **Low to medium risk:** a score of 3 in any single measurement, a ward-based doctor urgently reviews them to decide on the frequency of monitoring or if their clinical care should be escalated.
- **Medium risk:** If the patient scores 5 or 6, a ward-based doctor urgently reviews

them to decide if they need to be escalated to the critical care team.

- **High risk:** A total score of 7 or higher, often leading to their transfer to a unit with a higher level of care.

2) **Second:** Initial vital signs upon arrival at ED triage to evaluate the SPEED score.

SPEED score calculation	Points
Immunosuppressed state (presence of HIV/AIDS, any malignancy, transplant organ recipient or current use of immunosuppressive therapy)	3
Hypotension (systolic blood pressure < 90 mmHg)	3
Hypothermia (body temperature < 36.0°C)	3
Hypoxemia (pulse oxymetry < 90%)	2
Low hematocrit (hematocrit < 0.38)	2
Elevated lactate (blood lactate > 2.4 mmol/l)	2
Pneumonia	2
Acidosis (blood pH < 7.35)	1
SPEED score relevance	% Mortality
Score < 3 points	11.0
Score 4–6 points	29.7
Score 7–9 points	57.2
Score > 10 points	93.8

Outcomes:

- **Primary (main) outcome:** Mortality during the 30-day follow-up.
- **Secondary outcomes:** Hospital admission, ICU/HDU admission, or readmission in the ED in Assiut & Suez Canal Universities.

Results:

Table (1): NEWS distribution among patients in the studied group.

	Survive N=57	Nonsurvive N=63	P value
Temperature °C			
36.1: 38	42	54	0.099
35.1: 36	15	9	
38.1: 39	15	9	
≥39.1 , ≤35	0	0	
SBP (mmHg)			
111: 129	12	21	0.075
101: 110	3	0	
91: 100	0	0	
≤90	42	42	
Respiratory rate (BPM)			
12: 20	9	9	<0.001
9: 11	0	0	
21: 24	30	9	
≤ 8, ≥25	18	45	

Survive N=57	Nonsurvive N=63	P value
Oxygen saturation %		
≥96	27	18
94: 95	12	12
92: 93	3	12
≤91	15	21
Oxygen supplement		
Yes	15	27
Heart rate (BPM)		
51:90	15	27
41: 50	0	0
91: 110	30	24
111: 130	12	9
≤40, ≥131	0	3
Level of consciousness		
Alert	24	12
V, P, or U	33	51
Total score	Survived	nonsurvived
IQR	9 (7-14)	12 (7-14)

N: Number, NEWS: National Early Warning score, SBP: Systolic blood pressure, BPM: Breath Per Minute, Beat Per Minute, V: Voice, P: Pain, U: Unresponsive, SD: Standard Deviation, IQR: Interquartile range.

This table shows no statistically significant difference between survivors and nonsurvivors regarding body temperature, SBP, oxygen saturation, oxygen supplement, and heart rate, while a statistically significant difference between survivors and

nonsurvivors patients regarding respiratory rate, level of consciousness, and total NEWS score. The median (IQR) of the total score of survived news was 9 (7-14). The median (IQR) of the total score for non-survived news was 12 (7-14).

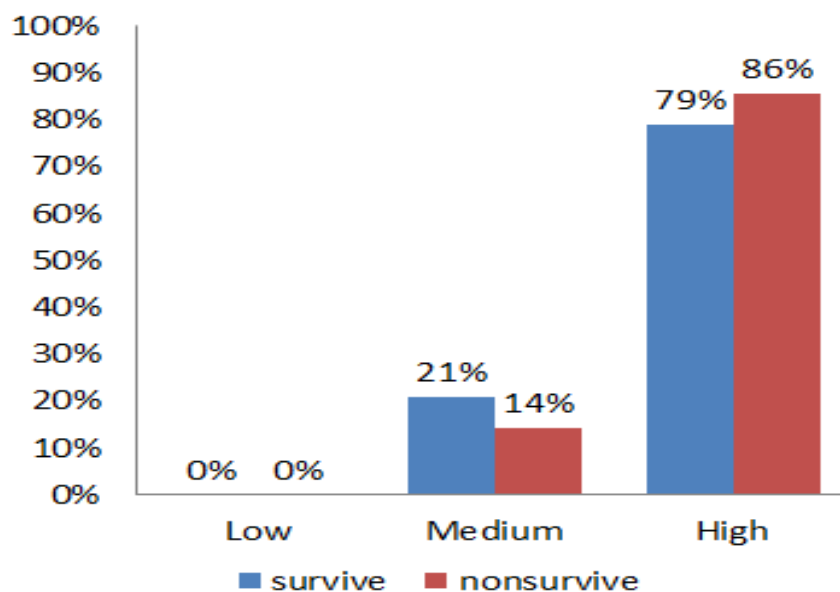


Figure (2): Distribution classification of National Early Warning score (NEWS) among patients in the studied group.

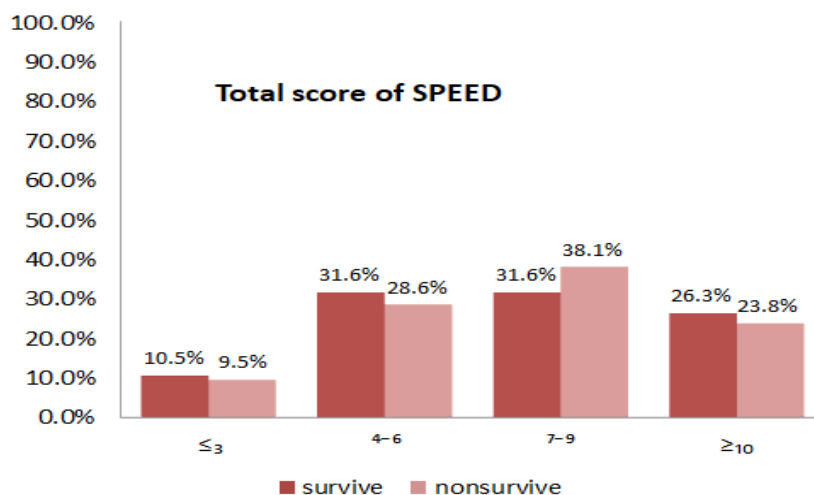
Table (2): Distribution of SPEED score among patients in the studied group.

	Survive N=57	Non-survive N=63	<i>P value</i>
Immunosuppressed state	12	15	0.718
Blood pressure [SBP < 90 mmHg]	42	39	0.168
body temp < 36°C	0	0	0
Hypoxemia [pulse oximetry <90]	9	15	0.272
Hct [< 0.38]	42	51	0.34
Blood lactate [> 2.4 mmol/l]	30	33	0.649
Pneumonia	36	39	0.887
Acidosis [blood PH < 7.35]	21	33	0.087
Total score			
IQR	7 (5 - 10)	8 (6-10)	

N: Number, SBP: Systolic blood pressure, Temp: Temperature, Hct: Hematocrit, SD: Standard Deviation, SPEED: sepsis patient evaluation in the emergency department, IQR: interquartile range.

This table shows no statistically significant difference between survivors and nonsurvivors regarding other parameters of the SPEED score, while there is a statistically significant difference between

survivors and nonsurvivors regarding the prevalence of hypotension. The median (IQR) of total score survived SPEED was 7 (5-10), while the median (IQR) of total score non-survived SPEED was 8(6-10).

**Figure (3):** Distribution of total SPEED score among patients in the studied group.

There were 27 patients with a high score >10, 15 patients (26.3%) survived, while 12 patients (23.8%) did not survive.

Table (3): Distribution of primary & secondary outcomes and ICU admission among patients in the studied group.

Studied group N=120	survive	nonsurvive
Primary outcome		
Mortality 30-day	57	63
Secondary outcome		
In ER	3	3
ICU admission	54	60
NEWS high score ≥ 7	42	54
SPEED high score ≥ 10	15	12
Length of ICU (days)		
Mean	7.08	
$\pm$ SD	4.6	

N: Number, ED: Emergency Department, ICU: Intensive Care Unit, NEWS: National Early Warning score, SPEED: sepsis patient evaluation in the emergency department, SD: Standard Deviation

According to this table, among 120 patients presented to the ED, the primary outcome was that 57 patients survived, whereas 63 patients did not survive. There were 3 patients (2.5%) who improved after ER intervention, and 3 patients (2.5%) died before admission. There were 114 patients

(95%) admitted to the ICU, 54 patients (47.3%) survived, while 60 patients (52.6%) did not survive. In the high score of NEWS, 42 patients survived and 54 patients did not; in SPEED, 15 survived and 12 did not. The mean length of ICU was 7.08 ± 4.6

Table (4): ROC curve for the Analysis of the total NEWS score and total SPEED score for the mortality prediction.

Test Result Variable(s)	total NEWS score	total SPEED score
Cutoff value	0.814	0.803
Area	0.749	0.580
sensitivity	76%	57%
specificity	75%	74%
PPV	77.4%	70.5%
NPV	74%	60.8%
Accuracy	76%	65%
Std. Error ^a	0.080	0.091
Asymptotic Sig. ^b	0.007	0.386
Asymptotic 95% Lower Bound	0.592	0.482
Confidence Upper Bound	0.907	0.826
Interval		

NEWS: National Early Warning score, SPEED: sepsis patient evaluation in the emergency department, PPV: Positive Predictive Value, NPV: Negative Predictive Value.

At a cutoff value of 0.81, the total NEWS score had a sensitivity of 76% and specificity of 75% with significance. At the cutoff value of 0.803, the total SPEED score had a sensitivity of 57% and a specificity of 74% with no significance. The total NEWS score had higher sensitivity (76%) than the

total SPEED score, and there was no difference between the total NEWS score and the total SPEED score in specificity for mortality prediction. AUC of the total NEWS score was higher than the total SPEED score in predicting mortality.

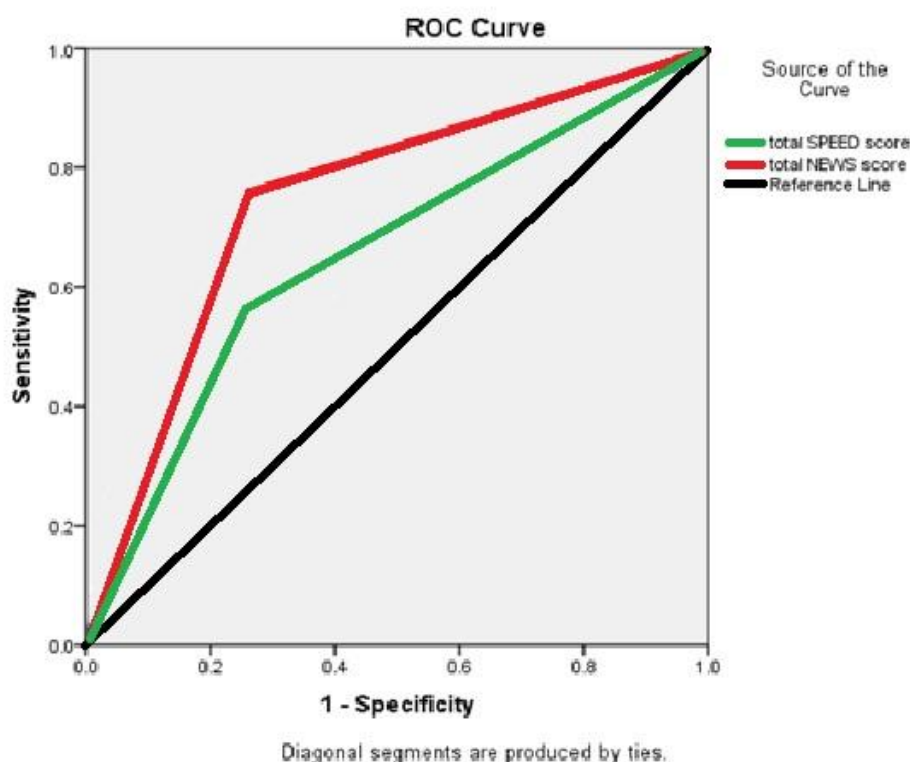


Figure (4): ROC curve for the prediction of mortality.

Discussion:

Our results revealed that there were 96 (80%) patients whose body temperature ranged from 36.1 to 38°C, while 24 (20%) had temperatures ranging from 35.1 to 36°C or from 38.1 to 39°C. Regarding SBP mmHg, most patients (70%) have SBP $\leq$ 90 mmHg. As regards respiratory rate (BPM), the majority of patients (52.5%) had a respiratory rate of $\leq$ 18, $\geq$ 25 breaths per minute. As regards oxygen saturation %, there were 45 patients (37.5%) who had oxygen saturation $\geq$ 96%, 24 patients (20%) had oxygen saturation ranging from 94 to 95, 15 patients (12.5%) had oxygen saturation ranging from 92 to 93, while 36 of them (30%) had oxygen saturation $\leq$ 91.

Regarding oxygen supplements, 42 patients (35%) needed oxygen supplements. As regards heart rate (BPM), there were 42 patients (35%) whose heart rate ranged from 51 to 90 beats per minute, 54 patients (45%) ranged from 41 to 50 or 91 to 110 beats per minute, 21 patients (17.5%) ranged from 111 to 130, while 3 of them (2.5%) their heart rate was $\leq$ 40, $\geq$ 131 beats per minutes. Regarding level of consciousness, 36 patients (30%) were alert, and 84 patients

(70%) were V, P, or U. The mean total NEWS score was 11.2 ± 4.3 . Regarding classification, 21 patients (17.5%) had a medium score, while 99 (82.5%) had high scores.

Similarly, our findings were in line with⁽¹³⁾, who reported that 88 (44%) patients had oxygenation, the median interquartile range (IQR) of respiratory rate was 27(20-30)/min, body temperature was 37.2(36.5-37.5)°C, and SpO₂ was 95(88-98)%. Regarding level of consciousness, 100(51%) patients were alert, and 49% were verbal, painful, and unresponsive.

Our findings demonstrated that 27(22.5%) patients had immunosuppressed state, 81 patients (67.5%) had hypotension, 24 patients (20%) had hypoxemia, 93 patients (77.5%) had low hematocrit, 63 patients (52.5%) had elevated lactate, 75 patients (62.5%) had pneumonia and 54 patients (45%) had acidosis. The mean total SPEED score was 7.42 ± 3.1 .

In agreement with our results, previous studies revealed that elevated lactate levels and an acidotic blood pH were linked to a worse prognosis. These parameters reflect the hypoperfusion of tissues in severe sepsis,

and lactate clearance has also been suggested as a predictor of survival. ^(14, 15)

Also, this study was consistent with⁽⁸⁾ who reported that 30(60.0%) of patients had immunosuppressed state, 44(59.1%) patients had hypotension, 58(51.7%) had hypoxemia, 176(40.3%) had low hematocrit, 75(49.3%) had acidosis, 122(46.7%) had elevated lactate, and 136(42.7) had pneumonia. They demonstrated that eight variables were identified as independent predictors of higher mortality: immunosuppressed state, hypotension, hypothermia, low hematocrit, hypoxemia, acidosis, elevated lactate, and pneumonia.

According to the SPEED score parameters, our results were in line with⁽⁴⁾, who compared the SPEED score and MEDS score for predicting the 28-day mortality in cases of emergency sepsis to improve the management processes of sepsis patients. They found a significant association between hypotension and mortality ($p = 0.048$).

The present study reported that there were 114 patients (95%) admitted to the ICU, 54 patients (47.3%) survived, and 60 patients (52.6%) did not survive. The mean length of ICU was 7.08 ± 4.6 .

Also, our findings agreed with⁽¹³⁾, who demonstrated that 134 (68.4%) patients were admitted to the ICU, 38 died, and 96 survived.

Our results revealed that at a cutoff value of 0.814, the total NEWS score had a sensitivity of 76% and a specificity of 75% with significance. At the cutoff value 0.803, the total SPEED score had a sensitivity of 57% and specificity of 74% with no significance. At the cutoff value of 0.754, the total q SOFA score had a sensitivity of 33% and a specificity of 94% with no significance.

This study demonstrated that the total NEWS score had higher sensitivity (76%) than the total SPEED score, and there was no difference between the total NEWS score and total SPEED score in specificity for the prediction of mortality. AUC of the total NEWS score was higher than the total SPEED score in predicting mortality.

These results also agreed with⁽⁴⁾, who revealed that the SPEED score was the best-fitting independent predictor of the 28-day mortality after performing logistic regression analysis.

Conclusion:

We concluded that the SPEED score predicts 30-day mortality in septic patients. It is simple, useful, and accurate, and its predictive value is comparable to that of other scoring systems.

The NEWS was immediately available as it does not require laboratories. However, scoring the NEWS may be more suitable for computerized assessment.

Recommendation:

- The SPEED is simpler than the NEWS score as it relies only on the most fundamental and readily available diagnostic tools, with a specificity of 74%.
- The SPEED revealed that elevated lactate levels and an acidotic blood pH were linked to a worse prognosis.
- The SPEED score predicts 30-day mortality in septic patients. It was simple, and its predictive value was comparable to other scoring systems.
- This study demonstrated that the total NEWS score had higher sensitivity (76%) than the total SPEED score; there was no difference between the total NEWS score and total SPEED score in specificity for the mortality prediction. AUC of the total NEWS score was higher than the total SPEED score in predicting mortality.

References:

1. De Virgilio C, Grigorian A, eds. *Surgery: A Case-Based Clinical Review*. New York: Springer; 2015. p. 591-699.
2. 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):801-10.
3. Kalil AC, Johnson DW, Lisco SJ, Sun J. Early goal-directed therapy for sepsis: a novel solution for discordant survival

- outcomes in clinical trials. *Crit Care Med*. 2017;45(4):607-14.
4. Elbaih AH, Elsayed ZM, Ahmed RM, Abd-Elwahed SA. Sepsis patient evaluation emergency department (SPEED) score & mortality in emergency department sepsis (MEDS) score in predicting 28-day mortality of emergency sepsis patients. *Chin J Traumatol*. 2019;22(6):316-22.
 5. Jevon P, Shamsi S. Using National Early Warning Score (NEWS) 2 to help manage medical emergencies in the dental practice. *Br Dent J*. 2020;229(5):292-6.
 6. Welch J, Dean J, Hartin J. Using NEWS2: an essential component of reliable clinical assessment. *Clin Med (Lond)*. 2022;22(6):509-13.
 7. Roberts MB, Fishman JA. Immunosuppressive agents and infectious risk in transplantation: managing the "net state of immunosuppression". *Clin Infect Dis*. 2021;73(7):e1302-17.
 8. Bewersdorf JP, Hautmann O, Kofink D, Zeden JP, Lachmann G. The SPEED (sepsis patient evaluation in the emergency department) score: a risk stratification and outcome prediction tool. *Eur J Emerg Med*. 2017;24(3):170-5.
 9. Wyatt JP, Illingworth RN, Graham CA, Hogg K, Oxford University Press. *Oxford handbook of emergency medicine*. 5th ed. Oxford: Oxford University Press; 2020.
 10. Marik PE, Taeb AM. SIRS, qSOFA and new sepsis definition. *J Thorac Dis*. 2017;9(4):943-5.
 11. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods*. 2007;39(2):175-91.
 12. Hodgson LE, Dimitrov BD, Congleton J, Venn R, Forni LG, Roderick PJ. A validation of the National Early Warning Score to predict outcome in patients with COPD exacerbation. *Thorax*. 2017;72(1):23-30.
 13. Haruna J, Tatsumi H, Kazuma S, Hirosawa A, Tanaka A, Kikuchi T, et al. Comparison of the National Early Warning Scores and Rapid Emergency Medicine Scores with the APACHE II Scores as a Prediction of Mortality in Patients with Medical Emergency Team Activation: A Single-centre Retrospective Cohort Study. *J Crit Care Med (Targu Mures)*. 2021;7(4):283-94.
 14. Puskarich MA, Trzeciak S, Shapiro NI, Arnold RC, Horton JM, Studnek JR, et al. Whole blood lactate kinetics in patients undergoing quantitative resuscitation for severe sepsis and septic shock. *Chest*. 2013;143(6):1548-53.
 15. Nguyen HB. Lactate in the critically ill patients: an outcome marker with the times. *Crit Care*. 2011;15(2):151.