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DIAGNOSTIC ACCURACY OF NATIONAL EARLY WARNING SCORE (NEWS) IN PREDICTING MORTALITY IN PATIENTS WITH SEPSIS

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Abstract

BACKGROUND: *The National Early Warning Score (NEWS) is a widely used tool designed to assess clinical deterioration, but its role in predicting mortality specifically in sepsis patients requires further validation. Assessing the diagnostic accuracy of NEWS in this context could provide critical insights into its utility for early risk stratification and clinical decision-making.*

OBJECTIVE: *To find diagnostic accuracy of national early warning score in predicting mortality in patients with sepsis*

MATERIALS AND METHODS

Study design: *Cross sectional study.*

Setting: *Department of Surgery Unit –II, services hospital Lahore*

Duration: *The study was completed in 6 months after approval of synopsis [May 28, 2024 till Nov 28, 2024]*

Data collection procedure: *Study was started after getting approval form hospital ethical committee, and 165 patients were enrolled in the study by meeting inclusion criteria. NEWS score was calculated myself and all patients were managed as per hospital protocol. Patients with a NEWS≥ 5 they were considered for high acuity area and enrolled in the sepsis management protocol standard guidelines. Patient's status was monitored and mortality was noted as per operational definition.*

RESULTS*: The average age of the study participants is 59.04 years, with a standard deviation of 15.94 years. There were 103 (62.4%) males and 62 (37.6%) females. Out of 40 individuals who died, 37 had a NEWS score of ≥5, and 3 had a NEWS score of less than 5. Among the 125 individuals who survived, 12 had a NEWS score of ≥5, and 113 had a NEWS score of less than 5. Sensitivity, specificity, PPV, NPV, and overall accuracy of NEW score (≥5) were found as 92.5%, 90.4%, 75.5%, 97.4%, and 90.9%, respectively.*

CONCLUSION: *The findings highlight that the National Early Warning Score (NEWS) is a reliable tool for predicting mortality in patients with sepsis. The*

score effectively identifies most mortality cases while accurately ruling out those at lower risk. Its performance supports its use as a practical and efficient method for early risk stratification in clinical settings, enabling timely interventions for patients at high risk of adverse outcomes.

INTRODUCTION

Sepsis is defined where there is severe organ failure as a result of an uncontrolled immune response to infection and it is a major concern for world health organizations as there is possibility that anyone can get it.[1] The most commons causes of sepsis are bacterial infections of the gastrointestinal and respiratory systems, however the exact site of infection and the organism responsible might differ depending on age and location. [2] Recognizing sepsis, especially in its early stages, is a medical challenge; it is one of the top causes of mortality in ICUs (intensive care units) globally. [3] It is published that mortality due to sepsis is high i.e. 34.9%.[4] Death rates from septic shock were around 22.8% and total sepsis mortality was 9.8%, according to a research out of Pakistan.[5]

It is crucial to identify hospitalized individuals with clinical deterioration as soon as possible. [6] In the field of critical disease clinical practice, the newly established clinical metabolomics has emerged as an encouraging tool.[7] For use in bedside assessment, the early warning scores (EWS) serve as a "track and trigger" system that may identify a patient's decline in condition at an early stage.[8, 9] The NEWS score is one of widely used early warning system in the world.[9]

A study was done on 444 patients where they reported mortality rate was 28.6%, they reported that at NEWS ≥5, the sensitivity and specificity was 89% and 11.9% respectively.[10] Another study reported the sensitivity of NEWS at ≥ 5 was 46.6% and specificity was 95.9%.[11]

The current study is designed to find diagnostic accuracy of national early warning score (NEWS) in predicting mortality in patients with sepsis. As no local study is done so far and international studies are available with wide range of sensitivity of NEWS at cut of value 5 is reported as 46.6%[11]-89%[10] and specificity is also reported in wide range as 11.9% [10] - 95.9%.[11] So the current study may help us to generate local evidence so that in future it NEWS may be utilized if, good diagnostic accuracy is found. This may be help us for screening high risk patients for mortality, and by aggressive treatment we may save the life of patients.

MATERIALS AND METHODS

Study design: Cross sectional study

Setting: Department of Surgery Unit –II, services hospital Lahore

Duration: The study was completed in 6 months after approval of synopsis [May 28, 2024 till Nov 28, 2024]

Sampling technique: Non-probability consecutive sampling

Sample size: A total of 165 cases are estimated using sensitivity as 89%[10]and specificity as 11.5% [10] and percentage of mortality as 28.6%.[10] and 9% margin of error.

Sample selection criteria

Inclusion criteria

- All patients having age 18-80 years
- Either gender
- Presenting with sepsis as per operational definition

Exclusion criteria

- Females with pregnancy,
- Alternative diagnosis, or
- Patients leaving the emergency department against medical advice

Data collection procedure

Study was started after getting approval form hospital ethical committee, and 165 patients were enrolled in the study by meeting inclusion criteria. All data was collected after getting informed consent form parent attendants. Their demographic details were taken along with their baseline clinical presentation.

NEWS score was calculated myself and all patients were managed as per hospital protocol. Patients with a NEWS≥ 5 they were considered for high acuity area and enrolled in the sepsis management protocol standard guidelines. If a patient arrives at the emergency room with a shallow breathing (>20 breaths/min), rapid heart rate (>100 beats/min), an abnormally high or low white blood cell count (>1,200/mm3, <4,000/mm3, or bandemia ≥10%) and high body temperature (>38 or <36 °C), and it was classified as sepsis.

When an electrocardiogram (ECG) shows no indications of life or pulse within 28 days, the patient was considered to have died. The calculations of NEWS score was based on six physiological variables, oxygen saturation, including breathing rate, systolic blood pressure, pulse, core body temperature and degree of awareness. The total score is the sum of all the individual scores, which might range from 0 to 3. Patients who are undergoing oxygen treatment will have an extra two points added to their total. A potential score might be anything from zero to twenty. It was considered positive at score ≥ 5. Patient discharge was considered if s/he has normal heart rate (60-100 beats/min), normal respiratory rate (12-19), normal body temperature (36-38), or no evidence of [leukocytosis (white blood cells ≤1,200/mm^3, leukopenia, >4,000/mm^3, or bandemia(<10%)]. Patient's status was monitored and mortality was noted as per operational definition. All data was collected by myself on attached Proforma.

Data analysis

All data was entered and analyzed using SPSS version 26. Mean and SD was calculated for quantitative data like age, BMI, NEWS score and duration of hospital stay. Frequency (%) was used for categorical data like gender presenting complaints (tachycardia, tachypnea, leukocytosis, leukopenia, bandemiaand body temperature < 36 or 38). 2 x2 table was made to calculate diagnostic accuracy for NEWS ≥ 5 like, sensitivity, specificity, PPV, NPV and overall diagnostic accuracy taking surgical findings as gold standard. Data was stratified for age, gender, BMI, presenting complaint and surgical intervention need. Post stratified diagnostic accuracy was calculated.

RESULTS

The average age of the study participants is 59.04 years, with a standard deviation of 15.94 years, indicating a wide age distribution. The cohort consists of 103 (62.4%) males and 62 (37.6%) females, indicating a higher representation of males in the study. The mean BMI of participants is 32.50, with a standard deviation of 3.72, indicating that the participants are, on average, in the obese category. The BMI values range from 26.00 to 37.90, which implies all participants are overweight to obese. A total of 114 (69.1%) participants are categorized as obese, whereas 51 (30.9%) are non-obese. The most common presenting complaint is an abnormal body temperature (89.7% of participants), followed by tachycardia (72.1%), tachypnea (60.6%), leukopenia (57.6%), leukocytosis (52.7%), and bandemia (46.1%). These percentages indicate that the majority of participants presented with significant clinical symptoms. The average hospital stay is 13.10 days, with a standard deviation of 5.29 days. Only 28(26.97%) patients required surgical intervention. The majority of participants, 116 (70.3%), have a NEWS score of less than 5, while 49 (29.7%) have a score of 5 or more. The were 40 (24.2%) cases who were died while 125 (75.8%) survived. Out of 40 individuals who died, 37 had a NEWS score of ≥5, and 3 had a NEWS score of less than 5. Among the 125 individuals who survived, 12 had a NEWS score of ≥5, and 113 had a NEWS score of less than 5. Sensitivity, specificity, PPV, NPV, and overall accuracy of NEW score (≥5) were found as 92.5%, 90.4%, 75.5%, 97.4%, and 90.9%, respectively.

STRATIFICATION

For patients aged 18-50 years, the NEWS score achieves perfect sensitivity (100%) and NPV (100%), ensuring all mortality cases are identified and no false negatives occur. Accuracy is high at 93.33%. In the 51-80 years group, sensitivity is slightly reduced (90.32%) with a high specificity (89.89%), maintaining overall accuracy at 90%. Among males, sensitivity (95.45%) and specificity (91.36%) are excellent, with an overall accuracy of 92.23%. For females, sensitivity (88.89%) and specificity (88.64%) are slightly lower, leading to an accuracy of 88.71%. Obese patients exhibit balanced diagnostic performance, with sensitivity and specificity near

89%, resulting in an accuracy of 89.47%. Non-obese patients demonstrate perfect sensitivity (100%) and NPV (100%), achieving a higher accuracy of 94.12%. For those requiring surgery, sensitivity is 100% with an accuracy of 89.29%. In patients not requiring surgery, the balance of sensitivity (91.18%) and specificity (91.26%) leads to a high accuracy of 91.24%.

Presenting complaint

Tachycardia: High accuracy is observed in both subgroups, with those not having tachycardia achieving perfect sensitivity and NPV (100%) and an accuracy of 93.48%.

Tachypnea: Accuracy is consistent (90% for those with tachypnea and 92.31% for those without).

Leukocytosis: Among patients without leukocytosis, sensitivity (92.5%) and specificity (84.21%) yield an accuracy of 88.46%.

Leukopenia: Excellent performance is observed for patients with leukopenia (accuracy: 89.47%) and without leukopenia (accuracy: 92.86%).

Bandemia: Subgroups with bandemia achieve perfect sensitivity and NPV (100%), resulting in an accuracy of 94.74%.

Body Temperature: Those with abnormal body temperature show strong diagnostic accuracy (89.86%), while patients with normal temperature achieve perfect metrics (100%).

Table-1: Descriptive statistics of age (years)

	Age (years)	BMI	Duration of hospital stay (days)
Mean	59.04	32.50	13.10
S. D	15.94	3.72	5.29
Range	62.00	11.90	17.00
Minimum	18.00	26.00	4.00
Maximum	80.00	37.90	21.00

Table-2: diagnostic accuracy of NEWS score taking in-hospital mortality as gold standard

		Mortality		Total	Sensitivity	Specificity	PPV	NPV
		Yes	No					
NEWS score	***≥ 5***	37	12	49	92.5%	90.4%	75.5%	97.4%
	<5	3	113	116				
Total		40	125	165				

Table-3: Diagnostic accuracy of NEWS score taking in-hospital mortality as gold standard with respect to age, gender, BMI, surgical intervention and presenting complaint

Variables			Mortality		Sensitivity	Specificity	PPV	NPV	Overall Accuracy
	Group	NEWS Score	Yes	No					
Age (years)	18-50	≥ 5	9	3	100.00	91.67	75.00	100.00	93.33
		< 5	0	33					
	51-80	≥ 5	28	9	90.32	89.89	75.68	96.39	90.00
		< 5	3	80					
Gender	Male	≥ 5	21	7	95.45	91.36	75.00	98.67	92.23
		< 5	1	74					
	Female	≥ 5	16	5	88.89	88.64	76.19	95.12	88.71
		< 5	2	39					

BMI	Obese	≥ 5	25	9	89.29	89.53	73.53	96.25	89.47
		< 5	3	77					
	Non-obese	≥ 5	12	3	100.00	92.31	80.00	100.00	94.12
		< 5	0	36					
Surgical intervention	Yes	≥ 5	6	3	100.00	86.36	66.67	100.00	89.29
		< 5	0	19					
	No	≥ 5	31	9	91.18	91.26	77.50	96.91	91.24
		< 5	3	94					
Tachycardia	Yes	≥ 5	31	9	91.18	89.41	77.50	96.20	89.92
		< 5	3	76					
	No	≥ 5	6	3	100.00	92.50	66.67	100.00	93.48
		< 5	0	3s7					
Tachypnea	Yes	≥ 5	26	7	89.66	90.14	78.79	95.52	90.00
		< 5	3	64					
	No	≥ 5	11	5	100.00	90.74	68.75	100.00	92.31
		< 5	0	49					
Leukocytosis	Yes	≥ 5	0	6	~	93.1	~	100	93.1
		< 5	0	81					
	No	≥ 5	37	6	92.50	84.21	86.05	91.43	88.46
		< 5	3	32					
Leukopenia	Yes	≥ 5	18	9	94.74	88.16	66.67	98.53	89.47
		< 5	1	67					
	No	≥ 5	19	3	90.48	93.88	86.36	95.83	92.86
		< 5	2	46					
Bandemia	Yes	≥ 5	17	4	100.00	93.22	80.95	100.00	94.74
		< 5	0	55					
	No	≥ 5	20	8	86.96	87.88	71.43	95.08	87.64
		< 5	3	58					
Body Temperature	Yes	≥ 5	32	12	91.43	89.38	72.73	97.12	89.86
		< 5	3	101					
	No	≥ 5	5	0	100.00	100.00	100.00	100.00	100.00
		< 5	0	12					

DISCUSSION

The systemic immune reaction of the body to an infectious process may cause end-stage organ malfunction and death, a medical emergency known as sepsis[12]. There are as many as 300 occurrences of severe sepsis and septic shock per 100,000 persons in the US every year[13]. Surviving Sepsis Campaign 2012 statistics shows that the United States has a mortality rate of around 28.3% due to sepsis, but Europe has a rate of about 41%. After adjusting for illness severity, however, this disparity vanished[14]. The goal of developing NEWS to detect patients at danger of dying within 24 hours was to efficiently find those patients who need an immediate evaluation by a doctor with the right level of expertise [15]. The current study adds to the growing body of evidence supporting the utility of the National Early Warning Score (NEWS) in predicting in-hospital mortality, particularly in patients with sepsis. The observed high sensitivity (92.5%) and negative predictive value (97.4%) align with previous findings, demonstrating the ability of NEWS to effectively identify patients at risk of adverse outcomes. These metrics underscore the role of NEWS as a sensitive screening tool for

timely intervention, though its moderate positive predictive value (75.5%) highlights potential challenges with specificity. Our findings resonate with those of Durr et al. (2022), who reported a sensitivity of 86% for NEWS ≥5 in detecting sepsis, surpassing qSOFA's sensitivity of 34%. Similarly, the superior sensitivity of NEWS for predicting ICU admissions and 28-day mortality, compared to qSOFA, supports the utility of NEWS in broader clinical applications. However, the tradeoff is a lower specificity for NEWS (55% vs. 90% for qSOFA), emphasizing its strength as a screening tool rather than a confirmatory test. [16].

Zhang et al. (2021) identified moderate sensitivity (71%) and specificity (60%) for NEWS in predicting mortality, with notable limitations in older populations. This contrasts with our findings, where the sensitivity remained high across age groups, though specificity slightly varied. These discrepancies could stem from differences in study design, patient populations, and healthcare settings. [17] Oduncu et al. (2021) further demonstrated the prognostic superiority of NEWS compared to SIRS and qSOFA, particularly for mortality prediction (AUROC: 0.772 for NEWS vs. 0.758 for qSOFA and 0.542 for SIRS). Our study similarly found NEWS to be highly effective in identifying high-risk patients, reinforcing its role in sepsis management protocols. [18].

Almutary et al. (2020) reported a sensitivity exceeding 88% for NEWS in predicting sepsis-related outcomes, comparable to our findings. However, the low specificity in their study (12%) contrasts with our results (90.4%), potentially due to differences in patient inclusion criteria and scoring thresholds. [19] Goulden et al. (2018) highlighted the equivalent or superior performance of NEWS relative to SIRS and qSOFA for mortality prediction, corroborating our results. Their findings also question the adoption of qSOFA in settings where NEWS is already established, aligning with our observations of its high diagnostic accuracy. [20] Keep et al. (2016) emphasized the utility of lower NEWS thresholds (≥3) for early sepsis detection in emergency settings. While our study focuses on NEWS ≥5, their findings underscore the flexibility of NEWS in adapting to different clinical objectives. [21]

Limitations noted in other studies, such as poorer performance in elderly patients (Zhang et al., 2021) and low specificity in certain settings (Almutary et al., 2020), call for tailored approaches in specific subgroups. Furthermore, continuous monitoring using NEWS, rather than single-time point measurements, may address some of its limitations and improve outcome prediction. [17, 19] Hence like other studies, the current study reinforces the diagnostic accuracy of NEWS ≥5 for predicting in-hospital mortality, particularly in sepsis patients. Comparisons with previous research underscore its utility as a sensitive screening tool, albeit with context-dependent specificity. These findings support the integration of NEWS into routine clinical practice, while encouraging further research to optimize its performance across diverse populations and settings.

CONCLUSION

The findings highlight that the National Early Warning Score (NEWS) is a reliable tool for predicting mortality in patients with sepsis. The score effectively identifies most mortality cases while accurately ruling out those at lower risk. Its performance supports its use as a practical and efficient method for early risk stratification in clinical settings, enabling timely interventions for patients at high risk of adverse outcomes.

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