Original Research Article

A COMPARATIVE STUDY BETWEEN SIRS, QSOFA, NEWS ANSD MEWS SCORE AS PREDICTORS FOR INHOSPITAL MORTALITY OF PATIENTS GETTING ADMITTED TO ICU OF A TERTIARY CARE TEACHING HOSPITAL

ABSTRACT

Sepsis screening in the Emergency Department (ED) is necessary for the rational management of patients. Multiple severity screening scores such as Systemic Inflammatory Response Syndrome (SIRS), quick Sepsis-related Organ Failure Assessment (qSOFA), National Early Warning Score (NEWS), and the Modified Early Warning Score (MEWS) are available. Though "Sepsis-3" recommends the use of the qSOFA score. This study seeks to validate each of these scores in a critical care setting and identify the score with the greatest predictive value for in hospital mortality. This comparative study included 188 patients determined to have sepsis. The information required for calculating SIRS, qSOFA, NEWS, and MEWS was extracted with careful history taking, patient assessment, and necessary investigations. The sensitivity, specificity, positive predictive value, negative predictive value, and area under the receiver-operating characteristic (AUROC) for each scoring system were measured for Intensive Care Unit (ICU) mortality. qSOFA had the highest specificity (73.61%) and the lowest sensitivity (36.02%). SIRS and NEWS scores had the highest sensitivity (77.78%) while SIRS had the lowest specificity (23.88%). The NEWS score had a specificity of 41.79%. MEWS score had an intermediate sensitivity of 76.36% and specificity of 63.91%. The ability to predict ICU mortality was highest for MEWS≥5 score (AUC 0.76; 95 % CI 0.68-0.84) compared to NEWS≥5 (AUC 0.61; 95% CI 0.52-0.71), qSOFA≥2 (AUC 0.56; 95% CI 0.46-0.66), and SIRS≥2 (AUC 0.49; 95% CI 0.37-0.61). By comparing HSROC curves, the MEWS score showed higher overall prognostic accuracy than SIRS, qSOFA and NEWS. Among qSOFA, SIRS, NEWS, and MEWS, the MEWS score showed the highest overall prognostic accuracy. However, no scoring system showed both high sensitivity and specificity for predicting the accuracy of mortality in patients with sepsis.

KEYWORDS: Sepsis scoring, SIRS, qSOFA, NEWS, MEWS.

ABBREVIATIONS:

SIRS : Systemic Inflammatory Response Syndrome
qSOFA : Quick Sequential Organ Failure Assessment
NEWS : National Early Warning Score
MEWS : Modified Early Warning Score
AUC : Area Under the Curve
AUROC : Area Under the Receiver Operating Characteristic
ICU : Intensive Care Unit

1. INTRODUCTION:

According to Sepsis-3, sepsis is a potentially fatal organ dysfunction brought on by an improperly controlled host response to an infection [1]. Every year, more than 970,000 people with sepsis are admitted to hospitals in the United States, and that number has been going up. Management of sepsis remains a significant concern for healthcare systems around the world [2]. A 2-decade study of U.S. hospitals showed a rise in the frequency of sepsis among hospitalized patients of 8.7% per year [3]. Additionally, sepsis causes more than 50% of hospital deaths [4], and mortality increases significantly with higher disease severity: 10–20% for sepsis, 20–40% for severe sepsis, and 40–80%

for septic shock [5]. Septic patients represent a disproportionately high burden in terms of hospital utilization. The typical length of stay (LOS) for patients with sepsis in American hospitals is almost 75% longer than for most other conditions [6], and the mean LOS in 2013 was reported to sharply rise with sepsis severity: 4.5 days for sepsis, 6.5 days for severe sepsis, and 16.5 days for septic shock [7].The cost of sepsis management in U.S. hospitals ranks highest among admissions for all disease states [8]. Sepsis hospital expenditures are currently more than twice as high as those for other diseases and are increasing at a rate that is three times that of other hospitalizations [9].Given the severe and acute effects of sepsis, the timing of the diagnosis is crucial for survival. When sepsis develops or is not discovered until after hospital admission, as well as when diagnosis and treatment are delayed [10–16], poor sepsis outcomes have been observed [17].Early identification of sepsis is crucial from a therapeutic standpoint since early antibiotic therapy is linked to greater survival. Both for sepsis detection and sepsis prognostication, numerous scoring systems have been developed. These include Systemic Inflammatory Response Syndrome (SIRS), Quick Sequential Organ Failure Assessment (qSOFA) most recently, National Early Warning Score (NEWS) and Modified Early Warning Score (MEWS) [2]. The purpose of this study is to compare the predictive value of SIRS, quick sequential organ failure assessment (qSOFA), the national early warning score (NEWS), and the modified early warning score (MEWS) for ICU mortality at a rural population catering tertiary care center.

2. MATERIALS AND METHODS:

This comparative study was carried out at the Department of General Medicine and Critical Care at rural population catering tertiary care teaching hospital. Based on careful clinical assessment and judgment of the treating physician 188 patients were admitted in ICU and followed for outcome. The information required for calculating SIRS, qSOFA, NEWS and MEWS was extracted with careful history taking, patient assessment and necessary investigations. The obtained data was compiled for data analysis.

2.1 Objectives of the study

To compare SIRS, qSOFA, NEWS and MEWS scores as predictors for ICU mortality in patients presenting with sepsis at a tertiary care teaching hospital.

2.2 Scoring systems

SIRS criteria are defined as a heart rate >90 beats per minute, a respiratory rate >20 breaths per minute, a temperature <36°C or >38°C, and a white blood cell count <4000/mm3 or >12 000/mm3. A positive score is defined as ≥2 out of 4 [19]. qSOFA criteria are a systolic blood pressure ≤100 mm Hg, a respiratory rate ≥ 22 breaths per minute and a Glasgow Coma Scale score <15. A positive score is defined as ≥ 2 out of 3 [20]. The Early Warning Score (EWS) is a tool for bedside evaluation based on five physiological parameters: systolic blood pressure, pulse rate, respiratory rate, temperature, and the AVPU score (A for "alert", V for "reacting to vocal stimuli", P for "reacting to pain", U for "unconscious") [21]. The NEWS score ranges from 0 to 20 and is based on respiratory rate, oxygen saturations, use of supplemental oxygen, temperature, systolic blood pressure, pulse rate, and level of consciousness. A positive score is defined as 5 out of 20, the suggested threshold for a "red score" indicating significant physiological derangement [22]. The Modified EWS (MEWS) score comprises five physiologic variables: systolic blood pressure (SBP), HR, RR, temperature, and mental status. The MEWS score considers the relative deviation from a patient's normal blood pressure and urine output, to identify surgical patients who would potentially benefit from intensive care [23]. The purpose of this study is to validate each of these scores in an Indian critical care setting and to identify the score with the highest predictive value for in-hospital mortality.

2.3 Eligibility criteria:

Inclusion criteria

- Adult patient (ages ≥18 years).
- Suspected infection (based on the opinion of the emergency physician).
- Planned for hospitalisation.

- Willing to give oral informed consent (per centre policy).

Exclusion criteria

- Presentation to ED is not due to infection (e.g., autoimmune diseases, myocardial infarction, stroke, venous thromboembolism, trauma, intoxication … etc.).
- Pregnancy.
- Transferred from another hospitals.
- Code status is "Do-Not-Resuscitate" (DNR).
- Elective admission to the hospital (i.e., not through emergency department).

3. RESULTS AND DISCUSSION:

SIRS, qSOFA, NEWS and MEWS scores were determined in a total of 188 patients. Out of 188 patients (126 males and 62 females) included in the study 42 (22.34%) patients did not survive.

Table:1-Distribution of cases.

Sr no.	Outcome	Number of patients
1	Did not Survive	42
2	Survived	146
Total		188

SIRS score was evaluated for all participating 188 patients, out of these 188 patients included in the study 144 patients had a score of ≥ 2 whereas 44 patients had
a score of < 2.

qSOFA scores were also determined for 188 total patients out of which 61 patients had a score of ≥ 2 and 127 patients had a score of < 2.

Similarly NEWS score was also determined for these patients. Out of 188 patients 120 patients had a score of ≥ 5 and 68 patients had a score of < 5.

MEWS score were also determined for these patients. Out of 188 patients 90 patients had a score of ≥ 5 and 98 patients had a score of <5.

The sensitivity of NEWS≥5 (77.78%) was similar to SIRS≥2 (77.78%) and MEWS≥5 (76.36%) but was higher compared to qSOFA≥2 (36.02%). The specificity of NEWS≥5 (41.79%) was higher than SIRS≥2 (23.88%) but lower than qSOFA≥2 (73.61%) and MEWS≥5 (63.91%). The negative predictive value was 41.73% for qSOFA≥2, 72.72% for SIRS≥2, 82.35% for NEWS≥5 and 86.73% for MEWS≥5. The positive predictive value was 68.85%, 29.16%, 35.00%, 46.66% for qSOFA≥2, SIRS≥2, NEWS≥5 and MEWS≥5 respectively.

Table:2-Comparision of various scoring systems.

Scoring System	Sensitivity	Specificity	PPV	NPV	AUROC
SIRS	77.78%	23.88%	29.16%	72.72%	0.49
qSOFA	36.02%	73.61%	68.85%	41.73%	0.56
NEWS	77.78%	41.79%	35.00%	82.35%	0.61
MEWS	76.36%	63.91%	46.66%	86.73%	0.76

PPV: Positive Predictive Value; NPV: Negative Predictive Value; AUROC: Area Under the Receiver Operating Characteristic

ROC curves were used to assess ICU mortality for these prediction scoring methods.

The ability to predict ICU mortality was highest for MEWS≥5 score (AUC 0.76; 95 % CI 0.68-0.84) compared to NEWS≥5 (AUC 0.61; 95% CI 0.52-0.71), qSOFA≥2 (AUC 0.56; 95% CI 0.46-0.66) and SIRS≥2 (AUC 0.49; 95% CI 0.37-0.61).

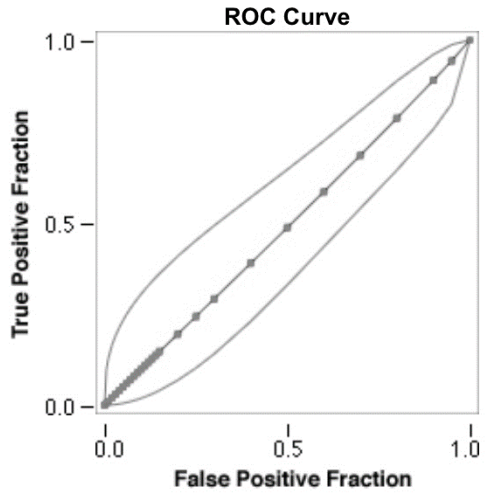

Figure1: ROC curve SIRS≥2 score in predicting ICU mortality showing AUC 0.49; 95% CI 0.37-0.61.

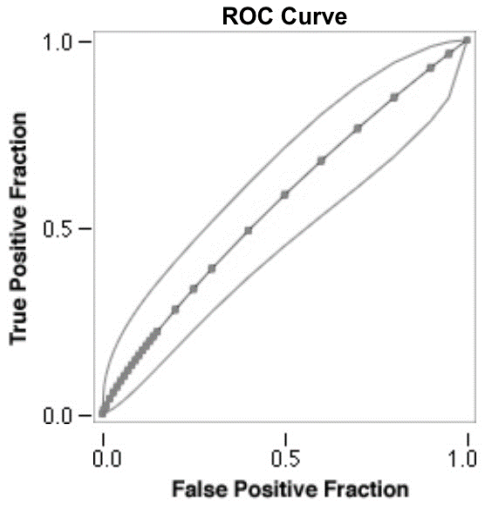

Figure2: ROC curve qSOFA≥2 score in predicting ICU mortality showing AUC 0.56; 95% CI 0.46-0.66.

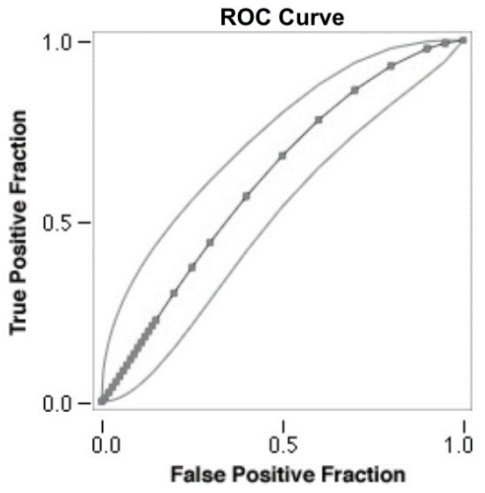

Figure3: ROC curve NEWS≥5 score in predicting ICU mortality showing AUC 0.61; 95% CI 0.52-0.71.

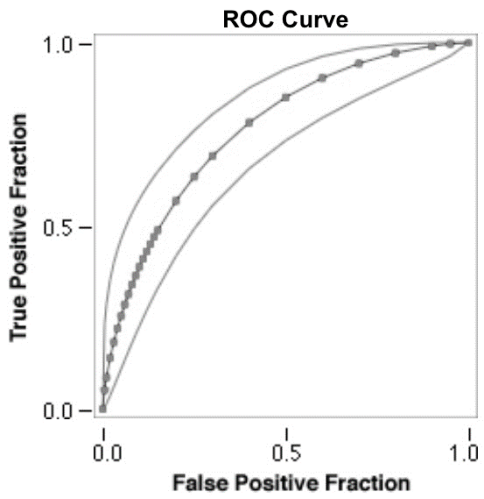

Figure4: ROC curve MEWS≥5 score in predicting ICU mortality showing AUC 0.76; 95 % CI 0.68-0.84.

ROC curves to assess ICU mortality suggested MEWS≥5 score (AUC 0.76; 95 % CI 0.68-0.84.) was superior at predicting ICU mortality compared to SIRS≥2, qSOFA≥2 and NEWS≥5.

Our study found out that no scoring system had both high sensitivity and high specificity for predicting ICU mortality in patients having sepsis. However in terms of AUROC, MEWS score outperformed all other scoring systems. NEWS, qSOFA and SIRS had comparable AUROC for ICU mortality prediction. Similar to our study where we found qSOFA outperformed SIRS, Finkelsztein E.J. et al. and Freund Y et al. also found qSOFA outperforming SIRS in terms of AUROC however qSOFA had significantly lower sensitivity compared to SIRS[24,25]. Our findings are in line with prior studies that demonstrate problematically low specificity of SIRS [24] and qSOFA's low sensitivity [26, 27, 28, 29] for predicting adverse outcomes. In a similar study done by Goulden R et al. found sensitivity of

NEWS≥5 to be of 74%, specificity of 43%, negative predictive value of 91% and AUROC of 0.65 for predicting inhospital mortality [30].
The better predictive accuracy of NEWS is most likely due to the fact that it incorporates a larger number of physiological parameters than qSOFA and SIRS, including the majority of their constituent atoms. Any scoring system for sepsis should favour better sensitivity over specificity because the consequences of false-negative results (delayed or missed therapy) are arguably much higher than those of false positive results (unnecessary antibiotics). The AUROC for SIRS, however, was so low that it appears to have very little clinical use. However, since most hospitals routinely collect all of the NEWS components as part of basic triage and nursing care, it is unclear what good a score based on a subset of these measures would do.
All three scoring systems in our study performed poorly, highlighting how difficult it is to predict outcomes in suspected sepsis, especially in the beginning stages. Despite the fact that SIRS and qSOFA were created particularly to detect or predict sepsis, neither one seems to have adequate sensitivity and specificity. Indeed neither are truly sepsis-specific scoring systems, having similar prognostic characteristics in patients without infection as in those with infection[28, 31].
Although not widely used, other scoring systems like PIRO and MEDS have been proven to have superior predictive power than SIRS [32].
The surviving sepsis guidelines recommends against the use of qSOFA alone as a screening tool when compared to NEWS, MEWS and SIRS taking into consideration it's sensitivity for the diagnosis of sepsis [33]. Clinicians have to follow a variety of, sometimes conflicting, recommendations while trying to diagnose sepsis. The international consensus definition recommends qSOFA,[1] while the US national quality standards are based on SIRS. The limitations of all scoring systems in our study highlight the fact that they should be used as only one part of a much broader clinical assessment and that caution must be exercised in developing sepsis identities.

5. CONCLUSION:

When used alone SIRS, qSOFA, NEWS and MEWS have substantial limitations in predicting the outcomes of patients who present to the hospital with suspected sepsis. It was noted that NEWS score is at least equivalent to qSOFA in predicting ICU mortality. The adoption of qSOFA by hospitals and healthcare systems where NEWS is already routinely recorded should be carefully reconsidered for any potential clinical benefits. In our study MEWS score clearly had better AUROC compared to other scoring systems for predicting ICU mortality. However further larger scale studies are required in India to determine the efficacy of MEWS score for prediction of ICU mortality and Indian scenario.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

CONFLICT OF INTEREST

None

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