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ORIGINAL RESEARCH

Comparison of qSOFA, SIRS, NEWS and REWS Scores in Predicting Severity and 28-day Mortality of older Suspected Sepsis Cases; a Prognostic Accuracy Study

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Abstract: **Introduction:** Various scores have been developed to predict sepsis mortality. This Study aimed to evaluate the accuracy of the quick Sequential Organ Failure Assessment (qSOFA), Systemic Inflammatory Response Syndrome (SIRS), National Early Warning Score (NEWS) and Ramathibodi Early Warning Score (REWS) for predicting severity and 28-day mortality of older suspected sepsis cases in emergency department (ED). **Methods:** This prognostic accuracy study was performed using data obtained from patients aged ≥ 60 years with suspected sepsis who visited the Ramathibodi Hospital ED between May and December 2019. The accuracy of NEWS, SIRS, REWS, and qSOFA in predicting the studied outcomes were evaluated using the receiver operating characteristic (ROC) curve analysis. **Results:** A total of 531 cases with the mean age of 77.6 ± 9.39 (range: 60-101) years were evaluated (45% male). The overall 28-day mortality was 11.6%. The area under ROC curve of qSOFA scores ≥2 showed moderate discrimination (0.66, 95% confidence interval [CI]: 0.59–0.73) in predicting mortality, which was significantly higher than SIRS ≥2 (ROC: 0.56, 95% CI: 0.50–0.63; p=0.04), NEWS ≥5 (ROC: 0.56, 95% CI: 0.50–0.63; p=0.01), and REWS ≥4 (ROC: 0.56, 95% CI: 0.50–0.63; p<0.01). **Conclusion:** qSOFA score ≥2 was superior to SIRS ≥2, NEWS ≥5, and REWS ≥4 in predicting 28-day mortality and septic shock in older patients with suspected sepsis in the ED. However, the predictive performance of qSOFA ≥2 was only moderate (AUC<0.8). Therefore, to reduce mortality and improve outcomes, we suggest the use of qSOFA ≥2 combined with clinical or other early warning scores, or the development of new prediction scores for screening, triage, and prediction of mortality and of severity of sepsis in older patients with suspected sepsis in the ED.

Keywords: Aged; Sepsis; Mortality; Emergency service, hospital; Clinical decision rules

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1. Introduction

Sepsis is defined as a syndrome caused by a dysregulated host response to infection, which causes life-threatening organ dysfunction (1). Septic shock has been defined as sepsis with peripheral circulatory failure and inadequate tissue perfusion (2). The global mortality rate of sepsis and severe sepsis in 2016 was estimated at 17% and 26%, respectively (3). Early detection and prompt management of sepsis are key to successful sepsis treatment.

Many tools have been developed for early detection of sepsis. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) recommended the application of the Sequential Organ Failure Assessment (SOFA) to identify organ dysfunction in sepsis patients. The consensus statement suggested the use of quick SOFA (qSOFA) as a screening tool for patients who are suspected to have sepsis (1). Moreover, many predictive scores, such as the Systemic Inflammatory Response Syndrome (SIRS) score and the National Early Warning Score (NEWS), have been developed and implemented to predict deterioration and clinical outcomes of sepsis patients (4).

NEWS has been applied in all National Health Service hospitals in the United Kingdom. A Modified Early Warning Score (MEWS) has been recommended for use in low-resource settings, and has been adopted in some district hospitals in

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Thailand.

Additionally, the Ramathibodi Early Warning Score (REWS) was developed and is used in Ramathibodi Hospital in Bangkok, Thailand.

SIRS, qSOFA, NEWS and REWS have proven to be useful for predicting clinical outcomes in the emergency department (ED) due to their use of simple parameters that are available as early as the triage zone. These sepsis screening tools have been shown to be capable of early detection, improving treatment outcomes, and reducing mortality (1).

After early detection of sepsis, if we can predict its severity then apply appropriate treatment and monitoring for the patient, we can reduce mortality from sepsis. However, all sepsis scores to date have shown poor to moderate accuracy in categorizing mortality risk in older sepsis patients. older patients represent a special population who may have atypical presentation. Their immune systems are less responsive than those of young people, which may delay the recognition of and response to sepsis, leading to worse outcomes.

Understanding which scoring system is the most effective can assist emergency care teams in identifying high-risk patients and making informed decisions about their emergency management, especially among older patients who may present with unique clinical presentation, comorbidities, and physiological responses. The identification of the most effective scoring system for older ED patients has the potential to improve patient outcomes and optimize resource utilization.

Therefore, this study aimed to compare the accuracy of qSOFA ≥2, SIRS ≥2, NEWS ≥5 and REWS ≥4 in predicting the 28-day mortality and diagnosis, and severity of sepsis in older patients with suspected sepsis in the ED of Ramathibodi Hospital.

2. Methods

2.1. Study design and setting

We performed a retrospective cohort study in the ED of Ramathibodi Hospital a university-affiliated tertiary care hospital in Bangkok, Thailand. The data of suspected sepsis cases were collected from the Ramathibodi electronic medical record database (RAMA-EMR) between 1 May 2019 and 31 December 2019. The accuracy of NEWs, SIRS, REWS, and qSOFA in predicting the studied outcomes were evaluated using the receiver operating characteristic (ROC) curve analysis. The study was approved by the Committee on Human Rights Related to Research, Faculty of Medicine, Ramathibodi Hospital, Mahidol University (IRB COA MURA2020/1996).

2.2. Study participants

We enrolled patients older than 60 years who presented to the ED of Ramathibodi Hospital, had suspected sepsis and had been treated with the Ramathibodi sepsis protocol. We excluded patients who were treated at outpatient departments (OPD) or emergency medical services (EMS) before transfer to ED, those referred from other hospitals, or patients with missing data in RAMA-EMR.

2.3. Data gathering

Data collection included patient demographic data, comorbidities, physical and functional status, vital signs, source of infection, initial diagnosis in the ED, triage to antimicrobial (ATB) time, initial venous lactate, volume of fluids given in the third hour, vasopressor use, mechanical ventilator use, and final diagnosis. Each patient's qSOFA, SIRS, NEWS, and REWS scores were calculated. We compared each sepsis score in predicting various clinical outcomes, including 28-day mortality, sepsis diagnosis, and ICU admission.

older patients were defined as those aged 60 years or older (5). Patients were described as having suspected sepsis if their chief complaint was fever or they had signs of infection (6). Patients with a sepsis diagnosis were those who had been diagnosed with sepsis based on ICD-10 or attending physician's opinion, or via blood culture, body fluid culture or specimen culture (1). Sepsis-induced hypotension was defined as Mean Arterial Pressure (MAP) < 65 mmHg in patients with sepsis diagnosis, which responded to initial fluid therapy (MAP ≥ 65 mmHg after fluid therapy) (1). Septic shock was defined as requiring vasopressor therapy to maintain MAP ≥ 65 mmHg in patients with sepsis diagnosis (1).

2.4. Outcomes

We followed the clinical outcomes until 28 days after treatment. The primary outcome was 28-day all-cause mortality. The secondary outcomes were diagnosis of sepsis + septic shock, diagnosis of septic shock, and need for ICU admission.

2.5. Statistical analysis

The sample size was calculated using unpublished data from 445 previous patients treated in Ramathibodi Hospital. The proportion of non-surviving patients who had a qSOFA score ≥2 was 70% (12/17), and the proportion of surviving patients who has a qSOFA score ≥2 was 21% (88/428). The allocation ratio (N2/N1) was 25:1, alpha () = 0.05, and beta () = 0.20. We therefore required a total sample size of 234 patients, with an expected mortality group of nine patients and a survival group of 225.

Descriptive data are presented as means with standard deviations (SD) or medians (interquartile ranges [IQRs]) for con-

Table 1: Comparing the baseline characteristics of older sepsis patients in the emergency department between cases with and without 28-day survival

Characteristic	All patients (n=531)	28-day survival		P
		No (n=55)	Yes (n=476)	
Age, years				
Mean (±SD)	77.55(±9.39)	76.98(±9.94)	77.62 (±9.33)	0.63
Very older (≥80 years)	242 (45.57)	24 (43.64)	218(45.80)	0.78
Sex				
Male	239 (45.01)	29 (52.73)	210 (44.12)	0.25
Female	292 (54.99)	26 (47.27)	266 (55.88)	
Comorbidities				
Systemic hypertension	363 (68.36)	34 (61.82)	329 (69.12)	0.29
Diabetes mellitus	214 (40.3)	22 (40.00)	192 (40.34)	1.00
Congestive heart failure	39 (7.34)	6 (10.91)	33 (6.93)	0.28
Chronic kidney disease	138 (25.99)	18 (32.73)	120 (25.21)	0.25
Airway disease	31 (5.84)	4 (7.27)	27 (5.67)	0.55
Malignancy	111 (20.90)	22 (40.00)	89 (18.70)	<0.01
Transplant	27 (5.08)	5 (9.09)	22 (4.62)	0.18
Liver cirrhosis	31 (5.84)	4 (7.27)	27 (5.67)	0.55
Ischemic heart disease	84 (15.82)	9 (16.36)	75 (15.76)	0.85
Neuromuscular disease	202 (38.04)	31 (56.36)	171 (35.92)	<0.01
Pulmonary	91 (17.14)	13 (23.64)	78 (16.39)	0.19
Immunocompromised	40 (7.53)	9 (16.36)	31 (6.51)	0.03
Status				
Independent	345 (64.97)	21 (38.18)	324 (68.07)	<0.01
Partially dependent	45 (8.47)	5 (9.09)	40 (8.40)	
Totally dependent	141 (26.55)	29 (52.73)	112 (23.53)	
Source of infection				
Respiratory system	231 (43.50)	32 (58.18)	199 (41.81)	0.02
Gastrointestinal system	39 (7.34)	2 (3.64)	37 (7.77)	0.41
Hepatobiliary system	18 (3.39)	1 (1.82)	17 (3.57)	1.00
Urinary system	151 (28.44)	12 (21.82)	139 (29.20)	0.27
Skin joint infection	45 (8.47)	5 (9.09)	40 (8.40)	0.8
CNS	6 (1.13)	2 (3.64)	4 (0.84)	0.12
Bloodstream	4 (0.75)	0 (0)	4 (0.84)	1.00
Other	7 (1.32)	0 (0)	7 (1.47)	1.00
ESI triage level				
ESI 1	72 (13.56)	14 (25.45)	58 (12.18)	0.06
ESI 2	341 (64.22)	33 (60.00)	308 (64.71)	
ESI 3	113 (21.28)	8 (14.55)	105 (22.06)	
ESI 4	5 (0.94)	0 (0)	5 (1.05)	
ESI 5	0 (0)	0 (0)	0 (0)	
Initial vital signs				
Systolic blood pressure, mmHg	133.37 (±32.38)	116.89 (±34.9)	135.27 (±31.56)	<0.01
Mean arterial pressure, mmHg	91.49 (±19.80)	83.59 (±21.84)	92.4 (±19.37)	<0.01
Diastolic blood pressure, mmHg	70.82 (±14.88)	66.95 (±16.92)	71.27 (±14.58)	0.04
Heart rate, bpm	102.59 (±22.78)	106.02 (±26.73)	102.19 (±22.28)	0.24
Temperature, °C	38.11 (±1.14)	37.46 (±1.12)	38.18 (±1.11)	<0.01
Respiratory rate, BPM	24.52 (±5.22)	26.18 (±6.78)	24.33 (±4.98)	0.01
Oxygen saturation, %	94.51 (±5.93)	90.62 (±10.28)	94.96 (±5.02)	<0.01
Shock index >0.9	171 (32.2)	24 (43.64)	147 (30.88)	0.07
Consciousness status				
Alert	449 (84.56)	37 (67.27)	412 (86.55)	<0.01
Response to verbal	48 (9.04)	9 (16.36)	39 (8.19)	
Response to pain	29 (5.46)	7 (12.73)	22 (4.62)	
Unresponsive	5 (0.94)	2 (3.64)	3 (0.63)	
Initial lactate, mmol/L				
Median [IQR]	2.59 [1.6,3.0]	4.1 [1.9,5.3]	2.42 [1.5,2.8]	<0.01
White blood cell count ($\times 10^3$)				
Median [IQR]	10.1 [7.30,14.4]	11.2 [6.4,15.4]	10.1 [7.3,14.3]	0.83

Table 1: Comparing the baseline characteristics of older sepsis patients in the emergency department between cases with and without 28-day survival

Characteristic	All patients (n=531)	28-day survival		P
		No (n=55)	Yes (n=476)	
Platelet count (×10^3)				
Median [IQR]	203.0[152.0,263.0]	172.0[102.0,253.0]	206.0[157.5,265.0]	<0.01
Creatinine, mmol/l				
Median [IQR]	1.03 [0.73,1.63]	1.37 [0.9,2.14]	1.01 [0.72,1.59]	<0.01
Sepsis scoring				
SIRS	2.34 ±1.05	2.07 ±1.17	2.37 ±1.04	0.05
qSOFA	1.03 ±0.72	1.47 ±0.84	0.98 ±0.69	<0.01
NEWS	5.66 ±2.90	7.56 ±3.99	5.44 ±2.66	<0.01
REWS	4.10 ±2.47	5.8 ±3.82	3.90 ±2.18	<0.01
Diagnosis at ED				
All sepsis & septic shock	498 (93.79)	52 (94.55)	446 (93.70)	1.0
Sepsis	417 (78.53)	29 (52.73)	388 (81.51)	<0.01
Sepsis + sepsis-induced HN	449 (84.56)	32 (58.18)	417 (87.61)	<0.01
Septic shock	48 (9.04)	17 (30.91)	31 (6.51)	<0.01
Non-sepsis	33 (6.21)	3 (5.45)	30 (6.30)	1.00
Sepsis with ICU admission	39 (7.34)	11 (20)	28 (5.88)	0.01

Data are presented as mean ± standard deviation (SD), frequency (%) or median (IQR). IQR: interquartile range; BPM: breaths per minute; CNS: central nervous system; ESI: emergency severity index; HN: hypotension; ED: Emergency Department; ICU: intensive care unit; NEWS: National Early Warning Score; qSOFA: quick Sequential Organ Failure Assessment; REWS: Ramathibodi Early Warning Score; SIRS: Systemic Inflammatory Response Syndrome.

tinuous variables and as percentages for categorical variables. Chi-square and Wilcoxon's rank-sum tests were used to compare categorical variables and continuous variables, respectively. The area under the receiver operating characteristic curve (AUC), with a 95% confidence interval (CI), was used to evaluate the discrimination performance of each score. All tests were two-sided, and values with a p-value less than 0.05 were considered to be statistically significant. All data analyses were performed using Stata version 16 (StataCorp LLC, College Station, TX, USA).

3. Results

3.1. Baseline characteristics of studied cases

A total of 637 older patients presented to the ED of Ramathibodi Hospital, had suspected sepsis, and were treated with the Ramathibodi sepsis protocol during May through December 2019. We excluded patients who were treated at OPD or EMS before transfer to ED (n=93) and patients who were referred from other centers (n=13). The 531 remaining patients were included in this analysis (figure 1).

The mean age of patients was 77.6 ± 9.39 (range: 60-101) years (45% male) and the overall 28-day mortality was 11.6%. The three most common comorbidities were systemic hypertension (68.4%), diabetes mellitus (40.3%), and neuromuscular disease (38%).

Mortality was significantly higher in patients with some specific comorbidities versus patients without them, notably neuromuscular disease (56.4% vs. 35.9, p<0.01), malignancy (40.0% vs. 18.7%, p<0.01), and immunocompromised patients (16.4% vs. 6.5%, p=0.03). Patients with a partially dependent or totally dependent activities of daily living score had higher mortality than who did not (61.8% vs. 31.9%, p<0.01). Table 1 compares the baseline characteristics of studied cases between cases with and without 28-day survival.

3.2. Characteristics of deceased cases

Deceased cases had higher rates of respiratory tract infections (p=0.02), respiratory rate (p = 0.01), alteration of consciousness (p <0.01), initial venous lactate (p<0.01), serum creatinine level (p<0.01), SIRS (p=0.05), qSOFA (p<0.01), NEWS (p<0.01), REWS (p<0.01), fluid administration in the first 3 hours (p<0.01), using vasopressor (p<0.01), need for mechanical ventilation (p<0.01), and need for ICU admission (p<0.01).

In addition, systolic blood pressure (p<0.01), MAP (p<0.01), diastolic blood pressure (p=0.04), temperature (p<0.01), oxygen saturation (p<0.01), and platelet count (p<0.01) were lower in non-survived cases.

3.3. Screening performance characteristics of studied score

- In predicting 28-day mortality

The primary outcome, 28-day mortality, was most accurately predicted by qSOFA≥2, with an AUC = 0.66 (95%

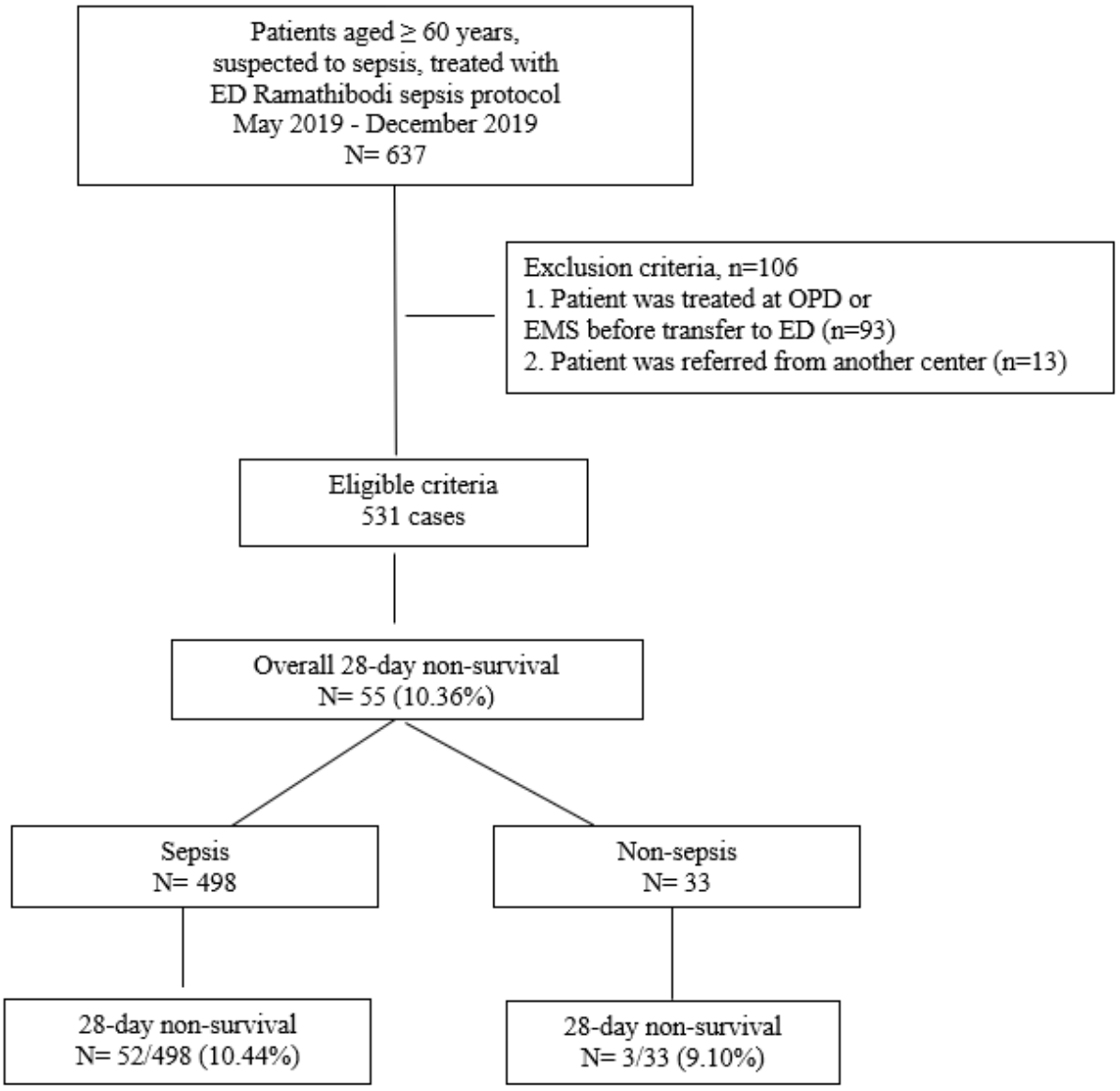

Figure 1: Patient flow chart. ED: emergency department; OPD: outpatient department; EMS: emergency medical services.

CI: 0.59–0.73), which was significantly higher than NEWS≥5 (AUC: 0.56 (95% CI: 0.50–0.63), p=0.01), SIRS≥2 (AUC: 0.56 (95% CI: 0.50–0.63), p=0.04), and REWS≥4 (ROC: 0.56 (95% CI: 0.50–0.63), p<0.01), as shown in figure 2.

- In predicting sepsis + sepsis shock

The secondary outcome, diagnosis of all sepsis, was best predicted by REWS≥4 (AUC = 0.60 (95% CI: 0.52–0.69), which was higher than SIRS≥2 (AUC = 0.60 (95% CI: 0.51–0.68), p=0.86), qSOFA≥2 (AUC = 0.55 (95% CI: 0.49–0.61), p=0.29), and NEWS≥5 (AUC = 0.51 (95% CI: 0.46–0.60), p=0.02), as shown in figure 2.

- In predicting septic shock

In predicting septic shock, qSOFA≥2 was the most predictive score (AUC = 0.68 (95% CI: 0.60–0.75), higher than REWS≥4 (AUC = 0.67 (95% CI: 0.62–0.72), p=0.88), NEWS≥5 (AUC = 0.62 (95% CI: 0.57–0.68), p=0.13) and SIRS≥2 (AUC = 0.51 (95% CI: 0.45–0.57), p<0.01), as shown in figure 2.

- In predicting need for ICU admission

ICU admission was best predicted by REWS≥4 (AUC = 0.65 (95% CI: 0.59–0.72), which was higher than qSOFA≥2 (AUC = 0.59 (95% CI: 0.51–0.67), p=0.13), NEWS≥5 (AUC = 0.57 (95% CI: 0.50–0.64), p<0.01) and SIRS ≥2 (AUC = 0.55 (95% CI: 0.47–0.62), p=0.07), as shown in figure 2.

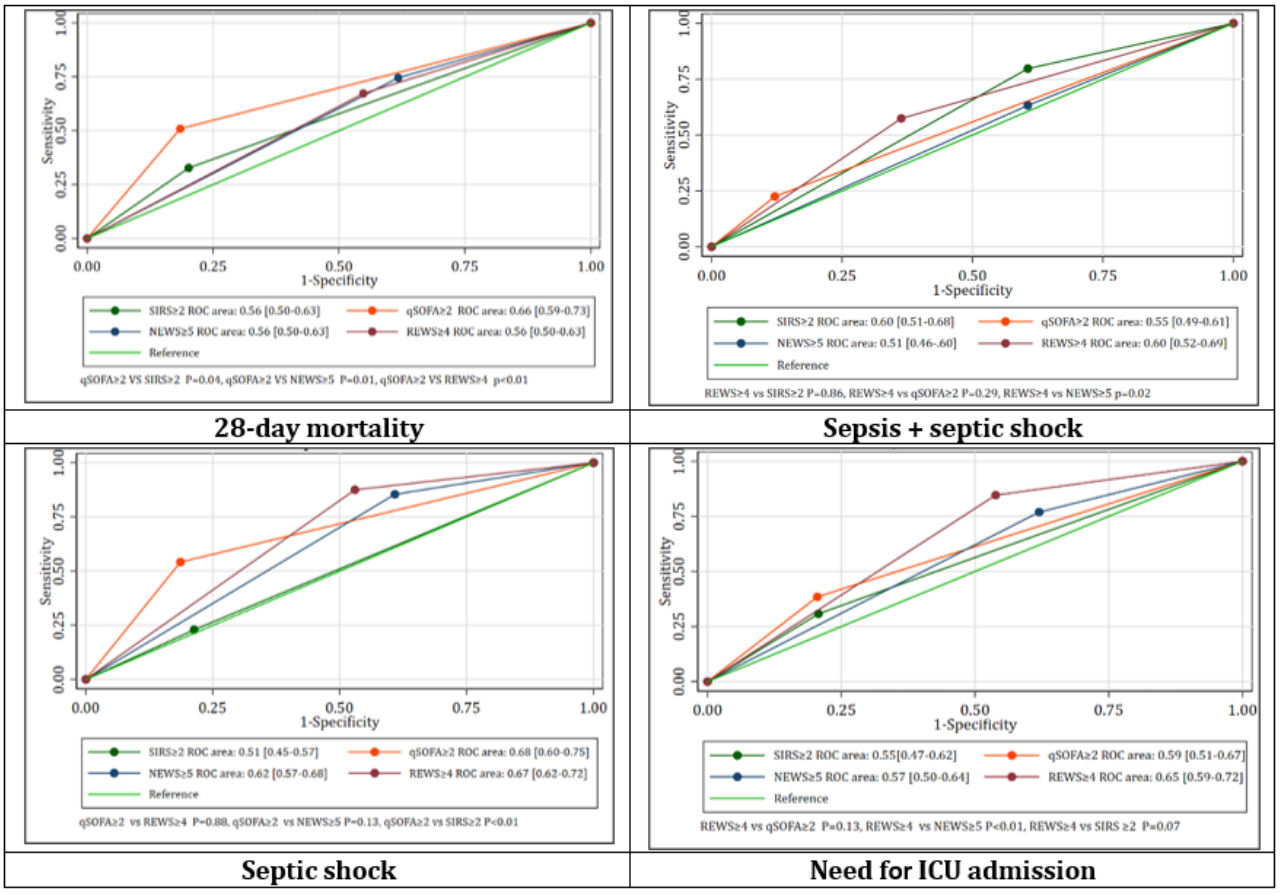

Figure 2: The area under the receiver operating characteristic (ROC) curve of quick Sequential Organ Failure Assessment (qSOFA), Systemic Inflammatory Response Syndrome (SIRS), National Early Warning Score (NEWS), and Ramathibodi Early Warning Score (REWS) in predicting 28-day mortality, sepsis + septic shock, septic shock, and need for ICU admission of older sepsis patients.

4. Discussion

In this retrospective cohort study of older patients visiting the ED with suspected sepsis, we have shown the baseline characteristics and comorbidities associated with 28-day mortality, including malignancy, neuromuscular disease, immunocompromised status, dependence status, respiratory tract infection, state of consciousness, lactate, platelet count, and creatinine.

Our report is in accordance with previous studies, which found advanced age, Charlson Co-morbidity Index ≥5, qSOFA≥2, low platelet count, lactate ≥4mmol/l, the Acute Physiology and Chronic Health Evaluation (APACHE) II modified score, polypharmacy, pre-admission functional status, malnutrition, and respiratory tract infection to be risk factors for increased mortality from sepsis (7-9).

We found that qSOFA≥2 was more accurate in predicting 28-day mortality and septic shock than were SIRS≥2, NEWS≥5, and REWS≥4. Similar to the report from the Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock 2021, qSOFA was identified as a predictor of poor outcome in patients with known or suspected infection, but no analysis was performed to support its use as a screening tool (10). Moreover, the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) suggested that the qSOFA criteria should be used in wards or emergency departments to identify sepsis patients who are likely to have poor outcomes, that is, prolonged ICU course or mortality (1). Likewise, Boonmee et al. determined that the qSOFA score had moderate predictive capability, but it had the highest AUC in predicting in-hospital mortality among both very older and older sepsis patients (AUC 0.60 [95% CI: 0.55–0.65]) compared with SIRS and NEWS (6). Also, Abdullah et al. found moderate prognostic capability of qSOFA for predicting 28-day mortality (AUC 0.63 [95% CI: 0.58–0.67]) (11). Similarly, Brink et al. determined that qSOFA performed moderately in predicting 30-day mortality among patients with suspected sepsis in the ED (AUC 0.70 [95% CI: 0.67–0.73]) (12). Furthermore, Churpek et al. found that the AUC for in-hospital mortality of qSOFA was

0.69 (95% CI: 0.67–0.70), with moderate prediction (13).

Systematic reviews have reported that the sepsis scores commonly used worldwide, both in Western and Asian countries were similar including SIRS, SOFA, qSOFA, NEWS, and MEWS (14-17). However, the updated NEWS2, which is endorsed by the National Health Service in England, has been adopted early in European countries (15).

In Thailand, qSOFA, MEWS and SIRS are frequently used as screening tools in the ED in urban, provincial and rural hospitals.

Additionally, qSOFA is easier to assess for less experienced medical professionals (1). NEWS is also widely used in some provincial hospital centers; REWS is only applied in Ramathibodi Hospital. We therefore had limited data for this score on prediction of mortality and other clinical outcomes in older sepsis patients. The Predisposition, Infection, Response, Organ dysfunction (PIRO), Mortality in ED Sepsis (MEDS), and the Modified Early Warning (MEWS) scores were applied in some clinical practices, but they still lacked the capability of risk stratification for older sepsis patients in ED (18).

Weng et al. developed the Prediction Of Sepsis Mortality in ICU (POSMI) with complex parameters, including age≥50 years, temperature<37 °C, RR>35 bpm, MAP50 mmHg, oxygen saturation<90%, albumin2 g/dL, bilirubin≥0.8 mg/dL, lactate≥4.2 mmol/L, BUN≥21 mg/dL, mechanical ventilation, hepatic failure, and metastatic cancer, and reported it to have good performance (AUC 0.83 [95% CI: 0.81–0.85]) but it was difficult to apply in the ED (19).

We encourage the use of qSOFA combined with other early warning scores in the ED. Additionally, we should develop new clinical prediction scores by using independent risk factors to add value to existing clinical prediction scores or other warning scores to predict morbidity and mortality outcomes. Any newly developed clinical prediction score should be simple and easy to apply in the ED, allowing categorization of patients by their risk scores and provision of appropriate treatment and monitoring.

In terms of predicting ICU admission for older sepsis patients visiting the ED, we found that REWS was superior to SIRS, qSOFA, and NEWS. Predicting ICU admission scores may aid in categorizing older sepsis patients in ED and correct disposition, allowing them to receive close monitoring and early resuscitation, and helping prevent morbidity and mortality. However, we have limited data for comparison of other early warning scores in predicting ICU admission due to sepsis.

The strengths of our study include that we thoroughly reviewed the EMR to gather data at the initial triage assessment of older patients with suspected sepsis. As a result, we were able to make early predictions, perform initial resuscitation, monitor patients, and make a treatment plan. Categorizing patients based on prognosis of sepsis may improve morbidity and survival outcomes. Furthermore, this represents the first study to measure the performance of REWS in evaluating mortality and clinical outcomes in older patients with suspected sepsis.

5. Limitations

Our study has some limitations to note. First, this was a retrospective design using data from a single tertiary care center. In our center, we treat many patients with congenital and acquired immunodeficiencies (e.g., patients with organ or bone marrow transplantation or chemotherapy), which may limit the generalizability of our findings. Second, we collected and analyzed 28-day all-cause mortality, therefore our analyses were limited in terms of patient–time outcomes and whether the cause of death was sepsis.

Third, we collected data from patients who had been treated with the Ramathibodi sepsis protocol, which may have led to selection or misclassification bias. In future studies, we anticipate developing a new prediction score for predicting clinical outcomes of older sepsis patients by exploring and reviewing the independent factors that can improve the performance of qSOFA or early warning scores in predicting outcomes.

6. Conclusion

qSOFA score ≥2 was superior to SIRS ≥2, NEWS ≥5, and REWS ≥4 in predicting 28-day mortality and septic shock in older patients with suspected sepsis in the ED. However, the predictive performance of qSOFA ≥2 was only moderate (AUC<0.8).

Therefore, to reduce mortality and improve outcomes, we suggest the use of qSOFA ≥2 combined with clinical or other early warning scores, or the development of new prediction scores for screening, triage, and prediction of mortality and of severity of sepsis in older patients with suspected sepsis in the ED.

7. Declarations

7.1. Acknowledgments

We wish to acknowledge the contributions of all the medical and nursing staff of the emergency department of Ramathibodi Hospital and thank them for their collaboration. We thank John Daniel from Edanz (www.edanz.com/ac) for editing a draft of this manuscript.

7.2. Consent for publication

Not applicable.

7.3. Funding

No external funding was obtained for this study.

7.4. Authors' contribution

PS and WT designed this study and developed the protocol. PS and WT were responsible for data collection. PS, WT and SW were responsible for data analysis. PS, WT and CA wrote the manuscript. PS and CA agree to be accountable for all aspects of the work. All authors read and approved the final version of manuscript.

7.5. Availability of supporting data

The data supporting this study's findings are openly available in Harvard Dataverse: "The Comparison of qSOFA, SIRS, NEWS and REWS Score for Predicting Severity and 28-day mortality in suspicious older sepsis patients in emergency department", https://doi.org/10.7910/DVN/EKQVH7.

7.6. Competing interests

The authors report that there are no competing interests to declare.

7.7. Using artificial intelligent chatbots

None.

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