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Early identification and prediction of adverse outcomes in emergency sepsis: a mini review

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Abstract

Sepsis is a systemic disease process and is the leading cause of death globally. Early identification of septic patients is crucial to initiate timely treatment and improve survival chances. The nurse has a central role in this process, using severity scores to identify patients at risk early and predict adverse outcomes. This mini review aims to identify severity scores that can be used by nurses in the context of sepsis in emergencies and compare them to identify the most appropriate tools for early identification and prediction of adverse outcomes, such as mortality (primary outcome) and Intensive Care Unit (ICU) admission (secondary outcome). The search was conducted between April and June 2024 in PubMed (MEDLINE), Web of Science, Scopus and the Cochrane Library, selecting articles published within the last 5 years, limited to systematic reviews and meta-analyses. The PICOM method was used for processing the search string. The SIRS criteria appeared to be useful for early identification. The qSOFA and NEWS showed consistent prognostic performance for mortality prediction, while NEWS showed promising results for predicting ICU admission. SOFA and UVA also showed good performance. The literature highlights several scores applicable by the nurse in emergency sepsis. Further studies are needed to confirm the effectiveness of the

UVA score and to evaluate its routine adoption. The results made it possible to propose an update of the sepsis protocol of the ASL Toscana Sud-Est in Italy.

Introduction

Sepsis is one of the biggest global health problems. The World Health Organisation (WHO) has shown that in 2017 alone there were 49 million cases worldwide and 11 million sepsis-related deaths. Furthermore, 48.7% of sepsis cases develop this condition in hospital, with a mortality rate of 52.3%.¹ It is a systemic pathological condition that threatens a person's life. It is defined as multiple organ failure, characterised by an abnormal, dysfunctional and disorganised response by the host's immune system. It always has an infectious origin, so it is important to recognise any infection early, as it can quickly degenerate and initially lead to SIRS (Systemic Inflammatory Response Syndrome) and then worsen into multiple organ dysfunction and septic shock. It is considered a medical emergency, the severity of which increases rapidly and can even lead to death: rapid intervention is essential. The role of nurses in these situations is crucial: in emergencies, healthcare professionals use scores that help to detect and quantify the clinical deterioration of patients and thus serve to identify potentially septic patients at an early stage. Following this, a multidisciplinary approach and collaboration between various professionals is important to confirm septic status.² In light of the above, the aim of this mini review is to see which scores are used by nurses for sepsis in emergencies and to understand which of these may be most suitable for both early identification and predicting outcomes such as mortality and admission to intensive care in patients with confirmed or suspected sepsis. Its ultimate goal is therefore to indicate the most suitable score based on the situation at hand and the outcome we want to predict.

Materials and Methods

This study was conducted as a mini review based on a structured literature search. The aim was not to perform a formal systematic review, but rather to provide a concise synthesis of the highest level of available evidence regarding sepsis scoring systems used in emergency settings. To improve transparency, a structured search strategy and a PRISMA flow diagram were used to describe the study selection process.

The research question addressed by this mini review was: what scores are used by nurses for sepsis in emergency settings and which are the most suitable for early identification and prediction of adverse outcomes such as mortality and ICU admission?

The articles included were identified through a literature search conducted between April and June 2024 in PubMed (MEDLINE), Web of Science, Scopus, and the Cochrane Library. The PICOM framework was used to define the research question and guide the search strategy (Table 1).

In this mini review, the target population included adult patients with confirmed sepsis, suspected sepsis, or infections associated with a risk of developing sepsis. The intervention of interest was the use of clinical scoring systems for early identification and risk stratification. The outcomes considered were mortality (primary outcome) and Intensive Care Unit (ICU) admission (secondary outcome).

Eligibility criteria

Studies were eligible for inclusion if they were systematic reviews or meta-analyses involving adult patients with confirmed sepsis, suspected sepsis, or infections associated with a risk of sepsis.

Eligible studies had to evaluate one or more clinical scoring systems used for sepsis identification or prognostic assessment and report outcomes related to mortality and/or ICU admission.

Studies were excluded if they were primary studies, narrative reviews, editorials, letters, conference abstracts, studies focused exclusively on pediatric populations, or studies not reporting outcomes relevant to the objectives of this review.

The following terms were used to construct the search strategy: “Early Warning Score” ([MeSH]), “Sepsis” ([MeSH]), “Emergency Service, Hospital” ([MeSH]), and “Score” (free-text term) (Table 2).

Once the terms had been identified and combined using the Boolean operators AND and OR, four different search strategies were developed, one for each database: i) PubMed: (“Early Warning Score” [MeSH]) OR “Score” AND “Sepsis” [MeSH]) AND “Emergency Service, Hospital” [MeSH]; ii) Web of Science: “Early Warning Score (Topic)” OR “Score (Topic)” AND “Sepsis (Topic)” AND “Emergency Service, Hospital (Topic)”; iii) Scopus: “Early Warning Score (any field, contains)” AND “Sepsis (any field, contains)” AND “Emergency Service (any field, contains)”; iv) Cochrane Library: “Early Warning System (Title, Abstract and Keywords)” AND “Sepsis (Title, Abstract and Keywords)”.

The following limits were applied to the PubMed, Web of Science and Scopus searches: i) last 5 years; ii) study type: systematic reviews and meta-analyses.

Titles and abstracts were screened for relevance. Potentially eligible studies underwent full-text assessment. Studies meeting all predefined eligibility criteria were included in the final synthesis.

Results

To summarise the screening process and best represent the results obtained, the “PRISMA statement” flow chart was used (see Figure 1).³ The keywords yielded 5,002 articles. 279 articles were removed because they were duplicates. After applying the search limits and performing the relevance screening, 7 articles were identified. Finally, after retrieving the full texts and reading the articles in their entirety, all 7 citations met the inclusion and exclusion criteria for the mini review. The article by *Chua WL, Rusli KD and Aitken LM*⁴ shows that for the identification of sepsis, EWS (NEWS/NEWS-2 and MEWS) showed greater sensitivity than qSOFA and similar sensitivity to SIRS criteria, but lower specificity than qSOFA and higher specificity than SIRS criteria. The resulting outcome is that EWS showed worse identification capabilities than qSOFA, but slightly better than SIRS criteria. Moving on to in-hospital mortality, EWS showed better sensitivity than qSOFA and was very similar to SIRS criteria.

The article by Wang *et al.*⁵ reports that in predicting mortality, the SIRS criteria showed the highest sensitivity, while qSOFA showed the highest specificity. The result is that in predicting mortality, qSOFA is certainly the most effective score in this field compared to NEWS and the SIRS criteria. The article by Waligora *et al.*⁶ shows that qSOFA has a rather low sensitivity in identifying sepsis in patients attending the emergency department, while in the same setting, SIRS criteria showed significantly better sensitivity. It is concluded that the SIRS criteria are better in this case, as qSOFA showed poor performance in identification. In terms of specificity in predicting mortality, however, qSOFA scored quite highly, while the SIRS criteria scored lower; therefore, qSOFA is the better score in this case. In intensive care, it was also observed that qSOFA had rather poor capabilities in terms of identifying septic patients, but that it performs much better in predicting the need for admission to intensive care (therefore outside this care setting).

The article by Sabir *et al.*⁷ reports that NEWS obtained better average values than qSOFA for mortality prediction, but the latter showed higher average specificity. With regard to the prediction of ICU admission, the situation is similar to the previous one. Therefore, the authors concluded (based on the studies they selected) that NEWS is a highly sensitive tool in both cases, but lacks specificity, whereas qSOFA shows higher values. Finally, based on only two studies included in the systematic review, NEWS performs better than MEWS.

The article by Qiu *et al.*⁸ shows that NEWS is the most effective score for identifying sepsis because it is applicable in multiple contexts, but it has also been seen that if SIRS criteria (which have the highest sensitivity) are used followed by qSOFA (with higher specificity), diagnostic accuracy increases significantly. For predicting short-term and 28/30-day mortality, SOFA appears to be the most reliable in low-income countries, and it seems that its accuracy increases when used

in combination with qSOFA. In predicting 7/10/14-day mortality, NEWS, numerically speaking (in terms of sensitivity and specificity), has achieved the best results, and in predicting ICU admission, no single score appears to be the most effective.

The article by Adegbite *et al.*⁹ reports that, for the primary identification of sepsis, the SIRS criteria would have greater accuracy (especially in identifying high-risk patients), but it would still be advisable to use the other scores as a secondary measure. In terms of mortality prediction, all scores obtained fairly similar results. Furthermore, it was found that qSOFA performed better in predicting mortality in the ICU than outside the ICU. The authors conclude that the scores performed in a fairly similar manner and therefore no single score is more effective than the others in predicting the aforementioned outcome.

The article by Kai *et al.*¹⁰ highlights that NEWS has an excellent ability to predict in-hospital mortality in patients with suspected or confirmed infection outside the ICU (despite fairly heterogeneous results), although it is emphasised that it loses effectiveness in older patients. The authors decided to divide patients into two groups for their systematic review: one with non-septic infection (diagnosed following positive blood cultures) and one with septic infection (identified not only by positive blood cultures but also by the “Sepsis-3 criteria”). NEWS showed significantly superior performance in the group of patients with septic infection. In comparison with the other scores, it was found that in terms of sensitivity, the SIRS criteria certainly showed better performance, although NEWS also achieved excellent results; in terms of specificity, qSOFA achieved better results. Despite the direct comparison between sensitivity and specificity, taking into account the overall values reported, NEWS would still remain the most effective tool. For predicting admission to intensive care, the results are good in terms of sensitivity, while specificity is rather poor. Finally, it is recommended that NEWS would be better for long-term patient monitoring rather than as a score to trigger immediate intervention; in this field, in fact, the authors feel that qSOFA and SIRS (thanks also to their ease of use) are more suitable. For each result relating to the identification of sepsis and prediction of adverse outcomes (in-hospital mortality and ICU admission), please refer to Table 3, 4 and 5.

Discussions

An important consideration when interpreting the findings of this mini review is that the evaluated scoring systems were originally developed for different clinical purposes. SIRS criteria are primarily used for the early identification of patients at risk of sepsis,¹¹ whereas qSOFA was developed as a rapid bedside risk stratification tool.¹² NEWS and MEWS belong to the category of Early Warning Scores and are intended to identify clinical deterioration and support escalation of

care.¹³ In contrast, SOFA is used to assess organ dysfunction and disease severity and requires laboratory parameters, making it more comprehensive but less readily applicable than qSOFA in emergency settings.¹⁴ UVA, on the other hand, has been proposed primarily as a prognostic tool, particularly in resource-limited settings.¹⁵

Consequently, direct comparisons between these instruments should be interpreted with caution, as differences in sensitivity and specificity may reflect their original purpose rather than their overall superiority. For this reason, the concept of a single “best” score may be misleading, and score selection should be guided by the specific clinical objective, whether early identification of sepsis, prediction of mortality, or prediction of ICU admission.

Following an in-depth analysis of the results obtained from this mini review, it can be said that, according to two studies, one conducted by Waligora *et al.*⁶ and the other by Adegbite *et al.*,⁹ the SIRS criteria would be more appropriate for identifying sepsis in the emergency department. On the other hand, however, the more recent study by Chua *et al.*⁴ states that none of the scores analysed appears to be the best, but the authors emphasise that EWS (NEWS/NEWS-2 and MEWS) are more suitable for identifying patients who may require a higher level of care. In the study by Qiu *et al.*,⁸ NEWS appeared particularly useful because of its versatility across different clinical contexts. The article also recommends that using SIRS criteria in conjunction with qSOFA would greatly increase diagnostic accuracy. With regard to the studies analysed that deal with the identification of sepsis, hypothetically it could be said that the SIRS criteria would seem to be the most appropriate, but it should be noted that the studies supporting this hypothesis are less recent and have grouped smaller samples than the study conducted by Chua *et al.*:⁴ the latter is more recent and has grouped a significantly larger sample. With regard to predicting in-hospital mortality, two studies (one by Wang *et al.*⁵ and another by Waligora *et al.*)⁶ consider qSOFA to be the most useful score for predicting this outcome, while the study by Chua *et al.*⁴ reports that NEWS is the most useful score. The article by Sabir *et al.*,⁷ following a direct comparison between qSOFA and EWS (NEWS and MEWS), states that both scores are excellent for predicting mortality. In particular, however, NEWS, showing high average sensitivity values with a cut-off of 5, is less likely to develop false negatives: for this reason, the score would be (albeit slightly) more suitable than qSOFA. It is important to note that this study boasts a very high number of participants (403,865 patients, to be precise), so the results are quite reliable. The article by Kai *et al.*¹⁰ considers NEWS to be an excellent tool overall (with an optimal cut-off of 5), even though the SIRS criteria have greater sensitivity and qSOFA has greater specificity. It should be noted that this article also compared the performance of NEWS among patients of different ages and found that it is indeed more effective in younger patients (therefore, it would appear that as age increases, the score's ability to predict in-

hospital mortality decreases). The articles analysed showed that a cut-off of 5 would be optimal, but raising the threshold to 7 would seem to identify patients at even greater risk of acute deterioration.^{7,10} Continuing with this review, it was found that NEWS would appear to be the most suitable for predicting mortality at 7/10/14 days, while SOFA would be the most recommended for 28/30 days (particularly in low-income countries).⁸ We can say that this result is partly justified by the fact that the latter is actually more detailed and complex than the other scores examined, considering that it evaluates parameters that require in-depth blood tests (therefore, it is also more “comprehensive” in terms of the patient's organ function but also slower in its assessment, as it takes longer to perform a SOFA). In this mini review of the literature, it emerged that another score, namely UVA, can also be used for sepsis in emergencies, showing excellent results,⁹ particularly in terms of specificity. It can therefore be said that its performance is good, but further studies are needed to confirm or refute these findings and to understand whether it can be a useful score in this field. That said, it can be confirmed that NEWS and qSOFA are both excellent scores in general, particularly the former in terms of sensitivity (although in the article by Kai *et al.*¹⁰ it did not achieve such excellent numerical results) and the latter in terms of specificity (moreover, in the article by Adegbite *et al.*⁹ showed better performance in the ICU). For predicting admission to the ICU, qSOFA performs very well in terms of specificity but lacks sensitivity,^{7,8} while NEWS shows excellent overall results, although in the article by Qiu *et al.*⁸ it shows poor sensitivity, to say the least. Furthermore, NEWS showed slightly better performance when directly compared with qSOFA.⁷

Another limitation of this review concerns lactate-based prognostic assessment. Although serum lactate is widely used in clinical practice for risk stratification in patients with suspected sepsis, and several studies have suggested that combining lactate measurement with qSOFA may improve prognostic accuracy and mortality prediction compared with qSOFA alone,^{16–18} lactate-based tools were not specifically targeted by the predefined search strategy. Consequently, studies focusing on the combined use of qSOFA and serum lactate were not included in the present review. Future research should further explore the role of lactate as an adjunctive marker in the early identification and prognostic assessment of septic patients.

The references concerning lactate-enhanced qSOFA were not identified through the predefined search strategy and are discussed only to provide additional clinical context.

In this review, some noteworthy limitations emerged. First, the results showed high heterogeneity, making it difficult to draw conclusions about the prediction of adverse outcomes. Second, the results obtained refer to the effectiveness of the scores strictly in the hospital setting: therefore, there is insufficient data to highlight their performance in the emergency setting.

Finally, as can be seen from the analysis of the article by Adegbite *et al.*,⁹ it emerged that UVA is a score that can be effectively used, but there are no other articles supporting its use in emergency sepsis.

Conclusions

In conclusion, SIRS criteria may be considered a useful tool for the early identification of septic patients in emergency settings.^{6,9} For predicting in-hospital mortality, qSOFA and NEWS demonstrated consistent prognostic performance across the studies included in this review.⁴⁻⁷ In particular, qSOFA appeared to perform well when applied to septic patients in intensive care,⁹ while NEWS showed promising results in younger patients and for long-term monitoring,¹⁰ including non-intensive care settings.⁹ Furthermore, SOFA showed good performance in predicting long-term mortality when applied in low-income countries.⁸ Considering that UVA also demonstrated encouraging results,⁹ further studies are recommended to clarify its role in emergency sepsis assessment.

Overall, no single score can be considered universally superior across all clinical objectives. Score selection should therefore be guided by the specific clinical purpose, whether early identification of sepsis, prediction of mortality, or prediction of ICU admission. Among the evaluated tools, NEWS and qSOFA showed consistent prognostic performance, while SIRS criteria remained useful for early identification of septic patients.⁴⁻¹⁰

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Table 1. PICOM.

P: Population	Patients with sepsis, with suspected sepsis or at risk of sepsis
I: Intervention	Using score for early identification
C: Comparison	Other scores
O: Outcome	Identification and prediction of adverse outcomes
M: Methods	Systematic reviews and meta-analysis

Table 2. Research strategy.

PubMed	((“Early Warning Score” [MeSH]) OR “Score” AND “Sepsis” [MeSH]) AND “Emergency Service,Hospital” [MeSH]
Web of Science	“Early Warning Score (Topic)” OR “Score (Topic)” AND “Sepsis (Topic)” AND “Emergency Service, Hospital (Topic)”
Cochrane	“Early Warning System (Title, Abstract and Key words)” AND “Sepsis (Title, Abstract and Key Words)”
Scopus	“Early Warning Score (any fields, contains)” AND “Sepsis (any fields, contains)” AND “Emergency Service (any fields, contains)”

Table 3. Results of ability of identification.

Authors	Score	Sensitivity (%)	Specificity (%)
Chua <i>et al.</i> ⁴	qSOFA	37	94
	EWS>5	65	77
	SIRS	70	62
Waligora <i>et al.</i> ⁶	qSOFA	32-58.3	/
	SIRS	72-94.5	/
Qiu <i>et al.</i> ⁸	qSOFA	42	98
	NEWS	71	85
	SIRS	85	41
	SOFA	61	76

Table 4. Results of prediction of in-hospital mortality (primary outcome).

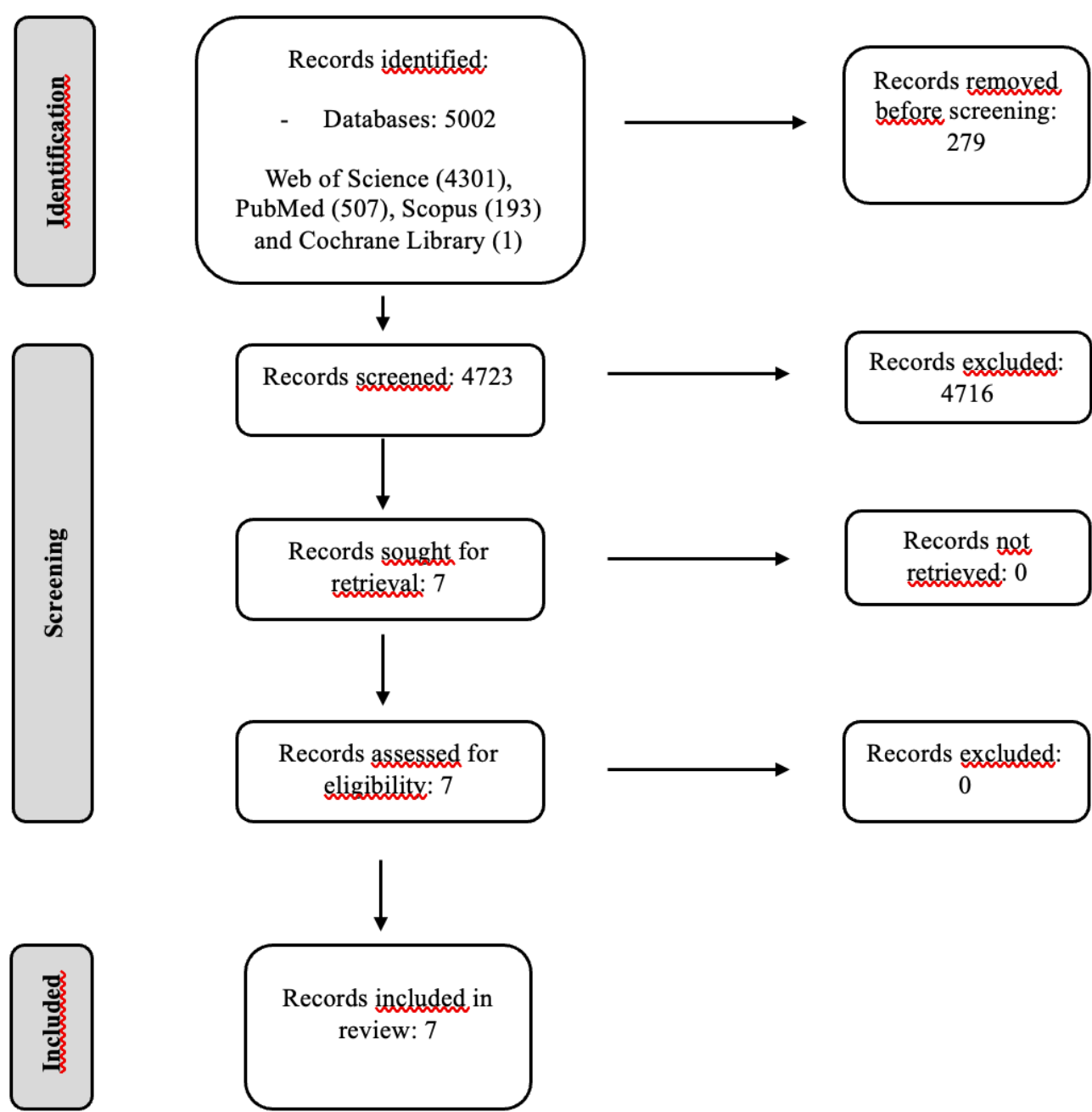
Authors	Score	Sensitivity (%)	Specificity (%)
Chua <i>et al.</i> ⁴	qSOFA	65	59
	EWS>5	94	21
	SIRS	92	12
Wang <i>et al.</i> ⁵	qSOFA	46	82
	NEWS	73	52
	SIRS	82	24
Waligora <i>et al.</i> ⁶	qSOFA	/	86-96.7
	SIRS	/	45-75.2
Sabir <i>et al.</i> ⁷	qSOFA	14-71	58-99
	NEWS>5-7	51-97	22-91
	MEWS>5	23.8-75.4	62.1-87

Qiu <i>et al.</i> ⁸		(Breve termine)	(Breve termine)
	qSOFA	70	65
	NEWS	77	59
	SIRS	89	22
	SOFA	89	69
		(7/10/14 giorni)	(7/10/14 giorni)
	qSOFA	48	75
	NEWS	73	64
	SIRS	87	43
		(28/30 giorni)	(28/30 giorni)
	qSOFA	41	88
	NEWS	71	59
	SIRS	68	46
	SOFA	97	14
Adegbite <i>et al.</i> ⁹	qSOFA	70	73
	SIRS	88	34
	MEWS	70	61
	UVA	49	91
Kai <i>et al.</i> ¹⁰	qSOFA	48	80
	NEWS>5	71	60
	SIRS	85	25

Table 5. Results of prediction of ICU admission.

Authors	Score	Sensitivity (%)	Specificity (%)
Sabir <i>et al.</i> ⁷	qSOFA	12-53	67-99
	NEWS > 5	46-91	25-91
	MEWS>5	52.1-60.57	64.5-68.4
Qiu <i>et al.</i> ⁸	qSOFA	33	88
	NEWS	34	82
	SIRS	84	29
Kai <i>et al.</i> ¹⁰	NEWS>5	71	55

Figure 1. PRISMA statement



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