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Original Contributions

CLINICAL SCORES AND FORMAL TRIAGE FOR SCREENING OF SEPSIS AND ADVERSE OUTCOMES ON ARRIVAL IN AN EMERGENCY DEPARTMENT ALL-COMER COHORT

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□ Abstract—Background: Early recognition of sepsis remains a major challenge. The clinical utility of the Quick Sepsis-Related Organ Failure Assessment (qSOFA) score is still undefined. Several studies have tested its prognostic value. However, its ability to diagnose sepsis is still unknown. Objective: Our aim was to compare the performance of qSOFA, systemic inflammatory response syndrome (SIRS) criteria, National Early Warning Score (NEWS), and formal triage with the Emergency Severity Index (ESI) algorithm to identify patients with sepsis and predict adverse outcomes on arrival in an emergency department (ED) all-comer cohort. Methods: We included all patients presenting consecutively to the ED during a 3-week period. We used vital signs recorded at triage to calculate the study scores. Two independent assessors retrospectively assigned the primary outcome of sepsis according to Third International Consensus Definitions for Sepsis and Septic Shock criteria in a chart review process. Results: There were 2523 cases included in the analysis and 39 (1.6%) had the primary outcome of sepsis. The area under the curve for sepsis was 0.79 (95% confidence interval [CI] 0.71–0.86) for qSOFA, 0.81 (95% CI 0.73–0.87) for SIRS, 0.85 (95% CI 0.77–0.92) for NEWS, and 0.77 (95% CI 0.70–0.83) for ESI. Conclusions: qSOFA offered high specificity for the prediction of sepsis and adverse outcomes. However, its low sensitivity does not support widespread use as a screening tool for sepsis. NEWS outperformed qSOFA for prediction of adverse outcomes and screening for sepsis. © 2019 Published by Elsevier Inc.

□ Keywords—sepsis; screening; triage; SOFA; qSOFA; SIRS; NEWS; ESI

INTRODUCTION

Early recognition of patients with sepsis, defined as a life-threatening organ dysfunction due to a dysregulated host response to infection, remains a major challenge. The Surviving Sepsis Campaign 1-h bundle stressed once more the importance of time-sensitive measures (1).

The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) task force introduced the Quick Sequential Organ Failure Assessment (qSOFA), validated to predict poor outcomes in patients with a suspected infection, specifically in-hospital mortality (2,3). The task force proposed the score as a bedside "screening for patients likely to have sepsis" outside the intensive care unit (ICU) (1,4). The authors stressed its simplicity and independence from laboratory testing, and issued a call for external validation (5,6). However, the clinical utility of qSOFA is still undefined (3,7). This led to an ongoing debate over the proper role and limitations of qSOFA, both as a sepsis screening tool and as a prognostic score (3).

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Several studies confirmed the prognostic value of qSOFA for risk stratification in the emergency department (ED) and compared it with systemic inflammatory response syndrome (SIRS) criteria and several other scores (8–13). However, most of these studies were carried out retrospectively, in specific populations (i.e., patients with suspicion of infection), used maximal score values within a time window ranging from 6 h to several days and focused on prognostication rather than screening (8–14). Moreover, sepsis according to the Sepsis-3 definitions has not been examined as an endpoint yet.

Therefore, we aimed to assess qSOFA measured at presentation as a tool to identify sepsis in an all-comer cohort of ED patients. We also aimed to compare its performance with National Early Warning Score (NEWS), SIRS criteria, and formal triage with the Emergency Severity Index (ESI), as well as to test qSOFA in patients with and without suspected infection. Lastly, we aimed to assess and compare the scores' prediction of adverse outcomes.

METHODS

Study Design

We carried out a preplanned analysis of prospectively collected data within a quality-control study in a single Swiss academic tertiary hospital with over 50,000 visits per year. We included all patients presenting to the ED during a period of 3 weeks (January 30–February 19, 2017). We did not include pediatric, obstetric, and ophthalmologic patients, as they were treated in separate facilities nearby.

Ethics

The local ethics committee approved the study protocol (236/13, www.eknz.ch/). The need to provide written informed consent was waived. We excluded patients if they actively declined participation or the electronic health record (EHR) contained a general rejection to participation in research.

Study Protocol

Upon arrival, a team consisting of a registered triage nurse and a board-certified emergency physician routinely triaged patients using the German version of the ESI algorithm (15). The team triage process is described in more detail elsewhere (16). The triage team recorded the triage category and a set of vital signs and mental status as medically indicated in case report forms.

We obtained information on demographics, ESI triage category, laboratory measurements, medication, disposition, International Classification of Diseases, 10th revision (ICD-10) discharge codes, and in-hospital mortality from the hospital's EHR.

Scores

A study physician calculated the qSOFA, NEWS, and SIRS scores using the vital signs documented at triage. Additionally, we used the first leukocyte count, pCO_2 and bandemia available to calculate the SIRS score if the values had been documented within 24 hours after presentation to the ED. Missing data were recorded as missing, but assumed to be normal in the analysis.

The qSOFA score is defined as 1) systolic blood pressure $\leq$ 100 mmHg; 2) respiratory rate $\geq$ 22 breaths/min, and 3) altered mental status. A score of $\geq$ 2 is meant to identify a greater risk of death or prolonged ICU stay in patients with suspected infection. In our study, we used the Alert, Voice, Pain, and Unresponsive (AVPU) Scale, considering anything other than "Alert" to be an altered mental status.

NEWS is an aggregate score validated as a risk indicator of clinical deterioration and mortality. It includes heart rate, systolic blood pressure, respiratory rate, arterial oxygen saturation, and mental status, weighing each item with 0–3 points. The score is divided into three "trigger levels": low risk (0–4 points), medium risk (5–6 points), and high risk ($\geq$7 points) (17).

SIRS criteria comprised the original 1992 sepsis definition (18). They assigned 1 point to each of the following items: body temperature $> 38°C$ or $< 36°C$; pulse rate > 90 beats/min; respiratory rate > 20 breaths/min or pCO_2 < 32 mmHg; and leukocyte count $< 12,000/mm^3$, $< 4000/mm^3$, or the presence of $> 10\%$ immature neutrophils. SIRS criteria are fulfilled with $\geq$ 2 points.

The ESI is a widely used reliable and valid triage algorithm with 4 decision points. Patients are assigned to one of five triage categories, ESI level 1 being the most acute and ESI level 5 being the least acute triage category (15). Patients with ESI levels 1 and 2 should not wait to be seen and treated.

Outcomes

Primary outcome. The primary outcome was sepsis, defined in line with the 2016 definitions as a confirmed or suspected infection and an increase of $\geq$ 2 points in the SOFA score. To exclude hospital-acquired sepsis, we only considered data concerning the first 48 hours of hospitalization (19).

We determined the primary outcome in a chart review process. Eligible charts had at least one of the following: 1) an ICD-10 discharge code of sepsis or septic shock (A40.X, A41.X, R57.2); 2) an ICD-10 discharge code related to an infection potentially leading to sepsis, as

described previously, combined with an increase of ≥ 2 points in the SOFA score at presentation; and 3) or a positive blood culture drawn within 48 hours of hospitalization (20).

We calculated the SOFA score at presentation using the first blood pressure and mental status documented at triage, as well as the first available laboratory results (platelets, bilirubin, creatinine and pO_2/FiO_2 ratio derived from arterial blood gas analyses) if documented within 24 hours of presentation to the ED. We identified chronic organ dysfunction comparing previously documented measurements in the EHR (platelets, bilirubin, and creatinine) and downgraded the SOFA score accordingly. We upgraded the SOFA score according to the need for ventilation or ionotropes within the first 24 hours of hospital stay.

Two chart reviewers, C.H.N. (emergency medicine specialist) and C.R. (infectious diseases specialist), independently reviewed eligible charts and answered the question: "Did the patient have an acute infection (identified within 48 hours of hospital stay)?" For charts included due to sepsis ICD-10 codes or positive blood cultures, the reviewers also answered the question: "Did the patient have an increase in the SOFA score of ≥ 2 points within the first 48 hours of hospital stay?" Charts answered affirmatively had the primary outcome. In case of disagreement, reviewers sought consensus through discussion of individual cases. The chart review adhered to methodologic standards, with the exception of blinding to the study hypothesis (21,22).

Secondary outcomes. Predefined secondary outcomes were admission to ward, admission to ICU, in-hospital mortality, and 30-day mortality. We defined admission to ward as admission to any hospital inpatient department, including transfer to other acute care hospitals directly from the ED. We defined admission to the ICU as admission to one of the hospital's ICU or intermediate care units. We defined in-hospital mortality as death before discharge. We defined 30-day mortality as death within 30 days after presentation to the ED.

Suspicion of Infection

We planned a subanalysis to test the scores in patients with suspected infection as described for qSOFA in the original Sepsis-3 publication (4). We defined "suspicion of infection" as either 1) the start of an antimicrobial therapy in the ED or 2) the decision to order a microbiological test within 24 hours of presentation.

Statistical Analysis

Data are displayed as frequencies and percentages for categorical variables and as median with interquartile range for continuous variables.

We assessed the performance of the scores using receiver operator characteristic (ROC) curves. We computed the area under the curve (AUCs) with 95% confidence intervals (CI) and performed AUC comparison using two-sided DeLong's test. We calculated sensitivity, specificity, and likelihood ratios for each cut-off point. We assessed interrater reliability using the intraclass correlation coefficient (ICC). We used multivariate logistic regression models adjusted for age and sex to assess the association of the scores with secondary outcomes. The statistical analysis was performed using R, version 3.4.1 (https://www.R-project.org/).

RESULTS

During the study period, 2930 patients presented to the ED, 2698 were screened, and 2523 (86.1%) were included in the study (Figure 1). Median age in the cohort was 53 years, 1233 (49%) were female, and 634 (25.1%) patients had a suspected infection (186 received antibiotics in the ED and 592 underwent microbiological sampling).

One-third (n = 849 [33.6%]) of patients were admitted to the hospital, 137 (5.4%) patients required ICU admission, 37 (1.5%) patients died before being discharged, and 62 (2.5%) patients died within 30 days after presenting to the ED. We lost 101 (4.0%) patients to follow-up after 30 days. Baseline demographics, ESI triage levels, score distribution, and overall secondary outcomes are displayed in Table 1.

Main Analysis

Four hundred and ten patients had an infection-related ICD-10 code and 139 patients had an increase of ≥ 2 points in the SOFA score at presentation, resulting in 68 patients with the combination of infection and multi-organ dysfunction. In addition, 26 patients had a sepsis-related ICD-10 code and 22 patients had positive blood cultures drawn in the first 48 h after presentation. This resulted in 82 patients eligible for chart review (see Figure 1). Some patients complied with more than one criterion.

The primary outcome occurred in 39 patients. Agreement between assessors had an ICC of 0.82 (95% CI 0.74–0.88). Table 2 shows the demographics and outcomes of patients with and without the primary outcome.

Figure 2 shows the ROC curve of qSOFA, SIRS, NEWS, and ESI for the primary outcome. The AUCs were: qSOFA 0.79 (95% CI 0.71–0.86), SIRS 0.81 (95% CI 0.73–0.87), NEWS 0.85 (95% CI 0.77–0.92), and ESI 0.77 (95% CI 0.70–0.83). The AUC of qSOFA and NEWS differed significantly ($p = 0.03$), and so did the AUC of NEWS and ESI ($p = 0.04$). We found no
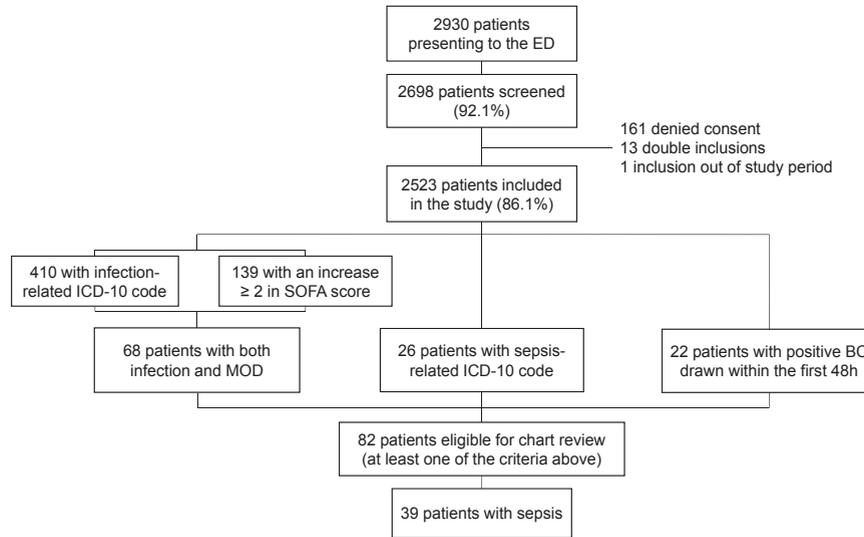
Figure 1. Study flow diagram. Eighty-six percent of patients presenting to the ED during the study period were included in the study. BC = blood culture; ED = emergency department; ICD-10 = International Classification of Diseases, 10th Revision; MOD = multi-organ dysfunction; SOFA = Sepsis-Related Organ Failure Assessment.

significant difference between the AUC of SIRS and NEWS ($p = 0.24$). The performance of all score cut-offs is shown in Appendix Table 1. Cut-off points with the highest sum of sensitivity and specificity (Youden's Index) were qSOFA ≥ 1, SIRS ≥ 2, NEWS ≥ 4, and ESI ≤ 3.

The qSOFA ≥ 1 cut-off showed a sensitivity of 69.2% (95% CI 53.9–82.1%) and a specificity of 86.5% (95% CI 85.1–87.8%), while SIRS ≥ 2 showed a lower sensitivity of 56.4% (95% CI 41.0–71.8%) with an almost identical specificity of 86.4% (95% CI 85.0–87.8%). NEWS ≥ 4 had the highest combination of sensitivity and specificity, with 71.8% (95% CI 56.4–84.6%) and 90.2% (95% CI 89.1–91.3%), respectively. ESI ≤ 3 showed a sensitivity of 97.4% (95% CI 92.3–100%) and a specificity of 32.5% (95% CI 30.6–34.2%). The qSOFA cut-off proposed by

Table 1. Baseline Characteristics of the Study Population

Characteristic	Data
Total cases, n	2523
Age, years, median (IQR)	52 (38)
Female sex, n (%)	1233 (48.9)
Suspected infection, n (%)	634 (25.1)
ESI category, n (%)	
1	79 (3.1)
2	516 (20.5)
3	1120 (44.4)
4	754 (29.9)
5	54 (2.1)
qSOFA score, n (%)	
0	2159 (85.6)
1	333 (13.2)
2	31 (1.2)
3	0 (0)
SIRS criteria, n (%)	
0	1308 (51.8)
1	855 (33.9)
2	277 (11.0)
3	76 (3.0)
4	7 (0.3)
NEWS, n (%)	
0–4	2360 (93.5)
5–6	106 (4.2)
≥ 7	57 (2.3)
Admission to ward n (%)	849 (33.7)
Admission to ICU, n (%)	137 (5.4)
In-hospital mortality, n (%)	37 (1.5)
30-day mortality, n (%)	62 (2.5)
Lost to follow-up, n (%)	101 (4.0)

ESI = Emergency Severity Index; ICU = intensive care unit; IQR = interquartile range; NEWS = National Early Warning Score; qSOFA = Quick Sepsis-Related Organ Failure Assessment; SIRS = systemic inflammatory response syndrome.

Table 2. Comparison of Patients With and Without Sepsis at Presentation

Variable	No Sepsis	Sepsis
n (%)	2484 (98.5)	39 (1.6)
Age, years, median (IQR)	51 (39)	76 (21)
Female, n (%)	1217 (49.0)	16 (41.0)
Suspicion of infection, n (%)	598 (24.1)	36 (92.3)
Antimicrobial therapy in the ED, n (%)	164 (6.6)	22 (56.4)
Microbiological test within 24 h, n (%)	556 (22.4)	36 (92.3)
qSOFA, median (IQR)	0 (0)	1 (1)
SIRS, median (IQR)	0 (1)	2 (2)
NEWS, median (IQR)	1 (2)	5 (4)
Admission to ward, n (%)	810 (32.6)	39 (100)
Admission to ICU, n (%)	123 (5.0)	14 (35.9)
In-hospital mortality, n (%)	28 (1.1)	9 (23.1)
30-day mortality, n (%)	51 (2.1)	11 (28.2)

ED = emergency department; ICU = intensive care unit; IQR = interquartile range; NEWS = National Early Warning Score; qSOFA = Quick Sepsis-Related Organ Failure Assessment; SIRS = Systemic Inflammatory Response Syndrome.
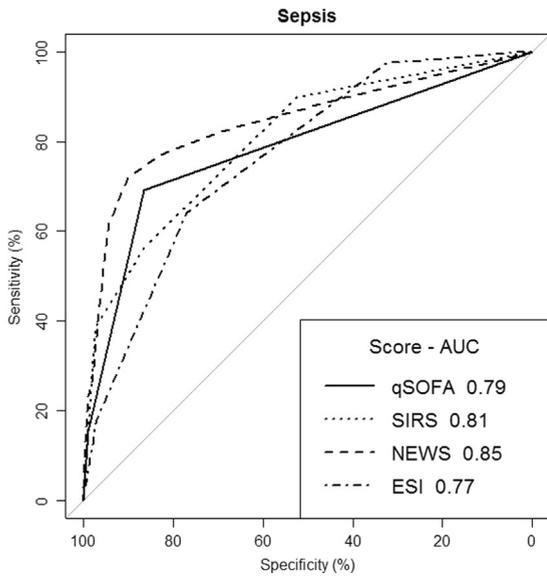
Figure 2. ROC curve for sepsis. AUC = area under the curve; ESI = Emergency Severity Index; NEWS = National Early Warning Score; qSOFA = Quick Sepsis-Related Organ Failure Assessment; ROC = receiver operating characteristic; SIRS = systemic inflammatory response syndrome.

the Sepsis-3 task force (qSOFA $\geq$ 2) showed a sensitivity of 15.4% (95% CI 5.1–28.2%) and a specificity of 99.0% (95% CI 98.5–99.4%). When applying qSOFA to the subgroup of patients with suspected infection, qSOFA $\geq$ 1 showed a sensitivity of 72.2% (95% CI 55.6–86.1%) and a specificity of 72.9% (95% CI 69.2–76.6%), while qSOFA $\geq$ 2 had a sensitivity 16.7% (95% CI 5.6–30.1%) and a specificity of 97.3% (95% CI 96.0–98.5%).

Scores and secondary outcomes are presented in Table 3. The multivariate logistic regression analysis adjusted for age and sex showed the following for admis-

sion to ward: qSOFA odds ratio (OR) 4.1 (95% CI 3.1–5.3), SIRS OR 2.1 (95% CI 1.9–2.4), NEWS OR 1.4 (95% CI 1.3–1.5), ESI OR 3.6 (95% CI 3.1–4.2); admission to ICU: qSOFA OR 4.2 (95% 3.1–5.7), SIRS OR 2.3 (95% CI 1.9–2.7), NEWS OR 1.5 (95% CI 1.4–1.6), ESI OR 7.2 (95% CI 5.4–9.7); for in-hospital mortality: qSOFA OR 4.6 (95% CI 2.8–7.6), SIRS OR 2.7 (95% CI 2.0–3.7), NEWS OR 1.5 (95% CI 1.4–1.7), ESI OR 5.0 (95% CI 3.2–8.1); and 30-day mortality: qSOFA OR 3.9 (95% CI 2.5–5.9), SIRS OR 2.2 (95% CI 1.7–2.8), NEWS OR 1.5 (95% CI 1.3–1.6), and ESI OR 3.2 (95% CI 2.3–4.6).

Appendix Figure 1 shows the ROC curves and AUC for the prediction of the secondary outcomes. For all outcomes, qSOFA $\geq$ 2 showed a high specificity (>80%) with a moderate sensitivity (30–60%). NEWS had a significantly higher AUC than qSOFA ($p < 0.001$) and SIRS ($p < 0.05$) for all outcomes. ESI showed the highest AUC for the discrimination of admission to ward and ICU ($p < 0.001$). SIRS and qSOFA were not significantly different in predicting mortality.

DISCUSSION

In this prospective all-comer cohort study, a qSOFA $\geq$2 cut-off measured on arrival at the ED had a high specificity and a low sensitivity for identifying sepsis, both in all-comer ED attendees and in patients with suspected infection. All scores as well as formal triage were predictive of adverse outcomes, with NEWS showing a higher overall predictive power for mortality.

Sensitive and simple decision tools are needed to promptly identify patients at risk of sepsis, as waiting times and resource allocation rely mostly on clinical information alone. We showed that the qSOFA cut-off

Table 3. Secondary Outcomes According to Scores

Variable	n (%)	Hospitalization, n (%)	ICU Admission, n (%)	In-Hospital Mortality, n (%)	30-Day Mortality, n (%)
Overall	2523	849 (33.6)	137 (5.4)	37 (1.5)	62 (2.5)
qSOFA score					
0	2159 (85.6)	610 (28.3)	66 (3.1)	14 (0.7)	27 (1.3)
1	333 (13.2)	212 (63.7)	62 (18.6)	19 (5.7)	30 (9.0)
2	31 (1.2)	27 (87.1)	9 (29.0)	4 (12.9)	5 (16.1)
3	0 (0)	—	—	—	—
SIRS criteria					
0	1308 (51.8)	330 (25.2)	28 (2.1)	5 (0.4)	14 (1.1)
1	855 (33.9)	285 (33.3)	51 (6.0)	12 (1.4)	22 (2.6)
2	277 (11.0)	165 (59.6)	36 (13.0)	10 (3.6)	15 (5.4)
3	76 (3.0)	62 (81.6)	19 (25.0)	10 (13.2)	10 (13.2)
4	7 (0.3)	7 (100)	2 (28.6)	0 (0)	1 (14.3)
NEWS					
0–4	2360 (93.5)	717 (30.4)	92 (3.9)	17 (0.7)	33 (1.4)
5–6	106 (4.2)	82 (77.4)	23 (21.7)	11 (10.4)	17 (16.0)
$\geq$ 7	57 (2.3)	50 (87.7)	22 (38.6)	9 (15.8)	12 (21.1)

ICU = intensive care unit; NEWS = National Early Warning Score; qSOFA = Quick Sepsis-Related Organ Failure Assessment; SIRS = systemic inflammatory response syndrome.

proposed by the Sepsis-3 task force favors specificity rather than sensitivity, showing a similar performance to an ESI level 1, which represents patients in need of life-saving interventions. When only considering patients with suspected infection, the high specificity of qSOFA improved marginally, but its sensitivity remained low.

Formal triage was able to virtually rule out sepsis with an ESI level of ≤ 3, but at the cost of a high number of false positives. NEWS of ≥ 4 showed an almost identical sensitivity and specificity as the qSOFA ≥ 1 cut-off to identify sepsis, and all of the SIRS cut-offs were inferior. However, NEWS showed an overall superior predictive performance in predicting both sepsis and adverse outcomes.

Strengths and Limitations

Our study has several strengths. To our knowledge, this is the first study to test these scores to screen for sepsis in all-comer ED patients. This analysis portrays the incidence and severity of sepsis in an urban ED rather than a selected sample of patients. Further, we tested the performance of the score measured at the time of presentation to the ED rather than choosing the most deranged values over a period of time (9,10,13).

Our study also has some limitations. First, this is a single-center study and its external validity is limited.

Second, the primary outcome was relatively rare in our cohort, with sepsis accounting for 1.6% of all presentations to the ED. This reflects the challenge of identifying relatively few sepsis cases in a heterogeneous ED population with a high level of suspicion for infection (25%). However, the sepsis incidence in our study is in line with the literature (23–25).

Third, our study was affected by missing data, as 816 (32.3%) patients had an incomplete qSOFA score. Of note, our study only evaluated vital parameters routinely assessed at triage. This pragmatic approach aimed to evaluate the scores in a realistic triage environment rather than ideal conditions, as it portrays the incompleteness of measurements we experience in daily practice. Missing values were predominantly defined by the triage clinician's decision not to measure specific variables, that is, due to low urgency. Data completeness also proved challenging in high-urgency cases, including unstable patients, those in need of resuscitation, or those directly referred to surgery. This is shown in the higher proportion of ESI 1 patients with incomplete vital parameters (37 of 816 [4.5%]) than in the group with complete measurements (42 of 1707 [2.5%]). In-hospital mortality was also higher in the group with missing data (2.0% vs. 1.5%), but all other secondary endpoints did not differ. Of note, only 5 patients with the primary outcome had an incomplete qSOFA score.

Fourth, one of the factors we defined suspicion of infection with was the decision to order a microbiological test within 24 hours of presentation. The 24-hour threshold is an arbitrary timeframe intended to represent a reasonable time for the suspicion of infection. However, this lapse might have overestimated the suspicion of infection originated in the ED in some cases.

CONCLUSIONS

qSOFA calculated at triage offers high specificity for the prediction of sepsis and adverse outcomes in patients presenting to the ED. NEWS showed a higher sensitivity for both overall risk prediction and the screening of sepsis at triage. None of the scores could reliably rule out sepsis at triage.

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ARTICLE SUMMARY

1. Why is this topic important?

Early identification of sepsis remains a major challenge. The clinical utility of the Quick Sepsis-Related Organ Failure Assessment (qSOFA) score is still undefined.

2. What does this study attempt to show?

We aim to show the performance of clinical scores to detect and predict sepsis and adverse outcomes on arrival in an emergency department (ED) all-comer cohort.

3. What are the key findings?

qSOFA offers high specificity and low sensitivity for the screening of sepsis on arrival at the ED. National Early Warning Score (NEWS) shows a higher sensitivity for both prediction of adverse outcomes and the screening of sepsis at triage.

4. How is patient care impacted?

Our data do not support the use of qSOFA for screening purposes. Systemic inflammatory response syndrome criteria and NEWS offer moderate sensitivity and specificity, but are not able to rule out sepsis on arrival.

Appendix
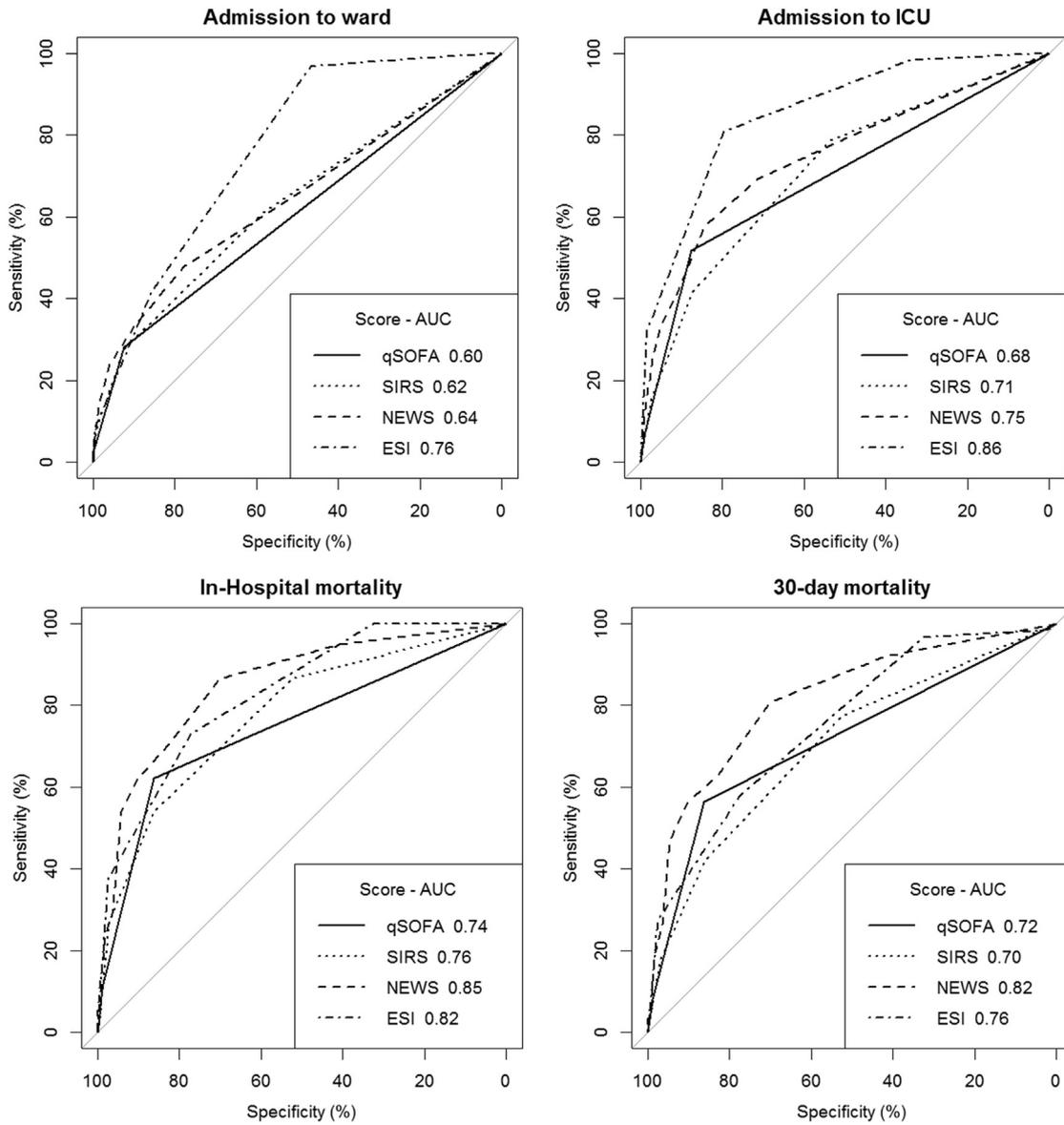
Appendix Figure 1. ROC curves for the secondary outcomes of admission to ward, admission to ICU, in-hospital mortality, and 30-day mortality. AUC = area under the curve; ESI = Emergency Severity Index; ICU = intensive care unit; NEWS = National Early Warning Score; qSOFA = Quick Sepsis-Related Organ Failure Assessment; ROC = receiver operating characteristic; SIRS = systemic inflammatory response syndrome.

Appendix Table 1. Discriminative Performance of All Score Cut-Offs for Sepsis

Cut-Off	TPs, n	FPs, n	TNs, n	FNs, n	LR+	LR–	Sensitivity (95% CI), %	Specificity (95% CI), %
NEWS								
≥ 1	35	1443	1041	4	1.54	0.25	89.7 (79.5–97.4)	41.9 (40.1–43.9)
≥ 2	32	742	1742	7	2.75	0.26	82.1 (69.2–92.3)	70.1 (68.4–72.0)
≥ 3	30	424	2060	9	4.50	0.28	76.9 (64.1v89.7)	82.9 (81.4–84.4)
≥ 4	28	243	2241	11	7.33	0.31	71.8 (56.4–84.6)	90.2 (89.1–91.3)
≥ 5	24	139	2345	15	11	0.41	61.5 (46.2–76.9)	94.4 (93.5–95.3)
≥ 6	17	86	2398	22	12	0.58	43.6 (28.2–59.0)	96.5 (95.8–97.3)
≥ 7	10	47	2437	29	13	0.76	25.6 (12.8–38.5)	98.1 (97.5–98.6)
≥ 8	9	26	2458	30	21	0.78	23.1 (10.3–38.5)	98.9 (98.6–99.3)
≥ 9	5	12	2472	34	26	0.88	12.8 (2.6–25.6)	99.5 (99.2–99.8)
≥ 10	2	3	2481	37	51	0.95	5.1 (0.0–12.8)	99.9 (99.7–100)
≥ 11	2	2	2482	37	51	0.95	5.1 (0.0–12.8)	99.9 (99.8–100)
13	1	0	2484	38	—	0.97	2.6 (0.0–7.7)	100.0 (100–100)
qSOFA score								
≥ 1	27	337	2147	12	5.13	0.36	69.2 (53.9–82.1)	86.5 (85.1–87.8)
≥ 2	6	25	2459	33	15	0.85	15.4 (5.1–28.2)	99.0 (98.5–99.4)
SIRS score								
≥ 1	35	1180	1304	4	1.89	0.20	89.7 (79.5–97.4)	52.5 (50.5–54.5)
≥ 2	22	338	2416	17	4.15	0.5	56.4 (41.0–71.8)	86.4 (85.0–87.8)
≥ 3	15	68	2416	24	14	0.63	38.5 (23.1–53.9)	97.3 (96.6–97.9)
4	1	6	2478	38	—	0.98	2.6 (0.0–2.6)	99.8 (99.6–99.9)
ESI category								
≤ 4	39	2430	54	0	1.02	0.0	100 (100–100)	2.2 (1.6–2.8)
≤ 3	38	1677	807	1	1.44	0.08	97.4 (92.3–100)	32.5 (30.6–34.2)
≤ 2	25	570	1914	14	2.80	0.47	64.1 (48.7–79.5)	77.1 (75.4–78.7)
1	7	72	2412	32	6.21	0.84	18.0 (7.7–30.8)	97.1 (96.4–97.8)

CI = confidence interval; ESI = Emergency Severity Index; FN = false negative; FP = false positive; LR+ = positive likelihood ratio; LR– = negative likelihood ratio; NEWS = National Early Warning Score; qSOFA = Quick Sepsis-Related Organ Failure Assessment; SIRS = systemic inflammatory response syndrome; TN = true negative; TP = true positive.