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Original Article

Comparison of qSOFA and SOFA score for predicting mortality in severe sepsis and septic shock patients in the emergency department of a low middle income country

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ABSTRACT

Objective: We aimed to determine a comparison between the Quick Sequential Organ Failure Assessment (qSOFA) score and existing Sequential Organ Failure Assessment (SOFA) score when applied to severe sepsis & septic shock patients in the Emergency Department (ED) for prediction of in-hospital mortality in the setting of a tertiary care hospital ED in a low-middle income country.

Method: We conducted a prospective observational cohort study on 760 subjects. The qSOFA, SOFA score and in-hospital mortality were assessed by area under the receiver operating curve (AUROC). We calculated sensitivity and specificity for each score for outcomes at cut-offs of 0.92 and 0.63 for qSOFA and SOFA in Severe Sepsis respectively and 0.89 and 0.63 for qSOFA and SOFA in Septic shock respectively.

Results: In patients with severe sepsis, the AUROC of qSOFA for predicting mortality in subjects was 0.92 (95% CI; 0.89–0.94) with 96% sensitivity and 87% specificity in comparison to the AUROC of SOFA score which was 0.63 (95% CI; 0.55–0.70 with 71% sensitivity and 57% specificity. In patients with septic shock, the AUROC of qSOFA for predicting mortality in subjects was 0.89 (95% CI; 0.85–0.92) with 92% sensitivity and 85% specificity in comparison to the AUROC of SOFA score which was 0.63 (95% CI; 0.55–0.70 with 70% sensitivity and 59% specificity.

Conclusion: Our study concludes that qSOFA score is an effective tool at predicting in hospital mortality in comparison to SOFA score when applied to severe sepsis and septic shock patients in the setting of a tertiary care hospital ED of a low-middle income country however, further studies are needed before application for this purpose.

1. Introduction

Sepsis is a fatal syndrome with dire consequences.[1–3] It progresses rapidly and delays in its identification and treatment can cause a higher mortality.[4,5] Presently, there are many clinical scoring systems that measure the disease severity in septic population.[6–11] Many of these scores are time consuming and require information that is not readily available.

With the introduction of the Severe Inflammatory Response Syndrome (SIRS) criteria in 1991 for rapid bedside identification of sepsis[6] to current era where various complex clinical outcome prediction model snow exist, a few of which that are notable to mention such as the Acute Physiology and Chronic Health Evaluation Score,[7] the Simplified Acute Physiology Score III,[8] the Logistic Organ Dysfunction

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Score,[9] and the Mortality Probability Model III,[10] were actually derived and validated in the intensive care unit (ICU) setting. Previous investigations have demonstrated these scores to be inadequate when applied to ED patients.[11] The one ED-based scoring system, the Mortality in Emergency Department Sepsis score (MEDS), was designed for ED septic patients[12,13] however, it is said to be inaccurate in severely ill patients.[14] Previous investigators have determined an association between the organ dysfunction and mortality in ED septic patients.[15] The Sequential Organ Failure Assessment (SOFA) score calculates the number and severity of dysfunction in six organ systems (Pulmonary, coagulation, hepatobiliary, cardiovascular, renal, and neurologic).[16]The Sepsis III definitions have introduced a new diagnostic tool termed the Quick Sequential Organ Failure Assessment (qSOFA) which enables rapid risk stratification of septic patients requiring prolonged ICU stay alongwith in hospital death. Patients having high qSOFA scores need further assessment by the SOFA score.[17–19] The surviving sepsis campaign has suggested qSOFA to be used for prognostication only. Further implementation of this within existing guidelines for sepsis is yet to be seen.[20]

Our study aims to compare the qSOFA score and existing SOFA score when applied to severe sepsis & septic shock patients in the ED for prediction of in-hospital mortality in the setting of a tertiary care hospital ED in a low-middle income country.

2. Methods

We conducted a prospective observational cohort study in the ED from October to March 2017. The study was approved by the Ethical Review Committee (ERC) of (4328-EM-ERC-16) and informed consent was exempted. We recruited adult patients presenting to the ED, equal to or above 18 years of age and examined by an ED physician for assessment & fulfillment of the clinical criteria of severe sepsis or septic shock as per the guidelines of the Surviving Sepsis Campaign and were subsequently admitted to the hospital. Patients were considered as having severe sepsis when they fulfilled criteria for sepsis along with signs of acute organ dysfunction or hypoperfusion as defined either by sepsis-induced hypotension (systolic blood pressure (SBP) < 90 mm Hg or mean arterial pressure (MAP) < 70 mm Hg or a SBP decrease > 40 mm Hg or less than two standard deviations below normal for age in the absence of other causes of hypotension), serum lactate above upper limits normal, urine output < 0.5 mL/kg/h for more than 2 h despite adequate fluid resuscitation, acute lung injury (ALI) with PaO2/FIO2 < 250 in the absence of pneumonia as infection source, ALI with PaO2/FIO2 < 200 in the presence of pneumonia as infection source, serum creatinine > 2.0 mg/dL (176.8 μmol/L), total bilirubin > 2 mg/dL (34.2 μmol/L), platelet count < 100,000 μL or coagulopathy (international normalized ratio > 1.5). Patients were considered having septic shock when they fulfilled criteria for severe sepsis with the presence of hypotension (systolic blood pressure < 90 mm Hg) despite adequate fluid resuscitation.[21]

Patients who were below 18 years of age, pregnant, dead on arrival to the ED, suffered multiple trauma injuries, underwent major surgery in previous 30 days before ED arrival or had preexisting do-not- resuscitate orders were excluded. A sample size of 1267 subjects was calculated after achieving 80% power to detect a difference of −0.130 between two diagnostic tests whose sensitivities are 0.550 and 0.680. This procedure used a two-sided McNemar test with a significance level of 0.05. The prevalence of disease in the population is 0.090. The proportion of discordant pairs is 0.230. Eligible patients were be identified by daily review of ED census sheets and data collection was performed by trained research assistants. We recorded the date of visit, demographic data, vital sign parameters, severity of sepsis, diagnosis and focus of infection, comorbidity, lactate results, items of the qSOFA and SOFA score. The diagnosis of severe sepsis and septic shock was made by the treating ED physician when the patient was seen in the ED. Investigators calculated the qSOFA and the SOFA score of patients on

Table 1
Baseline characteristics.

Variables	Severe sepsis n = 421 (53.9%)	Septic Shock n = 339 (46.1%)
Socio-demographics:		
Age (Mean ± SD in years)	59.6 ± 17.2	60.2 ± 17.9
Gender [N(%)]		
Male	242 (57.5)	196 (57.7)
Female	179 (42.4)	143 (42.2)
Comorbids:		
Malignancy [N(%)]		
No	386 (91.7)	296 (87.4)
Yes	35 (8.2)	43 (12.6)
Cardiovascular [N(%)]		
No	202 (48.7)	173 (51.1)
Yes	219 (51.2)	166 (48.9)
Diabetes [N(%)]		
No	185 (44.0)	172 (50.7)
Yes	236 (56.0)	167 (49.2)
Neurological [N(%)]		
No	366 (87.0)	298 (88)
Yes	55 (12.2)	41 (12.0)
Congestive heart failure [N(%)]		
No	17 (3.9) 404 (96.1)	20 (5.8)
Yes	404 (96.1)	319 (94.2)
Psychiatric illness [N(%)]		
No	419 (99.5)	337 (99.4)
Yes	2 (0.5)	2 (0.6)
Others comorbidities [N(%)]		
No	396 (94)	292 (86)
Yes	25 (5.9)	47 (13.8)
Lower Respiratory tract infection [N (%)]		
No	234 (56)	128 (37.7)
Yes	187 (44)	211 (62.2)
Urinary tract infection [N(%)]		
No	158 (77.0)	271 (80.0)
Yes	47 (22.9)	68 (20.0)
Gastrointestinal infection [N(%)]		
No	320 (76.1)	283 (83.4)
Yes	101 (23.9)	56 (16.5)
Skin/Joint infection [N(%)]		
No	365 (86.9)	315 (93.1)
Yes	56 (13.1)	24 (7.0)
Hepatobiliary infection [N(%)]		
No	412 (97.9)	329 (97.1)
Yes	9 (2.11)	10 (2.86)
Other sources [N(%)]		
No	382 (90.7)	325 (95.8)
Yes	39 (9.27)	14 (4.0)
Unit of admission [N(%)]		
Special care unit	370 (88.8)	136 (40.0)
Intensive care unit	51 (12.1)	203 (60.0)
SOFAparameters:		
Lactate (Mean ± SD in mmol/L)	2.9 ± 2.79	4.2 ± 3.7
PaO2/FiO2 ratio in mmHg [N(%)]		
0	49 (11.6)	20 (5.8)
< 400 = +1	215 (51.0)	114 (33.6)
< 300 = +2	104 (24.7)	84 (24.7)
< 200 & mechanically ventilated = +3	49 (11.6)	90 (26.6)
< 100 & mechanically ventilated = +4	4 (0.95)	31 (9.2)
Platelets ($\times 10^3$/μL) [N(%)]		
0	310 (73.6)	190 (56.0)
< 150 = +1	55 (13.0)	81 (24.0)
< 100 = +2	33 (7.8)	31 (9.1)
< 50 = +3	18 (4.39)	27 (8.0)
< 20 = +4	5 (1.18)	10 (2.9)
GCS [N(%)]		
0	111 (26.3)	42 (12.3)
+1	238 (56.5)	193 (57.1)
+2	47 (11.2)	66 (19.4)
+3	20 (4.8)	29 (8.5)
+4	4 (0.98)	9 (2.8)
Total bilirubin in mg/dl [N(%)]		
0	304 (72.2)	201 (59.4)
1.2–1.9 = +1	55 (13.0)	66 (19.4)
2–5.9 = +2	31 (7.3)	42 (12.5)

(*continued on next page*)

Table 1 (*continued*)

Variables	Severe sepsis n = 421 (53.9%)	Septic Shock n = 339 (46.1%)
6–11.9 = +3	18 (4.2)	12 (3.5)
> 12 = +4	13 (3.0)	18 (5.3)
MAP or administration of vasopressin mics/kg/min [N(%)]		
No hypotension = 0	170 (40.4)	33 (9.7)
MAP < 70 mmHg = +1	127 (30.2)	58 (17.1)
Dopamine ≤5 or dobutamine (any dose) = +2	16 (3.9)	7 (2.2)
Dopamine > 5 OR epinephrine ≤0.1 OR norepinephrine ≤ 0.1 = +3	99 (23.5)	163 (48)
Dopamine > 15 OR epinephrine > 0.1 OR norepinephrine > 0.1 = +4	9 (1.9)	78 (22)
Creatinine in mg/dl [N(%)]		
< 1.2 = 0	100 (23.9)	66 (19.4)
1.2–1.9 = +1	85 (20.9)	81 (24.0)
2.0–3.4 = +2	57 (29.2)	101 (29.7)
3.5–4.9 = +3	124 (12.2)	46 (13.7)
> 5.0 = +4	55 (13.6)	45 (13.1)
SOFA score [N(%)]		
0 to 6 = < 10% mortality	240 (57.0)	70 (20.5)
7 to 9 = 15–20% mortality	125 (29.7)	130 (38.2)
10 to 12 = 40–50% mortality	46 (10.7)	83 (24.5)
13 to 14 = 50–60% mortality	6 (1.46)	34 (10.2)
15 = > 80% mortality	2 (0.5)	2 (0.57)
15 to 24 = > 90% mortality	2 (0.5)	20 (5.7)
qSOFA parameters:		
New/worsened altered mentation [N(%)]		
No	199 (47.3)	99 (29.1)
Yes (+1)	222 (52.6)	240 (70.8)
RR ≥ 22breaths/min [N(%)]		
No	137 (32.6)	64 (18.8)
Yes (+1)	284 (67.4)	142 (81.1)
SBP ≤ 100 mmHg [N(%)]		
No	220 (52.2)	64 (18.8)
Yes (+1)	201 (47.8)	275 (81.1)
qSOFA risk/score [N(%)]		
Low (1)	183 (43.4)	52 (15.4)
High (> 1)	238 (56.5)	287 (84.6)
Mortality [N(%)]		
No	280 (66.6)	131 (38.8)
Yes	141 (33.3)	208 (61.2)

arrival in ED. The patients were subsequently followed for their in hospital stay for all-cause mortality. Collected data was analyzed in SPSS version 19. Descriptive data was reported as mean and median for quantitative and proportions for qualitative data. The qSOFA, SOFA score and in-hospital mortality was assessed by area under the receiver operating curve (AUROC).

3. Results

We were able to achieve a calculated sample size of 760 patients due to limitation of resources therefore we decided to proceed with data analysis.

Table 1 shows that the mean age of participants was 59.6 + 17.2 years among the severe sepsis group and was 60.2 + 17.9 years among the septic shock group. Urinary tract infections were reported in majority septic shock patients compared to gastrointestinal infections reported in severely septic patients. The majority of septic shock patients (60%) were admitted to the Intensive care unit while 88.8% of severe sepsis patients were admitted to Intermediate care units. The mean lactate value among the severe sepsis group was 2.9 + 2.79 mmol/L and 4.2 + 3.7 mmol/L among the septic shock group. The proportion of death among participants with severe sepsis was 33.3% and it was observed to be even higher among subjects with septic shock i.e. 61.2%.

Overall the SOFA score was highest among subjects with septic shock. However, a higher proportion of subjects (84.5%) with septic shock scored as high risk on qSOFA when compared to subjects with severe sepsis.

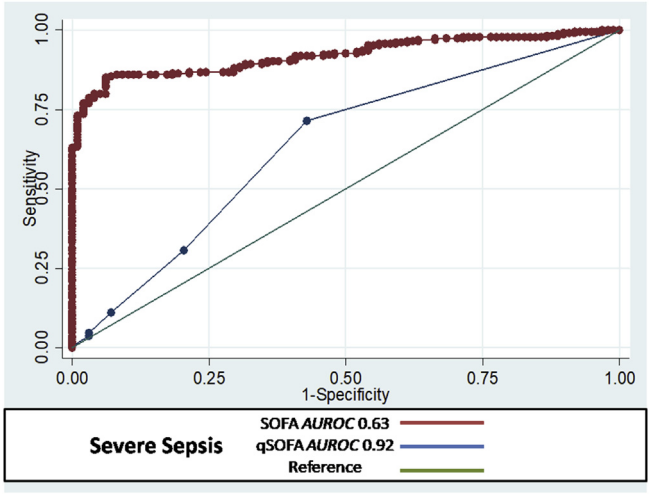

Fig. 1. QSOFA score in severe sepsis AUROC = 0.92 with 95% CI; 0.89–0.94, sensitivity = 96% and specificity = 87%. And SOFA score in severe sepsis AUROC = 0.63 with 95% CI; 0.55–0.70, Sensitivity = 71%, Specificity = 57%.

In patients with severe sepsis, the AUROC cutoff of qSOFA for predicting mortality in subjects was 0.92 (95% CI; 0.89–0.94) with 96% sensitivity and 87% specificity in comparison to the AUROC cutoff of SOFA score which was 0.63 (95% CI; 0.55–0.70 with 71% sensitivity and 57% specificity (Fig. 1). In patients with septic shock, the AUROC cutoff of qSOFA for predicting mortality in subjects was 0.89 (95% CI; 0.85–0.92) with 92% sensitivity and 85% specificity in comparison to the AUROC cutoff of SOFA score which was 0.63 (95% CI; 0.55–0.70 with 70% sensitivity and 59% specificity (Fig. 2).

The results confirm that the model for qSOFA appears well calibrated and has adequate discriminative ability indicating its clinical applicability.

4. Discussion

Our study evaluated and compared performance of the qSOFA score and SOFA in septic ED patients from a low to middle income country with a high reported severity of illness and mortality than quoted locally[3,22] as well as those from high income nations.[17]

The utility of qSOFA has been established in numerous instances within and outside the intensive care unit setting.[17,23] Through our

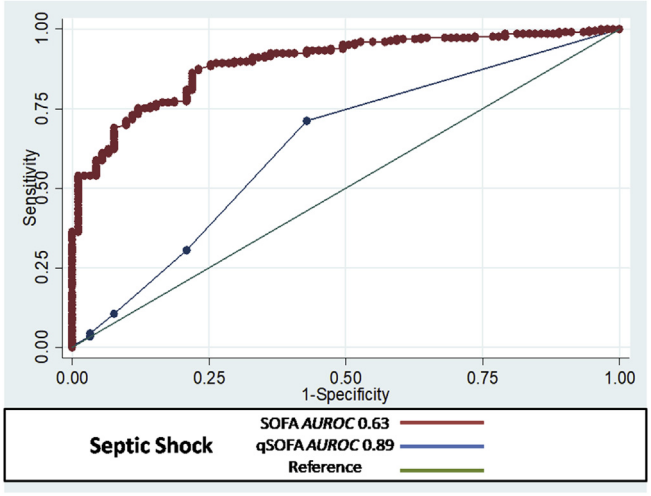

Fig. 2. QSOFAscore in septic shock AUROC = 0.89 with 95% CI; 0.85–0.92, sensitivity = 92% and specificity = 85%. and SOFA score in septic shock AUROC = 0.63 with 95% CI; 0.55–0.70, Sensitivity = 70%, Specificity = 59%.

study, we established that qSOFA was reported high (> 1 parameters which are Altered mentation, Systolic Blood Pressure and Respiratory rate) in accordance with the severity of sepsis with cumulative values of 56.5% in severe sepsis and 84.6% in septic shock patients. This is in contrast to prior literature, examples include one study that validated the qSOFA outside the ICU setting concluded with a low sensitivity identified in septic patients in pre-hospital setting.[24]Churpek et al. found that only 9% of the 30,667 patients admitted to an ED or a ward with defined infection suspicion had a qSOFA ≥2 at time of suspicion of infection[25] and the qSOFA only had 29.9% sensitivity for detecting organ dysfunction according to the sepsis-3 definition in an Australian ED.[26]

Although, it has been reported previously that the discriminative ability of qSOFA is better than SIRS (qSOFA AUROC of 0.81 compared to SIRS AUROC of 0.76),[23]a recent retrospective study conducted in multicenter ICUs showed that the predictive ability for determining mortality of the qSOFA score is inferior to SOFA score with AUROC of 0.75 and 0.60 respectively.[27] We were able to demonstrate that qSOFA score has better discriminative ability than SOFA score in assessing mortality in our ED septic patients. In patients with severe sepsis, the AUROC for predicting mortality was higher for qSOFA score (AUROC cutoff = 0.92 with 95% CI; 0.89–0.94, sensitivity = 96% and specificity = 87%) when compared to SOFA score (AUROC cutoff = 0.63 with 95% CI; 0.55–0.70, Sensitivity = 71%, Specificity = 57%). Similarly, in patients with septic shock, the AUROC for predicting mortality was greater for qSOFA score (AUROC cutoff = 0.89 with 95% CI; 0.85–0.92, sensitivity = 92% and specificity = 85%) when compared to SOFA score (AUROC cutoff = 0.63 with 95% CI; 0.55–0.70, Sensitivity = 70%, Specificity = 59%).

4.1. Limitations

Prospective larger multicenter studies in LMIC settings are needed to validate our results. We were not able to achieve our desired sample size therefore further studies are required. Secondly, our study included more critically-ill septic patients therefore our results may be limited in the application to all septic patients in EDs. The consequences of high predictive performance of qSOFA than SOFA are useful in our setting as this tool allows for rapid bedside analysis with indication for immediate therapy. However, we believe that there is a significant delay in our septic patients for receiving appropriate medical attention and it may be because of this lead time bias that we may be dealing with a sicker cohort of patients that demonstrated higher scoring values.

5. Conclusion

From our study, qSOFA score appears to be an effective tool at predicting in hospital mortality in comparison to SOFA score when applied to severe sepsis and septic shock patients in the setting of a tertiary care hospital ED of a low-middle income country. However, it is still necessary to rigorously evaluate its applicability in settings outside the ICU environment before concluding its utility beyond what it was designed for.

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