

# The quick sequential organ failure assessment score for predicting outcome in patients with sepsis and evidence of multiorgan failure at the time of emergency department presentation

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## Abstract

**Background:** Sepsis is defined as a life-threatening organ dysfunction due to an inflammatory immune response triggered by an infection. In 2016, a shortened sequential organ failure assessment score (SOFA score), known as the quick SOFA (qSOFA) score, replaced the systemic inflammatory response syndrome (SIRS) system of diagnosis.

**Objective:** The aim of our work was to investigate the validity of qSOFA in predicting the outcome of patients with sepsis in the emergency department (ED).

**Methods:** This prospective comparative study was conducted on 100 patients from August 2017 to August 2018, with sepsis and evidence of multi-organ failure (MOF) at the time of emergency department presentation, who was admitted to the critical care department, Cairo University, Egypt, to evaluate the qSOFA score for predicting outcome in septic patients.

**Results:** The mean age of all patients was 67.55±13.3 years and the majority (74%) of pa-

tients were males. The predominant cause of sepsis was pneumonia (87%). Multiple regression analysis showed that qSOFA at day-0 had an independent effect on increasing organ dysfunction ( $p<0.05$ ).

The overall mortality was 32%. By using receiver operating characteristic (ROC) curve analysis, qSOFA score at day-0 predicted patients' mortality with poor accuracy (sensitivity=43% and specificity=70%) ( $p=0.042$ ). SOFA score at day-1 predicted patients' mortality with good accuracy (sensitivity=84% and specificity=76%) ( $p<0.01$ ). The Acute Physiology and Chronic Health Evaluation II (APACHE II) score predicted patients' mortality with good accuracy (sensitivity=87% and specificity=72%) ( $p<0.01$ ).

**Conclusion:** qSOFA at admission is a useful predictor of sepsis and evidence of multi-organ failure in critically ill patients in ED. qSOFA had poor sensitivity and moderate specificity for short-term mortality.

**Key words:** APACHE II, mortality, qSOFA, sepsis, SOFA.

## Introduction

Sepsis is one of the oldest, costliest, and most devastating medical conditions in the world. (1) Sepsis was first described in ancient Egypt almost 5,000 years ago and given its current name by the Greek

physician Hippocrates about 2,400 years ago. (1) Sepsis is a clinical syndrome characterized by systemic inflammation due to infection. There is a continuum of severity ranging from sepsis to septic shock. Although wide-ranging and dependent upon the population studied, mortality has been estimated to be  $\geq 10$  percent, and  $\geq 40$  percent when shock is present. (2)

In 1992, a conference was held by the Society of Critical Care Medicine and the American College of Chest Physicians to address the lack of consensus regarding the definition of sepsis and the difficulties this created in studies and treatment. This conference and its outcomes are now referred to as sepsis-1. This was followed by sepsis-2 in 2002 and sepsis-

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3 in 2016.

The sepsis-1 conference also established four clinical stages or steps. Each stage had specific clinical indicators as well their challenges for healthcare providers.

The first stage is systemic inflammatory response syndrome (SIRS) and is defined by the presence of at least two of the following four indicators: (1) a body temperature above 38.0 °C or below 36.0 °C, (2) a heart rate above 90 beats/minute, (3) a respiratory rate above 20 breaths/minute, (4) a white blood cell counts higher than 12,000 or lower than 4,000 cells/microliter, or >10% immature bands. (3) The sepsis-3 task force recognized sepsis as more complex than infection and inflammation, and defined sepsis as a “life-threatening organ dysfunction due to a dysregulated host response to infection. (2) Organ dysfunction is defined as an increase in the Sequential Sepsis Organ Assessment (SOFA) score of 2 or more points for patients in the intensive care unit (ICU). A new bedside score, termed quick SOFA (qSOFA), was developed to describe organ dysfunction in non-ICU patients. Patients require at least two of the following qSOFA criteria to be diagnosed as having sepsis: respiratory rate of 22 per minute or greater, altered mentation, or systolic blood pressure of 100 mmHg or less. (4)

### Patients and method

This was a prospective comparative study conducted on 100 patients from August 2017 to August 2018 with sepsis and evidence of multi-organ failure (MOF) at the time of emergency department (ED) presentation, who were admitted to the critical care department, Cairo University, Egypt. The study was to evaluate the qSOFA score for predicting outcomes in septic patients.

Inclusion criteria:

- Age > 18 years.
- Suspected or confirmed infection.
- Two or more systemic inflammatory response syndrome criteria.
- Quick SOFA criteria.

Exclusion criteria:

- Age < 18 years.
- Pregnancy.
- Advanced comorbidity.
- Terminal malignancy.

The following data were recorded from all patients and included in the study:

- Personal data, medical history.
- Routine laboratory tests include kidney function test, liver function test, coagulation profile (prothrombin concentration, international normal-

ized ratio [INR], partial thromboplastin time [PTT]), arterial and central venous blood gases, and serum lactate.

- The qSOFA score (day-0 and day-1).
- The SOFA score (day-1, day-3, and day-7).
- The acute physiology and chronic health evaluation II (APACHE II) (day-0).

Statistical analysis: Data entry, processing, and statistical analysis were carried out using MedCalc ver. 18.2.1 (MedCalc, Ostend, Belgium). Tests of significance (Mann-Whitney's, Wilcoxon's, Friedman's, chi-square tests, logistic and multiple regression analysis, Spearman's correlation, receiver operating characteristic [ROC] curve analysis, and Kaplan-Meier survival analysis) were used. Data were presented and suitable analysis was done according to the type of data (parametric and non-parametric) obtained for each variable. p values less than 0.05 (5%) were considered to be statistically significant.

### Results

In our study, the mean age of all patients was 67.55±13.3 years. Regarding the gender of the patients, the majority (74%) of patients were males.

As regards the comorbid conditions, 53% of the studied patients had hypertension (HTN), 57% had diabetes mellitus (DM), 32% had ischemic heart disease (IHD), 16% had atrial fibrillation (AF), 18% had an old cerebrovascular stroke (CVS), 5% had peripheral vascular disease (PVD), 17% had chronic kidney disease (CKD), 6% had chronic liver disease (CLD), 13% had chronic obstructive pulmonary disease (COPD), 31% had central nervous system (CNS) disease, 12% had diabetic foot, and 16% had bedsores (**Figure 1**).

Regarding the source of infection, the chest infection source and urinary tract infection (UTI) source were the highest in frequency in our study (**Table 1**).

#### Predictor parameters

**Table 2** shows the median value of each baseline and follow-up predictor. There was a marked decline in qSOFA median value on day-1, and there was a stationary in SOFA median value till the 3rd day then it slightly declined on day-7 (**Figure 2**).

#### Outcome data

**Table 3** regarding outcome data. The overall mortality was 32%, with the median value of organ dysfunction of 2 organs.

#### Comparative studies

There was a significant increase in age in the non-

survivor group compared to the survivor group with a significant statistical difference ( $p=0.036$ ). There was a non-significant difference in regard to the gender of the patients ( $p>0.05$ ) (**Table 4**).

There was a significant decrease in systolic blood pressure (SBP), diastolic blood pressure (DBP), and Glasgow coma scale (GCS) in the non-survivor group compared to the survivor group with a highly significant statistical difference ( $p<0.05$ , respectively) (**Table 5**).

There was a highly significant decrease in IHD, CVS, and COPD in the non-survivor group compared to the survivor group with a highly significant statistical difference ( $p<0.05$ , respectively). There was a non-significant difference as regards all the remaining co-morbidities ( $p>0.05$ ) (**Table 6**).

Comparison between the 2 groups as regards source of infection there was a non-significant difference as regards all sources of infection ( $p>0.05$ ) (**Table 7**).

There was a highly significant decrease in hemoglobin, hematocrit, platelets with a highly significant statistical difference ( $p<0.01$ , respectively), and there was a significant increase in lactate, urea, creatinine, and bilirubin with a highly significant statistical difference ( $p<0.05$ , respectively) in the non-survivor group compared to survivor one (**Table 8**).

#### *Predictor parameters*

There was a significant increase in baseline and follow-up predictor parameters (APACHE II, SOFA, qSOFA scores) in the non-survivor group compared to the survivor group with a highly significant statistical difference ( $p<0.01$ , respectively) (**Table 9**).

#### *Outcome data*

There was a significant increase in organ dysfunction and ICU duration in the non-survivor group compared to the survivor group (**Table 10**).

#### *Correlation studies*

Correlation studies between mortality and organ dysfunction outcomes and their relative independent predictors will be conducted with multiple, logistic regression analyses and Spearman's correlation coefficient (as suitable) (**Table 11**).

Regarding predictor factors:

- Spearman's correlation analysis shows that organ dysfunction had a significant positive correlation with baseline APACHE II, SOFA at day-1 (SOFA-1), and qSOFA on admission (qSOFA-0) scores with a highly significant statistical difference ( $p<0.01$ , respectively).
- Spearman's correlation analysis shows that organ dysfunction had a significant positive corre-

lation with follow-up SOFA at day-3 (SOFA-3), SOFA at day-7 (SOFA-7), and qSOFA at day-1 (qSOFA-1) scores with a highly significant statistical difference ( $p<0.01$ , respectively).

Multiple regression analysis shows that the increase in creatinine, APACHE II, SOFA-1, qSOFA-0, and SOFA-3 scores had an independent effect on increasing organ dysfunction with a significant statistical difference ( $p<0.05$ , respectively) (**Table 12**).

Logistic regression analysis shows that the increase in APACHE II, qSOFA-1 scores, and ICU duration had an independent effect on increasing the probability of mortality occurrence with a significant statistical difference ( $p<0.05$ , respectively) (**Table 13**).

#### *ROC curve analysis to predict mortality (Figure 3 and Table 14)*

Regarding APACHE II predictor:

- By using ROC curve analysis, baseline APACHE II score at a cutoff point  $>16$  predicted patient mortality with good accuracy (sensitivity=87% and specificity=72%) ( $p<0.01$ ).

Regarding qSOFA predictor:

- By using ROC curve analysis, qSOFA-0 score at a cutoff point  $>2$  predicted patient mortality with poor accuracy (sensitivity=43% and specificity=70%) ( $p=0.042$ ).

Regarding SOFA predictor:

- By using ROC curve analysis, baseline SOFA-1 score at a cutoff point  $>6$  predicted patient mortality with good accuracy (sensitivity=84% and specificity=76%) ( $p<0.01$ ).

#### **Discussion**

Sepsis is a fatal syndrome with dire consequences. (5) It progresses rapidly and the delay in its identification and treatment can cause higher mortality. (6) Many clinical scoring systems measure the disease severity in the septic population. Many of these scores are time-consuming and require information that is not readily available. (7) The scoring systems currently used to predict mortality in the critically ill were validated mainly on populations of ICU patients. APACHE II score is the world's most widely used severity of illness score that includes 12 physiological variables collected during the first 24 hours of ICU stay, age, and a measure of chronic health status. (8) In several ICU populations, it demonstrates good prognostic accuracy for predicting in-hospital mortality. (9)

The SOFA score is based on commonly available clinical and laboratory parameters to evaluate the severity of individual organs damage (platelets, Glasgow coma scale, mean arterial pressure, creati-

nine, partial pressure of arterial oxygen [PaO<sub>2</sub>]/fraction of inspired oxygen [FiO<sub>2</sub>] ratio, and bilirubin) and it is easily assessed at the bedside, and it may be calculated several times during the patients' in-hospital stay. This score demonstrated a good ability to predict a bad outcome within 24 hours from ED admission. (10) However, because of a lack of familiarity with SOFA outside of the ICU, and because SOFA requires laboratory values that may not be rapidly available, the quick SOFA score was developed to provide an abbreviated version that can easily be performed at the bedside by the non-specialist. (7)

In our study, we aimed to investigate the validity of qSOFA in predicting the outcome of patients with sepsis in the ED. We found that the mean age of all patients was 67.55±13.3 years and the majority (74%) of patients were males, which came in concordance with Martin et al who found that men were more likely than women to develop sepsis. However, it is not clear whether this difference could be due to a higher prevalence of comorbidities in men, or whether women are protected against the inflammatory changes that occur in severe sepsis and septic shock. (11)

In our study, the overall mortality was 32%, which came in concordance with Levy et al who found that 25375 patients fulfilled the cohort description and were analyzed from the database. The overall hospital mortality was 32% (8032 of 25375 patients died) (12) and in discordance with Raith et al who found that 34578 patients (18.7%) died in the hospital. (13) In our study the predominant cause of sepsis was pneumonia (87%), which came in concordance with Raith et al who reported bacterial pneumonia was listed as the most common diagnosis among 32634 patients (17.7%). (13) Concordance to Levy et al, the predominant cause of severe sepsis was pneumonia, 8589 (45.8%) patients in USA and 2986 (45.2%) patients in Europe. (12)

In our study, the earliest qSOFA, SOFA, and APACHE II scores represented baseline severity of illness, while the change in qSOFA and SOFA scores reflected events during hospitalization, such as clinical deterioration or inadequate response to therapeutic interventions.

Our results revealed that organ dysfunction had a significant positive correlation with baseline APACHE II, SOFA-1, and qSOFA-0 scores with a highly significant statistical difference ( $p < 0.01$ , respectively). Our results were concordant with Wang et al who reported that the average values of APACHE II, SOFA, and qSOFA scores were considerably higher in non-survivors than survivors ( $p < 0.001$ ). (14)

In the present study, there was a highly significant decrease in COPD in the non-survivor group ( $p < 0.05$ ), which came in concordance with Wang et al who reported the incidence of COPD was higher among survivors than non-survivors (17.6% vs 14.5%,  $p < 0.05$ ). (14) Our results were concordant with the study done by Bai et al, which reported that initial serum lactate levels and APACHE II scores were significantly higher in the non-survivors than in the survivors. (15)

In the present study, the area under the curve (AUC) of qSOFA, APACHE II, and SOFA scores at admission in predicting mortality on day 1 were 0.617, 0.835, and 0.874, respectively. From ROC curve analysis, qSOFA score at admission at a cutoff point  $> 2$  predicted mortality with poor accuracy (sensitivity=43.75% and specificity=70.59%) ( $p = 0.042$ ). The AUC of qSOFA score at admission in predicting mortality was lower than APACHE II and SOFA scores on day-1. The AUC of SOFA score on day-1 in predicting mortality was higher than APACHE II with sensitivity and specificity of 84.37% and 87.50%, and 76.47% and 72.06%, respectively. According to Seymour et al, qSOFA score was developed to predict the likelihood of organ dysfunction in patients with suspected infection. When initially introduced, qSOFA was reported to have an AUC of 0.81 for predicting 1-month mortality. (4)

In the study conducted by Shahsavarinia et al, regarding the evaluation of the validity of qSOFA in early detection and risk stratification of 140 septic patients in the emergency department, the ROC curve of the study regarding the prediction of outcome with qSOFA showed an AUC of 0.59 ( $p = 0.04$ ), the sensitivity of qSOFA for detection of sepsis was 66.3% with a specificity of 60.6%. The negative predictive value and positive predictive value for qSOFA in sepsis detection were 35.7% and 84.5%, respectively, based on the clinical diagnostic statement by surviving sepsis campaign. (16) He concluded that in patients with suspected sepsis, qSOFA has an acceptable value for risk stratification of severity, multi-organ failure, and mortality. It seems that the education of medical staff and frequent screening of patients for warning signs can help to increase the value of qSOFA in the prediction of mortality in critically ill septic patients. (16) According to Gando S. et al in a study performed on emergency department patients with suspected infection, the SIRS criteria were significantly more accurate in predicting an established infection. These results may suggest that the qSOFA score can be replaced with the SIRS criteria as a screening tool for infection likely to progress to sepsis. Alter-

natively, the combined application of both the SIRS criteria and qSOFA score in patients with suspected of having infection may improve the screening and prognostic accuracy of these factors for predicting infection and/or sepsis and a poor outcome. (17)

The study conducted by Wattanasit and Khwannimit found that early warning scores, qSOFA, and SIRS were not likely to be useful for detecting sepsis and predicting hospital admission and in-hospital mortality. Modifying the scores or adding new parameters such as biomarkers may lead to the development of clinical useful scoring systems in the future. (18)

In the study conducted by Loritz et al, the qSOFA score has poor sensitivity to identify patients at risk of developing sepsis and can therefore not be considered as an adequate screening for sepsis in patients presenting to the ED. Furthermore, a positive qSOFA at arrival at the ED showed no sufficient reliability in detecting patients with adverse clinical course. (19)

According to Klimpel et al, which investigated the predictive values of the qSOFA score and the SOFA score regarding hospital admission, the SOFA score was the better predictor of ICU admission. (20)

The study conducted by Li Y. et al reported that SOFA score, and qSOFA score, could be used to predict the prognosis of septic patients. So, this study found that the SOFA score had higher accuracy than the qSOFA score, however, qSOFA was simpler to use, making it a more suitable tool in an emergency setting. (21)

In the study conducted by Thapa et al on 156 patients, the AUC of SOFA score and qSOFA for predicting mortality were 0.978 and 0.886 with a sensitivity of 96.9% and specificity of 57% for SOFA, and sensitivity of 96.9% and specificity of 76.1% for qSOFA. Both SOFA and qSOFA could be used as a tool in predicting mortality among septic patients presenting to the ED in resources limited countries. (22)

According to Ronson et al, the systematic review of 45 studies with 413,634 patients showed that the AUC of qSOFA for the in-hospital mortality in all patients (with or without suspected infection) was poor, and it showed that it was not suitable for routine clinical use. qSOFA was not a clinically useful prognostic tool for in-hospital, 1-month mortality, or ICU admission for all-comers, with or without suspected infection. (23) Fernando et al found that qSOFA had poor sensitivity and moderate specificity for short-term mortality. The SIRS criteria had sensitivity superior to that of qSOFA, supporting

their use for screening of patients and as a prompt for treatment initiation. (24)

The study conducted by Khwannimit et al reported that the SOFA was a superior prognostic tool for predicting mortality and organ failure than qSOFA and SIRS criteria among septic patients admitted to the ICU. The SOFA score presented the best discrimination with an AUC of 0.839. The AUC of SOFA score for hospital mortality was significantly higher than qSOFA (AUC 0.814,  $p=0.003$ ) and SIRS (AUC 0.587,  $p<0.0001$ ). (25)

The study conducted by Song et al reported that the prognostic performance of positive qSOFA scores had a sensitivity of 0.51 and a specificity of 0.83 for in-hospital mortality. A positive qSOFA score had high specificity but poor sensitivity for predicting in-hospital mortality, acute organ dysfunction, and ICU admission in patients with infection outside the ICU. Therefore, a positive qSOFA score seemed limited in identifying early poor outcomes in these patients in routine clinical practice. (26) The study conducted by Baig et al reported that the qSOFA score appeared to be an effective tool for predicting in-hospital mortality in comparison to the 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, (27) which came in discordance with our study.

### Limitations

The limitations of the present study were as follows. First, it was a single-center prospective study, and the available variables were limited. Larger multi-center prospective studies are needed to validate our results. Second, the enrolled patients had clinically diagnosed infection based on different criteria from either the “old” or “new” definition of sepsis. Third, no organ dysfunction measurements evaluated in this study distinguished between chronic and acute organ dysfunction, assessed whether the organ dysfunction had an explanation other than infection, or attributed dysfunction specifically to a dysregulated host response.

### Conclusion

qSOFA at admission is a useful predictor of sepsis and evidence of multiorgan failure in critically ill patients in ED. qSOFA had poor sensitivity and moderate specificity for short-term mortality. The SOFA is a superior prognostic tool for predicting mortality and organ failure than qSOFA among septic patients admitted to the ICU.

**Table 1.** Sources of infection in the study population

Source of infection	Frequency, n (%)
Chest infection	87 (87%)
Urinary tract infection	40 (40%)
Tissue infection	18 (18%)
Abdominal sepsis	9 (9%)

**Table 2.** Predictor parameters in the study population

Variables	Median
Baseline APACHE II	16
Baseline qSOFA-0	2
Follow up qSOFA-1	1
Baseline SOFA-1	5
Follow up SOFA-3	5
Follow up SOFA-7	4

Legend: APACHE II=Acute Physiology and Chronic Health Evaluation II; qSOFA-0=qSOFA on admission; qSOFA-1=qSOFA on day-1; SOFA-1=SOFA on day-1; SOFA-3=SOFA on day-3; SOFA-7=SOFA on day-7.

**Table 3.** Outcome data in the study population

Variables	Frequency
Mortality rate, n (%)	32 (32%)
Organ dysfunction (number of failed organs), median (range)	2 (1-4)

**Table 4.** Comparison between the 2 groups as regards socio-demographic data using Mann-Whitney U and chi-square tests

Variable	Non-survivor group (n=32)	Survivor group (n=68)	Mann-Whitney U test
	Median (IQR)	Median (IQR)	p value
Age (years)	72 (62.5-81.5)	67 (58-76)	0.036*
Variable	Non-survivor group (n=32)	Survivor group (n=68)	Chi-square test
			p value
Gender, n (%)	Female	9 (28.1%)	0.7409
	Male	23 (71.9%)	

Legend: IQR=interquartile range. \*Percentage of column total.

**Table 5.** Comparison between the 2 groups as regards basic clinical data using Mann-Whitney U test

Variables	Non-survivor group (n=32)	Survivors group (n=68)	Mann-Whitney U test
	Median (IQR)	Median (IQR)	p value
Systolic BP (mmHg)	90 (80-110)	100 (85-120)	0.025*
Diastolic BP (mmHg)	60 (40-60)	60 (50-80)	0.009**
HR (beats/min)	112 (97-130)	110 (98-130)	0.629
Temperature (°C)	37 (37-38.5)	37.8 (37-38.5)	0.440
RR (breaths/min)	25 (25-30)	28 (25-30)	0.817
UOP (cc/hour)	50 (50-100)	50 (50-100)	1.000
CVP (mmHg)	14.5 (8-19)	8 (4-11)	0.00037**
GCS	11.5 (9.5-13)	13 (12-15)	0.00074**

Legend: BP=blood pressure; HR=heart rate; RR=respiration rate; UOP=urin output; CVP=central venous pressure; GCS=Glasgow coma scale; IQR=interquartile range. \*Significant; \*\*Highly significant.

**Table 6.** Comparison between the 2 groups as regards co-morbidities using chi-square test

Variables		Non-survivor group (n=32)	Survivors group (n=68)	Chi-square test
				p value
HTN, n (%)	+ve	14 (43.7%)	39 (57.4%)	0.2059
DM, n (%)	+ve	19 (59.4%)	38 (55.9%)	0.7433
IHD, n (%)	+ve	5 (15.6%)	27 (39.7%)	0.0166*
AF, n (%)	+ve	4 (12.5%)	12 (17.6%)	0.5146
Old CVS, n (%)	+ve	2 (6.2%)	16 (23.5%)	0.036*
PVD, n (%)	+ve	0 (0%)	5 (7.4%)	0.1174
CKD, n (%)	+ve	7 (21.9%)	10 (14.7%)	0.3757
CLD, n (%)	+ve	1 (3.1%)	5 (7.4%)	0.4086
COPD, n (%)	+ve	0 (0%)	13 (19.1%)	0.0083**
CNS diseases, n (%)	+ve	11 (34.4%)	20 (29.4%)	0.6184
Diabetic foot, n (%)	+ve	4 (12.5%)	8 (11.8%)	0.9164
Bed sores, n (%)	+ve	4 (12.5%)	12 (17.6%)	0.5146

Legend: HTN=hypertension; DM=diabetes mellitus; IHD=ischemic heart disease; AF=atrial fibrillation; CVS=cerebrovascular stroke; PVD=peripheral vascular disease; CKD=chronic kidney disease; CLD=chronic liver disease; COPD=chronic obstructive pulmonary disease; CNS=central nervous system. \*Significant; \*\*Highly significant.

**Table 7.** Comparison between the 2 groups as regards source of infection using chi-square test

Source of infection		Non-survivor group (n=32)	Survivor group (n=68)	Chi-square test p value
Urinary tract infection, n (%)	+ve	14 (43.7%)	26 (38.2%)	0.6013
Chest infection, n (%)	+ve	29 (90.6%)	58 (85.3%)	0.4619
Abdominal sepsis, n (%)	+ve	2 (6.2%)	7 (10.2%)	0.8027
Tissue infection, n (%)	+ve	6 (18.8%)	12 (17.6%)	0.8940

**Table 8.** Comparison between the 2 groups as regards laboratory data using Mann-Whitney U and chi-square tests

Variables	Non-survivor group (n=32)	Survivor group (n=68)	Mann-Whitney U test
	Median (IQR)	Median (IQR)	p value
Hb (g/dl)	9.5 (8.9-11.8)	11.7 (9.9-12.8)	0.0087**
HCT (%)	28.6 (25-32.9)	33.8 (29.8-38.2)	0.0031**
TLC ( $10^3/\mu\text{l}$ )	14.9 (9.3-27.8)	15.9 (12-20.2)	0.9293
PLT ( $10^3/\mu\text{l}$ )	185.5 (92.5-306)	291 (176-356)	0.0034**
ESR (mm/h)	30 (0-60)	14.5 (0-82.5)	0.7225
CRP (mg/dl)	227 (42-347.5)	96 (50-281)	0.1831
Lactate (mmol/l)	2.8 (0.9-3.9)	1.8 (0-3.1)	0.035*
Urea (mg/dl)	113.5 (68-149)	75 (47-116)	0.028*
Creatinine (mg/dl)	2.5 (2-3.4)	1.4 (1-2.9)	0.0013**
Bilirubin (mg/dl)	1.2 (0.6-2.9)	0.7 (0.5-1)	0.0025**

Legend: Hb=hemoglobin; HCT=hematocrit; TLC=total leukocyte count; PLT=platelet count; ESR=erythrocyte sedimentation rate; CRP=C-reactive protein; IQR=interquartile range. \*Significant; \*\*Highly significant.

**Table 9.** Comparison between the 2 groups as regards predictor parameters using Mann-Whitney U test

Variables	Non-survivor group (n=32)	Survivors group (n=68)	Mann-Whitney U test
	Median (IQR)	Median (IQR)	p value
Baseline predictors			
- APACHE II	23 (19-26)	14 (12-18)	<0.0001**
- qSOFA-0	2 (2-3)	2 (1-3)	0.034*
- SOFA-1	10.5 (7-12)	5 (3-6)	<0.0001**
Follow up predictors			
- qSOFA-1	2 (2-2)	1 (1-1)	<0.0001**
- SOFA-3	12 (9-15)	4 (2-5)	<0.0001**
- SOFA-7	12 (9.7-14.2)	3 (2-4)	<0.0001**

Legend: APACHE II=Acute Physiology and Chronic Health Evaluation II; qSOFA-0=qSOFA on admission; SOFA-1=SOFA on day-1; qSOFA-1=qSOFA on day-1; SOFA-3=SOFA on day-3; SOFA-7=SOFA on day-7. \*Significant; \*\*Highly significant.

**Table 10.** Comparison between the 2 groups as regards outcome data using Mann-Whitney U test

Variables	Non-survivor group (n=32)	Survivor group (n=68)	Mann-Whitney U test
	Median (IQR)	Median (IQR)	p value
Organ dysfunction (number of failed organs)	4 (3-6)	2 (0-5)	<0.0001*
ICU duration (days)	9 (8-12)	9 (7-10)	0.027*

Legend: ICU=intensive care unit; IQR=interquartile range. \*Highly significant.

**Table 11.** Spearman's correlation analysis for predictor parameters associated with organ dysfunction

Associated factors (predictor parameters)	Organ dysfunction	
	rho	p value
- APACHE II	0.628	<0.0001*
- qSOFA-0	0.440	<0.0001*
- qSOFA-1	0.654	<0.0001*
- SOFA-1	0.809	<0.0001*
- SOFA-3	0.858	<0.0001*
- SOFA-7	0.630	<0.0001*

Legend: APACHE II=Acute Physiology and Chronic Health Evaluation II; qSOFA-0=qSOFA on admission; qSOFA-1=qSOFA on day-1; SOFA-1=SOFA on day-1; SOFA-3=SOFA on day-3; SOFA-7=SOFA on day-7; rho=Spearman's rho (correlation coefficient). \*Highly significant.

**Table 12.** Multiple regression model for the factors predicting organ dysfunction using forward method

Predictor factors	$\beta$	SE	p value
(Constant)	-0.6571		
Creatinine	0.1931	0.07251	0.0096*
APACHE II	0.02211	0.005876	0.0003*
qSOFA-0	0.4977	0.1317	0.0003*
SOFA-1	0.01699	0.005299	0.002*
SOFA-3	0.02914	0.004613	<0.0001*

Legend: APACHE II=Acute Physiology and Chronic Health Evaluation II; qSOFA-0=qSOFA on admission; SOFA-1=SOFA on day-1; SOFA-3=SOFA on day-3; SE=standard error. \*Highly significant.

**Table 13.** Logistic regression model for the factors affecting mortality occurrence using forward method

Predictor factors	Coefficient	SE	p value
(Constant)	-10.59325		
APACHE II	0.13682	0.056761	0.015*
qSOFA-1	3.57138	1.57064	0.023*
ICU duration	1.02492	0.45478	0.024*
SOFA-3	0.12247	0.065270	0.0606

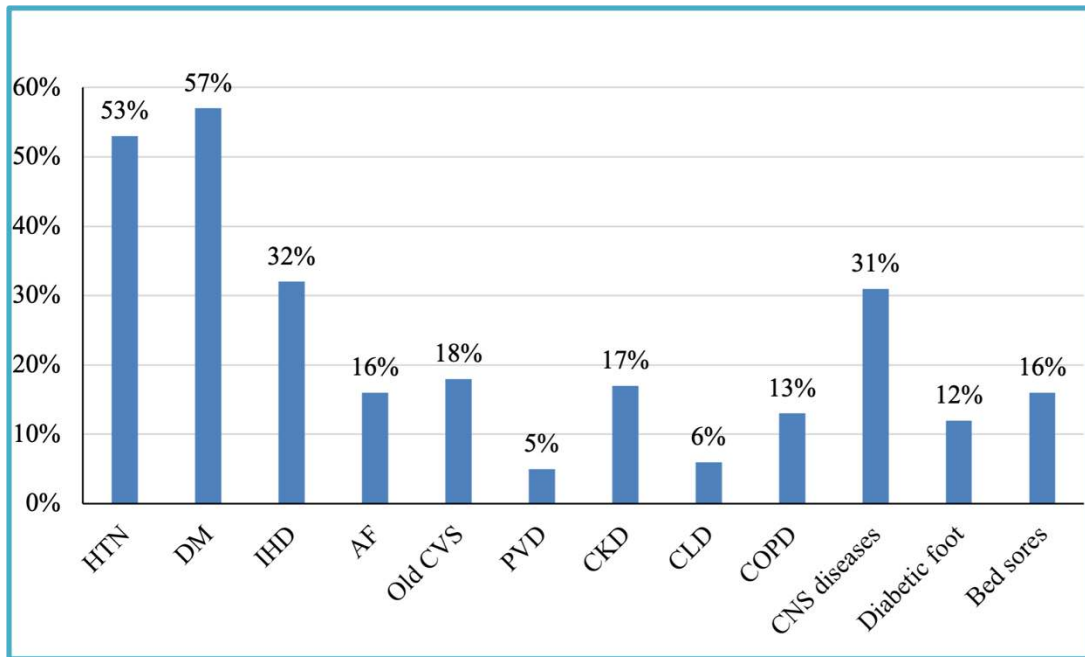
Legend: APACHE II=Acute Physiology and Chronic Health Evaluation II; qSOFA-1=qSOFA on day-1; ICU=intensive care unit; SOFA-3=SOFA on day-3; SE=standard error. \*Significant.

**Table 14.** ROC curve of predictor parameters to predict mortality

Variables	AUC	SE	Best cut off point (criterion)	Sensitivity (%)	Specificity (%)	p value
APACHE II	0.835	0.0475	>16	87.50	72.06	<0.0001**
SOFA-1	0.874	0.0347	>6	84.37	76.47	<0.0001**
qSOFA-0	0.617	0.0576	>2	43.75	70.59	0.042*
qSOFA-1	0.835	0.0444	>1	78.12	86.76	<0.0001**

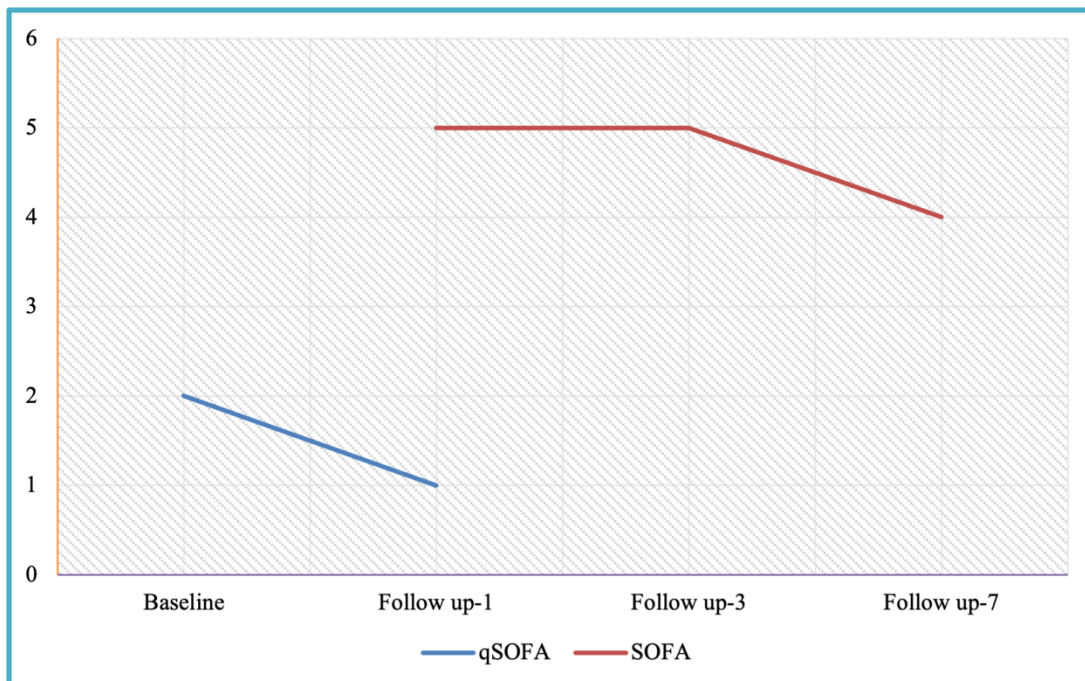
Legend: ROC=receiver operating characteristic; APACHE II=Acute Physiology and Chronic Health Evaluation II; SOFA-1=SOFA on day-1; qSOFA-0=qSOFA on admission; qSOFA-1=qSOFA on day-1; ICU=intensive care unit; AUC=area under the curve; SE=standard error. \*Significant; \*\*Highly significant

**Figure 1.** Co-morbidities among 100 patients



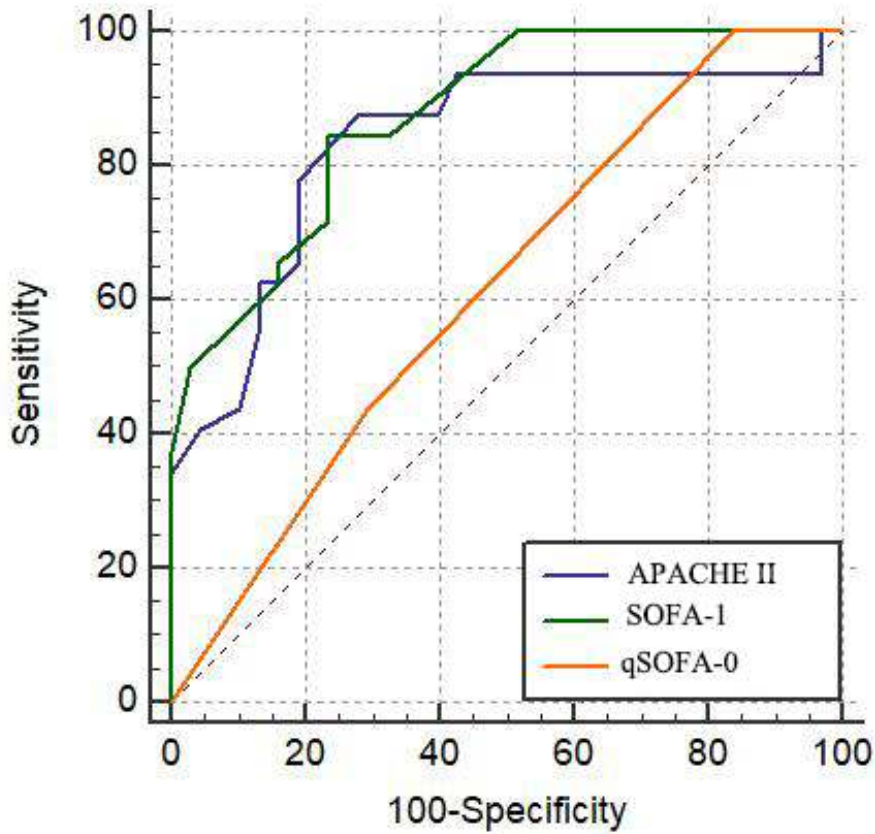
Legend: HTN=hypertension; DM=diabetes mellitus; IHD=ischemic heart disease; AF=atrial fibrillation; CVS=cerebrovascular stroke; PVD=peripheral vascular disease; CKD=chronic kidney disease; CLD=chronic liver disease; COPD=chronic obstructive pulmonary disease; CNS=central nervous system.

**Figure 2.** Predictor parameters trend in the study population



Legend: SOFA=Sequential Sepsis Organ Assessment; qSOFA=quick SOFA.

**Figure 3.** ROC curve of predictor parameters to predict mortality



Legend: ROC=receiver operating characteristic; APACHE II=Acute Physiology and Chronic Health Evaluation II; SOFA-1=SOFA on day-1; qSOFA-0=qSOFA on admission.

## References

1. Botero JSH, Pérez MCF. The History of Sepsis from Ancient Egypt to the XIX Century. In: Azevedo L, editor. *Sepsis - An Ongoing and Significant Challenge*. London: IntechOpen; 2012.
2. Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA* 2016;315:801-10.
3. Bone RC, Balk RA, Cerra FB, Dellinger RP, Fein AM, Knaus WA, et al. Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. The ACCP/SCCM Consensus Conference Committee. American College of Chest Physicians/Society of Critical Care Medicine. *Chest* 1992;101:1644-55.
4. Seymour CW, Liu VX, Iwashyna TJ, Brunkhorst FM, Rea TD, Scherag A, et al. Assessment of clinical criteria for sepsis: for the third international consensus definitions for sepsis and septic shock (sepsis-3). *JAMA* 2016;315:762-74.
5. Russell JA, Walley KR, Singer J, Gordon AC, Hébert PC, Cooper DJ, et al. Vasopressin versus norepinephrine infusion in patients with septic shock. *N Engl J Med* 2008;358:877-87.
6. Rivers EP, Coba V, Whitmill M. Early goal-directed therapy in severe sepsis and septic shock: a contemporary review of the literature. *Curr Opin Anaesthesiol* 2008;21:128-40.
7. Jones AE, Fitch MT, Kline JA. Operational performance of validated physiologic scoring systems for predicting in-hospital mortality among critically ill emergency department patients. *Crit Care Med* 2005;33:974-8.
8. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: A severity of disease classification system. *Crit Care Med* 1985;13:818-29.
9. Vincent J-L, Moreno R. Clinical review: scoring systems in the critically ill. *Crit Care* 2010;14:207.
10. Innocenti F, Bianchi S, Guerrini E, Vicidomini S, Conti A, Zanobetti M, et al. Prognostic Scores for Early Stratification of Septic Patients Admitted to an Emergency Department-High Dependency Unit. *Eur J Emerg Med* 2014;21:254-9.
11. Martin GS, Mannino DM, Eaton S, Moss M. The epidemiology of sepsis in the United States from 1979 through 2000. *N Engl J Med* 2003;348:1546-54.
12. Levy MM, Artigas A, Phillips GS, Rhodes A, Beale R, Osborn T, et al. Outcomes of the Surviving Sepsis Campaign in Intensive Care Units in the USA and Europe: A Prospective Cohort Study. *Lancet Infect Dis* 2012;12:919-24.
13. Raith EP, Udy AA, Bailey M, McGloughlin S, MacIsaac C, Bellomo R, et al. Prognostic Accuracy of the SOFA Score, SIRS Criteria, and qSOFA Score for In-Hospital Mortality Among Adults With Suspected Infection Admitted to the Intensive Care Unit. *JAMA* 2017;317:290-300.
14. Wang J-Y, Chen Y-X, Guo S-B, Mei X, Yang P. Predictive Performance of Quick Sepsis-Related Organ Failure Assessment for Mortality and ICU Admission in Patients with Infection at the ED. *Am J Emerg Med* 2016;34:1788-93.
15. Bai X, Yu W, Ji W, Lin Z, Tan S, Duan K, et al. Early versus Delayed Administration of Norepinephrine in Patients with Septic Shock. *Crit Care* 2014;18:532.
16. Shahsavarinia K, Moharramzadeh P, Arvanagi RJ, Mahmoodpoor A. qSOFA score for prediction of sepsis outcome in emergency department. *Pak J Med Sci* 2020;36:668-72.
17. Gando S, Shiraishi A, Abe T, Kushimoto S, Mayumi T, Fujishima S, et al. The SIRS criteria have better performance for predicting infection than qSOFA scores in the emergency department. *Sci Rep* 2020;10:8095.
18. Wattanasit P, Khwannimit B. Comparison the accuracy of early warning scores with qSOFA and SIRS for predicting sepsis in the emergency department. *Am J Emerg Med* 2021;46:284-8.
19. Loritz M, Busch H-J, Helbing T, Fink K. Prospective evaluation of the quick SOFA score as a screening for sepsis in the emergency department. *Intern Emerg Med* 2020;15:685-93.
20. Klimpel J, Weidhase L, Bernhard M, Gries A, Petros S. The impact of the Sepsis-3 definition on ICU admission of patients with infection. *Scand J Trauma Resusc Emerg Med* 2019;27:98.
21. Li Y, Yan C, Gan Z, Xi X, Tan Z, Li J, et al. Prognostic values of SOFA score, qSOFA score, and LODS score for patients with sepsis. *Ann Palliat Med* 2020;9:1037-44.
22. Thapa S, Upreti AR, Bajracharya R, Lingden BK. Prognostic Accuracy of SOFA Score and qSOFA as a predictor of mortality among sepsis patients presenting to Emergency Department in one of a tertiary Hospital in Kathmandu, Ne-

- pal. Nepal Med Coll J 2020;22:18-21.
23. Lo RSL, Leung LY, Brabrand M, Yeung CY, Chan SY, Lam CCY, et al. qSOFA is a Poor Predictor of Short-Term Mortality in All Patients: A Systematic Review of 410,000 Patients. *J Clin Med* 2019;8:61.
  24. Fernando SM, Tran A, Taljaard M, Cheng W, Rochwerg B, Seely AJE, et al. Prognostic Accuracy of the Quick Sequential Organ Failure Assessment for Mortality in Patients with Suspected Infection: A Systematic Review and Meta-analysis. *Ann Intern Med* 2018;168:266-75.
  25. Khwannimit B, Bhurayanontachai R, Vattanavanit V. Comparison of the performance of SOFA, qSOFA and SIRS for predicting mortality and organ failure among sepsis patients admitted to the intensive care unit in a middle-income country. *J Crit Care* 2018;44:156-60.
  26. Song J-U, Sin CK, Park HK, Shim SR, Lee J. Performance of the Quick Sequential (Sepsis-related) Organ Failure Assessment Score as a Prognostic Tool in Infected Patients Outside the Intensive Care Unit: A Systematic Review and Meta-Analysis. *Crit Care* 2018;22:28.
  27. Baig MA, Sheikh S, Hussain E, Bakhtawar S, Khan MS, Mujtaba S, et al. 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. *Turk J Emerg Med* 2018;18:148-51.