RESEARCH
www.commprac.com
ISSN 1462 2815

COMPARISON OF THE QUICK SEQUENTIAL ORGAN FAILURE ASSESSMENT (qSOFA) AND SIRS SCORES IN PREDICTING IN-HOSPITAL MORTALITY AMONG PATIENTS WITH SEPSIS

Dr. Jinka Venkata Durga Prasad [1], Manickam Senthil Kumar [2], Sudarshan Bandagar [3], T. Pooja Rani [4], Sreelakshmi V K [5], Sai Vineeth [6] and Dr. Melvin Dominic [7]*

[1,4,5,6] Postgraduate, Department of Emergency Medicine,
Vinayaka Missions Kirupanandha Variyar Medical College Hospital,
Vinayaka Missions Research Foundation (Deemed to be University) Salem, Tamilnadu, India.
[2] HOD & Professor, Department of Emergency Medicine,
Vinayaka Missions Kirupanandha Variyar Medical College Hospital,
Vinayaka Missions Research Foundation (Deemed to be University) Salem, Tamilnadu, India.
[3]Specialist physician, Department of Emergency medicine, Madinat Zayed Hospital,
Al Dhafra SEHA, Abu Dhabi.
[7]Associate Professor, Department of Emergency Medicine,
Vinayaka Missions Kirupanandha Variyar Medical College Hospital,
Vinayaka Missions Research Foundation (Deemed to be University) Salem, Tamilnadu, India.
*Corresponding Author Email: dr.melvindominic@gmail.com

DOI: 10.5281/zenodo.10875499

Abstract

Background- Sepsis is defined as a life-threatening organ dysfunction due to a dysregulated response to an infection, and organ dysfunction is defined as an increase in a sequential (sepsis- related) organ failure assessment (SOFA) score of 2 points or more. The concept of SIRS has thus disappeared from this new definition of sepsis. The task force for international consensus definitions for sepsis and septic shock has introduced a new screening tool named quickSOFA (qSOFA) that has a predictive validity superior to that of SOFA and SIRS for in-hospital mortality outside an intensive care unit (ICU). **Objectives-** to determine whether qSOFA has prognostic value when compared to systemic inflammatory response syndrome (SIRS) in predicting in- hospital mortality in patients with a sepsis in an emergency department (ED). **Methods-** It was a retrospective cross-sectional study design conducted at Tertiary Care Hospital 800 bedded capacity, nonprofit, premier teaching hospital offering tertiary level and secondary level healthcare services to the people. The electronic medical records were reviewed for all consecutive adult patients (≥18 years) with a suspected infection. The study period was between March 2021 and February 2022. A total of 750 records were retrieved. SPSS (Version 22.0) was used for analysis. **Results-** The majority were male 559 (77.6%). Non-survivors were older (59 vs. 52 years, P = 0.002). Majority of the patients, 352 (78.2%) came to the critical care units through the emergency department. The most common comorbidity was diabetes mellitus, 123 (27.3%), followed by malignancy, 74 (16.5%). Prediction of in-hospital mortality was significantly higher using qSOFA (AUROC, 0.79 [95% CI, 0.752 to 0.846]) than SIRS (AUROC, 0.69 [95% CI, 0.641 to 0.748]); The sensitivity, specificity, PPV, and NPV of Qsofa with a cutoff value of 1 point for in-hospital mortality were 81%, 50%, 22%, and 92%, respectively. **Conclusion-** qSOFA has a superior ability compared to SIRS in predicting the occurrence of in- hospital mortality patients with a suspected infection. However, given the low sensitivity of qSOFA, further confirmatory tests are needed.

Keywords: SOFA, SIRS, Emergency Department, Sensitivity, Specificity, Sepsis.

INTRODUCTION

Sepsis is a life-threatening condition with organ dysfunction caused by a dysregulated host response to an infection.[1] In 2016, there were an estimated 30 million cases of sepsis and 6 million deaths attributed to sepsis globally.[2] The incidence of sepsis has increased by 8.7% from 1979 to 2000. Sepsis is now the leading cause of critical care mortality. Furthermore, Sepsis survivors have a higher risk for long-term physical,

cognitive and psychosocial morbidity.[3] In view of these, the World Health Organization (WHO) declared sepsis a global health priority in 2017.[4]

Since the 1991 consensus conference, sepsis has been defined as a proven or suspected infection accompanied with two or more systemic inflammatory response (SIRS) criteria.[5] The SIRS criteria has been used to treat and research sepsis for a long time.[6] However, there has been conflicting evidence regarding the value of SIRS,[7] with the SIRS criteria being criticized for having inadequate specificity and sensitivity.[8]

In March 2016, the third international consensus definition for sepsis and septic shock (SEPSIS 3) was published. SEPSIS 3 defined sepsis as life-threatening organ dysfunction caused by a dysregulated host response to infection. Organ dysfunction is an increase in the sequential (sepsis-related) organ failure assessment (SOFA) score of two points or more.[1]

qSOFA has been recommend to screen sepsis based on its prognostic value for in-hospital mortality outside the ICU. However, it is currently unclear whether qSOFA can be used to directly identify organ failure in patients with an infection in terms of differentiation from uncomplicated infection.

Generally, there is paucity of data on sepsis from developing countries particularly where there is a larger population at risk due to the high burden of HIV and other infectious diseases predisposing to sepsis at a younger age compared to the high-income countries.9 The rationale behind the study was to determine the prognostic value of qSOFA compared to SIRS to predict organ failure in patients with a suspected infection in the emergency department (ED) within 24 h of ED admission.

MATERIALS AND METHODS

It was a retrospective cross-sectional study design conducted at Tertiary Care Hospital 800 bedded capacity, nonprofit, premier teaching hospital offering tertiary level and secondary level healthcare services to the people. The electronic medical records were reviewed for all consecutive adult patients (≥18 years) with a suspected infection.

The study period was between March 2021 and February 2022. A total of 750 records were retrieved. We included all patients aged ≥ 18 and suspected infection at admission; defined as those patients who have bodily fluids sampled for cultures with or without receiving antimicrobials within the first 24 hours of admission to the critical care units.

We excluded participants with incomplete data; defined as cases without outcome data (alive or dead at hospital discharge) or lacked necessary data to complete the SOFA and qSOFA score for the first 24 hours of admission to critical care.

We also excluded situations that could affect qSOFA at triage where tracing primary outcomes is impossible or if the Patients were excluded if they had been transferred from another hospital and also if they were discharged or transferred to another hospital within 24 h after ED admission.

Any cardiac arrest at ED was excluded. The clinical and demographic characteristics were retrieved from the electronic hospital records of all patients. The initial vital signs at triage were used to calculate the qSOFA and SIRS criteria. The qSOFA criteria were: respiratory rate ≥22/min, systolic blood pressure ≤100 mm Hg, and altered mentation.[10] When calculating the full SOFA score, the PaO2/FiO2 ratio was used if

there was a result of arterial blood gas analysis and the SpO2/FiO2 ratio was used if there was no PaO2 information.[11] For single missing values, the baseline values were used as the worst ones to calculate the SOFA score. The maximum SOFA score was calculated at 24 h after ED admission.

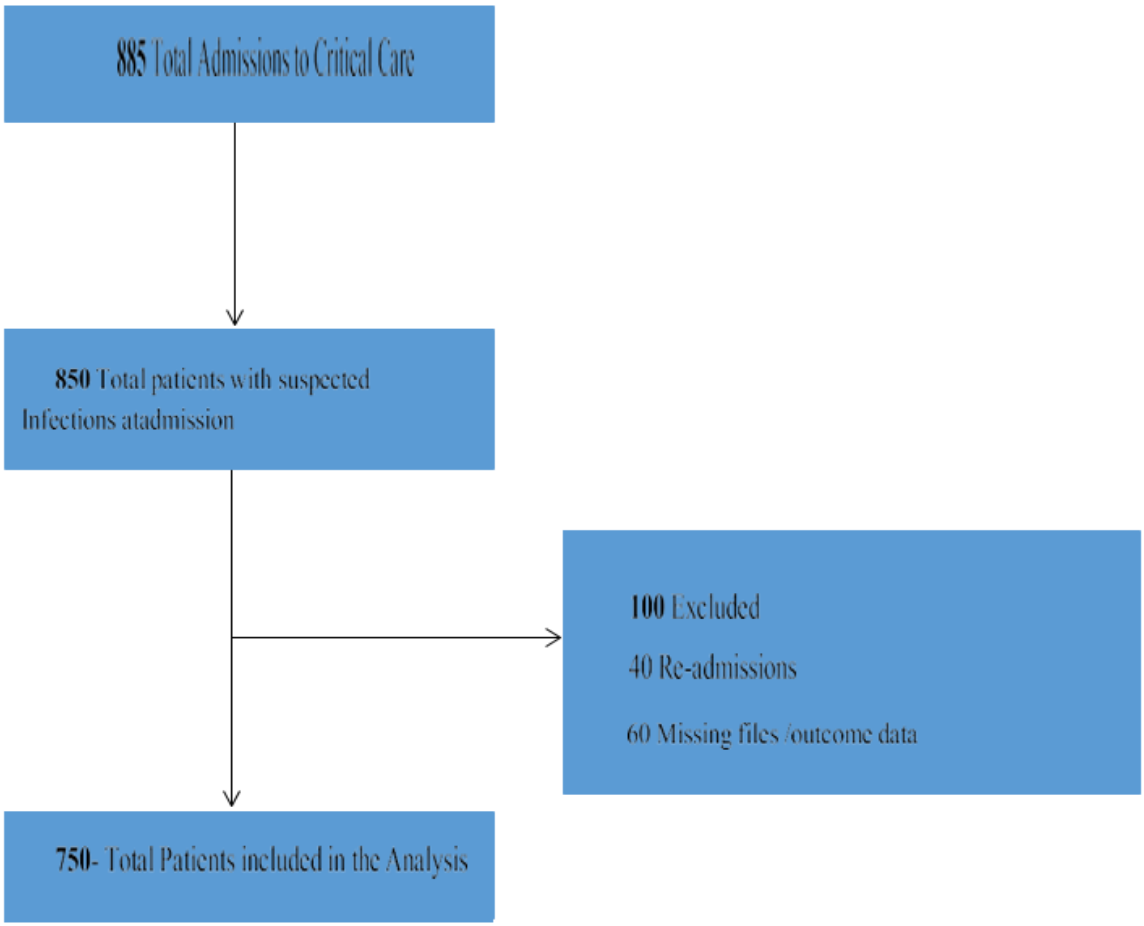

Figure 1: Flow Diagram Showing selection of Study COHORT

STATISTICAL ANALYSIS

We developed a data abstraction tool to extract variables of interest. The scores for the first 24 hours of critical care admission were calculated and the highest score in that first 24 hours taken. Student's t-test or the Mann-Whitney U test was used to compare continuous variables.

The Chi- square test was used to compare categorical variables. The area under the receiver operating characteristic (AUROC) curve was computed to compare the prognostic value of qSOFA to that of SIRS for in-hospital mortality. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of qSOFA and SIRS were analyzed. A p value ≤0.05 was considered to be statistically significant. All statistical analyses were performed using SPSS (Version 22.0).

RESULTS AND OBSERVATIONS

Table 1: Demographic details and Clinical Characteristics of Study Participants

	All Patients (N = 750)	Survivors (N =658)	Non- survivors (N = 92)	P value
Demographics				
Age (Median(IQR))	56 (40-70.5)	52 (38-70)	59 (48-76)	**0.002***
Age, n (%) Below 18 years	11 (1.8%)	10 (2%)	1 (1.1%)	0.068
18-34 years	45 (16.7%)	38 (19%)	7 (7.6%)	
35-49 years	119 (20.9%)	100 (21%)	19 (20.7%)	
50-64 years	240 (28.9%)	210 (27.9%)	30 (32.6%)	
>= 65 years	335 (31.8%)	300 (30.2%)	35 (38.0%)	
Gender: Male	559 (77.6%)	501 (76.1%)	58 (63%)	0.23
Female	191 (22.4%)	157 (23.9%)	34 (37%)	
ICU Admission Source (N (%) :				**0.001***
Emergency departments	352 (78.2%)	293 (81.9%)	59 (64.1%)	
Other	98 (22.7%)	65 (18.1%)	33 (35.9%)	
(Co-morbidities): (N (%))				
Diabetes Mellitus	123 (27.3%)	96 (26.8%)	27 (29.4%)	0.826
Liver Disease	40 (8.9%)	26 (7.3%)	14 (15.2%)	**0.040**
Malignancy:	74 (16.5%)	42 (11.7%)	32 (34.8%)	**< 0.001**
Site of Infections:				
Respiratory	293 (65.1%)	242 (67.6%)	51 (55.4%)	**0.029**
Renal/Urinary tract	102 (22.7%)	87 (24.3%)	15 (16.3%)	0.102
Blood stream	98 (21.8%)	69 (19.3%)	29 (31.5%)	**0.011**
Abdominal	49 (10.9%)	36 (10.1%)	13 (14.1%)	0.263
CNS	21 (4.7%)	19 (5.3%)	2 (2.2%)	0.274
Clinical Parameters				
Temperature (> 38 or < 36 °C)	127 (28.2%)	91 (25.4%)	36 (39.1%)	**0.024**
Heart Rate (> 90)	348 (97.2%)	259 (72.3%)	89 (96.7%)	**0.001**
White cell count (> 12 × 10^3/< 4 × 10^3)	242 (53.8%)	176 (49.2%)	66 (71.7%)	**0.002**
Lactate (≥ 2 mmol/l)	138 (30.7%)	79 (22.1%)	59 (64.1%)	**0.0001**
SIRS	1	1	0	**0.001**
Qsofa Score	1	2	0	**0.01**
In Hospital Mortality	20	4	16	**0.01**

As per table 1 the age of the patients ranged between 18 and 98 years with a mean age of 56 years [SD ± 19.10]. The majority were male 559 (77.6%). Non-survivors were older (59 vs. 52 years, P = 0.002). Majority of the patients, 352 (78.2%) came to the critical care units through the emergency department. The mortality rate was higher among patients referred from other sources compared to the emergency department (33.67% 16.76%, P < 0.001). The most common comorbidity was diabetes mellitus, 123 (27.3%), followed by malignancy, 74 (16.5%). Patients with liver disease and malignancy had a higher mortality, 7.3% vs. 15.2%, P = 0.05 and 11.7% vs. 34.8%, P <0.001 respectively. The commonest sites of infection were respiratory system, 293 (65.1%), followed by urinary tract 102 (22.7%) and bloodstream infection 98 (21.8%). The patients with a respiratory source of infection had a higher mortality (67.6% vs. 55.4%, P < 0.029).

Table 2: Severity of illness and length of stay in critical care and hospital stay

	All Patients (N = 750)	Survivors (N = 658)	Non-survivors (N = 92)	P value
Severity of illness on admission to ICU:				
qSOFA score (>= 2), n (%)	671 (82%)	432 (75.5%)	21 (24.5%)	**< 0.001***
qSOFA Scores, n (%):				
< 2	78 (17.4%)	78 (21.8%)	0 (0%)	**< 0.001***
2-5	197 (44%)	173 (48.3%)	24 (26.4%)	
6-10	126 (28%)	89 (24.9%)	37 (40.7%)	
11-14	42 (9.4%)	17 (4.8%)	25 (27.5%)	
>= 15	6 (1.3%)	1 (0.3%)	5 (5.5%)	
Critical care stay >= 3 days (Secondary outcome)	284 (63%)	218 (60.9%)	66 (71.7%)	0.054
ICU length of stay, Median (IQR) days	4 (2-8)	3 (2-7)	5 (2-11)	**0.008***
Hospital length of stay, Median (IQR) days	8 (4-15)	8 (4-15)	7.5 (3-13)	0.130

As per table 2 in hospital mortality was 24.53% and 34.21% for patients with SIRS and qSOFA scores of two or more respectively (P < 0.001). qSOFA at ICU was significant. Non-survivors had a longer critical care length of stay compared with survivors (median length of stay of 3 days vs. 5 days, P < 0.008)

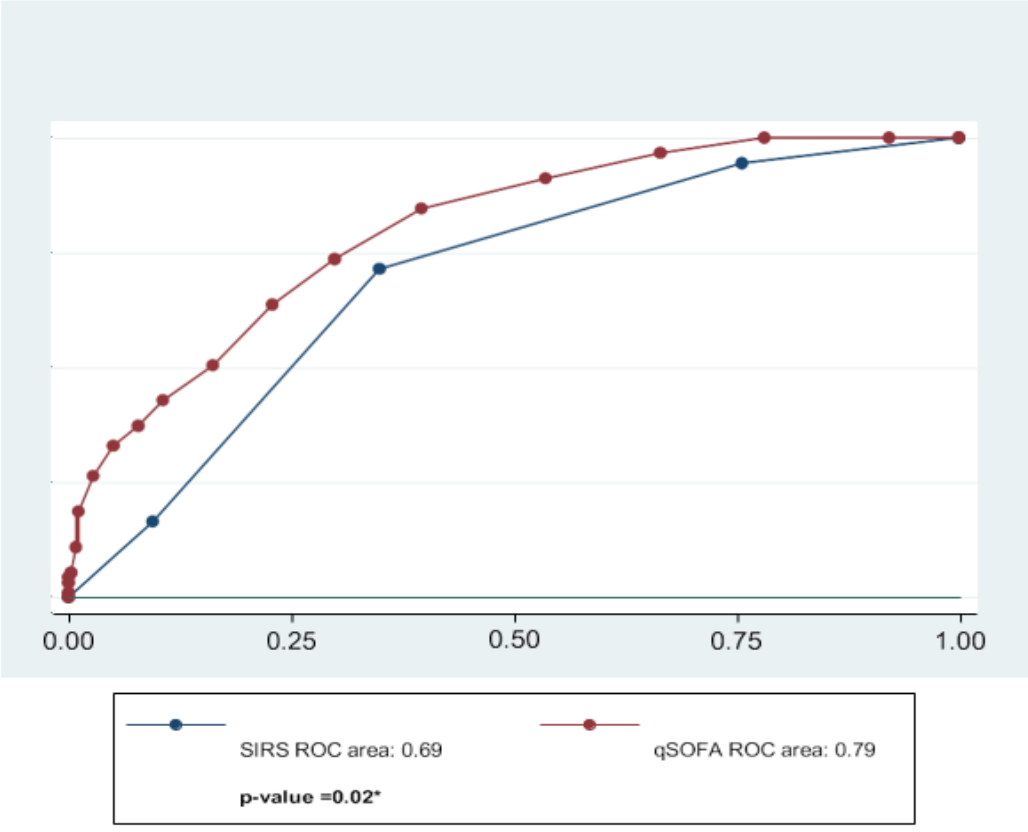

Figure 2: ROC curve of qSOFA and SIRS for in-hospital mortality in patients with suspected infection

As per figure 2 Prediction of in-hospital mortality was significantly higher using qSOFA (AUROC, 0.79 [95% CI, 0.752 to 0.846]) than SIRS (AUROC, 0.69 [95% CI, 0.641 to 0.748]); all p- VALUE =0.02. The superior performance of qSOFA was not maintained in the secondary outcome of a critical care length of stay of three or more days, qSOFA (AUROC, 0.658 [95% CI, 0.605-0.712]) vs. SIRS (AUROC, 0.669.

Table 3: Sensitivity, specificity, PPV, and NPV of quick SOFA to predict in-hospital mortality

Qsofa score	Sensitivity	Specificity	PPV	NPV
≥1	81	50	22	92
≥2	51	84	34	90
≥3	12	97	36	86

As per table 3 The sensitivity, specificity, PPV, and NPV of Qsofa with a cutoff value of 1 point for in-hospital mortality were 81%, 50%, 22%, and 92%, respectively. The sensitivity, specificity, PPV, and NPV of qSOFA for organ failure were 75%, 82%, 87%, and 67%, respectively, when qSOFA was equal to or higher than 1 point (table not shown).

DISCUSSION

The results of our present study indicated that qSOFA is superior to SIRS in predicting the occurrence of organ failure in patients with a suspected infection in the ED. qSOFA was also better at predicting in hospital mortality than SIRS. When compared to the full SOFA score, the predictive value of qSOFA for in-hospital mortality was not inferior.

According to the revised definition, SIRS criteria are not included in sepsis diagnosis or screening, and instead, qSOFA has been introduced as a screening tool for sepsis.1,2,3 Actually, qSOFA is good at predicting in- hospital mortality without directly identifying organ failure in sepsis, which is essential for diagnosis. In addition, the clinical criterion for organ failure has been newly defined as a change in SOFA.

Therefore, there is a need to investigate the prognostic value of qSOFA for organ failure. This study cohort had more males than females in keeping with similar studies by Seymour, et al10, Raith, et al12 and Khwannimit, et al.13 This may be explained by the gender difference in sepsis with males having a higher predisposition.

4 Patients in our study were younger with a mean age of 54 years compared to 62 years in both Raith, et al.12 and Khwannimit, et al.13 There were also more patients with diabetes (27.3% vs. 3.5%) and malignancies (16.5% vs. 3.2%) in this cohort compared to the Raith, et al.12 cohort. In a study by Angele MK et al.14 the AUROC of qSOFA for in-hospital mortality is 0.81, which is higher than that in our result.

Such a difference might be a result of the cohort of the original study consisting of patients from the ED and hospital ward while only ED patients were used in our study. In addition, we used the initial qSOFA at triage.

In other studies in an ED and a prehospital setting, qSOFA showed high specificity and poor sensitivity for organ failure, similar to our results.15, 16 further confirmatory tests using the SOFA calculation for organ failure are needed. We found that a cutoff value of qSOFA for in-hospital mortality at 2 or more exhibited the highest test accuracy (AUROC = 0.684; 95% CI: 0.59–0.78).

This study has confirmed that a qSOFA score of two or more points within the first twenty-four hours in critical care had a good predictive for in hospital mortality. The study also demonstrated qSOFA was superior to SIRS in predicting in hospital mortality in this cohort of critical care patients with suspected infection at the point of admission in a low-income country. This suggests that qSOFA would be an appropriate data based starting point in diagnosing sepsis in a developing country population.

CONCLUSION

qSOFA at ED can predict the occurrence of organ failure in patients with suspected infection, and it has a superior predictive ability than SIRS. qSOFA also has better prognostic validity at predicting in-hospital mortality than SIRS. This finding suggests that qSOFA is an appropriate tool in the initial diagnosis sepsis in critical care setting in a developing country. However, given the low sensitivity and NPV of qSOFA, further confirmatory tests for organ failure are needed.

Source of funding: None

Conflict of Interest: None declared

References

1) Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, et al. The third international consensus definitions for sepsis and septic shock (sepsis-3). JAMA;2016; 315: 801-810.

2) Fleischmann C, Scherag A, Adhikari NK, Hartog CS, Tsaganos T, et al. Assessment of global incidence and mortality of hospital-treated sepsis. current estimates and limitations. Am J Respir Crit Care Med;2016; 193: 259-272.

3) Iwashyna TJ, Ely EW, Smith DM, Langa KM. Longterm cognitive impairment and functional disability among survivors of severe sepsis. JAMA;2010; 304: 1787-1794.

4) Reinhart K, Daniels R, Kissoon N, Machado FR, Schachter RD, et al. Recognizing sepsis as a global health priority - A WHO resolution. N Engl J Med;2017; 377: 414-417.

5) Bone RC, Balk RA, Cerra FB, 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.

6) Sprung CL, Sakr Y, Vincent JL, et al. An evaluation of systemic inflammatory response syndrome signs in the Sepsis Occurrence in Acutely Ill Patients (SOAP) study. Intensive Care Med 2006; 32:421–7.

7) Vincent JL, Opal SM, Marshall JC, et al. Sepsis definitions: time for change. Lancet 2013; 381:774–5.

8) Kaukonen KM, Bailey M, Pilcher D, et al. Systemic inflammatory response syndrome criteria in defining severe sepsis. N Engl J Med 2015; 372:1629–38.

9) Rello J, Leblebicioglu H. Sepsis and septic shock in low-income and middle-income countries: Need for a different paradigm. Int J Infect Dis;2016; 48: 120-122.

10) Seymour CW, Liu VX, Iwashyna TJ, 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.

11) Pandharipande PP, Shintani AK, Hagerman HE, et al. Derivation and validation of Spo2/Fio2 ratio to impute for Pao2/Fio2 ratio in the respiratory component of the Sequential Organ Failure Assessment score. Crit Care Med 2009; 37:1317–21.

12) Raith EP, Udy AA, Bailey M, McGloughlin S, MacIsaac C, 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.

13) 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- 160.

14) Angele MK, Pratschke S, Hubbard WJ, Chaudry IH. Gender differences in sepsis: Cardiovascular and immunological aspects. Virulence;2014; 5: 12-19.

15) Dorsett M, Kroll M, Smith CS, et al. qSOFA has poor sensitivity for prehospital identification of severe sepsis and septic shock. Prehosp Emerg Care 2017:1–9.

16) Williams JM, Greenslade JH, McKenzie JV, et al. SIRS, qSOFA and organ dysfunction: insights from a prospective database of emergency department patients with infection. Chest 2016.