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Original Contributions

SEPSIS CLINICAL CRITERIA IN EMERGENCY DEPARTMENT PATIENTS ADMITTED TO AN INTENSIVE CARE UNIT: AN EXTERNAL VALIDATION STUDY OF QUICK SEQUENTIAL ORGAN FAILURE ASSESSMENT

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☐ **Abstract—Background: Quick Sequential Organ Failure Assessment (qSOFA) is a prognostic score for patients with sepsis. Objective: Our aim was to compare the area under the receiver operating curve (AUROC), sensitivity, specificity, and likelihood ratios of qSOFA vs. systemic inflammation response syndrome (SIRS) in predicting in-hospital mortality among emergency department (ED) patients with suspected infection admitted to intensive care units (ICUs). Methods: We conducted a retrospective cohort chart review study of ED patients admitted to an ICU with suspected infection from August 1, 2012 to February 28, 2015. We included all patients with body fluid cultures sampled either during their ED stay without antibiotic administration or within 24 h of antibiotics administered in the ED. Trained chart abstractors blinded to the study hypothesis double-entered data from each patient's electronic medical record including demographic characteristics, vital signs, laboratory study results, physical examination findings, and in-hospital mortality. We then calculated the AUROC, sensitivity, specificity, and likelihood ratios for qSOFA and SIRS for predicting in-hospital mortality. Results: Of 214 patients admitted to an ICU with presumed sepsis, 39 (18.2%) died during hospitalization. The AUROC value was 0.65 (95% confidence interval [CI] 0.56–0.74) for SIRS vs. 0.66 (95% CI 0.57–0.76) for qSOFA; 2+ qSOFA criteria predicted in-hospital mortality with 89.7% sensitivity, 27.4% specificity, 1.2 positive likelihood ratio, and 0.4 negative likelihood ratio. Conclusions: Among ED patients admitted to an ICU, the SIRS and qSOFA criteria had comparable prognostic value for predicting in-hospital mortality. These prognostic values are similar to those reported by the Sepsis-3 guidelines for ICU encounters. Published by Elsevier Inc.**

☐ **Keywords—sepsis; mortality; emergency department; critical care**

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INTRODUCTION

Conceptually, sepsis is life-threatening organ dysfunction resulting from a dysregulated host response to infection (1). No gold standard tests or diagnostic criteria exist to definitively diagnose and prognosticate sepsis (2). The Society of Critical Care Medicine, in collaboration with other professional organizations, provided the initial clinical definition of sepsis in 1991. This definition classified sepsis as two or more systemic inflammatory response syndrome (SIRS) criteria (Table 1) in the presence of suspected or proven infection (3). The SIRS criteria have

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Table 1. Clinical Criteria for Sepsis

Criteria
Systemic Inflammatory Response Syndrome (0–4)
Respiratory rate > 20 breaths/min or arterial carbon dioxide < 32 mm Hg
White blood cell count > 12,000/mm^3, < 4,000/mm^3, or > 10% bands
Heart rate > 90 beats/min
Temperature > 38°C or < 36°C
Quick Sequential Organ Failure Assessment (0–3)
Respiratory rate > 22 breaths/min
Glasgow Coma Scale < 14
Systolic blood pressure < 100 mm Hg
Logistic Organ Dysfunction System (0–22)
Glasgow Coma Scale 9–13 (1); 6–8 (2); 4–5 (3); 3 (4)
PaO_2/FiO_2 ratio 150–249 (2); 50–149 (3); < 50 (4)*
Heart rate, beats/min 140–159 (1); ≥ 160 (2); < 30 (3)
Systolic blood pressure, mm Hg 240–269 or 70–89 (1); ≥ 270 or 40–69 (2); < 40 (3)
Urea, mmol/L 6–9.9 (1); 10–19.9 (2); ≥ 20.0 (3)
Creatinine, mg/dL 1.2–1.6 (1); > 1.6 (2)
White blood cell count/mm^3 1,000–2,400 or ≥ 50,000 (1); < 1,000 (2)
Total bilirubin, mg/dL 0.6–4.0 (1); > 4.0 (2)
Platelets < 50,000/μL
Prothrombin time < 25% of standard
Sequential Organ Failure Assessment (0–24)
PaO_2/FiO_2 ratio, < 400 (1); < 300 (2); < 200 (3)†, < 100 (4)†
Glasgow Coma Scale, 13–14 (1); 10–12 (2); 6–9 (3); < 6 (4)
Mean arterial pressure < 70 mm Hg (1) or vasopressors (2–4)‡
Total bilirubin, mg/dL 1.2–1.9 (1); 2.0–5.9 (2); 6.0–11.9 (3); > 12.0 (4)
Platelets/μL < 150,000 (1); < 100,000 (2); < 50,000 (3); < 20,000 (4)
Creatinine, mg/dL 1.2–1.9 (1); 2.0–3.4 (2); 3.5–4.9 (3); ≥ 5.0 (4)

* Scores > 0 require that the patient be undergoing mechanical ventilation or administration of continuous positive airway pressure.
† Scores of 3 or 4 require that the patient be undergoing mechanical ventilation.
‡ Patients on any dose of dobutamine or a dopamine dose ≤ 5 μg/kg/min receive a score of 2; patients on dopamine doses > 5 μg/kg/min but ≤ 5 μg/kg/min or norepinephrine ≤ 0.1 μg/kg/min or epinephrine ≤ 0.1 μg/kg/min receive a score of 3; patients on higher doses of vasopressors receive a score of 4.

since been used to define sepsis research study inclusion criteria and prognosticate sepsis patient outcomes (4–8). Yet, some studies noted these criteria to have inadequate sensitivity in identifying patients with sepsis at high risk for mortality (9). Other proposed criteria include the Sequential Organ Failure Assessment (SOFA), and the Logistic Organ Dysfunction System (LODS) (10,11). Studies of hospitalized patients with sepsis highlight the importance of accurate prognostication, given highly variable in-hospital mortality rates reported using alternative disease entity definitions and classifications, with individual study estimates ranging from 17.9% to 45.8% (12,13). Estimated mortality rates among patients with sepsis admitted to an intensive care unit (ICU) generally lie on the upper end of this spectrum, making prognostication for these patients early in their care even more important (14).

Early 2016 saw the release of the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) (15–17). These guidelines derived and validated a new set of criteria to prognosticate outcomes in patients with sepsis. These guidelines established a new set of criteria for use in non-ICU settings: the Quick SOFA (qSOFA, Table 1) score. Sepsis-3 specifically promotes the use of SOFA in ICU patients vs. qSOFA in non-ICU patients. According to the guidelines, non-ICU patients (including all ED patients), meeting two or more qSOFA criteria in the presence of suspected or proven infection can be "rapidly identified as being more likely to have poor outcomes" (17).

The Sepsis-3 guidelines examined the use of qSOFA separately in patients with sepsis admitted to the ICU and patients with sepsis in non-ICU settings including the ED. They concluded that while qSOFA was highly predictive of mortality in non-ICU settings, with an area under the receiver operator curve (AUROC) of 0.81, it had less prognostic value in ICU patients, with an AUROC of 0.66 (15). While their analysis of non-ICU encounters encompassed all ED encounters together with all other non-ICU encounters, ED patients are likely to be highly heterogeneous. The diagnostic and prognostic values of qSOFA specifically in an ED population remain unclear, as the authors did not report any subgroup analyses comprising ED encounters only. Of particular interest to the emergency physician will be the value of these criteria in the ED patients with the greatest severity of illness requiring admission to an ICU.

The aim of this study is external validation of the qSOFA criteria as a prognostication tool among ED patients admitted to an ICU. Specifically, we aimed to compare the prognostic accuracy as measured by AUROC, sensitivity, specificity, and likelihood ratios of SIRS vs. qSOFA for predicting in-hospital mortality in a population of ED patients admitted to an ICU with presumed sepsis. We hypothesized a priori that SIRS is non-inferior to qSOFA for prognosticating in-hospital mortality in this patient population.

METHODS

We performed a retrospective cohort study. We obtained all data by chart review methodology (18).

The study population comprised all ED patients admitted to an ICU setting. The study facility was San Antonio Military Medical Center. This facility is an urban tertiary care hospital serving active duty military personnel and beneficiaries in San Antonio. The annual ED census is approximately 90,000 patients. Facilities