



Original Contribution

Predictive performance of quick Sepsis-related Organ Failure Assessment for mortality and ICU admission in patients with infection at the ED[☆]



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ABSTRACT

Objective: The objectives of this study are to investigate the performance of the quick Sepsis-related Organ Failure Assessment (qSOFA) in predicting mortality and intensive care unit (ICU) admission in patients with clinically diagnosed infection and to compare its performance with that of Mortality in Emergency Department Sepsis (MEDS), Acute Physiology and Chronic Health Evaluation (APACHE) II, and Sepsis-related Organ Failure Assessment (SOFA). **Methods:** From July to December 2015, we retrospectively analyzed 477 patients clinically diagnosed with infection in the emergency department. We compared the performance of SOFA, MEDS, APACHE II, and qSOFA in predicting ICU admission and 28-day mortality.

Results: All scores were higher in nonsurvivors and ICU patients than in survivors and non-ICU patients ($P < .001$). The area under the receiver operating characteristic curve of qSOFA was lower than that of MEDS (0.666 vs 0.751; $P < .05$) and similar to that of SOFA (0.729) and APACHE II (0.732) in predicting 28-day mortality. The areas under the receiver operating characteristic curve of qSOFA, SOFA, MEDS, and APACHE II in predicting ICU admission were 0.636, 0.682, 0.661, and 0.640, respectively. There were no significant differences among the score systems. In patients with qSOFA scores less than 2 and greater than or equal to 2, 28-day mortality rates were 17.4% and 42.9% ($P < .001$), and ICU admission rates were 16.0% and 33.3% ($P < .001$).

Conclusions: Quick SOFA predicted ICU admission with similar performance to that of SOFA, MEDS, and APACHE II. Its prognostic ability was similar to that of SOFA and APACHE II but slightly inferior to that of MEDS.

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1. Introduction

The definitions of sepsis and septic shock were recently modified in The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) [1]. A new screening tool, the quick Sepsis-related Organ Failure Assessment (qSOFA), has been recommended to evaluate sepsis in accordance with its new definition. qSOFA criteria for sepsis include a Glasgow Coma Scale score of less than or equal to 13, systolic blood pressure less than or equal to 100 mm Hg, and respiratory rate greater than or equal to 22 per minute (1 point each to yield a score

value between 0 and 3) [2]. In the original retrospective qSOFA study, the area under the receiver operating characteristic (ROC) curve (AUC) for qSOFA was 0.81. This scoring system was found to perform better than full Sepsis-related Organ Failure Assessment (SOFA) (AUC, 0.79; $P < .01$) in predicting inhospital mortality in settings other than the intensive care unit (ICU). According to the recommendations in Sepsis-3, patients outside the ICU with a qSOFA score of greater than or equal to 2 who are suspected of having an infection should be closely monitored for sepsis and further assessed using the SOFA score.

Simplicity in calculation and close accordance with complex systems used for non-ICU settings are the main advantages of qSOFA. Furthermore, its independence from laboratory test results means that qSOFA can be calculated within a few minutes at the patient's bedside. The original qSOFA study enrolled a broad-spectrum cohort, including prehospital patients, those treated at the emergency department (ED), hospitalized patients, and those admitted to ICU. In that study, the inhospital mortality (4%–11%) was relatively low in non-ICU patients, who comprised 89% of the entire cohort, and was increased in patients admitted to the ICU (18%). The prognostic ability of qSOFA was found

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to be lower for ICU patients; thus, its predictive performance remains unclear in high-risk patients in the ED. In the same study, qSOFA was compared with SOFA and Logistic Organ Dysfunction Score, which were derived from critically ill ICU patients and were rarely used in non-ICU settings. Compared with SOFA and Logistic Organ Dysfunction Score, the Mortality in Emergency Department Sepsis (MEDS) is more widely used at the ED than the ICU. The MEDS score was derived from patients at the ED suspected of having an infection, and its high prognostic performance was demonstrated in predicting short- and long-term mortality [3,4]. However, the performances of qSOFA and MEDS have not yet been compared.

The present study aimed to investigate the performance of qSOFA for predicting mortality and ICU admission in patients with clinically diagnosed infection at the ED and to compare its performance with that of MEDS, Acute Physiology and Chronic Health Evaluation (APACHE) II, and SOFA [5,6].

2. Patients and methods

2.1. Setting and design

The present study was a single-center, retrospective analysis of a prospective observational research database in patients with clinically diagnosed infection at the ED of Beijing Chao-Yang Hospital from July to December 2015. Our hospital is a 2000-bed teaching hospital with approximately 20 000 ED visitors per year. This study was approved by the Ethics Committee of our institution (13-ke-02/2015.01.12). All the patients gave written informed consent.

2.2. Patients

Adult patients (age, ≥ 18 years) with clinically diagnosed infection who were treated at the ED were enrolled. Clinically diagnosed infections were defined as follows: pneumonia diagnosed by new infiltrates on chest imaging studies (radiograph or computed tomography) with 2 or more symptoms consistent with pneumonia, including fever, cough, dyspnea, sputum production, breathlessness, and/or pleuritic chest pain [7]; intraabdominal infections were those occurring within an abdominal organ or in the abdominal cavity, including radiographic evidence of infection and at least 2 of the following signs or symptoms with no other recognized cause: fever, nausea, vomiting, abdominal pain, or jaundice; and other infections include skin and soft tissue infections, cerebral infection, and pyelonephritis.

The exclusion criteria were as follows: age younger than 18 years, terminal disease, HIV positivity, use of immunosuppressants, and patients who declined to participate in the study. The flowchart of patient enrollment is shown in Fig. 1.

2.3. Data collection

Data on demographic characteristics, infection sites, vital signs, imaging, and laboratory test results of enrolled patients were recorded upon ED arrival. The qSOFA, SOFA, APACHE II, and MEDS scores were calculated using the data at enrollment.

2.4. Outcome variables

All enrolled patients were followed up for 28 days. The 28-day mortality was the primary outcome. The admission to ICU during the follow-up period was the secondary outcome.

2.5. Statistics

All statistical analyses were performed by SPSS software version 16.0 (SPSS, Inc, Chicago, IL). Normally distributed data are given as means \pm SDs and were compared using the independent-samples *t* test. Data

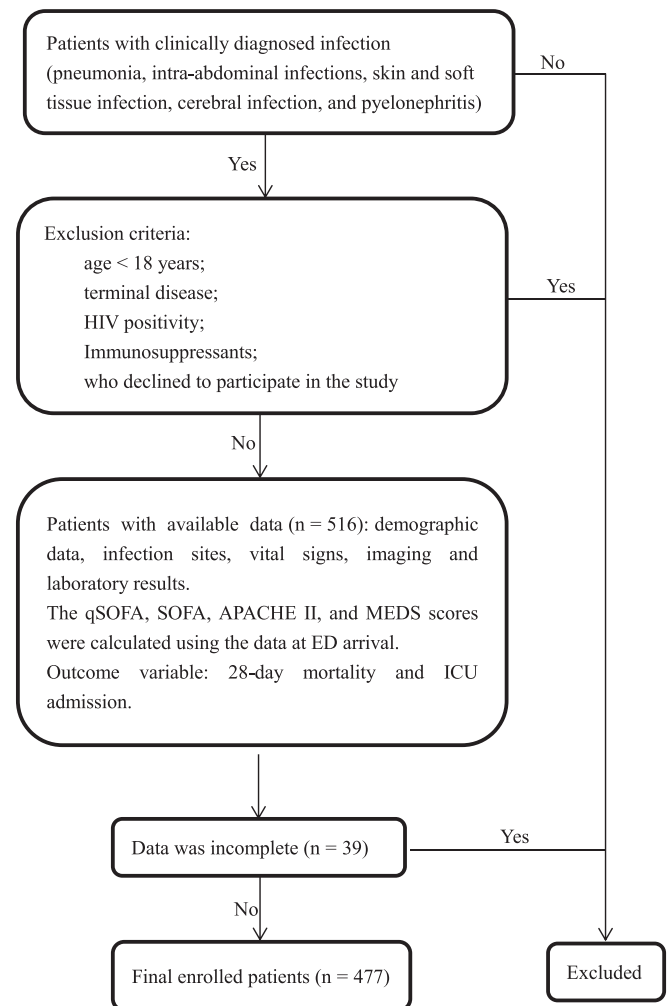


Fig. 1. Flowchart of patient enrollment.

with skewed distribution are expressed as median and quartiles and were analyzed by Mann-Whitney *U* test. Categorical variables were compared using χ^2 statistics. The independent predictors of outcomes were determined by logistic regression analysis. All variables with statistical difference were tested in a binary logistic analysis together with qSOFA. As APACHE II, MEDS, and SOFA contained most of the vital signs and laboratory test results, they were not analyzed together with qSOFA in the binary logistic analysis. The ROC curve was used for evaluating the predictive value of each indicator, and differences in the AUC values were analyzed using the following equation: $Z = (A_1 - A_2) / \sqrt{SE_1^2 + SE_2^2}$; test criteria: $Z_{0.05} = 1.96$, $Z_{0.01} = 2.58$, $Z > Z_{0.05}$ represents $P < .05$. A 2-tailed $P < .05$ was considered statistically significant.

3. Results

3.1. Baseline information

A total of 516 patients with clinically diagnosed infection were enrolled in this study from July to December 2015. Thirty-nine patients were excluded because of incomplete data, and 477 patients were finally included. Most patients (61.8%) were male, with a median age of 73 years (60–79). The 28-day mortality and ICU admission rate of the entire cohort were 27.5% and 22.9%, respectively. Vasopressors and mechanical ventilation were used in 9.9% and 6.9% of all enrolled patients, respectively. Overall, the mean APACHE II score was 17 ± 8 , and the median scores of MEDS, SOFA, and qSOFA were 11 (8–16), 4 (3–7),

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