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# Pre-hospital qSOFA as a predictor of sepsis and mortality

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ABSTRACT

*Background:* The quick sequential organ failure assessment score (qSOFA) has been proposed as a simple tool to identify patients with sepsis who are at risk for poor outcomes. Its utility in the pre-hospital setting has not been fully elucidated.

*Methods:* This is a retrospective observational study of adult patients arriving by ambulance in September 2016 to an academic emergency department in Fresno, California. The qSOFA score was calculated from pre-hospital vital signs. We investigated its association with sepsis, ED diagnosis of infection, and mortality.

*Results:* Of 2292 adult medical patients transported by ambulance during the study period, the sensitivity of qSOFA for sepsis and in-hospital mortality were 42.9% and 40.6%, respectively. Specificity of qSOFA for sepsis and mortality were 93.8% and 91.9%, respectively. Of those with an ED diagnosis of infection compared to all patients, qSOFA was more specific but less sensitive for sepsis. Increasing qSOFA score was associated with a discharge diagnosis of sepsis (OR 4.21, 95% CI 3.41–5.21, $p < 0.001$), in-hospital mortality (OR 3.30, 95% CI 2.28–4.78, $p < 0.001$), and ED diagnosis of infection (OR 1.37, 95% CI 1.18–1.58, $p < 0.001$). Higher qSOFA score was associated with triage to a higher acuity zone and longer hospital and ICU length of stay, but not up-triage during ED stay.

*Conclusions:* Pre-hospital qSOFA is specific, but poorly sensitive, for sepsis and sepsis outcomes, especially among patients with an ED diagnosis of infection. Higher qSOFA score was associated with worse outcomes.



## 1. Background

Early identification and initiation of treatment for sepsis and septic shock are critical to decrease morbidity and mortality [1]. Despite robust research, the Surviving Sepsis Campaign, and national core measures, sepsis mortality remains high; some sources estimate up to 15% mortality in recent years [2]. The diagnosis remains challenging, and there are continued efforts to derive and validate helpful clinical prediction rules.

In response to criticisms that previous definitions of sepsis suffered from poor sensitivity and specificity, the 2016 Society of Critical Care Medicine (SCCM) and European Society of Intensive Care Medicine (ESICM) task force published new definitions and clinical criteria for sepsis and septic shock (SEP-3) [3]. Sepsis is now defined as "life-threatening organ dysfunction caused by a dysregulated host response to infection" and is recommended to be assessed clinically with the sequential organ failure assessment (SOFA) score [3]. Because the SOFA score calculation is cumbersome and requires many laboratory tests, the task force proposed a quick SOFA score (qSOFA), which relies on vital signs and clinical signs to identify patients with sepsis and predict those who are at risk for poor outcomes [3]. The qSOFA score is a three-point score, with a patient receiving one point each for systolic blood pressure (SBP) ≤ 100 mmHg, Glasgow Coma Score (GCS) < 15, and respiratory rate (RR) ≥ 22/min. qSOFA is considered positive with a score of two or three. Given its simplicity, this score can be used in the pre-hospital setting and in the emergency department (ED) to rapidly identify adult patients with suspected infections who are more likely to have poor outcomes.

Since the SEP-3 guidelines have been published, several studies have assessed qSOFA's utility in the emergency setting, with mixed results. While one study found that emergency department qSOFA is associated with inpatient mortality, hospital and intensive care unit (ICU) admission, and hospital length of stay (LOS) [4], a systematic review found poor sensitivity and only moderate specificity for short-term mortality [5]. Another study found that emergency medical services (EMS) patients with positive qSOFA scores were more likely to be septic, with a

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positive predictive value (PPV) of 66.7% (95% CI 55.8–77.6%) [6]. However, other recent studies have called into question the utility of pre-hospital qSOFA (and SIRS, for that matter) to select septic patients and predict outcomes such as ICU admission [7,8].

Given that early treatment of sepsis decreases mortality [1], and patients who arrive by EMS (and have an EMS provider who suspects sepsis) have faster administration of antibiotics and fluids [9,10], our study was designed to assess whether calculation of pre-hospital qSOFA score in medical patients can adequately predict patient outcomes or improve current triage practices in the emergency department.

## 2. Methods

### 2.1. Data collection

This is a retrospective study of adult medical patients arriving by ambulance to Community Regional Medical Center (CRMC), a large urban academic tertiary care center in Fresno, CA in September 2016. American Ambulance, our local ambulance company, provided all sets of pre-hospital vital signs recorded, from which the pre-hospital qSOFA score was abstracted manually and calculated. The "worst" combination of vital signs were included for this calculation and patients did not need to meet all qSOFA components at the same point of time to be considered qSOFA positive. The EMS company also provided demographic data, which was used to locate patients in the hospital electronic medical record (EMR) database (EPIC©), and data on STAT v non-STAT pre-hospital designation. STAT designation is defined per EMS policy as potentially life or limb-threatening conditions where the patient is unstable, in a rapidly changing status, or unstable as identified by pre-hospital assessment (i.e. acute MI) [11]. Under STAT designation, it is up to the discretion of the EMS provider if lights and sirens are appropriate, depending on the distance to transport and other safety conditions. Inclusion criteria were all medical patients (STAT and non-STAT) transported by American Ambulance within the study period. Exclusion criteria included age <18 years, patients with a pre-hospital trauma designation, patients with CPR in progress, transfers from other hospitals, and direct triage to another location of the hospital (i.e. labor and delivery, direct admissions). EMR data was accessed and the following data were manually abstracted: triage zone; patients who were moved to a higher acuity area while physically located in the emergency department (up-triage); final triage zone; disposition from the ED; ED diagnosis of infection; location of admission; discharge diagnosis of sepsis; hospital and ICU LOS; and in-hospital mortality. In the CRMC ED, EMS patients are triaged by mobile intensive care nurses (MICN) to various zones, listed from highest to lowest acuity: trauma/red, yellow, green, or provider at triage (PAT)/waiting room.

We analyzed qSOFA as an ordinal categorical, rather than binary, variable (i.e. analyzing it as 0, 1, 2, 3 instead of qSOFA positive [2, 3] versus negative [0,1]). Primary outcomes were qSOFA association with a hospital diagnosis of sepsis, in-hospital mortality, and ED diagnosis of infection. We also aimed to calculate the sensitivity and specificity of binary qSOFA for these outcomes, among all patients and also those with ED suspicion of infection, as that was the original suggested application of the score. Secondary outcomes include qSOFA's association with original and final triage locations, up-triage, disposition, admission location, and hospital and ICU LOS.

All data abstractors were blinded to qSOFA scores during data abstraction from the EMR. All data abstractors were trained by the principal investigators so that data abstraction was completed in a similar fashion, and one of the principal investigators reviewed the data abstraction throughout data collection to ensure consistency of data collection.

### 2.2. Data analysis

Data was analyzed using SPSS v24© and STATA v14©; we used chi-squared tests, Fisher exact tests, and ANOVA to calculate associations and logistical and multinomial regression to calculate odds ratio of

**Table 1**
Characteristics of study population.

| | All patients (N = 2292) N(%), median [IQR[a]], mean ± SD | Admitted patients (N = 960) N(%), median [IQR[a]], mean ± SD | Patients diagnosed with infection in the ED (N = 428) N(%), median [IQR[a]], mean ± SD |
|---|---|---|---|
| Males | 1250 (54.5%) | 519 (54.1%) | 234 (54.7%) |
| Age (years) | 52 [37, 63] | 59.5 [48, 71] | 58 [45, 68] |
| qSOFA score | | | |
| 0 | 1386 (60.5%) | 475 (49.5%) | 242 (56.5%) |
| 1 | 709 (30.9%) | 352 (36.7%) | 123 (28.7%) |
| 2 | 167 (7.3%) | 104 (10.8%) | 45 (10.5%) |
| 3 | 30 (1.3%) | 29 (3.0%) | 18 (4.2%) |
| STAT transport priority | 163 (7.1%) | 142 (14.8%) | 33 (7.7%) |
| Initial triage zone | | | |
| Low acuity | 1570 (68.5%) | 429 (44.7%) | 276 (64.5%) |
| Mid acuity | 381 (16.6%) | 255 (26.6%) | 79 (18.5%) |
| High acuity | 341 (14.9%) | 276 (28.8%) | 73 (17.1%) |
| Final triage zone | | | |
| Low acuity | 1453 (63.4%) | 338 (35.2%) | 246 (57.5%) |
| Mid acuity | 434 (18.9%) | 289 (30.1%) | 87 (20.3%) |
| High acuity | 405 (17.7%) | 333 (34.7%) | 95 (22.2%) |
| Up-triage to higher acuity zone while in ED | 147 (6.4%) | 119 (12.4%) | 42 (9.8%) |
| Disposition/admission location | | | |
| Not admitted | 1332 (58.1%) | – | 131 (30.6%) |
| Floor | 811 (35.4%) | 811 (84.5%) | 244 (57.0%) |
| Stepdown unit | 59 (2.6%) | 59 (6.1%) | 24 (5.6%) |
| Intensive care unit/OR/Cath lab | 90 (3.9%) | 90 (9.4%) | 29 (6.8%) |
| Diagnosed with Infection in the ED | 428 (18.7%) | 297 (30.9%) | – |
| Diagnosed with sepsis on hospital discharge | 147 (6.4%) | 147 (15.3%) | 121 (28.3%) |
| In-hospital mortality | 32 (1.4%) | 32 (3.3%) | 11 (2.6%) |
| Hospital length of stay (HLOS) | 0 [0, 3] | 4 [2, 6] | 3 [0, 6] |
| | 2.63 ± 8.68 | 6.24 ± 12.5 | 5.45 ± 10.3 |
| Intensive care unit length of stay (ICU LOS) | 0 [0, 0] | 0 [0, 0] | 0 [0, 0] |
| | 0.18 ± 1.50 | 0.43 ± 2.30 | 0.30 ± 1.72 |

[a] Interquartile range.

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**Table 2**
Sensitivity, specificity, positive and negative predictive value, positive and negative likelihood ratio of qSOFA (with 95% confidence intervals) for sepsis, mortality, and ED diagnosis of infection[a].

| | Sepsis | | Mortality | | ED diagnosis of infection |
|---|---|---|---|---|---|
| | All patients | Pt with ED diagnosis of infection | All patients | Pt with ED diagnosis of infection | |
| Sensitivity | 42.9% [35.1%, 51.0%] | 41.3% [32.9%, 50.3%] | 40.6% [25.3%, 58.1%] | 54.5% [26.8%, 79.7%] | 14.7% [11.7%, 18.4%] |
| Specificity | 93.8% [92.6%, 94.7%] | 95.8% [92.8%, 97.5%] | 91.9% [90.7%, 92.9%] | 86.3% [82.7%, 89.3%] | 92.8% [91.5%, 93.9%] |
| PPV | 32.0% [25.8%, 38.8%] | 79.4% [67.6%, 87.6%] | 6.60% [3.87%, 11.0%] | 9.52% [4.33%, 19.6%] | 32.0% [25.8%, 38.8%] |
| NPV | 96.0% [95.1%, 96.8%] | 80.5% [76.2%, 84.3%] | 99.1% [98.6%, 99.6%] | 98.6% [96.8%, 99.4%] | 82.6% [80.9%, 84.1%] |
| +LR | 6.86 [5.35, 8.80] | 9.76 [5.50, 17.30] | 4.99 [3.21, 7.76] | 3.99 [2.21, 7.21] | 2.05 [1.55, 2.71] |
| −LR | 0.60 [0.53, 0.70] | 0.61 [0.53, 0.71] | 0.65 [0.49, 0.86] | 0.52 [0.27, 1.01] | 0.92 [0.88, 0.96] |

[a] Calculated with intercept only logistic regression model.

ordinal qSOFA score as a predictor to various outcomes. We used generalized Poisson regression to assess non-normal LOS data. An ROC curve was fit to the sensitivity and specificity of qSOFA for mortality. Sensitivity, specificity, and positive and negative predictive values were calculated based on intercept-only logistic regression models with qSOFA calculated as a binary positive (2,3) or negative score (0,1), in contrast to the other measures which analyzed qSOFA as an ordinal score (0,1,2,3). We used descriptive statistics to characterize patients who were qSOFA positive but were not septic. We calculated relative agreement percentage as well as Cohen's kappa statistic to assess inter-rater reliability during data collection.

## 3. Results

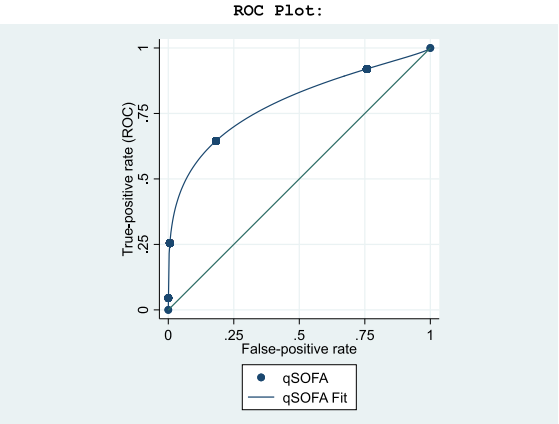
During the study period, 2675 STAT and non-STAT medical patients were transported via EMS to CRMC. Of these, 103 (3.9%) met exclusion criteria and were not included for analysis. Two hundred eighty patients (10.5%) were further excluded for lack of outcome data: 248 patients eloped from the ED, 27 patients left against medical advice prior to final ED disposition, and 5 patients were transferred to another hospital from our ED. We completed data analysis on the remaining 2292 patients. The percent (relative) agreement among different data abstractors was 94.1%, with a kappa statistic, $\kappa = 0.8824$ (i.e. near perfect agreement).

In our patient population, 1250 patients (54.5%) were male and the median age was 52 years (IQR 37–63). The number of patients with qSOFA scores of 0, 1, 2, and 3 were 1386 (60.5%), 709 (30.9%), 167 (7.3%), and 30 (1.3%), respectively (Table 1). STAT medical transports made up 7.1% of the patient population; 16.6% of all patients were initially triaged to mid-acuity and 14.9% to high-acuity zones. A small percentage (6.4%) of patients were up-triaged during their ED stay. The admission rate was 41.9%, with 84.5%, 6.1%, and 9.4% of those admitted dispositioned to the floor, stepdown unit, and intensive care unit, respectively. The rate of suspected infection in the ED was 18.7%, while 6.4% of patients were diagnosed with sepsis. The in-hospital mortality rate in our study population was 1.4%. Of those admitted, average hospital LOS was 6.24 days, and ICU LOS was 0.43 days.

We found that qSOFA was 42.9% sensitive (95% CI 35.1–51.0%) and 93.8% specific (95% CI 92.6–94.7%) for sepsis, with PPV 32.0% (95% CI 25.8–38.8%) and NPV 96.0% (95% CI 95.1–96.8%) (Table 2). qSOFA was 40.6% sensitive (95% CI 25.3–58.1%) and 91.9% specific (95% CI 90.7–92.9%) for in-hospital mortality, with PPV 6.60% (95% CI 3.87–11.0%) and NPV 99.1% (95% CI 98.6–99.6%). qSOFA was 14.7% sensitive (95% CI 11.7–18.4%) and 92.8% specific (95% CI 91.5–93.9%) for ED diagnosis of infection. Among those with infection diagnosed in the ED compared to all patients, sensitivity of qSOFA for sepsis was lower (41.3%; 95% CI 32.9–50.3%), whereas the specificity of qSOFA for sepsis was higher (95.8%; 95% CI 92.8–97.5%). Of note, the converse was true for qSOFA's sensitivity and specificity for mortality, when comparing those with ED diagnosis of infection with all patients. The area under the receiver operating characteristic (AUROC), or c-statistic, a measure of how well the logistic regression model fits our accuracy data, was 0.7893 (95% CI 0.7452–0.8334) for the diagnosis of sepsis (Fig. 1). The c-statistic can range between 0.5 and 1, with a value of 0.5 representing the tool as doing no better than chance, 0.7 representing a good model, 0.8 representing a strong model, and 1.0 representing a model with perfect prediction.

Every increase of 1 in qSOFA score was associated with an increase in the probability of sepsis diagnosis (OR 4.21, 95% CI 3.41–5.21, $p < 0.001$), in-hospital mortality (OR 3.30, 95% CI 2.28–4.78, $p < 0.001$), and ED diagnosis of infection (OR 1.37, 95% CI 1.18–1.58, $p < 0.001$) (Table 3). Older patients were more likely to be qSOFA positive, and qSOFA positive patients were more likely to be transported STAT rather than non-STAT to our emergency department. Multinomial analysis also found qSOFA to be associated with triage zone and admission location (Table 4). For example, a qSOFA of 3 was associated with much higher odds of being triaged to high acuity rather than low acuity initially, and much higher odds of being admitted to the ICU, when compared to a patient with a qSOFA score of 0 ($p < 0.001$). Every increase of 1 in qSOFA score was also associated with increased hospital LOS and ICU LOS (Table 5). On average, patients with a qSOFA score of 0, 1, 2, and 3 had a hospital LOS of 2.03, 3.10, 4.74, and 7.24 days, respectively, and an ICU LOS of 0.09, 0.22, 0.4, and 1.33 days, respectively. qSOFA score was not associated with up-triage to a higher acuity zone (OR 1.146, CI 95% 0.910–1.44, $p = 0.107$) (Table 3).

Of the 197 qSOFA positive patients, 134 (68.0%) patients were not septic but had another final discharge diagnosis (Fig. 2). The most frequent alternate diagnoses in qSOFA positive patients were substance abuse or withdrawal (27.6%), seizure (15.6%), uni- or multifactorial altered mental status (9.0%), hemorrhage (6.7%), syncope (6.0%), and respiratory failure (6.0%). Less common diagnoses that made up the remaining 29.1% of qSOFA positive, non-septic, patients were: simple




| | Est. | 95% Confidence Interval |
|---|---|---|
| C-Statistic (Area Under Curve) | .7893 | [.7452 , .8334] |

**Fig. 1.** ROC curve of qSOFA sensitivity and specificity for sepsis.

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**Table 3**
Factors associated with pre-hospital qSOFA positive score[a].

| Factor N(%), mean ± SD | qSOFA score 0 | 1 | 2 | 3 | OR[d] [95% CI] | p-Value |
|---|---|---|---|---|---|---|
| TOTAL | 1386 (60.5%) | 709 (30.9%) | 167 (7.3%) | 30 (1.3%) | | |
| Male sex | 761 (54.9%) | 382 (53.9%) | 90 (53.9%) | 17 (56.7%) | 1.018 [0.904, 1.147] | 0.963 |
| Age[b] | 49.6 ± 17.3 | 54.3 ± 18.3 | 54.7 ± 19.1 | 64.4 ± 18.25 | 1.015 [1.007, 1.024][e] | <0.001 |
| STAT transport priority | 25 (1.8%) | 77 (10.9%) | 40 (24.0%) | 21 (70.0%) | 0.001 [3.486, 5.269] | <0.001 |
| Initial triage zone | | | | | [f] | <0.001 |
| Low acuity | 1121 (80.9%) | 395 (55.7%) | 53 (31.7%) | 1 (3.3%) | | |
| Mid acuity | 173 (12.5%) | 153 (21.6%) | 49 (29.3%) | 6 (20.0%) | | |
| High acuity | 92 (6.6%) | 161 (22.7%) | 65 (38.9%) | 23 (76.7%) | | |
| Final triage zone | | | | | [f] | <0.001 |
| Low acuity | 1044 (75.3%) | 364 (51.3%) | 44 (26.3%) | 1 (3.3%) | | |
| Mid acuity | 220 (15.9%) | 163 (23.0%) | 46 (27.5%) | 5 (16.7%) | | |
| High acuity | 122 (8.8%) | 182 (25.7%) | 77 (46.1%) | 24 (80.0%) | | |
| Up-triage to higher acuity zone | 85 (6.1%) | 43 (6.1%) | 18 (10.8%) | 1 (3.3%) | 1.146 [0.910, 1.443] | 0.107 |
| Disposition | | | | | [f] | <0.001 |
| Not admitted | 911 (65.7%) | 357 (50.4%) | 63 (37.7%) | 1 (3.3%) | | |
| Floor | 444 (32.0%) | 286 (40.3%) | 68 (40.7%) | 13 (43.3%) | | |
| Stepdown unit | 17 (1.2%) | 23 (3.2%) | 9 (5.4%) | 10 (33.3%) | | |
| Intensive care unit/OR/Cath lab | 14 (1.0%) | 43 (6.1%) | 27 (16.2%) | 6 (20.0%) | | |
| Diagnosed with Infection in the ED | 242 (17.4%) | 123 (17.3%) | 45 (26.9%) | 18 (60.0%) | 1.366 [1.184, 1.575] | <0.001 |
| Diagnosed with sepsis on hospital discharge | 31 (2.2%) | 53 (7.5%) | 42 (25.1%) | 21 (70.0%) | 4.211 [3.406, 5.206] | <0.001 |
| In-hospital mortality[c] | 3 (0.2%) | 16 (2.3%) | 12 (7.2%) | 1 (3.3%) | 3.301 [2.282, 4.777] | <0.001 |
| Hospital length of stay[b] (HLOS) | 2.0 ± 9.2 | 3.2 ± 7.7 | 3.95 ± 6.0 | 9.5 ± 13.6 | [g] | <0.001 |
| Intensive care unit length of stay[b] (ICU LOS) | 0.08 ± 1.2 | 0.27 ± 1.8 | 0.47 ± 1.9 | 1.27 ± 3.6 | [g] | <0.001 |

[a] Analyzed using Chi-squared analysis unless otherwise specified.
[b] Analyzed using ANOVA.
[c] Analyzed using Fisher's exact test.
[d] Analyzed using regression (logistic for binary outcome variables, multinomial for categorical outcome variables with >3 categories, or linear for continuous variables).
[e] Given qSOFA cannot predict age but rather age possibly predicts qSOFA, this variable was analyzed using logistic regression for binary qSOFA outcome and age as predictor.
[f] Multinomial OR reported in Table 4.
[g] Standard Poisson regression output recorded in Table 5.

infection, pain (acute on chronic or chronic), congestive heart failure, intracranial bleed, hypoglycemia, malnutrition, and psychiatric illness.

Nine of the thirty qSOFA 3 patients were transported non-STAT by EMS, and all were diagnosed with sepsis (88.9%) except one, who was diagnosed with respiratory failure. They were all transported to higher acuity zones, 55.6% to mid- and 44.4% to high-acuity. On more extensive chart review of these nine patients, it appears that the majority had mildly abnormal vital signs (SBP 90–100, RR low 20s) that were unchanging or improving during transport. Two of these patients had SBP ≤ 70 during transport, yet were transported non-STAT. Only one of the qSOFA 3 patients was transported to a low-acuity zone; this patient was transported from a skilled nursing facility, with a physician order for life sustaining treatment (POLST) form stating: "do not resuscitate (DNR), comfort-measures only". This patient was diagnosed as septic, not up-triaged during his ED stay, and ultimately expired during hospitalization. The only patient among the thirty qSOFA 3 patients who was up-triaged to high-acuity from mid-acuity was the patient diagnosed with respiratory failure, and none of the septic patients in the mid-acuity zone needed up-triage during their ED stay.

## 4. Discussion

We found that pre-hospital qSOFA was specific, but not sensitive, for ED diagnosis of infection, in-hospital diagnosis of sepsis, and in-hospital mortality. This is consistent with results from similarly designed studies, as a recent meta-analysis found that qSOFA was 81.3% specific for the

**Table 4**
qSOFA score as predictor for initial triage zone, final triage zone, and disposition decision.

| | | OR [95% CI] of qSOFA score as predictor[a] 1 | 2 | 3 |
|---|---|---|---|---|
| Initial triage zone[b] | Yellow | 2.51 [1.96, 3.21] | 5.99 [3.94, 9.12] | 38.88 [4.65, 324.89] |
| | Red | 4.97 [3.75, 6.58] | 14.94 [9.81, 22.75] | 280.25 [37.42, 2098.66] |
| Final triage zone[b] | Yellow | 2.13 [1.68, 2.69] | 4.96 [3.20, 7.69] | 23.73 [2.76, 204.09] |
| | Red | 4.28 [3.30, 5.54] | 14.98 [9.89, 22.68] | 205.38 [27.54, 1531.49] |
| Admission location[c] | Floor | 1.64 [1.36, 1.99] | 2.22 [1.54, 3.18] | 26.67 [3.48, 204.54] |
| | Stepdown | 3.45 [1.82, 6.54] | 7.66 [3.28, 17.86] | 535.88 [64.91, 4423.95] |
| | ICU/OR/Cath | 7.84 [4.24, 14.50] | 27.89 [13.93, 55.83] | 390.43 [44.06, 3460.12] |

[a] qSOFA score 0 was reference group.
[b] Green Zone not reported given it was the reference group.
[c] Those not admitted served as the reference group.

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**Table 5**
qSOFA score as predictor for hospital and ICU length of stay (LOS)[a].

| | Model variable [95% Wald CI] | Intercept [95% Wald CI] | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|
| Hospital LOS (days) | 0.423 [0.392, 0.454] | 0.710 [0.676, 0.744] | 2.03 | 3.10 | 4.74 | 7.24 |
| ICU LOS (days) | 0.896 [0.794, 0.998] | −2.403 [−2.551, −2.254] | 0.09 | 0.22 | 0.54 | 1.33 |

[a] Analyzed with standard Poisson regression.

diagnosis of sepsis among ED patients, but was only 46.7% sensitive [5]. qSOFA was not designed to be a screening tool [12] and a negative qSOFA score cannot rule out the diagnosis of sepsis.

Although pre-hospital qSOFA is not a useful screening tool, it does appear to identify patients at higher risk for poor outcomes. In our study, increasing pre-hospital qSOFA score was strongly associated with the diagnosis of sepsis, ICU admission, ICU and hospital length of stay, and in-hospital mortality. Other studies in ED patients have found similar results [4]. Among patients suspected of having an infection in the ED, nearly 80% of those with a positive pre-hospital qSOFA score were ultimately diagnosed with sepsis on hospital discharge.

The specificity for in-hospital mortality in our study was also high at 91.9%. The reported sensitivity, specificity, and AUROC for qSOFA for short term mortality has ranged significantly between studies (29%–68%, 52%–97%, and 0.60–0.76 respectively) [4,5,8,13-16]. The original validation study found that for non-ICU encounters with suspected infection, qSOFA had good predictive validity for in-hospital mortality with an AUROC of 0.81 [17]. In our data set, among patients with ED diagnosis of infection and a positive qSOFA score, nearly one-tenth died during hospitalization. Mortality in all patients was only 0.9% among those who were qSOFA negative. It is noteworthy that the Surviving Sepsis Campaign, SCCM, and ESICM convened spring 2018 to discuss research priorities, and the resulting publication did note the limitations to qSOFA score [18].

We found that pre-hospital qSOFA was significantly associated with a STAT transport priority and a high acuity initial triage zone, but was not significantly associated with up-triage while patients were in the ED. This suggests that the addition of pre-hospital qSOFA to our existing

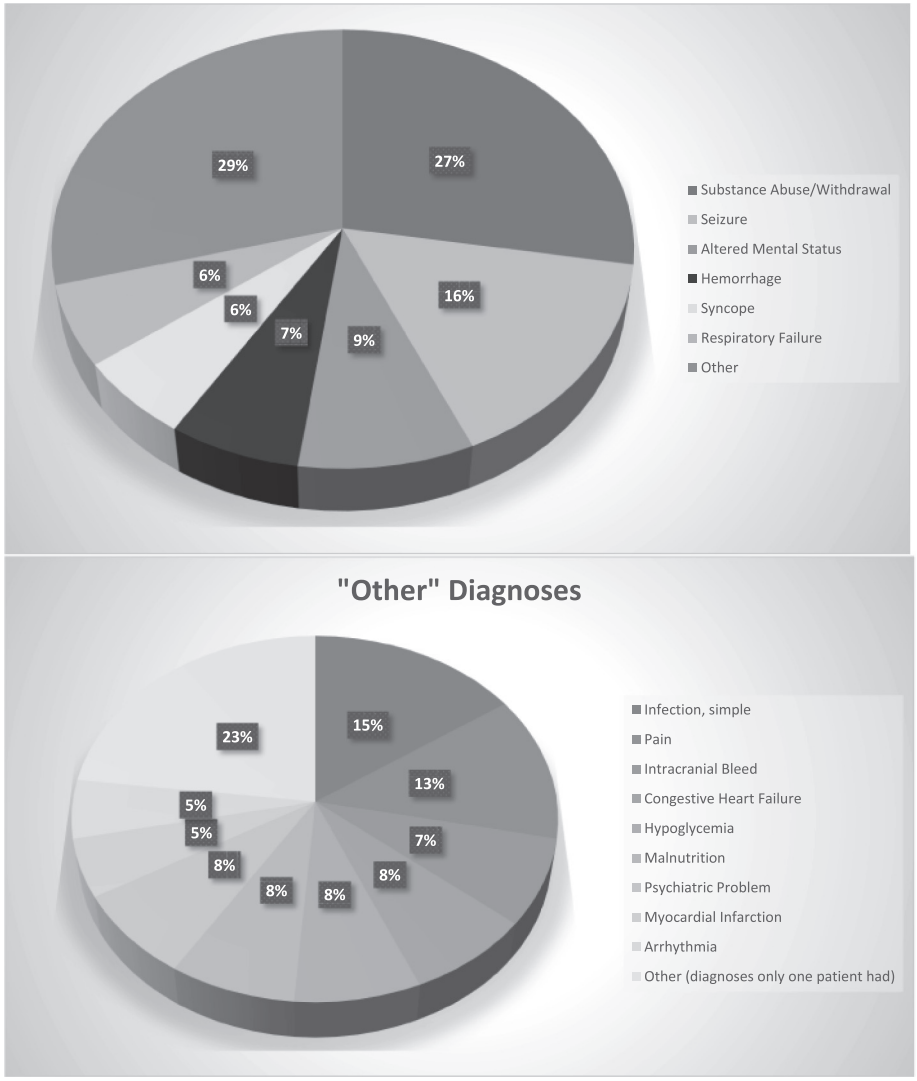


**Fig. 2.** Proportions of diagnoses for qSOFA positive, non-septic patients.

triage system would not likely be helpful, a finding consistent with other centers including a recent meta-analysis that assessed the value of triage qSOFA score [8,19–21]. Patients with positive pre-hospital qSOFA scores were readily identified by our current triage system as sick and requiring resuscitation. While 30% of the qSOFA 3 patients were not transported as STAT, this is not in compliance with EMS protocol [11]. This perhaps has identified an opportunity to educate our paramedic colleagues within our system, however it remains unclear if this would improve patient outcomes. Only one patient in this group required eventual up-triage to a higher acuity zone. This patient was not septic, but did require intubation for pulmonary edema and respiratory failure. Overall, pre-hospital qSOFA was not useful in identifying the well-appearing individual that later decompensated. We did find that more than half of all qSOFA positive patients were diagnosed with either sepsis or substance abuse or withdrawal. Among those who are qSOFA positive, these diagnoses should be strongly considered by the treating physician.

There were several limitations to our study. We did not compare qSOFA with other illness severity scoring systems, although such a comparison can be found in other studies. There was potential for systemic error in abstracting all the data manually; however, we found a high kappa score between abstractors. Given there were few patients with qSOFA 3, we had wide confidence intervals for this particular group. Also, this was a single center retrospective study and therefore extrapolating our results to other centers or settings may not be appropriate. Future studies should focus on finding clinical decision rules and guidelines that may help in the rapid identification of sepsis that may be used and easily applied in the pre-hospital setting, since qSOFA is insufficiently sensitive to be used as a screening test.

## 5. Conclusions

Pre-hospital qSOFA is specific, but not sensitive, for ED diagnosis of infection, discharge diagnosis of sepsis, and in-hospital mortality. Although strongly correlated with poorer outcomes, we did not find evidence to support the use of pre-hospital qSOFA in our current triage system.

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