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The Characteristics and Outcomes of Clinic Visits Immediately Preceding Sepsis Hospitalization

H. Catherine Miller, MD¹, Vincent X. Liu, MD, MS^{2,3}, Hallie C. Prescott, MD, MSc^{1,4}

¹Department of Internal Medicine, University of Michigan, Ann Arbor, MI.

²Kaiser Permanente Division of Research, Oakland, CA.

³Kaiser Permanente Santa Clara Medical Center, Santa Clara, CA.

⁴VA Center for Clinical Management Research, Health Services Research & Development Center of Innovation, Ann Arbor, MI.

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INTRODUCTION

Sepsis contributes to 1.7 million U.S. hospitalizations annually and has a 25–30% in-hospital mortality rate (1,2). Prompt management is important as hourly delays in antibiotics are associated with increased mortality (3,4). For this reason, sepsis quality improvement initiatives have focused on early recognition and treatment upon hospital presentation. However, there has been less attention to opportunities for identification and treatment in the pre-hospital setting.

Despite the current focus on early hospital care, many patients seek evaluation in other healthcare settings prior to hospital presentation. More than 45% of patients hospitalized for sepsis see a physician in the prior week (5), nearly 50% contact their primary care physician within 72 hours of admission (6), and 10–20% are seen in the outpatient setting on the day of admission (5). Yet, little is known about these outpatient visits. It remains unclear whether they represent an opportunity for earlier detection of impending sepsis, or conversely, whether they are unrelated to sepsis hospitalization and simply reflect the high burden of comorbid disease among sepsis patients.

We sought to understand the circumstances of clinic visits immediately preceding sepsis hospitalization—specifically, to measure (1) illness severity and symptoms, (2) the proportion of patients referred to the emergency department (ED) or hospital, and (3) the average time delay and change in illness severity from clinic to ED/hospital presentation.

METHODS

Setting and Cohort

Michigan Medicine (MM) is a tertiary academic center with 1,000 beds and 49,000 hospitalizations annually. We identified all adult medical and surgical hospitalizations with an ICD10 diagnosis of severe sepsis (R65.20) or septic shock (R65.21) discharged in 2017. We limited our cohort to patients with an established outpatient provider at Michigan Medicine so that outpatient visits could be examined in the electronic health record.

Chart Abstractions

Through manual chart review, we determined whether patients had a clinic visit within one calendar day of admission and then abstracted data from the clinic visit and ED/hospital presentation. Study definitions are presented in Table S2. Illness severity was measured by qSOFA score and vital sign abnormalities relative to a patient's own baseline. Change in illness severity was measured by increasing qSOFA score or change in vitals from clinic to ED/hospital presentation (*e.g.* increase in heart rate by 20+ beats per minute). Time lapse from clinic to ED/hospital presentation was calculated from vital sign timestamps. Cohort demographics and comorbidities were extracted using DataDirect, a query tool for our electronic health record.

We present data as number (%), mean (SD) or median (interquartile range). All analyses were conducted using Stata/MP version 15 (College Station, TX). This study was approved by University of Michigan IRB (HUM00146288).

RESULTS

We identified 1,450 adult sepsis discharges in 2017, including 1,150 (79.3%) patients with an established outpatient provider. Of these 1,150 patients, 118 (10.3%) were seen in clinic—88 (74.6%) on day of and 30 (25.4%) on the day prior to admission. The majority (73.7%) of these visits were routine, while 26.3% were acute. Patients were a median 58 years old (IQR 49–70), majority male (61.0%) with a moderate-high comorbidity burden (median Charlson score 6, IQR 3–9) (Table 1).

In clinic, most patients (65.2%) had abnormal vitals and/or a qSOFA ≥ 1 . Specifically, 37 (31.3%) had qSOFA of 1, 10 (8.5%) had qSOFA of 2, and 59 (50%) had abnormal vitals. Of the 47 patients with an abnormal qSOFA, only 9 had an abnormal qSOFA in prior clinic visits. Symptoms of infection or sepsis were documented in 95 (80.5%) patients, most commonly fatigue ($n=31$, 26.3%), fever ($n=28$, 23.7%), and decreased oral intake ($n=25$, 21.2%) (Table 1). Of the 41 patients with normal vitals and qSOFA, 28 (68.3%) reported symptoms in clinic.

The majority (74, 62.7%) of patients were referred directly to the ED/hospital. Of the 44 patients not referred to the hospital/ED, 9 (7.6%) were treated in the outpatient setting, and 35 (29.7%) were sent home without intervention.

Upon arrival to the ED/hospital, 62 (52.5%) patients had worsening illness severity; 42 (35.6%) had an increased qSOFA (Figure 1), 23 (19.5%) had an increased heart rate, 23 (19.5%) had decreased systolic blood pressure, and 27 (22.9%) had worsening of multiple parameters. Illness severity worsened in 37.8% of patients instructed to present vs 77.3% not instructed to present to the ED/hospital (Figure 1).

The median time lapse from clinic to ED/hospital was 3.2 hours (mean 8.3); 1.8 hours (mean 2.5) for patients instructed to present vs. 18.1 hours (mean 18.4) for patients not instructed to present. Ten (8.5%) patients died during hospitalization, of which 8 (80%) were instructed to present, and 5 (50%) had a clinic qSOFA of 0. Median time lapse for this subgroup was 1.4 hours (mean 4.2).

DISCUSSION

In this study, we found that 10% of patients hospitalized for sepsis were seen in clinic within one day of admission. In clinic, 80% had symptoms consistent with infection, and 64% had a qSOFA ≥ 1 or abnormal vital signs relative to his or her baseline. Most patients (63%) were referred to the ED/hospital, and over half of patients experienced worsening illness severity from clinic to ED/hospital presentation. The high burden of symptoms, abnormal vitals, and qSOFA ≥ 1 suggest that signs of impending sepsis were present in clinic for many patients.

Our results identify two populations that deserve attention. First, approximately one-half of patients experienced worsening illness severity over several hours between clinic and ED/hospital presentation, suggesting a trajectory of rapid deterioration requiring urgent action. These patients would benefit from an accelerated transfer and ED triage process. Second, one-third of patients had qSOFA of 0 and normal vital signs in clinic but were nonetheless hospitalized for sepsis shortly after the clinic visit. Majority of these patients reported symptoms consistent with infection, suggesting that it may still be possible to detect an increased risk for sepsis in clinic. Risk stratification algorithms incorporating non-vital sign-based features (*e.g.* symptoms consistent with infection, recent hospitalizations, repeated visits for unresolved symptoms) may assist physicians in identifying patients at high risk for deterioration.

Our study has several limitations. First, as a single-center study, it may not generalize to other settings. Second, mental status and respiratory rate were missing for many clinic visits. In these instances, we assumed normality, which may underestimate qSOFA in clinic and overestimate deterioration from clinic to ED/hospital. Finally, our study examined only patients who were ultimately hospitalized with sepsis.

In the future, we hope to compare our cohort to patients who were also evaluated in outpatient clinic during the same time frame, instructed to present to the ED for subjective or objective symptoms/signs concerning for infection but ultimately discharged home without admission. We hope that this will further delineate risk factors to identify those patients at highest likelihood of clinical deterioration. We anticipate that such work will contribute to the development of risk-stratification algorithms for sepsis identification in the outpatient setting.

In conclusion, 10% of patients were evaluated in clinic prior to sepsis hospitalization, the majority of whom had symptoms consistent with infection and objective evidence of illness. Potential opportunities to improve sepsis care in the outpatient setting include accelerated transfer to ED and risk-stratification algorithms that incorporate non-vital-sign based features.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Conflicts of Interest and Source of Funding:

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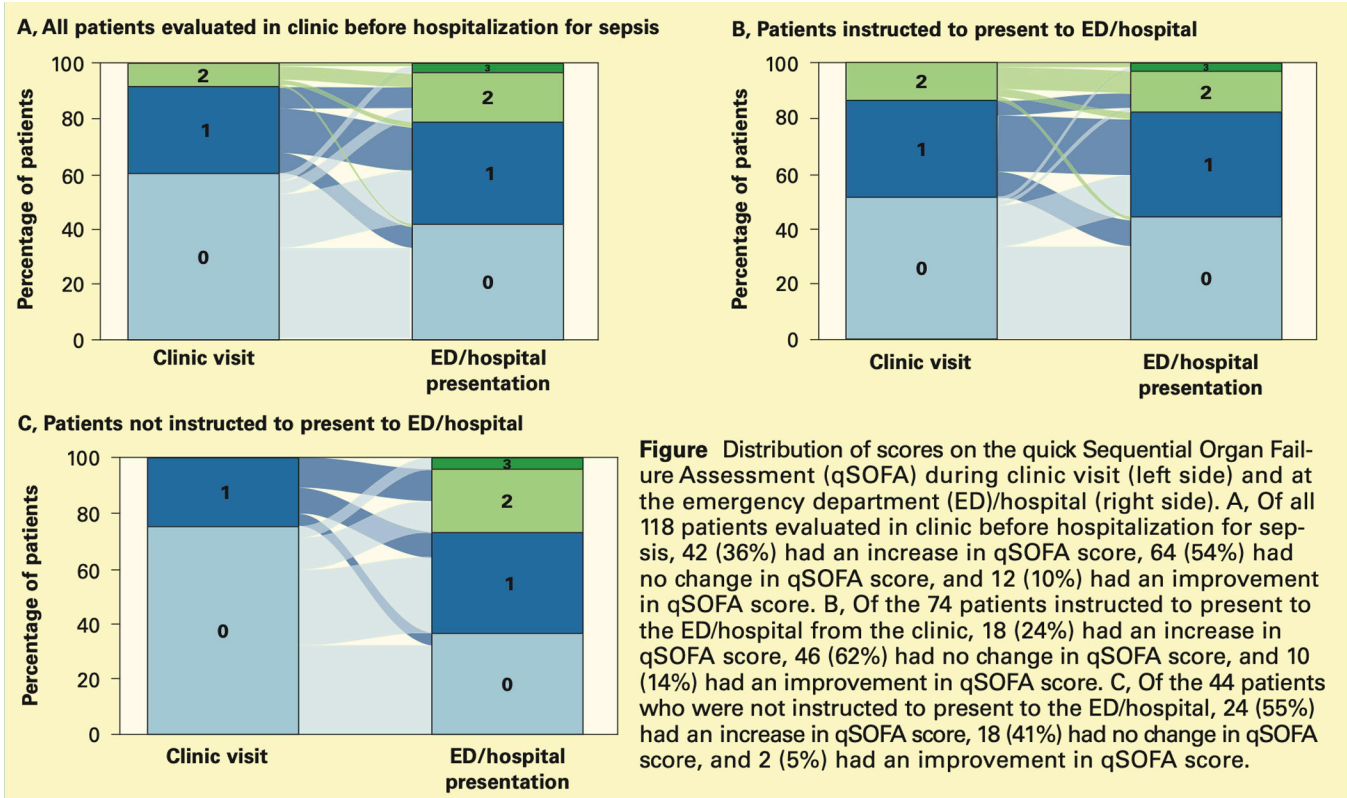


FIGURE 1: qSOFA at Clinic and ED/hospital Presentation

Figure 1a: Total Cohort

Figure 1b: Patients instructed to present to the ED/hospital

Figure 1c: Patients not instructed to present to the ED/hospital

This figure depicts the distribution of qSOFA scores during clinic (left column) versus ED/hospital presentation (right column). Of 118 patients evaluated in clinic prior to sepsis hospitalization, 42 (35.6%) had an increase in qSOFA, 64 (54.2%) had no change, and 12 (10.2%) had an improvement in qSOFA (1a). Of the 74 patients instructed to present to the ED/hospital from clinic, 18 (24.3%) had an increase in qSOFA, 46 (62.2%) had no change, and 10 (13.5%) had an improvement in qSOFA (1b). Of the 44 patients who were not instructed to present to the ED/hospital, 24 (54.5%) had an increase in qSOFA, 18 (40.9%) had no change in qSOFA, and 2 (4.5%) had an improvement in qSOFA (1c).

Table 1:

Patient, clinic visit, and ED/hospital characteristics

Patient Characteristics	
Age, median (IQR)	58 (49–70)
Race, n (%)	
African American	12 (10.2)
Caucasian	95 (80.5)
Other	11 (9.3)
Male, n (%)	72 (61.0)
Comorbid conditions	
Chronic pulmonary disease, n (%)	28 (23.7)
Diabetes, n (%)	56 (47.5)
Liver disease, n (%)	22 (18.6)
Metastatic cancer, n (%)	25 (21.2)
Chronic kidney disease, n (%)	32 (27.1)
Clinic Visit Characteristics	
Clinic Visit Type, n (%)	
Specialty care	80 (67.8)
Primary care	33 (28.0)
Urgent care	5 (4.2)
Specialist Visits, n (%)	
Gastroenterology/Hepatology	16 (13.6)
Hematology	5 (4.2)
Oncology	23 (19.5)
Physical Medicine and Rehabilitation	5 (4.2)
Surgical subspecialist	11 (9.3)
Other internal medical subspecialist ^a	16 (13.6)
Other specialist ^b	4 (3.4)
Acuity of clinic visit, n (%)	
Acute or urgent visit	31 (26.3)
Routine visit	87 (73.7)
Most common symptoms documented in clinic ^c , n (%)	
Fatigue	31 (26.3)
Fever	28 (23.7)
Decreased oral intake	25 (21.2)
Cough	23 (19.5)
Shortness of breath	21 (17.8)
Weakness	18 (15.3)
Chills	16 (13.6)
Skin edema or erythema	15 (12.7)
Abdominal pain	13 (11.0)

Nausea	12 (10.2)
None	23 (19.5)
qSOFA upon clinic presentation, n (%)	
qSOFA 0	71 (60.2)
qSOFA 1	37 (31.4)
qSOFA 2	10 (8.5)
qSOFA 3	0 (0.0)
Most common vital sign abnormalities documented in clinic ^d , n (%)	
Elevated heart rate	40 (33.9)
Decreased systolic blood pressure	28 (23.7)
Decreased diastolic blood pressure	17 (14.4)
Altered mentation	17 (14.4)
qSOFA abnormalities in clinic, n (%)	
Decreased systolic blood pressure	35 (29.7)
Tachypnea	5 (4.2)
Altered mentation	18 (15.3)
Clinic triage decision, n (%)	
Refer to the ED	64 (54.2)
Admit directly to the hospital	10 (8.5)
Outpatient evaluation/treatment	9 (7.6)
Discharge home without further evaluation/treatment	35 (29.7)
ED/hospital characteristics	
qSOFA upon hospital presentation, n (%)	
qSOFA 0	49 (41.5)
qSOFA 1	44 (37.3)
qSOFA 2	21 (17.8)
qSOFA 3	4 (3.4)
Changes in illness severity from clinic to ED/hospital, n (%)	
Decrease in systolic blood pressure	23 (19.5)
Increase in heart rate	23 (19.5)
New tachypnea	21 (17.8)
Newly altered mental status	14 (11.9)
Decrease in diastolic blood pressure	13 (11.0)
New hypoxia or oxygen requirement	5 (4.2)
Length of hospital stay (days)	
Median	6
Mean	9.47
ICU characteristics, n (%)	
Admitted to an ICU ^e	37 (31.4)
Treated with vasopressors	19 (16.1)
Received mechanical ventilation	21 (17.8)

^aOther internal medicine subspecialist included Allergy, Cardiology, Endocrinology, Infectious Disease, and Sleep Medicine.

^b Other specialists included Dermatology, Ophthalmology, Radiation Oncology.

^c Additional symptoms documented in <10% of clinic visits: diarrhea, dizziness or lightheadedness, exertional dyspnea, vomiting, confusion, painful skin lesion, nasal congestion, urinary frequency, urinary urgency, flank pain, sore throat, myalgias, dysuria, purulent skin lesion, malodorous urine.

^d Additional vital signs abnormalities documented in <10% of clinic visits: hypoxemia or new oxygen requirement, abnormal temperature, tachypnea.

^e 27 patients were admitted directly to an ICU, while an additional 10 patients were transferred to an ICU later during hospitalization.

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