

Improving Early Sepsis Recognition and Timely Antibiotic Administration in the Emergency Department: A PDCA-Based Quality Improvement Initiative

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Abstract: *Background:* Sepsis is a life-threatening condition associated with substantial morbidity, mortality, and healthcare utilization. In the emergency department (ED), early recognition and prompt antibiotic administration are essential components of high-quality care. In 2024, compliance with timely antibiotic administration for sepsis in our ED fell below the institutional target, with recurrent delays observed in obstetric and gynecologic (OB-GYN) presentations. *Objective:* To improve early sepsis recognition and increase the rate of timely antibiotic administration in the ED using a Plan-Do-Check-Act (PDCA) quality improvement framework. *Methods:* We conducted a single-center quality improvement initiative in the ED of Beijing United Family Hospital. Interventions included implementation of a triage sepsis alert, screening with the National Early Warning Score 2 (NEWS2), a standardized sepsis order set, workflow standardization, targeted staff education on atypical and OB-GYN sepsis presentations, and monthly audit-and-feedback cycles. The primary outcome was the proportion of ED patients with sepsis or septic shock who received antibiotics within the target time window after recognition. Secondary process measures included time from triage to antibiotic order, time from order to administration, and time from triage to first antibiotic dose. *Results:* Following implementation, timely antibiotic administration improved from 33% at baseline to 100% from August 2024 through January 2025. Although monthly case numbers were small, sustained full compliance across consecutive months suggested improved process reliability. The mean time from triage to antibiotic order was approximately 5 minutes, the mean time from order to administration was approximately 6 minutes, and the mean time from triage to first antibiotic dose was approximately 11 minutes. *Conclusion:* A PDCA-based sepsis quality improvement initiative was associated with substantial and sustained improvement in timely antibiotic administration in the ED. Standardized recognition processes, clear escalation pathways, and continuous feedback may improve the reliability of sepsis care, including in atypical presentations such as OB-GYN cases.

Keywords: Sepsis; Septic shock; Emergency department; Quality improvement; PDCA; Antibiotics; NEWS2

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1. Introduction

Sepsis, defined by the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3), is a life-threatening organ dysfunction caused by a dysregulated host response to infection ^[1]. In clinical practice, organ dysfunction is commonly operationalized as an increase of 2 or more points in the Sequential Organ Failure Assessment (SOFA) score in a patient with suspected or confirmed infection ^[1]. Septic shock is a severe subset of sepsis characterized by persistent hypotension requiring vasopressor therapy to maintain a mean arterial pressure of at least 65 mmHg and a serum lactate level greater than 2 mmol/L despite adequate fluid resuscitation ^[2].

Sepsis remains a major global health burden and is associated with substantial morbidity, mortality, prolonged hospitalization, intensive care utilization, and increased healthcare costs ^[3,4]. A global burden analysis estimated that sepsis accounted for 48.9 million cases and 11.0 million deaths worldwide in 2017 ^[3]. Mortality is particularly high in patients with septic shock, underscoring the need for early recognition and timely treatment ^[3,4]. Current international guidelines emphasize prompt initiation of evidence-based management, including early antimicrobial therapy, hemodynamic resuscitation, and source control where indicated ^[4].

Historically, sepsis recognition in the ED has relied heavily on clinician judgment, intermittent vital sign assessment, and the identification of overt clinical deterioration. This approach may delay diagnosis, especially in patients with atypical presentations or subtle early physiologic abnormalities, and such delays are associated with worse outcomes ^[4,5]. In recent years, sepsis care has evolved through the use of standardized screening tools, electronic alerts, and real-time monitoring systems to support earlier identification of high-risk patients ^[5,6]. These systems can strengthen detection but should be viewed as adjuncts to, rather than replacements for, clinical judgment.

In the ED, sepsis is an important quality target because it is common, time-sensitive, and highly dependent on the timeliness of initial management ^[4]. Among the key process measures in sepsis care, timely antibiotic administration is especially critical. However, performance may be limited by delayed recognition, workflow variability, and inconsistent implementation of sepsis pathways ^[4]. In response to these challenges, our ED implemented a structured quality improvement initiative based on the PDCA framework to improve early sepsis recognition and timely antibiotic delivery.

2. Objectives

This project aimed to:

- (1) Increase the rate of timely antibiotic administration for ED patients with sepsis or septic shock to a target of at least 98%, with a minimum acceptable threshold of 90%.
- (2) Standardize early sepsis recognition at triage using a sepsis alert and screening tool.
- (3) Implement a sepsis order set to improve the reliability of bundle elements, including lactate measurement, blood cultures before antibiotics when appropriate, fluid resuscitation, reassessment, and documentation.
- (4) Address recognition gaps in OB-GYN sepsis presentations through targeted education on pregnancy-related warning signs and escalation pathways.
- (5) Establish continuous monthly monitoring using audits and run charts to identify variation and support rapid corrective action.

- (6) Sustain improvement through case review, multidisciplinary feedback, and refresher training.

3. Methods

3.1. Study design and setting

This was a single-center quality improvement project conducted in the ED of Beijing United Family Hospital. The project used the PDCA framework to improve the timeliness and reliability of sepsis care processes.

3.2. Intervention

The intervention included several coordinated components:

- (1) Implementation of a triage sepsis alert within the nursing platform;
- (2) Use of a standardized screening process incorporating NEWS2;
- (3) Deployment of a standardized sepsis order set;
- (4) Workflow standardization for diagnosis documentation and treatment initiation
- (5) Immediate physician notification for patients with abnormal vital signs at triage; and
- (6) Targeted education for ED and triage teams, with particular emphasis on OB-GYN sepsis presentations.

3.3. Measures

The primary performance indicator was the sepsis antibiotic administration rate. The numerator was the number of adult ED patients with sepsis or septic shock who received antibiotics within the defined target time after recognition. The denominator was the number of ED patients with a sepsis alert or positive screening result and a final diagnosis of sepsis or septic shock. Performance was tracked through monthly audits using alert logs, screening forms, and timestamp review.

Secondary process measures included time from triage to antibiotic order, time from antibiotic order to administration, and total time from triage to first antibiotic dose.

3.4. Improvement cycle

Monthly performance data were reviewed to identify gaps and guide countermeasures. When performance fell below the threshold, the team reinforced education, refined alert criteria, optimized order set use, and conducted focused case reviews. Effective practices were retained through ongoing monitoring, feedback, and refresher training. See **Figure 1**.

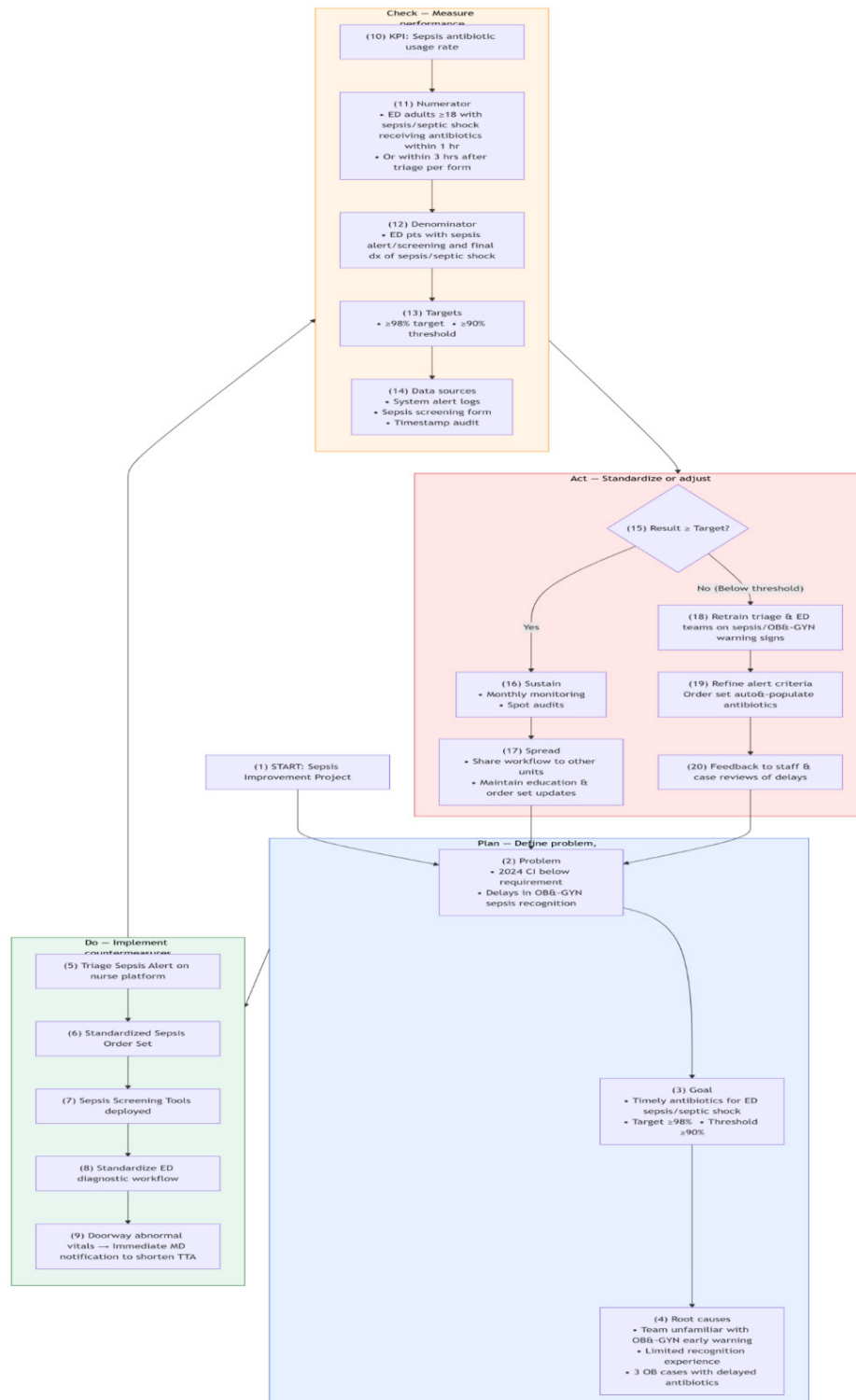


Figure 1. Monthly performance data.

4. Results

Following implementation of the PDCA-based intervention, timely antibiotic administration improved markedly. Monthly compliance increased from a baseline low of 33% to 100% from August 2024 through

January 2025. Although monthly case numbers were small, sustained achievement of 100% across multiple consecutive months suggests a meaningful improvement in process reliability rather than random variation.

NEWS2-triggered alerts clustered in clinically important acuity ranges, particularly scores of 5 to 7, indicating that the revised workflow was being applied in patients at meaningful risk of deterioration. This finding supports the clinical relevance of the intervention and suggests that the improvement was not solely attributable to documentation changes.

Process timing also improved substantially. The mean time from triage to antibiotic order was approximately 5 minutes, the mean time from order to administration was approximately 6 minutes, and the mean time from triage to first antibiotic dose was approximately 11 minutes. Together, these findings suggest that both recognition and operational execution improved after implementation.

5. Discussion

This quality improvement initiative was associated with substantial improvement in the timeliness of antibiotic administration for ED patients with sepsis. The findings suggest that sepsis care can be strengthened through a combination of standardized screening, simplified ordering, visible triage prompts, and continuous performance feedback.

Several factors likely contributed to the observed improvement. First, standardization reduced variation in early recognition and treatment initiation. Second, the sepsis order set appeared to streamline clinician decision-making and reduce delays between recognition and action. Third, targeted education addressed an important gap in atypical or less familiar sepsis presentations, particularly in OB-GYN cases. Finally, continuous audit and feedback supported rapid identification of barriers and reinforcement of desired practices.

The observed treatment intervals were favorable and suggest improvement in both the cognitive and operational components of care. The short interval from triage to order implies faster recognition and decision-making, while the short interval from order to administration suggests efficient nursing and medication-delivery processes. Together, these changes indicate a more reliable end-to-end sepsis workflow.

This study has several limitations. It was conducted at a single center, and the monthly number of sepsis cases was small, which limits statistical inference and generalizability. In addition, the project focused primarily on process measures rather than patient-centered clinical outcomes such as mortality, intensive care unit admission, or hospital length of stay. The impact of the intervention on these downstream outcomes remains to be determined. Future work should evaluate long-term sustainability and assess whether similar interventions can be scaled to other departments or patient populations.

6. Conclusion

A PDCA-based sepsis quality improvement initiative in the ED was associated with rapid and sustained improvement in timely antibiotic administration. Standardized triage alerts, structured screening, a sepsis order set, targeted staff education, and continuous feedback together improved workflow reliability and reduced treatment delays. These findings support the use of practical, system-based interventions to strengthen early sepsis care in the ED ^[7].

Disclosure Statement

The authors declare no conflicts of interest.

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