Improving Sepsis Bundle Implementation Times

A Nursing Process Improvement Approach

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ABSTRACT

Background: Early recognition of sepsis in the emergency room (ER) has been shown to improve treatment intervention times and decrease mortality.

Local Problem: Failure to recognize early signs and symptoms of sepsis in the ER has led to poor sepsis bundle completion times.

Methods: A comparison of preintervention and postintervention data was performed to determine whether sepsis bundle implementation times, mortality, and length of stay (LOS) improved.

Interventions: An ER Nurse Sepsis Identification Tool, leadership buy-in from key stakeholders, and systemic inflammatory response syndrome (SIRS) education were implemented.

Results: Postintervention, average bundle compliance time decreased 458 minutes ($P < .001$), average antibiotic administration time decreased 101 minutes ($P < .001$), overall sepsis mortality decreased 5.9% ($P = .074$), and there was no change to LOS.

Conclusions: The implementation of an ER early sepsis identification tool, leadership buy-in, and SIRS education can lead to improved bundle implementation times in the ER.

Keywords: early sepsis identification tool, emergency room, nursing, sepsis, sepsis bundle

In the United States, more than 1.7 million people are diagnosed with sepsis each year and over 270 000 Americans die as a result.[1] The mortality rate can be as high as 29% in patients diagnosed with severe sepsis and septic shock.[2] The Centers for Disease Control and Prevention[1] estimates that 1 in 3 hospital deaths in the United States involves sepsis. Sepsis is considered the most expensive hospital condition to treat, costing nearly $24 billion annually.[3,4] Every year nearly 850 000 emergency room (ER) visits are attributed to sepsis.[5] It is a challenge to accurately identify sepsis patients when ER nurses are not equipped with the proper screening tools.

The Surviving Sepsis Campaign's (SSC) guidelines recommend the implementation of 4 bundle elements (eg, measure lactate, blood cultures prior to antibiotics, antibiotics, and IV fluid resuscitation) as timely as possible with antibiotics within the first hour of ER triage.[6] In order for the implementation of sepsis bundles under the 1-hour window to be successful, it is critical that ER nurses recognize the signs and symptoms of sepsis. The purpose of this project was to evaluate the impact that implementing an evidence-based ER Nurse Sepsis Identification Tool (ERNSIT) has on sepsis bundle completion times (particularly antibiotic administration), mortality, and length of stay (LOS).

BACKGROUND

Early implementation of sepsis treatment interventions as soon as sepsis has been identified has significantly decreased mortality and improved patient outcomes.[2,6,7] According to the SSC, sepsis patient outcomes can be improved through performance improvement measures.[6] As a result, performance improvement indicators and treatment bundles were developed. SSC guidelines recommend obtaining lactate and blood cultures prior to antibiotics, administering antibiotics, and administration of intravenous (IV) fluids at 30 mL/kg within 1 hour of admission to the hospital.[8] In 2014, Ferrer et al[9] found that patients who received effective antibiotic treatment within the first hour of having signs and

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symptoms of severe sepsis or septic shock had an associated mortality rate of 32.0%. For every hour thereafter over the next 6 hours, the average survival rate decreased by 7.6%. By the sixth hour after onset, hospitalized patients were 1.52 times more likely to expire compared with patients who received antibiotics within the first hour of sepsis recognition.[9] The results highlight the importance of early identification and treatment of sepsis patients. Sepsis is a time-sensitive condition and should be recognized as an emergent situation that requires immediate treatment.[2,6-8]

Many challenges exist when initiating sepsis treatment protocols, and there are several sepsis screening tools in practice with different alert mechanisms.[10,11] The identification of signs and symptoms of sepsis, initiation of sepsis treatments, and timely initiation of those interventions remain the biggest barriers to achieving SSC's 1-hour implementation goal.[7-9] However, the impact of nurse-led sepsis screening tools has demonstrated improvements in early recognition of sepsis.[12] Lehman and Thiessen[13] have also shown there are improvements to bundle compliance, quality metrics, and patient outcomes through developing process improvement (PI) strategies.

The process of sepsis care at a 310-bed acute care hospital located in the Southeast region of the United States begins with the screening for sepsis upon admission to the ER. Patients are triaged based on acuity and resource needs. A triage nurse must make the decision whether a patient needs to be seen immediately by a physician or whether the patient can wait in the ER waiting room. Patients with an Emergency Severity Index level of 1 or 2 are seen immediately by a physician and/or placed in a bed immediately. This patient population generally receives all sepsis bundle elements within the recommended 1-hour timeframe. Patients with a triage level of 3 or greater could potentially wait in the ER waiting room for an extended time before seeing a physician depending on ER volume at the time of the patient's arrival. This patient population is at a greater risk of not receiving sepsis bundles in a timely manner, and this has been identified as a primary barrier to successful bundle implementations.

The purpose of this project was to implement an evidence-based ER nurse sepsis screening tool to assist ER nurses with early identification of signs and symptoms of severe sepsis and septic shock in an effort to improve sepsis bundle compliance, bundle completion times, and ultimately improve antibiotic administration times in the ER. Bruce et al[14] found antibiotic administration times and lactate collection improved when implementing a sepsis screening tool for patients admitted to the ER with a final discharge diagnosis of severe sepsis or septic shock. An evaluation of clinical data was included to identify potentially septic patients who did not have an initial ER sepsis diagnosis. In addition to evaluating bundle implementation times, this project analyzed mortality and LOS. Early bundle implementation can significantly decrease mortality and improve patient outcomes.[2,4,6]

METHODS

The John Hopkins Nursing Evidence-Based Practice (JHNENP) model was used as a framework for this evidence-based PI project. The JHNENP model is specifically designed for practicing nurses using a process called PET: practice question, evidence, and translation.[15] The Plan-Do-Study-Act cycle was used throughout the duration of this project to accelerate quality improvement. A multidisciplinary team consisting of the chief nursing officer, chief medical officer, ER director, ER educator, nursing staff, and project leader was developed. This team evaluated barriers to the early identification of sepsis in the ER, approved the intervention, and analyzed data throughout the project. An institutional review board reviewed the project proposal and declared it exempt.

Interventions

Evidence-based screening tool development and workflow

The paper-based ERNSIT was developed using SSC's guidelines[4] and evaluated by the multidisciplinary team. The tool was developed with a focus in identifying patients with 2 or more systemic inflammatory response syndrome (SIRS) indicators at triage: temperature more than 38°C or less than 36°C, heart rate more than 90 beats per minute, respiratory rate more than 20 breaths per minute, white blood cell count less than 4000 or more than 12 000 or immature neutrophils more than 10%, and arterial carbon dioxide tension less than 32 mm Hg. Once a patient was identified with 2 or more positive SIRS indicators, a "code sepsis" was called

through the overhead hospital intercom system, and the ER physician was notified to implement the electronic sepsis order set through the electronic health record. The nurse continued to use the ERNSIT to track the progress of the sepsis bundles and documented the date and time each bundle element was implemented: lactic acid, blood cultures × 2, antibiotic administration, IV fluid administration (30 mL/kg), and repeat lactate within 1 hour of ER triage.

If the patient was admitted to the hospital, the ERNSIT was included in the SBAR (Situation, Background, Assessment, and Recommendation) process and given to the inpatient nurse to continue sepsis bundle implementation tracking and documentation. Once the ERNSIT was complete, the tool was collected by the sepsis coordinator and reviewed with the project leader. Each week, patients with a discharge diagnosis of severe sepsis and septic shock were reviewed along with PI opportunities.

Education and leadership rounds

During the implementation phase, education was provided to both morning and night shift staff a week prior to go-live during the daily safety huddle rounds. The ER director provided staff with why this project was important to improving the quality of care provided to sepsis patients. On the day of go-live, staff again were educated on the process and screening tool. The project leader rounded in the ER daily (Monday to Friday) to evaluate the intervention process. Nurses and physicians were queried during rounds to evaluate possible PI opportunities.

Measures and analysis

This PI project plan evaluated data elements during the pre- and postimplementation phases of hospitalized patients with a final diagnosis of severe sepsis and septic shock admitted through the ER. Preintervention data were collected from December 2017 to July 2018 and postintervention data collection was from August 2018 through January 2019. The project plan consisted of 2 phases. During the first phase, the Clinical Data Warehouse was used to identify dependent and independent variables. This phase laid the foundation for the second phase. During the second phase, a detailed comparative analysis was completed to determine the impact the ERNSIT had on the average time to complete sepsis bundles, the average time to antibiotic administration, the average LOS, and mortality. Calculations between ER triage time (time zero) and the time to obtain lactate and blood cultures, as well as the time to administer first antibiotic and IV fluids, were performed.

Pre- and postintervention data were used to determine whether there was a significant change in bundle implementation times, antibiotic administration time, the average LOS, and mortality. This included a statistical analysis using SPSS version 25 (IBM Corp, Armonk, NY). The pre- and postimplementation average bundle completion time and antibiotic administration time were compared using Levene's test. A 2-sample *t* test was conducted to evaluate variation in LOS among pre- and postintervention patients. Lastly, a Pearson χ^2 was conducted to evaluate differences in mortality for both the pre- and postintervention patient populations.

RESULTS

Preintervention data

Prior to the intervention, the average time to complete sepsis bundles was 593 minutes in ER patients (n = 165) with a final diagnosis of severe sepsis or septic shock. This is 888% above the SSC's recommended 1-hour goal and 360% above a hospital network's 90th percentile benchmark. During the baseline period of analysis, sepsis mortality was 12.1% (20/165) compared with 6% mortality benchmark. While the mortality rate is likely multifactorial, one presumed contributing factor is the time to effective antibiotic delivery. During the above period, appropriate antibiotics were delivered within 1 hour in 34.5% (57/165) of patients with sepsis present on admission to the ER.

As displayed in the Table, the average time to complete sepsis bundles in patients diagnosed with severe sepsis (n = 100) and septic shock (n = 65) was 593 minutes (median = 110) prior to the intervention. The average time to antibiotic administration during this period was 185 minutes (34.8% within 1 hour of triage). Average LOS was 9.15 days and mortality was 12.1%. Four patients were excluded due to incomplete sepsis bundles.

Postintervention data

As displayed in the Table, the average time to complete sepsis bundles in patients diagnosed with severe sepsis (n = 91) and septic shock (n = 54) decreased by 458 minutes from 593 minutes

Table. Bundle Completion Time, Antibiotic Completion Time, LOS, and Mortality

Variable	Preintervention (n = 165) Mean (SD)	Postintervention (n = 145) Mean (SD)	*P*
Time to bundle complete	593 (1388)	135 (236)	<.001
Time to antibiotic administration	185 (337)	84 (150)	<.001
LOS	9.15 (10.77)	9.17 (8.97)	.663
Mortality	12.1%	6.2%	.074

Abbreviations: LOS, length of stay; SD, standard deviation.

to 135 minutes ($P < .001$) postintervention. The average time to antibiotic administration during this period decreased 101 minutes from 185 minutes to 84 minutes ($P < .001$). Mortality decreased 5.9% from 12.1% to 6.2% (9/145, $P = .074$), and there was relatively no change in average LOS. Two patients were excluded due to incomplete sepsis bundles.

DISCUSSION

A diagnosis of sepsis can have a negative impact on hospitalized patients, their families, and health care organizations' ability to provide high-quality care. High-quality care and patient safety are of the utmost importance to the organization that participated in this PI project. Even with a significant focus in the sepsis program, opportunities still existed in bundle completion time, antibiotic administration time, LOS, and mortality. After the implementation of ERNSIT, overall bundle completion time ($P < .001$), antibiotic administration time ($P < .001$), and mortality ($P = .074$) decreased significantly in patients diagnosed with severe sepsis and septic shock. In an effort to continually improve, there will be a continued focus on education, particularly with new hires, and concurrent reviews with every sepsis case to identify opportunities that may lead to improvements in bundle completion times. Average LOS remained relatively flat possibly due to the number of comorbidities and complications during the postintervention phase, which was associated with the peak flu season. The change in LOS was not statistically significant. While other studies have shown the implementation of sepsis bundles in a timely manner can improve LOS,[16] this study did not yield the same results. LOS can be multifaceted, and it is unclear whether the timeframe and/or patient condition had any impact on LOS.

Limitations

The implementation of an evidence-based sepsis nurse screening tool was in a 19-bed ER that has close to 50 000 patient visits per year. While outcomes in this project could not be generalized across multiple organizations, the implementation strategies of this project could be utilized to improve early recognition of the signs and symptoms of sepsis. In addition, the tool was paper-based and not incorporated into the electronic health record due to time limitations. This potentially disrupted nurse workflow. Lastly, the tool was not incorporated into the new hire onboarding process. Future projects should consider these limitations in their implementation process.

CONCLUSIONS

This PI project demonstrated that the implementation of an ERNSIT screening tool can have a positive impact on bundle implementation times, antibiotic administration times, and mortality. Early identification of sepsis in the ER can have a direct impact on sepsis bundle implementation times. Having a multidisciplinary team along with buy-in from key stakeholders including leadership teams and staff are critical to the success of any PI project. Future recommendations using this project framework include developing a continuous PI approach when evaluating sepsis quality measures, include ongoing PI projects into the onboarding education process, and expanding education to inpatient nurses and providers. Early sepsis recognition in the ER leads to improved bundle implementation times, and the implementation of an evidence-based ERNSIT may improve the time in which nurses recognize the signs and symptoms of sepsis and ultimately improve patient outcomes.

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