Improving 3-Hour Sepsis Bundled Care Outcomes: Implementation of a Nurse-Driven Sepsis Protocol in the Emergency Department

Authors: Wendy R. Moore, MSN, RN, NE-BC, Alicia Vermuelen, MSN, RN, CEN, Rachelle Taylor, MSN, RN, David Kihara, MSN, RN, CRRN, and Erik Wahome, MSN, RN, Rochester, MN, Sioux Falls, SD, Richardson, TX, Kansas City, MO, and Lakewood, MO

CE Earn Up to 8.0 Hours. See page 734.

Contribution to Emergency Nursing Practice

- The current literature on treatment of sepsis in the emergency department indicates that early detection will improve patient outcomes.
- This article contributes recommendations for improvements in time to screen, implementation of bundled sepsis-care interventions, shorter emergency department stay, and total hospital days.
- Key implications for emergency nursing practice found in this article are the importance of developing nurse-driven protocols that facilitate implementation of bundled sepsis care and developing interdisciplinary communication processes that reinforce the time sensitivity in the management of sepsis.

Abstract

Problem: Sepsis, a life-threatening condition, can rapidly progress to death. The Hospital Inpatient Quality Reporting program has implemented bundled care metrics for sepsis care, but timely completion of these interventions is challenging. Best-practice interventions could improve patient outcomes and reimbursement. The purpose of this project was to improve the timeliness of sepsis recognition and implementation of bundled care interventions in the emergency department.

Methods: This evidence-based practice improvement project implemented a Detect, Act, Reassess, Titrate (DART)-based nursing protocol embedded within a checklist communication tool in the emergency department of a tertiary level-2 trauma center. Data comparisons between preintervention and post-DART protocol/checklist implementation included compliance with the individual Inpatient Quality Reporting 3-hour bundled elements, number of hospital days, and time to screen. Staff also completed a survey designed to assess their satisfaction with the DART algorithm/checklist. The Pearson χ^2 test was used to assess bundled-care intervention variables. Wilcoxon rank sum tests were used to explore hospitalization outcomes. Staff satisfaction survey results were summarized.

Results: Improvement was statistically significant for lactate levels, blood cultures, and early antibiotic administration in the intervention period compared with baseline. Time to screen, ED length of stay, and number of hospital days improved between baseline and the intervention period, with an average number of hospital days decreasing by 2.5 days. Compliance with all Inpatient Quality Reporting metrics increased from 30% to 80%.

Discussion: When the nurse-driven protocol and communication tool were implemented, compliance with time-sensitive sepsis bundled interventions improved significantly. The outcomes suggest nurse-driven protocols can improve sepsis outcomes.

Key words: Bundles; DART; Emergency department; Evidenced-based project; Protocol; Sepsis

Wendy R. Moore is a nurse in the Department of Nursing, Mayo Clinic, Rochester, MN.

Alicia Vermuelen is a nurse in the Department of Nursing, Avera McKennan Hospital and University Health Center, Sioux Falls, SD.

Rachelle Taylor is a nurse at United Health Care, Richardson, TX.

David Kihara is a nurse in the Department of Endocrinology and Nephrology, Truman Medical Center, Kansas City, MO.

Eric Wahome is a nurse at Truman Medical Center, Lakewood, MO.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

For correspondence, write: Wendy R. Moore, MSN, RN, NE-BC, Department of Nursing, Mayo Clinic, 200 First St SW, Rochester, MN 55905; E-mail: moore.wendy@mayo.edu.

J Emerg Nurs 2019;45:690-8.
Available online 22 June 2019
0099-1767

Copyright © 2019 Emergency Nurses Association. Published by Elsevier Inc. All rights reserved.

https://doi.org/10.1016/j.jen.2019.05.005

Sepsis is a life-threatening clinical syndrome that causes physiologic, biologic, and biochemical abnormalities in a deregulated response to infection.[1,2] It is the second leading cause of death in intensive care units and the tenth leading cause of death in the United States.[3] Moreover, the mortality rate for patients presenting to the emergency department with sepsis is 20% to 50%.[4] The incidence of sepsis has increased dramatically in the United States and globally. From 1979 through 2000, more than 1,665,000 cases occurred annually in US hospitals.[5] From 1998 to 2000, the incidence of sepsis increased from 13 to 78 cases per 100,000.[6] Similar increases in the incidence of sepsis have occurred in Australia, New Zealand, and England.[7] These increases most likely reflect the aging population, immunosuppression, and the increasing prevalence of infections caused by multidrug-resistant organisms.[6,7]

According to the Centers for Disease Control and Prevention (CDC), a patient with sepsis has an increased risk of developing complications or dying, in addition to accruing higher health care costs with treatment.[1] Moreover, earlier identification of sepsis and the use of evidence-based treatment could decrease the number of deaths by 92,000 per year, decrease the number of hospital days by 1.25 million annually, and decrease hospital expenditures by more than $1.5 billion.[8] Thus, given the increasing incidence of sepsis and the financial impact it has on health care costs and reimbursement and—more importantly—on patient outcomes and mortality rates, management of sepsis is a clinical, societal, and organizational priority.

In 2015, the Centers for Medicare & Medicaid Services (CMS) introduced a new quality measure as part of the Inpatient Quality Reporting (IQR) program. This measure outlines bundled care with specific time-sensitive interventions that should occur within 3 hours and 6 hours of time zero. Time zero is defined as the time of triage in the emergency department or, if the patient presented from elsewhere, from the earliest chart annotation consistent with all elements of severe sepsis or septic shock.[9] CMS reimbursement for care is directly correlated to the IQR-reported sepsis metrics, and the quality measures are passed only if 100% of the bundled care is met for the 3- and 6-hour time frames.

The IQR bundled care is based on the Society of Critical Care Medicine (SCCM) Surviving Sepsis Campaign (SSC),[9] which established international guidelines for sepsis and septic shock. The time-sensitive bundled-care interventions recommended by the SSC include measuring the lactate level, obtaining blood cultures, and performing a complete blood cell count; administering 30 mL/kg crystalloid intravenous (IV) fluid for hypotension or a lactate level of 4 mmol/L or more; and administering broad-spectrum antibiotics. The 6-hour bundle includes the use of vasopressors if needed after initial fluid resuscitation to maintain the patient's mean arterial pressure at 65 mm Hg or more. After the initial administration of fluid, if mean arterial pressure remains less than 65 mm Hg, or if the initial lactate was 4 mmol/L or higher, volume status and tissue perfusion are reassessed and treated with ongoing IV fluid boluses as necessary and followed with repeated measurement of lactate levels.

The American College of Emergency Physicians (ACEP) convened an expert panel on sepsis and developed the Detect, Act, Reassess, Titrate (DART) tool. *Detect* refers to identifying and executing sepsis measures appropriately; *act*, to administering 500 mL crystalloid bolus IV at 30 mL/kg in 1 hour; *reassess*, to the nurse staff re-evaluating the lactate level and the crystalloid bolus; and *titrate*, to addressing ongoing hypotension. This evidenced-based tool provides a guide for early detection and treatment of sepsis and septic shock and the acronym provides a ready reference to key components of care interventions for bundled care.[10]

The literature related to sepsis clearly identifies the SSC care guidelines as the gold standard for management of sepsis. In addition, given that these standards are embedded within the hospital-reporting IQR mandates for reimbursement, we focused efforts to align our project with this best evidence. We then centered the literature review on the nurse's role in sepsis care, early screening, protocols, and studies exploring enhancement of compliance within the emergency department. The literature suggests that early sepsis screening and recognition are critical components related to patient outcomes because early treatment and compliance with sepsis bundles decrease morbidity and mortality rates from complications of sepsis.[11]

Challenges related to the implementation of the sepsis bundles in the emergency department may include delayed diagnosis or screening, delayed initiation of antibiotics and IV fluids, and challenges related to communication during patient handoffs and transitions of care.[12] A study exploring these challenges within the emergency department implemented a nurse-based early sepsis screening tool, response protocols, and specific education and training for nurses.[13] Findings included increased detection of sepsis, a decrease in mortality, and a decrease in Medicare-related costs. Moreover, nurse-initiated protocols that support early screening, detection, and completion of bundled care have been shown to increase compliance with serum lactate, blood collection, and identification of sepsis. The sepsis cares (such as the administration of antibiotics and IV fluids) require multidisciplinary interaction to

procure the order and then to implement the order and have been shown in studies exploring implementation barriers to be problematic in regard to compliance and timing of cares, highlighting the need for enhanced team communication.[14-16]

The aims of this evidenced-based practice project were to 1) evaluate the impact and effectiveness of a nurse-driven DART protocol, 2) develop a checklist communication tool to enhance communication within the interdisciplinary team, and 3) track sepsis care needs in compliance with the established 3-hour bundle metrics. We focused only on the 3-hour care bundle because patients are rarely transferred from emergency departments during the first 3 hours, and the findings would likely be translatable to the 6-hour care bundle if the interventions were successful. The population/patient Problem, Intervention, Comparison, Outcome, Time (PICOT) question for this project was as follows: For adult patients admitted in the emergency department (*problem*), how does implementation of a nurse-driven DART algorithm and checklist communication tool (*intervention*) compared with lack of using these tools (*comparison*) affect sepsis quality outcomes (*outcome*) within 3 hours of admission (*time*)?

Methods

SETTING

The project was reviewed and approved by both the university and the project site institutional review boards as an exempt quality project. The project organization is a 400-bed level-2 trauma center in the upper Midwest. At the time of the project, the emergency department reported more than 26,000 annual patient visits, with 2% to 3% meeting the sepsis criteria. Before the intervention, sepsis bundle adherence occurred in 30% of the ED patients with sepsis diagnoses, and process improvement was given priority.

INTERVENTIONS

A nurse-driven sepsis algorithm based on the aforementioned DART tool was developed by the project team (Table 1). A checklist was developed to track progression with DART and IQR bundled care (Figure 1). This checklist also served as the basis for communication with all care transitions and multidisciplinary handoffs, keeping the focus on the timing of the next reassessment, titration, or intervention. The checklist was then used to track the DART bundled care.

TABLE 1
DART (Detect, Act, Reassess, Titrate) Protocol

Detect
Identify sepsis early (complete sepsis screening tool)
Broadcast, "Code sepsis"
Measure lactate level and start blood cultures according to order from physician
Act
Give 500-mL crystalloid bolus
Anticipate an order for antibiotics administered as soon as possible
Reassess
Remeasure lactate ≤6 hours after initial lactate measurement
Reassess volume status after fluid boluses
Titrate
Monitor patient response (heart rate, blood pressure)

Modified from DART, American College of Emergency Physicians;[10] adapted with permission.

To further enhance general awareness within the care setting, a "code sepsis" was called over the loudspeaker within the emergency department whenever a patient had a positive screening for sepsis, thereby alerting all staff that a patient required time-sensitive sepsis-related care. This was implemented to engender a culture of urgency among staff in regard to management of sepsis. The checklist communication was to be used during all patient handoffs to keep a focus on time sensitivity related to interventions.

Before implementing the project, all ED staff received education regarding sepsis and the DART communication checklist. The education consisted of key points about the rise in sepsis, review of sepsis bundle-care goals, and current quality performance data for bundled care. Education was completed through meetings with oral presentation of didactics and the ability to discuss concepts followed by online reference material over the course of 2 weeks.

After project implementation, ongoing feedback was provided to the entire team on findings from bundled-care audits with specific e-mail notes identifying a lapse in care compliance or identification of successful implementation. In addition, verbal follow-up from the project coordinator was provided, and educational needs were addressed at those times. Finally, after project completion, an online survey was distributed to the staff to obtain input regarding the project, processes, and tools.

A retrospective chart review of patients who had confirmed positive sepsis screenings or diagnoses was completed for 90 charts over a 2-month period before the

Severe Sepsis/Septic Shock Checklist	Time
Positive sepsis screening: Severe sepsis screening completed with triage assessment **Severe sepsis criteria:** Sepsis plus evidence of organ dysfunction (any 1 of the following): ☐ SBP <90 ☐ MAP <65 ☐ SBP decrease of 40 points ☐ Lactate >2.0 ☐ Acute respiratory failure with need for invasive or noninvasive ventilation	Time zero ED arrival time _____
Blood cultures: 2 samples drawn with IV start and sent to laboratory	
Initial lactate Lactate level _____	
IV fluids: 30 mL/kg to be administered if patient exhibits signs of **septic shock** **Septic shock**: Severe sepsis plus signs of tissue hypoperfusion or evidence of organ dysfunction (any 1 of the following): ☐ SBP <90 ☐ MAP <65 ☐ SBP decrease of 40 points ☐ Lactate >4.0 ☐ Acute respiratory failure with need for invasive or noninvasive ventilation Patient weight in kg_____ x 30 mL = _____ mL Total IV fluids given in ED = _____ (goal is to give IV fluids within 3 hours of positive sepsis screening time). Recheck BP within 1 hour of fluid bolus completion	IV fluids start:
Vasopressors: Norepinephrine preferred if not responsive to initial 30 mL/kg fluid bolus or with profound hypotension while concurrently receiving fluids	Vasopressor: Yes/No If yes, time _____
Antibiotics: Goal is to administer in <1 hour. Name of antibiotic _____	Antibiotic start time _____
Recheck lactate: If initial lactate is >2.0, recheck within 3 hours	Recheck lactate due_____

FIGURE 1

Nursing Communication Checklist. Blood pressure (BP), mean arterial pressure (MAP), and systolic blood pressure (SBP) are reported as millimeters of mercury; the serum level of lactate is reported as millimoles per liter. *ED,* emergency department; *IV*, intravenous.

intervention implementation (*baseline*), and 91 charts were reviewed for the 2-month postintervention data. The chart review included the performance tracking and time of completion of bundled-care interventions for lactate levels, blood cultures, antibiotics and IV fluids, and documentation of intake and output. In addition, arrival time in the emergency department and time to screen were tracked. In an effort to explore general financial care costs, available retrospective data were obtained for ED length of stay (LOS), total number of hospital days, and cost of care. Descriptive analyses were performed for baseline and intervention period data as mean (standard deviation [SD]), median, and range for continuous variables as well as number and percentage for categorical variables. The χ^2 test of independence was used to analyze relationships among the categorical variables: obtaining a lactate level, obtaining blood cultures, infusing IV fluids, administering antibiotics, and documenting input and output. Wilcoxon rank sum tests were used to explore differences between the interval variables: time to screen, ED LOS, hospital days, and cost. The level of significance was set at $P \leq 0.05$. A 5-question survey regarding staff satisfaction with the DART protocol/checklist implementation was sent electronically along with emails and reminders to complete the survey (Figure 2). Descriptive statistics were used to assess these responses, and open-ended comments were summarized. All analyses were performed with SAS JMP statistical software (Version JMP14, SAS Institute Inc, Cary, NC). Standards for Quality Improvement Reporting Excellence guidelines[17] were followed.

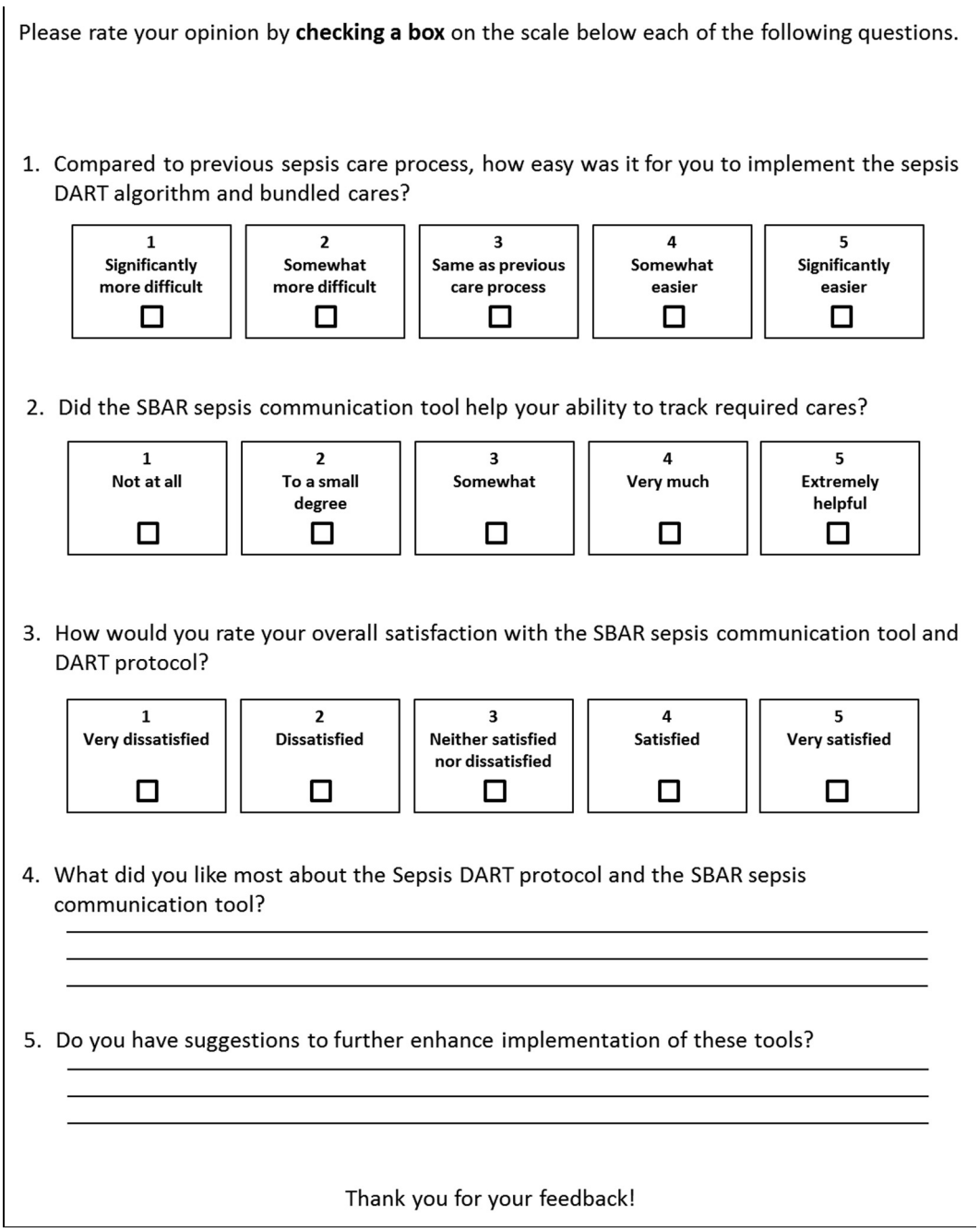

FIGURE 2
Project survey.

Results

Outcomes for compliance with bundled-care interventions are summarized in Table 2. The χ^2 test of independence comparing key bundled-care interventions at baseline and during the intervention period for patients with a positive screening for sepsis showed statistically significant improvements for the variables lactate ($\chi^2 = 8.9$, $P = 0.003$), blood cultures ($\chi^2 = 10.1$, $P = 0.002$), antibiotic initiation ($\chi^2 = 4.2$, $P = 0.04$), and intake and output ($\chi^2 = 21.4$,

TABLE 2
Bundled care intervention outcomes

Variable	Baseline, number of patients	Intervention period, number of patients	Pearson χ^2 value (*df* = *1*)	*P* value
Lactate			8.9	0.003
Yes	61	168		
No	8	4		
Blood cultures			10.1	0.002
Yes	51	155		
No	15	13		
Antibiotics			4.2	0.04
Yes	35	106		
No	28	43		
IV fluid			0.02	0.88
Yes	12	25		
No	16	31		
Intake and output			21.4	<0.001
Yes	63	165		
No	46	36		

$P < 0.001$). Overall compliance with meeting all the bundled IQR program metrics increased from 30% at baseline to 50% at the end of the first month of the intervention period and further improved to 80% by the end of the intervention period.

Wilcoxon rank sum test analysis showed no significant difference between baseline and the intervention period for time to screen ($z = 1.36$, $P = 0.17$), ED LOS ($z = 0.49$, $P = 0.62$), number of hospital days ($z = 1.12$, $P = 0.26$), and cost of care ($z = 0.25$, $P = 0.80$) (Table 3). Although the differences were not statistically significant, mean time to screen improved by 7 minutes, mean ED LOS decreased by 7 minutes, and mean number of hospital days decreased by 2.5 days during the implementation period.

Cost analysis (Figure 3) reflected a cost savings between baseline (mean cost, $13,355; range, $1,312 to $101,675) and the intervention period (mean cost, $8,561; range, $877 to $52,574). The difference of $4,794 was not

TABLE 3
Hospitalization outcomes

Variable	Baseline, mean (SD) (range) (N = 110)	Intervention period, mean (SD) (range) (N = 202)	Wilcoxon rank sum test *z* score	Wilcoxon rank sum test *P* value
Time to screen, min	29.30 (29.44) (1-138)	22.24 (20.60) (0-136)	1.36	0.17
ED LOS, min	220 (90.94) (47-565)	213 (76.03) (54-452)	0.49	0.62
Hospital days, No.	7.07 (8.99) (0-52)	4.50 (4.48) (0-26)	1.12	0.26
Cost, $	13,355 (20,457) (1,312-101,675)*	8,561 (8,412) (877-52,574)†	0.25	0.80

LOS, length of stay; *SD*, standard deviation
* n = 44
† n = 78

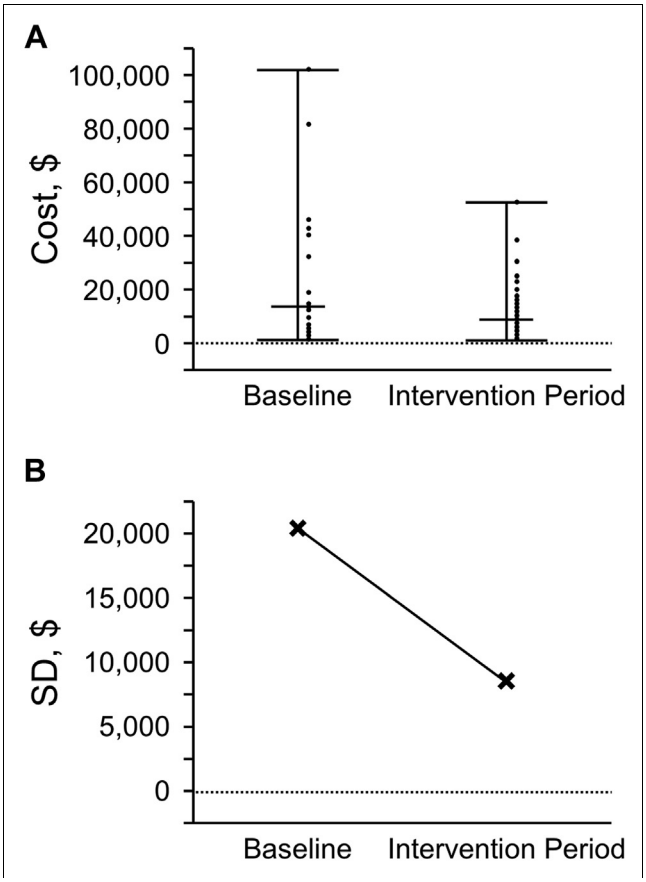

FIGURE 3

Variability in cost. (A) Cost at baseline and during intervention period. The upper and lower horizontal lines indicate the range; the horizontal line between the upper and lower lines indicates the mean. (B) Standard deviation (SD) of cost at baseline and during intervention period.

statistically significant, but it may have been important to the patient, to third-party payers, and—if multiplied over time and by patient volume—to organizational finances.

The staff survey had a low response rate of 9% (only 10 of 110 were completed). Of the nurses who responded, 80% (n = 8) reported that the nurse-driven DART algorithm was easy to use compared with previous sepsis-care processes and that it helped them initiate interventions with more fluidity. In addition, 90% of the respondents (n = 9) reported that the communication tool helped them track and organize care interventions. The self-entered survey comments emphasized the difficulty of managing care interventions that are time sensitive when caring for multiple patients. Nurses frequently expressed frustration because all team members did not respond to the sepsis code in a manner consistent with a cardiac code.

Discussion

This project was facilitated by strong organizational support and active participation by ED nursing and physician leaders. The project team actively followed the implementation process and communicated ongoing progress in a timely fashion. Each patient with a positive screening for the sepsis care bundles was tracked for compliance, and when a bundled-care intervention was not met on time, the project liaison reviewed this with the care provider involved with the patient's care for additional insight into barriers, reinforced the project process, and addressed educational opportunities. Staff members involved in care that met all IQR expectations were acknowledged by leadership with a personalized e-mail letter thanking them for their efforts and attention to detail, reinforcing their importance on care outcomes.

The management of sepsis is evolving once again with a new SSC proposal comprising a new bundled-care package focused on the first hour of care after a positive screening.[18] Implementation of this proposed bundle is on hold in the United States pending further review by the SCCM and the ACEP. However, this pending issue highlights a crucial point related to implementation of standards in the inpatient setting. Our project used a paper-based checklist communication tool that worked with protocols embedded within the electronic health record, which creates a potential disconnect because standards for best care evolve and change. Therefore, the integration of best practices and evidence-based care projects must be embedded within the electronic health record to be fully effective. Our paper-based project elicited improvement in timeliness of care, but updating paper sheets and dispersing new information regarding changes to care metrics is complicated in the paper format. Future studies should explore embedding tools, such as the ones our project piloted, into the electronic health record.

Limitations

Several barriers to project implementation were identified. The cost estimates did not include the entire sample, and this could have introduced a potential bias. Another limitation to this research was the lack of a control or comparison group. In addition, the implementation occurred in only 1 location and simultaneously with the organization's opening of a new freestanding emergency department, so additional new staff hires and environment of care changes were occurring simultaneously during our project. This situation affected our project

negatively because staff members needed to learn a large amount of new information and many care processes, requiring established team members to train several new staff members. This challenge was mitigated through active communication and by the study coordinator attending to the project needs and providing frequent feedback on outcomes and progress with goals. Overall, engagement to project aims improved in the second month of implementation.

Other limitations included the absence of a power analysis to determine the number of chart reviews required before and after the intervention. In addition, the low survey response rate from staff raised questions regarding the representation of this feedback. Future surveys are needed to explore staff satisfaction with the checklist communication tool and the DART algorithm.

Another limitation involved the use of paper tools, which contributed to a possible disconnect between charting in the medical record and a potentially inaccurate view of patient progress when comparing the medical record to the checklist. Such unintended effects are difficult to measure in clinical practice but emphasize the need to consider informatics issues and the institution's medical record when choosing to implement practice improvement projects into long-term use. Ideally, our paper forms would have been integrated into the medical record.

Implications for Emergency Nursing

Early recognition of sepsis is critical to patient outcomes, and emergency nurses are often the first to assess patients for sepsis. The DART-based checklist and communication tools used in this project showed promise, and more attention should be given to the development of protocols that assist the nurse in implementing bundled sepsis care.

Conclusions

During the initial 2 months of implementation, institutional IQR compliance rates meeting all 3-hour bundle interventions increased from 30% to 80%. Results of this project suggest that nurse-driven protocols facilitating rapid implementation of treatment interventions can have a positive impact on meeting IQR metrics and result in positive patient outcomes and shorter hospital stays. Future studies are needed to determine whether the approaches used in this study may be translatable to other organizations and care settings across the continuum of sepsis management.

Acknowledgment

The authors express sincere appreciation to Claudia Dietrich, MSN, RN, NE-BC, who served as project advisor for this capstone project.

Author Disclosures

Conflict of interest: none to report.

REFERENCES

1. Centers for Disease Control and Prevention. Making health care safer: think sepsis. Time matters [Internet]. https://www.cdc.gov/vitalsigns/pdf/2016-08-vitalsigns.pdf; 2016. Accessed December 6, 2018.
2. Singer M, Deutschman CS, Seymour CW, et al. The third international consensus definitions for sepsis and septic shock (Sepsis-3). *JAMA*. 2016;315:801-810. https://doi.org/10.1001/jama.2016.0287.
3. Martin GS, Mannino DM, Eaton S, Moss M. The epidemiology of sepsis in the United States from 1979 through 2000. *N Engl J Med*. 2003;348:1546-1554.
4. Dellinger RP, Levy MM, Rhodes A, et al. Surviving sepsis campaign: international guidelines for management of severe sepsis and septic shock, 2012. *Intens Care Med*. 2013;39:165-228. https://doi.org/10.1007/s00134-012-2769-8.
5. Elixhauser A, Friedman B, Stranges E. *Septicemia in U.S. Hospitals, 2009:* Statistical Brief #122. *Healthcare Cost and Utilization Project (HCUP) Statistical Briefs [Internet]*. Rockville, MD: Agency for Healthcare Research and Quality; 2011.
6. Walkey AJ, Wiener RS, Lindenauer PK. Utilization patterns and outcomes associated with central venous catheter in septic shock: a population-based study. *Crit Care Med*. 2013;41:1450-1457. https://doi.org/10.1097/CCM.0b013e31827caa89.
7. Kaukonen KM, Bailey M, Suzuki S, Pilcher D, Bellomo R. Mortality related to severe sepsis and septic shock among critically ill patients in Australia and New Zealand, 2000-2012. *JAMA*. 2014;311:1308-1316. https://doi.org/10.1001/jama.2014.2637.
8. Centers for Disease Control and Prevention. Data reports Vol 2018 [Internet]. 2012. https://www.cdc.gov/nchs/; 2018.
9. Rhodes A, Evans LE, Alhazzani W, et al. Surviving sepsis campaign: international guidelines for management of sepsis and septic shock: 2016. *Intens Care Med*. 2017;43:304-377. https://doi.org/10.1007/s00134-017-4683-6.
10. American College of Emergency Physicians. DART [Internet]. https://www.acep.org/dart/#sm.0001g2fha1n5teskvkp2e82vh2va1; 2018. Accessed May 10, 2018.
11. Levy MM, Rhodes A, Phillips GS, et al. Surviving sepsis campaign: association between performance metrics and outcomes in a 7.5-year study. *Crit Care Med*. 2015;43:3-12. https://doi.org/10.1097/CCM.0000000000000723.
12. Cronshaw HL, Daniels R, Bleetman A, Joynes E, Sheils M. Impact of the surviving sepsis campaign on the recognition and management of severe sepsis in the emergency department: are we failing? *Emerg Med J*. 2011;28:670-675. https://doi.org/10.1136/emj.2009.089581.

13. Jones SL, Ashton CM, Kiehne L, et al. Reductions in sepsis mortality and costs after design and implementation of a nurse-based early recognition and response program. *Jt Comm J Qual Patient Saf*. 2015;41:483-491. https://doi.org/10.1016/S1553-7250(15)41063-3.

14. Bruce HR, Maiden J, Fedullo PF, Kim SC. Impact of nurse-initiated ED sepsis protocol on compliance with sepsis bundles, time to initial antibiotic administration, and in-hospital mortality. *J Emerg Nurs*. 2015;41:130-137. https://doi.org/10.1016/j.jen.2014.12.007.

15. Kent N, Fields W. Early recognition of sepsis in the emergency department: an evidence-based project. *J Emerg Nurs*. 2012;38:139-143. https://doi.org/10.1016/j.jen.2010.07.022.

16. Tromp M, Hulscher M, Bleeker-Rovers CP, et al. The role of nurses in the recognition and treatment of patients with sepsis in the emergency department: a prospective before-and-after intervention study. *Int J Nurs Stud*. 2010;47:1464-1473. https://doi.org/10.1016/j.ijnurstu.2010.04.007.

17. Goodman D, Ogrinc G, Davies L, et al. Explanation and elaboration of the SQUIRE (Standards for Quality Improvement Reporting Excellence) Guidelines, V.2.0: examples of SQUIRE elements in the healthcare improvement literature. *BMJ Qual Saf*. 2016;25:e7. https://doi.org/10.1136/bmjqs-2015-004480.

18. Society of Critical Care Medicine. Surviving sepsis campaign: SSC hour-1 bundle [Internet]. http://www.survivingsepsis.org/Bundles/Pages/default.aspx; 2018. Accessed December 6, 2018.

Editor's Note:

Strategies in this performance improvement project can be applied to optimize care using the current Surviving Sepsis Campaign guidelines, which have been updated and approved, effective January 10, 2019. Readers are encouraged to review the updated bundle time frames (Hour-1 Bundle) and terminology for the Surviving Sepsis Campaign at http://www.survivingsepsis.org/Guidelines/Pages/default.aspx and in the related guidelines.[1-3]

References

1. Levy MM, Evans LE, Rhodes A. The surviving sepsis campaign bundle: 2018 update. *Crit Care Med*. 2018;46(6):997-1000. https://doi.org/10.1097/ccm.0000000000003119.

2. Rhodes A, Evans LE, Alhazzani W, et al. Surviving sepsis campaign: International guidelines for management of sepsis and septic shock: 2016. *Crit Care Med*. 2017;45(3):486-552. https://doi.org/10.1097/CCM.0000000000002255.

3. Rhodes A, Evans LE, Alhazzani W, et al. Surviving sepsis campaign: International guidelines for management of sepsis and septic shock: 2016. *Intensive Care Med*. 2017;43(3):304-377. https://doi.org/10.1007/s00134-017-4683-6.