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A Quality Improvement Initiative to Evaluate the Effectiveness of the ABCDEF Bundle on Sepsis Outcomes

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Sepsis affects 1.7 million Americans annually and often requires an intensive care unit (ICU) stay. Survivors of ICU can experience long-term negative effects. This quality improvement initiative was designed to increase compliance with ABCDEF bundle elements and improve clinical outcomes. A significant improvement was seen in the completion of spontaneous awakening and breathing trials ($P = .002$), delirium assessment ($P = .041$), and early mobility ($P = .000$), which was associated with a reduction in mortality and 30-day readmission rates. Findings were consistent with other research that demonstrated an improvement in care delivery and some clinical outcomes. **Key words:** ABCDEF bundle, length of stay, mortality, sepsis

SEPSIS is a life-threatening condition with profound national impact, affecting at least 1.7 million Americans annually and results in 270 000 American deaths each year.¹ Sepsis can be devastating for patients and their families due to multisystem or-

gan involvement, loss of work, extensive hospitalization, and even death. It is the costliest medical condition for hospitals to treat and resulted in a nearly \$24 billion national expenditure in 2013.² Despite considerable worldwide focus over the past 10 years, it remains one of the leading causes of death for hospitalized patients and the incidence of sepsis cases continues to rise each year.² Because their hospitalization often includes a stay in the intensive care unit (ICU), sepsis places patients at risk for experiencing pain, ventilator dependence, delirium, and immobility as a result of their ICU stay and may experience long-term cognitive defects, posttraumatic stress disorder, and depression.³

The American College of Critical Care Medicine published an updated Clinical Practice Guideline in 2013 in collaboration with the Society of Critical Care Medicine and the American Society of Health-System Pharmacists, which communicated recommendations for the management of adult ICU patients within the Pain, Agitation, and Delirium

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The authors thank all the nurses, therapists, unit-based nursing leaders, clinical nurse specialists, educators, quality coordinator, and biostatistician in the medical respiratory intensive care unit and the surgical intensive care unit for their participation and diligence in this project. In addition, the authors thank Percy Ittikathra for assisting with the education and Ashley Bonus, Crystal Brandt, and Anna Coppin for developing the Early Mobility Protocol.

Conflict of Interest: None declared.

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DOI: 10.1097/CNQ.0000000000000387

(PAD) guidelines.³ This was further developed into the “ABCDEF” bundle, which is an evidence-based guide for multidisciplinary care of all ICU patients.⁴ This bundle outlines strategies to Assess, prevent, and manage pain; complete Both spontaneous awakening and breathing trials; recommendations for the Choice of analgesia and sedation; plans to assess, prevent, and manage Delirium; focus on early mobility and Exercise; and encourage Family engagement/empowerment.⁴ When fully implemented, this comprehensive bundle was designed to prevent complications and improve care around some of the most challenging aspects of critical care nursing.

The ABCDEF bundle is an innovation that was created by a team of international experts after evaluating many randomized controlled trials and offers a strategy to combat the complications associated with sepsis. The ABCDEF bundle was designed to guide practice along a path that has the capacity to improve outcomes and shorten the ICU stay. Studies were able to accomplish these goals, particularly when more bundle elements were successfully completed.⁵⁻⁷ Bounds and colleagues⁷ demonstrated a significant reduction in overall prevalence of delirium, mean number of days with delirium, and increased the number of patients with delirium-free days after implementation of the ABCDEF bundle. Barnes-Daly and associates⁸ found that for every 10% increase in total bundle compliance, there was a 7% higher rate of hospital survival and a 15% increase in hospital survival was associated with every 10% increase in partial bundle compliance. Pun and colleagues⁴ found similar findings in hospital survival and appreciated an increased reduction in delirium and ventilator-days when a higher proportion of ABCDEF bundle elements were completed. A systematic review demonstrated a higher reduction in mortality when more ABCDEF bundle elements were utilized and ICU length of stay (LOS) was reduced when more than 6 bundle elements were implemented in comparison with fewer interventions.⁶

Delirium is a challenging complication to manage within the ICU environment and places patients at risk for prolonged ventilation, restraint use, longer hospital stays, increased hospital costs, and death.⁷ Therefore, it is imperative to first assess delirium accurately using a standardized tool and then take steps to prevent and effectively treat the problem. Early detection when subtle symptoms are present triggers the nurse to implement patient-centered interventions that may prevent long-lasting effects.⁹ Data suggest that use of benzodiazepines and psychoactive medications is a risk factor for delirium development.¹⁰

Early mobility was added to the PAD guidelines when it was developed into the ABCDEF bundle because bed rest was recognized as a strong contributing factor to ICU-acquired muscle weakness. This sequela can impair survival, physical performance, and quality of life.¹⁰ Studies have demonstrated that mobilizing ICU patients can be done safely and effectively, but the methods and frequency vary considerably.¹¹⁻¹³

The goal of this quality improvement (QI) intervention was to improve sepsis outcomes. The metrics the team identified included a reduction in total ventilator-days, ICU LOS, hospital LOS, in-hospital mortality, and 30-day readmission rates for patients with sepsis. Another key goal focused on improving registered nurse compliance with the ABCDEF bundle elements.

METHODS

This intervention was performed at a large (609-bed) Midwest metropolitan hospital within an economically and racially diverse community. This hospital is part of a not-for-profit integrated health system that serves 2.7 million unique patients. Most patients with sepsis are routinely cared for in the medical respiratory intensive care unit (MRICU) and the surgical intensive care unit (SICU). The MRICU is a 24-bed unit that cares for patients with a wide variety of medical conditions such as chronic obstructive

pulmonary disease exacerbation, sepsis, and pneumonia. SICU is a 21-bed unit that cares for patients with liver disease or those undergoing vascular, abdominal, and abdominal transplant surgery.

This QI intervention was reviewed by a formal internal university process approved by the institutional review board (IRB) using a QI checklist. It was determined not to be human subjects research. Therefore, this initiative was deemed QI in nature and not subject to IRB oversight.

A pre/posttest design was used, and a convenience sample of all patients with sepsis admitted to the MRICU and the SICU over a 3-month period was used. Patients with sepsis were identified through coded data that utilized provider documentation. Preimplementation data were collected between January 2019 and March 2019. Postimplementation data collection occurred between October 2019 and December 2019. Data on the registered nurse's utilization of the ABCDEF bundle elements before and after implementation were collected during this same time frame through medical record review. Aggregate data on in-hospital mortality for patients with sepsis were collected between January 2019 and March 2019 and between October 2019 and December 2019. The 30-day readmission rates were collected from January 2019 to March 2019 and from November 2019 to January 2020. Patients were included if they had an LOS of more than 24 hours. Patients were excluded if their LOS was less than 24 hours, or if they converted to hospice or palliative care within the first 24 hours after admission.

A multidisciplinary team of physicians, nurses, nurse leaders, a QI coordinator, and a biostatistician was gathered over a 4-month period to plan, implement, and evaluate the effectiveness of an education session on the ABCDEF bundle, including an Early Mobility Protocol. The existing electronic health record (EHR) and the sedation and analgesia order set for patients requiring mechanical ventilation were reviewed and determined to support the needed documentation for

pain and delirium assessment along with daily orders for interruption of sedation and spontaneous breathing trials. The nurse champions, with input from unit-based therapists, created an Early Mobility Protocol that was based on the patient's level of consciousness and included activity suggestions, criteria for progression, and exclusion criteria¹⁴ (see Tables 1 and 2). Additional support for the initiative was garnered through the Critical Care Committee where critical care providers (physicians, nurse practitioners, and physician assistants), pharmacy, critical care nursing, and respiratory therapy leadership are in attendance.

Nursing education about the ABCDEF bundle was provided in 1 hour in-person education sessions for all registered nurses and unit-based nursing leadership in the MRICU and the SICU between late August and early September 2019. These sessions reviewed the impact that sepsis poses for the health care system on a national and local level, facility sepsis outcomes, new and existing interventions for the ABCDEF bundle, and proper documentation of the bundle elements in the EHR. Following the education, the ABCDEF bundle was implemented for all patients in both ICUs. The bundle was not limited to patients with sepsis for ease of staff and to help drive compliance of all bundle elements as this bundle is intended as an evidence-based guide for all ICU patients. However, data collection and analysis were only conducted on patients meeting both inclusion and exclusion criteria.

Sustainability of an intervention was led by the Outcome Facilitation Team (OFT), which consisted of unit leadership. This team rounded daily and monitored compliance of the bundle elements, provided real-time reminders about the bundle, and engaged nurses in the implementation. If nurses were not participating in the bundle implementation plan, unit leadership provided coaching on an individual basis and determined whether unanticipated challenges were responsible for the lack of compliance. Challenges were escalated by the unit leadership

Table 1. Early Mobility Protocol

	Level 1	Level 2	Level 3	Level 4
<i>Level of consciousness</i>	<i>Unconscious</i> RASS -5/-4	<i>Conscious</i> RASS -3/-2	<i>Conscious</i> RASS -1	<i>Conscious</i> RASS -1/0/+1
<i>Description</i>	Patient unable to complete simple commands.	Patient able to follow simple commands. Patient is severely weak and unable to stand.	Patient weak but requires only minimum to moderate assistance to sit and support body weight.	Patient able to support the majority of their own body weight. Requires minimum assistance to sit, with moderate assistance to stand.
<i>Treatment plan</i>	<i>RN/CNA to complete:</i> <ul style="list-style-type: none"> • Passive ROM TID • Consider consulting physical therapy/occupational therapy for ROM 	<i>RN/CNA to complete:</i> <ul style="list-style-type: none"> • Active assisted/active ROM TID • Chair position minimum 20 min TID 	<i>RN/CNA to complete:</i> <ul style="list-style-type: none"> • Chair position minimum 20 min TID • Dangle at edge of bed • Up to chair TID (with lift equipment if indicated) • Up to bedside commode 	<i>RN/CNA to complete:</i> <ul style="list-style-type: none"> • Chair position minimum 20 min TID • Up to chair TID • Ambulation as tolerated • Up to bathroom
<i>Criteria for progression</i>	Patient able to follow simple commands. Hemodynamic status and oxygenation stable.	Patient able to move arms against gravity. Patient requires moderate to minimal assistance to support majority of his or her body weight	Patient able to move leg against gravity. Patient can support the majority of his or her own body weight.	Patient would be prepared for discharge to floor.

Abbreviations: CNA, certified nursing assistant; RASS, Richmond Agitation Sedation Scale; RN, registered nurse; ROM, range of motion; TID, 3 times daily.

Table 2. Early Mobility Protocol Exclusion Criteria^a

Exclusion Criteria
1. Patient/ventilator asynchrony
2. Nasotracheal intubation
3. Difficult airway (red taped ET tube, flag in chart to be difficult intubation, etc)
4. Patient in shock (multiple vasopressors, large GIB, etc)
5. New neuro event: CVA, SAH, ICH
6. Neuromuscular blockade
7. New orthopedic problem/surgery (clarify activity orders with surgeon)
8. New vascular intervention in lower extremities (clarify activity orders with surgeon)
9. Bed rest orders (collaborate with MD to increase activity based on your clinical judgment)
10. Collaborate with treatment team and use clinical judgment for patients with the following: high FiO ₂ and/or PEEP requirements, RR >40, HR >130, new PE, rising cardiac enzymes, etc
11. Unstable fractures
12. Cerebral edema with uncontrolled ICP
13. Active bleeding
14. Open chest/open abdomen
15. Femoral arterial sheath

Abbreviations: CVA, cerebrovascular accident; ET, endotracheal; FiO₂, fraction of inspired oxygen; GIB, gastrointestinal bleed; HR, heart rate; ICH, intracerebral hemorrhage; ICP, intracranial pressure; PE, pulmonary embolism; PEEP, positive end-expiratory pressure; SAH, subarachnoid hemorrhage.

^aAlways collaborate with treatment team prior to exclusion decision.

to medical staff, support departments, and unit champions as needed for collaboration on a plan for problem resolution.

Mørk and colleagues¹⁵ identified that unit-based champions played a key role in the successful implementation of their complex ICU change. Therefore, unit-based champions were recruited by unit leadership based on ICU expertise and interest in participation with a unit practice change. They were trained by department-based nurse educators and received ongoing support from the edu-

cators and unit-based nursing leadership. The champions provided valuable insight into the nurses' routine during the planning phase. These engaged nurses encouraged peers to follow the bundle elements and bring challenges to the attention of unit leadership for resolution. These stakeholders played a pivotal role in the successful implementation and sustainability plan.

Bundle compliance for each element was measured and delineated in the following manner:

Bundle element A: Pain assessment expectations were required at least every 4 hours using an objective pain scale. Compliance was measured by dividing the number of completed pain assessments by the number of assessment opportunities. If 90% or more of opportunities were documented in the EHR, this bundle element was considered met.

Bundle element B: Daily spontaneous awakening trials (SATs) and spontaneous breathing trials (SBTs) have been associated with shorter ventilation times and ICU and hospital LOS.¹⁶ For this bundle, the number of completed SAT assessments was divided by the number of assessment opportunities when no contraindications were present. If the patient was on a ventilator, the number of completed SBT assessments was divided by the number of assessment opportunities when no contraindications were present. When both the spontaneous awakening and breathing trial outcomes were 90% or more, this bundle element was considered met.

Bundle element C: Lighter sedation levels and avoidance of benzodiazepines have been associated with less ventilator-days and shorter ICU and hospital LOS.^{10,17,18} If a patient required sedation and dexmedetomidine, propofol, and/or ketamine were utilized, this bundle element was considered met. If midazolam, other benzodiazepines, or psychoactive agents were utilized for sedation, this bundle element was not considered met.

Bundle element D: Unit standards require delirium assessment be done twice daily using the standardized Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) tool. The number of completed assessments was divided by the number of assessment opportunities. If 90% or more of opportunities were documented, this bundle element was considered met.

Bundle element E: Early mobilization of patients has been associated with less delirium and time on the ventilator as well as improved ICU LOS.^{10,19,20} In the Early Mobility Protocol, a patient without contraindications was expected to be at least dangled at the side of the bed within 8 hours or less following admission or when the patient met criteria for activity advancement. If this level of activity was completed within 8 hours, this bundle element was considered met.

Bundle element F: High-quality communication between the critical care team and the family has reduced ICU LOS.²¹ If family participation in care was documented in the progress notes by the nurse, social worker, or medical team or within the goals of care note in the EHR, this bundle element was considered met.

RESULTS

Descriptive statistics of subject demographics are displayed in Table 3. Descriptive statistics, mean (SD) or n (%), and comparative statistical test results for all study outcomes are presented in Table 4. Ventilator-days and ICU and hospital LOS were compared between groups using independent-samples *t* tests (see Table 4). Individual bundle compliance elements for each unit and for the total sample were analyzed using Fisher’s exact tests comparing pre- and postimplementation. Overall compliance percentages were calculated for each participant as the number of elements with compliance out of the total number of elements assessed. The average overall compliance was compared between pre- and postimplementation using an

Table 3. Descriptive Statistics

Variable	Full Sample			MRICU			SICU		
	Pre (n = 136)	Post (n = 124)	P	Pre (n = 82)	Post (n = 74)	P	Pre (n = 54)	Post (n = 50)	P
Gender, n (%)	74 (54.4)	68 (54.8)	.999	46 (56.1)	41 (55.4)	.999	28 (51.9)	27 (54)	.847
Male									
Race, n (%)	119 (87.5)	103 (83.1)	.707	71 (86.6)	61 (82.4)	.865	48 (88.9)	42 (84)	.516
White	1 (0.7)	2 (1.6)		1 (1.2)	1 (1.4)		0 (0)	1 (2)	
American Indian/Native Hawaiian	1 (0.7)	2 (1.6)		1 (1.2)	2 (2.7)		0 (0)	0 (0)	
Asian	15 (11)	17 (13.7)		9 (11)	10 (13.5)		6 (11.1)	7 (14)	
Black	19 (14)	12 (9.7)	.340	12 (14.6)	10 (13.5)	.999	7 (13)	2 (4)	.163
Ethnicity, n (%)	63.87 (15.68)	64.82 (14.89)	.616	66.18 (15.95)	67.91 (14.87)	.488	60.35 (14.71)	60.26 (13.82)	.974
Hispanic									
Age, mean (SD), y									

Table 4. Outcomes Statistics

Variable	Full Sample			MRICU			SICU		
	Pre (n = 136)	Post (n = 124)	P	Pre (n = 82)	Post (n = 74)	P	Pre (n = 54)	Post (n = 50)	P
Element A, n (%)	118 (86.8)	96 (77.4)	.053	67 (81.7)	54 (73)	.249	51 (94.4)	42 (84)	.113
Element B, n (%)	12 (26.7)	23 (62.2)	.002	5 (19.2)	8 (40)	.187	7 (36.8)	15 (88.2)	.002
Element C, n (%)	45 (80.4)	44 (91.7)	.161	23 (79.3)	22 (88)	.480	22 (81.5)	22 (95.7)	.199
Element D, n (%)	9 (6.6)	18 (14.8)	.041	2 (2.4)	8 (11.1)	.046	7 (13)	10 (20)	.428
Element E, n (%)	18 (16.7)	41 (41)	.000	9 (14.3)	20 (33.9)	.018	9 (20)	21 (51.2)	.003
Element F, n (%)	116 (85.9)	114 (91.9)	.167	73 (89)	68 (91.9)	.597	43 (81.1)	46 (92)	.152
ICU LOS, mean (SD)	5.61 (6.37)	5.11 (4.61)	.475	5.20 (5.53)	4.49 (4.46)	.383	6.24 (7.45)	6.04 (4.72)	.872
Hospital LOS, mean (SD)	13.04 (11.24)	14.22 (11.89)	.414	11.29 (8.98)	13.24 (11.83)	.245	15.7 (13.65)	15.66 (11.9)	.986
Ventilator-days, mean (SD)	5.71 (6.28)	5.15 (6.92)	.660	5.19 (5.42)	5.65 (8.48)	.796	6.42 (7.37)	4.52 (4.42)	.305
Overall, mean (SD)	51.6% (0.192)	59.8% (0.205)	.001	48.6% (0.169)	55.4% (0.205)	.025	56.1% (0.216)	66.3% (0.189)	.013

Abbreviations: ICU, intensive care unit; LOS, length of stay; MRICU, medical respiratory intensive care unit; SICU, surgical intensive care unit. Element A: Assess, prevent, and manage pain; Element B: Both spontaneous awakening and breathing trials; Element C: Choice of analgesia and sedation; Element D: Assess, prevent, and manage delirium; Element E: Focus on early mobility and exercise; Element F: Encourage family engagement/empowerment.

independent-samples *t* test for the full sample and within each unit.

Prior to implementation, 95 patients in the MRICU and 54 patients in the SICU were considered for inclusion. Of these, 13 patients (13.7%) in the MRICU met exclusion criteria and were not included. All patients in the SICU met inclusion criteria; therefore, none were excluded. In the postimplementation phase, 98 patients in the MRICU and 64 patients in the SICU were considered for inclusion. Of these, 24 patients (24.5%) in the MRICU and 14 patients in the SICU (21.9%) met exclusion criteria and were not included in the final analysis. This resulted in a final sample of 156 MRICU patients and 104 SICU patients.

Demographics for the full sample and each unit are included in Table 3. The majority of patients were male, and the average age was at least 60 years. Most patients' race was reported as Caucasian. There were no differences in demographic variables between the pre- and postimplementation groups for the full sample, nor within either unit.

There was a significant improvement in the overall completion of spontaneous awakening and breathing trials ($P = .002$), delirium assessment ($P = .041$), and early mobility ($P = .000$) (see Table 4). Significant improvements in MRICU patients were isolated to

the delirium assessment ($P = .046$) and early mobility ($P = .018$), while those in SICU patients were isolated to the spontaneous awakening and breathing trials ($P = .002$) and early mobility ($P = .003$) (see Table 4). Pain assessment documentation decreased after implementation, but this did not reach a significant level. Total bundle compliance improved significantly overall ($P < .001$) as well as for each individual unit (MRICU: $P = .025$; SICU: $P = .013$) (see Table 4). There was a 0.5-day reduction in overall ICU LOS ($P = .475$) and a 0.56-day reduction in ventilator time ($P = .660$), but this did not reach statistical significance (see Table 4). Overall hospital LOS increased by 1.1 day, but this was not significant ($P = .414$) (see Table 4).

The observed versus expected mortality and 30-day readmission rates for patients with sepsis were compared using hospital aggregate data. Overall rates improved in both categories following implementation of the ABCDEF bundle (see Figures 1 and 2, respectively).

DISCUSSION

Improvements in completion of SATs and SBTs, delirium assessment, and early patient mobilization were achieved in this QI

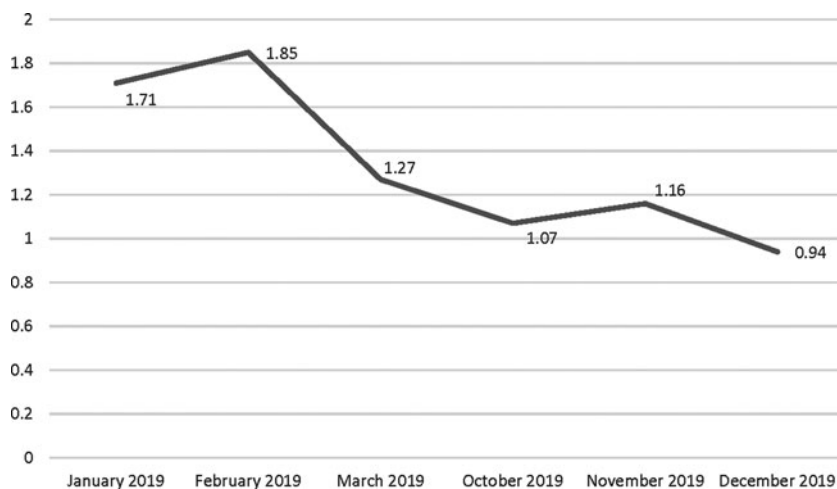


Figure 1. Mortalities observed/expected.

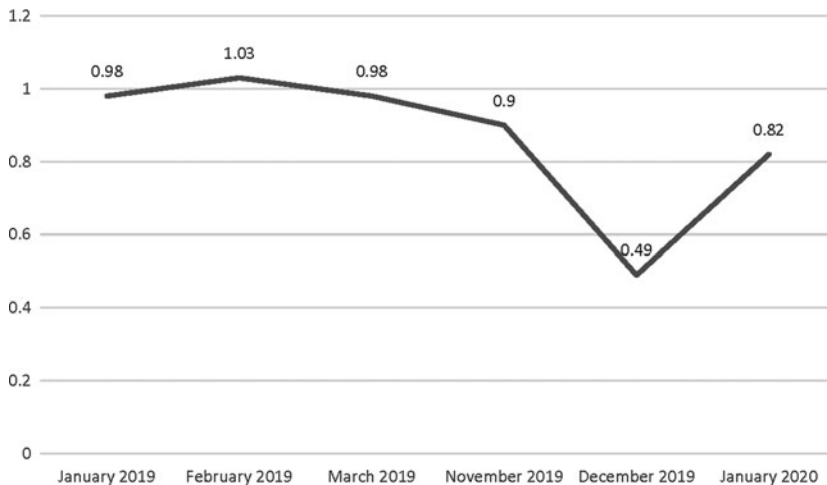


Figure 2. Readmission observed/expected.

intervention. Overall bundle compliance also improved significantly in both ICUs and overall (see Table 4). Similar outcomes are documented within the literature and were associated with reduction in ventilator-days and mortality, particularly when increases in total bundle compliance were achieved.^{4,8} Strong team-based collaboration is considered a key factor in the achievement of these improvements in care delivery.

Pain assessment documentation every 4 hours was a facility strength, with baseline compliance at 86.8%. Postimplementation data decreased to 77.4% compliance, but this was not statistically significant. This reduction in performance may be related to an upgrade to the EHR, which altered the pain documentation structure during the implementation phase of the study. Nurses consistently documented pain using a standardized assessment tool based on the patient's ability to participate, which is consistent with recommendations within the literature.¹⁰ Nurses utilized narcotic, non-narcotic pharmacologic treatment, and nonpharmacologic strategies to treat the patient's pain.

During implementation, significant improvement in completion of both SATs and SBTs was achieved in the SICU and overall. These findings were associated with a

reduction in ventilator-days and ICU LOS but did not reach the level of statistical significance. Bounds and colleagues⁷ experienced similar findings and were unable to produce a significant difference in ventilator-days and ICU or hospital LOS. Other researchers were able to demonstrate a reduction in ventilator-days following implementation of the bundle, but no significant change in ICU or hospital LOS.⁵ Finally, Girard and colleagues¹⁶ were able to demonstrate a significant reduction in time to extubation and improvement in ICU and hospital LOS. In the MRICU, an increase in ventilator-days may be attributed to the minimal increase in compliance with this bundle element.

Bundle element C, which focused on the choice of analgesia and sedation, had an 80.4% baseline compliance. Following implementation of the ABCDEF bundle, statistical significance was not achieved but an increase in frequency was observed, reaching 91.7% compliance. This strong performance was attributed to the availability of an order set that included criteria for nurses to utilize the lightest sedation level possible and guided providers to use dexmedetomidine and propofol over benzodiazepines and midazolam. Both practices have been associated with reduced time to extubation, shorter ICU

LOS, and lower mortality rates.^{10,17,18} During this intervention, similar findings were achieved.

Bundle element D includes assessment, prevention, and management of delirium. This project focused on twice-daily delirium assessment and avoidance of medications associated with the development of delirium (ie, benzodiazepines and psychoactive agents). Statistically significant improvement in both practices was noted in the MRICU (2.4%-11.1% compliance) and overall metrics (6.6%-14.8% compliance). Despite this positive outcome, opportunities for further improvement remain in both ICUs. Delirium screening is complicated and burdensome for nurses to conduct, and literature supports completion by highly trained nurses.²² The MRICU and the SICU did receive education on the CAM-ICU tool. Providing opportunities for the nurses to practice using the tool will increase confidence and competence of correct nursing assessment.

Bundle element E focused on early mobility and resulted in the most substantial findings in each unit and in overall performance. The overall compliance with early activity improved from 16.7% to 41%. Despite inconsistent definitions within the literature for early mobility, the practice has been associated with reduced incidence of delirium, ventilator-days, and ICU LOS but no substantial reduction in mortality.^{10,19,20} The ICU environment poses several challenges when mobilizing patients due to invasive lines and hemodynamic instability, but literature supports this practice as a safe contribution to the plan of care.^{5,11} This QI intervention did not have any significant complications related to the Early Mobility Protocol. In addition, there was a reduction in ventilator-days, ICU LOS, and mortality, though these metrics did not reach statistical significance.

Preimplementation compliance with bundle element F was high at 85.9% and increased further to 91.9% overall following implementation of the bundle. Research focusing on family involvement in the ICU is relatively new, so the quality and

quantity of evidence are limited, yielding weak recommendations for family presence and participation in care as well as structured interdisciplinary communication.²³ Some evidence supports an association between high-quality communication and a reduction in ICU LOS, which is similar to the findings in this intervention.²¹

A reduction in ventilator-days of 0.56 was appreciated and a 0.5-day reduction in overall ICU LOS was also noted. These findings, however, did not reach statistically significant levels. Mechanical ventilation increases the daily cost of care by 25.8%, and 1 day in the ICU has been estimated to cost \$3518.^{24,25} Therefore, any reduction in ICU LOS is financially advantageous as well as beneficial to patient outcomes.^{5,6} Overall hospital LOS was similar to preimplementation findings (13.04 days vs 14.22 days; $P = .414$) and consistent with other research.⁷ Further opportunities for improvement within each bundle element's compliance may have contributed to these findings.

Mortality data were collected using hospital sepsis aggregate data (see Figure 1). The data are provided as an observed-to-expected ratio through a national health care improvement company that creates a database of 4000 hospitals and health systems.²⁶ The ratio is calculated by using the average LOS observed divided by the average LOS expected. An observed-to-expected ratio of greater than 1.0 means the average observed was greater than the average expected. The postimplementation data revealed a downward trend between January 2019 and December 2019. A reduction in mortality is consistent with other published data, particularly when more bundle interventions were implemented.^{4,6,27}

This QI initiative has limitations to its generalizability. These may include single-center implementation, a racially and ethnically homogeneous sample, and a relatively small sample size. In addition, severity of illness using an objective tool such as the Acute Physiology and Chronic Health Evaluation II (APACHE II) was not utilized to compare the

pre- and postimplementation samples, which inhibited the ability to understand the nature of illness of subjects. The intervention was also not designed as a randomized controlled study but rather utilized as convenience sampling. These factors limit the generalizability of the findings to patients in every setting. Future multicenter studies with targeted recruitment for a heterogeneous sample that considers severity of illness are warranted to improve generalizability to a wider patient demographic.

As an additional limitation, a lower than desired compliance rate with the bundle elements was experienced. Despite the education sessions, some nurses were confused about patient inclusion and documentation. Nurses also identified that at times the level of consciousness in the first row of the Early Mobility Protocol did not align with the patient's description in the second row. Both ICU managers took other positions during the implementation phase, an EHR upgrade changed nursing documentation, and changes to system order sets may also have affected the compliance rates. To address the specific limitations of leadership attrition and system updates, it is recommended to clearly explain documentation expectations to the nursing staff, and provide guidance on correctly documenting the highest "level" in the Early Mobility protocol, if that level is not contradicted for the patient. Facilities should also establish a strong unit-based leadership structure prior to implementation. Triggers for bundle element compliance

built into the EHR documentation would be valuable to the nursing division. Finally, order sets that guided care in accordance with bundle expectations would enhance bundle compliance. Improvements in most bundle elements were achieved, but complete bundle compliance was not reached and may be a contributing factor to the lack of significant improvement in clinical outcomes. Despite these findings, this intervention offers encouragement because even without full compliance, there were findings that improved the clinical results for patients with sepsis.

CONCLUSIONS

Implementation of the ABCDEF bundle in the setting of sepsis was consistent with other research that indicated that this multidisciplinary plan of care effectively enhanced care delivery and improved some clinical outcomes. As the coordinators of care, nurses are in the perfect position to lead this initiative and collaborate with other key stakeholders in the critical care environment. Lessons learned from this project will assist the team with improving the consistency of nursing interventions, which may further enhance patient outcomes. Nurses should keep these interventions at the forefront of their minds while utilizing clinical judgment to determine when bundle interventions are feasible and safe to execute. This practice requires autonomy while molding together both the science and art of nursing.

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