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## A Multisite Study of Nurse-Reported Perceptions and Practice of ABCDEF Bundle Components

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### Abstract

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**Clinical Trial Registration Number:** [NCT01211522](https://clinicaltrials.gov/ct2/show/study/NCT01211522)

**Conflict of Interest:** There are no conflicts of interest to disclose.

**Ethical Statement:** The study was approved by the Vanderbilt University Human Research Protections Program.

**Objectives:** ABCDEF bundle implementation in the Intensive Care Unit (ICU) is associated with dose dependent improvements in patient outcomes. The objective was to compare nurse attitudes about the ABCDEF bundle to self-reported adherence to bundle components.

**Research Methodology/Design:** Cross-sectional study

**Setting:** Nurses providing direct patient care in 28 ICUs within 18 hospitals across the United States

**Main Outcome Measures:** 53-item survey of attitudes and practice of the ABCDEF bundle components was administered between November 2011 and August 2015 (n=1661)

**Results:** We did not find clinically significant correlations between nurse attitudes and adherence to Awakening trials, Breathing trials, and sedation protocol adherence ( $r_s=0.05-0.28$ ) or sedation plan discussion during rounds and Awakening and Breathing trial Coordination ( $r_s=0.19$ ).

Delirium is more likely to be discussed during rounds when ICU physicians and nurse managers facilitate delirium reduction ( $r_s=0.27-0.36$ ). Early mobilization is more likely to occur when ICU physicians, nurse managers, staffing, equipment, and the ICU environment facilitate early mobility ( $r_s=0.36-0.47$ ). Physician leadership had the strongest correlation with reporting an ICU environment that facilitates ABCDEF bundle implementation ( $r_s=0.63-0.74$ ).

**Conclusions:** Nurse attitudes about bundle implementation did not predict bundle adherence. Nurse manager and physician leadership played a large role in creating a supportive ICU environment.

## Keywords

intensive care unit; interprofessional; ABCDEF bundle; nurse; implementation

## Introduction

Overuse of sedatives and prolonged mechanical ventilation (MV) during critical illness can lead to delirium, intensive care unit-acquired weakness (ICU-AW), and reduced survival.[1] The Society of Critical Care Medicine clinical practice guidelines have recommended an interprofessional and integrated approach to improve these outcomes.[2, 3] Such an approach is provided by the ABCDEF bundle (Assess, prevent and manage pain; Both spontaneous awakening and breathing trials [SAT, SBT]; Choice of sedation; Delirium: assess, prevent, and manage; Early mobility; Family engagement and empowerment), an interprofessional, multicomponent, evidence-based process that serves as a framework for implementation of the PADIS guidelines.[4, 5] Implementation of the ABCDEF bundle is associated with reduced delirium, ventilator, and hospital days; increased frequency of early mobilization and restraint-free care; and improved survival.[6–9] Despite strong evidence for its use, uptake of the bundle and its components remains limited.[10]

A meta-analysis of bundle implementation studies indicated utilization of six or more implementation strategies to significantly lower mortality and reduce ICU length of stay.[11] Patient clinician, protocol, and environmental barriers have been identified to influence ABCDEF bundle implementation[12], but, limited multicenter data is available to inform organizational factors influencing healthcare provider attitudes regarding execution of the

ABCDEF bundle. Identification of such organizational factors may guide development of efficient and nimble individual and system-based implementation strategies to improve ABCDEF bundle utilization.

The study's guiding framework, Conceptual Framework for Interprofessional Protocol Implementation (Figure 1).[13, 14] The framework illustrates the interrelationship of organizational domains (e.g., number and competence of staff), unit milieu (e.g., coordination among disciplines), tasks (e.g., autonomy and time demands), physical environment (e.g., unit layout and access to supplies), provider attitudes, and adherence to interprofessional protocols. The objective of this study was to examine the associations of nurse attitudes and perceptions of ABCDEF bundle components with self-reported bundle component adherence.

## Materials and Methods

We conducted a quantitative descriptive study with survey methods during the MIND-USA study – a multicenter, randomized controlled trial (RCT) funded by the National Institutes of Health National Institute on Aging (NCT01211522).[15] In 2010, at the initiation of the current study, the bundle was described as an evolving framework open to new strategies, thus we applied the original ABCDE bundle (Awakening and Breathing trial Coordination, Delirium assessment/management, Early mobility).[16, 17] Since its original publication, the bundle has developed into the ABCDEF bundle to include family engagement and recommendations from recent guidelines.[4, 5, 18] The methods and results sections of this paper will identify the bundle as ABCDE since pain assessment and management, choice of sedative, and family engagement and empowerment were not evaluated in this study. Bedside nurses tracked ABCDE bundle adherence daily for MIND-USA enrolled patients while in the ICU. We obtained Institutional Review Board approval was obtained, including a waiver of documentation of informed consent for administration of the anonymous survey to ICU nurses. No financial incentives were offered for recruitment.

## Setting & Sample

Registered nurses (RNs) were recruited from the 28 medical and surgical ICUs in 18 participating hospitals (17 academic medical centers and 1 community hospital) within the continental United States. Hospital size ranged from 175 to 1541 licensed beds and 10 to 40 beds per ICU. Study participation was limited to charge RNs and other RNs providing direct patient care 4 shifts/month. Advanced practice nurses, nurse managers, and nurse educators were excluded from participation.

## Variables and Measures

A 53-item survey was developed to examine nurse-reported practice habits, behaviors, attitudes, and perceptions regarding the ABCDE bundle. The survey was informed by previous surveys completed by the research team.[18–20] All responses utilized a 4-point ordinal scale with higher scores indicating more positive views (e.g., 0=strongly disagree, 3=strongly agree) or more adherent practices (e.g., 0=never, 3=routine [>70%]). The survey contained four demographic questions for the purpose of obtaining nurse experience and

ICU information. Cognitive interviewing with a sample of 10 nurses indicated no duality in meaning of survey items. Further testing indicated the survey required less than 10 minutes to complete.

## Procedures

The voluntary and anonymous survey was administered annually between November 2011 and August 2015. The coordinating research team reviewed nurse eligibility with representatives from each research team and determinations were made for unit-specific methods to reach all eligible nurses while also minimizing sampling bias. For example, the nurse manager from one unit communicated that study personnel would be in the unit to distribute and collect surveys during designated time frames over a one week period while another site distributed and collected surveys to willing participants during unit-based inservices. Other units sent an email link for survey responses to all eligible nurses in the unit. Each unit could complete the survey via paper or Research Electronic Data Capture (REDCap) electronic survey link.[21] All data was entered into the REDCap electronic database.

## Statistical Analysis

R version 3.3.2 was used for all statistical analyses (<https://www.r-project.org/>). Graphical and descriptive statistical methods were used to evaluate data distributions. Frequency distributions were used to summarize ordinal data. Continuous data were normally distributed and are, thus, presented in means and standard deviations. No data transformations were necessary to meet statistical assumptions. Individual survey items were evaluated for systematic nonresponse patterns for the entire sample.[22] No individual survey items were omitted from analysis due to missingness. However, we excluded 65 participant surveys due to <50% of items answered. We used median substitution by variable to impute missing values for all surveys included in the analysis.[23]

Since surveys were distributed annually, it was possible for nurses to have taken the survey more than once. However, only first-time surveys were included in this analysis to avoid repeat responder bias (n=269 repeat respondents). Spearman correlations ( $r_s$ ) with 95% confidence intervals were used to assess the associations of selected nurse perception/attitude scores and self-reported bundle practice. Tests of statistical significance maintained a Type I error rate of 0.05 ( $p < 0.05$ ). The a priori minimally important correlation was  $r_s = 0.45$  (moderate strength). A correlation of this degree or greater denotes at least 20% shared variance between the two rank-transformed variables.[24]

## Results

Survey participation ranged from a minimum of 6 to a maximum of 316 nurses (median=68) per site. A total of 1661 surveys were included in the analysis, a response rate of 26%. Participants had a mean 2.4 total years of ICU experience (SD=1.4) and 2 years of experience in their current ICU (SD=1.4). Descriptive survey data are presented in Table 1. The results section includes survey items for which relationships were clinically significant per the predetermined effect size of  $r_s = 0.45$ .

### Awakening and Breathing Trial Coordination

Routine compliance was reported at 73% for the unit's sedation protocol, 59% for performing a daily SAT, 76% for having a daily SBT, and 44% trial coordination (SBT preceded by SAT). Though the majority of respondents reported feeling bad when patients become more agitated during an SAT, few reported embarrassment when family enters the room of an agitated patient. Nurse discomfort or embarrassment with patient agitation during a SAT was not associated with sedation protocol compliance or performance of SATs ( $r_s=0.05-0.13$ ; Figure 2a). Likewise, nurse discomfort with performing an SAT or feeling bothered with an uncooperative patient were not associated with sedation protocol compliance or SAT performance ( $r_s=0.03-0.08$ ). Nurse discomfort with taking care of a patient receiving a SBT was not associated with reduced SBT performance ( $r_s=0.28$ ). Routine discussion of sedation plans during rounds was weakly associated with more frequent performance of SAT and SBT coordination ( $r_s=0.19$ ).

### Delirium Assessment and Management

The majority of participants expressed agreement that ICU physicians (70%), nurse managers (70%), staffing (69%), and the ICU environment (64%) facilitate reductions in delirium occurrence and duration. Facilitation to reduce delirium occurrence and duration by ICU physicians and nurse managers was moderately associated with more frequent delirium discussion during rounds ( $r_s=0.27-0.36$ ) (Figure 2b). ICU environments that facilitate delirium reduction were characterized by better staffing and nurse manager and ICU physician facilitation ( $r_s=0.50-0.63$ ). Similarly, nurse manager facilitation was characterized by better staffing ( $r_s=0.60$ ).

### Early Mobility

The minority of participants reported providing routine (i.e., >70% of the time) range of motion (19%), dangling at the edge of the bed or getting out of bed to the chair (21%), and standing or walking (14%). The majority of participants reported nurse managers (73%), the ICU environment (72%), ICU physicians (71%), equipment (68%), and staffing (62%) facilitate early mobility. More frequent mobilization at any level was characterized by ICU physicians and the ICU environment facilitating early mobility ( $r_s=0.45-0.47$ ) (Figure 2c) and less so characterized by facilitation from nurse managers, staffing, and equipment ( $r_s=0.24-0.40$ ). The ideal early mobility environment was characterized by greater perceived physician, nurse manager, staffing, and equipment facilitation of early mobility implementation ( $r_s=0.59-0.74$ ).

### Discussion

We examined ICU nurse perceptions and attitudes and self-reported practice of bundle components in an effort to explore interventions to enhance ABCDEF bundle implementation. We found that bedside nurses with greater self-reported adherence to delirium and early mobility bundle elements are more likely to report facilitation by the nurse manager and ICU physician leadership and the physical environment of the ICU. Survey results indicate 25 to 54% of variation in environments ideal for delirium monitoring and early mobility can be explained by nurse manager and ICU physician facilitation of

bundle components. Despite some nurses reporting that SATs are uncomfortable, bothersome, and have the potential to result in embarrassing situations, these attitudes were not associated with reported changes in practice, indicating that respondents could perceive the bundle as the “right thing to do” for improved patient outcomes. Overall, the data suggest that bedside clinicians understand the motivation for performing elements of the bundle, but whether they actually do adhere to the ABCDEF bundle is determined by institutional factors more than personal beliefs.

### **Multidisciplinary Engagement**

Advocates in leadership or management positions are perceived to powerfully impact successful implementation.[25, 26] Our findings indicate that prioritizing the engagement of key unit leaders (e.g., ICU nurse managers and physicians) as a multidisciplinary team of advocates for daily conduct of the ABCDEF bundle may improve implementation. A limitation of our current work is that the roles of other key stakeholders as advocates were not addressed. Pharmacists, for example, should be considered advocates for implementation of ABCDEF bundle activities given that pharmacists are often present within the ICU, are familiar with all ICU patients, and have successfully served as role models and advocates for daily execution of ABCDEF bundle activities in previous investigations.[27–32] Additional key stakeholder advocates may include social workers, chaplains, and patients who survive critical illness and return to share their experiences

Likewise, successful implementation of ABCDEF bundle components requires more than participation by unit nurse leaders and physicians. Patient care by a multidisciplinary team accompanied by multifaceted training and protocols is correlated with successful implementation of programs to improve systematic management of analgesia, sedation and delirium.[33, 34] Effective strategies for multifaceted education include didactic instruction, case-based scenarios, one-on-one teaching, and use of unit metrics to inform staff on accuracy and compliance with delirium assessment and management.[35]. Multidisciplinary training programs should also consider inclusion of respiratory and rehabilitation therapists (physical, occupational, speech).

### **Early Mobility – The hardest part of the bundle**

Participants reported the availability of appropriate ICU equipment and adequate staffing facilitate early mobility. However, there was a weak relationship between these organizational factors and the frequency of early mobilization activities, suggesting other factors contribute to early mobility compliance. Previous research indicates adequate staffing plays a role in following through with ABCDEF bundle activities.[36] Likewise, access to appropriate equipment and adequate staffing is necessary for early mobility but not always sufficient. Adequate staffing and training to appropriately use the equipment is also necessary. Key leadership should also advocate for early mobility. Early mobility relies on teamwork and collaboration more than any other elements of the bundle and is dependent on successful completion of other bundle elements to be successfully executed. In future studies, it will be important to evaluate the impact of additional factors such as teamwork, collaboration, and coordination on early mobility specifically.



## Strengths and Limitations

The study has important strengths. We incorporated providers from medical and surgical ICUs in both academic and nonacademic institutions across the continental United States. We were able to identify relationships suggesting unit milieu and environmental factors amenable to intervention.

This study also has important limitations that may impact the results. First, the survey has not been rigorously tested for validity and reliability. However, the study team included a sample of 10 nurses, constituting a “focus group”. This group reviewed the survey questions and agreed the questions were clear and unambiguous. Second, assessment of bundle practice was reliant on the self-report of survey respondents willing to take the survey rather than independent monitoring of bundle component adherence in the unit; thus, it may not be an accurate reflection of actual bundle adherence due to bias. Third, the observational study design demonstrates correlations and not causation. We have discussed the relationships among variables and speculated on potential causes and direction for future study. It is important to note, however, that it is unlikely that a randomized prospective study will be performed looking at the factors we have identified as being important for adoption of these best practices. Lastly, the study utilizes an earlier iteration of the bundle rather than a more contemporary framework including pain assessment and management, choice of sedation, and family engagement and empowerment. Despite this limitation, the findings are still applicable to implementation of the ABCDEF bundle framework including key interprofessional activities.[18]

## Conclusions

Changing critical care practices requires a holistic interprofessional approach that addresses cultural, psychological, and practical issues for healthcare professionals and the organization. Small tests of change in conjunction with non-nurse clinicians offers an ideal mechanism for implementation that also addresses risk aversion associated with ABCDEF bundle activities. Future research, including multivariate analyses, is indicated to determine how to improve attitude and perception of the bundle through the use of unit-based advocates could enhance adherence and ultimately patient outcomes.

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## References

1. Harvey MA, Davidson JE: Postintensive Care Syndrome: Right Care, Right Now... and Later. *Crit Care Med* 2016, 44(2):381–385. [PubMed: 26771784]
2. Barr J, Fraser GL, Puntillo K, et al.: Clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit. *Crit Care Med* 2013, 41(1):263–306. [PubMed: 23269131]
3. Devlin JW, Skrobik Y, Gelinac C, et al.: Clinical Practice Guidelines for the Prevention and Management of Pain, Agitation/Sedation, Delirium, Immobility, and Sleep Disruption in Adult Patients in the ICU. *Crit Care Med* 2018, 46(9):e825–e873. [PubMed: 30113379]
4. Balas MB, Burke WJ, Gannon D, et al.: Implementing the Awakening and Breathing Coordination, Delirium Monitoring/Management, and Early Exercise/Mobility Bundle into Everyday Care: Opportunities, Challenges, and Lessons learned for Implementing the ICU Pain, Agitation, and Delirium Guidelines. *Crit Care Med* 2013, 41(9):S116–127. [PubMed: 23989089]
5. Barr J, Pandharipande PP: The pain, agitation, and delirium care bundle: synergistic benefits of implementing the 2013 pain, agitation, and delirium guidelines in an integrated and interdisciplinary fashion. *Crit Care Med* 2013, 41(9 Suppl 1):S99–S115. [PubMed: 23989099]
6. Balas MC, Vasilevskis EE, Olsen KM, et al.: Effectiveness and safety of the awakening and breathing coordination, delirium monitoring/management, and early exercise/mobility bundle. *Crit Care Med* 2014, 42(5):1024–1036. [PubMed: 24394627]
7. Barnes-Daly MA, Phillips G, Ely EW: Improving Hospital Survival and Reducing Brain Dysfunction at Seven California Community Hospitals: Implementing PAD Guidelines Via the ABCDEF Bundle in 6,064 Patients. *Crit Care Med* 2017, 45(2):171–178. [PubMed: 27861180]
8. Kram SL, DiBartolo MC, Hinderer K, et al.: Implementation of the ABCDE Bundle to Improve Patient Outcomes in the Intensive Care Unit in a Rural Community Hospital. *Dimensions of critical care nursing* 2015, 34(5):250–258. [PubMed: 26244238]
9. Pun BT, Balas MC, Barnes-Daly MA, et al.: Caring for critically ill patients with the ABCDEF bundle: results of the ICU liberation collaborative in over 15,000 adults. *Crit Care Med* 2019, 47(1):3–14. [PubMed: 30339549]
10. Miller MA, Govindan S, Watson SR, et al.: ABCDE, but in that order? A cross-sectional survey of Michigan intensive care unit sedation, delirium, and early mobility practices. *Ann Am Thorac Soc* 2015, 12(7):1066–1071. [PubMed: 25970737]
11. Trogrlic Z, van der Jagt M, Bakker J, et al.: A systematic review of implementation strategies for assessment, prevention, and management of ICU delirium and their effect on clinical outcomes. *Crit Care* 2015, 19:157. [PubMed: 25888230]
12. Costa DK, White M, Ginier E, et al.: Identifying barriers to delivering the ABCDE bundle to minimize adverse outcomes for mechanically ventilated patients: A systematic review. *Chest* 2017.
13. Boehm LM, Vasilevskis EE, Mion LC: Interprofessional Perspectives on ABCDE Bundle Implementation: A Focus Group Study. *Dimensions of critical care nursing* 2016, 35(6):339–347. [PubMed: 27749438]
14. Boehm LM, Vasilevskis EE, Dietrich MS, et al.: Organizational Domains and Variation in Attitudes of Intensive Care Providers Toward the ABCDE Bundle. *Am J Crit Care* 2017, 26(3):e18–e28. [PubMed: 28461551]
15. Girard TD, Exline MC, Carson SS, et al.: Haloperidol and Ziprasidone for Treatment of Delirium in Critical Illness. *N Engl J Med* 2018, 379(26):2506–2516. [PubMed: 30346242]

16. Vasilevskis EE, Pandharipande PP, Girard TD, et al.: A screening, prevention, and restoration model for saving the injured brain in intensive care unit survivors. *Crit Care Med* 2010, 38(10 Suppl):S683–691. [PubMed: 21164415]
17. Vasilevskis EE, Ely EW, Speroff T, et al.: Reducing iatrogenic risks: ICU-acquired delirium and weakness-crossing the quality chasm. *Chest* 2010, 138(5):1224–1233. [PubMed: 21051398]
18. Ely EW: The ABCDEF Bundle: Science and Philosophy of How ICU Liberation Serves Patients and Families. *Crit Care Med* 2017, 45(2):321–330. [PubMed: 28098628]
19. Soja SL, Pandharipande PP, Fleming SB, et al.: Implementation, reliability testing, and compliance monitoring of the Confusion Assessment Method for the Intensive Care Unit in trauma patients. *Intensive Care Med* 2008, 34(7):1263–1268. [PubMed: 18297270]
20. Pun BT, Gordon SM, Peterson JF, et al.: Large-scale implementation of sedation and delirium monitoring in the intensive care unit: a report from two medical centers. *Crit Care Med* 2005, 33(6):1199–1205. [PubMed: 15942331]
21. Harris PA, Taylor R, Thielke R, et al.: Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of biomedical informatics* 2009, 42(2):377–381. [PubMed: 18929686]
22. Fowler FJ: *Survey research methods*, Fifth edition. edn. Los Angeles: SAGE; 2014.
23. Tabachnick BG, Fidell LS, Ullman JB: *Using multivariate statistics*, vol. 5: Pearson Boston, MA; 2007.
24. Huck SW: *Reading statistics and research*, 6th edn. Boston: Pearson; 2012.
25. Landry MD, Sibbald WJ: Changing physician behavior: a review of patient safety in critical care medicine. *J Crit Care* 2002, 17(2):138–145. [PubMed: 12096377]
26. Flodgren G, Parmelli E, Doumit G, et al.: Local opinion leaders: effects on professional practice and health care outcomes. *Cochrane Database Syst Rev* 2011(8):CD000125. [PubMed: 21833939]
27. Stollings JL, Foss JJ, Ely EW, et al.: Pharmacist leadership in ICU quality improvement: coordinating spontaneous awakening and breathing trials. *Ann Pharmacother* 2015, 49(8):883–891. [PubMed: 25907528]
28. Marshall J, Finn CA, Theodore AC: Impact of a clinical pharmacist-enforced intensive care unit sedation protocol on duration of mechanical ventilation and hospital stay. *Crit Care Med* 2008, 36(2):427–433. [PubMed: 18091554]
29. Swan JT: Decreasing inappropriate unable-to-assess ratings for the confusion assessment method for the intensive care unit. *Am J Crit Care* 2014, 23(1):60–69. [PubMed: 24382618]
30. Devlin JW, Marquis F, Riker RR, et al.: Combined didactic and scenario-based education improves the ability of intensive care unit staff to recognize delirium at the bedside. *Crit Care* 2008, 12(1):R19. [PubMed: 18291021]
31. Gesin G, Russell BB, Lin AP, et al.: Impact of a delirium screening tool and multifaceted education on nurses' knowledge of delirium and ability to evaluate it correctly. *Am J Crit Care* 2012, 21(1):e1–11. [PubMed: 22210704]
32. Kher S, Roberts RJ, Garpestad E, et al.: Development, implementation, and evaluation of an institutional daily awakening and spontaneous breathing trial protocol: a quality improvement project. *Journal of intensive care medicine* 2013, 28(3):189–197. [PubMed: 22596087]
33. Skrobik Y, Ahern S, Leblanc M, et al.: Protocolized intensive care unit management of analgesia, sedation, and delirium improves analgesia and subsyndromal delirium rates. *Anesth Analg* 2010, 111(2):451–463. [PubMed: 20375300]
34. Hager DN, Dinglas VD, Subhas S, et al.: Reducing deep sedation and delirium in acute lung injury patients: a quality improvement project. *Crit Care Med* 2013, 41(6):1435–1442. [PubMed: 23507716]
35. Brummel NE, Vasilevskis EE, Han JH, et al.: *Implementing Delirium Screening in the ICU: Secrets to Success*. *Crit Care Med* 2013.
36. Boehm LM, Vasilevskis EE, Mion LC: Interprofessional perspectives on ABCDE bundle implementation: a focus group study. *Dimensions of critical care nursing* 2016, 35(6):339. [PubMed: 27749438]

### Implications of Clinical Practice

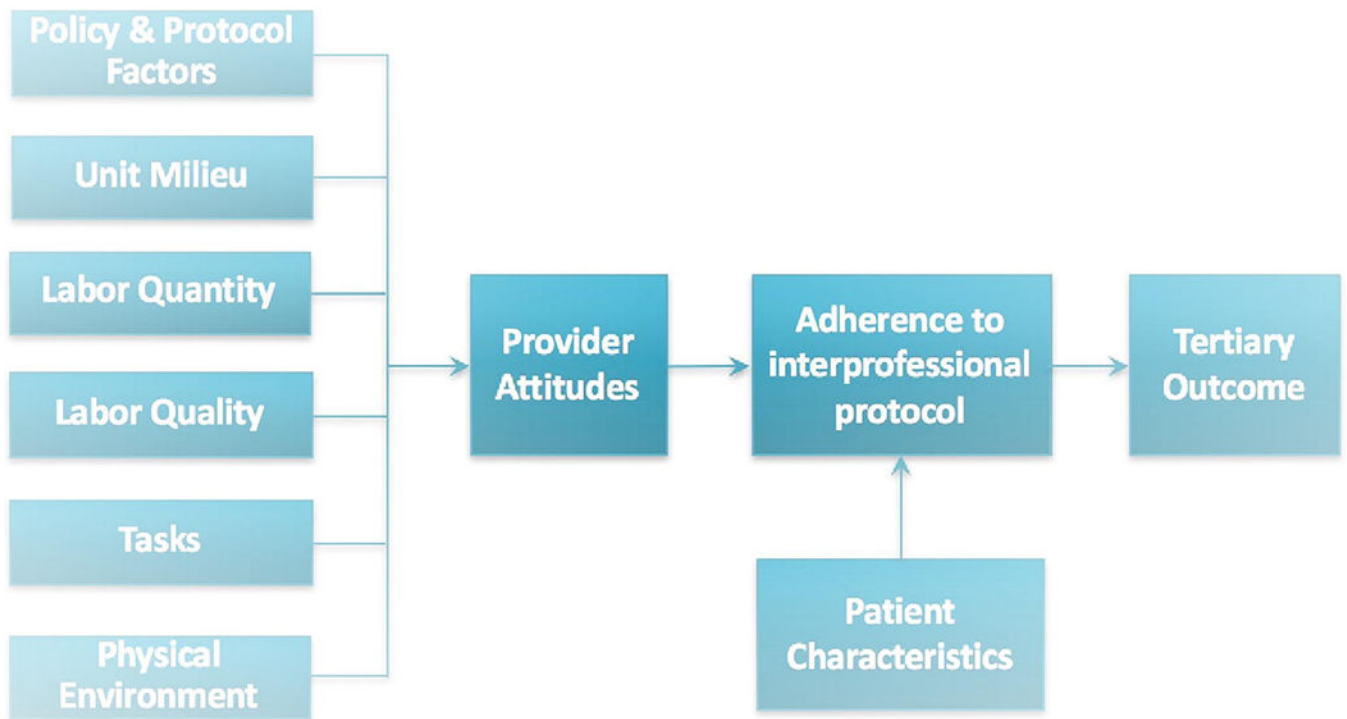
- ABCDEF bundle implementation is enhanced by purposeful physician and nurse manager facilitation.
- Small tests of change are an optimal strategy to address nurse risk aversion to performing ABCDEF bundle components.
- Consider input by non-nurse clinicians early and often for ABCDEF bundle implementation.

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**Figure 1.** Conceptual Framework for Interprofessional Protocol Implementation  
Organizational domains influence provider decision/ability to adhere to the ABCDEF bundle. Adherence can also be influenced by patient characteristics. Bundle utilization influences tertiary outcomes such as hospital length of stay, cognition, and physical function

**Spontaneous Awakening and Breathing Trial Coordination**

**SAT done before SBT?**

0.39	SBT done daily?							
-0.08	-0.06	I feel bothered when a patient is agitated during an SAT.						
-0.09	-0.08	0.53	I feel embarrassed when family witnesses agitation during an SAT.					
-0.05	-0.04	0.48	0.45	I feel bad when a patient is agitated during an SAT.				
-0.06	-0.07	0.18	0.18	0.25	I feel uncomfortable doing an SAT.			
0.37	0.35	-0.11	-0.10	-0.12	0.08	SAT done daily?		
0.18	0.25	-0.10	-0.10	-0.06	-0.04	0.23	Sedation plans discussed during rounds?	
0.18	0.17	-0.10	-0.10	-0.03	-0.08	0.23	0.24	How often do you comply with your units sedation protocol?

**Delirium assessment and management**

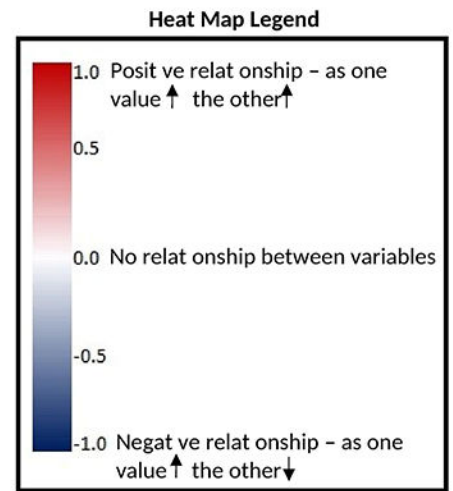
The staffing in my ICU facilitates reducing delirium.

0.58	My ICU nurse manager facilitates reducing delirium.							
0.51	0.56	My ICU physicians facilitate reducing delirium.						
0.52	0.49	0.63	My ICU environment facilitates reducing delirium.					
0.24	0.25	0.35	0.24	Delirium discussed during rounds?				

**Early mobility**

My ICU equipment facilitates early mobility.

0.64	My ICU staffing facilitates early mobility.							
0.49	0.54	My ICU nurse manager facilitates early mobility.						
0.55	0.57	0.67	My ICU physicians facilitate early mobility.					
0.59	0.63	0.59	0.73	My ICU environment facilitates early mobility.				
0.28	0.31	0.29	0.36	0.41	I feel comfortable performing early mobility.			
0.35	0.35	0.34	0.44	0.45	0.31	How often do patients stand or walk?		
0.36	0.39	0.32	0.46	0.46	0.29	0.70	How often do patients dangle?	
0.27	0.25	0.23	0.31	0.29	0.18	0.24	0.30	How often do patients get ROM?



**Figure 2.**  
Spearman Correlation Matrix of Nurse Self-Report of ABCDEF Bundle Component Adherence and Bundle Attitudes/Perceptions  
Abbreviations: SAT = spontaneous awakening trial, SBT = spontaneous breathing trial, ICU = intensive care unit, ROM = range of motion

Table 1.

Survey descriptive data, n=1661 \*

Awakening and Breathing Trial Coordination				
Frequency	Never	Occasionally (<30%)	Frequently (30-70%)	Routinely (>70%)
How often do you comply with your unit's sedation protocol?	28(1.7)	51(3.1)	340(20.5)	1242(74.8)
How often are your patient's sedation plans discussed during rounds?	3(0.2)	73(4.4)	366(22.0)	1219(73.4)
How often do you perform a daily SAT with a mechanically ventilated patient?	47(2.8)	183(11.0)	413(24.9)	1018(61.3)
How often do your mechanically ventilated patients have a daily SBT when eligible?	6(0.4)	56(3.4)	307(18.5)	1292(77.8)
How often are SBTs preceded by an SAT?	52(3.1)	277(16.7)	533(32.1)	799(48.1)
Agreement	Strongly Disagree	Disagree	Agree	Strongly Agree
It makes me feel bad when patients become more agitated during an SAT.	144(8.7)	559(33.7)	843(50.8)	115(6.9)
I feel embarrassed when the family enters the room of a patient who is agitated.	189(11.4)	884(53.2)	506(30.5)	82(4.9)
I feel bothered when a patient is uncooperative during an SAT.	182(11.0)	910(54.8)	521(31.4)	48(2.9)
I feel uncomfortable performing an SAT.	415(25.0)	781(47.0)	283(17.0)	182(11.0)
In general, I feel comfortable taking care of a patient who is receiving an SBT.	25(1.5)	54(3.3)	531(32.0)	1051(63.3)
Delirium Assessment and Management				
Frequency	Never	Occasionally (<30%)	Frequently (30-70%)	Routinely (>70%)
How often is delirium discussed during rounds?	34(2.0)	416(25.0)	750(45.2)	461(27.8)
Agreement	Strongly Disagree	Disagree	Agree	Strongly Agree
The ICU physicians facilitate reducing delirium occurrence and duration.	54(3.3)	399(24.0)	1047(63.0)	161(9.7)
My nurse manager facilitates reducing delirium occurrence and duration	70(4.2)	382(23.0)	1048(63.1)	161(9.7)
Staffing in my ICU facilitates reducing delirium occurrence and duration.	56(3.4)	416(25.0)	1038(62.5)	151(9.1)
My ICUs environment facilitates reducing delirium occurrence and duration.	87(5.2)	465(28.0)	916(55.1)	193(11.6)
Early Mobility				
Frequency	Never	Occasionally (<30%)	Frequently (30-70%)	Routinely (>70%)
How often do your patients receive range of motion?	30(1.8)	566(34.1)	773(46.5)	292(17.6)
How often do your patients dangle or get out of bed to a chair?	36(2.2)	545(32.8)	753(45.3)	327(19.7)
How often do your patients stand or walk?	121(7.3)	913(55.0)	406(24.4)	221(13.3)
Agreement	Strongly Disagree	Disagree	Agree	Strongly Agree



Awakening and Breathing Trial Coordination				
Frequency	Never	Occasionally (<30%)	Frequently (30-70%)	Routinely (>70%)
In general, I feel comfortable performing early mobility with my patients.	29(1.7)	233(14.0)	1081(65.1)	318(19.1)
My nurse manager facilitates early mobility.	66(4.0)	337(20.3)	994(59.8)	264(15.9)
My ICUs environment facilitates early mobility.	48(2.9)	389(23.4)	925(55.7)	299(18.0)
The ICU physicians facilitate early mobility.	41(2.5)	407(24.5)	942(56.7)	271(16.3)
The equipment in my ICU facilitates early mobility.	81(4.9)	416(25.0)	948(57.1)	216(13.0)
Staffing in my ICU facilitates early mobility.	119(7.2)	463(27.9)	866(52.1)	213(12.8)

\* All values presented in n(%)

Abbreviations: SAT = spontaneous awakening trial, SBT = spontaneous breathing trial, ICU = intensive care unit

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