Organizational Domains Influencing Interprofessional Protocol Implementation in Intensive Care

By

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First and foremost, the present work is dedicated to critically ill patients and providers for whom I hope this research will benefit.

This work is also dedicated to my supportive husband, Jonathan, for being with me through thick and thin during the entire doctoral program.

Thank you all.
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LIST OF ABBREVIATIONS

A – Awakening trial
ABC – Awakening and Breathing Coordination
ABCD – Awakening and Breathing Coordination, Delirium assessment/management, Early mobility
ABCDEF – Assess for and manage pain, Both spontaneous awakening and breathing trials, attention to Choice of sedation and analgesia, Delirium assessment/management, Early mobility, and Family engagement
APACHE II – Acute Physiology and Chronic Health Evaluation II
ARDS – Acute Respiratory Distress Syndrome
B – Breathing trial
C – Coordination (awakening trial precedes breathing trial)
CI – Confidence interval
D – Delirium assessment/management
DE – Delirium assessment/management and Early mobility
E – Early mobility
EBP – Evidence-based practice
FiO2 – Fraction of inspired oxygen
ICU – Intensive Care Unit
ICU-AW – Intensive Care Unit-Acquired Weakness
IQR – Interquartile range
IV – Intravenous
LOC – Level of consciousness
LOS – Length of stay
MICU – Medical Intensive Care Unit
MV – Mechanical ventilation
OR – Odds ratio
OT – Occupational Therapist
PEEP – Peak End Expiratory Pressure
PT – Physical Therapist
QOL – Quality of life
RASS – Richmond Agitation-Sedation Scale
RN – Registered Nurse
RT – Respiratory Therapist
SAT – Spontaneous Awakening Trial
SBT – Spontaneous Breathing Trial
SD – Standard deviation
SICU – Surgical Intensive Care Unit
VAS – Visual analog scale
CHAPTER I
INTRODUCTION AND BACKGROUND

Overview

This doctoral research explores organizational domains influential in interprofessional provider attitudes related to the Awakening and Breathing Coordination, Delirium assessment/management, Early mobility (ABCDE) bundle and thus adherence to this evidence-based protocol. Recent reports have highlighted the underutilization of the ABCDE bundle in practice as well as factors that have been identified as barriers and facilitators to implementation. However, review of the literature yielded no studies on the relationship of organizational domains with provider attitudes or provider attitudes with ABCDE bundle adherence.

Significance

The magnitude of the problem of delirium in critically ill adult patients

Delirium (i.e., neurocognitive dysfunction) is an acute syndrome that disrupts brain neurotransmission leading to disturbances of consciousness, inattention, fluctuations in mental status, and changes in cognition or development of perceptual disturbances. Delirium occurs in up to 80% of mechanically ventilated and 50% of lower severity Intensive Care Unit (ICU) patients. Associated financial and societal burdens include increased morbidity, increased mortality, prolonged hospitalization, higher reintubation rates, and higher costs of care. Delirium duration is associated with a 3- to 13-fold higher risk of one-year mortality after controlling for severity of illness, coma, sedatives, and other covariates. Each additional day of delirium increases the probability of death by 10% (p=0.03), strongly supporting the need to identify barriers to assessment and management. Delirium is also a predictor of long-term sequela including cognitive impairment, akin to acquired dementia, which occurs in 50-66% of ICU survivors and affects their ability to live independently after discharge. ICU delirium is estimated to cost $4-$16 billion dollars annually in the United States, which does not include the costs of lost workdays, caregiver burden, or cognitive rehabilitation. The cost of delirium is likely to grow rapidly in the coming decades with the influx of aging baby boomers utilizing intensive care with
predisposing conditions that increase the likelihood of delirium incidence and impact.\textsuperscript{15-17} This burden also carries the weight of lives lost, reduced quality of life (QOL), frailty, depression, post-traumatic stress disorder, and long-term cognitive impairment.\textsuperscript{9-13,18-21} Early work evaluating use of the ABCDE bundle has been associated with reduced prevalence of delirium incidence.\textsuperscript{22-24}

The magnitude of the problem of ICU-acquired weakness (ICU-AW) in critically ill adult patients

ICU-AW (i.e., neuromuscular dysfunction) occurs in 25-100\% of ICU patients, and the effects of this condition are quite profound.\textsuperscript{25-30} ICU-AW predicts prolonged weaning from mechanical ventilation (MV) and increased risk of death.\textsuperscript{30,31} ICU-AW also results in long lasting consequences of continued disability, loss of functional independence, and persistent lower health-related QOL for many ICU survivors because of muscle wasting and fatigue. Of acute respiratory distress syndrome (ARDS) survivors, 45\% had still not returned to work two years after hospital discharge due to physical impairment.\textsuperscript{32} Several studies report significant numbers of individuals with incomplete recovery of baseline muscle function one to five years following ICU hospitalization.\textsuperscript{21,30,31,33-35} Motor weakness was associated with disproportionate health care expenditures of more than $66,000 per patient hospitalization in one retrospective study.\textsuperscript{36} This does not include the costs of post discharge rehabilitation, home care, or readmissions to the hospital (mean total cost = $21,930 per patient).\textsuperscript{32} Patients with ICU-AW have a 7-fold increased risk of in-hospital death (p<0.007), spend at least 10 days longer on MV (p=0.03), and a higher likelihood for requiring inpatient rehabilitation.\textsuperscript{27,30,37} In a meta-analysis of 39 RCTs using bed rest as a form of therapy, it was found that bed rest had no significant beneficial effect when used as a treatment and actually seemed to be harmful in some disorders.\textsuperscript{38} Importantly, early work evaluating use of the ABCDE bundle has been associated with an increase in mobilization during critical illness.\textsuperscript{22,23}

Methods for managing delirium and ICU-AW

Recent guidelines recommend identifying and treating the underlying cause and removing risk factors for delirium and ICU-AW.\textsuperscript{39} Modifiable (e.g., precipitating/iatrogenic) risk factors for ICU delirium include severity of illness, abnormal blood tests (arterial pH, bilirubin, creatinine, tryptophan, tyrosine), pain level, acute diagnoses (anxiety, coma, medical admission), procedures (# of intravenous
[IV] infusions, tubes, catheters), medications (opioids, benzodiazepines, dopamine, epidurals, antipsychotics, propofol), and environmental factors (isolation, daylight, family visits). Sedative exposure can be reduced using daily spontaneous awakening trials (SATs, i.e., turning off sedatives) and sedation protocols to achieve patient comfort, cooperation, and MV goals. By modifying sedative exposure, clinicians can reduce the prevalence of delirium, reduce time on MV, and improve patient survival and QOL. Yet, delirium remains an under recognized organ dysfunction.

ICU-AW management includes initiation of physical and/or occupational therapy within the earliest days (1-3 days) of critical illness. Activity with MV and non-MV patients can be advanced along a continuum of active range of motion, sitting on the edge of the bed, active transfers, and ambulation. Early mobility benefits include a 24% increase in functional independence at discharge (p=0.02), reduced duration of delirium (4 days vs. 2 days, p=0.02), decreased time on the ventilator (23.5 days vs. 21.1 days, p=0.05), decreased hospital length of stay (LOS) (14.5 days vs. 11.2 days, p=0.006), and reduced costs. Research indicates early mobility is safe and feasible from the onset of critical illness, even with the presence of life support devices, with <1% activity-related adverse events. Thus, barriers must be studied to improve uptake as part of a bundled approach.

Evidence for an ABCDE interdisciplinary protocol for treatment of delirium and ICU-AW

Physical and cognitive performance are fundamentally linked. Critical illness and the use of sedatives during MV can lead to prolonged MV and delirium. Likewise, critical illness, the use of sedatives, and occurrence of delirium also instigate ICU-AW (see Figure 1-1). The multicomponent ABCDE bundle (Awakening and Breathing Coordination, Delirium monitoring and management, and Early mobility) is designed to bring synergy to a group of evidence-based practices (EBPs) to break the cycle of oversedation and prolonged MV leading to ICU delirium and ICU-AW. The ABCDE bundle provides order to and alignment for currently existing people, processes, and technology to improve collaboration among disciplines and standardize processes of care in the ICU. The ABCDE bundle is
designed to move patients toward a return to baseline physical and cognitive function. *Awakening and Breathing Coordination (ABC)* is the daily performance of an SAT followed by a Spontaneous Breathing Trial (SBT, i.e., trial of independent breathing with minimal ventilator support). This ‘Wake up and Breathe’ approach capitalizes on a more alert, cooperative patient during an SBT and has resulted in reduced hospital LOS (19.2 vs. 14.9, p=0.04), reduced prevalence of coma (p=0.002), 14% absolute risk reduction in death at one year (p=0.01), and reduced incidence of cognitive impairment at three months (p=0.03).41 *Delirium monitoring and management (D)* is the daily screening for delirium utilizing a validated delirium assessment tool like the Confusion Assessment for the ICU (CAM-ICU) or Intensive Care Delirium Screening Checklist (ICDSC) and utilization of management strategies.2,4,53 Delirium screening improves the recognition of delirium, provides a method of concise communication of cognitive function, and signals the need for clinicians to evaluate and change aspects of critical care therapy to improve cognitive function.54-57 *Early mobility (E)* is both feasible and safe to perform with critically ill patients in the earliest days of ICU care.49,50 Overall, utilization of the ABCDE bundle is hypothesized to dramatically improve the care of and outcomes for critically ill patients. High-value patient outcomes related to ABCDE bundle components include improved likelihood of survival, reduced length of hospital stay, and improved physical function (see Figure 1-2).52 Furthermore, identification of barriers to implementation, with subsequent development of strategies to reduce such barriers, could produce positive health and economic outcomes.
Opportunities to improve scientific knowledge and clinical practice

Despite evidence for use, there is limited uptake of ABCDE practices.\textsuperscript{58} The Society of Critical Care Medicine recommends daily SATs, frequent use of validated delirium screening tools, and level of consciousness (LOC) assessment in the 2013 guidelines for the assessment and management of pain, agitation, and delirium in critically ill adults.\textsuperscript{39} Yet, competing ICU priorities make it difficult for uptake of clinical practice guidelines and evidence-based practice (EBP). The ABCDE bundle molds together EBP\textsuperscript{s} and aligns multiple disciplines to improve processes of care, but an interdisciplinary protocol can be complicated to implement. Research indicates that organizational structure and process variables may affect uptake of EBP. There is limited information regarding organizational structure and process variables that influence the provider’s choice to adhere to interdisciplinary protocols. Identifying factors that facilitate complex protocol implementation in different ICU settings may improve adherence. The proposed study was urgently needed to inform clinical process improvement strategies, inform future studies and implementation strategies to improve adherence to interdisciplinary protocols, and shape...
future work to enhance implementation of interdisciplinary protocols in the ICU and across other hospital settings.

**Related Work**

Using a prospective, concurrent triangulation, one-group before-after mixed methods study, Balas et al. sought to identify facilitators and barriers to ABCDE bundle adoption and evaluate the extent to which bundle implementation was effective, sustainable, and conducive to dissemination in a single academic medical center. The Consolidated Framework for Implementation Research was a guiding framework for the study. Convenience samples of a range of providers (physicians, nurses, respiratory therapists, pharmacists, rehabilitation therapists) were asked to take part in focus groups, surveys, and education evaluations before and after implementation of the ABCDE bundle. Collective themes were derived from the focus group (N=36), survey (N=99), and education evaluation (N=328) participants. Intervention characteristics (i.e., evidence strength & quality, adaptability, relative advantages, and complexity), inner and outer setting (i.e., needs & resources, culture, and networks & communication), characteristics of individuals (i.e., self-efficacy), and the process of implementation were broad themes around ABCDE bundle implementation, conduciveness, and sustainability. Of education evaluation participants, 92% reported they would change practice with 70% of those expressing a strong commitment to change. Adequacy of knowledge of the ABCDE bundle went from 32% prior to online education to 90% afterward. The multidisciplinary input lends to diverse and comprehensive information regarding provider views of the ABCDE bundle. Surveys provide an anonymous method for expressing opinions for those who do not want to participate in focus group sessions. However, there is the potential that only those with strong opinions participated in focus groups and surveys, indicating a nonresponse bias.

Employing a similar prospective, concurrent triangulation, mixed methods pilot study, Carrothers et al. sought to identify the contextual factors that facilitate or hinder the implementation of the ABCDE bundle in four California hospitals. A two-person research team visited each ICU and conducted individual and group interviews with key ABCDE bundle stakeholders. ABCDE bundle adherence was
tracked once per week on all ICU patients and reported in aggregate (i.e., all participating units aggregated to one monthly compliance score per ABCDE bundle component). The authors also gathered observational data for hospital characteristics, policies, procedures, and rounding practices. The authors do not provide an explanation of how qualitative interview and observational data were processed.

Adherence to individual ABCDE bundle components increased from beginning to the end of the one-year implementation period across all sites. No site had reliably implemented the bundle by the end of the implementation period. Collective themes across survey, observation, and interview data resulted in the identification of key barriers and facilitators to ABCDE bundle implementation. Barriers included turnover, morale issues, lack of respect amongst disciplines, knowledge deficits, excessive use of registry staff, and resource deficits. Facilitators include organizational and structural characteristics of the ICU, patient safety culture, implementation planning, training and support, and prompts for documentation. A strength of this study is the multidisciplinary population across multiple centers. The themes identified in this study may not persist in other ICU settings or providers not part of the study. The study is in a single city (San Francisco, CA) with limitations in sample size (N=4 units), but did include both academic and community hospitals (ICU capacity 15-22 beds). The authors do not provide their method for analyzing the qualitative data collected through interviews/observations or whether there were specific instruments for this data collection. The majority of survey respondents were nurses, and there is a strong possibility of a nonresponse bias related to the limited participation of other disciplines or equal distribution of respondents across centers.

Bassett et al. shared case study reports of ABCDE bundle implementation for sites using the Model for Improvement framework. This quality improvement project involved a convenience sample of five hospitals and/or health systems whose representatives had attended an Institute for Healthcare Improvement Rethinking Critical Care seminar and were deeply invested in ABCDE bundle implementation. Brief summaries of the implementation process, protocol components, goals, as well as pre- and postimplementation findings were presented for each of the sites individually. The primary goal of implementation was to improve average ICU LOS and ventilator days. The sites were interconnected
with seminar faculty and other participants via a listserv, but no other formal follow-up was conducted. All sites experienced relative improvements in length of stay (6-28% improvement) and ventilator days (3-25% improvement). Site specific strategies for implementation were employed, yet the same key lessons rang true for each of the participating centers. Key lessons learned from the implementation process include use of small tests of change, regular feedback loops and education, and providing opportunities to see the work in action. Specific barriers and strategies utilized to overcome those barriers in implementation are also presented. Resistance to change, knowledge deficits, and sustainability were key barriers mentioned by both faculty and participants. There is inherent selection bias present within this investigation, limiting the generalizability of these findings. However, the identified barriers coincide with previous findings.

**Specific Aims**

Based on deficits in the current literature related to ABCDE bundle implementation, the primary goal of this pilot study was to further explore the relationship between different organizational domains and provider attitudes related to the ABCDE bundle and, thus, influence adherence. This information is urgently needed to inform ICU leaders of factors that influence bundle adherence to facilitate development of targeted strategies to mitigate barriers to implementation. Interdisciplinary protocols, like ABCDE, will never be successful unless we identify and rectify the reasons why they are not widely adopted. Information obtained from this study will inform future investigations of efficacy and interventional studies designed to improve adherence to interdisciplinary protocols and enhance interdisciplinary collaboration.

Specific aims are to:

1. Examine the associations between select organizational domains (i.e., policy and protocol factors, unit milieu, labor quantity, labor quality, tasks, physical environment) and provider attitudes.
2. Examine the associations of provider attitudes on adherence to the ABCDE bundle with risk adjustment for patient factors (i.e., age, comorbidity, severity of illness).
Conceptual Framework

A conceptual framework for interprofessional bundle implementation guided the study (see Figure 1-3). The framework identifies organizational constructs that are necessary to improve or influence outcomes but are also amenable to intervention. This approach captures the complexity and variation in factors that can influence an outcome of interest. A literature review of barriers and facilitators to the use of EBP in the ICU revealed several variables. The study’s conceptual framework proposes that policy and protocol factors, unit milieu, labor quantity, labor quality, tasks, and physical environment are organization-specific constructs that influence provider attitudes (Aim 1) and predicts their decision to adhere to the ABCDE bundle (Aim 2). Patient characteristics are factors related to the patient (e.g., age, severity of illness, comorbidity) and play an influential role in providers’ adherence to the ABCDE bundle. It is hypothesized that adherence to the ABCDE bundle can predict tertiary outcomes such as ICU delirium prevalence, functional status at ICU discharge, and ICU LOS.

Figure 1-3. Conceptual framework for interprofessional bundle implementation

Dissertation Chapters

The following three chapters of the dissertation are manuscripts that describe 1) the development of the conceptual framework and constructs, 2) the development of the ABCDE provider survey
instrument, 3) the methods and results of the analysis of aim one, and 4) the methods and results of the analysis of aim two. Lastly, chapter five is a summary of my research trajectory given the results of the dissertation research.
CHAPTER II
INTERPROFESSIONAL PERSPECTIVES ON ABCDE BUNDLE IMPLEMENTATION: A FOCUS GROUP STUDY

This chapter describes a qualitative study conducted to explore the constructs that contribute to variation in ABCDE bundle implementation and examine the capability of a conceptual framework for interprofessional protocol adherence. The results of this investigation led to refinement of the conceptual framework.

Background

Admission to the intensive care unit, especially when receiving mechanical ventilation, can result in oversedation and immobility that in turn can lead to ICU delirium and ICU-AW. Delirium and/or ICU-AW occur in as many as 80% of ICU patients, often go unrecognized, and are frequently augmented not only by critical illness, but also ICU treatment modalities. Delirium and ICU-AW are predictors of increased time on mechanical ventilation, hospital length of stay, hospital costs as well as lower probability of short- and long-term survival. Furthermore, both delirium and ICU-AW are predictors of institutionalization, inability to return to work, and the development of physical disability and cognitive impairment that result in a societal burden in the billions of dollars annually. With as many as 70% of mechanically ventilated patients surviving critical illness, the magnitude of delirium and ICU-AW necessitates the study of practices to optimize the care of individuals during their hospitalization.

The ABCDE bundle (Awakening and Breathing Coordination, Delirium assessment / management, Early mobility) is a recommended interprofessional, multicomponent strategy proposed to improve collaboration among disciplines, standardize ICU processes, as well as break the cycle of oversedation and prolonged mechanical ventilation that precipitates delirium and ICU-AW. The bundle is endorsed by the Society of Critical Care Medicine, amongst others, which has initiated a nationwide quality improvement collaborative of 77 ICUs to implement the bundle (www.iculiberation.org).
Implementation of the ABCDE bundle has been shown to be safe and is associated with reduced ventilator, delirium, and hospital days and increased mobility.\textsuperscript{22-24} Despite recommendations and supportive evidence, Miller and colleagues reported that, among over 280 interdisciplinary participants, only 12\% have implemented the ABCDE bundle.\textsuperscript{58} Two other recent studies have described the challenges of ABCDE bundle implementation and identified a variety of factors, including intervention-related issues, communication and coordination difficulties, knowledge deficits, staff turnover, workload concerns, and documentation burden. While these challenges have been identified, there is still limited interprofessional qualitative data describing factors associated with ABCDE bundle nonadherence or a conceptual framework to guide a standardized systematic approach for examination of factors that are amenable to intervention.

**Objectives**

The research aim for this open-dialogue phenomenological qualitative study was to 1) further describe constructs and factors that may contribute to variations in ABCDE bundle implementation, as reported by a multidisciplinary group of ICU providers responsible for the conduct of bundle components and 2) examine the capability of a conceptual framework for identifying variation in ABCDE bundle implementation. The factors contributing to variation in ABCDE bundle implementation will be generally defined as organizational domains.

**Methods**

*Setting and Sample*

A focus group study was conducted at an 834-bed metropolitan academic medical center. Participation was open to staff responsible for clinical implementation of ABCDE processes of care, including nurses (RN), physical therapists (PT), occupational therapists (OT), and respiratory therapists (RT). Eligibility required individuals work in the 22-bed Surgical or 34-bed Medical ICU and had employed one or more of the ABCDE bundle components at least twice in the previous month. Participant eligibility was confirmed via 1:1 conversation with the investigator prior to the focus groups.
ABCDE bundle activities were recommended practice in the two units at the time of the study, but neither unit had implemented a unified ABCDE protocol.

Conceptual Framework

The current literature provides frameworks for understanding organizational domains (e.g., work conditions, equipment, policies, labor quantity and quality) that influence organizational outcomes. However, there is no framework to elucidate variation in implementation of the ABCDE bundle. We devised a conceptual framework a priori to facilitate development of focus group questions and data analysis. The conceptual framework was built on the premise that organizational facets (policy/protocol matters & unit milieu), physical environment, labor quantity/quality, and tasks could have a direct influence on a provider attitudes and the internal disposition to execute the ABCDE bundle (Figure 2-1). Patient characteristics (e.g., gender, severity of illness, age, etc.) are factors proposed to moderate adherence to the ABCDE bundle.

Figure 2-1. Conceptual framework of organizational domains influencing provider adherence to the ABCDE bundle

Focus group procedure

The institutional review board approved the study. Participants were provided with an informed consent document; however, a waiver of documentation of informed consent was approved to preserve anonymity. Recruitment strategies consisted of 1:1 emails to individuals recommended by unit or department managers as well as break room flyers and word of mouth. Twenty-six potential participants
contacted the principle investigator; 16 (62%) were eligible and participated in the focus groups. The remaining potential participants (N=10) were excluded because they did not work in the eligible units or did not meet eligibility criteria. The participants represent two groups of interprofessional providers with a good working rapport. The participant sample number is also consistent with the SICU and MICU staffing models (i.e., one PT/OT consult team shared between units [n=4], two RTs/shift, and 1:2 nurse to patient ratio).

Two focus groups (N=7, N=9) were conducted in a private off-unit hospital meeting room during lunch, with a boxed meal provided. Each focus group included staff from both units and lasted approximately 1.5 hours. The focus groups utilized a dual moderator design as outlined by Krueger. The same procedure was used for each group. The principal investigator moderated the session and ran a digital recorder. The co-investigator, with extensive focus group experience, recorded notes, relevant cues, and body language. Participants were welcomed, provided lunch, and given an explanation of the study. After participant and investigator introductions, investigators reviewed ground rules of maintaining statement confidentiality and allowing each participant to finish a point before speaking.

We developed and utilized a set of semistructured, open-ended questions for both focus groups (see Appendix A). Questions enhanced direction of discussion to activities associated with the ABCDE bundle as a whole as well as the process required to conduct the individual components. In addition, participants were asked to discuss barriers and facilitators to ABCDE bundle execution. Active listening throughout the session enhanced the investigator’s use of probes to uncover unexpected information, gain detailed descriptions, and clarify concepts not clearly defined by the participants. Focus group sessions were audio taped. At the conclusion of each session, participants received $30 gift cards as compensation for their time.

**Qualitative Data Analysis**

An independent transcription service transcribed discussions verbatim. The data consisted of approximately 170 minutes of interview data, represented as 65 pages of transcription and focus group notes. The two investigators first reviewed the transcripts and field notes independently, applying first
cycle provisional coding guided by the conceptual framework to color-code similar themes. Together, through a joint and iterative process, we then categorized the codes into final themes. Supportive quotes were extracted to illustrate study themes. Validation was obtained through member checking with study participants as well as triangulation through the use of two analysts, consideration of different theories, and comparison of study themes to previous research findings.

Results

Participant information is described in Table 2-1. The majority of participants were nurses (63%) and female (88%). For privacy purposes, further participant demographic information was not collected. Additionally, because of low number representation, PT/OT comments were combined to protect confidentiality. Seven themes were consistent with the study’s framework and described below.

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<td><strong>9</strong></td>
<td><strong>16</strong></td>
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Organizational Facets “Alone we can do so little; together we can do so much.” (Helen Keller)

Organizational facets are defined as those constructs related to policy and protocol factors (i.e., policy/protocol accessibility, clarity, complexity; role/shift clarity; practice variation; training & understanding) as well as unit milieu (i.e., teamwork, coordination, unit culture, peer advocacy).

Policy and Protocol Factors. Participants cited that ABCDE bundle components were an expected part of their practice. Participants verified the presence of protocols for spontaneous awakening trials and spontaneous breathing trials, but no clear protocol existed for early mobilization.

RT: “As far as respiratory, no matter which unit they’re on, they do have protocols to go by.”
RN: “…the mobility part isn’t really a protocol…so a lot of it is nursing judgment if PT and OT aren’t there…”

It is not surprising then that discussion demonstrated practice variation across units. Participants from each discipline commented on their personal role in ABCDE bundle execution and the timing of different components. Variation in understanding of provider-specific roles and bundle-specific processes required as part of the ABCDE bundle was noted among disciplines. While experts have provided a guideline for implementation of the ABCDE bundle, participant summaries demonstrate the process is not so straightforward. Jointly, they described the process to occur as follows:

“The RT will do a [SBT] screen around 3 and 4am…RT will determine if [the patient] passes the screen. We [RN] do our spontaneous awakening screen and then trial in the morning…roughly between 7:30 and 8:30… It’s really key to coordinate both of those things together, the nurse’s aspect of waking up the patient…and the respiratory therapist…starting the breathing trial. …we [nursing] use RASS and CAM-ICU all the time [to assess delirium], and I’m sure all the other ICUs do as well. That’s pretty much our standard for assessing [delirium].”

“[RN] calls [RT] when they turn the sedation off. We [RT] try to give [the patient] oxygen with what we consider therapeutic PEEP and pressure support…to see if [the patient] can…sustain life.”

“We [PT/OT] try to coordinate with the nurses and then RT, if [the patient] is on a breathing trial, how [the patient] is doing…if [the patient] is stable enough for us to get in and start moving them, or if they need to be put back on a rate while we’re working with them just to give them a little extra support. …we [PT/OT] go ahead and work with [the patient] and try to use our clinical judgment.”

Despite the collective participant agreement on the ABCDE bundle process, a number of comments demonstrated variation in the actual practice of select bundle components as described below.

**Delirium assessment:** “[PT/OTₐ] I defer [delirium] assessment to the nurse.” “[PT/OTₐ] We will also do cognitive assessments as well and, if we think we need a full assessment, we’ll defer to speech [therapy].” “[RNₐ] We use the SAVE-AHAART [CAM-ICU], squeeze my hand on the letter ‘A’.” “[RNₐ] If I walk in the room and am able to have a conversation with [the patient], RASS [Richmond
Agitation-Sedation Scale] is zero, and appropriate and have a good attention span, then I won’t do SAVEAHAART with them or anything.”

Awakening trial: “[RNc] At a designated time you pause the sedation and you let the patient wake up, and you make as assessment of how the patient is doing with the sedation turned off.” “[RNd] If they’ve been on 30 [mcg/kg/min] of propofol, at least half it to 15 [mcg/kg/min] and then…turn it off and evaluate.” “[RNe] If the patient passes the screen, then I will…delay both sedation and analgesic medications. I usually set it for 15 minutes and I’m standing, watching the patient. But, I pause everything completely, I don’t know if people do it differently.”

**Unit Milieu.** Interprofessional team dynamics was noted to play a significant role in enhancing bundle awareness and coordination in addition to fostering teamwork. For example, PT/OT indicated that early mobility doesn’t end when they leave the room and good handoff communication and bundle advocacy through peer leadership is essential to continue patient progress. However, nurse participants did not seem to have a full understanding of PT/OT job demands and role in early mobility within the ICU. Current literature suggests at least once daily mobilization, describing the PT role as assessment of the patient’s physical ability to participate in mobility. Of note, the PT/OT team can only evaluate a patient if a consult order is placed. Nurses are responsible for ensuring safety screening and mobilization for all patients. Indeed, participants frequently mentioned the difficulty with coordinating and implementing the mobility component of the bundle. Mobilization, more so than any other bundle component, required all the health professionals to coordinate their activities. As one RN provider indicated below, the outcome may not be perceived to be worth the effort.

**RN:** “…you spend all this time prepping for it [mobility] and getting [equipment] and getting all these people in the room and then [the patient] only make[s] it three feet.”

**RN:** “Because PT and OT have so many patients, they don’t see every patient every day… you never know what time they’re going to be coming to see your patient, if they are that day.”

**RN:** “I didn’t know how important it [mobility] was, or that it could benefit a patient. In nursing school you don’t learn about mobilization…or ICU delirium.”
PT/OT: “I mean mobility isn’t just a PT thing and it’s not just an RN thing, it’s a team thing. Whatever I think the nurses can safely do I’m like, ‘Hey, I’m leaving the walker in the room. You can walk [the patient] to the bathroom. They don’t need to be using the bedpan anymore.’ Whatever it is just so I’ve handed off to [the nurse] what they’re able to do with a patient when I’m not there.”

RN: “When you’re talking about assessing delirium, the SBT [Spontaneous Breathing Trial], the SAT [Spontaneous Awakening Trial], all of these things can be done with your hands tied behind your back. Essentially…it’s an assessment that is not requiring your physical strength or that of more than one person… If I can get someone up by myself, it’s not such a big deal. It’s a part of your normal assessment or a part of what you’re trying to get done…but as soon as you have to start coordinating things it gets complicated.”

**Physical Environment “The Right Tool for the Job”**

The physical environment includes those factors that require significant capital input by the organization (e.g., furniture, equipment, technology). Patients unable to ambulate were described as being put in chair position in the bed or transferred to a neuro or cardiac chair for upright positioning, while patients capable of standing were described as being transferred to a chair. One RT described some mechanically ventilated patients as capable of ambulation, but, “A lot of our RTs never walked anybody on the vent because you can’t make the [portable] vent to be 40% [FiO2].” This RTs primary point—some RT staff are not aware of an option to temporarily utilize more oxygen during ambulation. Nurses also expressed dissatisfaction with equipment, primarily lifts, due to “trouble fitting [lifts] under the beds or around the chair” and “…you have to…figure out where you’re going to hang chest tubes and [catheters]”. Yet, others described lifts as useful.

RN: “We…used the Steady [lift]…because we wanted her using her legs. …rather than three people dragging her across the room and throwing her up in the bed, we made use of the equipment.”

Lastly, unit size and layout influenced participant ability to monitor patients or conduct bundle activities. As one nurse described, “…we’re not in a wide open unit where you can sit and have eyes on two patients. You literally can't do that. Even though there are windows, it doesn’t work. So I have a
feeling…if we had a more open unit…I would be more comfortable.”

**Labor Quantity “All hands on deck” and Labor Quality “The right people on the bus” (Jim Collins)**

The dearth of ancillary staff (e.g., nurse aides), nurses, and physical and occupational therapy staff (i.e., labor quantity) was commonly cited as a barrier to conducting ABCDE bundle activities, especially early mobility. Even with a PT/OT consult in place, staffing may still not be sufficient for ICU patients to be evaluated by a therapist (e.g., weekends, holidays).

**PT/OT:** “…on weekends ICU is last priority…you are not going to see a therapist, unless we’re slow…we’re not staffed to do it.”

**RN:** “…we all have a job to do and we all want the best for patients. If physical therapy can't get to them, that’s just another responsibility as an RN…that you’re doing PT and nursing today.”

**RN:** “…you’re really busy all day. What falls to the bottom of the priority list is range of motion [mobility].”

Participants noted the expertise and education level of a provider (i.e., labor quality) could influence the provider’s ability to discern delirium, whether a patient is ready to advance within the bundle (e.g., level of mobility, sedation cessation, ventilator weaning), or to perform early mobilization. PT and OT participants described utilizing clinical judgment to discern a patient’s capability of and stability for performing mobilization activities, working with respiratory therapists and nurses to ensure patient safety.

**RN:** “…observations and monitoring of the patient…the appropriate interventions. You really have to put a lot of emphasis on not only assessment, but on the entire nursing process [for ABCDE]...”

**RN:** “It probably wouldn’t occur to many ICU nurses to walk a ventilated patient.”

**PT/OT:** “I can’t tell you how many nurses...are like, ‘Why does my back hurt so badly?’ I’m like, ‘Did you ask the patient to help?’ you know.”

**PT/OT:** “…if [nursing is] weaning [the patient] and there’s plans for extubation in the next couple hours usually we’ll hold off and let them get extubated. If there are no plans for extubation for the day we go ahead and work with [the patient] and try to use our clinical judgment. Do they need to be
back on a rate or a different setting or should we just try working with [the patient] on their wean settings? We may have RT come in and put [the patient] back on a rate or whatever they need to be on.”

**Tasks “Juggling Responsibilities”**

Participants commented on the complexity of scheduling the various interdisciplinary tasks as well as coordinating with patients and other providers. Participants noted difficulties secondary to competing patient needs and job responsibilities as well as a lack of sufficient time to assess patients for readiness. Competing responsibilities in the ICU include the number of admissions, discharges, and transfers during a shift; critical events (e.g., cardiopulmonary arrest events); and off unit procedures requiring nurse and/or respiratory therapist accompaniment (e.g., MRI, CT scan, etc.).

**RN:** “…it requires coordinating someone else getting involved to watch [your] other patient. But usually we wouldn’t say, ‘Oh, I’ll titrate your drips while you go do the heavy lifting,’…usually you’ll offer…to get the other patient up or something. …I’ll look for a moment where I feel safe going in and mobilizing one patient, but there’s days where that just is not going to happen…”

**RN:** “If I’m talking about getting my intubated patient up out of the bed, walking around, I know that’s at least going to take an hour out of my twelve hours. Then I may have another patient, so it’s really just carving out the time, scheduling a time with PT and RT.”

**RT:** “…one patient you can do mobility with, but the next patient…is having problems… It just seems like all day they’re [the nurse] in that one room, every time you look…”

**RN:** “…it’s terrifying the thought of being caught with a patient I’m trying to mobilize and seeing on a monitor my other patient needing someone to titrate their drip and I’m not there. …and it’s for the safety of one patient…to not mobilize another one, which is kind of sad, you know?”

Nurses described their decision-making as being influenced by time constraints. The length of time involved with accessing and utilizing lift equipment often resulted in abandonment of use. Nurses reported performing activities of daily living for a patient in an effort to conserve time. Nurses also reported working diligently on a time schedule in order to successfully conduct the ABCDE bundle. Including patients in that scheduling process added an additional challenge.
RT: “…it takes the patient 5 minutes to roll over, but they can do it, just giving them that time.”

RN: “…sometimes when I say I can do it at two, [PT has] got their schedule mapped out and they can’t. So, we need to work better on that.”

RN: “I’m not available when the patient wants to get up, and when I’m ready the patient wants to take a nap.”

Provider Attitudes “…no risk…no reward” (Christy Raedeke)

Provider attitudes refer to the internal disposition of providers and their way of thinking. Reports of provider’s apprehension, fear, or discomfort could be significant barriers to conducting the ABCDE bundle. For example, participants referred to staff abandoning attempts to complete ABCDE bundle activities for fear of device removal (e.g., endotracheal tube, central line, etc.) or patient decompensation. In addition, physical and occupational therapists described challenges in physician and nurse comfort level with rehabilitation approaches.

PT/OT: “There’s been nurses that say, ‘Uh uh, you’re not touching them intubated.’ …I just do education with them and ask, ‘Could you at least let me try?’”

Sharing a successful history of safe practice seemed to facilitate nurse and physician agreement with conducting early mobilization. One occupational therapist reported, “…we’ve never had a self extubation while walking [patient], and we’ve never had a fall while walking [patient].” Some participants expressed more comfortable with progressing the patient through bundle activities. These providers rationalized that the ICU is the safest place to attempt the ABCDE bundle. As the participants stated, “…sometimes it works great…it’s a crap shoot, just try” and “…if something were to go wrong, we’re in the exact place we need to be.”

Patient Characteristics

Lastly, participants identified patient physical and mental states that influence provider decisions to execute ABCDE bundle components. Physical states described to preclude ABCDE execution included the patient’s weight (“our average patient is 250 plus pounds”), use of an artificial airway (e.g., tracheostomy or endotracheal tube), severity/type of illness (e.g., severe ARDS, open abdomen), and
apneic episodes.

RN: “…open belly patients, they’re not a candidate to be extubated at all. So, we’re not doing any spontaneous awakening trials on those patients because…that would be very unsafe for the patient.”

RT: “…[the patient] can’t do SBT because we can’t wean him off of 100% [FiO₂]...it’s the disease process.”

Patient mental states hindering ABCDE bundle execution were described as anxiety and fear of movement due to “too many beeps”. Nurses described patients inhibiting their own progress for fear of doing something wrong stating, “[patients] are afraid to move, they’re attached to so many things that every time they move, something beeps…they’re happy just lying in one spot and not moving.” In addition, a patient’s ability and willingness to follow directions for participation were key factors influencing adherence (e.g., heavy sedation, not waking up, and agitation). Patients “have to be alert enough and willing to follow instructions” to participate in the ABCDE bundle.

Discussion

The goal of this exploratory study was to describe organizational domains that contribute to ABCDE bundle implementation based on a conceptual framework derived from literature review. This study demonstrated the adequacy of the conceptual framework in revealing organizational domains responsible for practice variation and underutilization of the ABCDE bundle. Five major interrelated domains (i.e., organizational facets, labor quantity, labor quality, tasks, physical environment) were noted to affect provider attitudes (i.e., internal disposition and way of thinking) and subsequently ABCDE protocol adherence. Based on participant discussion, we identified that the organizational facets domain requires refinement. Dividing this domain would allow for closer scrutiny for potential interventions. Thus, the framework would better serve future research and ABCDE bundle implementation efforts if organizational facets were divided into two domains: 1) Policy and Protocol Factors and 2) Unit Milieu (e.g., teamwork, coordination, etc.). This modification to the framework would be necessary prior to utilization in the conduct of intervention studies.

Additional findings bear further comment. ICU professionals varied in their knowledge and
practice, which was further complicated by variation in or lack of unit policies and protocols. The presence of a protocol and accessibility of this information not only clarified shift and role responsibilities, but also provided guidelines for consistent protocol application. A nurse may feel uneasy with independently carrying out mobilization due to lack of knowledge, skill, or protocol to guide practice. Respiratory, physical and occupational therapists may not be comfortable with mobilization of ICU patients due to severity of illness, lack of training or equipment naiveté. PTs and OTs described nurse and physician lack of comfort in allowing them to independently conduct mobility activities with the patient, citing a need to “earn the right” to work independently by demonstrating their competence. However, in this pilot study, this discomfort was not consistently expressed amongst all participants and, thus, caution should be applied in generalizing this as a barrier. Interprofessional and multifaceted education might be considered with interprofessional protocol implementation to enhance knowledge, understanding, and role clarity and competency across providers.

Multiple participants reflected on discipline-specific challenges regarding ABCDE bundle execution and the role of the patient. Indeed, we discovered that a major organizational domain that influenced adherence was the complexity of the protocol and the number of disciplines required. First, a number of nurses described the difficulty of coordinating care across disciplines and arranging activities while still managing the care of multiple patients. Next, respiratory therapists described themselves as auxiliaries, being called in when needed. If the RT is not available when called, delays and challenges in conducting bundle activities emerge. Third, participants indicated the importance of the patient as a team member and the role of the patient in being able to implement. For example, a patient may prefer to conduct mobilization after a nap or watching an episode of a television show. Subsequently, other members of the interprofessional team may not be available when the patient is ready. Ultimately, participant comments revealed that those ABCDE activities that can be done by one provider are more likely to be successfully implemented; whereas, those requiring coordination among multiple providers and the patient are more challenging and reluctantly executed (e.g., mobility).

Interestingly, several participants classified themselves as unit peer leaders based on their self-
described knowledge and ability to influence others to utilize the ABCDE bundle. Per the literature, peer leaders (e.g., opinion leaders) are friendly, trustworthy, influential role models whose employ has been linked with the adoption of evidence-based practice. Though the role has not been clearly described, it is apparent that peer/opinion leaders may persuade providers to manage patients using evidence. Similar to other studies on implementation of best evidence, the presence of effective peer/opinion leaders to endorse the ABCDE bundle may facilitate utilization and sustainability and thus advocacy needs to be further refined specific to the peer leader who advocates, not just administration.

There are limitations to consider in this study. First, the study was conducted in a single academic medical center. Despite the uniqueness of the setting, the conceptual framework identifies generalizable organizational domains influencing ABCDE bundle implementation and adherence that can be applied to any ICU setting. Second, the small number of participants (n=16) could have limited our ability to fully assess all factors that contribute to variations in bundle implementation, though we did achieve a good representation from each of the eligible professions. We need to continue examining the ability of the conceptual framework to guide future research. In addition, the participating providers may have had strong beliefs about the ABCDE bundle driving their desire to attend focus group interviews. Lastly, there is a loss of richness in the data due to the absence of ABCDE bundle observation in the real world setting. Despite these limitations, the study offers a multidisciplinary perspective on structure and processes factors that influence ABCDE bundle practice. One strength of the study is the interprofessional team of experienced as well as novice ICU provider participants who could speak to ABCDE bundle use in both Medical and Surgical ICUs. In addition, the interprofessional dialogue was without tension and not limited during the interviews. Probes and active listening were successful strategies for gaining added knowledge. Overall, the use of open-ended questions through interprofessional focus group interviews was a successful way of gathering information about the factors that influence ABCDE bundle implementation.

**Clinical Implications and Research Priorities**

Participants identified the complexity of bundle coordination, especially the collaboration
required for early mobilization. The best return on investment for ICUs may comprise staffing sufficient to ease the coordination of mobility, given mobility was described as the most complex and difficult bundle component to initiate. Considerations for sufficient staffing might include specially trained, unit-based nurse aides, mobility technicians, or other dedicated staff to offset the task burden associated with mobility to improve not only adherence but also patient and organizational outcomes.\textsuperscript{23} Awareness of the bundle practices and equipment through interprofessional education and training may also facilitate adherence. Patient benefits demonstrated from protocol use should be emphasized in training (e.g., improved survival, reduced ventilator days and length of stay, better quality of life).\textsuperscript{22,41,48} Lastly, tracking and reporting patient and organizational outcome data may enhance provider buy-in and performance.\textsuperscript{76} Additional recommendations to facilitate ABCDE bundle adherence and strategies to address organizational challenges are presented in Figure 2-2.

Future research priorities include multisite, interprofessional investigation of ABCDE bundle barriers and facilitators at the provider, unit and organization level to explore the associations hypothesized in the conceptual framework. Input should be expanded to include physicians, pharmacists, and nurse aides as these professions also play a role in ABCDE bundle implementation. Collection of unit level staffing, architecture, protocol, and training data are indicated to determine correlations of organizational domains with provider attitudes and ABCDE bundle adherence. Examination of the influence of patient type (e.g., surgical vs. neuro vs. medical) is indicated to explore the nuances of the ABCDE bundle and evidence for best approaches depending on patient type. Lastly, further work is needed to capitalize on existing models of care and delivery of care to enhance adherence despite constrained resources.

**Conclusions**

The ABCDE bundle is an evidence-based protocol that can improve hospital outcomes for critically ill patients (e.g., ICU-AW and delirium).\textsuperscript{22} We developed a conceptual framework to explain variation in ABCDE bundle implementation and identified several organizational domains that influence ABCDE bundle implementation and interprofessional coordination. Improving patient outcomes related
to delirium and ICU-AW requires the successful implementation of the ABCDE bundle through further exploration of organizational domains that are amenable to intervention.

**Figure 2-2. Addressing challenges to ABCDE bundle implementation**

<table>
<thead>
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<th>Organizational facets</th>
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<tr>
<td>&quot;advocating for [physical and occupational] therapy orders...double check bedrest orders”</td>
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<tr>
<td>“good handoff [with the nurse] on what the patient was able to do [e.g., mobility, SBT]“</td>
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<tr>
<td>&quot;show us videos of other...units that are mobilizing patients“</td>
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<tr>
<td>Clear guidelines and protocols for consistent ABCDE bundle application</td>
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<tr>
<td>Interprofessional multifaceted training to build knowledge and awareness</td>
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<tr>
<td>Design opt-out protocols</td>
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<tr>
<td>Use multiprofessional peer leaders to role model, advocate and act as experts of the ABCDE bundle</td>
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<tr>
<th>Physical environment</th>
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<tbody>
<tr>
<td>Unit layout considerations during design phase</td>
</tr>
<tr>
<td>Strategic placement of necessary equipment to foster ease of use</td>
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<tr>
<th>Labor quantity</th>
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<tr>
<td>Unit dedicated staff (e.g., PT/OT, mobility tech) or more manpower in general</td>
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<tr>
<td>Sufficient number of nurse aids or orderlies</td>
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<tr>
<th>Labor quality</th>
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<tr>
<td>Use 'small tests of change' or simulation as an opportunity to provide experience for providers</td>
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<th>Tasks</th>
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<tr>
<td>Standardize approaches for care to improve efficiency and effectiveness (e.g., timing, process)</td>
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<tr>
<td>Encourage family members and patients to independently mobilize, if indicated</td>
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<tr>
<td>Create balanced patient assignments that foster ABCDE bundle execution</td>
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<tr>
<th>Provider attitudes</th>
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<tr>
<td>Employ 'small tests of change' to inspire clinician confidence</td>
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<thead>
<tr>
<th>Patient characteristics</th>
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</thead>
<tbody>
<tr>
<td>&quot;communicate to [patient] the importance...you need to work so...you'll be strong and...progress&quot;</td>
</tr>
<tr>
<td>Reassure patient about &quot;beeps&quot; and &quot;really praise them&quot;</td>
</tr>
<tr>
<td>Build a routine for the patient</td>
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<tr>
<td>Document goals on white boards to enhance overall communication</td>
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Focus group participants provided suggestions for addressing barriers to ABCDE bundle implementation are demonstrated in quotations. Further methods for addressing barriers have been included based on recommendations in the literature.62,77,78
CHAPTER III
ORGANIZATIONAL DOMAINS EXPLAIN VARIATION IN ICU PROVIDER ATTITUDES REGARDING THE ABCDE BUNDLE

This chapter reports the results of aim one examining the association of select organizational domains with provider attitudes. Upon completion of the focus group study, we made the suggested modifications to the conceptual framework dividing organizational facets into 1) policy and protocol factors and 2) unit milieu which were operationalized in this investigation and represented in Figure 3-1.

Background

Critical illness and the use of sedatives during MV can lead to delirium and ICU-AW. The ABCDE bundle is an interprofessional, multicomponent, evidence-based process designed to break the cycle of oversedation and prolonged MV leading to delirium and ICU-AW. More importantly, the bundle is designed to reduce patient suffering by providing care that increases the likelihood of survival and return to baseline physical and cognitive function. ABCDE bundle utilization has resulted in a reduction of delirium, ventilator and hospital days. In addition, the ABCDE bundle increases the frequency of early mobilization during critical illness and reduces costs.

Despite evidence for use, research suggests limited uptake of ABCDE components. In a survey of 212 providers, only 12% reported implementation of routine spontaneous awakening trials (SAT), delirium assessment and early mobility. Less than half the respondents achieved the outcome measure of >75% of ventilated patients undergoing daily awakening trials and delirium assessment. Likewise, early mobility was reported as an active unit goal by only 65% of respondents. Policy and protocol factors (protocol clarity/complexity, role clarity, training and understanding), unit milieu (staff morale, respect across disciplines, coordination, ICU/organizational culture, peer advocates), tasks (workload, documentation, autonomy), labor quality (provider competence, experience, knowledge) and labor quantity (staff turnover, staff type [e.g., registry nurse]), and physical environment (structural ICU characteristics, electronic medical record, equipment) have been identified as factors that affect
implementation of the ABCDE bundle. However, there is limited multicenter data regarding organizational domains that affect the provider’s attitude (i.e., internal disposition) to execute the ABCDE bundle. Identifying factors that affect provider attitudes and ABCDE bundle implementation in different ICU settings may guide further targeted interventions to improve utilization.

**Objectives**

The objective of this study was to examine the associations of selected organizational domains of 

- **a)** policy/protocol factors (protocol attributes, role clarity, training & understanding),
- **b)** unit milieu (coordination, peer advocates, teamwork),
- **c)** tasks (autonomy, time demands),
- **d)** labor quality (competence),
- **e)** labor quantity (sufficient staff, type of staff), and
- **f)** physical environment (unit layout, access to supplies and equipment) with provider attitudes of
  - **a)** perceived ease of completion,
  - **b)** perceived safety,
  - **c)** confidence, and
  - **d)** perceived strength of evidence regarding the ABCDE bundle.

**Methods**

This was a one-time cross-sectional survey conducted as part of a multicenter, prospective cohort pilot study funded by the American Association of Critical Care Nurses-Sigma Theta Tau Critical Care Grant. Study approval was obtained from the Vanderbilt University Institutional Review Board and the Institutional Review Board of each participating site. A waiver of documentation of informed consent was obtained for administration of the anonymous survey to ICU providers. Financial incentives for recruitment were not available.

**Setting & Sample**

Vanderbilt University was the coordinating center for the study. Participants were recruited from Baystate Medical Center (Springfield, MA), Vanderbilt University Hospital (Nashville, TN), University Hospital San Antonio (San Antonio, TX), Harborview Medical Center (Seattle, WA), University of Maryland Medical Center (Baltimore, MD), and University of Michigan Health System (Ann Arbor, MI). Registered nurses (RN), physical therapists (PT), occupational therapists (OT), respiratory therapists (RT), pharmacists, advanced practice nurses, nursing leadership, and physicians working ≥4 shifts/month
and age ≥18 y/o within participating medical and surgical ICUs at each hospital were eligible for study participation.

**Conceptual Framework**

The principal investigator (LMB) reviewed the literature and, along with co-investigator (LCM), devised a conceptual framework a priori that was a modification of the health services Outcome Production Model (Figure 3-1). Through previous study, this framework adequately revealed organizational domains to describe provider variation and underutilization of the ABCDE bundle. The purple arrow signifies the associations under investigation in the current study.

**Figure 3-1. Conceptual framework for Interprofessional Bundle Implementation**

**Variables and Measures**

A 71-item electronic ABCDE Provider Survey (see Appendix B) was generated specifically for this study. Data from a review of the literature and two single-center interprofessional focus group sessions (n=16) conducted by the principal investigator informed the survey. Focus group data were coded with affinity diagramming resulting in seven constructs: policy and protocol factors, unit milieu,
physical environment, labor quality, labor quantity, tasks and provider attitudes. Survey questions were
developed by the investigators for the collection of data on the seven identified constructs in relation to
execution of the ABCDE bundle and individual components. All responses utilized a 10-point visual
analog scale with higher scores indicating more positive views. The survey contained seven demographic
questions (e.g., age, experience, education level) and one open-ended question for respondents to share
any additional thoughts they had regarding barriers and facilitators to implementing the ABCDE bundle.
Content validation (scale CVI=0.96, p=0.05) was conducted according to the Lynn method using a nine-
person expert panel. The panel was comprised of physicians (n=3), RNs (n=4), a PT (n=1), and a
pharmacist (n=1) all having at least two years of ICU experience and familiarity with the ABCDE bundle.
Feasibility testing demonstrated the survey took between 5-7 minutes to complete. Multidisciplinary pilot
testing revealed minimal nonresponse potential for individual items. Cronbach’s alpha for the overall
ABCDE provider survey was 0.95.

The majority of organizational domain and provider attitude responses were grouped into
subscale themes for ease of comparison. Means were calculated for each of the subscales. The remaining
domains were analyzed as single items. Descriptions of subscales and items are provided below.

Organizational domains:

- Policy and protocol factors
  - Protocol attributes (i.e., accessibility, clarity and complexity – 13 items, α=0.90)
  - Provider role clarity (i.e., clarity of own others’ roles – 8 items, α=0.84)
  - ABCDE bundle training and understanding (2 items, α=0.57)

- Unit Milieu
  - Coordination among disciplines (4 items, α=0.58)
  - ABCDE bundle advocates (e.g., MD/RN leadership, peer leaders – 3 items, α=0.59)
  - ICU clinician teamwork (4 items, α = 0.02)

- Tasks
  - Time demands and having enough time (5 items, α=0.78)
Autonomy (4 items, α=0.70)

- Labor quality (i.e., provider competence – 6 single items, α=0.77)
- Labor quantity (i.e., sufficient staffing – 1 item)
- Physical environment (i.e., unit layout and access to supplies – 2 single items, α=0.73)

Provider attitudes (i.e., internal disposition and way of thinking):

- Perceived Ease of ABCDE bundle completion (2 items, α=0.16)
- Perceived Safety of ABCDE bundle completion (4 items, α=0.73)
- Confidence with performing the ABCDE bundle (4 items, α=0.69)
- Perceived Strength of Evidence with the ABCDE bundle (5 items, α=0.86)

Procedures

The principal investigator (LMB) flew to each site to meet 1:1 with the leadership of each unit and department at participating hospitals to determine strategies for survey distribution and completion. Subject eligibility was reviewed and determinations were made for site-specific methods to reach the target sample while also minimizing sampling error. For example, the nurse manager from one site forwarded the survey using an email distribution list including just full- and part-time RNs working in the unit, excluding temporary personnel. Another site’s respiratory and physical therapy managers forwarded the survey invitation only to those therapists working in eligible unit(s). Leadership forwarded an electronic survey link to the targeted sample population. Reminders were sent at four and eight weeks to maximize survey response rates. Unit signage and recruitment postcards were employed across sites to enhance participation. Study data were collected and managed using Research Electronic Data Capture (REDCap) tools hosted at Vanderbilt University.81

Statistical Analysis

IBM SPSS version 23 was used for all statistical analyses. Graphical and descriptive statistical methods were used to evaluate data distributions. Frequency distributions were used to summarize nominal and ordinal data. Continuous data distributions were skewed, therefore, median and interquartile
range were used to summarize those data. No data transformations were necessary to meet statistical assumptions. Individual survey items were evaluated for systematic nonresponse patterns for the entire sample and within each discipline to determine if data were missing randomly or nonrandomly.\textsuperscript{82} No survey items were omitted from analyses. Spearman correlations ($r_s$) were used to assess the associations of the selected organizational domains with provider attitudes. Because of very low Cronbach coefficient values, individual items for Teamwork and Perceived Ease of Completion were correlated rather than subscale values. Tests of statistical significance maintained a Type I error rate of 0.05 ($p<0.05$). An $r_s \geq 0.32$ was considered clinically important, the coefficient of variation explaining at least 10% of the variance in provider attitudes.\textsuperscript{83}

**Results**

A total of 315 surveys were included in the analysis (69 excluded for ineligible unit or <4 survey items completed), a response rate of 25%. A descriptive summary of participants is presented in Table 3-1. Nurses and physicians comprised the largest proportion of the sample, N=156 (50%) and N=72 (23%) respectively. Participants were a median age of 38 years (IQR=31,49), had 9 years of ICU experience (IQR=4,19), and 69% were female (N=168). RTs tended to be older (median=50 years, IQR=43,57) and more experienced (median=18 years, IQR=9,25).

**Table 3-1. Demographics of the multisite sample**

<table>
<thead>
<tr>
<th>Position</th>
<th>Age Median (IQR)</th>
<th>Gender Female N (%)</th>
<th>Years ICU Experience Median (IQR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse (N=156)</td>
<td>36 (28, 45)</td>
<td>108 (87)</td>
<td>9 (4, 19)</td>
</tr>
<tr>
<td>Nurse practitioner (N=8)</td>
<td>34 (30, 40)</td>
<td>5 (83)</td>
<td>8 (5, 13)</td>
</tr>
<tr>
<td>Occupational therapist (N=7)</td>
<td>30 (27, 44)</td>
<td>5 (100)</td>
<td>6 (3, 21)</td>
</tr>
<tr>
<td>Pharmacist (N=9)</td>
<td>34 (31, 64)</td>
<td>4 (50)</td>
<td>9 (6, 32)</td>
</tr>
<tr>
<td>Physical therapist (N=21)</td>
<td>31 (28, 37)</td>
<td>14 (82)</td>
<td>7 (3, 10)</td>
</tr>
<tr>
<td>Physician (N=72)</td>
<td>40 (35, 46)</td>
<td>17 (30)</td>
<td>9 (4, 15)</td>
</tr>
<tr>
<td>Respiratory therapist (N=41)</td>
<td>50 (43, 57)</td>
<td>15 (58)</td>
<td>18 (9, 25)</td>
</tr>
<tr>
<td><strong>Sample (N=315)</strong></td>
<td><strong>38 (31, 49)</strong></td>
<td><strong>168 (69)</strong></td>
<td><strong>9 (4, 19)</strong></td>
</tr>
</tbody>
</table>
Descriptive summaries of provider attitude subscales are presented in Table 3-2. On a 10-point scale, participants tended to disagree with the statement that the ABCDE bundle was difficult to carry out (median=4.0, IQR=2.0,5.9) but were neutral on impact to workload (median=5.2, IQR=2.8,7.0). They agreed the bundle has strong supporting evidence (median=9.4, IQR=8.3,9.9). Lastly, the bundle was perceived as safe to execute (median=8.8, IQR=7.8,9.6) with a relatively high level of confidence (median=8.6, IQR=7.0,9.5).

<table>
<thead>
<tr>
<th>Question</th>
<th>Median VAS score (range 0-10)</th>
<th>IQR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceived EASE of Completion of the ABCDE bundle (α = 0.16)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The bundle greatly increases my <strong>WORKLOAD</strong> (0-10 strongly [dis]agree)</td>
<td>5.2</td>
<td>2.8, 7.0</td>
</tr>
<tr>
<td>The team has <strong>DIFFICULTY</strong> carrying out the bundle (0-10 strongly</td>
<td>4.0</td>
<td>2.0, 5.9</td>
</tr>
<tr>
<td><strong>Perceived SAFETY</strong> of the ABCDE bundle (α=0.73)</td>
<td>8.8</td>
<td>7.8, 9.6</td>
</tr>
<tr>
<td>Spontaneous Awakening Trial (hazardous 0, safe 10)</td>
<td>9.4</td>
<td>7.9, 10.0</td>
</tr>
<tr>
<td>Spontaneous Breathing Trial (hazardous 0, safe 10)</td>
<td>9.6</td>
<td>8.4, 10.0</td>
</tr>
<tr>
<td>Delirium assessment/management (hazardous 0, safe 10)</td>
<td>9.8</td>
<td>8.6, 10.0</td>
</tr>
<tr>
<td>Early mobility (hazardous 0, safe 10)</td>
<td>8.0</td>
<td>6.1, 9.6</td>
</tr>
<tr>
<td><strong>CONFIDENCE</strong> in performing the ABCDE bundle (α=0.69)</td>
<td>8.6</td>
<td>7.0, 9.5</td>
</tr>
<tr>
<td>Spontaneous Awakening Trial (uncertain 0, confident 10)</td>
<td>9.6</td>
<td>7.4, 10.0</td>
</tr>
<tr>
<td>Spontaneous Breathing Trial (uncertain 0, confident 10)</td>
<td>9.7</td>
<td>7.8, 10.0</td>
</tr>
<tr>
<td>Delirium assessment/management (uncertain 0, confident 10)</td>
<td>9.0</td>
<td>7.3, 10.0</td>
</tr>
<tr>
<td>Early mobility (uncertain 0, confident 10)</td>
<td>8.0</td>
<td>6.0, 9.8</td>
</tr>
<tr>
<td><strong>Perceived STRENGTH OF EVIDENCE</strong> of the ABCDE bundle (α=0.86)</td>
<td>9.4</td>
<td>8.3, 9.9</td>
</tr>
<tr>
<td>Importance of completing the ABCDE bundle (not important 0, important 10)</td>
<td>8.9</td>
<td>7.1, 10.0</td>
</tr>
<tr>
<td>The literature strongly supports SATs (0-10 strongly [dis]agree)</td>
<td>9.8</td>
<td>8.8, 10.0</td>
</tr>
<tr>
<td>The literature strongly supports SBTs (0-10 strongly [dis]agree)</td>
<td>9.8</td>
<td>8.9, 10.0</td>
</tr>
<tr>
<td>The literature strongly supports delirium assessment/management (0-10</td>
<td>9.8</td>
<td>8.5, 10.0</td>
</tr>
<tr>
<td>strongly [dis]agree)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The literature strongly supports early mobility (0-10 strongly [dis]agree)</td>
<td>9.8</td>
<td>8.4, 10.0</td>
</tr>
</tbody>
</table>

*a VAS = Visual Analog Scale (range 0-10); higher values indicate more positive attitudes for most items

*b All subscale totals are in bold
Association of provider attitudes with organizational domains

Correlations of organizational variables with provider attitudes are summarized in Table 3-3. A majority of the correlations were statistically significant ($p < 0.05$) with one third as clinically meaningful ($r \geq 0.32$).

Table 3-3. Association of organizational domains and provider attitude subscales

<table>
<thead>
<tr>
<th>Organizational Domains</th>
<th>Provider Attitudes ($r_{s}$)</th>
<th>Perceived Ease of Completion</th>
<th>Perceived Safety</th>
<th>Confidence</th>
<th>Perceived Strength of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Workload</td>
<td>Difficulty</td>
<td>Perceived Safety</td>
<td>Confidence</td>
</tr>
<tr>
<td>Policy &amp; Protocol Factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocol attributes</td>
<td>-0.06</td>
<td>-0.37**</td>
<td>0.44**</td>
<td>0.58**</td>
<td>0.44**</td>
</tr>
<tr>
<td>Role clarity</td>
<td>-0.06</td>
<td>-0.38**</td>
<td>0.42**</td>
<td>0.59**</td>
<td>0.46**</td>
</tr>
<tr>
<td>Training &amp; understanding</td>
<td>0.02</td>
<td>-0.22**</td>
<td>0.33**</td>
<td>0.46**</td>
<td>0.40**</td>
</tr>
<tr>
<td>Unit Milieu</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coordination</td>
<td>0.03</td>
<td>-0.33**</td>
<td>0.33**</td>
<td>0.45**</td>
<td>0.38**</td>
</tr>
<tr>
<td>Peer advocates</td>
<td>0.01</td>
<td>-0.32**</td>
<td>0.37**</td>
<td>0.31**</td>
<td>0.48**</td>
</tr>
<tr>
<td>ICU Teamwork</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work well together</td>
<td>-0.02</td>
<td>-0.44**</td>
<td>0.29**</td>
<td>0.36**</td>
<td>0.36**</td>
</tr>
<tr>
<td>Help each other</td>
<td>0.25**</td>
<td>0.41**</td>
<td>-0.27**</td>
<td>-0.30**</td>
<td>-0.33**</td>
</tr>
<tr>
<td>Rely on each other</td>
<td>0.23**</td>
<td>0.22**</td>
<td>0.17**</td>
<td>0.14*</td>
<td>0.10</td>
</tr>
<tr>
<td>Workload not fairly shared</td>
<td>0.10</td>
<td>0.26**</td>
<td>-0.02</td>
<td>0.03</td>
<td>-0.02</td>
</tr>
<tr>
<td>Tasks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time demands</td>
<td>-0.17*</td>
<td>-0.25**</td>
<td>0.28**</td>
<td>0.14*</td>
<td>0.27**</td>
</tr>
<tr>
<td>Autonomy</td>
<td>-0.08</td>
<td>-0.15*</td>
<td>0.35**</td>
<td>0.47**</td>
<td>0.31**</td>
</tr>
<tr>
<td>Labor Quality (i.e., competence)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurses</td>
<td>-0.10</td>
<td>-0.26**</td>
<td>0.29**</td>
<td>0.28**</td>
<td>0.33**</td>
</tr>
<tr>
<td>Occupational therapists</td>
<td>-0.02</td>
<td>-0.16*</td>
<td>0.16*</td>
<td>0.19*</td>
<td>0.29**</td>
</tr>
<tr>
<td>Pharmacists</td>
<td>-0.13</td>
<td>-0.29**</td>
<td>0.39**</td>
<td>0.28**</td>
<td>0.46**</td>
</tr>
<tr>
<td>Physical therapists</td>
<td>-0.00</td>
<td>-0.17**</td>
<td>0.23**</td>
<td>0.25**</td>
<td>0.29**</td>
</tr>
<tr>
<td>Physicians</td>
<td>-0.23**</td>
<td>-0.25**</td>
<td>0.39**</td>
<td>0.25**</td>
<td>0.38**</td>
</tr>
<tr>
<td>Respiratory therapists</td>
<td>-0.18**</td>
<td>-0.30**</td>
<td>0.30**</td>
<td>0.31**</td>
<td>0.38**</td>
</tr>
<tr>
<td>Labor Quantity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit layout</td>
<td>-0.08</td>
<td>-0.29**</td>
<td>0.22**</td>
<td>0.18*</td>
<td>0.16*</td>
</tr>
<tr>
<td>Access to supplies &amp; equipment</td>
<td>-0.01</td>
<td>-0.32**</td>
<td>0.28**</td>
<td>0.18*</td>
<td>0.40**</td>
</tr>
</tbody>
</table>

*N range=220-269  *$p$-value <0.05  **$p$-value <0.001

**bold**=clinically significant at $\geq 0.32$ accounting for $\geq 10\%$ of variance
Perceived ease of completion via workload burden assessment was not clinically significantly associated with any organizational domain. Absolute values of clinically significant correlations were found for provider attitudes of ABCDE bundle difficulty, perceived safety, confidence and perceived strength of evidence with policy and protocol factors and unit milieu (i.e., protocol attributes \( r_s = 0.37-0.58 \), role clarity \( r_s = 0.38-0.59 \), training & understanding \( r_s = 0.33-0.46 \), coordination \( r_s = 0.33-0.45 \) and peer advocates \( r_s = 0.32-0.48 \)). Provider attitudes of bundle difficulty, confidence, and perceived strength of evidence were correlated with teamwork (work well together \( r_s = 0.36-0.44 \), help each other \( r_s = 0.33-0.41 \)). In addition, ABCDE bundle perceived safety \( r_s = 0.35 \) and confidence \( r_s = 0.47 \) was correlated with provider reports of task autonomy. The labor quality (i.e., competence) of pharmacists and physicians was associated with perceived safety \( r_s = 0.39 \) and perceived strength of evidence \( r_s = 0.38-0.46 \), while nurse and RT labor quality was associated just with perceived strength of evidence \( r_s = 0.33-0.38 \). Unit layout was associated with bundle difficulty \( r_s = 0.32 \) and perceived strength of evidence \( r_s = 0.40 \). Lastly, bundle difficulty was associated with access to supplies \( r_s = 0.37 \).

**Discussion**

As a first step in examining methods for intervention to enhance ABCDE bundle adherence, we examined selected organizational domains that may impact provider attitudes. Our study found that the more 1) straightforward the role of providers; 2) clear, accessible and simple the protocol; 3) training and understanding; and 4) provider autonomy, the more likely they are to feel safe and confident with ABCDE bundle implementation. Notably, 35% of the variability in provider confidence performing the ABCDE bundle was explained by role clarity. Next, protocol attributes, such as accessibility, clarity and complexity, explained 19-34% of the variability in provider confidence, perceived safety, and perceived strength of ABCDE bundle evidence, but only 11% of perceived difficulty. Likewise, 21% of variation in provider reported confidence using the ABCDE bundle was explained by training and understanding. Perception of team members’ willingness to help one another and rely on one another explained 16% of difficulty performing the ABCDE bundle. Finally, reported level of provider autonomy explained 12% of the variation in provider attitudes toward perceived safety of the ABCDE bundle and 22% of the variation
in provider confidence in performing ABCDE bundle activities. Given these were the most clinically significant organizational domains found to explain variation in provider attitudes, they are a reasonable starting point for examining methods for intervention to enhance ABCDE bundle adherence.

Our findings are consistent with the study’s guiding conceptual framework as well as previous ABCDE bundle implementation findings.\textsuperscript{59-61,79} Though previous studies have not evaluated the influence of organizational domains on provider attitudes regarding the ABCDE bundle, they have identified similar organizational domains serving as barriers to ABCDE bundle implementation. Key findings affirming our results include awakening and breathing trial timing (i.e., protocol clarity), knowledge deficits (i.e., training and understanding), coordination and communication challenges, unclear protocols, and absence of peer advocates identified as implementation barriers.\textsuperscript{59-61} Furthermore, our findings are supported by implementation studies of other interprofessional protocols identifying policy and protocol factors such as unclear role responsibilities, timing for protocol completion, and challenges learning complex protocols as barriers to successful implementation.\textsuperscript{84,85}

Through the survey we obtained multidisciplinary input for provider perspectives on the perceived competence of other ICU professionals (i.e., labor quality). With the exception of PTs and OTs, perceived competence of the remaining ICU providers was clinically significantly associated with provider attitudes regarding strength of evidence with the ABCDE bundle, explaining 11-21\% of the variance. Critical care expertise and clinical experience have been attributed as moderators to interprofessional protocol adherence in prior work and warrant further evaluation in ABCDE bundle adherence.\textsuperscript{86-88} PTs and OTs are part of a centralized staffing structure and, thus, may not rotate through consistent units. When there is less consistency in PT and OT staffing, they may be perceived as outside the regular ICU team. Consequently, PT and OT competence for performing the ABCDE bundle may come into question because the consistent ICU staff does not have the interprofessional experiences to affirm competence. If the PT and OT are truly participating in the interprofessional team, then competence is more likely to be known.
We identified further evidence of role clarity problems from the pattern of missing data associated with particular professions. PTs and OTs tended have missing responses for questions related to awakening and breathing coordination, delirium assessment and management, and the complete ABCDE bundle. Similarly, RTs tended to consistently have missing responses for questions related to SATs, delirium assessment and management, early mobility, and the complete ABCDE bundle. Perhaps these providers see themselves outside of the interprofessional team or protocol because they come from centralized departments rather than decentralized ICU staffing. Subsequently, PTs, OTs and RTs may be less involved in ICU protocol development and not as well integrated into implementation processes contributing to loss of a team mentality. Clear articulation of each provider’s role can foster ownership and promote smooth team functioning allowing team members to complete the ABCDE bundle amidst a chaotic ICU environment. Likewise, use of a unified ABCDE protocol, as opposed to separate protocols for each component of the bundle, may improve interprofessional role clarity and, thus, provider attitudes regarding the ABCDE bundle.

The clinical implications of this study lie in the potential for interprofessional collaboration that may improve provider attitudes and implementation of the ABCDE bundle (Figure 3-2). First, interprofessional workgroups may be indicated for protocol development and implementation to increase confidence in conducting the ABCDE bundle by clarifying protocol attributes and provider roles. Second, strong interprofessional peer leaders have been reported as necessary for successful daily ABCDE bundle execution, especially when unit culture has not yet adapted. Next, unit culture change and interprofessional engagement may be fostered through structured feedback and reporting of ABCDE metrics and associated outcomes. Lastly, the implementation process may benefit from the inclusion of interprofessional education and training opportunities to improve ABCDE bundle role clarity, understanding and coordination. Access and exposure to ABCDE bundle literature influencing provider attitudes of perceived strength of evidence likely varies across professions. Interprofessional journal clubs is another method for dissemination of ABCDE evidence and enhance understanding.
This study has important limitations that must be addressed. First, there was low participation in the online survey. We utilized ICU leadership and peer leaders to foster participation; however, there is the potential for bias due to participation motivated by those who are strongly for or against the ABCDE bundle. Second, the study was a cross-sectional single survey design. Variance in exposure to the ABCDE bundle at each of the participating centers is likely and we are unable to infer causality of organizational domains with provider attitudes regarding ABCDE bundle ease of completion, safety, confidence and strength of evidence. Lastly, the subscales for perceived ease of completion and teamwork had low internal consistency. Modification of these items is required prior to future study.

Despite limitations, the study also has important strengths. The study includes multidisciplinary participation of physicians, RNs, advanced practice nurses, pharmacists, PTs, OTs, and RTs with a sample size that is greater than prior studies of ABCDE bundle barriers and facilitators. Though there are smaller number participants for some disciplines (e.g., OTs, pharmacists, nurse practitioners), this sample
is representative of the staffing ratios represented within the participating ICUs. The study also incorporated providers from ten different medical and surgical ICUs in six different hospitals across the continental United States. Though the generalizability of the findings may be limited, we were able to identify several organizational domains amenable to intervention that can be studied on a larger scale.

**Conclusions**

In this study, we found a number of organizational domains that are positively associated with provider attitudes of ABCDE bundle difficulty, perceived safety, confidence, and perceived strength of evidence. We identified issues with role clarity and labor quality across professions. Implementation of the ABCDE bundle is dependent upon successful interprofessional collaboration. Though the nurse is uniquely qualified due to participation in each component of the ABCDE bundle, other members of the interprofessional team are equally important for achieving success. Future research efforts would benefit from more intensive recruitment of PTs, OTs, RTs and pharmacists. Likewise, exploration of the relationship between provider attitudes and execution of the ABCDE bundle is indicated.
CHAPTER IV

ICU PROVIDER PERCEPTIONS OF ABCDE BUNDLE WORKLOAD BURDEN ARE ASSOCIATED WITH ADHERENCE

This chapter reports the results of aim two examining the association of provider attitudes with ABCDE bundle adherence. The same provider attitude subscales generated for aim one were utilized in this analysis. To make the analysis more precise, adherence to the bundle was evaluated using both ventilator days (ABCDE bundle) and ventilator-free days (DE bundle).

Background

ICU delirium and ICU-AW are common and serious public health problems. Duration of ICU delirium has been associated with reduced probability of survival after hospital discharge and long-term cognitive impairment.\(^6,7,70\) Likewise, ICU-AW is independently associated with postdischarge mortality and reduced physical functioning up to five years following critical illness.\(^31,90\) Attention is now turning to the long-term outcomes of ICU survivors and the role of critical care therapies on daily life. Interprofessional approaches are a solution for taking the complexity of critical care therapies and bundling them into organized, practical, and traceable procedures.\(^91\)

The ABCDE bundle (Awakening and Breathing Coordination, Delirium assessment/management, and Early mobility), is an interprofessional, evidence-based bundle that, when implemented, has resulted in a reduction in ventilator, delirium, and hospital days; an increase in ICU mobilization; and significant financial benefits.\(^22-24\) Implementation of the ABCDE bundle is not only endorsed by critical care societies (i.e., Society of Critical Care Medicine, American Association of Critical-Care Nurses), but also national quality improvement agencies (i.e., Institute for Healthcare Improvement, Agency for Healthcare Research and Quality, and the Centers for Disease Control and Prevention) as a means to enhance the quality and safety of critical care. Despite endorsements and evidence for effectiveness of the ABCDE bundle, uptake is limited.\(^92-99\) A recent survey of 212 interprofessional Michigan ICU providers reported that only 12% have implemented the ABCDE bundle despite a statewide quality improvement initiative.\(^58\)
Factors affecting interprofessional ICU protocol implementation and adherence are poorly understood. Review of the literature suggests that provider attitudes (i.e., prevailing tendencies and way of thinking) influence protocol implementation and adherence.\textsuperscript{59,61,79} For example, a study to evaluate factors influencing nurses administration of sedatives in mechanically ventilated patients found that nurse attitudes toward the efficacy of sedation was associated with reports of sedative administration. Nurse attitudes toward the mechanical ventilation experience was positively correlated with sedation practices ($r_s=0.28$, $p<0.01$) and the intention to administer sedatives to all mechanically ventilated patients ($r_s=0.58$, $p<0.01$).\textsuperscript{100}

The association of ICU provider attitudes on adherence to the ABCDE bundle, a complex and interprofessional protocol, is unknown. Therefore, the objective of this study was to examine the associations of ICU provider attitudes with ABCDE bundle adherence. Specific provider attitudes include 1) workload burden, 2) difficult to carry out, 3) perceived safety, 4) confidence, and 5) perceived strength of evidence of the ABCDE bundle. The Interprofessional Bundle Implementation conceptual framework (Figure 4-1), described in detail in previous publications, illustrates the organizational domains previously studied and the association of adherence with provider attitudes currently under investigation.\textsuperscript{79,101}

Methods

This was a multicenter, prospective, cohort study funded by the American Association of Critical-Care Nurses and Sigma Theta Tau International Critical Care Grant. Approval was obtained from the Institutional Review Board at each of the participating centers. Vanderbilt University was the coordinating center for the study. Recruitment was conducted within the medical and surgical ICUs in six participating centers: Baystate Medical Center (Springfield, MA), Vanderbilt University Hospital (Nashville, TN), University Hospital San Antonio (San Antonio, TX), University of Maryland Medical Center (Baltimore, MD), University of Michigan Health System (Ann Arbor, MI), and Harborview Medical Center (Seattle, WA).
Organizational domains such as policy and protocol factors, unit milieu, labor quantity, labor quality, tasks, and physical environment are proposed to influence provider attitudes and, thus, adherence to the ABCDE bundle. This study is looking for the associations of provider attitudes with ABCDE bundle adherence in particular.

*Provider attitudes: workload burden, difficult to carry out, perceived safety of ABCDE bundle implementation, confidence in performing the ABCDE bundle, and perceived strength of evidence for the ABCDE bundle.

**Sample**

A total sample of 268 ICU providers included registered nurses (RNs), advanced practice nurses, physical therapists (PTs), occupational therapists (OTs), respiratory therapists (RTs), pharmacists, and physicians age ≥18 years providing care to patients (≥4 shifts/month) nested in eligible medical and surgical ICUs practicing the ABCDE bundle in participating hospitals. A waiver of documentation of informed consent was obtained for administration of the anonymous survey for ICU providers. Patients included those with qualifying organ failure (i.e., mechanical ventilation, noninvasive ventilation, treatment for shock) enrolled in an ongoing clinical trial with daily tracking of ABCDE bundle adherence.

**Procedures**

A 71-item content-validated electronic ABCDE Provider Survey (see Appendix B) was used to collect data on the provider attitudes (CVI=0.96, p=.05, α=0.95). The investigator conducted in-person meetings with the leadership of each unit and department at participating hospitals to describe
survey distribution requirements. An electronic survey link was forwarded to the targeted ICU providers by unit and departmental leadership. Survey participation was facilitated through the use of unit signage and recruitment postcards. Site-specific methods were employed to reach the target sample while, at the same time, reducing sampling error. Reminders were sent to ICU providers at four and eight weeks to maximize survey response rates.

Daily conduct of the ABCDE bundle was at the discretion of the ICU team and guided by a standardized protocol (see Appendix C). The investigators had no role in performing ABCDE bundle components. Adherence was tracked via the ABCDE adherence checklist (see Appendix D). The checklist was placed at the patient bedside and completed daily (i.e., 24h calendar day) by the RN and other providers involved in completing ABCDE bundle components. ABCDE bundle adherence checklists were distributed, collected and recorded daily by trained study staff. All study data were managed using Research Electronic Data Capture (REDCap) tools hosted at Vanderbilt University by either the study principal investigator or trained personnel.81

Variables and Measures

Provider attitudes are defined as the internal disposition of providers to adhere to the ABCDE bundle. Provider attitudes were calculated from 10-point visual analog scale responses. Higher scores represented more positive views for all but workload burden and difficult to carry out attitudes. Five analyses of two individual items and three subscales of provider attitudes were run. The three provider attitude subscales, perceived safety of ABCDE bundle implementation (α=0.73), confidence in performing the ABCDE bundle (α=0.69), and perceived strength of evidence for the ABCDE bundle (α=0.86) were used for ease of analysis. Workload burden and difficult to carry out were each analyzed as individual items due to poor subscale reliability (α=0.16). Averages for each of the provider attitude subscales and individual items were subsequently calculated and aggregated by unit.

ABCDE bundle adherence was defined as all five components (ABCDE bundle) requiring completion during ventilator ICU days and Delirium assessment/management and Early mobility components (DE bundle) requiring completion during ventilator-free ICU days, as Awakening and
Breathing trial Coordination are not relevant for patients who are not on the ventilator. ABCDE bundle adherence was computed for the entire period of ventilator ICU days as [(days of ABCDE adherence) / (total ventilator ICU days)]. DE bundle adherence was computed for the entire period of ventilator-free ICU days as [(days of DE adherence) / (total ventilator-free ICU days)]. Adherence to individual components on ventilator days (ABCDE bundle) and ventilator-free days (DE bundle) was computed separately using the same equation.

Statistical Analysis

Statistical analyses were conducted using IBM SPSS version 23 and STATA version 14. Graphical and descriptive statistical methods were used to summarize and evaluate data distributions. Frequency distributions summarized nominal data. Continuous variable distributions for provider attitudes and adherence data were skewed, therefore median and interquartile ranges were used to summarize the data. Provider attitude data were first aggregated at the unit level. Subsequently, those unit level provider attitude scores were linked with the patient adherence records in the respective units. Logistic regression models were used to test the effects of unit level provider attitude values on ABCDE bundle adherence and select individual bundle components (i.e., Coordination and Early mobility) while controlling for relevant patient characteristics (i.e., age, Charlson comorbidity index, APACHE II score, ventilator status). There were not enough cases of nonadherence to evaluate logistic regression in the remaining individual bundle components. To maintain the statistical power and variability in ABCDE adherence among assessments for the same patient the standard errors in each model were adjusted for patient data clustering. Tests of statistical significance maintained a Type I error rate of 0.05 (p<0.05).

Results

Patient Characteristics

A total of 101 patients were enrolled in the study, N=70 enrolled in medical units (median=11, min=3, max=22) and N=32 enrolled in surgical units (median=10, min=2, max=13). Patients were a majority Caucasian (89%) and male (58%) with a mean age of 58 years (Table 4-1). Patients were admitted to the ICUs for several different medical and surgical reasons with the highest percentage
presenting for management of sepsis and/or septic shock (39%). APACHE II scores for the sample population indicated a high severity of illness (mean=27.7, SD=9.3), yet there was a minimal comorbidity per the Charlson Comorbidity Index (median=1.5, IQR=0.2.3).103,104

Table 4-1. Characteristics of patients monitored for ABCDE bundle adherence*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Patient values (N=101)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>54.6 (13.6)</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>42 (41.6)</td>
</tr>
<tr>
<td>Caucasian, n (%)</td>
<td>89 (88.1)</td>
</tr>
<tr>
<td>APACHE II, mean (SD)</td>
<td>27.7 (9.3)</td>
</tr>
<tr>
<td>Charlson Comorbidity Index, median (IQR)</td>
<td>1.5 (0, 2.3)</td>
</tr>
<tr>
<td>Admitting diagnosis, n (%)</td>
<td></td>
</tr>
<tr>
<td>• Sepsis/Septic Shock</td>
<td>38 (37.6)</td>
</tr>
<tr>
<td>• Airway protection, Other pulmonary</td>
<td>26 (25.7)</td>
</tr>
<tr>
<td>• COPD/Asthma</td>
<td>15 (14.8)</td>
</tr>
<tr>
<td>• Acute Lung Injury</td>
<td>10 (9.9)</td>
</tr>
<tr>
<td>• Transplants</td>
<td>4 (4.0)</td>
</tr>
<tr>
<td>• Metabolic Imbalance or Cirrhosis</td>
<td>3 (3.0)</td>
</tr>
<tr>
<td>• Cardiomyopathy or Arrhythmia</td>
<td>2 (2.0)</td>
</tr>
<tr>
<td>• Other reason</td>
<td>3 (3.0)</td>
</tr>
</tbody>
</table>

*Patient inclusion criteria include age ≥18 years, in one of the study ICUs with qualifying organ failure (i.e., mechanical ventilation, noninvasive ventilation, treatment for shock). This sample represents a population highly susceptible to the development of delirium and ICU-AW and require the full ABCDE bundle. Patient exclusion criteria included severe dementia, neurological injuries, pregnancy, moribund, active seizures, and prisoners.

Provider Characteristics and Attitudes

The survey response rate was 25% with N=268 included in the analysis. Surveys were excluded for wrong unit (n=9) and lack of provider attitude data for analysis (n=106). The majority of participants were nurses (58%) and physicians (24%). The remainder of the sample included nurse practitioners (n=6), occupational therapists (n=7), pharmacists (n=10), physical therapists (n=20), and respiratory therapists (n=30).

Participants reported a high perceived strength of evidence (median=9.4, IQR=8.3,9.9) for the ABCDE bundle. Most participants reported feeling confident (median=8.6, IQR=7.0,9.5) with ABCDE bundle implementation with a moderate perceived level of safety (median=8.8, IQR=7.7,9.6). Workload
burden associated with the bundle was neutral (median=5.2, IQR=2.8,7.0) and participants tended to disagree with having difficulty carrying out the bundle (median=4.0, IQR=2.0,5.9).

**ABCDE (ventilator days) and DE (ventilator-free days) Bundle Adherence**

Adherence was measured for 101 patients on a total of 752 ICU days (Figure 4-2). Variation in ABCDE bundle adherence (on ventilator days) was noted across units, ranging between 38% and 85%. DE bundle adherence (on ventilator-free days) was less variable among units, ranging between 86% and 100%. Overall bundle adherence was greater on ventilator-free (DE bundle) days compared to ventilator (ABCDE bundle) days across all units (97% vs. 72%, \( z=5.47, p<0.001 \)). Overall ABCDE bundle adherence was lower in surgical units compared to medical units, but did not reach statistical significance (63% vs. 75%, \( z=1.89, p=0.059 \)).

When bundle components were evaluated individually (see Appendix E), Coordination (i.e., breathing trial preceded by awakening trial, 89%) and Early mobility (86%) had the lowest levels of adherence for mechanically ventilated patients. Reasons for ABCDE bundle components not being completed are recorded in Table 4-2. The most common reason for Awakening trials not being completed was respiratory instability (33.3%). The most common reason for Breathing trials not being completed was PEEP >7.5 (36.9%). The most common reason for Early mobility not being completed was RASS -4 or -5 (23.8%). Reasons for not completing Coordination and Delirium assessment/management were not tracked.
Figure 4-2. Unit adherence to ABCDE (ventilator days) and DE (ventilator-free days) bundle

101 patients were observed for adherence over 561 ventilator ICU days and 191 ventilator-free ICU days across 10 ICUs (6 medical units, 4 surgical units). Overall ABCDE bundle adherence (72% represented by orange dash line) was less than DE bundle adherence (97% represented by orange dash line) in all units \(p<0.001\) as well as when compared by medical \(p<0.001\) and surgical units \(p<0.001\). Overall ABCDE bundle adherence was not statistically significantly greater in medical vs. surgical units \(p=0.059\).

*Hospital 5 and 6 surgical ICUs did not participate in the study. Hospital 5 did not have DE bundle data, all measured bundle days were on the ventilator.
Table 4-2. Documented reasons for ABCDE bundle components not being completed

<table>
<thead>
<tr>
<th>Bundle Component</th>
<th>Adherent – Failed Screen</th>
<th>NonAdherent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Awakening trial</strong></td>
<td>33.3 (65) Respiratory instability</td>
<td>5.1 (10) Patient off unit</td>
</tr>
<tr>
<td></td>
<td>26.2 (51) Agitation</td>
<td>4.6 (9) Other, SAT was indicated</td>
</tr>
<tr>
<td></td>
<td>17.4 (34) Myocardial ischemia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13.3 (26) Paralytic infusion or neuro instability</td>
<td></td>
</tr>
<tr>
<td><strong>Breathing trial</strong></td>
<td>36.9 (168) PEEP &gt;7.5</td>
<td>3.1 (12) Patient off unit/other</td>
</tr>
<tr>
<td></td>
<td>19.7 (87) FiO2 &gt;50%</td>
<td>3.7 (17) Other, SBT was indicated</td>
</tr>
<tr>
<td></td>
<td>13.4 (61) Failed SAT, no SBT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11.6 (53) Significant vasopressor infusion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.2 (28) Agitation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.6 (21) Respiratory or myocardial instability</td>
<td></td>
</tr>
<tr>
<td><strong>Coordination</strong></td>
<td>Not recorded</td>
<td></td>
</tr>
<tr>
<td><strong>Delirium assessment/management</strong></td>
<td>Not recorded</td>
<td></td>
</tr>
<tr>
<td><strong>Early mobility</strong></td>
<td>23.8 (113) RASS -4 or -5</td>
<td>16.7 (79) Unknown, mobility was indicated</td>
</tr>
<tr>
<td></td>
<td>17.7 (84) PEEP &gt;10</td>
<td>1.3 (6) No staff or staff unavailable</td>
</tr>
<tr>
<td></td>
<td>11.8 (56) FiO2 &gt;60%</td>
<td>&lt;1 (2) Patient of unit</td>
</tr>
<tr>
<td></td>
<td>9.9 (47) Increased vasopressors in last 2 hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.4 (16) Respiratory or myocardial instability</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Adherent – Other reason</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8.4 (40) Recent effect of sedative medications</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.9 (23) Clinical team refused</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.7 (8) Other, mobility not indicated</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>NonAdherent</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16.7 (79) Unknown, mobility was indicated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.3 (6) No staff or staff unavailable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;1 (2) Patient of unit</td>
<td></td>
</tr>
</tbody>
</table>

**Associations of provider attitudes and ABCDE bundle adherence**

Results of the logistic regression analyses are presented in Table 4-3. After controlling for patient characteristics (i.e., age, Charlson comorbidity index, APACHE II score, ventilator status), there was a 53% decrease in likelihood of adherence to the ABCDE bundle for every unit increase in the response to workload burden (OR=0.47, CI=0.28-0.79, p=0.004). Provider attitudes of difficult to carry out,
perceived safety, confidence, and perceived strength of evidence were not statistically significantly associated with ABCDE bundle adherence.

Upon evaluation of individual bundle components, for every unit increase in the response to difficult to carry out, there was a 59% decrease in the likelihood of Early mobility adherence (OR=0.41, CI=0.19-0.90, p=0.027). Provider attitudes of difficult to carry out, perceived safety, confidence, and perceived strength of evidence were not statistically significantly associated with Coordination adherence. There was minimal variation in Awakening trial, Breathing trial, and Delirium assessment/management adherence; thus odds ratios could not be calculated for these components.

Table 4-3. The relationship between provider attitudes and ABCDE bundle adherence: Adjusted odds ratios†

<table>
<thead>
<tr>
<th>Provider Attitudes</th>
<th>Results, OR (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ABCDE bundle</td>
</tr>
<tr>
<td>Perceived Ease of Completion</td>
<td>0.47 (0.28-0.79)</td>
</tr>
<tr>
<td>- Workload burden</td>
<td>0.29 (0.08-1.07)</td>
</tr>
<tr>
<td>- Difficult to carry out</td>
<td></td>
</tr>
<tr>
<td>Perceived Safety of ABCDE Bundle</td>
<td>0.51 (0.10-2.65)</td>
</tr>
<tr>
<td>Implementation</td>
<td></td>
</tr>
<tr>
<td>Confidence Performing ABCDE Bundle</td>
<td>0.37 (0.10-1.35)</td>
</tr>
<tr>
<td>Perceived Strength of Evidence for ABCDE Bundle</td>
<td>0.69 (0.14-3.35)</td>
</tr>
</tbody>
</table>

†Select patient covariates included in all regression analyses included age, APACHE II score, and Charlson Comorbidity Index. Ventilator status was also included as a covariate in the logistic regression for ABCDE bundle and Early mobility adherence.

‡This table reflects the attitudes of 268 unique providers who cared for 101 patient clusters with 727 total opportunities for ABCDE bundle and individual component adherence at the unit level.

*Bolded results are statistically significant at a p <0.05 level.

†There was not enough variation (i.e., nonadherence) in Awakening trial, Breathing trial, and Delirium assessment/management adherence; therefore, odds ratios could not be calculated.
Discussion

Although previous investigations associated nurses’ attitudes with sedation practices, no one has linked interprofessional provider attitudes with ABCDE bundle adherence. A multisite, multidisciplinary study of ICU providers was conducted to investigate whether provider attitudes are associated with ABCDE bundle adherence. We demonstrated statistically significant relationships between provider attitudes and ABCDE bundle adherence (Table 3). After adjusting for select patient characteristics, the odds of ABCDE bundle adherence were 53% less with perceptions of high workload burden as compared to low workload burden. Additionally, adherence to early mobility was 59% less likely when reported difficulty with carrying out the bundle was high. Therefore, focusing interventions on reducing workload burden and simplifying task implementation may facilitate ABCDE bundle adherence.

Overall, adherence to the ABCDE bundle was 72% on ventilator days, when all bundle components are required, and 97% on ventilator-free days, when only delirium assessment/management and early mobility components are required (p<0.001). Upon evaluation of previous work, we were unable to find reports of full ABCDE bundle adherence on ventilator days or DE bundle adherence on ventilator-free days for comparison. Various studies report adherence to individual ABCDE bundle components as follows: waking trials 71-100%, breathing trials 67-100%, coordination 87%, delirium assessment/management 46-92%, and early mobility 82%. Differing definitions for adherence across studies make comparisons difficult. For example, Balas et al. reported breathing trial adherence as patients receiving a breathing trial at least once during the ICU stay while Klompas et al. reported breathing trial adherence as the percent of days with a breathing trial done when indicated. In spite of that, our individual component adherence results are consistent with the previous reports of ABCDE bundle implementation.

The adherence results found in this investigation support previous findings suggesting bundle complexity influences adherence. Those components of the ABCDE bundle that require the most coordination across disciplines (i.e., coordination of awakening and breathing trials and early mobility)
have the lowest percent of adherence on ventilator days, 89% and 86%, respectively. **Awakening trial** (97%), **Breathing trial** (96%), and **Delirium** (100%) bundle components, which are essentially single discipline activities, had higher rates of adherence on ventilator days. This is further evidenced by increased adherence to **Early mobility** (98%) on ventilator-free days when mobilization may not necessitate respiratory, physical, or occupational therapy presence for execution.

Understanding the particular provider attitudes associated with ABCDE bundle adherence provide a basis for devising interventions to improve implementation. Evidence from this study suggests that intervening upon factors that influence perceived ease of completion factors, such as workload burden and difficulty with carrying out the bundle, may lead to improved adherence to the ABCDE bundle as well as those bundle components that require the most coordination across disciplines (i.e., awakening and breathing trial coordination and early mobility). Organizational domains including protocol attributes, role clarity, coordination, peer advocates, and teamwork factors have been described as explaining the most variance in provider perceived difficulty with carrying out the bundle. Thus, intervening within these organizational domains may be indicated when designing strategies to improve ABCDE bundle implementation. Specific strategies that target both policy and protocol factors as well as unit milieu is the development of standardized protocols (e.g., checklists, daily goal sheets), structured rounding processes (e.g., interprofessional rounds), and interprofessional training (e.g., simulation training, core competencies).

We hypothesized that provider attitudes regarding perceived safety, confidence, and perceived strength of evidence would be associated with ABCDE bundle adherence, but the findings were null. The internal consistency of both our perceived safety ($\alpha=0.73$) and confidence ($\alpha=0.69$) subscales may not have been reliable enough to make associations and likely require further refinement prior to future attempts to evaluate relationships. Further investigation of perceived safety and confidence with refined subscales is necessary to elucidate whether a relationship with ABCDE adherence is present. Further refinement of the perceived strength of evidence subscale items may also be required to ensure that the appropriate constructs are being captured. A second potential explanation for the null findings include the
studies small sample size. Future studies employing larger sample sizes may be more able to identify relationships between provider attitudes and ABCDE bundle adherence.

Strengths of the current study include interprofessional input for provider attitudes regarding the ABCDE bundle and a statistical analysis that allowed us the ability to control for covariates. Still, there are limitations to address. First, we applied the ABCDE bundle framework as originally described by Vasilevskis et al. At this time, the bundle was described as an evolving framework open to new strategies being included. Since its original publication, the bundle has now developed into the ABCDEF bundle to include family engagement and recommendations from recent guidelines. Next, ABCDE adherence data were not collected on every patient in the ICU. Bedside providers were encouraged to perform ABCDE bundle components daily; thus, adherence data for this study is likely an overestimation of the actual unit adherence. Lastly, there is the potential for nonresponse bias due to a low survey response rate. The assistance of ICU leadership was solicited for guidance on the best methods to achieve survey response goals, but it is possible that only those with strong opinions for or against the ABCDE bundle participated in the survey.

Conclusions

The ABCDE bundle is recommended practice in critical care, but there is evidence that utilization is low and implementation varies. In this study, adherence to the ABCDE bundle was influenced by workload burden of the bundle. Secondary analysis demonstrated adherence to early mobility was influenced by perceived difficulty with carrying out the bundle. Focusing on interventions to address workload burden and difficulty with carrying out the bundle may optimize implementation. Future research requires refinement of provider attitude subscales, which will allow us to further investigate relationships with ABCDE bundle adherence using larger sample sizes for ICU providers, patients, and units. A prospective study is indicated to determine if interventions to influence provider attitudes regarding workload and simplicity of task implementation result in improved ABCDE bundle adherence.
CHAPTER V

IMPLICATIONS FOR RESEARCH TRAJECTORY

The goal of this initial inquiry was to explore the relationships between a) various organizational domains and provider attitudes related to the ABCDE bundle and b) provider attitudes with ABCDE bundle adherence. This information is urgently needed to inform ICU leaders of factors that influence bundle adherence to facilitate development of targeted strategies to mitigate barriers to implementation. Interprofessional protocols, like the ABCDE bundle, will never be successful unless we identify the reasons why they are not widely adopted. Through the focus group study I was able to refine the conceptual framework for application to future study designs. The findings of aim one and aim two, utilizing the evolved conceptual framework, suggest several directions for research that have been described within the chapters and further elucidated here.

Gaps to Address

**Short-term research trajectory.** First, the ABCDE bundle was originally published as a framework for interprofessional care that could be modified pending new evidence and recommendations for critical care. Originally ABCDE (Awakening and Breathing Coordination, Delirium assessment/management, Early mobility), the bundle has now transformed into ABCDEF (Assess for and manage pain, Both spontaneous awakening and breathing trials, attention to Choice of sedation and analgesia, Delirium assessment/management, Early mobility, and Family engagement).

Future investigations would be enhanced by application of the currently published ABCDEF framework and utilization of standardized and generalizable methods for measuring adherence to these components.

Second, several of the subscales for provider attitudes and organizational domains had low internal consistency (α<0.70). Further modification of the instrument with testing employing larger sample sizes is required prior to future study. An improved instrument will reduce the likelihood of a type II error not identifying a true relationship among factors because of low internal consistency. Furthermore, profession-specific surveys may be necessary to improve item completion. Several non-nurse and non-physician providers commented that certain survey questions did not apply to their
profession. And, as mentioned in chapter three, PT, OT, and RT providers tended to have missing responses to questions that were not related to their specific profession. Whether this is indicative of poor interprofessional understanding of the bundle or actual flaws in survey design could be the subject of qualitative study. The survey utilized for this study was content validated by an interprofessional group of ICU providers; however, their views may not be reflective of the larger population of providers.

Third, the ABCDE bundle has been associated with improved patient and organizational outcomes, but the association of the amount of ABCDE bundle adherence with patient and organizational outcomes is yet to be explored. For example, there are limited numbers of reports evaluating the effectiveness of the ABCDE bundle (e.g., ICU LOS, duration of delirium, ventilator days, physical function). Are all ABCDE bundle components equivalent when compared with outcomes? Does adherence to delirium assessment and management contribute to outcomes as strongly as awakening and breathing trial coordination or early mobility? Furthermore, it is of ultimate importance to understand factors that influence adherence in a variety of settings before moving into the study of interventions to improve adherence. The current literature regarding ABCDE bundle implementation has largely been conducted in academic medical centers.

Lastly, upon examination of organizational domains influencing provider attitudes and, thus, adherence to the ABCDE bundle, we did not control for bundle exposure. At the time of survey data collection, exposure to the ABCDE bundle ranged between 18 and 43 months. In a changing and dynamic workplace, the evaluation of sustainability and bundle implementation is important to consider. Furthermore, examination of models for implementation that include sustainability may be the next evolutionary step for the conceptual framework utilized in this dissertation. Modification and further testing of the conceptual framework to include exposure and sustainability is indicated.

**Long-term research trajectory.** Fiscal implications of the ABCDE interprofessional protocol is a research area of great significance to health services research and the health care system. The examination of costs associated with bundle implementation is foremost. Several staffing models can be utilized to implement the ABCDE bundle. For example, one ICU may decide to hire a full-time physical
therapist or respiratory therapist (i.e., decentralized), while others are limited to staff that float among several different units (i.e., centralized). The cost associated with one staffing model may be more affordable for an organization than the other. Second is the examination of the potential cost savings related to improved outcomes such as increase in ventilator-free days and reduced LOS. Healthcare system leadership may require this information to justify the expense of additional personnel. Once fiscal implications of the ABCDE bundle in a variety of settings are established, investigations can transition to the exploration of interventions that improve adherence.

The results of aim one suggest that there are organizational domains that influence provider attitudes regarding the ABCDE bundle. Specifically, protocol attributes, role clarity, training and understanding, coordination, peer advocates, and task autonomy were most clinically significant. Examination of the relationship between provider attitudes and bundle adherence suggest that increases in workload are associated with reductions in adherence. Likewise, increases in difficulty with carrying out awakening and breathing trial coordination, one of the most complex components of the bundle, is associated with reductions in adherence. Organizational domains explaining the most variation in workload burden and difficulty carrying out the ABCDE bundle include protocol attributes, role clarity, coordination, peer advocates, and ICU teamwork factors. Future studies focusing on interventions to address ABCDE bundle workload burden and difficulty may optimize implementation. A prospective design is indicated to allow for determination of whether interventions upon applicable organizational domains which influence provider perceived ease of completion of the ABCDE bundle result in improved bundle adherence. Future research efforts would also benefit from more intensive recruitment of PTs, OTs, RTs and pharmacists so to include a subgroup analysis of organizational domain relationships with provider attitudes by profession, leading to further targeted interventions to improve adherence to the bundle.

**Contributions to Science and Nursing**

Factors affecting interdisciplinary ICU protocol implementation and adherence have been poorly understood. In addition, there have been knowledge gaps as to the best method for implementation of
complex care bundles and enhancing adherence. This current work has led to the development of a conceptual framework for interprofessional protocol implementation that can be utilized in research and quality improvement work to aid in interprofessional bundle implementation. This framework is not limited by setting and can be applied within units or systems for the identification of factors influencing bundle adherence. The findings of this investigation also provide a structure for the identification of targeted interventions to improve ABCDE bundle adherence, thereby reducing the perpetuation of siloed ICU care. Ultimately, this work contributes to transforming ICU teams into interdependent, collaborative groups working in an environment suited to meet individual patient needs.
Appendix A

Focus Group Interview Guide

“First I’d like to have your thoughts on what the ABCDE protocol entails.”

Investigators will be taking notes and seeking clarification about any comments that are confusing without evaluative judgments.

“What are the activities for the Spontaneous Awakening Trial (SAT) from your perspective as a nurse, PT, OT, or RT? Spontaneous Breathing Trial (SBT)?”

Investigators will be taking notes and seeking clarification about any comments that are confusing without evaluative judgments. Sample prompt includes: “What is the definition to you? What is the specific procedure to you?”

“What are the activities for Delirium assessment from your perspective as a nurse, PT, OT, or RT? Delirium management? Early mobility?”

Investigators will be taking notes and seeking clarification about any comments that are confusing without evaluative judgments. Sample prompt includes: “What is the definition to you? What is the specific procedure to you? What specific interventions do you use? What, to you, are the levels of therapy for early mobility?”

“Tell me about the last mechanically ventilated patient you cared for.”

Investigators will be taking notes and seeking clarification about any comments that are confusing without evaluative judgments. Sample prompt includes: “What was the level of ventilator support? Was the patient on any vasopressors? Did you consider the patient hemodynamically stable? Hemodynamically unstable?”

“Where you able to do an SAT with this patient? If no, what were the reasons for not being able to do the SAT? [repeat same question about SBT, Delirium assessment/management, and Early mobility]

Investigators will be taking notes and seeking clarification about any comments that are confusing without evaluative judgments. Sample prompt includes: “Is it more likely to happen if you have more time? Is it more likely to happen if there was better staffing? Is it more likely to happen if there was a policy? Is it more likely to happen if you had special equipment? Were there any things that might happen but were not listed that might influence the likelihood of doing components of ABCDE? Is it difficult to apply?”

“Tell me about things that would facilitate your ability to do an SAT. [repeat same statement about SBT, Delirium assessment/management, and Early mobility]

Investigators will be taking notes and seeking clarification about any comments that are confusing without evaluative judgments. Sample prompt includes: “Is it more likely to happen if you have more time? Is it more likely to happen if there was better staffing? Is it more likely to happen if there was a policy? Is it more likely to happen if you had special equipment? Were there any things that might happen but were not listed that might influence the likelihood of doing components of ABCDE? Is it difficult to apply?”
“What do you think would help with using the ABCDE protocol?”

*Investigators will be taking notes and seeking clarification about any comments that are confusing without evaluative judgments.*

A short general period for participants to share any other observations or thoughts will conclude the group. Participants will be reminded how and when overall results will be available and how they can be accessed.
Appendix B

ICU Provider Survey

Hospital name: [choose from dropdown of participating sites]
Primary Unit where you work: [choose from dropdown of participating units]

1. What is your position?
   - Nurse Practitioner
   - Occupational therapist
   - Pharmacist
   - Physical therapist
   - Physician
   - Respiratory therapist
   - Nurse
   If so, are you any of the following?
   - None
   - Unit manager
   - Assistant manager
   - Nurse educator
   - Clinical Nurse Specialist

2. Mark the box that best describes access to your protocol/procedure for:
   - Spontaneous Awakening Trials (SAT)
   - Spontaneous Breathing Trials (SBT)
   - Delirium Assessment/Management
   - Early Mobility
   - Complete ABCDE Bundle

3. The protocol/procedure for
   - Spontaneous Awakening Trials (SAT) is
   - Spontaneous Breathing Trials (SBT) is
   - Delirium Assessment/Management is
   - Early Mobility is
   - Complete ABCDE Bundle is

4. Coordination with other disciplines for
   - Awakening & Breathing Trial Coordination is
   - Delirium Management is
   - Early Mobility is
   - Completing the ABCDE Bundle is

5. My role in performing the following is:
   - Spontaneous Awakening Trials (SAT)
   - Spontaneous Breathing Trials (SBT)
   - Delirium Assessment/Management
   - Early Mobility
6. The role of other disciplines in performing the following is:
   - Spontaneous Awakening Trials (SAT) Clear
   - Spontaneous Breathing Trials (SBT) Clear
   - Delirium Assessment/Management Clear
   - Early Mobility Clear

7. The time of day designated (e.g., which shift) to perform the following is
   - Spontaneous Awakening Trials (SAT) Clear
   - Spontaneous Breathing Trials (SBT) Clear
   - Delirium Assessment/Management Clear
   - Early Mobility Clear
   - Complete ABCDE Bundle Clear

8. In my unit, performing the following activities is
   - Spontaneous Awakening Trials (SAT) Expected
   - Spontaneous Breathing Trials (SBT) Expected
   - Delirium Assessment/Management Expected
   - Early Mobility Expected
   - Complete ABCDE Bundle Expected

9. Mark the box that best describes your opinion about the length of time required to complete each of the following tasks
   - Using portable lifts to transfer patients Quick
   - Having patients reposition themselves Quick
   - Having patients bathe themselves Quick
   - Complete ABCDE bundle Quick

10. Mark the box that best describes your opinion about the importance of completing each of the following tasks
    - Using portable lifts to transfer patients Not Important
    - Having patients reposition themselves Not Important
    - Having patients bathe themselves Not Important
    - Complete ABCDE bundle Not Important

11. How do you feel when performing the following tasks? (Assume patients have already passed a safety screen)
    - Spontaneous awakening trial (SAT) Confident
    - Spontaneous breathing trial (SBT) Confident
    - Delirium assessment/management Confident
    - Early mobility Confident

12. What is your opinion about performing the following tasks? (Assume patients have already passed a safety screen)
    - Spontaneous awakening trial (SAT) Safe
    - Spontaneous breathing trial (SBT) Safe
    - Delirium assessment/management Safe
    - Early mobility Safe
13. Think of the last 3 shifts you worked. To what degree did any of the following activities affect your ability to perform the ABCDE protocol:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Degree of Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient transport off the unit (e.g., CT scan, MRI)</td>
<td>Never</td>
</tr>
<tr>
<td>Critical event (e.g., code)</td>
<td>Never</td>
</tr>
<tr>
<td>Patient admission</td>
<td>Never</td>
</tr>
<tr>
<td>Patient discharge</td>
<td>Never</td>
</tr>
</tbody>
</table>

14. I have professional autonomy to conduct the following components of the ABCDE bundle independently

<table>
<thead>
<tr>
<th>Component</th>
<th>Autonomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneous awakening trial (SAT)</td>
<td>Complete Autonomy</td>
</tr>
<tr>
<td>Spontaneous breathing trial (SBT)</td>
<td>Complete Autonomy</td>
</tr>
<tr>
<td>Delirium assessment/management</td>
<td>Complete Autonomy</td>
</tr>
<tr>
<td>Early mobility</td>
<td>Complete Autonomy</td>
</tr>
</tbody>
</table>

15. Think of the last time you performed parts of the ABCDE protocol with a patient. If present, to what extent did any of these factors hinder the patient’s ability to participate.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Present</th>
<th>Did not hinder</th>
<th>Unable to participate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral endotracheal tube</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tracheostomy tube</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apneic episodes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy (&gt;250 lbs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muscle weakness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unable to follow direction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced LOC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signs of fear or anxiety</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

16. The current evidence in the literature strongly supports the use of

<table>
<thead>
<tr>
<th>Component</th>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneous Awakening Trials (SAT)</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Spontaneous Breathing Trials (SBT)</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Delirium Assessment/Management</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Early Mobility</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Complete ABCDE Bundle</td>
<td>Strongly Agree</td>
</tr>
</tbody>
</table>

17. The layout of my unit makes it easy for me to perform the parts of the ABCDE bundle.

<table>
<thead>
<tr>
<th>Layout</th>
<th>Strongly disagree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

18. I have an excellent understanding of how to use all of the parts of the ABCDE bundle.

<table>
<thead>
<tr>
<th>Understanding</th>
<th>Strongly disagree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

19. The number of staff in my unit makes it easy for me to perform the parts of the ABCDE bundle.

<table>
<thead>
<tr>
<th>Staff</th>
<th>Strongly disagree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

20. On average, I have sufficient time to perform the parts of the ABCDE bundle during my shift.

<table>
<thead>
<tr>
<th>Time</th>
<th>Strongly disagree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>
21. In completing parts of the ABCDE bundle, our ICU multidisciplinary team works well together.
   Strongly disagree • • • • Strongly agree

22. The supplies or equipment I need to perform parts of the ABCDE bundle are easily accessible.
   Strongly disagree • • • • Strongly agree

23. The nurse leadership of my unit places high value on doing the ABCDE bundle.
   Strongly disagree • • • • Strongly agree

24. The physicians on my unit place high value on doing the ABCDE bundle.
   Strongly disagree • • • • Strongly agree

25. The ABCDE bundle greatly increases my workload.
   Strongly disagree • • • • Strongly agree

26. Members of the ICU team have their own individual jobs and typically do not help each other.
   Strongly disagree • • • • Strongly agree

27. The ABCDE bundle is an excellent way to standardize practice.
   Strongly disagree • • • • Strongly agree

28. Conducting the ABCDE bundle requires a great deal of communication and coordination among disciplines in the ICU.
   Strongly disagree • • • • Strongly agree

29. Clinicians within the ICU have to depend heavily on one another to get the ABCDE bundle completed.
   Strongly disagree • • • • Strongly agree

30. The ICU team has a great deal of difficulty carrying out the ABCDE bundle.
   Strongly disagree • • • • Strongly agree

31. My unit has a peer leader(s) (aka, unit champion, unit expert) who advocates for the use of the ABCDE bundle. ☐ Yes ☐ No

32. My unit is staffed with highly competent critical care nurses.
   Strongly disagree • • • • Strongly agree

33. My unit is staffed with highly competent physicians.
   Strongly disagree • • • • Strongly agree

34. My unit has access to highly competent pharmacists.
   Strongly disagree • • • • Strongly agree

35. My unit has access to highly competent respiratory therapists.
   Strongly disagree • • • • Strongly agree
36. The physical therapists working in my unit have training and experience in the care of critically ill patients.

   Strongly disagree ● ● ● Strongly agree

37. The occupational therapists working in my unit have training and experience in the care of critically ill patients.

   Strongly disagree ● ● ● Strongly agree

38. I was provided with detailed communication & training on all of the ABCDE protocol/procedures.

   Strongly disagree ● ● ● Strongly agree

39. Some clinicians on our ICU team do not carry a fair share of the ABCDE bundle workload.

   Strongly disagree ● ● ● Strongly agree

40. Among the ABCDE bundle components, which is most difficult for you to perform (check all that apply).

   □ Spontaneous Awakening Trials (SAT)
   □ Spontaneous Breathing Trials (SBT)
   □ Delirium Assessment/Management
   □ Early Mobility
   □ Coordinating ABCDE Bundle components

41. Among the ABCDE bundle components, which is most easy for you to perform (check all that apply).

   □ Spontaneous Awakening Trials (SAT)
   □ Spontaneous Breathing Trials (SBT)
   □ Delirium Assessment/Management
   □ Early Mobility
   □ Coordinating ABCDE Bundle components

Tell us a little bit about yourself.
Age: __________

Gender: [ ] Male  [ ] Female

Please indicate your highest degree.

  □ Associate’s degree
  □ Diploma
  □ Bachelor’s degree
  □ Master’s degree
  □ Doctorate (MD, PhD, PharmD, etc)

List your current professional certifications (e.g., CCRN, FCCM)  [ ] None

________________________________________________________

Number of years experience in your profession since licensure: ______________
Number of years experience in intensive care since licensure: ______________

Please share any additional thoughts you have regarding barriers and facilitators to the ABCDE bundle, if applicable:

_________________________________________________________________________________
_________________________________________________________________________________
Appendix C

ABCDE Bundle Protocol

**Awakening and Breathing Coordination**

**Eligibility for ABC = On the ventilator**

**SAT Safety Screen:** No active seizures, no active alcohol withdrawal, no active agitation, no active paralytics, no active myocardial ischemia, no evidence of ↑ intracranial pressure

*If passed the safety screen, Perform SAT*

(stop all sedatives/analgesics used for sedation)

*If fail → restart sedatives if necessary at ½ dose and titrate as needed*

*If pass → Perform SBT safety screen*

**SBT Safety Screen:** No active agitation, oxygen saturation ≥ 88%, FiO2 ≤ 50%, PEEP ≤ 7.5 cm H2O, no active myocardial ischemia, no significant vasopressor use, displays any inspiratory efforts

*If passed the safety screen, Perform SBT*

SBT is discontinuation of active ventilator support through a T-tube or ventilator with a rate set as 0, CPAP/PEEP ≤ 5 cm H2O, and pressure support of ≤ 5 cm H2O.

*If fail → Return to ventilator support at previous settings*

*If pass → Team should consider extubation*

---

**Delirium Nonpharmacologic Interventions**

**Eligibility for D = RASS > -3 (any movement or eye opening to voice)**

**Pain:** Monitor and/or manage pain using an objective scale

**Orientation:** Talk about day, date, place; discuss current events; update white boards with caregiver names; use clock and calendar in room

**Sensory:** Determine need for hearing aids and/or eye glasses

**Sleep:** Provide & encourage sleep preservation techniques like noise reduction, day-night variation, “time-out” to minimize interruptions of sleep, promoting comfort & relaxation

---

**Early Exercise and Mobility**

**Eligibility for E = All study patients**

**Exercise Safety Screen:** RASS > -3, FiO2 < 0.6, PEEP < 10 cm H2O, no increase in vasopressor dose (2 hrs), no active myocardial ischemia (24 hrs), no arrhythmia requiring the administration of a new antiarrhythmic agent (24hrs)

**Levels of Therapy** (if passes safety screen):

1. Active range of motion exercises in bed and sitting position in bed
2. Dangling
3. Transfer to chair (active), includes standing without marching in place
4. Ambulation (marching in place, walking in room/hall)
Appendix D

ABCDE Bundle Daily Checklist

DATE: __________/__________/__________

**Awakening and Breathing Coordination**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Check if yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAT done?</td>
<td></td>
</tr>
<tr>
<td>SBT done?</td>
<td></td>
</tr>
<tr>
<td>SAT &amp; SBT paired?</td>
<td></td>
</tr>
</tbody>
</table>

**Delirium assessment and management**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Check if done</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain assessment/management</td>
<td></td>
</tr>
<tr>
<td>Orientation</td>
<td></td>
</tr>
<tr>
<td>Sensory (hearing aids, glasses)</td>
<td></td>
</tr>
<tr>
<td>Sleep (nonpharmacologic interventions)</td>
<td></td>
</tr>
<tr>
<td>Check any intervention that was performed</td>
<td></td>
</tr>
<tr>
<td>(including night shift).</td>
<td></td>
</tr>
</tbody>
</table>

**Early Exercise and Mobility**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Check if done</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active ROM &amp; Sitting Position</td>
<td></td>
</tr>
<tr>
<td>Dangle</td>
<td></td>
</tr>
<tr>
<td>Transfer to chair (active), Standing</td>
<td></td>
</tr>
<tr>
<td>Marching in place, Walking</td>
<td></td>
</tr>
<tr>
<td>Check any level of activity the patient</td>
<td></td>
</tr>
<tr>
<td>performed during your shift (including night shift).</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix E

### ABCDE bundle and individual component adherence rates

<table>
<thead>
<tr>
<th>Unit</th>
<th>% Adherence - Ventilator Days (N=561)</th>
<th>% Adherence - NonVentilator Days (N=191)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>All units, % (N)</td>
<td>97</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>(544)</td>
<td>(539)</td>
</tr>
<tr>
<td>Medical ICUs, % (N)</td>
<td>97</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>(399)</td>
<td>(394)</td>
</tr>
<tr>
<td>Surgical ICUs, % (N)</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>(145)</td>
<td>(145)</td>
</tr>
</tbody>
</table>

*N=101 patients observed over N=561 ventilator days and N=191 nonventilator days across N=10 ICUs (N=6 medical units, N=4 surgical units)
REFERENCES


