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ICU team composition and its association with ABCDE implementation in a quality collaborative

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Abstract

Purpose—Awakening, Breathing Coordination, Delirium, and Early Mobility bundle (ABCDE) should involve an interprofessional team, yet no studies describe what team composition supports implementation.

Materials & Methods—We administered a survey at MHA Keystone Center ICU 2015 workshop. We measured team composition by the frequency of nurse, respiratory therapist, physician, physical therapist, nurse practitioner/physician assistant or nursing assistant involvement in 1) spontaneous awakening trials (SATs), 2) spontaneous breathing trials, 3) delirium and 4) early mobility. We assessed ABCDE implementation using a 5-point Likert (“routine part of every patient’s care” - “no plans to implement”). We used ordinal logistic regression to examine team composition and ABCDE implementation, adjusting for confounders and clustering.

Results—From 293 surveys (75% response rate), we found that frequent nurse [OR 6.1 (1.1 – 34.9)] and physician involvement [OR 4.2 (1.3 – 13.4)] in SATs, nurse [OR 4.7 (1.6–13.4)] and

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nursing assistant's involvement [OR 3.9 (1.2–13.5)] in delirium and nurse [OR 2.8 (1.2–6.7)], physician [OR (3.6 (1.2–10.3)], and nursing assistants' involvement [OR 2.3 (1.1–4.8)] in early mobility were significantly associated with higher odds of routine ABCDE implementation.

Conclusions—ABCDE implementation was associated with frequent involvement of team members, suggesting a need for role articulation and coordination.

Keywords

patient care team; ventilator weaning; patient safety; quality improvement; implementation science

INTRODUCTION

The Awakening, Breathing Coordination, Delirium monitoring/management and Early exercise/mobility (ABCDE)¹ bundle is a complex multi-component intervention [1] associated with lower odds of delirium [1,2], improved functional outcomes [3] and shorter duration of mechanical ventilation [4]. A revised bundle has been developed (ABCDEF)[5] that incorporates three additional components (pain, sedation, and family involvement). However the original ABCDE bundle, which has been demonstrated to be highly effective, remains very difficult to implement with numerous documented barriers to delivery [6–14].

An integral part of ABCDE delivery is the participation of an intensive care unit (ICU) interprofessional team [1,4,9]. While recent work suggests variation in team interactions about ABCDE [15], few studies empirically describe team composition in ABCDE delivery—that is, which team members are involved in each bundle component—and how that may facilitate implementation. Without an understanding of team composition in ABCDE and how it contributes to implementation, efforts to improve delivery may fail. By knowing what team composition best supports implementation and then developing the corresponding team, hospital and ICUs can begin to overcome barriers to ABCDE delivery. Further, understanding what elements best support implementation of the ABCDE bundle may also assist in improving implementation of the more complex ABCDEF bundle.

We took advantage of an annual survey conducted at the Michigan Health and Hospital Association (MHA) Keystone Center ICU workshop to examine how team composition in ABCDE is associated with implementation. MHA Keystone is a Michigan statewide quality collaborative, formed in 2003 with an emphasis on improving patient safety. The purpose of this study was to describe team composition in ABCDE delivery and test the hypothesis that frequent involvement of a diverse team was associated with high levels of ABCDE implementation.

METHODS

Design

This study used a cross-sectional survey design. A written in-person survey was administered to MHA Keystone ICU annual workshop attendees in September 2015 in

¹ABCDE = Awakening, Breathing Coordination, Delirium monitoring/management and Early exercise/Mobility bundle

Dearborn, Michigan, during a one-day meeting for all Keystone ICU members. The annual survey is part of Keystone's ongoing efforts to improve ICU care. Using a paper survey, we queried attendees about perceptions of care in their ICU and hospital. Workshop attendees have been surveyed at this workshop since 2011 using the same approach [11,13,16].

Before the workshop, the 12-question survey instrument was developed using an iterative process of item generation, formatting, and pre-testing [17]. We piloted tested the survey for face validity, content validity, and survey mechanics (flow, salience, testability etc.) with 10 clinicians and researchers: 2 nurse researchers (one who also works as an ICU nurse), 6 ICU physicians, 1 researcher, and 1 respiratory therapist. The survey was modified based on feedback from the clinicians, [11,13] as recommended in survey development guidelines [17].

Consistent with prior years, we administered the paper survey at the annual workshop immediately after the welcome but before presentations. There was no specific framing of the survey aside from telling the workshop attendees that we were interested in gaining a better understanding of ICU care practices. The surveys were placed at each seat in the room and no other surveys were conducted. All workshop attendees were eligible to participate, but MHA Keystone Center staff was excluded. The attendees were given 10 minutes to complete the survey and after the allotted time, study staff and MHA Keystone staff collected the surveys. University of Michigan Institutional Review Board reviewed this study (HUM00112732) and determined it was exempt from IRB review.

Measures

We surveyed respondents on a range of ICU practices, demographics, and ICU organizational characteristics of the clinicians' hospital. We asked questions about team composition and ABCDE implementation.

Key Exposure Measures

Team composition: On a 6-point Likert scale ranging from "Always" to "Not available in my unit", we measured team composition by the reported frequency that team members were involved in: 1) spontaneous awakening trials (SAT); 2) spontaneous breathing trials (SBT); 3) delirium monitoring; and 4) early mobility. We specifically asked about the involvement of 6 team members: 1) respiratory therapists; 2) physicians; 3) physical therapists; 4) nursing assistants; 5) nurse practitioners/physician assistants; and 6) registered nurses.

Primary Outcome Measure

ABCDE implementation: We measured ABCDE implementation by asking "How well is ABCDE incorporated into your unit's practice?" on a 5-point Likert scale of responses: "ABCDE is a routine part of every patient's care"; "We are working on ABCDE but have a few remaining challenges"; "We have made some initial steps to implement ABCDE"; "We are thinking about implementing ABCDE but have made no steps to do so"; and, "We have no immediate plans to incorporate ABCDE"[13].

The entire survey (excluding hospital names) is included in the Supplementary Digital Content.

Statistical Analysis

We described the sample and team composition in SAT, SBT, delirium assessment, and early mobility using descriptive statistics, histograms, and frequency tables. To evaluate whether variation in team composition was associated with ABCDE implementation, multivariable ordinal logistic regression was performed.

In regression analyses, we used respondents with complete survey responses. We classified the 6-point Likert scale responses of team composition into three categories. “Always” and “mostly” were classified as “mostly.” “Sometimes” and “rarely” were classified as “occasionally.” “Never” or “not available” were classified as “never.” Categories of team composition by profession that still had less than ten responses were combined (i.e. “occasionally/never” or “mostly/occasionally”) for model convergence. A detailed table of these categorizations is included in the Supplementary Digital Content (Table E2).

We collapsed the 5-point Likert responses for ABCDE implementation into three categories: 1) routine (“routine part of every patient’s care”); 2) working on it (“we are working on ABCDE but have a few remaining challenges” and “we have made some initial steps to implementing ABCDE”); and 3) not currently implemented (“we are thinking about implementing ABCDE but have made no steps to do so” and “we have no immediate plans to incorporate ABCDE”).

Each component of ABCDE was assessed in separate models. The exposure variable was team composition defined as team member involvement in each component of ABCDE. The primary outcome was ABCDE implementation (routine/working on it/not currently). Multivariable ordinal logistic regression models were adjusted *a priori* for confounders, including the type of ICU (general, medical, surgical, other), whether the respondent provided direct patient care at least 50% of the time, and for the other team members’ involvement.

All regression models estimated robust standard errors with clustering at the hospital level.

Adjusted absolute rates of self-reported routine ABCDE implementation were estimated using predictive margins for relationships with statistically significant results in the multivariable ordinal regression models. Interaction effects were not assessed because of poor model convergence. We evaluated goodness-of-fit statistics for our models that examined the relationship between team composition and ABCDE implementation as well as testing the proportional hazards assumption of the ordinal model. These tests supported our analytic approach and were consistent with the results of our original modeling approach. Thus, we present our original results in the following tables and figures. We did not make any adjustments for multiple analyses as we were testing multiple distinct hypotheses regarding team composition in ABCDE and report the individual p-value for each hypothesis.

Data management and analysis were performed by using Stata 14.1 (Stata Corporation, College Station, TX). All tests were two-sided, with a P value < 0.05 considered significant.

RESULTS

Three hundred and ninety-two individuals attended the 2015 September MHA Keystone ICU Annual workshop. We received 293 surveys from 61 hospitals yielding a 75% response rate at the individual level, consistent with prior years [13,16]. The range of respondents per hospital was 1–24 (median 3, IQR 2–7). Table 1 displays the demographic and ICU organizational characteristics. Staff nurses comprised 40% of the sample but respiratory therapists (6%) and clinical pharmacists were also represented (4%). Two thirds provided direct patient care in their role. Forty percent indicated that ABCDE was routine. The majority of ICUs were general ICUs (62%).

Figure 1 displays the distribution of team member involvement in ABCDE, by each component. Eighty percent indicated that nurses were always involved and 41% of respondents indicated that respiratory therapists were always involved in SATs (Fig 1, panel A). Eighty-one percent indicated that respiratory therapists were always involved in SBTs and 66% indicated that nurses were always involved in SBTs (Fig 1, panel B). Approximately 80% indicated that nurses were always involved in delirium assessments (Fig 1, panel C). Sixty percent reported that nurses were always involved in early mobility and more than a quarter (26%) reported that physical therapists were always involved in early mobility (Fig 1, panel D). Early mobility had the greatest diversity of team members always involved: nurse (60%); physical therapist (26%); nursing assistant (10%); respiratory therapist (9%); physician (7%); nurse practitioner/physician assistant (3%). However, team member involvement varied for each individual bundle component. Interestingly, there was not one bundle component in which all respondents indicated that all team members were always involved. A detailed frequency table of the team member involvement is included in the Supplementary Digital Content (Table E1).

The results of our multivariable ordinal logistic regressions are displayed in Table 2 where we individually modeled every team member's involvement on self-reported ABCDE implementation. Frequent nurse [OR 6.1 (1.1 – 34.9)] and physician involvement [OR 4.2 (1.3 – 13.4)] in SATs were significantly associated with higher odds of routine ABCDE at the ICU level. There was no statistically significant association between type of team member involvement in SBTs and routine implementation. Frequent nurse [OR 4.7 (1.6–13.4)] and nursing assistant involvement [OR 3.9 (1.2–13.5)] in delirium monitoring was also significantly associated with higher odds of routine ABCDE implementation. Three unique team member types when frequently involved in early mobilization were significantly associated with higher odds for routine ABCDE implementation: nurses [2.8 (1.2–6.7)]; physicians (3.6 (1.2–10.3)); and nursing assistants [2.3 (1.1–4.8)].

We also examined how different combinations of team members influenced ABCDE implementation (Figure 2 and Supplementary Digital content Figure E1 and E2). For example, does ABCDE implementation improve when nurses, physicians and nursing assistants are involved in early mobility compared to having one or none of them involved?

In Figure 2, we assume that nurse involvement is frequent. We display the absolute adjusted rates of routine ABCDE implementation (y-axis) when physicians and nursing assistants are mostly or occasionally involved in early mobility (x-axis). Here we find that when physicians, nurses, and nursing assistants are all mostly involved (green line) in early mobility, the absolute adjusted rate of ABCDE being routine increases (from 45% to 62%). This suggests that the most effective combination of team composition for early mobility – nurses, physicians and nursing assistants– has the highest likelihood of ABCDE being implemented routinely. Yet, in practice, this combination was uncommon. Only 11% of respondents reported these three team members frequently working together for early mobility.

DISCUSSION

This is the first paper, to our knowledge, which empirically examines self-reported ICU team composition in ABCDE and its association with self-reported ABCDE implementation. Self-reported involvement of specific types of ICU team members was associated with self-reported routine ABCDE implementation overall. We demonstrate considerable variation in how frequently each team member is reported to be involved in each component of the ABCDE bundle. Some interprofessional team members are perceived to be more involved in some activities than others – suggesting a need for clarification of team members' roles in clinical practice and underscoring the complex coordination demanded by ABCDE. There is also evidence that specific team composition, demonstrated by routine involvement of multiple professionals in the same task, may help achieve higher levels of implementation.

Routine ABCDE implementation was associated with frequent nurse and physician involvement in SATs, frequent nurse and nursing assistant involvement in delirium monitoring, and frequent involvement of nurses, physicians, and nursing assistants in early mobility. The various team members involved in the different components of ABCDE delivery may not be altogether surprising for clinicians but these are the first data to provide empiric support for prior work that acknowledged critical care nurses' role in the ABCDE bundle [18] and the benefits of an interprofessional team in early mobility [19]. While such benefits are perhaps to be expected, few respondents reported having all team members engaged in these activities. This suggests that while the presence of an ICU interprofessional team is important in clinical practice, it is possible that staffing constraints and hiring practices at various hospitals may prevent ICUs from leveraging the benefits of the interprofessional team simply because those team members are not available. For hospital administrators, nurse managers and medical directors, evaluating current staffing approaches in their respective ICUs may help generate creative solutions to ensuring that the appropriate team members are available for ABCDE delivery. Similarly, for bedside clinicians, particular attention may be needed to facilitate inclusion of various team members in rounds, for example, when discussing ABCDE and coordinating next steps.

Interestingly, this is the first study to examine the role of nursing assistants in aspects of ABCDE. Much of the research does not conceptualize nursing assistants as part of the team. However, given the complexity and labor-intensive work of mobilizing ICU patients, it stands to reason that nursing assistants may play a vital role. For clinicians and

administrators, aligning the work that needs to be done with an individual's job duties, according to the fullest scope of an individual's practice, and the team members available—as in the case of nursing assistant's role in early mobility—may improve ABCDE delivery and subsequently patient outcomes.

Higher levels of ABCDE implementation were noted with diverse team composition, particularly for specific components of ABCDE. This may suggest that in units with higher levels of reported implementation, the ICU interprofessional team may understand the unique contributions of each team member and may be able to share the cognitive and physical aspects of work appropriately. Or more specifically, all team members may share the same perceptions of team member involvement. Indeed, understanding team members' roles and knowledge is a fundamental part of teamwork and achieving a shared mental model [20–22] – having a common understanding of the situation and being on “the same page” [23,24]. Having all team members on the same page, may assist the ICU team to coordinate the roles and care activities needed to meet the needs of the team and the patient [23]. Future work should attempt to disentangle the cognitive and physical care activities of ABCDE delivery to assist ICU teams in coordinating to achieve effective implementation.

ICUs able to achieve higher levels of ABCDE implementation may also be more effective because the culture and context of those ICUs creates an environment that fosters collaboration and coordination [14,25]. Cultural and contextual factors[25] as well as effective coordination are important facilitators of interprofessional teamwork [26,27]. Our findings suggest that coordination may also be a crucial element of effective ABCDE implementation. Indeed, a recent early mobility trial demonstrated that use of a facilitator to encourage the interprofessional team to define and implement a mobility goal was associated with significantly shorter lengths of stay and improved outcomes [28]. It is possible that in-person facilitators may assist in creating an environment that supports identification of team member contributions thereby optimizing ABCDE implementation.

Although this is the first study to examine team composition in ABCDE and its association with self-reported implementation, there are limitations. We relied on self-report which may over-estimate ABCDE implementation. Our study only focused on ABCDE implementation and did not evaluate the more recent, revised ABCDEF bundle; this is a noted limitation of our work. Clinicians were asked to report on their perceptions of other clinicians' behaviors and their level of involvement. The individuals that pilot-tested our survey (not KICU workshop attendees) described in respondent debriefing that they interpreted involvement as referring to one's physical presence or role in leading that component (i.e. nurses decreasing sedation to conduct a SAT). However we recognize that there are other potential interpretations of “involvement”, such as being notified or placing an order remotely without being physically present. We administered the survey at a workshop where the agenda was pre-determined and focused on ICU quality care. While the survey was conducted before presentations, the agenda was known in advance so it is possible that clinicians were primed to think about ABCDE. Our survey was brief which limited our ability to assess multiple characteristics for risk adjustment. However, we were able to account for individual hospitals by clustering which may account for other unmeasured ICU organizational characteristics. There were a range of respondents from each hospital but we did not weight

responses by the number of respondents per hospital. Although we used a robust approach to survey development, the reliability of this tool is unknown and response bias is a potential limitation. Lastly, it is possible that the results may differ by role of respondent. We could not evaluate single team member responses (e.g., only staff nurse responses) due to the small sample size, but we did adjust for respondent role in direct care, which may help mitigate these concerns.

CONCLUSION

Our findings suggest that routine self-reported ABCDE implementation is associated with frequent nurse and physician involvement in SATs, frequent nurse and nursing assistant involvement in delirium monitoring, and frequent involvement of nurses, physicians, and nursing assistants in early mobility. These findings suggest that a diverse interprofessional team in ABCDE delivery may be important for ICUs striving for routine implementation. ICUs with higher levels of ABCDE implementation may be able to align the unique contributions of each team member by creating an environment in which team members may work from a shared mental model to coordinate ABCDE. Future work should further examine how to develop an effective interprofessional team to ensure routine ABCDE implementation within and across ICUs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- This is the first paper to examine ICU team composition and ABCDE implementation
- We find variation in how frequently each team member is involved in ABCDE
- Some team members are perceived to be more involved in some activities than others
- These data suggest a need for role clarification and complex coordination
- ICUs with high levels of ABCDE may create teams that work from shared mental models

Figure 1.

Distribution of team composition in ABCDE practices

A=always; M=mostly; S=sometimes; R=rarely; N=never;N/A=not available

Figure 2.

Association between physician and nursing aide's involvement in early mobility and routine ABCDE implementation, when nursing involvement is frequent[^]

[^]The above figure displays the relationship between physician and nursing aide's involvement and ABCDE implementation conditional on nursing participation as mostly involved

Table 1

Demographic and organizational characteristics of respondents and ICUs (n=293 respondents within 61 unique hospitals)~

Respondent role	n=293
Staff nurse	118 (40%)
Nurse manager	54 (18%)
Nurse educator/clinical nurse specialist	26 (9%)
Respiratory therapist	19 (7%)
Clinical pharmacist	12 (4%)
Physical, Occupational & Speech Therapist	3 (1%)
Nurse practitioner/physician assistant	8 (3%)
Physician	12 (4%)
Medical director/administrator	2 (1%)
Other ^	36 (12%)
Provide direct patient care at least 50% of time	117 (60%)
ABCDE implementation~	
Routine part of every patient's care	112 (40%)
Implemented ABCDE but few remaining challenges	98 (34%)
Made initial steps to implement ABCDE	44 (15%)
Thinking about implementing ABCDE	12 (4%)
No plans to implement ABCDE	11 (4%)
ICU type	n=61
Medical	12 (20%)
Surgical	5 (8%)
General	38 (62%)
Other	6 (10%)

^ Other included roles such as quality coordinator, nursing supervisor, performance improvement leader and clinical nurse leader for example.

~ Sample size differs slightly due missing (respondent role: n=3 missing; ABCDE implementation: n=16 missing)

Table 2

Results of the multivariate ordinal logistic regression examining the association between team member involvement and routine overall ABCDE performance, adjusting for potential confounders[~] and for the clustering of respondents within hospitals[^]

Odds Ratio (95% Confidence Interval)							
	RN	MD	RT	PT	Aide	NP/PA	
Spontaneous Awakening Trial							
Never	Reference	Reference	Reference	Reference	Reference	Reference	
Occasionally		2.1 (0.5–8.5)	1.8 (0.6–6.0)	1.0 (0.4–2.1)	0.8 (0.4–1.8)	0.9 (0.4–1.9)	
Mostly	6.1 (1.1–34.9) *	4.2 (1.3–13.4) *	1.3 (0.5–3.7)	3.3 (0.4–25.5)	0.8 (0.1–4.1)	1.1 (0.5–2.7)	
Spontaneous Breathing Trial							
Never	Reference	Reference	Reference	Reference	Reference	Reference	
Occasionally		1.1 (0.4–3.6)		1.1 (0.5–2.3)	1.1 (0.5–2.3)	1.3 (0.6–2.8)	
Mostly	2.2 (0.8–5.8)	1.6 (0.5–5.0)	2.3 (0.2–21.8)	0.8 (0.1–5.4)	0.8 (0.1–5.4)	1.3 (0.6–3.2)	
Delirium							
Never	Reference	Reference	Reference	Reference	Reference	Reference	
Occasionally		0.7 (0.3–1.5)	1.4 (0.8–2.5)	1.7 (0.7–4.3)	0.7 (0.3–1.6)	0.9 (0.4–1.9)	
Mostly	4.7 (1.6–13.4) *	1.7 (0.5–5.1)	3.0 (0.7–12.5)		3.9 (1.2–13.5) *	1.0 (0.4–2.6)	
Early Mobility							
Never	Reference	Reference	Reference	Reference	Reference	Reference	
Occasionally		1.7 (0.7–4.0)	1.6 (0.8–3.4)	0.4 (0.2–1.3)	2.0 (1.0–3.8) *	0.7 (0.4–1.4)	
Mostly	2.8 (1.2–6.7) *	3.6 (1.2–10.3) *	1.8 (0.7–10.3)	0.8 (0.2–2.4)	2.3 (1.1–4.8) *	1.2 (0.4–3.9)	

^{*} $P < 0.05$

[^] Confounders included: type of ICU (medical/surgical/general) and whether respondent provides direct patient care at least 50% of the time

[~] Missing data was case-wise deleted from our analyses. SAT, SBT and delirium: n=258 (35 missing) and early mobility: n=257 (36 missing).

RN= nurse; MD= physician; RT=respiratory therapist; PT=physical therapist; Aide = nursing aide or assistant; NP=nurse practitioner/physician assistant