Contextual Issues Influencing Implementation and Outcomes Associated With an Integrated Approach to Managing Pain, Agitation, and Delirium in Adult ICUs

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Objective: This pilot study was designed to identify which contextual factors facilitate/hinder the implementation of the awakening, breathing, coordination, delirium, and early mobility (ABCDE) bundle for guidance in future studies.

Design: The sources of data for this study included document review, planned site visits (including interviews and observations), a brief online contextual factors survey, and self-reported process and outcome data.

Patients: All patients in the four participating SF Bay Area ICUs were eligible to be included in this pilot study.

Setting: This study took place in the four San Francisco Bay Area ICUs participating in the ICU Clinical Impact Interest Group, funded by the Gordon and Betty Moore Foundation from January 2012 through June 2013.

Interventions: This was a pilot evaluation study to identify factors that facilitated/hindered the implementation of the ABCDE bundle, interventions designed to decrease the prevalence of ICU-acquired delirium and muscle weakness. The ABCDE bundle consists of spontaneous awakening trials, spontaneous breathing trials, coordination of awakening and breathing trials, choice of sedation, delirium screening and treatment, and early progressive mobility.

Measurements: Process data related to bundle element compliance were collected at baseline and monthly during the intervention period. Outcome data (average ICU length of stay and average days on mechanical ventilation) were collected at baseline and quarterly during the intervention period. Hospital-specific results of the online contextual factors survey and information gathered through interviews and observations during site visits also contributed to the analysis.

Main Results: Factors related to structural characteristics of the ICU, an organizational-wide patient safety culture, an ICU culture of quality improvement, implementation planning, training/support, and prompts/documentation are believed to have facilitated the rate and success of ABCDE bundle implementation. Excessive turnover (both in project and ICU leadership), staff morale issues, lack of respect among disciplines, knowledge deficits, and excessive use of registry staff are believed to have hindered implementation.

Conclusions: Successful implementation of the elements of the ABCDE bundle can result in significant improvements in ICU patient care. The results of this study highlight specific structural and cultural elements of ICUs and hospitals that can positively and negatively influence the implementation of complex care bundles like the ABCDE bundle. Further research is needed to assess the influence of these contextual factors across a broader variety of ICUs and hospitals. (Crit Care Med 2013; 41:S128–S135)

Key Words: ABCDE bundle; contextual factors; delirium; early progressive mobility; evaluation; implementation; intensive care unit; intensive care unit-acquired weakness; pain, agitation, and delirium guidelines; quality improvement
It takes an average of 17 years for research to become widely used in clinical practice (1). Translating research into practice is a complex process that involves the dissemination of information, implementation into practice, and sustainability of the interventions. Implementation, as defined by the National Institutes of Health, is the use of strategies to adopt and integrate evidence-based health interventions and change practice patterns within specific settings.

The goal of this pilot study was to identify which contextual factors facilitate/hinder the implementation of the awakening, breathing, coordination, delirium, and early mobility (ABCDE) bundle in four San Francisco Bay Area hospitals’ ICUs for guidance in future studies. Specific aims included observing the implementation of bundle elements, comparing and contrasting experiences across ICUs, documenting the factors associated with successful implementation, and identifying any aspects of the ABCDE bundle implementation that might require refinement or modification prior to broader implementation.

The ABCDE bundle is designed to reduce ICU-acquired delirium and muscle weakness (2–5). Delirium and immobility in ICU patients lead to increased length of stay, increased morbidity and mortality, higher costs of care, and long-term harm, including long-term cognitive and functional deficits (6–12).

The ABCDE bundle consists of spontaneous awakening trials (SATs) to decrease the use of sedation, spontaneous breathing trials (SBTs) to wean patients off mechanical ventilation faster, coordination of awakening and breathing trials to maximize benefits of SATs and SBTs, choice of sedation to reduce use of harmful sedatives, delirium screening and treatment, and early progressive mobility to decrease ICU-acquired muscle weakness.

In the fall of 2011, Cynosure Health was awarded an 18-month grant by the Gordon and Betty Moore Foundation (http://www.moore.org/patient-care/) to facilitate the implementation of the ICU Clinical Impact Interest Group (CIIG), with the goal of reducing ICU-acquired delirium and muscle weakness in participating San Francisco Bay Area hospitals. CIIG participating facilities attended four in-person meetings, 10 webinars, bimonthly peer-to-peer learning conference calls, bimonthly physician champion calls, and received on-site and consultative support from an improvement advisor (IA). Dr. Ely (Vanderbilt University Medical Center), Dr. Balas (University of Nebraska Medical Center), and Dr. Barr (VA Palo Alto Health Care System and Stanford University School of Medicine) served as faculty experts, providing content and guidance to participants.

CIIG-participating facilities were required to create a multidisciplinary team (including an executive sponsor) to implement the ABCDE bundle, complete a preimplementation and postimplementation gap analysis, participate in CIIG educational offerings, submit quarterly outcome and monthly process data, and share lessons learned within the CIIG. Funding was provided to those facilities that ensured physician commitment and participation, submitted additional data, and agreed to participate in the pilot study discussed here.

Contextual factors that were thought to influence the implementation of the ABCDE bundle fell into the following categories: organizational/structural characteristics of the ICU, patient safety and quality improvement (QI) culture, prior experience in implementation of evidence-based practices, implementation planning, training and support, and prompts and documentation (13–18).

Organizational/structural characteristics of the ICU: The size of the ICU, “open” versus “closed” ICU models, whether or not the ICU had intensivist staffing, the presence of an electronic health record (EHR), and the stability of ICU leadership were among the organization/structural characteristics thought to influence the implementation of the ABCDE bundle.

Patient safety and QI culture: Both ICU- and hospital-wide patient safety and QI culture were hypothesized to play a big role in influencing bundle implementation. Patient safety culture characteristics thought to affect implementation include communication, respect, and “teamness” across disciplines (physicians, nurses, respiratory therapists, and physical/occupational therapists), a willingness to speak up/ask questions, and learning from errors. QI culture characteristics believed to influence implementation include an emphasis on quality, existence of a QI structure, QI training, staff involvement in QI, and an ICU management style that supports QI.

Prior experience in implementation of evidence-based practices: Whether or not the ICU had prior experience with implementing other bundles or protocols (e.g., sepsis, ventilator-associated pneumonia bundles and protocols) and experience with implementing precursors to the ABCDE bundle (e.g., sedation vacation) were also thought to influence successful bundle implementation.

Implementation planning: Team composition, type/frequency of team activities, and team performance are a few elements of implementation planning thought to impact success. Other elements included project leadership, support from managers, and adaptations to the ABCDE bundle.

Training and support: Dissemination of information is the first step to transforming research into clinical practice. Ongoing access to training, written and electronic materials, and hands-on support are factors believed to have some bearing on implementation. Additionally, leadership support was hypothesized to contribute to implementation success.

Prompts and documentation: Formal policies and procedures, multidisciplinary rounds (and checklists), standardized order sets, ease of documentation, and EHR support were included in the contextual factors assessed.

METHODS
The sources of data for this study included document review, planned site visits, a brief online contextual factors survey, and self-reported process and outcomes data. Because this was a QI initiative, IRB approval was neither sought nor obtained.

Documentation Review
Prior to visiting the four participating ICUs, the research team reviewed the literature surrounding the ABCDE bundle, the CIIG project plan, and the individual gap analyses...
submitted by the facilities. Each ICU CIIG project lead, with the help of his or her team, completed an ABCDE bundle process check (i.e., a gap analysis) between March and May 2012. The gap analysis was designed to evaluate the current state of policies and procedures, training materials, actual practice, and monitoring mechanisms for each of the ABCDE bundle elements.

### Site Visits

A two-person research team visited each ICU from August through December 2012. At each hospital, the research team conducted individual and small group interviews with hospital leaders, ICU team leaders, the physician champion, the nurse champion, respiratory therapists and managers, physical and occupational therapists and managers, and front-line ICU nurses. Interview topics included experience in implementation of the ABCDE bundle, required changes in internal processes, expected and unexpected barriers to implementation, anticipated and actual benefits of implementation, and lessons learned. The team also gathered information on structural characteristics of the hospitals and ICUs, reviewed policies and procedures surrounding the ABCDE bundle, and observed ICU rounds.

### Contextual Factors Survey

Based on the literature regarding the implementation of patient safety practices, a brief online contextual factors survey was developed specifically for this study. Survey questions were developed by the research team based on a review of materials on the ABCDE bundle, expert consultation, and knowledge of prior efforts to understand contextual factors related to the implementation of patient safety initiatives (18, 19). In particular, parts of two existing instruments were used: 1) the RAND Success Factors Survey (developed at the RAND Corporation under the auspices of the Agency for Healthcare Research and Quality [AHRQ]-funded Patient Safety Evaluation Center) (13) and 2) the AHRQ Hospital Survey on Patient Safety Culture (http://www.ahrq.gov/legacy/qual/patientsafety/culture/hospsurvindex.htm).

The 21-item survey assessed communication between disciplines, the existing culture of safety and QI (both unit-specific and hospital-wide), leadership involvement in the project, resource allocation to project, and project leadership (Table 1). Responses to multiple-part questions were rolled up into composite scores, using a method recommended by AHRQ for its Hospital Survey on Patient Safety Culture (14) for ease of comparisons. Although AHRQ composites were developed

<table>
<thead>
<tr>
<th>Item</th>
<th>Dimension</th>
<th>Origin of Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hospital identification</td>
<td>New item—fixed choice</td>
</tr>
<tr>
<td>2</td>
<td>Barriers: bundle A</td>
<td>New item—fixed choice</td>
</tr>
<tr>
<td>3</td>
<td>Barriers: bundle B</td>
<td>New item—fixed choice</td>
</tr>
<tr>
<td>4</td>
<td>Barriers: bundle D</td>
<td>New item—fixed choice</td>
</tr>
<tr>
<td>5</td>
<td>Barriers: bundle E</td>
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</tr>
<tr>
<td>6</td>
<td>Cross-disciplinary communication</td>
<td>New item—fixed choice</td>
</tr>
<tr>
<td>7</td>
<td>Culture of excellence (ICU)</td>
<td>RAND Success Factors (#6) plus 1 new item</td>
</tr>
<tr>
<td>8</td>
<td>Teamwork/communication/openness</td>
<td>AHRQ Hospital Culture Survey—Section A (#1); Section A (#7)</td>
</tr>
<tr>
<td>9</td>
<td>Staffing adequacy</td>
<td>AHRQ Hospital Survey—Section A (#10)—1 item plus 1 new item</td>
</tr>
<tr>
<td>10</td>
<td>Overall grade on quality (ICU)</td>
<td>AHRQ Hospital Survey—Section E</td>
</tr>
<tr>
<td>11</td>
<td>Patient safety culture (hospital)</td>
<td>RAND Survey (#1) plus 1 new item</td>
</tr>
<tr>
<td>12</td>
<td>Patient safety standards (hospital)</td>
<td>RAND Survey (#2)</td>
</tr>
<tr>
<td>13</td>
<td>Leadership involvement</td>
<td>RAND Survey (#7) minus 1 new item</td>
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<td>14</td>
<td>Leadership support</td>
<td>RAND Survey (#8) plus 2 new items</td>
</tr>
<tr>
<td>15</td>
<td>ICU implementation team</td>
<td>RAND Survey (#9) modified</td>
</tr>
<tr>
<td>16</td>
<td>Team performance</td>
<td>RAND Survey (#10) plus 2 new items</td>
</tr>
<tr>
<td>17</td>
<td>Most difficult barriers</td>
<td>New item—open ended</td>
</tr>
<tr>
<td>18</td>
<td>Lessons to share</td>
<td>New item—open ended</td>
</tr>
<tr>
<td>19</td>
<td>Respondent experience</td>
<td>Modified item—fixed choice</td>
</tr>
<tr>
<td>20</td>
<td>Respondent position</td>
<td>Modified item—fixed choice</td>
</tr>
<tr>
<td>21</td>
<td>Respondent hours</td>
<td>Modified item—fixed choice</td>
</tr>
</tbody>
</table>

**TABLE 1. Implementing the ABCDE Bundle in ICUs: A Survey (13, 14)**

ABCDE = awakening, breathing, coordination, delirium, and early mobility, AHRQ = Agency for Healthcare Research and Quality.
using factor analysis, determining empirically which items are related was not possible in this case given limited sample sizes. Instead, the composites were created using face validity. To mathematically obtain the composite score, the number of positive responses to each item in the dimension (e.g., “strongly agree” and “agree,” reversing any negatively worded items) was divided by the number of total responses for all items in the dimension.

Two open-ended questions were included to assess the most difficult barriers to overcome in the implementation of the ABCDE bundle and lessons learned throughout the implementation process.

**IA Communications and Observations**

As part of the grant support given to participating sites, an IA was in regular contact with the project leaders and team and often attended team meeting. The IA's role as facilitator, coach, cheerleader, relationship builder, and cross-pollinator allowed first-hand knowledge of practices, implementation, and data throughout the intervention period.

**Process and Outcome Data**

As a condition of participation in the CIIG, each facility submitted baseline and ongoing process and outcome data. Process measures included compliance with daily SATs, daily breathing trials, delirium screening every shift, and daily progressive mobility. Charts for 100% of ICU patients in-house were reviewed 1 day a week for compliance. Baseline data were submitted for March 2012, and intervention-period data were collected and reported monthly for the 12-month period from April 2012 through March 2013.

Average ICU length of stay and average days on mechanical ventilation were the two outcome measures used in the CIIG. Baseline data were submitted for 1Q12, and quarterly data were collected through 1Q13.

**RESULTS**

**Structural Characteristics**

Two of the four participating hospitals are urban academically affiliated facilities and the other two are community hospitals. Two of the hospitals also belong to a larger hospital system; all four hospitals are not-for-profit. Hospital bed size ranges from 200 to 750+, with ICU bed size ranging between 15 and 22 beds. All ICUs included in this pilot study are “open” mixed-medical/surgical ICUs. Two ICUs are staffed by intensivists who use EHR. ICU rounds include respiratory therapists in two of the ICUs and include physical therapists in three of the four ICUs. One ICU has a designated respiratory therapist and another has a designated physical therapist.

**Bundle Implementation**

All hospitals had prior bundle implementation experience and prior experience implementing pieces of the ABCDE bundle. Only one hospital did not report having other hospital initiatives competing for time and resources with ABCDE bundle implementation.

Each of the four participating ICUs implemented nearly all elements of the ABCDE bundle within the 12-month time frame. Aggregate compliance with the five process measures is shown in Figure 1. Compliance with SATs increased from 25% in March 2012 to 81% in March 2013. Daily SBTs occurred in just under 30% of eligible patients at baseline, rising to 67% in the most recent data. None of the four ICUs were actively assessing patients for delirium at the onset of the CIIG study. However, by March 2013, nearly 65% of all eligible ICU patients were assessed each nursing shift for delirium. Three of the four ICUs have implemented an early progressive mobility program since the start of the project. In these three facilities, 82% received some form of progressive mobility in March 2013, with 49% of the patients getting out of bed at least once per day. These results are similar to other ABCDE studies of bundle compliance (20).

Implementation of the bundle elements varied across the four ICUs. Table 2 illustrates the differences in success of element implementation across the four sites. To compare implementation across the ICUs, reliable implementation was defined as having greater than 85% compliance in at least 4 of the last 6 months for SATs, SBTs, delirium assessments, and early progressive mobility. Implementation is having the process defined, with or without a written protocol, and expectations set. Reliable implementation for choice of sedative is an indication that new policies and order sets were created limiting the use of benzodiazepines for sedation of ICU patients. SATs and choice of sedative were reliably implemented in three of the four ICUs. SBTs were implemented reliably in two of the four sites. To date, only one ICU has reliably implemented an at least once a shift delirium screening process, whereas another ICU has successfully implemented a reliable early progressive mobility program.

Each of the four sites chose to implement the Confusion Assessment Method for the ICU (CAM-ICU) as the tool to assess patients for the presence of delirium. The method of education and implementation of the CAM-ICU varied widely across the ICUs. For example, one ICU used an on-the-job-training model, where one nurse champion was pulled out of the count and trained fellow nurses one at a time using videos, demonstrations, other written and online materials, and coaching. A second ICU held an education session and subsequently implemented a train-the-trainer type model, using super champions. The remaining two ICUs employed the more traditional approach of educating all staff through educational sessions or skills day and rolling out the intervention once all staff were trained. Figure 2 shows compliance rates over the intervention period for each of the four ICUs, designated by type of education/rollout process.

**Contextual Factors Survey**

Eighty-one staff across the four ICUs completed the online contextual factors survey, with a range of 7–36 participants per site. All respondents were directly involved with ABCDE bundle implementation and/or compliance. The breakdown of respondents by profession was 76% registered nurses, 7% physicians, 11% ancillary staff (respiratory therapists, physical/
occupational therapists), 4% QI staff or management, and 3% physician assistants/nurse practitioners. Eighty-two percent of respondents worked in their current profession for at least 6 years. Sixty-seven percent of respondents had worked in their facility for at least 6 years, with 62% of respondents working in their current ICU for at least 6 years.

**Table 3** compares the survey responses across the four hospitals with respect to communication, culture of safety and improvement (both unit-specific and hospital-wide), leadership involvement, resource allocation to project, and project leadership. Respondents reported effective communication between nurses and other disciplines (physicians, respiratory therapists, and physical/occupational therapists) across the board. All other characteristics assessed varied across the participating hospitals.

Fifty-five survey respondents (68%) provided a free-text response describing the 1–2 most difficult barrier(s) to overcome in implementing the ABCDE bundle. The overwhelming majority of barriers identified were surrounding resources (70%), particularly in implementing an early progressive mobility program. Other identified barriers included coordination of disciplines (14%), knowledge/training requirements (11%), accountability (4%), and charting/documentation (2%).

**DISCUSSION**

All four participating ICUs took dramatic strides toward implementing the ABCDE bundle over a 12-month period,
with the goal of reducing ICU-acquired delirium and muscle weakness. Each ICU reliably implemented at least one of the bundle elements, with one ICU having reliably implemented three elements and one ICU having reliably implemented four elements. Based on the data gathered from site visits, the contextual factors survey, and bundle compliance data, the following factors were identified as having facilitated/hindered the implementation of the ABCDE bundle.

**Factors That Facilitated Bundle Implementation**

**Organizational/Structural Characteristics of the ICU.** Stable ICU leadership was among the structural characteristics that facilitated implementation. Other structural factors included consistent respiratory therapy (RT) and physical/occupational therapy (PT/OT) participation in daily multidisciplinary rounds, as well as having “dedicated” RT and PT/OT staff assigned to the ICU instead of “floating” staff.

**Patient Safety and QI Culture.** The two ICUs that have achieved higher and more reliable implementation of bundle elements (sites 1 and 3) were also the only two ICUs that were characterized as having an existing culture of QI.

**TABLE 3. Hospital-Specific Results of Contextual Factors Survey**

<table>
<thead>
<tr>
<th>Composite</th>
<th>Site 1</th>
<th>Site 2</th>
<th>Site 3</th>
<th>Site 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interdisciplinary communication</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Culture of improvement in ICU</td>
<td>✓</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Culture of improvement hospital wide</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Culture of safety in ICU</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Culture of safety hospital wide</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leadership involvement in implementation</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Leadership provided necessary resources</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Effective project leadership</td>
<td>✓</td>
<td>✓</td>
<td></td>
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</tr>
</tbody>
</table>

✓ = greater than 50% agreement among survey respondents. Blanks indicate <50% agreement among survey participants.

**Figure 2.** Compliance with delirium screening each shift by type of Confusion Assessment Method for the ICU (CAM-ICU) training implementation. Compliance rates with assessing patients each shift for delirium varied over time with respect to the type of education and rollout strategy.
**Implementation Planning.** Project management by an empowered ICU clinical champion who provides effective and stable project leadership, and conducting regular team meetings, were the implementation planning factors that predicted higher success.

**Training and Support.** Access to training materials, and even more so, access to hands-on support from “nurse champions/super-users” resulted in faster implementation of the delirium screening process. Based on site interview data, physician support and hospital leadership support are additional factors that facilitated implementation.

The most frequently cited barrier was the lack of resources, particularly those needed to implement an early mobility program in the ICU. So it is no surprise that the only site that has successfully implemented a progressive early mobility program to date is also the site that reported that leadership provided the necessary resources for an ICU early mobility program in the contextual factors survey. A financial model estimating the costs and benefits of an ICU early mobility program developed by Lord et al (21) from Johns Hopkins University predicts a significant net cost savings for most hospitals implementing an ICU early mobility program.

**Prompts and Documentation.** Those facilities that use an EHR to document ABCDE screening results and interventions, viewable by all relevant disciplines, achieved more success when compared with facilities that have more “silos” of patient care documentation. In addition, rounding checklists and “forcing functions” also facilitated compliance with the bundle elements.

**Factors That Hindered Bundle Implementation**
Excessive staff turnover (both in project and ICU leadership), morale issues, lack of respect among disciplines, knowledge deficits, and excessive use of registry staff are believed to have hindered the ABCDE bundle implementation process across these four ICUs.

**Bundle Implementation Factors That Remain Inconclusive**
Although both of the “high-performing” sites reported an organizational-wide “culture of patient safety” and an organizational-wide “culture of QI,” one other facility did as well. What possibly distinguishes the third ICU from the top two ICUs is that staff did not report a culture of QI in this third ICU. Based on the results of the contextual factors survey, a “culture of safety” in the ICU was not predictive of higher bundle implementation or compliance.

Contrary to the hypothesis that having intensivists in the ICU facilitates and accelerates adoption of best practices, that did not appear to be the case here. Facilities that have intensivists staffing their ICUs were not among the top two performers.

It remains unclear whether or not leadership involvement in bundle implementation facilitates the process, based on the results from the contextual factors survey and bundle compliance data.

**Additional Observations**
Although there is a natural chronological order to the ABCDE bundle, the starting point of bundle implementation for ICUs does not necessarily need to be “A” (i.e., SATs) in order to achieve successful implementation with the entire bundle. For example, one facility began with implementing “D” (i.e., delirium screening and treatment). Because the effects of delirium are more easily understood, starting the implementation process with delirium created the necessary ICU staff buy-in and will to tackle the “ABC” and “E” portions of the bundle later. Another facility motivated its ICU physicians and staff by starting with “E” (i.e., early progressive mobility). But when eligibility screenings for patient mobility demonstrated that a large number of their ICU patients were not eligible for progressive mobility due to over-sedation and heavy reliance on mechanical ventilation, physicians and staff resolved to work on “ABC.”

The approach to the education and rollout of the CAM-ICU tool to identify delirium varied across the four sites (Fig. 2). The ICU that used on-the-job-training achieved high levels of bundle compliance at a much faster pace than the other ICUs. The ICU that employed the train-the-trainer model to implement the CAM-ICU also achieved quicker results when compared with the other two ICUs that used the more traditional comprehensive staff training approach. By the end of the 12-month period though, just 4 months after rollout, one of the two ICUs that used the traditional approach had surpassed the ICU using the train-the-trainer model and is now on a trajectory to achieve a similar degree of reliability as well. More data and analysis would be necessary to determine which of the approaches achieves sustained reliable results over time.

**Study Limitations**
Although the goal of this study was to identify contextual factors to guide future directions for evidence-based bundle implementation, the small sample size of four hospitals included in this pilot study did not provide enough variability to test all of the hypothesized factors. For example, some ICU structural characteristics (size, “open” vs “closed” models of patient care) and prior experience with implementing protocols did not vary across participating ICUs. Further research is required to estimate the effects of these factors.

Another limitation of this pilot study is that the site visits and survey were conducted at different stages of implementation for each participating hospital. The rate at which bundle elements were implemented varied across elements within the same ICU and between the different facilities. Therefore, it was impossible to control the timing of the site visits and survey. This may have influenced participant’s perceptions of barriers and successes.

A third limitation is that the majority of the survey respondents (76%) were registered nurses. Although nursing plays the largest role in ABCDE bundle implementation, more input from other disciplines may have provided more insight, particularly as it relates to hospital-wide patient safety and improvement culture.

Finally, only 1 year of intervention data is not sufficient to determine whether implementation of the ABCDE bundle affected ICU average length of stay, average days on mechanical ventilation, and ICU average length of stay.
ventilation, or other clinical outcomes. Preliminary results from this study demonstrate a slight improvement in these clinical outcomes, but further study may provide more answers to determine which contextual factors may influence not only bundle implementation but also short- and long-term clinical outcomes in ICU patients.

CONCLUSIONS

Although broader research is needed, both in terms of number of facilities and ICU implementation studies beyond the ABCDE bundle, there are structural and cultural elements that should be in place and addressed either before or in conjunction with the implementation of the ABCDE bundle. In addition, effective project planning and securing the required support and resources should occur prior to implementation. During implementation, a focus on prompts and documentation is necessary to aid both in implementation and in long-term sustainability. The results of this pilot study may help other facilities to successfully implement the ABCDE bundle and other evidence-based strategies for managing pain, agitation/sedation, and delirium in an integrated and interdisciplinary fashion, as outlined in the recently revised ICU pain, agitation, and delirium clinical practice guidelines (22).

ACKNOWLEDGMENTS

We thank the four participating San Francisco Bay Area hospitals, their tireless project leaders, the ICU staff, and other participating staff members and physicians. These hospitals are among the early adopters nationwide and will help pave the way for others to follow.

REFERENCES