

Measurement of Implementation Components and Contextual Factors in a Two-State Healthcare Quality Initiative to Reduce Ventilator-Associated Pneumonia

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OBJECTIVE. To develop and field test an implementation assessment tool for assessing progress of hospital units in implementing improvements for the prevention of ventilator-associated pneumonia (VAP) in a two-state collaborative, including data on actions implemented by participating teams and contextual factors that may influence their efforts. Using the data collected, learn how implementation actions can be improved and analyze effects of implementation progress on outcome measures.

DESIGN. We developed the tool as an interview protocol that included quantitative and qualitative items addressing actions on the Comprehensive Unit-based Safety Program (CUSP) and clinical interventions for use in guiding data collection via telephone interviews.

SETTING. We conducted interviews with leaders of improvement teams from units participating in the two-state VAP prevention initiative.

METHODS. We collected data from 43 hospital units as they implemented actions for the VAP initiative and performed descriptive analyses of the data with comparisons across the 2 states.

RESULTS. Early in the VAP prevention initiative, most units had made only moderate progress overall in using many of the CUSP actions known to support their improvement processes. For contextual factors, a relatively small number of barriers were found to have important negative effects on implementation progress (in particular, barriers related to workload and time issues). We modified coaching provided to the unit teams to reinforce training in weak spots that the interviews identified.

CONCLUSION. These assessments provided important new knowledge regarding the implementation science of quality improvement projects, including feedback during implementation, and give a better understanding of which factors most affect implementation.

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The experiences of healthcare organizations that have undertaken quality improvement initiatives have yielded very mixed results, highlighting how difficult it is to achieve sustainable, improved outcomes.^{1,2} Many initiatives to implement best practices have faltered during the implementation phase. It is increasingly apparent that implementation components and contextual factors influence providers' ability to translate interventions into the clinical setting.^{3,4}

Multiple factors can challenge efforts of organizations to make sustainable changes in healthcare practices, including not only the interventions themselves but also the implementation actions taken and external forces within which they operate. When assessing quality improvement initiatives, greater attention needs to be paid to the actions required to make improvements and to situational factors that can affect those actions.⁵ Such information can be used (1) to learn how implementation actions themselves can be improved in

the future and (2) to analyze effects of the implementation interventions on measures of resulting outcomes.

In this article, we describe the development, application, and evaluation of an implementation assessment tool that was utilized as part of a two-state quality improvement collaborative for the prevention of ventilator associated pneumonia (VAP). This tool was used to collect data on the actions implemented by teams participating in the collaborative and the contextual factors that may have influenced their implementation efforts. As part of this assessment, we make a clear distinction between these "implementation components" and "contextual factors."

The collaborative, called the Comprehensive Unit-based Safety Program (CUSP) to Eliminate Ventilator-Associated Pneumonia (VAP), was funded by the National Institutes of Health (NIH) and Agency for Healthcare Research and Quality (AHRQ). Forty-three units from Maryland and Pennsyl-

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TABLE 1. Four Quantitative Measures of the Implementation Assessment Tool to Reduce Ventilator-Associated Pneumonia (VAP)

Measure	Interview question	Response option
No. of patient safety training actions taken by units	Since you began participating in the project, how many of your staff have viewed a video or presentation on the science of safety?	None/few, less than one half, one half or more, almost all/all (1–4 scale)
Implementation of the CUSP tools by units	Is a patient safety presentation now part of new staff orientation for your unit? What CUSP tools are you implementing? Daily goals checklist; culture checkup tool; learning from defects tool; shadowing; morning briefing; barrier identification and mitigation; observing rounds (fly on the wall); structured communications	Yes or no responses Yes or no responses for each tool
No. of leadership support actions taken by the organization	Is the organization leadership taking the following steps to reinforce its support for the work? Ensures training on the science of safety for all current and new employees; meets with the team on the unit at least monthly; makes VAP prevention an organization-wide goal and coordinates this as part of the strategic institutional plan; fosters organizational learning by disseminating learning-from defect lessons and the CUSP team's successes across the hospital or institution; provides protected time for VAP prevention team leaders: doctor, nurse, data collector; reviews VAP rates at least quarterly at board meetings	Yes or no responses for each action
Reported barriers to progress	In the past 6 months, how often did each of the following factors slow your CUSP team's progress in implementing the CUSP and VAP interventions? (1) Leadership support issues: not enough leadership support from executives, not enough leadership support from physicians, not enough leadership support from nurses, insufficient autonomy/authority; (2) team skills and cohesion issues: insufficient knowledge of evidence supporting interventions, lack of quality improvement skills, confusion about how to proceed with CUSP activities, lack of team member consensus regarding goals, inability of team members to work together, turnover on CUSP team; (3) stakeholder push-back issues: not enough buy-in from physician staff, not enough buy-in from nursing staff, not enough buy-in from other staff; (4) workload and time issues: not enough time; staff turnover on unit, data collection burden for staff, problems with data systems, competing priorities or distractions (eg, new electronic medical record, accreditation visit)	Barriers were each scored on 1–4 scale (1 = never/rarely to 4 = almost always)

NOTE. CUSP, Comprehensive Unit-based Safety Program.

TABLE 2. Implementation of Measures to Reduce Ventilator-Associated Pneumonia (VAP): Summary Results for Implementation Component Measures 1–3

Composite measures	Responses (<i>n</i> = 43)
Measure 1: no. of patient safety training actions taken by the units	
Mean no. of actions (composite, possible no. = 2)	1.2
Standard deviation	0.8
Distribution of actions (composite; %)	
No action	20.9
One action	41.9
Two actions	37.2
Individual items: units taking each action	
All/almost all staff view video on safety (4 on a 1–4 scale)	41.9
Video used for new staff orientation (Y/N)	74.4
Measure 2: implementation of CUSP tools	
Mean no. used (composite, possible no. = 8)	3.0
Standard deviation	1.8
Individual items: units using each CUSP tool	
Daily goals checklist	32.6
Culture checkup tool	27.9
Learning from defects tool	23.3
Shadowing	23.3
Morning briefing	60.5
Barrier identification and mitigation	20.9
Observing rounds (fly on the wall)	60.5
Structured communications	48.8
Measure 3: no. of leadership support actions taken	
Mean no. of actions (possible no. = 6)	3.5
Standard deviation	1.6
Individual items: units reporting each leadership support action	
Ensures employee training on the science of safety	65.1
Meets with the team on the unit at least monthly	41.9
Makes VAP prevention an organization-wide goal and in strategic plan	74.4
Fosters learning by disseminating CUSP teams successes and lessons	60.5
Provides protected time for VAP prevention team leaders	32.6
Reviews VAP rates at least quarterly at board meetings	74.4

NOTE. Data are % of units, unless otherwise indicated. CUSP, Comprehensive Unit-based Safety Program.

vania hospitals are participating in this 3-year collaborative cohort, from August 2012 to December 2015. Units included intensive care units (ICUs), adult long-term care facilities, and rehabilitation facilities. The hospitals included both teaching and nonteaching facilities located across a range of urban, suburban, and rural areas. Participation in the collaborative and the interview was voluntary and financial support was not provided for participation.

The VAP prevention initiative is a multifaceted intervention including 2 interventions, a VAP intervention and CUSP. The VAP intervention was based on a conceptual model to increase caregivers' use of 6 evidence-based therapies for the prevention of VAP, including maintaining elevation of the head of the bed to 30° or greater, performing oral care 6 times daily, the use of chlorhexidine 2 times daily while performing oral care, the use of subglottic suctioning endotracheal tubes for patients who received mechanical ventilation for greater

than 72 hours, the use of spontaneous awakening trials (sedation vacation), and the use of spontaneous breathing trials.^{6,7}

CUSP is a 5-step iterative and validated process to improve safety culture.^{8–11} CUSP focuses on the intrinsic versus extrinsic motivation of front-line staff, provides tools to help teams investigate when something goes wrong in care or there is an infection, and educates staff on why that is important. CUSP is designed to tap into the wisdom and experience of front-line staff and create partnerships with senior executives to support staff in their efforts to improve patient safety and quality of care. Participating teams were trained on the VAP intervention and CUSP implementation through monthly conference calls and coaching by members of the research team, including the Armstrong Institute for Patient Safety and Quality, Hospital and Healthsystem Association of Pennsylvania, and Maryland Hospital Association.



FIGURE 1. Number of patient safety training actions taken by the units, overall and by state (2 possible actions), to reduce ventilator-associated pneumonia.

METHODS

Implementation Assessment Tool Development

The Implementation Assessment Tool is an interview protocol developed to collect data via telephone interviews with the team leaders of each of the units participating in the VAP prevention collaborative. Results from these interviews, reported here, describe the early implementation progress and experiences of the participating units.

We drew upon 3 key sources to develop the contents of the implementation assessment tool. The first was the content of CUSP as applied in this VAP prevention collaborative, which was the primary topic of interest for implementation experiences. The other 2 sources were contents of the team checkup tool,¹² developed by Johns Hopkins researchers in 2005, and a success factor survey developed by RAND researchers in 2006.¹³⁻¹⁵ These 2 instruments addressed similar sets of factors that are well documented in the literature as influencing experiences in implementing quality improvement initiatives.

We used an iterative process to develop the contents of the interview protocol, drawing from these 3 sources. Questions were developed to address both implementation components and contextual factors relevant to implementation of VAP interventions in hospital ICUs. Some questions were designed to gather quantitative data, which we used directly in descriptive analyses and other statistical modeling. Others were designed to collect qualitative data, which we used to collect experiential data reported by the team leaders. In this article, we report results based on the quantitative data collected.

A draft of the written protocol was tested by interviewing a small number of team leaders and getting feedback from those interviews. Revisions were made in response to lessons

from this test before extending the interviews to the full number of team leaders.

The Johns Hopkins University School of Medicine institutional review board reviewed and approved this research. Informed consent was obtained from participants at the onset of interviews.

Measures Defined

The quantitative measures collected in the implementation assessment tool consist of 33 items grouped into 4 composite measures (Table 1). Three of the composite measures address implementation components: training on patient safety, implementation of CUSP tools, and leadership commitment and support. The fourth composite measure addresses barriers to progress as key contextual factors.

Measure 1: patient safety training actions. This composite measure consists of the sum of dichotomous responses to 2 interview items. Responses to the first item (scale of 1–4) were recoded as dichotomous responses where 1 equals “almost all/all” response and 0 equals any other response. The second item had yes/no responses, coded “yes” equals 1 and “no” equals 0. The 2 dichotomous variables were summed, yielding a response range from 0 to 2.

Measure 2: implementation of the CUSP tools. This composite measure aggregates the yes/no responses to 8 items about use of specific CUSP tools, where “yes” equals 1 and “no” equals 0. It is measured as the sum of responses to these items, yielding a response range from 0 to 8.

Measure 3: leadership support actions. This composite measure aggregates the yes/no responses to 6 items about leadership support actions reported by the units, where “yes” equals 1 and “no” equals 0. It is measured as the sum of responses to these items, yielding a response range of 0 to 6.

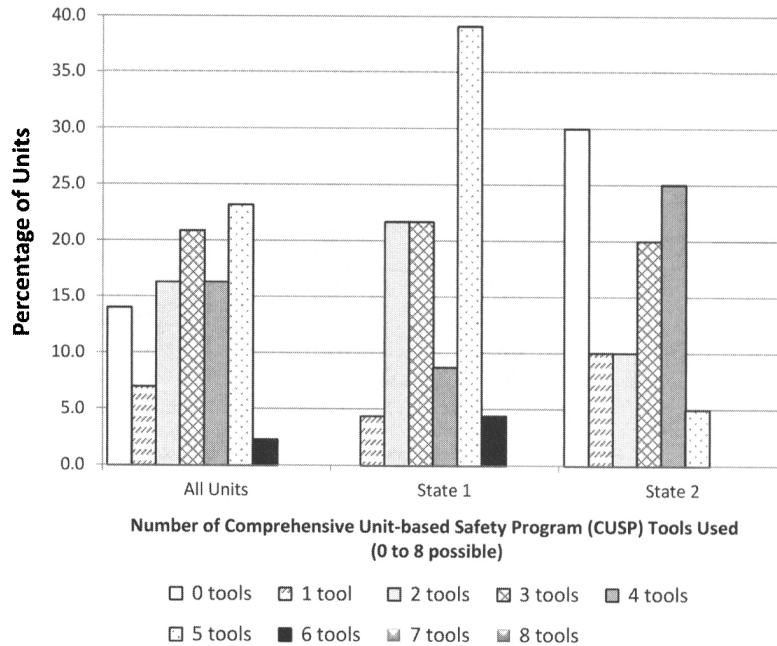


FIGURE 2. Percentage distribution of units by the number of Comprehensive Unit-based Safety Program (CUSP) tools used, overall and by state (8 possible tools), to reduce ventilator-associated pneumonia. No units used more than 6 of the 8 available CUSP tools.

Measure 4: barriers to progress. Responses for each of 18 possible barriers that affected units' implementation progress were obtained using Likert scale items for each barrier, with response options of never/rarely, occasionally, frequently, or almost all/all (scale of 1–4). To identify important barriers, responses for each barrier were recoded to a dichotomous variable where 1 equals “never/rarely” response and 0 equals any other response. These recoded data were used to develop 3 measures. The first was number of important barriers overall, and the second was the number of important barriers by barrier category. These composite measures were calculated as the sum of the 1/0 values for individual barriers (across all the barriers and across barriers within each category). The third measure was the rank ordering of each individual barrier based on the percentage of units rating it as an important barrier (coded 1 on the dichotomous variable), sorted in descending order.

Data Collection

Interviews using the implementation assessment tool were conducted with the team leaders of the participating units during the period January to July 2013. They were provided a copy of the interview protocol for review in advance of the interviews. The team leaders were the interviewees of interest. We allowed them to include other team members in the interview if they wished, but few decided to do so. Two members of the research team conducted the telephone interview with each quality improvement team leader. One of the re-

searchers conducted the interview, and both took notes. The interviews took an average of 1 hour to conduct.

Data Analysis

Descriptive analyses were performed for each of the 4 composite measures as well as for the individual items within each of the measures. These included estimated means, medians, and standard deviations for each measure. Distributions of responses also were developed. Comparisons were made for units in each of the 2 states in the collaborative (states 1 and 2 for presenting results). Alternative approaches were explored for presenting the data for each composite variable, to identify the most effective way to do so for different uses of the data. Aggregated results were presented to the participating teams via a webinar presentation and were available for download, to allow them to compare their experiences with those of other teams.

RESULTS

A total of 43 interviews were conducted; 23 interviews in hospitals in state 1 and 20 interviews in hospitals in state 2. The backgrounds of the leads varied, including nurses (most respondents), nurse managers, CUSP team leaders, infection preventionists, respiratory therapists, and physicians.

For the composite variable of “patient safety training actions taken,” the 43 units took an average of 1.2 patient safety training actions, and 37.2% of the units took both possible

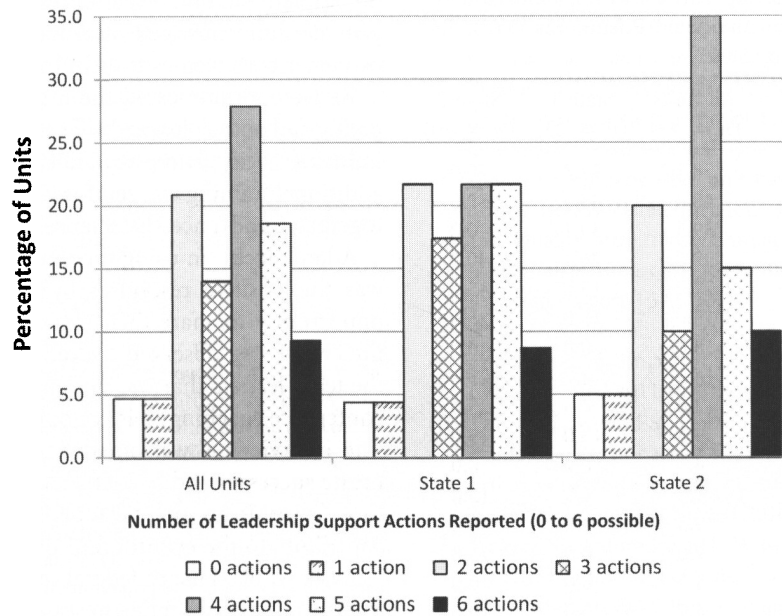


FIGURE 3. Percentage distribution of units by the number of leadership support actions taken, overall and by state (6 possible actions), to reduce ventilator-associated pneumonia.

actions (Table 2). Across both states, the units had an aggregated 74.4% rate of showing the video to new staff versus 41.9% of all units showing it to all/almost all of their existing staff. Conversely, 20.9% of the units took neither training action. In the percentage distributions of the units, 56.5% of the units in state 1 took both actions, compared with 15.0% of the state 2 units (Figure 1).

For the composite variable of “number of CUSP tools used,” the 43 units used a mean number of 3.0 tools of the 8 available tools (Table 2), and the distribution of units by the number tools used ranged from 0 to 6. State 1 and state 2 units differed substantially in their distributions (Figure 2). Although 45% of the units in state 1 reported using 5 or more tools, only 5% of the units in state 2 used 5 or more tools. Conversely, none of the state 1 units and 30% of the state 2 units reported using no tools at all (Figure 2).

For the composite variable of “number of leadership support actions taken,” an average of 3.5 leadership actions out of 6 possible actions was taken, as measured by the “strongest support” measure (Table 2). The units varied widely in the number of actions they took as well as in which specific leadership support actions they were likely to use. The distribution in the number of actions taken differed for the 2 states (Figure 3). A more even distribution is observed in state 1 units, whereas the distribution of state 2 units showed a clear peak at 4 actions taken.

For the composite variable of “barriers to progress encountered,” of the 18 potential barriers listed, the 43 units identified a mean of 3.3 barriers that most frequently affected their implementation progress. Barriers in the “workload and

time issues” category were encountered most frequently, with an average of 2.1 barriers identified in that category. Less than 1 barrier was identified as important for each of the other 3 categories (leadership support issues, team skills and cohesion, and stakeholder push-back; data not shown).

Overall, the state 2 units reported being affected by more barriers than did the state 1 units. The units in the 2 states were found to share issues with some barriers, and they differed with respect to other barriers (Table 3). The barrier of “competing priorities” was the most frequently reported barrier by units in both states, although the percentages reporting it differed by state (47.8% in state 1 and 70% in state 2). The barriers of “data collection burden” and “not enough time” also were in the top 5 barriers for units in both states, and “data system problems,” “staff turnover on unit,” and “lack of physician leadership support” were in the top 7 for both states. The states differed markedly for some other barriers: “confusion on CUSP” was a top-5 barrier for state 2 units but a low priority for state 1 units, whereas “executive leadership support” was a top-5 barrier for state 1 units but a low priority for state 2 units.

DISCUSSION

The first step for improving healthcare outcomes is the documentation, through clinical research, of best practices for various aspects of care. The next step is the translation from research to practice, to cross the bridge to healthcare delivery in the field. Many efforts by healthcare organizations to implement best practices have faltered, highlighting how difficult

TABLE 3. Contextual Factors: Top Barriers to Implementation of Measures to Reduce Ventilator-Associated Pneumonia (VAP) Reported by Units, Overall and by State

Barrier	All units (<i>n</i> = 43)	State 1 (<i>n</i> = 23)	State 2 (<i>n</i> = 20)
Competing priorities	58.1	47.8	70.0
Data collection burden	48.8	43.5	55.0
Not enough time	39.5	39.1	40.0
Data system problems	32.6	26.1	40.0
Staff turnover on unit	27.9	13.0	45.0
Leader support (physicians)	18.6	13.0	25.0
Confusion on CUSP	18.6	0.0	40.0
Poor buy-in (physician staff)	16.3	8.7	25.0
Turnover CUSP team	14.0	4.3	25.0
Leader support (executives)	9.3	13.0	5.0
Knowledge of evidence	4.7	8.7	0.0
Lack team agree on goals	9.3	4.3	15.0
Poor buy-in (nurse staff)	9.3	4.3	15.0
Poor teamwork	7.0	0.0	15.0
Leader support (nurses)	4.7	0.0	10.0
Lack quality improvement skills	4.7	0.0	10.0
Little autonomy	2.3	0.0	5.0
Poor buy-in (other staff)	2.3	0.0	5.0

NOTE. CUSP, Comprehensive Unit-based Safety Program.

it is to achieve sustainable improvements in outcomes. With awareness of this issue, we pursued development and application of the implementation assessment tool to assess the progress of participating units as they implemented a multifaceted intervention for VAP prevention. We had 2 aims for this work: to learn how implementation actions themselves can be improved, and to analyze effects of the implementation interventions on measures of resulting outcomes.

What we learned was that, early in the implementation of the VAP prevention initiative, many units had made only moderate progress overall in taking many of the CUSP actions known to support their improvement processes, and they varied widely in the extent of the efforts taken. It was clear that more work was needed, which led our project team to modify the coaching provided to the participating unit teams to reinforce training on the principles and practices of CUSP and other weak areas identified from the interviews.

For the contextual factors that we examined, the unit team leaders identified a relatively small number of barriers as having important negative effects on their implementation progress. Many of them shared some of the same barriers as being important, but they also identified a variety of other barriers, reflecting the unique circumstances under which each unit operated.

These quantitative results were reinforced by the qualitative data collected in the interviews, highlighting that the units lacked a cogent understanding of what is involved in CUSP and what actions they should take to create an environment sensitive to patient safety. These findings showed the value of having a combination of quantitative and qualitative data

on implementation experiences, where the qualitative data provide more nuanced information that can be used on its own merits as well as to help interpret the quantitative data.

As we communicated the interview results to the participating units, they learned that they shared many of the same implementation successes and challenges, and the need for additional training was reinforced. To that end, we could work together to advance the science of improved patient care.

A key success in using the implementation assessment tool was the positive responses by team leaders to having the opportunity to share their experiences during the telephone interviews. We observed a level of energy and enthusiasm by the team leaders that was not apparent on many of the group conference coaching calls conducted during the collaborative. The interviewees welcomed having this forum to communicate successes and barriers, and they appreciated the ability to offer feedback on the tools and provide input that may contribute to the evolution of the interventions and the project as a whole. Due to federal restrictions, we could not hold face-to-face collaborative meetings, which made it difficult to build synergy among participants; these interviews helped to build that sense of community.¹⁶

We note, however, several challenges that are inherent to collecting data on implementation experiences, largely because it is resource-intensive to do so. From past experience, we knew that asking participating entities to complete information logs yields high rates of incomplete data because of noncompliance.^{6,17} We opted to use an interview approach instead, which avoided that problem but also required substantial researcher time to conduct the interviews and enter data. Using the interview protocol developed, we found that the interviews lasted an hour or longer.

Additional limitations included issues of how to time the interviews relative to implementation status, the need for validation of the predictive power of the implementation measures with respect to effects on outcomes, and need to conduct additional interviews later in the collaborative to track changes in implementation status over time. To be fully comparable, the data should be collected from all participants at approximately the same time relative to their start of improvement work, which we were not able to achieve. We have not yet tested the predictive power of these measures, because the two-state project is still generating the outcome data. We plan to perform those analyses when we have complete outcome data, which also will inform future modifications to the implementation assessment tool. We are also conducting a second set of interviews to be able to perform a comparison of interview data at 2 points of time during implementation.

The results of these interviews are currently being used to modify and improve the approach for the two-state VAP prevention collaborative, as well as to inform the AHRQ-funded national initiative to eliminate VAP.¹⁸ These modifications include changes addressing the limitations described here, with the goal of shortening interviews while preserving the richness of data generated in the two-state project.

These assessments provide important new knowledge regarding the implementation science of quality improvement projects, both for feedback during implementation and to better understand which implementation factors most affect resulting healthcare outcomes. The lessons learned can likely be generalized to other efforts focused on eliminating health-care-associated infections.

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