2015

Ventilator-Associated Pneumonia Prevention Bundle

Patricia Cal
Walden University

Walden University

College of Health Sciences

This is to certify that the doctoral study by

Patricia Cal

has been found to be complete and satisfactory in all respects,
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Review Committee
Dr. Mary Verklan, Committee Chairperson, Health Services Faculty
Dr. Patrick Palmieri, Committee Member, Health Services Faculty
Dr. Janice Long, University Reviewer, Health Services Faculty

Chief Academic Officer
Eric Riedel, Ph.D.

Walden University
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Abstract

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Patricia Ellen Cal

MSN, Adult and Geriatric Nurse Practitioner, San Diego State University, 1999

BA in Psychology, University of California San Diego, 1994

Associate of Applied Science in Nursing, Orange County Community College, 1985

Project Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Nursing Practice

Walden University

November 2015

Abstract

Ventilator-associated pneumonia (VAP) is a serious complication in critically ill patients; it can prolong intubation, increase intensive care unit and hospital length of stay, and increase mortality to twice the level of patients who do not develop VAP. The purpose of this project was to determine the effect of an evidence-based educational program to prevent VAP on ICU nurses' actual and documented practices for preventing VAP. The research questions addressed whether an educational program focused on VAP prevention will affect critical care nurses' compliance with a VAP prevention bundle, and whether the education will result in maintenance of a rate of zero cases of VAP per 1000 ventilator days. Data will be collected from all ICU patients intubated more than 24 hours and will include: (a) the frequency of oral care, (b) head-of-bed elevation of 30–45 degrees, (c) daily sedation vacation, (d) assessment of readiness for extubation, and (e) whether prophylaxis for deep vein thrombosis and for peptic ulcer disease was ordered. Observations of care will verify the accuracy of nurses' documentation in the medical record. A survey will assess nurse satisfaction with the educational program. Paired *t* tests will be used to compare the compliance of the nurses with each element of oral care and hygiene practices before and after the intervention. Analysis of variance will be calculated on the mean duration of ventilation, mean ICU and hospital length of stay, mortality before discharge, patient acuity, and rates of VAP per 1000 ventilator days. The goal of this project is a compliance rate of 90% or greater with the elements of the VAP prevention bundle, leading to decreased ventilator and ICU days, decreased morbidity, decreased mortality, and lower emotional distress. Positive social change will be accomplished through an immediate improvement in the lives of VAP-prone individuals.

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Dedication

To my husband, Anthony, and children, Robert and Marcia, for your patience and support throughout this journey.

Acknowledgments

I would like to acknowledge Dr. Mary Verklan and Dr. Patrick Palmieri for their guidance and support throughout this project; Dr. Regina Stafford, my preceptor, for providing your mentorship, support, and friendship; and to my family, who wholeheartedly supported me even when the going was rough.

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Section 1: Overview of the Evidence-Based Project

Introduction

Ventilator-associated pneumonia (VAP) is a preventable lung infection acquired in mechanically ventilated patients that was not present at the time of intubation (Centers for Medicare and Medicaid Services [CMS], 2013; Institute for Healthcare Improvement [IHI], 2012). A serious complication in the intensive care unit, VAP prolongs intubation by 4-9 days compared to patients without VAP. Mortality attributable to VAP is reported at 25–50% (Efrati et al., 2010), double the mortality of patients without VAP (Safdar, Dezfulian, Collard, & Saint, 2005).

Due to extended hospital stays and increased morbidity and mortality, VAP is an expensive complication. A single VAP case can increase the cost of treatment by up to $25,000 (CDC, 2009). The cost to treat VAP is not reimbursed by CMS, resulting in negative financial repercussions for hospitals which fail to effectively prevent VAP cases. Starting in January 2013, the CDC required that the precursors of VAP be reported, specifically ventilator-associated events (VAEs). Because they do not require radiographic or bacteriologic evidence of infection (CDC, 2013), the identification of cases is likely to increase.

This paper proposes a project to strengthen the VAP/VAE prevention program in a community hospital by applying evidence-based practice guidelines.

Problem Statement

A number of strategies have been identified as effective in preventing VAP (Society for Healthcare Epidemiology of America/Infectious Diseases Society of America, SHEA/IDSA): limiting intubation time; preventing aspiration and airway contamination; reducing equipment

contamination; complying with hand hygiene; and training caregivers. Despite the available guidelines, knowledge of, and compliance with, the recommendations are not consistent among critical care nurses (Tolentino-DelosReyes, Ruppert, & Shiao, 2007), which places the patients at risk for harm and the facility at risk for financial loss.

Purpose Statement and Project Objective

The purpose of this project is to determine the effect of an evidence-based VAP educational program on actual and documented ICU nursing care practices for preventing VAP. The practices for this project derive from the "ventilator bundle" (VB) of interventions from the Institute for Healthcare Improvement (IHI, 2012). There are five VB practices: (a) Perform oral care with chlorhexidine gluconate oral rinse every 12 hours; (b) Maintain the head of the bed [HOB] elevation at 30-45 degrees; (c) Ensure a daily "sedation vacation" (a trial of decreased sedation to allow the patient to awaken and respond to commands) in order to assess patient readiness to be weaned from the ventilator; (d) Provide prophylaxis for deep vein thrombosis; and (e) Prophylaxis for peptic ulcer disease.

A secondary purpose is to determine the effect of the educational program on the outcome of cases of VAP and VAEs. Although the IHI bundle (2012) addresses only VAP, VAEs are included in this project as an outcome because as of January 2013, they are reportable to CMS, and in the future may result in reduced payments to hospitals under pay-for-performance computations.

The objective of this project is to maintain a rate of zero cases of VAP and VAEs per 1000 ventilator days.

Relevance to Practice

Since the advent of VAP prevention bundles, there has been about a 45% reduction in cases of VAP (IHI, 2012). Due to successfully bundled interventions, many hospitals report more than a year without a VAP. Researchers also report decreased ventilator and ICU days (Dezfulian et al., 2005; Girard, et al., 2008; Kress, Pohlman, O'Connor, & Hall, 2000; Metheney, Davis-Jackson, & Stewart, 2010), reduced hospital length of stay (Kress et al, 2000; Metheny et al, 2010) and reduced mortality (Girard et al., 2008).

With the implementation of simplified reporting criteria, previously unrecognized cases of VAP as well as VAEs will likely be identified. While this might have financial consequences, the ultimate goal of VAP prevention efforts is to reduce morbidity and mortality due to device-related complications (Magill et al., 2013). With decreased morbidity and mortality, the actual financial costs will be reduced.

Project Questions

The project questions are as follows:

1. What is the effect of an educational program (VAP prevention guidelines, rationales, and strategies) focused on critical care nurses' compliance with a VAP prevention bundle, as measured by care observed and documented in the medical record including (a) oral care with chlorhexidine per protocol, (b) elevation of the head of the bed to 30-45 degrees, (c) daily sedation vacations, and (d) assessment of readiness for extubation?

2. Will the education yield a rate of zero cases of VAP and VAEs per 1000 ventilator days for the first 3 months after the educational intervention?

3. What is the nurses' level of satisfaction with the educational program?

4. Will there be a difference in the severity of illness, as measured by the APACHE II score, between intubated patients in the ICU before and after the educational intervention?

Evidence-Based Significance of the Project

Pneumonia acquired in a healthcare setting is a continuous concern for health agencies. CDC first published guidelines for the prevention of nosocomial pneumonia in 1981 and revised them in 1994 with recommendations for VAP. The original guidelines for managing pneumonia acquired in a health care setting were published in 1996 by the American Thoracic Society (ATS). The guidelines were revised in 2005 (ATS, 2005) in collaboration with the Infectious Disease Society of America (IDSA) and incorporated new research and VAP data. The revised guidelines addressed modifiable risk factors for VAP. The CDC updated its VAP guideline in 2003 (CDC, 2003) using the 1996 ATS guidelines in their references. CMS (2013) also published VAP prevention guidelines based on these older sources.

As reported in Magill et al. (2013), a CDC-commissioned VAP surveillance definition working group recommended a new algorithm that considered a hierarchical classification of VAEs, ranging from ventilator-associated conditions (VACs), to infection-related ventilator-associated complications (IVACs), then possible VAP, and probable VAP. The recommended changes were incorporated by the CDC in its protocol clarification document (CDC, 2013) and apply only to patients in adult ICU settings. (The pediatric population will continue to be monitored under the older definitions.) In its update of the practice recommendations for prevention of VAP, the Society for Healthcare Epidemiology of America (SHEA, 2014) recognized that VAEs prolong a patient's duration of mechanical ventilation, length of stay in ICU and the hospital, and increase mortality, as does VAP. Under the new guidelines, to qualify

as a VAC, patients must display worsening oxygenation or the need for increased positive end-expiratory pressure (PEEP) after 2 days of stable or decreasing oxygen needs. For IVAC, the criteria for VAC must be met in addition to a fever or increased white blood cell (WBC) count and prescribing of a new antibiotic that continues for 4 days or more. For possible VAP, the patients must meet criteria for VAC and IVAC plus have purulent respiratory secretions *or* positive respiratory cultures. For probable VAP, criteria are the same as for possible VAP except both purulent secretions *and* positive cultures must be present, *or*, with or without purulent secretions, a positive pleural culture or viral culture of respiratory secretions must be present (CDC, 2013, p. 15).

One important justification for the revisions in the reporting measures is to objectify the criteria to prevent subjectivity in the reporting system, because decreased reported VAP rates or those near zero are not consistent with data from epidemiologic studies (CDC, 2013). The data to identify VAC and IVAC cases is objective and can be collected from all ventilator patients (Mietto, Pinciroli, Patel, & Berra, 2013). VAC and IVAC criteria do not include radiographic evidence of new or worsening infiltrates, nor the collection, processing, and interpretation of respiratory cultures as is the case for VAP, both of which are subject to interpretation bias (Magill, et al., 2013). Accordingly, only VAC and IVAC are being considered for reporting and pay-for-performance purposes (CDC, 2013). Possible and probable VAP cases, while they will continue to be included in surveillance reports, are intended to contribute to internal quality control efforts. The simplified criteria are intended to increase the likelihood of identifying ventilator-associated complications, which increase the costs for health care agencies.

Implications for Positive Social Change

The Institute of Medicine (IOM) in 2001 advanced an agenda to improve health care quality, including safe and effective care. In 2008, the U.S. Department of Health and Human Services set an agenda to guide public health practices for health systems, including a mandate to reduce risk for preventable harm, as well as utilize the best practices based on evidence. The proposed intervention is consistent with these agendas to develop effective strategies with high-level evidence to mitigate the risk for harm in vulnerable populations. The social impact of robust intervention is specific to advancing public health, improved patient outcomes and decreased financial risk.

This project is intended to provide ICU nurses with the ability to make evidence-based care decisions, and to practice in compliance with the VAP bundle. Ethics plays an important role in this project, since its focus is to avoid preventable complications for critically ill patients that can result in increased morbidity, mortality and cost (Scott, 2009), as well as emotional distress (Health.gov, 2014). In particular, the ethical tenet of beneficence or do no harm (Grove, Burns & Gray, 2013) is pertinent when there are strategies to prevent patient harm but these are not effectively implemented. Clinicians have an ethical responsibility to provide evidence-based care aimed to improve patient outcomes and to reduce patient risk for harm. Clinicians are remiss their duties if they fail to employ protocols such as the VAP bundle.

Definitions of Terms

The following operational definitions will be used for this improvement project:

Ventilator-associated pneumonia (VAP): VAP is the presence of purulent respiratory secretions along with a positive culture of these secretions or of lung tissue; or in the absence of

purulent secretions, a positive pleural culture, positive lung histopathology, positive Legionella test, or positive test for one of several viruses, such as influenza, in respiratory secretions, occurring on or after Day 3 of mechanical ventilation or 2 days before or after the onset of worsening oxygenation (see below) (CDC, 2013).

Ventilator-associated event (VAE): VAE is a worsening of oxygenation for 2 days after 2 days of stabilization or improvement as evidenced by increasing FiO2 requirements of 0.20 or PEEP >3 cm/H20 above the level noted in the stabilization period. These can be further classified as a ventilator-associated condition (VAC), infection-related ventilator-associated complication (IVAC), possible VAP, and probable VAP (CDC, 2013). See Appendix A for the complete algorithm as defined by the CDC.

VAP prevention bundle: A group of activities, when consistently performed together, that help to prevent VAP and improve outcomes for patients. These include oral care using chlorhexidine gluconate 0.12% oral rinse; maintaining the head-of-bed at 30-45 degrees; daily sedation vacation and daily assessment of readiness to extubate; peptic ulcer disease prophylaxis; and deep vein thrombosis prophylaxis (IHI, 2012).

Oral care protocol: The protocol is a set of prescribed activities for performance of oral care in ventilated patients according to a written policy and procedure developed in conjunction with this project (Appendix B). This policy is currently approved for implementation by the institution's nursing director.

Head-of-bed elevation: The measurement in degrees of the elevation of the backrest of the hospital bed according to a gauge built into the bed defines the head-of-bed elevation.

Sedation vacation: A temporary stoppage of continuous sedative infusion to allow the patient to awaken sufficiently to open eyes on command, follow the examiner with the eyes, or follow a command to squeeze a hand or protrude the tongue (Kress, Pohlman, O'Connor, & Hall, 2000).

Assumptions

This study was based on the following assumptions:

1. Nurses will perform the care that they document, and they will document all the care that they provide.
2. Cases of VAE and VAP, as well as the number of ventilator days, will be accurately identified and reported.
3. ICU nurses benefit from educational programs, enabling them to consistently implement the ventilator bundle.

Limitations

This study was subject to the following limitations:

1. Nurses may alter their practices based on the presence of an observer, and therefore what the observer sees may not reflect what a nurse normally does.
2. The facility implemented an electronic medical record (EMR) one year ago. This change represents a significant change in the documentation process, as well as the initiation of computerized physician order entry. Nurses will need instruction on where and how to properly document the practices of the VAP bundle. In addition, physicians entering orders for ventilated patients will need to be directed to the correct computerized order set within the EMR system.

Summary

VAP is a preventable patient complication resulting from poor patient care practices in intubation and mechanical ventilation. It causes harm to patients, including death, and increases the cost of care (Efrati et al., 2010). To prevent the complication, nurses must understand and implement recommended strategies. An educational program was designed to address the knowledge deficit and to provide a coherent rationale for the change in practice.

Section 2: Review of Scholarly Evidence

Introduction

The purpose of this project is to determine the effect of an evidence-based VAP educational program on actual and documented ICU nursing care practices for preventing VAP. There is a well-established body of research supporting an array of strategies for VAP prevention. Several of these could be used in this project. They relate to the precept that these events are caused by aspiration of oropharyngeal secretions that are contaminated with pathogens (Tablan, Anderson, Besser, Bridges, & Hajjeh, 2004), for which the removal or neutralization is helpful. Other strategies are aimed at the minimizing the duration of mechanical ventilation and intubation, given that the risk for VAP remains as long as the mechanical ventilation continues. In fact, the definition of VAP becomes applicable only after the patient experiences a worsening of her or his respiratory status for 2 days after having been stable or improving for 2 days; this means that the patient must be intubated for a minimum of 4 days before VAP can be diagnosed (CDC, 2013). In addition, general measures for infection prevention, such as hand hygiene, and optimizing care of the ventilated patient, have been shown to be beneficial in VAP prevention. This section will review the literature on each component of the recommended prevention strategies: The VAP bundle; hand hygiene; oral care; HOB elevation; subglottic secretion removal; and limiting the duration of mechanical ventilation.

Literature Search Strategy

The literature search consisted of searches of the following databases: Cinahl, Medline, Cochrane Database of Systematic Reviews, the Joanna Briggs Institute of EBP Database, as well as government sources such as the CDC and CMS websites. It also included foundational and

seminal sources 1985 to the present, and current peer-reviewed literature from 2010-2015. The following search terms were used: *Ventilator-associated pneumonia, VAP, VAP bundle, oral care, hospital-acquired infection, prevention, and nosocomial.*

VAP Bundle

The most current guidelines for VAP prevention focus on the components of the "ventilator bundle," a group of interventions supported by research to decrease the rates of VAP and other complications common in ventilated patients (IHI, 2012). Two elements of the bundle are not intended to actually prevent VAP but to improve the overall care of the ventilated patient, namely deep vein thrombosis (DVT) prophylaxis and peptic ulcer disease (PUD) prophylaxis. The remaining components of the IHI bundle are elevation of the HOB to 30-45 degrees; daily interruption of sedation and assessment of readiness for weaning; and, added in 2010, routine daily mouth care using chlorhexidine. Sedwick, Lance-Smith, Reeder, & Nardi (2012) implemented the complete IHI bundle with the addition of mouth care every 2 hours (in addition to chlorhexidine daily); an alarm to prompt nurses if the HOB was less than 30 degrees; a handwashing protocol that required hand hygiene before and after care, and glove wearing during care; and subglottic suctioning via specialized endotracheal tubes with a suction port above the cuff; along with compliance monitoring and feedback to staff. Staff training on all components of the VAP prevention bundle was included as part of the project. These interventions decreased the VAP rate from 9.47 to 1.9 cases per 1000 ventilator days .

In a handbook published online by the Agency for Healthcare Research and Quality (AHRQ) for promoting healthcare safety, Kleinpell, Munro and Giuliano (2008) discussed evidence-based strategies for prevention of hospital-acquired pneumonia, including VAP. They

reported that hand hygiene is an important component for reducing hospital-acquired pneumonia. Other evidence-based recommendations from this study as they relate to VAP prevention included elevation of the HOB from 30-45 degrees; daily assessment of readiness for extubation; management of oropharyngeal secretions and oral care to minimize bacterial colonization and formation of biofilm; educating staff on prevention strategies; formation of a multidisciplinary team focused on VAP prevention; and communication to trigger and remind staff about the importance of VAP prevention. These recommendations converge well with those of the IHI ventilator bundle.

Hand Hygiene

The CDC (2002) and WHO (2009) have long promoted the importance of hand hygiene in prevention of hospital-acquired infections, and recommend direct monitoring of compliance. Koff, Corwin, Beach, Surgenor, & Loftus (2011) were able to show a nearly 50% reduction in VAP cases after implementation of an intensive hand hygiene program. Similarly, a study that examined the effect of chlorhexidine bathing and enhanced hand hygiene showed a significant decrease in ICU patient infection rates (Martínez-Reséndez et al., 2014).

Oral Care

With regard to oral care practices, a recent systematic review revealed that there is no clear consensus about the optimal protocol for oral care. Hillier, Wilson, Chamberlain, & King (2013) found that chlorhexidine was the most commonly used oral care product, but there was no standard for concentration or method of application. They found further that the most important factors for reducing VAP were having a standard oral care protocol, ongoing education of nurses, and evaluation of the program. Munro, Grap, Jones, McClish, & Sessler (2009) enrolled

ventilated patients in a randomized, controlled trial to receive mouth care with either chlorhexidine twice daily, toothbrushing three times daily, both together, or usual care. They found that chlorhexidine significantly reduced VAP in patients without pneumonia at baseline ($p = .006$), whereas toothbrushing did not, nor did it enhance the effect of chlorhexidine. In addition, a systematic review of oral decontamination for VAP prevention (Li, Xie, Li, & Yue, 2013) found that decontamination of the oral cavity with antiseptics (chlorhexidine or povidone-iodine) or antibiotics significantly reduced the incidence of VAP (risk ratio (RR) for antiseptics 0.66, 95%, confidence interval (CI) 0.49-0.88; RR for antibiotics (except iseganan) was 0.27, 95%, CI 0.18-0.42). A recent systematic review (Shi et al., 2013) reported moderate level evidence that a chlorhexidine rinse or gel resulted in significant reductions in VAP versus placebo or usual care (odds ratio (OR) 0.60, 95 % CI, 0.47-0.77, $p< .001$; number needed to treat (NNT) to prevent one episode of VAP = 15). Interestingly, neither Li et. al (2013) nor Shi et. al (2013) found any significant difference in mortality, ventilator days or ICU stay. These results clearly support the inclusion of chlorhexidine rinse as a component of care for VAP prevention.

Backrest Elevation

HOB elevation has also been shown to be an effective intervention for the prevention of VAP. In their systematic review of VAP prevention strategies, Collard, Saint, & Matthay (2003) found that there was relatively high-level evidence that a semi-recumbent position significantly reduced aspiration or VAP. Metheny, Davis-Jackson and Stewart (2010) additionally found that implementing an aspiration risk-reduction protocol in ventilated patients that included backrest elevation of 30 degrees or higher, along with feeding tube placement into the distal small bowel

versus usual care, resulted in a much lower pneumonia rate of 19%, vs. 48% before instituting the protocol.

Subglottic secretion suctioning

In accordance with the idea that aspiration of contaminated secretions contributes to development of VAP, the use of specialized endotracheal tubes that include an additional opening above the cuff attached to an external port to allow either continuous, intermittent or manual suctioning of subglottic secretions has been evaluated. A meta-analysis of randomized trials found that the use of these devices reduced VAP by nearly half (Dezfulian, et al., 2005), mostly by reducing early-onset pneumonia; however, it was also shown to decrease intubation by two days and ICU stay by three days, and delayed onset of pneumonia in longer-term intubations by 6.8 days. A more recent systematic review of RCT's of the effectiveness of subglottic secretion suctioning for preventing VAP also found consistent evidence of its effectiveness (Scherzer, 2010). No complications to subglottic secretion suctioning were found in either this or the Dezfulian et.al. (2005) study. Implementing this strategy requires purchase and use of specialized endotracheal tubes, which may incur additional cost; however, an analysis by Dezfulian et. al (2005) showed a potential savings of $3535 per case of pneumonia avoided.

Limiting duration of ventilation

Interventions to limit the duration of ventilation are an important part of the ventilator bundle, given that the incidence of VAP increases with the duration of mechanical ventilation as does mortality with later-onset VAP. Strategies include using non-invasive positive pressure masks to avoid intubation, and protocols to facilitate weaning from the ventilator (ATS Documents, 2005). Daily sedation "vacations", or decreasing the amount of sedation to allow the

patient to awaken and be evaluated for readiness to wean from the ventilator each day, was found by Kress, Pohlman, O'Connor & Hall (2000) to significantly reduce the length of time a patient is intubated, from 7.3 to 4.9 days, as well as decreasing the ICU stay from 9.9 to 6.4 days. A randomized controlled trial of a daily awakening from sedation combined with a spontaneous breathing trial (SBT) protocol versus sedation per usual care with a daily SBT resulted in 3.1 days more of unassisted breathing, 3.8 fewer days in ICU and were discharged from the hospital 4.4 days sooner in the intervention group. Patients receiving the intervention also were less likely to die, with a number needed to treat of 7.4 to prevent one death (Girard et. al., 2008).

Summary of Literature on the VAP Bundle

Despite the availability of clearly defined strategies that have been shown to be effective in reducing the incidence of VAP, nurse compliance with the recommendations is not consistent (Jansson, Ala-Kokko, Ylipalosaari, Syrjala, & Kyngas, 2013). The reason for this may be a lack of knowledge about the etiology of VAP or the bundle strategies, or of the rationale for specific interventions. In a recent survey of critical care nurses, Jansson et al. (2013) found that knowledge levels on EBP practices for VAP prevention were low, and nurses cited a lack of resources or disagreement with guidelines as the main barriers to implementation of the recommended strategies. Educating nurses on the ventilator bundle as part of a project to fully implement the IHI VAP prevention bundle is an effective way to support change and improvement.

Conceptual Model/Theoretical Framework

In keeping with the IHI's (2012) recommendations for implementing the ventilator bundle, the Model for Improvement (IHI, 2014) will be used to guide the implementation of this

project. The model consists of two parts: the asking of three fundamental questions and executing the Plan-Do-Study-Act (PDSA) cycle. The three questions involve deciding what is to be accomplished; determining the measures that will indicate improvement; and selecting the strategies that will lead to improvement. In the PDSA model, a change is planned, then implemented, results are studied, and then the change is refined and the cycle can begin again. After completing the cycle several times, the change may be expanded and disseminated to other settings or organizations.

In the application of the first phase of the model, goals for what is to be achieved must be identified. The goal for this project is that the VAP and VAE rates will be maintained at zero cases per 1000 ventilator days through 100% compliance with the ventilator bundle for 90% of the ventilator patients within one year. The strategies that will lead to improvement are enumerated in the IHI (2012) VAP bundle and include specific recommended actions for each of the five elements. For example, for the bundle element concerning daily oral care with chlorhexidine, one of the IHI-suggested actions is to ensure that a comprehensive process for oral care that incorporates chlorhexidine oral rinse is in place. Accordingly, a new oral care protocol, which is in compliance with current evidence-based recommendations, will be initiated in conjunction with the project. Information on the protocol will be included in the educational program for the nurses. The measures that will indicate improvement include the results of data collection. For each day of the study, this will include an assessment of the ratio of patients for whom all five bundle elements were performed, over the total number of ventilator patients for the day. The data can be trended over time to give feedback to the nurses as to whether the changes have been effective.

The PDSA cycle for implementing change begins with planning, selecting where the change will take place and whom will be included on the team. As there is only one ICU at the facility, this will be the venue for the change. Besides myself and the unit's nurse manager, there will be involvement of the medical director, pharmacist, respiratory therapy department, and unit nurses. I plan to identify one day shift and one night shift nurse and respiratory therapist as resource staff for the project. Nurses and therapists work together to care for the ventilator patient, and collaborate closely to assess readiness for weaning from the ventilator, as well as carrying out the spontaneous breathing trials. The pharmacist has been involved in facilitating the availability of chlorhexidine oral rinse in unit doses, with bar-code scanning labels. The rinse had not previously been on the formulary, and the bar-code scanning ability will enable tracking of compliance with dosing. The unit's medical director is another key person, who supports the change and can help reinforce with the other medical staff the importance of ensuring that orders are entered for the patient in compliance with the VAP bundle. Planning also includes preparing an educational program for nurses, to promote their understanding of the need for change, and facilitate their understanding of how to accomplish the change.

The next step of the PDSA cycle is to put the plan into action. The IHI (2012) recommends starting with one patient upon intubation, ensuring that all nurses caring for the patient understand the VAP bundle and are able to carry it out from shift to shift. Feedback on the experience is used to improve the process, which is then expanded to every intubated patient. Once the process is fully implemented, the "study" portion of the PDSA cycle calls for data collection on VAP bundle compliance as outlined above, and on VAP/VAE rates. The VAE rates are included because although the ultimate goal is VAP prevention, VAE rates are reportable to

the National Healthcare Safety Network (NHSN) (Centers for Disease Control, 2013), and affect future reimbursement rates under CMS guidelines. Finally, the results of data collection will guide what further revisions need to be made. These results will be graphed on a run chart and shared with the nursing staff, to help motivate them to continue to improve.

Summary of Literature Review

As been shown in this subsection, there is strong support for the strategies outlined in the IHI (2012) ventilator bundle. Educating staff on the rationale and importance of each component of the bundle as part of an evidence-based practice project is a strategy that has been successfully employed for VAP prevention (Hutchins, Karras, Erwin, & Sullivan, 2009; Sedwick, Lance-Smith, Reeder, & Nardi, 2012). Following the IHI's improvement model will support the likelihood of success of the project by providing a guiding framework for the activities.

Section 3: Approach

Introduction

The purpose of this project is to determine the effect of an evidence-based VAP educational program on actual and documented ICU nursing care practices for preventing VAP. Implementation of an evidence-based practice project can take a variety of forms (White, 2012). According to White and Zaccagnini (2011), an evidence-based practice project should include structured and thorough data collection, as well as statistical analysis to determine the significance of the data and project outcomes. This section will describe the methodology of the study: design, data collection, population, data analysis and evaluation plans, and provisions for human subjects protection.

Project Design/Methods

A quasi-experimental, interrupted time-series design will be used. This design is used when observations as listed in the data collection checklist (see table 1 p.23) are recorded, then an intervention (the educational program) "interrupts" the data collection, data collection resumes after the intervention, and comparisons are made between scores before and after the intervention. This design is appropriate for practice-based interventions for which randomization and control group assignment would not be ethical because the known benefits of the intervention would be withheld from some participants (Handley, Schillinger, & Shiboski, 2011). In this case, the dependent variables will be the change in actual practice related to the VAP/VAE prevention bundle and hand hygiene, and documentation of the bundle components after the educational intervention. The independent variable is the educational intervention. The

rates of VAEs and VAP per 1000 ventilator days will also be compared for the 3 months before and for 3 months after the intervention.

Population and Sampling

This project will involve all full-time, part-time and unit-specific per diem critical care nurses working within a seven-bed adult ICU of a community hospital in upstate New York. Employed in this unit are 15 full-time, 2 part-time and 2 per diem nurses. There is one part-time nurse on each shift, and one per diem nurse on each shift. The nurses range in age from 28–63. The majority of the nurses possess an Associate's degree as their highest nursing degree. One nurse on each shift has a Bachelor's degree. A full-time day nurse and the per diem night nurse have Master's degrees. Their years of RN experience range from 5–35 years and ICU experience from 2–35 years.

The nurses will be given an educational program in the form of a power point slide show, to be accessed via the facility's intranet system. Included in this slide show will be information about how VAP/VAE is defined; the risk factors for VAP/VAE; the importance of VAP/VAE prevention; the components of and rationale for the ventilator bundle elements; and strategies for successful implementation of the bundle. I will explain and expand on the content. Data related to VAP/VAE will be collected on all ICU patients who remain intubated more than 24 hours.

To evaluate the educational program, their satisfaction with the program will be assessed using a survey of the type commonly administered after educational activities (see Appendix C). It will ask participants to indicate whether they agree or disagree with statements on a Likert-type scale. Open-ended questions will also be included to request comments on what would make this course better and what additional information is needed. The survey would be given

immediately after each participant completed the training and any feedback incorporated in a formative fashion. Any additional information that is deemed needed to add to the program will be communicated to any participants to whom it had not originally been included.

Data Collection

Electronic medical records for all intubated patients admitted to the unit for the 3 months before the intervention and 3 months after the intervention will be audited for documentation of the frequency of oral care and whether chlorhexidine rinse was used, how many hours per day the head of the bed was elevated to 30-45 degrees, whether patient had a daily sedation vacation and assessment of readiness for extubation, and if not, whether there was a documented contraindication. Compliance with the additional bundle measures concerning deep vein thrombosis (DVT) and peptic ulcer disease (PUD) prophylaxis will also be tracked, since these are components of the IHI (2012) ventilator bundle, all of which should be included in a comprehensive approach to care for the ventilated patient. Compliance with the bundle will be counted as complete only if all five components have been met. If there is a documented contraindication to a component that was not done, compliance will still be affirmed. The results will be compared on the same measures for the 3 months after the intervention. In addition, observations will be made of VAP bundle-related care being given to one ventilated patient in the unit twice each week during the first hour of each 12-hour shift for four weeks prior to the intervention and in the final four weeks of the project to verify the accuracy of the associated documentation. Information on the usage levels of oral care kits per ventilator day for 3 months before and 3 months after the educational intervention will also be collected by auditing stockroom orders as a proxy measure of the frequency of oral care provided. In terms of

outcomes, the rates of VAEs and VAP will be compared for the period of 3 months before and 3 months after the intervention.

Descriptive statistics on the characteristics of the nurses, including age, sex, their educational attainment level, number of years as an RN, years in critical care, and length of time employed at the facility and in the unit, will be included in a table. In addition, data will be collected on actual practices of nurses involving the oral care elements of the ventilator bundle and hand hygiene during 1-hour observations, with the use of a checklist (see Table 1). A score will be calculated on what percentage of the observations the practices were carried out to the levels expected according to the oral care protocol and ventilator bundle (IHI, 2012), as well as the WHO (2009) hand hygiene recommendations.

In addition, data will be collected through chart review on each ventilated patient using a data collection form (see Appendix D) on their duration of intubation, ICU and hospital length of stay, and whether they died before discharge. A score on the Acute Physiology and Chronic Health Evaluation II (APACHE II) classification system (Knaus, Draper, Wagner, & Zimmerman, 1985) will also be calculated for each patient on the day of initiation of mechanical ventilation, to enable comparison of patient acuity before and after the intervention (see Appendix E). This scale assigns points for indicators of acute physiological dysfunction, such as serum creatinine and temperature, and also for the patient's age, and presence of chronic health conditions. The APACHE II has been shown to be a valid predictor of 30-day mortality in patients with VAP (Zhou, Ben, Chen, & Ni, 2014). The data collection form will also record whether the patient had a daily sedation vacation and assessment of readiness for extubation, as well as DVT and PUD prophylaxis (or documented contraindication), the documented frequency

of oral care and number of hours that the HOB elevation was between 30 and 45 degrees each day of intubation, beginning at 24 hours after intubation and continuing until extubation.

Protection of Human Subjects

Human subject protection will be provided through the institutional review board (IRB) of Walden University (IRB approval number 06-05-15-0414936). A data use agreement was also granted by the agency in which the project is to take place. In addition, since it is an evidence-based practice improvement project, nurses involved in the process will not need to give consent (Terry, 2012). To protect privacy, no information that could be used to identify a patient or nurse will be collected. A separate file will be kept to link the patient and nurse information to a number on the data collection form and the files will be kept secure and confidential in a password-protected computer within the hospital.

Table 1

Data Collection Checklist

Observation #____ Nurse # _____ Patient # _____ Circle: Pre- or Post-education

1. Oral care	yes	no
Deep suctioning of oral cavity/pharynx		
Brush teeth with suction toothbrush		
Swab with chlorhexidine		
2. Head-of-bed elevation between 30-45 degrees		
Actual elevation (degrees)		
3. Hand hygiene		
Performed on entering the room		
Performed on leaving the room		
Gloves worn for oral care		

Data Analysis

Data analysis will consist of paired *t* tests, to compare the mean compliance rates of the nurses with each element of oral care and hygiene practices as noted on the data collection form before and after the intervention (Grove, Burns, & Gray, 2013). Paired *t* tests will also be performed on the questions of whether there was a difference in rates of patients having a daily sedation vacation and assessment of readiness for extubation, and were given DVT and PUD prophylaxis, and if they did not, whether there was a documented contraindication. The mean duration of ventilation, mean ICU length of stay and hospital length of stay, mortality before discharge, and rates of VAP and VAEs per 1000 ventilator days before as compared to after the intervention will be analyzed using ANOVA. Descriptive statistics will be used to characterize the nurses on the variables of age, years of RN and critical care experience, educational attainment, and years of employment in the unit, through use of frequency distribution tables. Grouped frequency distribution tables will be used to categorize the nurses' ages in 10-year increments (e.g., age 20-29, 30-39, etc.) by number and percentage in each category. Years as an RN, years in critical care and years working in this unit will be grouped in 5-year increments (0-4 years, 5-9 years, etc.). Number and percentage of nurses with each level of educational attainment (from Associate's to Master's) will also be displayed in tabular form.

Project Evaluation Plan

The goals, objectives and activities of the evaluation plan will need to include elements of performance measurement, monitoring, and overall evaluation of the project (Kettner, Moroney, & Martin, 2013). These may include formative and summative strategies, as well as process, impact and outcome evaluations (Hodges & Videto, 2011). As such, it is an ongoing

process throughout the project that seeks to determine whether the project is being implemented according to the intended design, whether it is accomplishing its intended goals, is cost-effective, and whether the outcomes can be attributed to the program. The specific activities will coincide with data collection to be carried out for the program. The types of data that can be sources of measurable changes attributable to the program may include numeric counts, standardized measures, level of functioning scales, and client satisfaction (Kettner, Moroney, & Martin, 2013).

Monitoring activities relate to formative evaluations of the processes of the project to evaluate fidelity to the intended design. To evaluate the effectiveness of the educational program, changes in observed and documented compliance with elements of the VAP/VAE prevention bundle will be monitored throughout the project. This will be done by sharing the results of the data collection checklist of observed activities (see Table 1) as well as data on the client data collection form (Appendix D), to give nurses feedback on their performance in a formative fashion to allow them to take corrective action. The data will also be summarized weekly and provided in the form of a "dashboard" to give the nurses information about performance in the unit overall.

Overall evaluation of the project involves a summative determination of the impact on short and long-term goals of the project, and whether it achieved its objectives. Objectives related to the overall goal include that all ICU nurses will perform and document 100% of recommended nursing actions for VAP prevention and that VAP/VAE cases will be maintained at zero cases per 1000 ventilator days. The evaluation is accomplished by comparative analysis of these data before and after the educational intervention and the implementation of the

program. Cost effectiveness will also be analyzed relative to the cost of additional patient care supplies compared to the cost savings of each VAP or VAE case avoided.

Summary

The methods outlined for the project are intended to determine the effects of an educational program on the VAP prevention practices utilized by nurses. By observing the nurses' care practices and examining their documentation both before and after the educational program, comparisons can be made to discern whether their compliance with the recommended practices increases. Also important to analyze are data on nurse and patient demographics, patient acuity, and nurse satisfaction with the educational activity.

The development of VAP or VAEs can result in significant morbidity, mortality and potential costs in both financial and human terms for critically ill ventilated patients (Ibrahim, Tracey, Hill, Fraser, & Kollef, 2001). Currently, knowledge of and compliance with the policies and practices included in the ventilator bundle is not consistent among nurses. If critical care nurses are educated about the risks for and importance of preventing these infections, and are knowledgeable about the measures shown to be effective for prevention, they will be more likely to employ them. If they do, this will provide patients with the best possible scenario for avoidance of potentially devastating complications.

Section 4: Evaluation and Discussion

Introduction

The purpose of this project is to examine the effect of an evidence-based VAP educational program on the on the actual and documented ICU nursing care practices for preventing VAP. Additional purposes are to determine whether the nurses were satisfied with the knowledge gained from the educational program, and whether the severity of illness of the patients as measured by the APACHE II scale would differ from pre- to post-intervention. The project has two goals: at least 90% compliance with all five components of the ventilator bundle and maintenance of a zero rate of VAP for the duration of the project period. Because the project has not been fully implemented, there are no results to report. This section will discuss the potential for using the results in evidence-based practice.

Evaluation and Discussion

Before beginning the project, the oral care policy and protocol for patients on a ventilator was revised. It consisted only of providing oral care every 8 hours. The protocol revision called for oral care every 2 hours, and outlined specific steps to be followed. Second, it specified the use of chlorhexidine gluconate 0.12% rinse every 12 hours, as recommended by the IHI VAP prevention guidelines (2012). Since chlorhexidine gluconate had not previously been used in this hospital, it had to be added to the hospital formulary. A barcode for scanning was required to ensure the drug is properly documented in the EMR system. Accomplishing this was a major success of the project.

All physicians credentialed to write orders for ventilator patients were made aware of the availability of the drug and were encouraged to prescribe it for all ventilator patients. (The

practice is supported by the medical director of the ICU.) The new protocol calls for a nurse to contact the physician for orders or for clarification if the drug is not ordered initially for the ventilator patient. .

Although the new oral care protocol was introduced more than 6 months ago, some physicians are still not consistently ordering the chlorhexidine rinse for their ventilator patients. And although nurses were given the new protocol to read, they have not been trained on the overall VAP prevention bundle. This program is anticipated to be given through the hospital's intranet educational system, at the end of September, 2015.

A new EMR system was implemented prior to any project activities. It included a section for documenting the five practices of the ventilator bundle which will facilitate collecting evidence of compliance. Upon implementation of the project, the EMR will reveal the number of times per day chlorhexidine was administered to the patient, as well as whether the rest of the VAP bundle practices were implemented. The goal of the project will be considered to have been met if there was 100% compliance, meaning all five practices were completed on 90% of ventilator days.

The EMR also contains an order set for ventilator patients that includes options for inclusion of all the bundle elements. It can act as a checklist to prompt the ordering provider to elements that may otherwise be missed. Providers must be encouraged to use this bundle as opposed to ordering "ala carte" to allow for consistency. Nurses are also empowered via the oral care policy protocol to request an order from the provider for chlorhexidine rinse. In addition, the educational program for the nurses encourage them to document the five bundle elements and prompt the ordering provider should they find an element has not been addressed.

Observations of care being given are intended to determine whether the oral care procedures are being done according to the policy, and whether the documentation of the bundle elements accurately reflects care practices. Substantiation of whether documentation reflects actual practice is an important element for increasing the validity of the assumption that documented activities are actually being performed. Observations will be compared to documentation for the same period, and the accuracy of documentation will be assessed by calculating a percentage of documented versus observed care activities.

The educational program to be provided to the nurses consists of a power point presentation covering the definition of VAP, its risk factors, the importance of prevention, and prevention strategies. Narration of the presentation is included to provide more detail and to appeal to the auditory learner. The educational program is to be assigned to all ICU nurses through the facility's intranet platform for online educational offerings, and will be a required course. The course evaluation will be presented at the end of the activity. User tracking is available to verify that all nurses have completed the activity.

VAP rates at this facility for the 2 years prior to initiation of the project have remained at zero cases per 1000 ventilator days according to published data. There was concern that simplified reporting criteria enacted in January 2013 would result in increased likelihood of identification of cases. The expected effect of this project would be maintenance of this rate of zero cases. To date the rate of zero cases has been maintained in this unit.

Implications

Implementation of a VAP prevention bundle promises to keep secure the trend of zero cases of VAP despite more broad criteria for diagnosing it being adopted. In terms of the benefit

to patients, this project serves as an example of how the translation of research to practice is vitally important for improving care and preventing complications that are potentially avoidable. This is a step for positive social change, as it contributes to quality improvement and decreases in patient suffering and/or demise. In terms of policy, the project makes clear that an institution needs to have protocols and procedures in place that are in line with evidence-based practice advances. However, it is not enough to have the policies in place – educating the stakeholders on the rationales and basis in science of changes that are enacted are key to effecting lasting improvements.

Project Strengths and Weaknesses

The strengths of the project are first that it is based on accepted standards of evidence-based care. The IHI (2012) ventilator bundle has been widely used and multiple published accounts have demonstrated its effectiveness for reducing ventilator-associated pneumonia. The evidence continues to accrue. Righi et al. (2014) found a significant decrease in ventilator-associated pneumonia rates with implementation of a VAP bundle, which included chlorhexidine oral rinse.

An additional strength is that in focusing on an educational intervention for nurses, there is an opportunity for the involvement of the front line caregivers in improving the quality of care. Their role as a part of a collaborative team is emphasized through the educational program. By creating a collaborative team in which the contributions of the members is recognized and valued, a shared responsibility for the outcomes is developed (Ash & Miller, 2011).

One notable weakness is that although observations will be carried out to confirm the fidelity of documentation to actual practice, one cannot be present in all instances where care is

taking place. In addition, nurses who know they are being observed may perform differently than when they are not being observed, and so the observations may not accurately reflect actual practice. In addition, it is unknown what effect the change to the oral care protocol prior to the initiation of the project has had on the incidence of VAP. It may be difficult to determine whether the maintenance of zero VAP cases was due to the new oral care protocol, or to the educational program.

Future evidence-based practice or research projects would help further the study of the problem of VAP. One topic could be to determine what is the optimal frequency and method for oral care, other than using chlorhexidine. This is an undecided issue based on the current literature (Hillier, Wilson, Chamberlain, & King, 2013).

Analysis of Self

The role of the DNP is that of expert clinician, scholar, and change agent in the promotion of advanced nursing practice (Tymkow, 2011). The evidence-based practice project can be seen as the culmination of the knowledge gained in the program of study and its practical application in the clinical practicum. The DNP Essentials (2006) call for the application of clinical scholarship and analysis of data to help design interventions and programs that are evidence-based. This translation of research into practice is a major role of the DNP and is a key to improving outcomes for patients and the health care system overall (IOM, 2001). Through in-depth inquiry in an area of clinical importance, the DNP takes a scholarly approach to a problem and uses leadership skills to bring about change in an organization. With regard to these definitions, I have had successes, but also a few missteps that have served to stimulate my development.

The DNP Essentials document (American Association of Colleges of Nursing, 2006) describes the advanced practice competencies of the DNP graduate as developing specialized expertise in a particular area of advanced practice, through the application of knowledge in the varied areas of physical and social sciences. These competencies extend across a variety of specialties and patient care settings, and include the ability to evaluate evidence-based care taking a systems view, as well as educating and mentoring others toward promoting optimal health outcomes. The DNP project has been the main vehicle for me in achieving these goals. Not only has it helped me to learn how to evaluate literature for best practices in relation to a clinical issue, but it also incorporated translation of this evidence into nursing care improvements, as well as the teaching and mentoring of the nursing staff who will ultimately be tasked with enacting the changes.

Leadership can be described as the ability to motivate and guide others toward the achievement of goals, through communication of vision and values (Ezziane, 2012). Through my experiences with leadership in the project, I have pushed out of my comfort zone to assume the responsibility for setting the tone and providing the vision for the need for change. Having to develop my own voice to communicate a larger picture of what can be accomplished in order to facilitate change in the organization is probably one of the most valuable skills that I have developed. My confidence in this area has increased tremendously and I now feel that the possibilities are limitless for being able to effect change in any organization.

In terms of project management, since the project has not yet been implemented, it remains to be seen how successful the effort will be. Through the preliminary steps that have been taken so far, there has been some success, but work remains to be done. According to

Harris & Roussel (2011), successful project planning and management requires one to be flexible and adaptable, and include stakeholders in the process early on. While the medical director has supported the project from the beginning, other physicians have not been fully on board. This will need to be addressed going forward, and will involve educating these stakeholders through presentation of the evidence on which the project is based. In addition, once implementation begins, adjustments may need to be made based on input from the nurses involved. In an effort to fully engage them, it will be important to recognize their value and expertise toward the successful implementation of the project.

Summary and Conclusions

This project's goal is to prevent VAP by way of an educational program for nurses on the ventilator-associated pneumonia prevention bundle, along with implementing a new oral care protocol. Data showing nurses' compliance with the bundle elements, and high levels of satisfaction of the nurses with the education received, can be construed as evidence of success of the project. The VAP prevention bundle is now the standard of care nationally, as supported by numerous research studies and the endorsement of several agencies that are concerned with the quality and safety of patient care: Institute for Healthcare Improvement (2012), Healthcare and Infection Control Advisory Committee of the CDC (Tablan, Anderson, Besser, Bridges, & Hajjeh, 2004), CMS (, 2013), and the Society for Healthcare Epidemiology of America (2014). The value of showing adherence to these guidelines is evident in that it reflects the commitment of the facility to maintaining the highest standards of evidence-based practice. This is especially relevant because the future of health care promises to reward those organizations that are successful in protecting their patients from preventable harms.

Section 5: Scholarly Product for Dissemination

Project Summary

Introduction

The project, entitled "Ventilator Associated Pneumonia Prevention Bundle" is a quality improvement project aimed at educating Intensive Care nurses on the prevention of ventilator-associated pneumonia (VAP). The education focused on the risk factors and prevention strategies for VAP, and on the ventilator 'bundle", a group of interventions that when performed together have been shown to reduce the incidence of VAP (Institute for Healthcare Improvement, 2012). The project was designed to answer the following questions: 1) What is the effect of an educational program focused on VAP prevention guidelines, rationales, and strategies on critical care nurses' compliance with the VAP prevention bundle, as measured by observed and documented oral care with chlorhexidine per protocol, elevation of the head of the bed to 30 - 45 degrees, daily sedation vacations and assessment of readiness for extubation; 2) Will the education result in the maintenance of a rate of zero cases of VAP and VAEs per 1000 ventilator days for the 3 months after the educational intervention; 3) What will be the nurses' level of satisfaction with the educational program; and, 4) Will there be a difference in the severity of illness as measured by the APACHE II score for patients enrolled before the intervention versus after the intervention?

Project Purpose and Outcomes

The purpose of the project was to determine the effect of an evidence-based VAP educational program on actual and documented ICU nursing care practices for preventing VAP. The practices for this project derive from the Institute for Healthcare Improvement's (IHI's)

(2012) “ventilator bundle” (VB) that consists of the following five interventions: 1) Performing oral care with chlorhexidine gluconate oral rinse every 12 hours; 2) Maintain the head of the bed at 30-45 degrees; 3) Ensure a daily “sedation vacation” in order to assess patient readiness to wean from the ventilator; 4) Provide prophylaxis for deep vein thrombosis; and, 5) peptic ulcer disease prophylaxis. Education is provided to the ICU nurses by use of a slide show that includes information about how VAP/VAE is defined; the risk factors for VAP/VAE; the importance of VAP/VAE prevention; the components of and rationale for the ventilator bundle elements; and strategies for successful implementation of the bundle. It includes narration by to explain and expand on the slide content, which also reviews the oral care protocol in depth.

A secondary project purpose was to determine the effect of the educational program on the outcome of cases of VAP and Ventilator-Associated Events (VAEs). Although the IHI bundle (2012) addresses only VAP, VAEs are included in this project as an outcome because as of January 2013, they are reportable to CMS, and in the future may result in reduced payments to hospitals under pay-for-performance computations. The objective of the implementation of this project was to avoid the preventable complication of VAP and VAEs, maintaining a rate of zero cases per 1000 ventilator days. This project has not yet been implemented. A new oral care protocol was developed that included chlorhexidine gluconate oral rinse in preparation for the project and assigned to be read by the nurses. When the educational program is assigned in late July 2015, renewed emphasis on the new oral care protocol will be included.

Theoretical Framework

The Model for Improvement (Institute for Healthcare Improvement, 2014) was used to guide the implementation of this project. The model consists of two parts: the asking of three

fundamental questions and executing the Plan-Do-Study-Act (PDSA) cycle. The three questions involve deciding what is to be accomplished; determining the measures that will indicate improvement; and selecting the strategies that will lead to improvement. In the PDSA model, a change is planned, then implemented, results are studied, and then the change is refined and the cycle can begin again. After completing the cycle several times, the change may be expanded and disseminated to other settings or organizations. This model, which was developed by the same organization that developed the ventilator bundle, is well suited for the project because the implementation of a practice change such as this requires refinement of the approach as experience is gained. The expected outcomes of the project are that the new oral care protocol is followed consistently by the nursing staff; that all VAP bundle elements are reliably performed and accurately documented; and that a zero rate of VAEs and VAP will be maintained.

Implications for Practice

This project is intended to provide ICU nurses with the ability to make evidence-based care decisions, and to monitor compliance with the VAP bundle. Clinicians have a responsibility to provide evidence-based care aimed to improve patient outcomes and to reduce patient risk for harm. The interventions included in the educational program have been the standard of care nationally for several years, and to neglect instituting them represents a failure of the organization to ensure the highest quality of care to their patients.

Specific implications for practice attributable to the project include several benefits. First, prevention of VAP can be financially advantageous to the institution, since VAP is considered preventable by CMS (Centers for Medicare and Medicaid Services, 2013), which will not reimburse the costs of care. Secondly, benefits to patients may include decreased ventilator days,

ICU and hospital stays (Metheney, Davis-Jackson, & Stewart, 2010), and even fewer deaths (Girard, et al., 2008). Finally, nurses may report increased satisfaction with their level of knowledge regarding VAP prevention as a result of the educational program. Patient satisfaction may increase owing to decreased complication rates and lengths of stay, which in turn can have positive effects on nurse satisfaction.

Plans for Dissemination

Once the educational program has been presented to the nurses within the ICU of the one facility, results of the satisfaction surveys and the feedback of the nurses will be incorporated and any needed changes to the program will be initiated. Since this facility is part of a larger health system, and has two sister hospitals, the educational program will be extended to include the other hospitals as well. Currently neither of the other hospitals has in place a policy and procedure for VAP prevention that includes the evidence-based components of this project, such as using chlorhexidine oral rinse. Consequently, these hospitals lag behind in implementation of the national standard of care. The new EMR contains the outline of a procedure which should facilitate the project. When implemented, the project operationalizes the full development of the policy and procedure to bring the facility into compliance with current guidelines.

In terms of a wider dissemination of the project, the project summary can be presented at a nursing conference via a poster board presentation (see Appendix G) including the results of the data analysis after project completion. Two possible candidate conferences include the American Nurses Credentialing Center Pathway to Excellence conference in April 2016 (American Nurses Credentialing Center, 2014), or a Contemporary Forums conference, which are offered in several specialty areas, including critical care (Contemporary Forums, 2015). In

addition, submission to a journal such as Critical Care Nurse or the American Journal of Infection Control is planned for publication of the project and results. Through these media, the project imparts national and global impact toward the goal of promoting evidence-based practice through clinical scholarship as called for in the DNP Essentials document (American Association of Colleges of Nursing, 2006).

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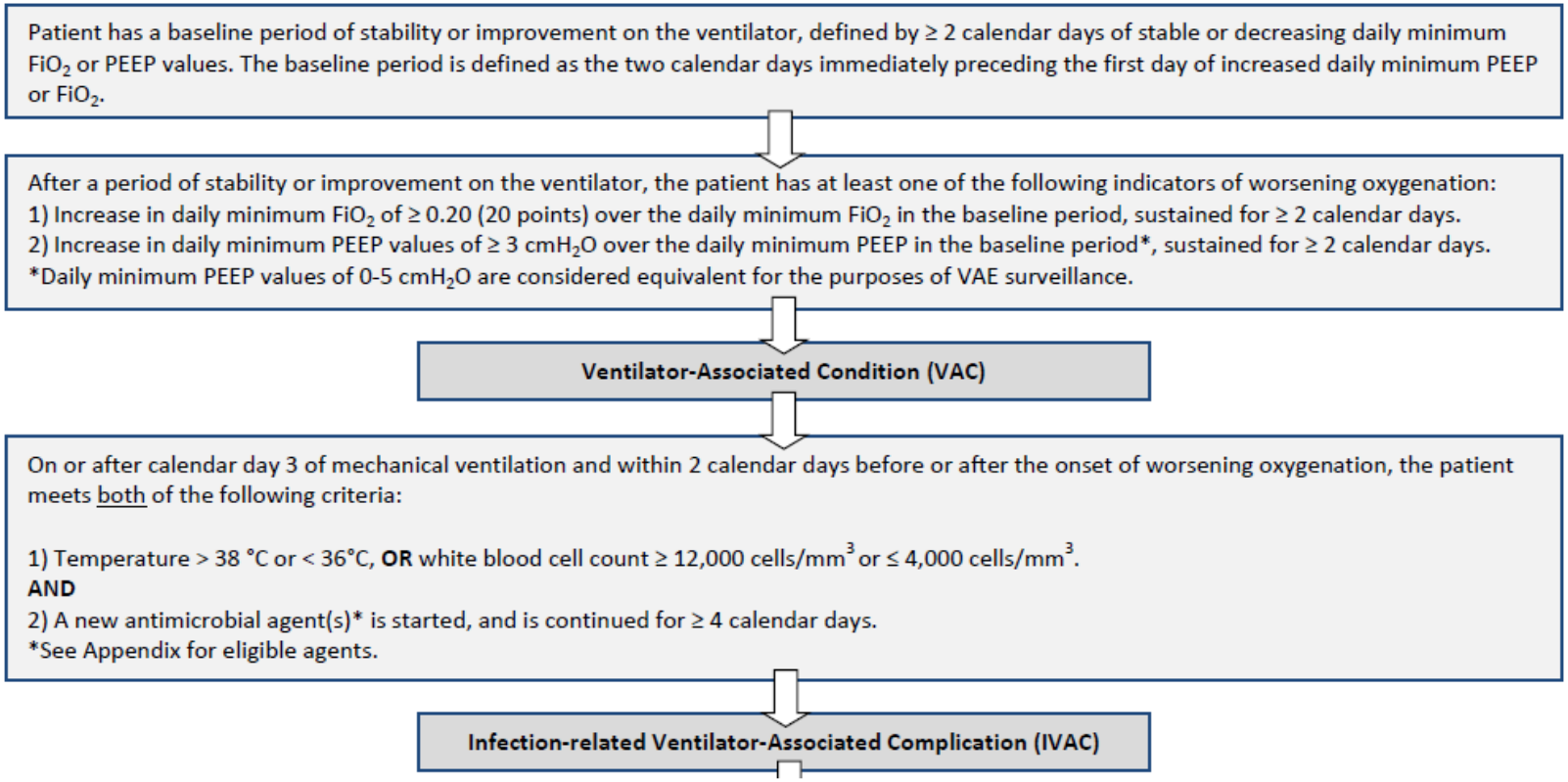
Appendix A. Ventilator-associated events surveillance algorithm



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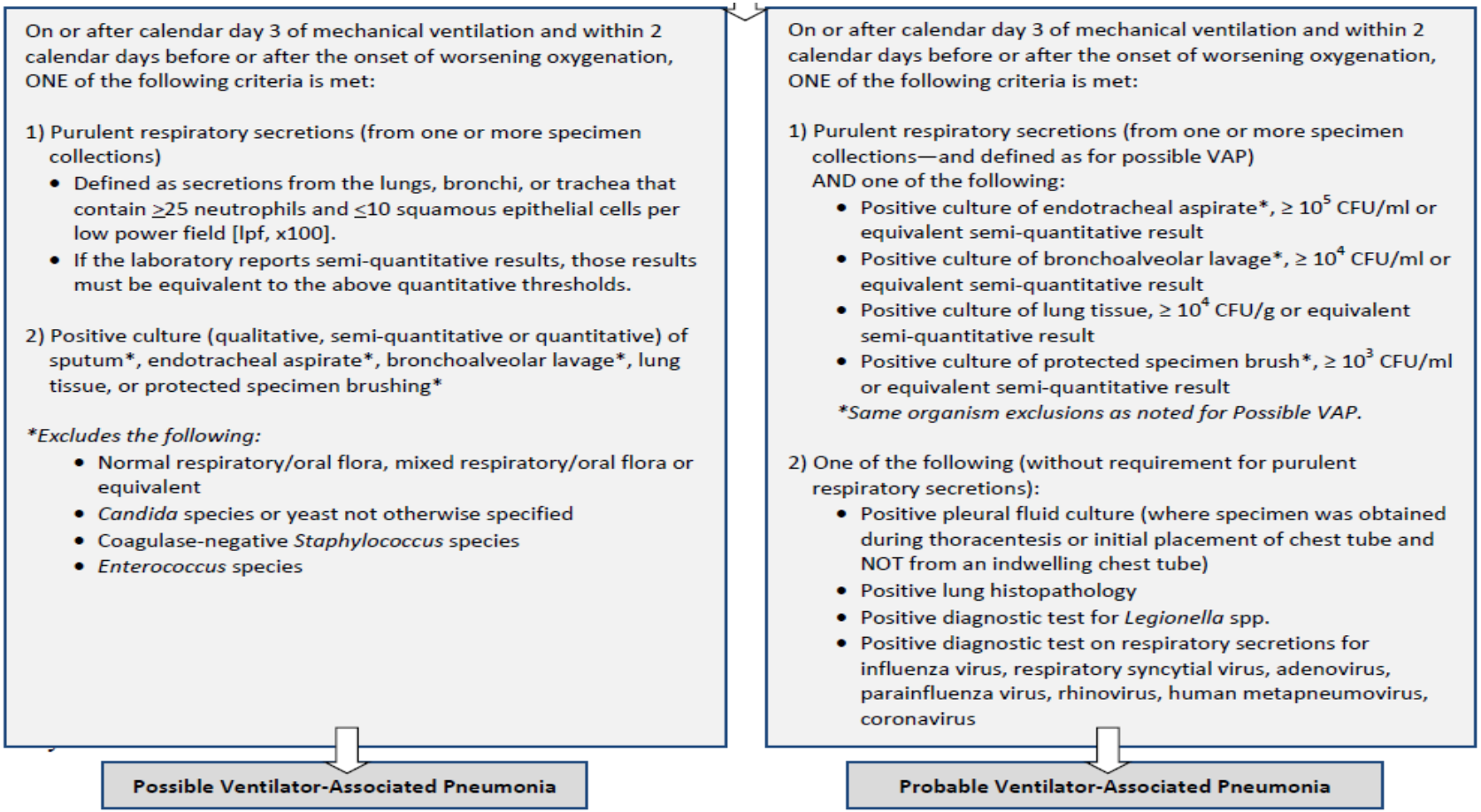

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Appendix B. Oral Care Policy

Topic:	Code No.	Date: 9/14
ORAL CARE OF PATIENT ON A VENTILATOR		
Area: **NURSING**	Page 1 of 5	**Approved by:** Nursing Professional Practice Task Force **Approved by:** VP Patient Care Services

PURPOSE

To promote safety by:

Standardization of oral care practices according to evidence-based guidelines

Prevention of ventilator-associated events (VAE) and ventilator-associated pneumonia

POLICY

Patients on a ventilator will have oral care performed every 2 hours and as needed using the identified equipment and procedure noted below. Two of the episodes of oral care will include the use of chlorhexidine gluconate oral rinse.

ROLES & RESPONSIBILITIES

1. Vice President Patient of Care Services & Medical Director

   The Vice President of Patient Care Services, in collaboration with the Medical Director has overall responsibility for implementation of the oral care protocol.

2. Medical Staff

   Medical Staff and collaborating practitioners facilitate adherence to the protocol by initiating applicable orders for patients on a ventilator. They also cooperate with the facility's quality improvement, patient safety and risk management procedures.

3. Clinical Directors and Supervisors and Clinical Director of Staff Development

   Ensures that caregivers within the unit are provided with education and training on oral care protocols and equipment, and ensures that they are utilized appropriately. Identifies and reports potential barriers to implementation of the protocol.

4. Admitting/Staff Nurse

   a. The RN will verify that the patient has orders for oral care according to the protocol upon intubation.

   b. If there are no orders written for oral care, the RN will seek such orders through collaboration with the physician or provider for the patient.

   c. If the patient has contraindications to the protocol being implemented as specified, the nurse will notify the provider and document the reason.

   d. Is responsible for performing the oral care on the specified schedule and documenting it on the electronic medical record, including bar code scanning of the chlorhexidine rinse as ordered.

PROCEDURE

1. An assessment of the condition or the oral cavity, teeth, gums and mucosa should be documented on the Complex or Simple Assessment flowsheet every shift and whenever there is a change in status.

2. Oral care will be performed every two hours using the commercial oral care kit (Sage® Q Care Q 4 hour,) according to the procedure outlined in this policy and the Lippincott Manual under Critical Care: Oral Care for an Intubated Patient, available through the link:

   http://procedures.lww.com/lnp/view.do?pId=2349172

a. Two of the episodes of care daily will include the use of chlorhexidine rinse according to the following procedure:
b. Barcode scan chlorhexidine gluconate (Peridex) 15 mL as ordered on MAR.
c. Perform deep oropharyngeal suctioning using the long catheters supplied in the Sage® Q Care Oral Care Kit.
d. Open the package with the suction toothbrush by laying it on a flat surface and peeling back the top. Pour the chlorhexidine into the open package. Saturate the suction toothbrush with the solution and brush all surfaces of the teeth and tongue.
e. Saturate the applicator swab included in kit with chlorhexidine and coat all surfaces of teeth, tongue and gums. Suction any remaining fluid from the mouth. Do not rinse with water or apply mouth moisturizer.
f. The Sage® Q Care Q 4 hour kit provides equipment for 6 episodes of oral care per day, including 2 suction toothbrushes to be used with chlorhexidine application, 2 oropharyngeal catheters, and 4 kits containing a suction swab, Perox-a-mint® solution packet, and an applicator swab for applying mouth moisturizer. The moisturizer is to be used each time oral care is given EXCEPT those in which chlorhexidine is used.

3. For additional episodes of care (6 per day), single-supplied kits including a swab with Perox-a-mint® solution packet and an applicator swab with mouth moisturizer may be used (Sage®).

4. The plan of care for ventilated patients includes risk for ventilator-associated pneumonia as an identified problem. The nursing care plan is reviewed when the patient is assessed daily and the appropriate interventions are initiated according to the care plan

5. Patient/family education
    a. Determine what the patient and/or family knows about oral care and prevention of ventilator-associated pneumonia. Education is not complete until confirmation of patient and/or family understanding has been adequately obtained.
    b. Document teaching on the appropriate documentation flowsheet.

6. Documentation and Communication
    a. Document each episode of oral care performed using chlorhexidine on the flowsheet under the "adult ventilator-associated pneumonia bundle" documentation (every 12 hours). These rows may need to be "pulled in" from the cascading group (green arrow in trigger row) next to "Age-specific ventilator-associated pneumonia bundle" by selecting "Adult" from the cascade options.
    b. Document additional episodes of oral care (NOT using chlorhexidine) under the "PCT Daily Care" flowsheet in the "Hygiene" row (select "mouth care"), noting any unusual conditions or responses.
    c. Communicate any issues related to the patient's oral assessment and care, primarily through off-going and on-coming RN communication at the change of shift, and including respiratory care staff.

STAFF EDUCATION AND COMPETENCY

Staff education will be provided during initial orientation and annual reorientation.

INCIDENT REPORTS

Any Incident Reports of adverse events related to the oral care protocol will be completed in Quantros and forwarded as defined in the Patient Safety/Risk Management Plan.

PERFORMANCE IMPROVEMENT

Data on cases of ventilator-associated pneumonia and events will continue as per Infection Control procedure.

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Appendix C. VAP Prevention Post-Education Survey

Please rate your level of agreement with the following statements on a 5-point Likert scale:

1 = Strongly disagree 2= Disagree 3= Neither agree nor disagree

4= Agree 5 = Strongly agree

1. After the educational program, I developed a better understanding of the pathophysiology of VAP
   - 1. Strongly disagree
   - 2. Disagree
   - 3. Neither agree nor disagree
   - 4. Agree
   - 5. Strongly agree

2. I know the risk factors for developing ventilator associated pneumonia.
   - 1. Strongly disagree
   - 2. Disagree
   - 3. Neither agree nor disagree
   - 4. Agree
   - 5. Strongly agree

3. After the educational program, I better understand the importance of VAP prevention.
   - 1. Strongly disagree
   - 2. Disagree
   - 3. Neither agree nor disagree
   - 4. Agree
   - 5. Strongly agree

4. I am confident that I can apply the VAP bundle elements in the care of the ventilator patient
   - 1. Strongly disagree
   - 2. Disagree
   - 3. Neither agree nor disagree
   - 4. Agree
   - 5. Strongly agree

5. The instructional methods were effective for meeting the objectives of the course.
   - 1. Strongly disagree
   - 2. Disagree
   - 3. Neither agree nor disagree
   - 4. Agree
   - 5. Strongly agree

6. I am familiar with my unit's oral care protocol.

- 1. Strongly disagree
- 2. Disagree
- 3. Neither agree nor disagree
- 4. Agree
- 5. Strongly agree

What would make this course better?

_____
_____
_____

What additional information do you need to improve VAP-prevention in your unit?

_____
_____
_____

Please share any other comments you may have.

_____
_____
_____

Appendix D. VAP Prevention Project Client Data Collection Form

Patient number _____ Pre or Post Intervention (circle) Deceased yes no (circle) APACHE II score on day of intubation _____

Hospital admission date ____ Hospital discharge date _____Hospital length of stay ____

ICU admission date _____ ICU discharge date _____ ICU length of stay _____

Date of intubation _____Date of extubation _____ Days on ventilator _____

Ventilator day	# of hours HOB documented to be at 30-45º per 24h	# times oral care documented per 24 hours	# times chlorhexidine oral rinse used in oral care per 24 hours	Had sedation vacation or contraindication documented	Had assessment of readiness for extubation or contraindication documented	DVT prophylaxis or contraindication documented	PUD prophylaxis or contraindication documented	Compliance met
2				Yes No	Yes No	Yes No	Yes No	Yes No
3				Yes No	Yes No	Yes No	Yes No	Yes No
4				Yes No	Yes No	Yes No	Yes No	Yes No
5				Yes No	Yes No	Yes No	Yes No	Yes No
6				Yes No	Yes No	Yes No	Yes No	Yes No
7				Yes No	Yes No	Yes No	Yes No	Yes No
8				Yes No	Yes No	Yes No	Yes No	Yes No
9				Yes No	Yes No	Yes No	Yes No	Yes No
10				Yes No	Yes No	Yes No	Yes No	Yes No
11				Yes No	Yes No	Yes No	Yes No	Yes No
12				Yes No	Yes No	Yes No	Yes No	Yes No
13				Yes No	Yes No	Yes No	Yes No	Yes No
14				Yes No	Yes No	Yes No	Yes No	Yes No
15				Yes No	Yes No	Yes No	Yes No	Yes No
16				Yes No	Yes No	Yes No	Yes No	Yes No
17				Yes No	Yes No	Yes No	Yes No	Yes No
18				Yes No	Yes No	Yes No	Yes No	Yes No

19				Yes No	Yes No	Yes No	Yes No	Yes No
20				Yes No	Yes No	Yes No	Yes No	Yes No
21				Yes No	Yes No	Yes No	Yes No	Yes No
22				Yes No	Yes No	Yes No	Yes No	Yes No
23				Yes No	Yes No	Yes No	Yes No	Yes No
24				Yes No	Yes No	Yes No	Yes No	Yes No
25				Yes No	Yes No	Yes No	Yes No	Yes No
26				Yes No	Yes No	Yes No	Yes No	Yes No
27				Yes No	Yes No	Yes No	Yes No	Yes No
28				Yes No	Yes No	Yes No	Yes No	Yes No
29				Yes No	Yes No	Yes No	Yes No	Yes No
30				Yes No	Yes No	Yes No	Yes No	Yes No
31				Yes No	Yes No	Yes No	Yes No	Yes No
32				Yes No	Yes No	Yes No	Yes No	Yes No
33				Yes No	Yes No	Yes No	Yes No	Yes No
34				Yes No	Yes No	Yes No	Yes No	Yes No
35				Yes No	Yes No	Yes No	Yes No	Yes No
36				Yes No	Yes No	Yes No	Yes No	Yes No
37				Yes No	Yes No	Yes No	Yes No	Yes No
38				Yes No	Yes No	Yes No	Yes No	Yes No
39				Yes No	Yes No	Yes No	Yes No	Yes No
40				Yes No	Yes No	Yes No	Yes No	Yes No
	Total #/#days _____	Total #/#days _____	Total #/#days _____	Total Yes/No _____/_____	Total Yes/No _____/_____	Total Yes/No _____/_____	Total Yes/No _____/_____	
	Mean _____	Mean _____	Mean _____	% yes _____	% yes _____	% yes _____	% yes _____	

Appendix E. APACHE II Severity of Disease Classification System

PHYSIOLOGIC VARIABLE	HIGH ABNORMAL RANGE					LOW ABNORMAL RANGE			
	+4	+3	+2	+1	0	+1	+2	+3	+4
TEMPERATURE — rectal (°C)	≥ 41°	39°-40.9°		38.5°-38.9°	36°-38.4°	34°-35.9°	32°-33.9°	30°-31.9°	≤ 29.9°
MEAN ARTERIAL PRESSURE — mm Hg	≥ 160	130-159	110-129		70-109		50-69		≤ 49
HEART RATE (ventricular response)	≥ 180	140-179	110-139		70-109		55-69	40-54	≤ 39
RESPIRATORY RATE — (non-ventilated or ventilated)	≥ 50	35-49		25-34	12-24	10-11	6-9		≤ 5
OXYGENATION: A-aDO_2 or PaO_2 (mm Hg) a. FIO_2 ≥ 0.5 record A-aDO_2	≥ 500	350-499	200-349		< 200				
b. FIO_2 < 0.5 record only PaO_2					PO_2 > 70	PO_2 61-70		PO_2 55-60	PO_2 < 55
ARTERIAL pH	≥ 7.7	7.6-7.69		7.5-7.59	7.33-7.49		7.25-7.32	7.15-7.24	< 7.15
SERUM SODIUM (mMol/L)	≥ 180	160-179	155-159	150-154	130-149		120-129	111-119	≤ 110
SERUM POTASSIUM (mMol/L)	≥ 7	6-6.9		5.5-5.9	3.5-5.4	3-3.4	2.5-2.9		< 2.5
SERUM CREATININE (mg/100 ml) (Double point score for acute renal failure)	≥ 3.5	2-3.4	1.5-1.9		0.6-1.4		< 0.6		
HEMATOCRIT (%)	≥ 60		50-59.9	46-49.9	30-45.9		20-29.9		< 20
WHITE BLOOD COUNT (total/mm3) (in 1,000s)	≥ 40		20-39.9	15-19.9	3-14.9		1-2.9		< 1
GLASGOW COMA SCORE (GCS): Score = 15 minus actual GCS									
[A] Total ACUTE PHYSIOLOGY SCORE (APS): Sum of the 12 individual variable points									
Serum HCO_3 (venous-mMol/L) [Not preferred, use if no ABGs]	≥ 52	41-51.9		32-40.9	22-31.9		18-21.9	15-17.9	< 15

[B] AGE POINTS:
Assign points to age as follows:

AGE(yrs)	Points
≤ 44	0
45-54	2
55-64	3
65-74	5
≥ 75	6

[C] CHRONIC HEALTH POINTS
If the patient has a history of severe organ system insufficiency or is immuno-compromised assign points as follows:
a. for nonoperative or emergency postoperative patients — 5 points
or
b. for elective postoperative patients — 2 points

DEFINITIONS
Organ insufficiency or immuno-compromised state must have been evident prior to this hospital admission and conform to the following criteria:

LIVER: Biopsy proven cirrhosis and documented portal hypertension; episodes of past upper GI bleeding attributed to portal hypertension; or prior episodes of hepatic failure/encephalopathy/coma.

CARDIOVASCULAR: New York Heart Association Class IV.

RESPIRATORY: Chronic restrictive, obstructive, or vascular disease resulting in severe exercise restriction, i.e., unable to climb stairs or perform household duties; or documented chronic hypoxia, hypercapnia, secondary polycythemia, severe pulmonary hypertension (>40mmHg), or respirator dependency.

RENAL: Receiving chronic dialysis.

IMMUNO-COMPROMISED: The patient has received therapy that suppresses resistance to infection, e.g., immuno-suppression, chemotherapy, radiation, long term or recent high dose steroids, or has a disease that is sufficiently advanced to suppress resistance to infection, e.g., leukemia, lymphoma, AIDS.

APACHE II SCORE
Sum of [A] + [B] + [C] :

[A] APS points _____

[B] Age points _____

[C] Chronic Health points _____

Total APACHE II _____

From “Apache II: A Severity of Disease Classification System” by W. Knaus, E. Draper, D. Wagner and J. Zimmerman (1985), *Critical Care Medicine*, Volume 13(10), pp. 818-829. Copyright 1986 by Wolters Kluwer Health. Reprinted with permission.

Appendix F. Permission to use APACHE II Severity of Disease Classification System

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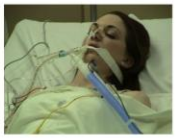
Number of figures/tables/illustrations	1
Figures/tables/illustrations used	APACHE II Severity of Disease Classification System(Figure 1)
Author of this Wolters Kluwer article	No
Title of your thesis / dissertation	Ventilator-Associated Pneumonia Prevention Bundle
Expected completion date	Feb 2015
Estimated size(pages)	50
Billing Type	Invoice
Billing Address	37 Delaware Street PORT JERVIS, NY 12771 United States Attn:
Total	0.00 USD

Appendix G. Poster Presentation of Project



VENTILATOR-ASSOCIATED PNEUMONIA PREVENTION BUNDLE

An Evidence-Based Practice Project

Patricia E. Cal, RN, MSN, NP, DNP Candidate
Walden University

BACKGROUND/SIGNIFICANCE

- Ventilator-associated pneumonia (VAP) and other ventilator-associated events (VAEs) are serious complications in ventilated patients
  - Prolongs intubation by 4-19 days
  - Increases mortality 25-50% over ventilated patients who do not acquire it (Efrati et. al., 2010)
- May cost up to $25,000.00 to treat
  - CMS will not reimburse cost of treatment since it is considered a preventable hospital-acquired infection (CMS, 2013)
  - New reporting guidelines identify precursors to VAP (Ventilator-Associated Events or VAEs) along with more objective criteria for VAP (CDC, 2013 July)
- The Institute for Healthcare Improvement (IHI) (2012) has published guidelines for VAP prevention that have resulted in a 45% average decrease in VAP
  - performing oral care in accordance with an oral care protocol that incorporates the use of chlorhexidine gluconate oral rinse
  - maintaining the head of the bed at 30-45 degrees
  - a daily sedation vacation and assessment of readiness to wean from the ventilator
  - prophylaxis for both deep vein thrombosis and peptic ulcer disease.
- Knowledge of and compliance with the recommendations is not consistent among critical care nurses (Tolentino-DelosReyes, Ruppert, & Shiao, 2007)

PURPOSE AND PROJECT OBJECTIVE

To determine the effect of an evidence-based VAP/VAE prevention educational program on ICU nurses' actual and documented nursing care practices for preventing VAP and VAEs as part of a "ventilator bundle" of interventions.

PROJECT QUESTIONS

- What is the effect of an educational program focused on prevention guidelines and strategies for VAP/VAE prevention on critical care nurses' compliance with the VAP/VAE prevention bundle, as measured by observed and documented oral care with chlorhexidine per protocol, elevation of the head of the bed to 30 - 45 degrees, daily sedation vacations and assessment of readiness for extubation?
- Will the education result in the maintenance of a rate of zero cases of VAP/VAEs per thousand ventilator days for the 3 months after the educational intervention?
- What is the nurses' level of satisfaction with the educational program?
- Will there be a difference in the severity of illness for patients enrolled before and after the intervention?

THEORETICAL MODEL/FRAMEWORK

The IHI's Model for Improvement (IHI, 2014) served as the theoretical framework for the project.

- Starts with asking 3 fundamental questions:
  - Decide what is to be accomplished
  - Determine measures that will indicate improvement
  - Select strategies that will lead to improvement
- Implement the Plan-Do-Study-Act cycle
  - Plan the change
  - Implement the change
  - Study the results
  - Refine the change and begin the cycle again

TRANSLATION OF EVIDENCE/INTERVENTIONS

- A new, comprehensive oral care protocol was developed that includes chlorhexidine oral rinse every 12 hours
- Chlorhexidine oral rinse was added to the formulary
- New oral care kits on hand that support compliance with the policy & procedure
- A power point presentation for nurses was developed that includes definitions and risk factors for VAP/VAE, prevention strategies including the components of the ventilator bundle, and tips on how to comply with the guidelines

DATA COLLECTION & ANALYSIS

Electronic medical records for all intubated patients admitted to the unit for the 3 months before the intervention and 3 months after the intervention will be audited for documentation of the frequency of oral care, how many hours per day the head of the bed was elevated to 30-45 degrees, whether patient had a daily sedation vacation and assessment of readiness for extubation, and if not, whether there was a documented contraindication (see form #1 below).

Compliance with the additional bundle measures concerning deep vein thrombosis (DVT) and peptic ulcer disease (PUD) prophylaxis will also be tracked.

Results will be compared on the same measures before and for the 3 months after the intervention.

Observations will be made of VAP/VAE bundle-related care being given to one ventilated patient in the unit twice each week during the first hour of each 12-hour shift for 4 weeks prior to the intervention and in the final 4 weeks of the project to verify the accuracy of the associated documentation (see form #2 below)

VAP Prevention Project
Client data collection form (form #1)

Patient number ____ Pre or Post Intervention (circle) Deceased yes no APACHE II score ___
Hospital admission date ___ Hospital discharge date _____ Hospital length of stay _____
ICU admission date _____ ICU discharge date _____ ICU length of stay _____
Date of intubation _____ Date of extubation _____ Days on ventilator ____

Ventilator day	# of hours HOB documented to be at 30-45° per 24h	# times oral care documented per 24 hours	# times chlorhexidine oral rinse used in oral care per 24 hours	Had sedation vacation or contraindication documented	Had assessment of readiness for extubation or contraindication documented	DVT prophylaxis or contraindication documented	PUD prophylaxis or contraindication documented
2				Yes No	Yes No	Yes No	Yes No
3				Yes No	Yes No	Yes No	Yes No
4				Yes No	Yes No	Yes No	Yes No
5				Yes No	Yes No	Yes No	Yes No

Data Collection Checklist (Form #2)

Observation # _____ Nurse # _____ Patient # _____
Circle: Pre or Post education

1. Oral care □Yes □No
   - Deep suctioning of oral cavity/pharynx □Yes □No
   - Brush teeth with suction toothbrush □Yes □No
   - Swab with chlorhexidine □Yes □No
2. Head of bed between 30-45 degrees □Yes □No
   - Actual elevation (degrees) _____
3. Hand hygiene
   - Performed on entering the room □Yes □No
   - Performed on leaving the room □Yes □No
   - Gloves worn for oral care □Yes □No

Sage® Oral Care Kit used in protocol

ANALYSIS AND EVALUATION PLAN

Objectives related to the overall goal include that all ICU nurses will perform and document 100% of recommended nursing actions for VAP prevention; and that VAP/VAE cases will be maintained at zero cases/1000 ventilator days.

Paired t-tests will be performed on the following measures comparing pre and post intervention scores:

- mean compliance rates of the nurses with each element of oral care and hygiene practices
- rates of patients having a daily sedation vacation and assessment of readiness for extubation
- Presence of DVT and PUD prophylaxis, or documentation of contraindication

Analysis of variance (ANOVA) will be used to analyze differences in:

- duration of ventilation
- mean ICU length of stay and hospital length of stay
- mortality before discharge
- rates of VAP and VAEs per 1000 ventilator days

Descriptive statistics will be used to characterize the nurses on the variables of age, years of RN and critical care experience, educational attainment, and years of employment in the unit, through use of frequency distribution tables.

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For additional information please contact: Patricia E. Cal, Walden University. Email: pcal65@hotmail.com