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Examining ICU Nurses' Knowledge of Ventilator-Associated Events and Ventilator-Associated Pneumonia

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This is to certify that the doctoral study by

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2019

Abstract

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MS, Walden University, 2010

BS, Alcorn State University, 1983

Project Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Nursing Practice

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Abstract

Ventilator-associated events (VAEs) are patients' complications of respiratory conditions including ventilator-associated pneumonia (VAP). Research shows that VAP is the most common hospital-acquired infection among ventilated patients and a leading source of mortality. With greater risk for complications among ventilated- supported patients, nurses working in the ICU must keep abreast of new knowledge and update expertise to develop technical and clinical skills in daily practice. The purpose of this project was to assess whether an educational intervention would increase the ICU nurses' level of knowledge of the evidence-based intervention. Knowles' adult learning theory was chosen for this project. A paired-samples *t*-test was conducted to examine nurses' knowledge of VAE/VAP using a questionnaire measuring knowledge of VAP; 58 ICU nurses participated an educational intervention. Findings showed that nurses had an increase in knowledge following the education (M = 11.43, SD = .775) compared to nurses prior to education (M = 9.55, SD = .976), $t(57) = -26.884$, $p < .001$. Results of this project may guide the use of an evidence-based practice educational intervention to improve the quality and safety of ventilated patients. The implications for positive social change include preventing VAEs/VAP among patients, thus decreasing the length of hospital stay, cost, and deaths related to ventilator infections.

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Dedication

My mother encouraged me to reach for my dreams. Her love and wisdom still sustain me when I doubt myself. The completion of this work is dedicated to her memory and everlasting love. I also dedicate this work to my brother.

Acknowledgments

To my committee chair, Dr. Jennings: I sincerely appreciate your support and guidance throughout this project. I want to thank and appreciate my preceptors, Hattie Anderson, MS, RN, and Kimberly Goss, MS, RN for all the time, mentorship, expertise, support, guidance, and encouragement. I would also like to acknowledge Drs. Diane Whitehead and Farrar for their support and guidance. Most of all, I am thankful for the love and understanding of my husband, Samuel. His support, encouragement, and prayers during this long process have been immeasurable. Finally, I want to acknowledge my sons, Byron and Tyron: they always knew when I needed a smile, hug, or text message.

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Introduction

Ventilator-associated pneumonia (VAP) is considered a healthcare-associated infection (HAI). According to the Centers for Disease Control and Prevention (CDC; 2010), HAIs are obtained while in a healthcare organization. In 2011, there were approximately 722,000 reported HAIs in the United States and 75,000 patient deaths related to HAIs (CDC, 2018; Magill et al., 2014). According to the CDC (2018), VAP accounts for 25% of HAIs in the intensive care unit (ICU).

VAP is a major source of morbidity, mortality, and healthcare costs in the United States (Vaz et al., 2015). It is defined as pneumonia that develops 48 hours post intubation (Kallet, 2015). It is one of the most severe HAIs for critically ill patients and has the potential to worsen with continued ventilator intubation (Chen, Cao, Li, Li, & Zhang, 2015). VAP rates range from 10%–22% of ventilated patients who are critically ill (Gianakis, McNett, Belle, Moran, & Grimm, 2015). Ventilator-associated infections have a reported cost of $9,000 to $40,000 per patient and more than $1.2 billion annually (Gianakis et al., 2015).

Critically ill patients on ventilators are susceptible to multiple complications, such as “pneumonia, acute respiratory distress syndrome (ARDS), pulmonary edema, thromboembolism, delirium, and atelectasis” (Klompas et al., 2015, p. 294). Traditionally, surveillance for complications of mechanical ventilation has been limited to VAP. The CDC has recommended new

surveillance definitions to create a three-tiered system for ventilator-associated events (VAEs; Jorens, 2016). VAEs were defined and clarified to include serious complications of ventilated patients (CDC, 2015). Whereas, VAP has the most stringent criteria, a VAE is an occurrence when a patient, after at least 2 days of stable ventilator settings, experiences at least 2 days of deteriorating oxygenation that requires minimal daily increases Fraction of inspired oxygen (Fio2) or Positive Expiratory End Pressure (PEEP; Jorens, 2016; Klompas et al., 2015).

VAP is a lethal HAI with devastating outcomes for critically ill patients. VAP mortality rates range from 15%–70% for ICU patients (Klevens et al., 2007). The mortality attributable to VAP is estimated at 10% among various patient populations (Klompas et al., 2014). Researchers suggest that 55% of VAP cases may be preventable with the use of evidence based (EB) recommendations and protocols (Umscheid et al., 2011; Klompas et al., 2015). Although numerous guidelines and protocols have been recommended, there continues to be a gap in delivering recommendations and protocols at the bedside (Craven, 2006; Umscheid et al., 2011).

One possible reason for the gap in the delivery of care may be lack of applicable instructions within the recommendations to assist the nurse with the execution of the protocols (Galiardi et al., 2008; Goutier et al., 2014; Sinuff et al., 2008; Weinert & Mann, 2008). Usually, when guidelines and recommendations are published, a period of adaptation is needed before implementation into practice (Goutier et al., 2014). In addition to the adaption period, ICU nurses

may be unaware of new practice recommendations or guidelines (Kiyoshi-Teo, Cabana, Froelicher, & Blegen, 2014).

Other issues that may impact the implementation of VAP/VAEs protocols are knowledge of recommendations, content, time, resources, education, and training (Kiyoshi-Teo et al., 2014). If nurses are unfamiliar with new recommendations and guidelines, VAP/VAE adherence may be affected (Kiyoshi-Teo et al., 2014). Knowledgeable nurses are the key to recognizing and preventing VAP in ventilated patients. Therefore, adequate education of ICU nurses on VAP/VAEs is essential and can be addressed through education.

Problem Statement

In 2015, the CDC announced new VAE surveillance definitions to clarify surveillance and expand surveillance to include other serious complications of ventilated patients. VAP has been in the spotlight as a leading cause of death among critically ill, ventilated patients (Jorens, 2016; Munaco, Dumas, & Edlund, 2014). The incidence of VAP is high; some studies indicate that up to 27% of ventilated ICU patients are “associated with increased length of ICU and hospital stay, hospital mortality, and financial burden” (Jorens, 2016, p. 390). Mortality can increase from 29.2%–63.5% if care is delayed or inadequate, thus increasing hospital stay by 16.4 days (Jorens, 2016). VAP and other complications of mechanical ventilation produce adverse outcomes for patients and increase hospital costs (Klompas et al., 2014).

The CDC outlined recommendations for prevention and interventions of VAP and other VAEs (CDC, 2012; 2014; 2017). Some best practices have been suggested, using interventions that produce best outcomes, carry the minimum risk of harm, and are cost neutral (CDC, 2012; Klompas et al., 2014). Preventive VAP and VAE interventions with low risk that reduce the duration of mechanical ventilation, length of stay, mortality, and cost in adult populations are (a) avoid intubation, (b) minimize sedation, (c) maintain and improve physical conditioning, (d) minimize pooling of secretions above the endotracheal tube cuff, (e) elevating head of bed, and (f) maintain ventilator circuits (CDC, 2012; Klompas et al., 2014). These findings have served as a rationale for this project (Jorens, 2016; Munaco et al., 2014).

Purpose

The purpose of this DNP project was to examine the knowledge of ICU nurses regarding the EB interventions included in the patients' campaign for preventing VAP/VAE—a partnership of the Institute for Healthcare Improvement (IHI), the CDC, and the Military Health System (MHS) for. ICU RNs are the leaders at the bedside and directly affect patient safety; therefore, ICU nursing knowledge and skills are required to assess patients at risk for VAP/VAEs. The practice-focused question for this project was as follows: What is the knowledge of ICU nurses of evidence-based interventions included in the IHI, CDC, ACCN, and MHS campaign for preventing VAEs/VAP?

Nature of the Study

This DNP project was conducted in a large, urban acute-care facility. The organization housed four critical care units, approximately 32 beds in total. The units were staffed with 30–50 registered nurses. The goal was to examine critical care nurses' knowledge of VAEs/VAP.

Significance of the DNP Project

VAP accounts for 25% of HAIs in the ICU, ranking second among HAIs in the United States (CDC, 2018). VAP mortality rates range from 15%–70% for ICU patients (Klevens et al., 2007). The mortality attributable to VAP is estimated at 10% among various patient populations (Klompas et al., 2014). Nurses working in the ICU require specialized skills and knowledge to provide safe and high-quality care to critically ill patients (Wagner, Alves, Brey, Waddrigues, & Caveiao, 2015). ICU nurses often identify changes in patients' condition early because of ongoing assessment. As this patient population is more at risk for complications, nurses working in the ICU must keep abreast of new knowledge and update their expertise to develop technical and clinical skills in daily practice (Goncalves et al., 2015). Nursing personnel have an instrumental role in applying non-drug-based preventive measures directly related to the care they provide; however, adherence to recommendations varies widely (Gatell et al., 2012). Understanding VAP/VAE pathophysiology is crucial to recognize the variations in a patient's condition and symptoms of VAP/VAE.

The purpose of this DNP project was to examine the knowledge of ICU nurses about the evidence-based interventions included in the IHI, CDC, ACCN, and MHS partnership for patients' campaign for preventing VAP/VAEs. The potential impact of this DNP project was to add to the existing knowledge. In the past 5 years, new definitions for surveillance of VAP/VAEs has been added to the literature; however, preventive measures have remained relatively stagnant. The current research is limited to ICU nurses' knowledge of VAP/VAE standard practices, updated guidelines, and prevention measures. Prevention of VAP/VAEs has the potential to decrease the length of stay, decrease costs, improve patient-related outcomes, improve patient safety, improve quality of care delivered, and improve customer satisfaction (Jansson, Ala-Kokko, Ylipalosaari, Syrjala, & Kyngas, 2013). Nurses' knowledge and awareness of EB prevention strategies may reduce and sustain minimal incidents of VAEs/VAPs. To successfully implement EBP, nurses require knowledge to examine the quality and evidence to improve patient outcomes. Therefore, this study may guide administrators and educators to enhance RN EBP to improve the quality of patient care, thus creating positive social change.

Another potential contribution of the doctoral project was to improve the quality of life for patients and an opportunity to drive change in the organization. Finally, with the new definition and limitations of VAP bundles (see definitions), an examination of current prevention was needed. Research on the knowledge of ICU nurses who are part of the IHI, CDC, ACCN, and MHS campaign may

identify factors that influence the need to implement new VAEs/VAP prevention initiatives.

Summary

In 2011, there were approximately 722,000 reported HAIs in the United States and 75,000 patient deaths related to HAIs (CDC, 2018; Magill et al., 2014). VAP accounts for 25% of HAIs in the intensive care unit (ICU), according to the CDC (2018). VAE is an occurrence when a patient, after at least two days of stable ventilator settings, experiences at least two days of deteriorating oxygenation that requires minimal daily increases Fio2 or PEEP (Jorens, 2016; Klompas et al., 2015). Although numerous guidelines and protocols have been recommended, there continues to be a gap in delivering recommendations and protocols at the bedside (Craven, 2006; Umscheid et al., 2011).

One possible reason for the gap in the delivery of care may be lack of applicable instructions within the recommendations to assist the nurses with the execution of the protocols (Galiardi et al., 2008; Goutier et al., 2014; Sinuff et al., 2008; Weinert & Mann, 2008). The CDC outlined recommendations for prevention and interventions of VAP and other VAEs (CDC, 2012; 2014; 2017). Some best practices have been suggested using interventions that produce best outcomes, carry the minimum risk of harm, and are cost neutral (CDC, 2012; Klompas et al., 2014).

The purpose of this DNP project was to examine the knowledge of ICU nurses regarding the evidence-based interventions in the Institute for Healthcare

Improvement (IHI), Centers for Disease Control and Prevention (CDC), American Association of Critical Care Nurses (AACN) and Military Health System's (MHS) partnership for patients' campaign for preventing VAP/VAE. The potential impact of this DNP project was to add to the existing knowledge on the topic. Another potential contribution of the doctoral project was to improve the quality of life for patients and an opportunity to drive change in the organization.

The model used for this project was Malcolm Knowles's adult learning theory. A survey developed by Lin, Lai, and Yang (2014) to examine nurses' knowledge of VAP prevention was used. The survey consisted of 12 multiple choice items with four possible answers and only one correct answer. The results of the study showed a statistically significant (0.05) level increase in the knowledge scores of the ICU nurses following an intervention.

There is a need for ongoing education of VAP and VAE prevention. As ventilated supported patients are more at risk for complications, nurses working in the ICU must keep abreast of new knowledge and update expertise to develop technical and clinical skills in daily practice (Goncalves et al., 2015). The results of this project may be used to inform practice and stimulate discussion of theoretical knowledge into clinical practice. Recommendations should be geared toward discussion the need to implement updated VAP/VAE prevention protocol and bundles. Therefore, further research is recommended to identify if VAEs

prevention protocols or bundles should be developed. Most of the questionnaires in practice are more geared toward VAP versus VAE.

In Section 2, I introduce the model that framed this project, discuss the project's relevance to nursing practice, provide the local background and context, and address my role with this project. Last, I explore the relevant EB literature.

Section 2: Background and Context

Introduction

VAP is an acquired infection that occurs 48 hours after a patient has been intubated (Kallet, 2015). Endotracheal intubation (ETT) lowers the body's normal defense systems that usually prevent infection (Kallett, 2015). The presence of the ETT decreases tracheobronchial mucus, which pools secretions and then causes microaspiration of infected oropharyngeal secretions to collect above the ETT cuff (Kallet, 2015). The pooling of these secretions is a primary source of infection and significant challenge in acute critical settings (Kallet, 2015; Safdar, Crnich, & Maki, 2005). Patients who acquire VAP have longer hospital stays, higher rates of morbidity and mortality, and increased hospital costs. Because of the severity of VAP, major efforts and initiatives have been implemented to prevent it (Kallet, 2015).

Concepts, Models, and Theories

The adult learning theory was introduced in 1950 by Malcolm Knowles and has been modified several times over the last 3 decades. In 1980, Knowles made four assumptions about the characteristics of adult learners (andragogy) that are different from the assumptions about child learners (pedagogy). Knowles believed that adults learn differently than children; his model includfour principles: (1) adults need to be in the planning and evaluation of their instruction, (2) Experiences (including mistakes) provides the basis for the learning activities, (3) adults are most interested in learning subjects that

have immediate relevance and impact to their job or personal life, and (4) adults learning is problem-centered rather than content-oriented (Kearsley, 2010; Knowles, 1980a; 1984a).

As adult learners in a rapidly changing field, ICU nurses must learn and apply new knowledge regularly. However, ICU nurses bring some knowledge and experience of VAEs/VAP prevention to this project. ICU experience prepares nurses to understand the importance of education related to VAEs/VAP prevention. Because ICU nurses have prior knowledge, some may be resistant to an examination of their knowledge of VAEs/VAP prevention. Using adult learning theory, resistance to new information may be reduced to create the potential for professional scholarship and membership as a knowledge stakeholder (Knowles, 1950, 1973; Knowles, Holton, & Swanson, 2005; Shrivastava & Shrivastava, 2017; Taylor & Hamdy, 2013). According to the adult learning theory, before nurses agreed to participate in the EB project, they were free to participate in the decision-making process. Tisdell (2007) compared the concept of lifelong adult learning to that freedom, which liberates an individual to make independent choices. This freedom empowers an individual to accept change, which leads to gaining new skills and knowledge (Tisdell, 2007).

Definitions of Terms

Healthcare-associated infections (HAI): HAI is defined as an infection obtained while in a healthcare organization (CDC, 2016). The CDC has implemented a set of measures to define HAIs as classified by the National Healthcare Safety Network (NHSN) guidelines.

National Healthcare Safety Network (NHSN) guidelines: NHSN is an internet-based system managed by the Division of Healthcare Quality Promotion (DHQP) at the Centers for Disease Control and Prevention (CDC, 2018). NHSN is a systemized method of classifying infection as present on admission (POA) or an HAI (HAI). According to CDC/NHSN (2018) an HAI is defined by the following objective surveillance and guidelines:

- Infection Window Period (IWP) within 7-days
- Date of Event (DOE)
- Present on admission (POA)
- Healthcare-associated infection (HAI)
- Repeat Infection Timeframe (RIT) within 14-days
- Secondary BSI Attribution Period (SBAP)
- Pathogen Assignment Guidance
- Location of Attribution (LOA)

RX for changes program: The Military Health System's Partnership Campaign (MHS, 2014) developed to reduce the occurrence of VAP and VAE and

focus on three components (1) workforce education, (2) colonization, and (3) aspiration reduction and prevention.

(RX) program for VAP/VAE prevention is a collection of preventions/protocols recommended by CDC (2014); The Institute for Healthcare Improvement (IHI; 2012) ventilator bundle, and the American Association of Critical Care Nurses (AACN; 2008, 2014). These prevention/protocol include the following interventions: elevate the head of bed (HOB), daily sedation interruption, deep Venous Thrombosis (DVT) Prophylaxis, Peptic Ulcer Disease (PUD) Prophylaxis. Rx also includes: intubate orally, replace the ventilator circuit only if soiled; replace airway humidifiers every 5-7 days as indicated; use closed suctioning system; change suctioning systems only if necessary; Use subglottic secretion drainage for expected ventilation >72 hours; set HOB at 45 degree when possible; use oral antibacterial (chlorhexidine), and weaning off ventilator as soon as possible.

Ventilator-associated events (VAE): VAE definitions include criteria for ventilator-associated conditions, infection-related ventilator-associated complications, possible pneumonia, and probable pneumonia. The VAE algorithm has three tiers identified by the NHSN: 1) Ventilator-Associated Condition (VAC); 2) Infection-related Ventilator-Associated Complication (IVAC); and 3) Possible VAP [PVAP] (CDC, 2018). Approximately 5%–10% of mechanically ventilated patients develop VAEs. The VAE algorithm classification

systems rely on specific interventions instead of diseases (White, Mahanna, Guin, Bora, & Fahy, 2015).

Ventilator-associated pneumonia (VAP) Bundle: VAP Bundle is defined by the Institute of Health Care Improvement (HI) and the Joint Commission (TJC) as a combination of evidence-based interventions implemented to reduce the incidence of VAP/VAEs in ventilated patients. VAP Bundles include interventions, for example, head of the bed elevation, oral care, sedation vacation, etcetera (IHI, 2012; TJC, 2005).

Ventilator-associated pneumonia (VAP): VAP is a hospital-acquired infection that occurs in patients intubated for more than 48 hours (Parisi et al., 2016).

Review of Scholarly Evidence

In this literature review, the focus was on scholarly evidence used to examine ICU nurses' knowledge of VAPs and VAEs. The following databases were searched (1989–2016): CINAHL Complete Plus Full Text, Electronic-Journal, Cochrane Database of Systematic Review, Google Scholar, ProQuest Dissertations and Theses, MEDLINE, Academic Search Complete, Ovid Nursing Journals, PsycINFO, and PubMed. The following search terms were used: *ventilator-associated pneumonia, VAP bundle, ventilator-associated events,* and *quality improvement*. These terms, in various combinations, yielded 4,017 after evaluating the abstracts, approximately 600 were reviewed. The keywords searched were *nursing education*, *interventions, healthcare cost*, *barriers,*

ventilator associated pneumonia (VAP), ventilator-associated events (VAE), evidence-based practice, adherence, and *ventilator-associated pneumonia (VAP) initiatives*, *nursing improvement programs,* and *ventilator-associated pneumonia interventions*. Websites such as American Nurses Association, (CDC), (IHI), and (NHSN) were also helpful.

Nurses working in the ICUs require specialized skills and knowledge to provide safe and high-quality care to patients who are critically ill (Wagner et al., 2015). As this patient population is more at risk for complications, nurses working in the ICU must keep abreast of new knowledge and update expertise to develop technical and clinical skills in daily practice (Goncalves et al., 2015). Educating bedside RNs on VAP and providing the appropriate tools to assist with workflow is an important part of decreasing VAP/VAE incidences (Aloush, 2017; Swearer et al., 2015).

Nursing personnel have an instrumental role in applying non-drug-based preventive measures directly related to the care they provide; however, adherence to recommendations varies. Nonadherence to VAP guidelines was reported by 22% of critical care nurses attending a conference. Nurses' nonadherence is associated with nurses' scientific knowledge, resistance to change, reluctance to apply some interventions, and staff workload (Gatell et al., 2012).

Munaco et al. (2014) conducted a study to evaluate an education module, the use of a VAP bundle checklist, and a change in documentation. The study evaluated if these changes in practice would improve knowledge of VAEs and

increase compliance with VAP prevention strategies among ICU nurses. The educational module featured the CDC updates regarding the definition of VAE, the VAE algorithm, components of the IHI ventilator bundle, and current hospital policies related to VAP prevention. To assess participants' knowledge of VAP and recommendation prevention strategies, a multiple-choice examination was administered pre- and post-intervention. This was a quantitative approach. Forty-one nurses completed the educational module. The nurses' knowledge improved from a score of 43%–88.6%. VAP bundle compliance was low in the unit. There was a slight improvement in documentation. Even with the increased use of bundles, possible and probable VAP n the ICU showed no direct correlation. Two suggestions for practice were as follows: (a) bundle elements must be clearly defined, and (b) incorporated in policies and technology.

The CDC distributed recommendations to prevent nosocomial pneumonia in 1983 (Munro & Ruggiero, 2014). This recommendation for prevention of nosocomial pneumonia with a fundamental focus on infection-control measures. These recommendations first focused on perioperative preventive measures such as hand washing and management of respiratory fluids, medications, and equipment, which are now routine measures in institutional infection control. In 1997, the recommendations were updated and included measures to prevent cross-contamination of healthcare providers' hands and improve appropriate decontamination of respiratory equipment. Additional recommendations were the use of vaccines to protect against specific infections and hospital staff

education. Researchers have investigated other measures, for example, decreasing oropharyngeal and gastric colonization of microorganisms. In 2003, these recommendations were again revised and replaced with recommendations for preventing healthcare–associated pneumonia. In 2003, the CDC recommended that surveillance monitoring should be performed for bacterial pneumonia in the ICU patient who is treated with mechanical ventilation to help identify, trend and evaluate for hospital comparison. Nevertheless, microbiological surveillance, VAP surveillance, and clinical diagnosis of VAP fluctuate greatly (Munro & Ruggiero, 2014).

The clinical diagnosis of VAP is neither sensitive nor specific (Munro & Ruggiero, 2014). Clinical suspicion for VAP requires intubation for more than 48 hours. Most infection-control professionals and hospital epidemiologists use definitions developed by the NHSN) that are based on three groups of criteria: radiographic, clinical, and optional microbiological. There were a number of EB studies that underpinned the relevance of VAP (Munro & Ruggiero, 2014).

Swearer et al.'s (2015) study was the result of an audit. The purpose of the quality improvement project was to demonstrate how enhanced electronic medical records (EMR) technology could increase documentation compliance, provide a support tool, and decrease pneumonia in ventilated patients. Chart audits were performed to identify potential causes of high VAP rates in trauma patients. The chart reviews found inconsistencies in initiating oral care timely and poor documentation. The project goal was to reduce pneumonia in intubated

patients by using mouth care sooner and appropriate documentation. The authors stated an interprofessional team approach was used to drive change with the expected outcome of decreasing VAP incidences and improving documentation efficiency. After the practice change was implemented documentation improved from 38.3%–86% compliance. Comparison of change in practice after three months showed a 62% decrease in VAP rates with a maintained 60% decrease in VAP rates after six months. Recommendations for future research were to conduct studies for effectiveness in other areas and evaluate the benefit of additional staff education. Continuous evaluation and updates can improve adherence to the guidelines, which are necessary to prevent VAP. Education on practice change includes in-services, handouts, and bulletin boards (Swearer et al., 2015).

Gallagher's (2012) implemented cinical practice guidelines for ICU nurses with the purpose of reducing the risk of VAP, reducing the length of stay (LOS), and decreasing the number of patients who received ventilator care. Nurses were educated on VAP/VAE prevention to improve outcomes for ventilated patients. The educational program was developed and presented to nurses. The nurses were given a pretest related to knowledge of VAP/VAEs and a posttest after educational sessions. The method used was quantitative. SPSS 11.5 software were used to analyze the data. Findings of the control group included 45 patients with a total of 235 ventilator days. Six of the patients developed VAP, yielding 25.5 VAP cases per 1,000 ventilator days for the control group. The experimental

group had 38 patients with a total of 153 ventilator days. None of the patients developed VAP, for a rate of 0 per 1,000 ventilator days. The data confirmed that education improved outcomes in patients requiring ventilator care and suggested that continued education is essential for quality care.

Wagner et al. (2015) performed a study to identify nurses' knowledge level related to nursing interventions to prevent VAP. A quantitative approach was used. Nine nurses participated in the study and data were collected through a questionnaire. The data were analyzed in four tables using Microsoft Excel 2010. Nurses' knowledge of VAP prevention interventions score was 81%. The authors emphasized that care of ventilated patients is a multidisciplinary responsibility. The researchers believe that informed scientific knowledge is important; as it is applied, the quality of care improves, and patients have better outcomes. The authors emphasized the need for updates for nurses. The study called for nursing programs to increase emphasis on VAP prevention.

Goncalves et al.'s (2015) research assessed the knowledge of nurses about VAP prevention. The authors used a mixed method approach. The researchers collected data by semi-structured interviews. Nurses reported it was possible to have some clinical practice and knowledge, particularly with critically ill patients. The authors believe this research adds value to the profession because it presents a discussion that places nurses in a position that requires attention and commitment to continuous recognition of preventive actions and problem solving.

Korhan et al.'s (2013) research purpose was to evaluate ICU nurses' knowledge of VAP prevention. The authors used a quantitative method. This study was conducted in Turkey. The nurses were surveyed using a questionnaire, and the results revealed there was a knowledge deficit. The median total score from the questionnaire was 4.00+2.00, which was low. SPSS v.17 was used to analyze the data. The application of knowledge to practice has received limited attention (Gatell et al., 2012). The recommendation was to repeat this research on VAP prevention in the general ICU. Another recommendation was to implement multifaceted educational programs on current VAP prevention guidelines.

El-Khatib et al. (2010) performed a study to assess the ICU healthcare providers' knowledge of EB guidelines for prevention of VAP. A quantitative method used. A multiple-choice questionnaire was distributed to 10 physicians, 47 ICU nurses, and 18 respiratory therapists. The mean total scores were 80.2% for physicians, 78.2 nurses, and 80.5% respiratory therapists. There were no significant differences in scores of professional with five years or more. The researchers suggested ICU healthcare model includes all ICU providers, which may result in adequate knowledge level of EB practice guidelines for VAP prevention. The authors recommended future studies evaluate the application and practice of EB guidelines of VAP prevention.

Aloush and Al Qadire (2017) research evaluated student nurses' knowledge about EB guidelines to prevent VAP. This was a quantitative study.

The researchers developed a questionnaire. Data was collected from 434 Jordanian student nurses. SPSS version 22 was used to analysis the data. The mean score and frequencies were calculated, along with a *t*-test. The mean score was 6.4 (32%; SD=2.9) with range of 16 (80%) to 0 (0%). The knowledge level was low on VAP prevention. The investigators recommended nursing schools evaluate curricula and integrate VAP prevention guidelines.

Aloush (2017) conducted a study of 102 ICU nurses in five Jordan hospitals. The study assessed nurses' compliance with VAP prevention guidelines after completion of a VAP educational program. Quantitative method using an experimental design, participants were randomly selected for the experimental or control groups. Fifty-nine nurses were in the experimental group and 43 nurses participated in the control group. The data was analyzed using SPSS version 21. The compliance scores were moderate for VAP prevention guidelines. Mean compliance scores were 14.1 ±4.4 for the (experimental group) compared with the mean of 12.8 ±3.7 for the (control group). Therefore, compliance scores showed no statistically significant difference (t [100] =1.43; P=.15). The researcher's findings differ from some earlier studies, which revealed a significant improvement in nurses' compliance after education and training. Future studies that may be helpful to investigate should consider factors that impact nurses' compliance with the VAP/VAE standards.

Gatell et al.'s 2012 study assessed a training program to improve nurses' compliance with VAP prevention measures with three objectives: (a) determine

the program impact on theoretical knowledge of compliance with measures, (b) analyze the relationship between workload and compliance, and (c) measure program impact on VAP incidence. A prospective, quasi-experimental, pre-post study method was used. Results were presented as mean and standard deviations and frequencies and percentages. SPSS version 15 was utilized for analysis. Nurses' scientific knowledge and compliance improved. Adherence to practice was inconsistent and low adherence has been reported by other researchers (Jansson et al., 2013). Workload was documented as reason for non-adherence to the guideline, which decreases compliance. This result is consistent with other studies of workload and VAP prevention (Wagner et al., 2015). VAP incidences improved after improved compliance. However, overall, no major difference was noted in VAP incidence pre/post intervention (9.9 versus 9.3 episodes per 1,000 ventilation days). The positive results support the CDC recommendations to strengthen training to increase adherence to VAP prevention strategies. Educational activities and EB protocols presented to ICU nurses improve the quality of care and narrowing the gap, linking scientific knowledge and clinical practice. The authors suggested future research to evaluate why nurses fail to practice measures they know are important (e.g., hand hygiene).

Kiyoshi-Teo et al. (2014) reported that little is known as to why nurses do not use VAP prevention guidelines. The researchers' objective was to discover dynamics that influence adherence to guidelines for VAP prevention of three nonpharmacological interventions: oral care, position of head of bed (HOB), and

spontaneous breathing trials (SBTs). The method used was quantitative. A survey was created to collect information related to adherence and factors that may impact adherence to VAP preventive guidelines. For this study, 576 nurses participated in the survey. The data was analyzed with the use of PASW Statistics 18 (IBM/SPSS). Adherence to oral care and HOB elevation were practiced most of the time. SBT guidelines were incorporated in five of the eight hospitals. Nurses' adherence to guidelines was better when guidelines were explained. Knowledge of guidelines thus improving adherence to guidelines. Hospital support for VAP prevention was positively correlated with adherence. This study found that nurse attitude was the most important factor associated with adherence. Researchers reported three factors associated with adherence: knowledge, awareness, and familiarity. Furthermore, adherence was linked with guideline content, education, and training.

Jansson et al. (2013) validated a questionnaire that explored ICU nurses' knowledge of and adherence to VAP/VAE EB guidelines. The study used a quantitative cross-sectional method. ICU nurses' mean score was 59.9%; however, previous studies have documented mean scores that range from 41.2%–78.1%. This study, as with previous studies, confirmed that nurses with five years or more of experience demonstrated more knowledge than nurses with less experience. Use of rigorous hand hygiene with alcohol was not adhered to consistently. As with previous studies, the frequency of the humidifier change was not well understood and adhered to less often. Nonetheless, some

researchers found the humidifier change has little effect on the occurrence of VAP (El-Khatib et al., 2010; Labeau et al., 2008; Masteron et al., 2008). The authors stated these results can contribute to the conversation regarding the registered nurse (RN) opinion in adherence to and knowledge of protocols to prevent VAP. Additionally, there is a need for improvement in education and implementation policies.

Goutier et al. (2014) conducted a systematic literature search to evaluate strategies to enhance adoption of VAP prevention interventions. To organize adherence strategies, the Four E's framework was translated into EB intervention into practice. The four strategies are *engagement, education, execution*, and *evaluation*. Variations in strategies described how the strategies may be useful in influencing change and increasing guideline compliance. There is evidence that clinical guidelines may improve, especially if shared with bedside staff.

Waters and Muscedere (2015) acknowledged that current clinical knowledge of VAP prevention, diagnosis, and management is important; therefore, this study was conducted. This research study reviewed changes to nomenclature for VAP surveillance, VAP/VAE related events, advances in diagnosis, treatment of VAP, pathophysiology, bacteriology, and diagnosis of VAP was discussed. VAE new terminology and the relationship to VAP were defined. VAEs have three tiers: ventilator-associated conditions (VAC), infection-related VAC (iVAC), and VAP (possible and probable) explained. Current prevention of VAP includes non-invasive positive pressure ventilator, positioning, ETT

modification, probiotics, oral hygiene, and appropriate antibacterial treatment. The research concludes with the realization that VAP remains elusive. Future advances in biomarkers may be available and helpful in prompt clinical diagnosis.

Klompas et al.'s (2014) study was published to assist acute-care organizations with implementation of VAP/VAE prevention techniques to improve outcomes for ventilated patients. The CDC VAE framework was divided into six specific sessions. Each session explained the recommendations and implementation strategies. The Four E's were included as part of the 2014 update for VAP prevention.

Klompas et al.'s (2015) study was to assess how to prevent VAEs. The authors proposed that decreased ventilation time and minimizing sedation might speed extubation of ventilated patients. A quantitative method was used. Data were collected on patients using the same VAE definition. VAE incidence, and Spontaneous Awakening Trials (*SATs*) or Spontaneous Breathing Trials (SBTs) performance rates were studied. The outcome of the study was VAE risk and SAT and SBT rates used generalized mixed effects to account for within-unit correlations. There were significant associations between monthly unit levels of SBT and SAT. Between surveillance-only units, there was no significant change in SAT performance and a modest increase in SBT performance rates.

HAIs present a severe problem in the United States. HAI is the leading cause of death in VAP patients, with a mortality rate of 20%–50% (Munaco et al.,

2014; White, Mahanna, Guin, Bora, & Fahy, 2015). HAIs have VAP infections have a reported cost of more than $1.2 billion annually and an estimated cost of $40,000 per cost admission (Gianakis et al, 2015; Munaco et al., 2014). HAI and VAP increase hospital length of stay (Kallet, 2015; Vaz et al., 2015). Length of stay is increased by 6 to 25 days and cost and added an estimated $28 to $33 billion to health costs annually (Munaco et al., 2014; Scott, 2009). HAI and VAP have a major financial impact on patients and healthcare organizations. Therefore, nurse's knowledge of HAI is important to prevent complications of VAP/VAE (Wagner et al., 2015; Goncalves et al., 2015).

Studies have analyzed nurses' theoretical knowledge about specific procedures (Gatell et al., 2012). However, the application of knowledge to practice has received limited attention (Gatell et al., 2012; Wagner et al.,2015). Furthermore, the instruments used were questionnaires or not appropriate. For this DNP project, a pre and posttest will be administered. The CDC considers training a key strategy in reducing VAP incidence and cost (Gatell et al., 2012). This project will examine ICU nurses' knowledge of VAP and VAE.

In 2013, the National Healthcare Safety Network introduced a new surveillance definition of VAP/VAE that includes both contagious and non-contagious complications of mechanical ventilation (CDC, 2017). Because of the new definition and limitations of VAP bundles, an examination of nurses of current prevention is needed. Examination of the knowledge of ICU nurses of the

IHI, CDC, AACN, and MHS campaign is warranted to identify factors that may influence the need to implement new VAP/VAE prevention initiatives.

Role of the DNP Student

The role of the DNP student was to examine the knowledge of ICU nurses' EB interventions of VAEs/VAP prevention according to the IHI, CDC, AACN, and MHS campaign. The DNP student was responsible for evaluating the effectiveness of the project. Pre- and post-evaluation tests of ICU nurses by asking questions to assess whether the project was beneficial in improving their knowledge on VAEs/VAP.

Summary

The project question was: What was the knowledge of ICU nurses of evidence-based interventions included in the IHI, CDC, ACCN and MHS campaign for preventing VAEs/VAP? VAP is an acquired infection that occurs after 48 hours of the time the patient has been intubated (Kallet, 2015). Patients who acquire VAP have longer hospital stays, higher rates of morbidities and mortalities, and increased hospital costs. Critical care nurses understand the importance of education related to VAEs/VAP prevention. ICU nurses bring some knowledge and experience of VAEs/VAP prevention. Malcolm Knowles's adult learning theory was appropiate for this project. Adult learning theory was chosen as a model because adults are most interested in educational topics that have immediate relevance and impact to their work or personal life.

The National Healthcare Safety Network (2013) introduced a new surveillance definition of VAP/VAE that includes both contagious and non-contagious complications of mechanical ventilation (CDC, 2017). Definitions of terms were discussed in this chapter. Six hundred abstracts were reviewed from various websites. Keywords searched were *nursing education*, *interventions, healthcare cost*, *barriers, ventilator associated pneumonia (VAP), ventilator-associated events (VAE), evidence-based practice, adherence,* and *ventilator-associated pneumonia (VAP) initiatives*, *nursing improvement programs,* and *ventilator-associated pneumonia interventions*.

My role as a DNP student was to examine the knowledge of ICU nurses' evidence-based interventions of VAEs/VAP prevention according to the IHI, CDC, AACN and MHS campaign. The DNP student evaluated the effectiveness of the project. In Section 3, I discuss the participants, procedures, and protections associated with this project. The process of collecting and analyzing the pre- and post-data and the process for analysis are also described.

Section 3: Collection and Analysis of Evidence

Introduction

VAP is one of the most serious HAIs for critically ill patients and a leading cause of mortality in ventilator patients (Chen et al., 2015; Goutier et al., 2014; Vaz et al., 2015). HAIs are costly for the hospital and increase patients' length of stay (Gianakis et al, 2015). VAP is a major problem for ICUs. Because of the severity of VAP, major efforts and initiatives have been implemented to prevent it (Kallet, 2015). The purpose of this project was to examine ICU nurses' knowledge of VAP/VAE and evaluate their knowledge of the VAP/VAE post-education program. The prevention of VAP is a national priority and has led to the development of detailed guidelines and EB recommendations (Munaco et al., 2014). Knowledge of this risk is essential; nurses must incorporate it when making decisions about care with respect to VAP/VAE prevention, adherence, and practice (Goncalves et al., 2015; Wagner et al., 2015).

In Section 3, I discuss the participants, procedures, and protection of the participants. I describe the process of collecting and analyzing the pre- and post-intervention and the process of analysis.

Practice-Focused Question

The project question was as follows: What was the knowledge of ICU nurses of evidence-based interventions included in the IHI, CDC, AACN, and MHS campaign for preventing VAEs/VAP? The justification for studying this ICU was related to a high volume of ventilated patients.

Sources of Evidence

A pre- and post-intervention questionnaire, which measured knowledge of VAP (QMKVAP) prevention strategies, was completed by the 58 participants. Permission to use this questionnaire was obtained from the authors, Lin, Lai, and Yang (2014), on July 7, 2017 (Appendix A). The survey consisted of 12 multiple-choice items, each with four possible answers and only one correct answer. The questions were validated by one infection control physician, two chest physicians, and two senior nurses with expertise in VAP (Lin et al., 2014, p. 923). Lin et al. (2014) studied 133 questionnaires that were identified as valid; this equated to an 88.6% response rate. The mean score on the questionnaire was 7.87 ± 1.36, 65.6%. Average scoring and cutoff values were established. The authors divided the respondents into two subgroups (high or low) based upon the score received on the questionnaire. A low score was ≤ 7 correct responses. A high score was ≥ 8 correct responses. The subgroup with the highest scores were 30+ years of age, team leaders, senior RNs, nurses with acute ICU experience (ICU-licensed). All data evaluation was at a $p<0.05$ significance level and a confidence interval of 95%. Multivariant analysis results for ICU RNs ($p = 0.03$) and ranking of RNs ($p = 0.041$) were significantly associated with high scores of respondents. Potential scientific rigor for the instrument related to internal validity were bias in selection of participants, for example, 92% of respondents were female. External weaknesses included the sample size, which was small (133), and limited to nurses in one hospital and one location (Taiwan).

Evidence Generated for the Doctoral Project

Participants

The participants targeted for this DNP project were ICU nurses, especially those in acute-care ICUs. Through this project, ICU nurses gained better understanding of EB education in the prevention of VAEs/VAP and HAIs. This EB project was intended to increase ICU nurses' awareness and participation in improving safety and quality of care for VAEs/VAP patients. The practice setting was an intensive care unit. The organization has four ICUs with 32 total beds. The ICU units are staffed with approximately 75 registered nurses (RNs). The ICU RNs were invited to participate in the project through invitation at staff meetings and ICU bulletin boards.

Procedures

The following steps were followed in planning, implementing, and evaluating this project. The DNP project was submitted for Walden University IRB approval, approval # is 05-01-19-0151966. The DNP project was initiated after receiving IRB approval was obtained. A paper survey was distributed to all ICU nurses who agreed to participate in the project.

Planning. The purpose of this project was to examine ICU nurses' knowledge of EB interventions included in the IHI, CDC, AACN and MHS campaign for preventing VAEs/VAP. A meeting was held with the ICU management team, the staff development specialist (SDS), and I discussed how the organization might improve the VAP scores or obtain zero. A consensus was

the project would be beneficial ICU staff. A multiple-choice examination was administered using paper and pen. The pre- and posttests were assigned numbers for tracking purposes. The QMKVAP was completed by the participants. No identifying information was placed on the questionnaires.

The staff development specialist and I met with the management team to identify the most convenient times and dates for staff to participate. Specially called staff meetings equivalent to mandatory meetings were held. Attendance of the unit staff meetings were held regularly. Several sessions were scheduled to meet the needs of the staff. The DNP student attended VAEs/VAP staff meetings scheduled with the permission of the nurse managers. The DNP student administered the pretest. A PowerPoint presentation was presented. A question and answer period followed the presentation. The posttest was then administered. The learning objective was to examine ICU nurses' knowledge level of evidence based VAEs/VAP prevention.

Implementation. A PowerPoint presentation with handouts were available for staff review. A question-and-answer period followed. The QMKVAP questionnaire was completed post presentation by the participants. ICU nurses were provided with handouts that emphasize the incidence and frequency of occurrence in the unit. The handout and PowerPoint presentation emphasized relevant and attributable risk factors of VAP. Resources detailing VAEs/VAP prevention methods, care bundles, the importance of adherence to VAEs/VAP protocols in practice and use of CDC clinical guidelines were available.

Evaluation. Effectiveness of the PowerPoint presentation was based on posttest scores. If the scores on the knowledge test for the participants increase, this would indicate the information in the presentation improved nurses' knowledge of VAEs/VAP. Participants completed the consent form for anonymous questionnaires found in the DNP Staff Education Manual (Walden, 2018).

Protections. After obtaining site approval, Form A was submitted to Walden University's Institutional Review Board (IRB). Participation in the project was voluntary. The data collection process protected the nurses' privacy. The information is securely locked in a file cabinet in my home office until completion of the project. This de-identified collected data will be kept for 5 years in a password-protected file as required by the Walden University IRB policy.

Analysis and synthesis. Descriptive statistics was used to calculate the frequency of participants' responses. Test scores were reported as a percentage. Additionally, descriptive statistical analysis was calculated, using SPSS v. 25 of demographic variables (age, gender, education level, etc.). A paired-samples *t* test was conducted to evaluate the impact of a survey intervention on knowledge of nurses' knowledge of VAE/VAP using the QMKVAP. Results of the descriptive statistics and the pre- and post-VAP/VAE analysis were shared with the SDS and ICU nurse administrators.

Summary

The project question was as follows: What was the knowledge of ICU nurses of evidence-based interventions included in the IHI, CDC, ACCN and MHS campaign for preventing VAEs/VAP? VAP is a major problem for ICUs. Because of the severity of VAP, major efforts and initiatives have been implemented to prevent VAP (Kallet, 2015). Knowledge of this risk is essential for the nurse to incorporate in making decisions of care as they relate to VAP/VAE prevention and practice (Goncalves et al., 2015; Wagner et al., 2015).

A pre- and post- intervention questionnaire measuring knowledge of VAP (QMKVAP) prevention strategies was completed by ICU nurses. An intervention was presented before the pretest. A question and answer period followed the presentation. The posttest was then administered. Descriptive statistical analysis was calculated, using SPSS v. 25 of demographic variables and a paired-samples *t* test was conducted to examine nurses' knowledge of VAE/VAP using the QMKVAP. Results of the study was shared with ICU nurse administrators.
In Section 4, I discuss the findings, implications, and recommendations for this project.

Section 4: Findings and Recommendations

Introduction

The purpose of this DNP project was to examine the knowledge of ICU nurses regarding the EB interventions for preventing VAEs/VAP. VAEs and VAP are lethal HAIs, with devastating outcomes for critically ill patients. Studies have reported VAP mortality rates as high as 70% for ICU patients. ICU nursing knowledge and skills are required to assess patients at risk for VAP/VAEs. It is important to examine ICU nurses' knowledge so that current practice can be sustained or improved. The learning objective of this project was to examine ICU nurses' knowledge related to EB prevention of VAEs/VAP. This project examined the difference between participants' pretest and posttest scores on the QMKVAP survey following a PowerPoint presentation on VAEs/VAP prevention.

The findings presented in this chapter include the quantitative analysis of the pre-and post-survey data gathered from nurses using the QMKVAP instrument. The EB project question that guided this project was as follows: What is the knowledge of ICU nurses of evidence-based interventions included in the IHI, CDC, ACCN and MHS campaign for preventing VAEs/VAP?

Descriptive statistics included frequencies, ratings, and percentages to describe demographics and participants' scores. Analyses were carried out using the Statistical Package for the Social Sciences for Windows version 25.0.

Findings and Implications

Fifty-nine ICU nurses at the project site were invited to participate in the project; all agreed and were interested in participating in the project. One nurse did not complete the pre-intervention survey and was excluded from the analyses. Therefore, all analyses are for 58 participants. Table 1 gives the demographic profile of the project's participants, who completed the pretest and posttest QMKVAP survey. Participants were asked to provide the following information: age, gender, education level, years of nursing experience, years of ICU experience, years in current ICU, current position, and level of clinical competence. In each case, the answers were provided according to categories for example, instead of providing their specific age, the nurses selected an age group. Table 1 will show that more than 50 of the participants were females (94.8%) while males accounted for 5.3% (n = 3) of the project's participants. The greatest number of ICU nurses in the sample was in the 40-49 age group (27 nurses) and they made up almost half (46.6%) of the nurses in the sample. There were fewer nurses in the other age groups, ranging from X in the 20-29 age group (5.2%) to X in the >60 age group (15.5%). The educational level of the nurses showed that the majority (77.6%) held BS degrees, 20.7% held AS degrees, and only one participant (1.7%) held an MS degree. Because the answers were provided categorically, frequency tables were appropriate and provided the number and percent of individuals in each category.

Table 1
Demographic Information for Participants (N = 58)

Variables	*n*	Percentages
Gender		
Female	55	94.8
Male	3	5.2
Age		
20-29	3	5.2
30-39	7	12.1
40-49	27	46.6
50-59	12	20.7
>60	9	15.5
Years of Nursing Experience		
1-3	3	5.2
3-5	3	5.2
6-10	6	10.3
10-15	26	44.8
>15	20	34.5
Years of ICU Experience		
1-3	4	6.9
3-5	4	6.9
6-10	19	32.8
10-15	13	22.4
>15	18	31.0
Years in Current ICU		
1-3	9	15.5
3-5	19	32.8
6-10	17	29.3
10-15	7	12.1
>15	6	10.3
Clinical Competence		
Novice	3	5.2
Experienced	45	77.6
Expert	10	17.2

In total, 44.8% of the participants had 10-15 years of experience in the nursing profession. It was most common for nurses to have 6-10 years of ICU experience (32.8%). It was most common for the nurses in the sample to have 3-5 years of experience in their current ICU (32.8%). The least common category was >15 years, although there were some nurses in the sample with this level of

experience (10.3%). The most common classification of clinical competency was "Experienced" with 77.6%; the least common was "Novice" with 5.2%. Current position was not included in the frequency table because all the ICU nurses who participated in the survey responded with "staff."

The project question to answer from the data collected was: What is the knowledge of ICU nurses of evidence-based interventions included in the IHI, CDC, ACCN, and MHS campaign for preventing VAEs/VAP? The project participants completed a pre- and post-QMKVAP survey. The project intervention occurred over a period of three weeks to ensure maximum attendance of the nursing shifts. Each occurrence was divided into three phases: pre-intervention, intervention, and post-intervention. In the pre-intervention phase, the nurses were examined using the QMKVAP survey (Table 2). In the intervention phase, a PowerPoint presentation was designed and training sessions were held covering VAE and VAP definition, problem epidemiology and scope, risk factors, etiology, risk reducing methods and endotracheal secretion aspiration procedure. In addition, informative posters were displayed in the ICU conference room, and handouts were available. In the post-intervention phase, nurses were assessed identically to the pre-intervention phase.

The knowledge survey, QMKVAP, was developed by Lin, Lai, and Yang (2014) to examine nurses' knowledge of VAP prevention. The survey consists of 12 multiple choice items with four possible answers and only one correct answer. Average scoring and cutoff values were established. The authors divided the

respondents into two subgroups (high or low) based upon score received on the questionnaire. A low score was (≤ 7) correct responses. A high score was ≥ 8) correct responses. The answers to the questions were divided into two subgroups (pretest scores and posttest scores) based upon score received on the questionnaire. The nurses took the survey both before and after an intervention designed to examine their knowledge.

The percentage of RNs, who answered each item is shown in Table 2. The most well-known EB interventions were about the weaning process and recommended oral care (100%). Thus, the top 2 questions to which nurses answered 100% correctly were Item 6 (when to perform the weaning process; *n* = 58), and item 11(which solution is recommended for oral care; *n* = 58). Item 7 (recommended patient position; *n* = 57, 98.3%) was the second most well-known EB intervention. Participants answered Item 5 (which pathogen does not cause VAP; *n* = 56, 96.5%) correctly. Items 3 oral versus nasal intubation and 8 use of sedative and analgesic agents were the best known EB interventions (54; 93%). The definition of VAP was item 1 (*n* = 51, 87.9%). Followed by item 10 (which intervention can prevent VAP; *n* = 48, 82.7%). In contrast items 12, 2 and 4 EB intervention scores were lower. Item 12 (frequency of oral care; *n* = 40, 68.9%). Item 2 (which is not a clinical feature of VAP; *n* = 36, 62.0%). Item 4 (pathogenesis of VAP; *n* = 34, 58.6%). The least well known EB intervention was Item 9 (use of peptic ulcer prophylaxis; *n*= 20, 34.5%).

The most improved knowledge score was question 9, use of peptic ulcer prophylaxis. The pre-intervention score for the correct answer was (*n* = 20, 34.5%) and post intervention (*n* = 50, 86.2%). One rational for this knowledge deficit may be related to different views in the literature. Researchers report prevention of peptic ulcer disease as a complication of mechanical ventilation has no relation to the prevention of VAP. Some studies have suggested that use of peptic ulcer prophylaxis may increase the incidence of gram-negative aspiration pneumonia. One other consideration as to the knowledge deficit of item 9, is peptic ulcer prophylaxis is use is closer related to EB drug therapy.

Table 2

Nurses' Knowledge of VAE/VAP: Pre- and Posttest Scores for QMKVAP Survey

Questions	Number of Respondents N=58	Number of Respondents N=58	Ratio of Respondents with high scores $\geq$ 8 correct answers of 12 items (%)
1. The definition of VAP, based on ATS guidelines			100
(a) Pneumonia that occurs $\geq$ 48 hours after endotracheal intubation	51	58	
(b) Pneumonia that occurs within 48 hours after endotracheal intubation	3	0	
(c) Pneumonia that occurs $\geq$ 24 hours after endotracheal intubation	3	0	
(d) I do not know	2	0	
2. Which one is not a clinical feature of VAP?			93.1
(a) Fever, productive cough, dyspnea, and rales	8 7	1 57	
(b) Chest radiography shows increased infiltration or consolidation	36 7	0 0	
(c) Clinical pulmonary infection score <5			
(d) I do not know			

(continued)

Questions	Number of Respondents N=58	Number of Respondents N=58	Respondents with high scores ≥ 8 correct answers of 12 items (%)
3. Oral versus nasal route for endotracheal intubation			98.2
(a) Nasal route is recommended	2	1	
(b) Oral route is recommended	54	57	
(c) Both routes are recommended	2	0	
(d) I do not know	0	0	
4. What is the pathogenesis of VAP?			96.6
(a) Via ventilator circuit	16	2	
(b) Via other patients	0	0	
(c) Via oral flora translocation	34	56	
(d) I do not know	8	0	
5. Which pathogen does not cause VAP?			100
(a) Staphylococcus aureus	2	0	
(b) Clostridium difficile	56	58	
(c) Enterobacteriaceae	0	0	
(d) I do not know	0	0	
6. When can we perform the weaning process?	0	0	100
(a) Dopamine >mcg/kg/min	58	58	
(b) Fraction of oxygen <50% and positive end-expiratory pressure <8 cm H2	0	0	
(c) Persistent irritability	0	0	
(d) I do not know			
7. What is the recommended position for ventilated patients?	57	58	100
(a) Semi recumbent position	0	0	
(b) Trendelburg position	0	0	
(c) Prone position	1	0	
(d) I do not know			
8. Use of sedative and analgesic agents			100
(a) Keep SAS within 1-2	2	0	
(b) Daily sedation vacation	54	58	
(c) Give analgesic after the use of sedative agents	1	0	
(d) I do not know	1	0	
9. Use of peptic ulcer prophylaxix			86.2
(a) Can prevent VAP	34	7	
(b) Use only for high risk patients	20	50	
(c) Should not use for ventilated patients	1	1	
(d) I do not know	3	0	

(continued)

10. Which interventions can prevent VAP?			98.3
(a) Use of endotracheal tube with subglottic suction	48	57	
(b) Keep the cuff pressure of the endotracheal tube <20 mm Hg	4	1	
(c) Change ventilator circuit weekly	6	0	
(d) I do not know	0	0	
11. Which solution is recommended for oral care?	58	58	100
(a) 0.12% chlorhexidine	0	0	
(b) Normal saline	0	0	
(c) povidone-iodine	0	0	
(d) I do not know			
12. Frequency of oral care			94.8
(a) Once daily	7	0	
(b) At least once per shift	40	55	
(c) Following suction	11	3	
(d) I do not know	0	0	

Note From, "Critical care nurses' knowledge of measures to prevent ventilator-associated pneumonia." by Lin, H. L., Lai, C.C., & Yang, L.Y. (2014), *American Journal of Infection Control, 42,* p.924

A pre- and post-intervention questionnaire measuring knowledge of VAP QMKVAP. Findings: A paired-samples *t* test was conducted to evaluate the impact of a survey intervention on knowledge of nurses' knowledge of VAE/VAP using the (QMKVAP). Table 3 showed a statistically significant increase on nurses' post survey knowledge of VAE/VAP using the QMKVAP from the pretest (Time 1); $M = 9.55$, $SD = .976$ to the posttest (Time 2) $M = 11.43$, $SD = .775$, $t(57) = -26.884$, $p < .001$ (two-tailed). The mean difference (-1.879) had a 95% confidence interval ranging from -2.019 to -1.739 (see Table 4).

Table 3

Paired-Samples Statistics (N = 58)

	Mean	*n*	Standard Deviation	Standard Error Mean
Pre intervention	9.55	58	.976	.128
Post intervention	11.43	58	.775	.102

Table 4:

Paired Samples of 2-tail t-Test (N = 58)

				Paired Differences				Sig. (2-tailed)
				Mean	Standard Deviation			
Pre intervention – Post intervention	-1.879	.532	.070	-2.019	-1.739	-26.884	57	.000

Implications

The decision to change behavior to impact performance was not the principal focus of this project. The purpose of this project was to examine nurses' knowledge of EB interventions included in the IHI, CDC, ACCN, and MHS campaign for preventing VAP/VAEs using the QMKVAP survey. The QMKVAP questionnaire provided an examination of nurses' knowledge of VAP/VAE prevention. There was a statistically significant increase in the knowledge scores of the ICU nurses following the intervention level of significance $p < .001$.

Overall, a reasonable level of knowledge was observed in the nurses' scores. This may be related to education, ICU policies, frequent nursing care, and provision of adequate information, which are implemented into practice. The results of the knowledge survey show an indication of knowledge and awareness of VAP/VAE prevention.

There is a need for ongoing education of VAP and VAE prevention. As ventilated supported patients are more at risk for complications, nurses working in the ICU must keep abreast of new knowledge and update expertise to develop technical and clinical skills in daily practice (Goncalves et al., 2015). Training programs improve nurses' awareness of VAP/VAE prevention protocols. The results of this project may be used to inform practice and stimulate discussion of theoretical knowledge into clinical practice. Further studies are needed for examination of educational awareness programs related to VAE and VAP. Education, guidelines, bundles, and instruments should be developed and updated to improve hospital-acquired infections.

Recommendations

VAP and VAE have a significant financial impact on patients and healthcare organizations. Prevention of VAP/VAEs has the potential to decrease the length of stay, decrease costs, improve patient-related outcomes, improve patient safety, improve quality of care delivered, and improve customer satisfaction. Therefore, nurse's knowledge is important to prevent complications of VAP/VAE.

Recommendations should be geared toward discussion the need to implement updated VAP/VAE prevention protocol and bundles. In 2013, the National Healthcare Safety Network introduced a new surveillance definition of VAP/VAE that includes both contagious and non- contagious complications of mechanical ventilation (CDC, 2017). Considering changes in definition, and the term VAEs has replaced VAP in the adult population. However, VAE protocols and bundles are limited. Therefore, further research is recommended to identify if VAEs prevention protocols or bundles should be developed. Most of the questionnaires in practice are more geared toward VAP versus VAE. The study should be expanded in number of participants and to other populations, because this study was conducted in one organization.

Strengths and Limitations of the Project

Strengths

The instrument used in this project KMVAP was valid and reliable. This questionnaire was developed by Lin et al. (2014) to examine nurses' knowledge of VAP prevention. The survey consisted of 12 multiple choice items with four possible answers and only one correct answer. The questions were validated by one infection control physician, two chest physicians, and two senior nurses with expertise in VAP (p. 923). One hundred thirty-three study questionnaires were identified as valid, which equated to an 88.6% response rate.

According to Polit (2013), *reliability* means the tool is consistent and accurate and delivers the measures that it is designed to measure. The data

collection tool used was appropriately tested to examine knowledge of VAP prevention. Another strength of this project was staff engagement and commitment to ensuring they had current knowledge of VAP/VAE prevention measures. Additionally, the results of this project can be used by ICU units to develop educational programs to accentuate nurses' knowledge and skills related to VAE prevention.

Limitations

There are a few limitations to this project. First, the sample was gathered from ICU nurses in one practice setting. The sampling was nonprobability. This study was conducted in a large urban hospital with a single location. Another weakness of this study was the small sample size (N=58). Consequently, it may be difficult to generalize the results. Although there were multiple sessions held, timing was a factor, which hampered full participation. Finally, the higher post-scores may have been influenced by memorization of answers from the pretest, which was completed first.

Summary

The findings presented in this chapter include the quantitative analysis of the pre-and post-survey data gathered from nurses using the QMKVAP instrument. The EB project question that guided this project was as follows: What is the knowledge of ICU nurses of evidence-based interventions included in the IHI, CDC, ACCN, and MHS campaign for preventing VAEs/VAP?

Descriptive statistics included frequencies, ratings, and percentages to describe demographics and participants' scores. Analyses were carried out using the Statistical Package for the Social Sciences for Windows version 25.0.

A pre- and post-intervention questionnaire measuring knowledge of VAP QMKVAP. Findings of the paired-samples *t* test were examined to evaluate the impact of a survey intervention on knowledge of nurses' knowledge of VAE/VAP using the QMKVAP. A statistically significant increase on nurses' post survey knowledge of VAE/VAP using the QMKVAP from the pretest (Time 1); $M = 9.55$, $SD = .976$ to the posttest (Time 2) $M = 11.43$, $SD = .775$, $t(57) = -26.884$, $p < .001$ (two-tailed). The mean difference (-1.879) had a 95% confidence interval ranging from -2.019 to -1.739. Recommendations from this study should be geared toward future discussions to implement and updated VAP/VAE prevention protocol and bundles.

Section 5: Dissemination Plan

Organizational Dissemination Plan

This DNP project was conducted in a large urban acute-care facility. The organization houses four critical care units. The ICU units specialized in care of cardiac, medical, surgical, and thoracic patients. These ICU units had a high volume of ventilated patients. The organization had an effective infection prevention program in place, which included VAP/VAE prevention and surveillance.

To disseminate the results of this project to the organization, I plan to present the results to the stakeholders through a poster presentation. I plan to seek opportunities to disseminate the work in the future. I also plan to publish in the *Journal of Critical Care*. The project can serve to inform nursing leadership educational programs to improve nurses' knowledge and practice of VAP/VAE prevention.

Analysis of Self

Scholar

The doctoral scholar individual developmental plan (2010) has six competencies:

- Discipline-specific knowledge
- Research skill development
- Communication skills
- Professionalism

- Leadership and management skills
- Responsible conduct of research

This project provided the opportunity to develop the six scholarly competencies listed above through (a) communications and interactions with staff and leadership, (b) presentation of material, (c) use of library resources, (d) obtaining research skills and knowledge, (e) gaining specific knowledge of topic and discipline, and (f) adding knowledge to the profession conversation.

Experience in critical care, experience as an educator and manager, and preparation as a DNP have enhanced my understanding, knowledge, and awareness as healthcare leader to engage in advocacy and integrate skills of collaboration and use of technology to demonstrate the value of the nursing profession and increase clinical scholarship and EB care. Additionally, developing and implementing this EB project has increased my confidence, skills, and ability to develop projects and strategically evaluate the results.

Practitioner

As a practitioner, I have learned that caring for various populations of patients can be challenging and rewarding, sometimes consecutively. Healthcare is in a constant state of change, which presents opportunities to improve the quality of care delivered as well as effect and lead healthcare practice changes. As a DNP student, I have learned that I am better prepared to accept advance assignments and complete them successfully. I feel confident that I am equipped

to lead and advance healthcare initiatives in the future. I recognize that I have the knowledge and skills to impact healthcare at a high level.

One of the experiences of the Walden DNP program is the DNP Intensive Retreat, led by Dr. Diana Whitehead. I attended the retreat and honestly, I am not sure I could have completed the prospectus or the beginning of the proposal without attending the DNP Intensive. The DNP Intensive Retreat provided valuable resources, which helped improve my writing skills.

Therefore, I consider myself a valuable asset to any organization. Additionally, my DNP program has given me the mindset to embrace and impact society in a positive way. Thus, the DNP program has made a difference in my personal and professional life.

Project Developer

I thought developing this project would be easy because of my familiarity with the subject. However, to my surprise, this was often challenging and frustrating. This project started as an educational module and was changed due to various setbacks. Within the organization, too, there were barriers as stakeholders' roles changed. Time management skills were key, as I worked full time while completing the project. Throughout this process, my leadership skills and knowledge have broadened.

As with any project, there are situations that define the moments of one's journey. Two events defined this journey as distinct and memorable. I sustained an injury while working on this project. Because of the injury, I was incapacitated

for seven months, during which I had to take a break from the project. Additionally, working through the IRB requirements, appropriate site documents and feedback responses created another set of stressful events. Although the events surrounding the project and stressors were great, the learning experience has proven greater.

Professional

Professionally, I know I have grown immensely. As a masters-prepared nurse, I thought I had gained a wealth of knowledge, skills, and tools to advance myself and the practice. Although I felt accomplished after gaining my master's, the DNP program has provided so much more knowledge and opened my mind to new perspectives and ways of thinking.

Summary

The DNP project focuses on the knowledge of ICU nurses regarding the EB interventions contained in the IHI, CDC, and MHS partnership for patients' campaign for preventing VAP/VAEs. The QMKVAP provided an examination of nurses' knowledge of VAP/VAE prevention. There was a statistically significant increase in the knowledge scores of the ICU nurses following the intervention level of significance $p < .001$.

The results of the test show clear indication of knowledge and awareness of VAP/VAE prevention. In conclusion, ongoing education of VAP and VAE prevention is important. As ventilator-supported patients are more at risk for

complications, nurses working in the ICU must maintain current and add new knowledge.

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Appendix A: Permission to Use QMPVAP Questionnaire

Request permission to use your tool
Dorothy J. Sanders-Thompson <dorothy.thompson2@waldenu.edu>
Fri 7/7/2017, 12:44 AM
Dr. Yang,
Thank you very much for your permission. I will cite the reference in my future publications.
Sincerely,
Dorothy
LIYU <a885019@kmu.edu.tw>
Reply all|

Fri 7/7/2017, 12:34 AM
Dorothy J. Sanders-Thompson <dorothy.thompson2@waldenu.edu>
Flag for follow up. Start by Friday, July 07, 2017. Due by Friday, July 07, 2017.

Action Items
Dear Dorothy,
Permission is gladly given to you to use the questionnaire from our article: "Critical care nurses' knowledge of measures to prevent ventilator-associated pneumonia" for scientific/medical purposes. Please cite the reference in your future publications.
Sincerely
Li-Yu

On Thu, 6 Jul 2017 17:16:48 +0000, Dorothy J. Sanders-Thompson wrote
Dorothy J. Sanders-Thompson <dorothy.thompson2@waldenu.edu>
Thu 7/6/2017, 12:16 PM
Hello Dr. Yang,
My name is Dorothy Sanders-Thompson. I am a doctoral student at Walden University in the U.S.A. I am working on a capstone project as part of my degree completion.
My Doctor of Nursing Practice (DNP) project is to educate ICU nurses on Ventilator-Associated Pneumonia. I am requesting permission to use your questionnaire from your article: "Critical care nurses' knowledge of measures to prevent ventilator-associated pneumonia". Also, I would appreciate any other materials you feel are helpful. An approximate number of critical care nurses to participate in the project is 60-75.
Thank you in advance for consideration for use of your instrument.
Dorothy Sanders-Thompson
Doctoral student @ Walden University
dorothy.thompson2@waldenu.edu

Appendix B: Demographic Form

All identifying information will be used only for the purposes of the study.

1. What is your gender?
_____ Female _____ Male

2. Which category below includes your age?
_____ 20-29 years old
_____ 30-39 years old
_____ 40-49 years old
_____ 50-59 years old
_____ 60 years or older

3. What is the highest level of education you have completed?
_____ Associate degree
_____ Bachelor's degree
_____ Master's degree
_____ Doctorate degree
_____ Others:

4. How long have you been a nurse?
_____ 1-3 years _____3-5 years _____6-10 years_____10-15years_____ > 15 years

5. How long have you been an ICU nurse?
_____1-3 year _____3-5 years _____6-10 years ____ 10-15 years _____ > 15 years

6. How long have you been in this ICU?
_____1-3 year _____3-5 years _____6-10 years _____10-15 years_____ > 15 years

7. What is your current position?
_____ Staff RN
_____ Clinical Nurse Leader
_____ Manager/Supervisor

8. What is your current clinical competence?
_____ Novice RN
_____ Experienced RN
_____ Expert RN