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Regis University
Rueckert-Hartman College for Health Professions
Loretto Heights School of Nursing
Doctor of Nursing Practice Capstone Project

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NR706C Use of High Volume Low Pressure Microcuffed Endotracheal Tubes to Reduce
Ventilator Associated Pneumonia.

Joyce M. Page

Submitted to Dr. Christine Finn, RN in partial fulfillment of

NR706C Capstone Project

Regis University

July 28, 2013

Abstract

Ventilator associated pneumonia (VAP), a major source of infection in Intensive Care Unit (ICU) that leads to higher mortality and cost. The PICO format is: Population: Adults with endotracheal tube (ETT) intubations during ICU stay. Intervention: The ® Kimberly Clark High Volume Low Pressure Micro Cuffed (KC) ETT for adults intubated in ICU. Comparison: The High Volume Low Pressure ETT ®Mallinckrodt (MK). Outcome: Reduce VAP incidence and improve patient outcomes. Do ICU adults intubated with KC ETTs have fewer VAPs than those intubated with the MK? VAP starts with pathogen's (Craven, 2006). Deem and Treggiari (2010) believes the ETT does impacts this pneumonia. Spiegel (2010) feels the newer cuffed ETTs seals the trachea, reducing aspirations, and that reduces VAP. Did the KC ETT decrease VAP incidence, compared to the MK? The main objectives are to determine if there are decreased VAPs with the KC ETT compared to the MK. Did compliance to the VB remain 100%, and did the number of ventilator days make any difference in the two ETTs and VAP rates. A descriptive retrospective data showed no significant difference in the number of VAPs based on the ETTs. There were more ventilator days with the KC; 821 than the MK at 580 indicating a difference between the number of ventilator days. The VAP rates for MK 1.7, the KC was 2.4. VB compliance did remain 100%.

Key words: VAP, ETTs design, Kurt Lewin CT, DNP Capstone Project

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EXECUTIVE SUMMARY

Problem

The practice issue is, that even with ventilator bundles (VB) at 100% compliance, ventilator associated pneumonia (VAP) is a major source of infection in the Intensive Care Unit (ICU), and leads to higher mortality and cost in the intubated adult patient. The PICO format is: Population: Adults with endotracheal tube (ETT) intubations during ICU stay. Intervention: The ® Kimberly Clark High Volume Low Pressure Micro Cuffed (KC) ETT for adults intubated in ICU.

Comparison: The High Volume Low Pressure ETT the ®Mallinckrodt (MK). Outcome: Reduce VAPs in ICU and improve patient outcomes. While in ICU, do adults intubated with KC ETTs have fewer VAPs than those intubated with the MK? Evidence shows that VAP starts with pathogen's (Craven, 2006). Deem and Treggiari (2010) agree, and supports VAP prevention at the time of the intubation and believes the design of the ETT impacts VAP incidence. Spiegel (2010) supports the use of the KC ETT and feels this newer cuff seals the trachea better and reduces aspirations, and that reduces VAP.

Purpose

The purpose of the Capstone Project (CP) was to determine if the KC ETT resulted in a decrease in VAP incidence, compared to the MK. Investigation into the role that the ETT plays in the reduction of a VAP must continue to be pursued.

Goal

The main goal to provide the best evidenced based practice (EBP) interventions to assure the most favorable outcome to the intubated and mechanically ventilated (MV) adult ICU patient.

Objectives

The main objectives were to determine if there are decreased VAPs with the KC ETT compared to the MK. Did compliance to the VB remain 100%, and did the number of ventilator days make any difference in the two ETTs and VAP rates.

Plan

Outcome plans: evaluate equally in twelve month periods the KC and MK on VAP incidence, VB compliance, ventilator days and VAP rates in the KC and MK in comparative periods. Application of the two-sample t-test, p value of .05, and a confidence interval of 95%, used to aid in the analysis, reliability and validity of the findings, and in the interpretation of the results of the outcomes identified. All findings will be disseminated.

Outcomes and Results

The CP results using the two sample t-test showed that there was no significant difference in the number of VAPs based on the two ETTs; there were more ventilator days with the KC at 821 than the MK at 580 which indicates there was a significant difference between the numbers of ventilator days. The VAP rates/1000ventilator days, for the two ETTs were as follows: MK VAP rate was 1.7 and the KC was a 2.4 VAP rate. In addition, the VB compliance remained at 100% for both 12 month time periods.

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Thank you all for your contribution and support these past two years.

May you always keep shining in the lives of others.

Very Respectfully,

Joyce P

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Use of High Volume Low Pressure Microcuffed Endotracheal Tubes to Reduce Ventilator Associated Pneumonia.

What is a Capstone Project (CP) and how does it relate to preventing ventilator associated pneumonias (VAP)? The CP is the final step of the Doctorate of Nursing Practice (DNP) program. It is reflecting a demonstration of synthesis and mastery of an advanced subject within the practice of nursing by the student completing their final academic steps (Zaccagnini & White, 2011). The purpose of a CP is to improve a practice and or a patient care outcome, and also set the tone for continuous improvement through evidence based practice (EBP) interventions (Zaccagnini & White, 2011).

The purpose of this project and paper was to provide in writing the CP problem recognition and definition, review of evidence, project plan and evaluation, project findings and results, limitations, recommendations, and implications for change with the aim of determining if the evidence indicates that the use of the newer designed endotracheal tubes (ETTs) did result in decreased VAP incidence and did promote better patient care outcomes.

Problem Recognition and Definition

Statement of Purpose Appropriate for Evidence-based Project

The main purpose of this CP was to ascertain whether there is strong evidence to support the use of newer designed ETT like the polyurethane ®Kimberly Clark high volume low pressure microcuffed (KCHVLPMC) ultrathin tube in decreasing VAP rates, compared to other high volume low pressure tube designs like the ®Mallinckrodt (MK). In addition, did investigation into the role that the two ETT designs play in the reduction of VAPs need to be pursued further. This could possibly save lives, decrease mortality and morbidity, reduce health care costs, and hospital days and result in better patient care outcomes.

Problem Statement/Change Clearly Identified

Starting out with the practice issue of concern, and using the recognized abbreviation PICO which includes the Population of concern, Intervention, Comparison method, and Outcome (PICO); a PICO statement was created, data was collected that could possibly support changes in practice that are evidence based and best practice methods, thus resulting in better patient care outcomes. The problem issue clearly identified was that there remains an increased incidence of VAP in spite of ventilator bundle (VB) protocols and 100% ventilator quality indicator (QI) compliance, and other EBP strategies. Based upon the evidence VAP is still occurring and remains a leading cause of hospital acquired infections (HAIs) (Bird, Zambuto, O'Donnel, Silva, Korn, Burke, Burke, & Agarwal, 2010). Further inquiry into the problem issue was constructed as an EBP question and included the patient population, intervention, comparison, and outcome, known as PICO.

PICO Articulated and Leads to Question

The PICO Format: In adult patients undergoing oral intubation while hospitalized in Intensive Care Unit (ICU), do patients who are orally intubated with the KCHVLPMC ETT have fewer VAPs than those who are intubated with other high volume low pressure ETTs like the MK? The PICO format is:

P-Population: Adults with oral ETT intubations during ICU hospitalization.

I-Intervention: Use of improved KCHVLPMC ETT for adult oral intubations in ICU.

C-Comparison: Another high volume low pressure ETT like the MK.

O-Outcome: Reduce or eliminate all incidences of VAP in ICU and provide better patient care outcomes.

The final question is: In adult ICU patients undergoing oral intubation while hospitalized in ICU, do patients who are orally intubated with the KCHVLPMC ETT have fewer VAPs than those who are intubated with other commercially designed high volume low pressure ETTs?

Project Significance, Scope, and Rationale

The project significance is VAP continues to be a major infection in ICU, leading to higher morbidity and mortality and an overwhelming health care cost factor in the intubated adult patient population. Conducting this CP was an exceptional opportunity to possibly play an important part in reducing the occurrence of this pneumonia. VAP is linked with the ETT instrumentation used to maintain the airway (Deem & Treggiari, 2010). The ETT can contribute to the aspiration of infected secretions that can establish just the right environment for a VAP to develop (Deem & Treggiari, 2010). It is critical that future research into the effects the ETT design has on the prevention of VAP be continued (Deem & Treggiari, 2010). It is equally important that future studies of ETTs designed to prevent VAP demonstrate effectiveness, and show evidence of improved patient care outcomes, safety, and cost (Deem & Treggiari, 2010). A multifaceted approach that includes the use of the ventilator bundle (VB) along with the initiation of the newer designed KCHVLPMC ETT may reduce VAP incidence and this method should be investigated further to determine its effectiveness and, that was the main rationale for this CP. Add to this, all VAP incidences from hospitals are also reported to the Center for Disease Control and Prevention (CDC) and are available to the community for viewing. This data is often used by the public when choosing a hospital for care delivery. Preventing VAP is a huge priority in ICU and adding to this precedence is the pressure being put on hospitals to

eliminate HAIs like VAP or face reductions in reimbursement from health insurance providers like Medicare and Medicaid and others (Bird et al., 2010).

Evidence suggests a VAP starts with a host factor and pathogen (Craven, 2006). Knowing this, several different prevention guidelines must be initiated at the time of the intubation. Pulmonary experts like Deem and Treggiari (2010) and Blot, Rello, and Vogelaers (2011) agree guidelines should focus on reducing the host factor and colonization of pathogens that contribute to a VAP. Craven (2006) realized prevention of aspiration into the lung field, effective antibiotic treatment, limited, or omitting the use of invasive devices such as nasal intubation and gastric tubes are areas for primary focus.

Even with the initiation of preventive measures and the development of VAP standing orders, hospitals still have not reached the expected number of reduced occurrences. The evidence suggests perhaps the design of the ETT being used for intubations may be a contributing factor to the lack of reduction of VAP incidence. However, Spiegel (2010) reports not being convinced that changing the design or contour of the ETT will reduce the VAP occurrences but does feel there is merit in changes in the cuff design which may improve sealing the trachea area better. This may reduce aspiration of contaminated secretions, which in turn may decrease VAP occurrences.

The KCHVLPMC ETT is an ultrathin high volume ultra low pressure cuff specifically invented to be above average in sealing the trachea location (Spiegel, 2010). Lorente, Blot, and Rello (2010) reports newer strategies such as the design of a ETT that is an ultrathin cuffed and low-volume low pressure cuff device is also being investigated as a possible answer to the reduction of VAP incidence. In 2008, a study conducted at a hospital in Tampa, Florida using the KCHVLPMC ETT demonstrated a 60% drop in VAP's as reported by the Head of Anesthesia

(Karnoski, Kolla, Munoz, Downes, Thompson, Klacsan, & Kelley, n.d.). Spiegel (2010) also reported this ETT showed a 43% decrease in VAP incidence. On the basis of this evidence and support, there is justification for further research into what is best in practice, and it should be pursued.

Theoretical Foundation for Project and Change

The theoretical foundation for the CP and any possible change in practice incorporates the use of the Kurt Lewin change theory (CT) known as unfreeze, change, and refreeze stages and would contribute even further in the successful implementation of EBP changes that promote the best patient outcome. The best patient care outcome would be recognized as evident by the reduction of VAP occurrences in ICU. First, unfreeze the present practice which was done in January 2012 when the KCHVLP MC ETT replaced the MK ETT. Next, make the change, which was done and started January 2012 with the implementation of the KC tube for all adult intubations, and evaluate the outcome over a stated period of time. If the change results in a reduction of VAP incidence and better patient care outcomes were achieved, refreeze the practice and keep the KCHVLP ETT. Next, it would be important to establish procedures and policies to preserve the practice until another change is deemed necessary (Kaminski, 2011).

Literature Selection/Systematic Review of Literature/Process Supports Problem

A literature selection and systematic process supporting the VAP problem was conducted. The literature subject goal of the CP was to address the problems associated with VAP incidence, and to better understand the difficulties involved, in hope of finding improved EBP interventions that contribute to the best outcome possible for the patient. An extensive literature review by means of a systematic process was conducted over the entire course of the DNP program. Using databases such as PUBMED, CINAHL, MD Consult, Cochrane, MEDLINE Agency for

Healthcare Quality and Research (AHRQ) and searching key words including ETT designs, VAP prevention, VB protocol, EBP, CDC definition of a VAP and Kurt Lewin's CT, and searching for levels of evidence that included levels I, II, III, IV, and V, and that were creditable based on systematic reviews, meta-analysis, randomized control trials (RCT), or evidence of one or more RCTs, case studies, qualitative studies or expert opinions. Included in this paper is the systematic review carried out to support the CP problem and practice issue of on-going VAP incidence (Appendix A). Need to add a sentence here that states the number of articles you found, how you narrow and your final number of articles included in your review and application to this project.

Scope of Evidence is Summarized and Appropriate

The scope of evidence summation clearly reveals the practice issue of concern, which is VAP continues to be a major source of HAI in ICU, and contributes to higher morbidity and mortality and an overwhelming health care costs in this intubated adult patient population. The evidence is strong that a VAP starts with a host factor and pathogen. Knowing this, several different prevention guidelines must be initiated at the time of the intubation. These guidelines should focus on reducing the host factor and colonization of pathogens that contribute to a VAP. As stated earlier, Craven (2006) did realize prevention of aspiration into the lung field, antibiotic treatment, and limiting or omitting the use of invasive devices such as nasal intubations, nasal gastric tubes, and even central venous lines inserted up at the neck location are areas that must be of primary focus.

Even with the initiation of preventive measures, and the development of VAP standing orders, hospitals still have not reached the expected number of reduced occurrences, which is set at reaching a zero in events (Wahl, Zalewski, & Hemmila, 2011). The evidence continues to support that perhaps the design of the ETT being used for intubations may be a contributing

factor to the lack of reduction in VAP incidence. As has been noted, Spiegel (2010) is not yet convinced changing the design or contour of the ETT will reduce the VAP occurrences but does feel there is merit in changes in the cuff design which has shown improved sealing of the trachea area better, and this may reduce aspiration of contaminated secretions, and that may decrease this type of pneumonia.

The KCHVLP ETT is an ultra low pressure cuff specifically invented to be above average in sealing in the trachea and, Spiegel, (2010) believes this is reducing the aspiration of contaminated secretions that contribute to VAP. Lorente, Blot, and Rello (2010) reported that newer strategies such as the design of ETT to be ultrathin cuffed and low-volume low pressure cuff devices are also a possible answer to the reduction of VAP because it too has demonstrated a reduction of the aspiration of these infected secretions. It is evident that further research into what is best in practice should be pursued. If the hospital in Florida who reported after using the KCHVLPMC ETT in practice showed a 60% drop in VAPs perhaps more healthcare facilities could as well.

Review of Evidence

Background of the Problem

The literature review on the background and problem of continued and persistent VAP incidence was executed. It concludes, in spite of the current strategies to prevent VAP in the mechanical ventilated (MV) adult ICU patient, this pneumonia remains the second most common HAI and carries a high mortality rate (Blot et al., 2011). It is an all encompassing and costly HAI is significantly related with the invasion of the ETT instrument used to maintain an airway (Blot et al., 2011). Contaminated secretions or fluids can bypass the ETT cuff and establish an

environment in the lungs is right for bacterial infections to grow and develop into a VAP (Blot et al., 2011).

Systematic Review of the Literature

The systematic review of the literature substantiated that VAP is a hospital acquired pneumonia (HAP) and could affect a great number of people in the 18 years or older age group and rise significantly in the 65+ age group. It is one of the most common HAI in adult ICUs and a significant concern of clinicians today (Bird et al., 2010). It may account for up to 60 percent of all deaths from HAIs in the United States (U.S.) (Bird et al. 2010). Other key U.S. statistics includes the following: Approximately eight to 28 percent of critical care patients intubated during their stay in ICU will develop a VAP (Bird et al. 2010). This patient population carries a mortality rate of 15 to 25 percent (Bird et al., 2010). Add to this, mortality and morbidity of a VAP can be induced by other unpredictable variables which can affect this patient population, such as the timing of the onset of pneumonia, other diagnostic lines of attack, other contributing organism, and delays of needed interventions (Bird et al., 2010). VAP also increases the adult patient population time in the ICU by four to six days, and prevention of VAP is a main priority in all ICUs throughout the nation (Bird et al., 2010). VAP though reduced in incidence has not reached a zero percent rate. In some cases 10.2 VAP cases /1000 ventilator days has been reported in some trauma ICUs (Bird et al., 2010). In spite of the current strategies to prevent VAP in the MV adult ICU patient, this pneumonia still remains the second most common HAI and still carries a high mortality rate (Blot et al. 2011). It is a costly HAI that is significantly related with the invasion of the ETT instrument used to maintain an airway (Blot et al., 2011). The contaminated secretions or fluids as already stated earlier can bypass the ETT cuff and

establish an environment in the lungs that is right for infections to grow and develop into a VAP (Blot et al., 2011). VAP prevention will most likely be best achieved by a multifaceted approach. This means not only with the continuation of current VAP prevention strategies such as basic infection control methods like excellent hand hygiene, proper patient positioning, effective mouth care, early removal of the ETT, but also considering the use of the newer designed ETT currently available and showing evidence of VAP incidence reduction.

Deem and Treiggari (2010) support the newer designed ETTs demonstrates evidence of VAP reduction must continue to be explored. Deem and Treiggari (2010) also believes there is strong support that further investigation into the effectiveness of current VAP prevention strategies along with novel prevention strategies like the newer designed ETT must continue. It is possible better patient care outcomes can be realized and reached with a multifaceted approach to VAP prevention strategies (Deem & Treiggari, 2010).

In 2010, the U.S. Census Bureau reported that the age group 65 and older is growing faster than the total U.S. population (United States Census Bureau, 2011). A hospital in the northern section of the U.S. where the data for the CP was obtained is a state identified as having above national average in the number of older adults 65+ age category (United States Census Bureau, 2011). The major population at risk for a VAP is the adult patient who requires oral intubation while hospitalized in the ICU and was the key population of interest for the CP. This population is also often prone to infection just by the nature of the stressful hospital environment. Therefore, further investigation into the effectiveness of current VAP prevention strategies along with novel prevention strategies like the newer designed ETT must be followed.

Project Plan and Evaluation

Market/Risk Analysis

The strength, weakness, opportunity, and threat (SWOT) market/risk analysis was conducted on the CP and did aid in identifying the driving and restraining forces of the project. A SWOT analysis model was effective in guiding and identifying the health promotion and disease prevention needs for the population identified as at risk for a VAP, which is the adult patient who requires oral intubation while hospitalized in the ICU. Table 1 is the modified SWOT analysis conducted to target VAP rate reduction. It contains the lists of the identified strengths, weaknesses, opportunities, and threats that were the most beneficial acknowledgements utilized when searching for the most effective VAP prevention strategies.

Project Strength, Weaknesses, Opportunities, and Threats

Table 1.

SWOT Analysis

Internal	Strengths:	Weaknesses:
	<ul style="list-style-type: none"> • Staff at all levels of the organization are ready to get serious about HAI and VAP infection rates • Policies and procedures to prevent the spread of infection are being enforced (Isolation). Hand washing before and after contact with the patient (pt) • Ventilator Bundles are automatically initiated upon intubation followed by mechanical ventilation • Endotracheal tube to reduce VAP incidence are trialed and used in all departments who intubate pts. • Reward system in place to reward doing an excellent job and keeping the HAI and VAP rates down • Equipment and Technology 	<ul style="list-style-type: none"> • Lack of sense of accountability from some healthcare providers • Ventilator Bundle implemented but not followed with 100% compliance • Staff cut corners and are resistant to change (don't follow isolation policies consistently) • Inadequate or inappropriate staffing ratios • CDC guidelines for the definition of a VAP vague and interpretation difficult and at times challenged • Visitors and family members are not always supporting the cause to prevent the spread of infection in the pt room • Poor communication
Internal	Opportunities:	Threats:
	<ul style="list-style-type: none"> • Patient and family involvement in infection control • Keep entire organization engaged with changes in practice with effective and ongoing communication and policing each other • Promote standardized practice for cleaning a room while occupied and after vacancy • Get pharmacy involved and improve effective antibiotic usage • Provide regular updates on HAI and VAP rates • Re-evaluate rates and publish on a community board with a data analysis graphic chart • Educate hospital associates in all departments on the non-payment for HAI occurring in the US hospitals • Engage and involve multi-professional rounding and include pt and family • Literature Search for Best Practice Protocols 	<ul style="list-style-type: none"> • Making public aware of HAI and VAP rates when not favorable • Financial ramification • Other priorities competing for time and resources • Doing nothing until forced to change • Lack of education of VAP threat • Poor hand hygiene • Poor compliance to policies/procedures/protocols • Poor staffing and ineffective leadership • Lack of resources • Other hospital departments that provide care to the pt besides the ICU

Driving/Restraining Forces

The driving force identified to implement the most current EBP VAP prevention strategies was to assure the MV ICU patient receives the best patient outcome possible. The restraining force to that possibility was identified and listed as weaknesses in the SWOT analysis, and was seen in the supply and demand areas of manpower. Being able to sustain a full workforce of qualified registered nurses (RN) and certified respiratory therapists (RT) was seen as a possible concern. Retention and recruitment of such skilled professional staff members will always have an impact on maintaining high quality care. The evidence indicates nurse-to-patient ratios are directly correlated to patient care outcomes (Aiken, Clarke, Slogane, Lake, & Cheney, 2009). In an effort to maintain high quality care to the MV patient in ICU ongoing efforts to retain and recruit highly qualified professional staff remains a priority at the facility where the CP was conducted in their 20 bed mixed ICU. Since a newly formed merger with a large healthcare service organization in July 2012, the hospital where the CP was conducted currently remains dedicated to providing their patients the best EBP care, which includes the use of the newer designed KCHVLPMC ETT for all intubations performed in their ICU. As a result of this merger a change in the ETT product other than the KCHVLPMC tube could be considered in the future, regardless of the outcome of this project. To date it remains the ETT of choice and has been throughout the CP process.

Need, Resources, and Sustainability

Vital implementation and ongoing monitoring of the project plan in order to facilitate any requested changes was conducted, and was based on the need, resources, and sustainability of the plan. The biggest need identified was the need to achieve Institution Review Board (IRB) approvals from Regis University, and the hospital granting permission for the CP to be

conducted on their adult MV ICU patient population and keep the CP on the proposed timetable to be met. The resources in the form of data retrieval, and the staff who provided such for the CP were provided in a timely fashion, and after IRB approvals had been granted. Based on the ability to complete the CP in the time allotted sustainability was maintained with no real issues experienced.

Feasibility/Risks/Unintended Consequences

The information achieved through the CP is feasible and applicable in the day to day care of the MV patient and is currently being practiced in the ICU where the project was conducted. As far as a risk benefit analysis there was no direct risk to the patient population that data was collected on for the CP. All of the information collected came from a retrospective data source. The greatest benefit is keeping MV patients from further VAP incidence; that starts on day one with implementation of the VB. This includes assuring that the ventilator QI is done every day and documentation of best strategies to prevent VAP occurrence are implemented and strictly adhered to. There were no unintended consequences identified as a result of the CP data collection process.

Stakeholders and Project Team

The author's opinion is that stakeholders are seen as any person, group or organization, members, or system that could be affected by an organization's action. The stakeholders and project team members of the CP associated with VAP prevention were recognized as the adult ICU intubated patient and family members who were affected the most from the delivery of care outcome. Next were the members of the VAP committee where the CP was conducted which were, the Medical Director of Critical Care, the Director of Nursing, the Critical Care Unit (CCU/ICU) Nurse Manager and Clinical Nurse Educator and Chairperson, the Respiratory

Therapy Manager and Coordinator, the Infectious Disease (ID) Nurse, and at times the Chief Nurse Officer (CNO) during a VAP occurrence investigation and review process. Also included were the staff members in CCU/ICU, the organization, and the author's mentor and chairperson who provided guidance and support throughout the CP.

Cost/Benefit Analysis

A process that must be conducted when considering a practice change is the cost-benefit analysis (Longest, 2010). One question to be considered is, can the organization substantiate the higher cost that a newer designed ETT may carry? A comparison in cost of the old product, the MK, to the newer KCHVLPMC tube was performed in 2010 at the facility where the CP was conducted (B. Seward, personal communication, January 13, 2012). When compared in 2013 using hypothetically similar prices; the MK costing approximately two dollars per tube and the KCHVLPMC model costing two dollars and forty cents per tube. The number of ventilator days used was 821 days which was the number of days reported for 2012. The MK tube would have had a cost of \$1641.00 dollars. Comparatively, the KCHVLPMC model for the same 821 ventilator days costs \$2070.00 dollars, a cost difference of \$429.00 dollars. The cost of one VAP is estimated to be \$5000 to \$25,000 for one incident (Bird et al., 2010). The cost of preventing one VAP would clearly support an investment in the newer designed ETT. Zolfaghan and Wyncoll (2011) states if a newer intervention, like implementing the use of the newly designed Kimberly Clark ETT, reduces the VAP rate by a mere one percent, it would be worth the change in practice. The staff involved with intubations required no additional training. Therefore, there was no additional cost incurred in training or educating the departments or personnel, who were responsible for these types of patients. The cost of orienting newer ICU employees in caring for the MV Adult ICU patient remains included in the six week Critical Care Course (CCC) that all

new graduate nurses must attend before working in the unit environment. The course costs approximately \$5700 and that covers approximately 8 participants per class.

When a nurse with prior experience or working at the facility where the CP was conducted accepts a nursing position in the ICU they may choose to take certain topics of the CCC. All are encouraged to take the pulmonary and cardiovascular topics, and must attend the 16 hour hands-on skill lab. Each topic alone will cost the hospital approximately \$900 and the pulmonary topic does include care of the MV adult ICU. The skill lab costs approximately \$650 for both days. Again, when compared to the cost of one VAP incidence these expenses are clearly worth the investment.

Mission/Vision/Goals

A mission statement was essential in the CP, and it is short and concise and still remained a simple thought, it was one that kept the mission alive and possible, and the focus meets the present, as well as future strategic plans (Ward, 2013). The mission of the CP was “to create and facilitate health care to the people being served” and that included all adult ICU patients requiring intubation while in ICU.

A vision statement was also created and it is concise and easy to remember, it continued to drive the goals and objectives needed to achieve the vision (Barker, 1992). The vision of the CP was “to restore to health caringly, educate resourcefully, and to constantly give rise to better patient care outcomes” through the use of EBP interventions. From time to time it was recapped and that kept the staff where the CP was conducted engaged in the vision, and promoted the main objective, which was and is to provide EBP care.

The most important goal and objective of the CP was to determine if, along with current VAP prevention strategies, did the use of the newer designed ETT like the KCHVLPMC reduce this pneumonia, and did it provide a better patient care outcome. The common core ethical, personal, and professional values of the CP included conducting everything concerned with the project, through the endorsement of accountability, advocacy for the patients involved, integrity, respect, honesty, resourcefulness, beneficence, justice, caring, dedication, collaboration with others, compassion, and also embraced the provisions needed for the delivery of excellent healthcare services to the MV patient population.

Process/Outcomes Objectives

The main objectives were to distinguish if there was a decrease in VAP incidence with the KCHVLP ETT compared to the MK tube, thus resulting in decreased mortality, ventilator days, VAP incidence, infections, and cost, and to conclude if there was increased compliance to the VB and improved patient care outcomes. Outcome plans were to, evaluate equally in 12 month periods the KCHVLPMC ETT and MK tube on VAP incidence, VB compliance, ventilator days, and VAP incidence in the comparative periods. The ventilator benchmark for year January 2011 to December 2011 when the MK tube was used for intubations in ICU was, number of VAP cases equal one, the number of ventilator days equals 580 (C. Parker, personal communication, March 1, 2013) These are the benchmarks being compared for year January 2012 to December 2012 when the KCHVLPMC tube was put into practice for all adult intubations in ICU. VAP where VAP cases equal two, and the number of ventilator days equals 821(C. Parker, personal communication, March 1, 2013).

As stated, the focus of the CP was to identify the measurable outcomes for the above selected study population and determine if the goals were met. There are four main outcomes measurements to be achieved.

First, assessment of the outcome measurement on the impact of product implementation using the KCHVLPMC ETT for all adult patients in ICU requiring intubations, compared to the MK ETT on the reduction in VAP incidence. The first and primary outcome measure will be the relationship between the KCHVLPMC ETT in a 12 month period compared to the MK ETT in a comparable period in VAP incidence in the ICU at the facility where the CP was conducted. Second, assessing the compliance of all current VAP prevention strategies, which includes the VB implementation at the time of intubation and data collected on the ventilator QI form by the nursing staff. Third, look at the number of ventilator days in a 12 month period of time January, 2011 to December, 2011 for the MK ETT and January, 2012 when the KCHVLPMC ETT was first implemented and the MK tube was removed from use to December, 2012. Fourth, the number of VAP incidence in the same time period January, 2011 to December, 2011, and January, 2012 through December, 2012. With exception of the ETT designs, the EBP strategies to prevent VAP for both ETT time frames have remained the same such as: basic infection control methods like excellent hand hygiene adherence, proper patient positioning that included head of bed elevated greater than 30 degrees at all times, effective mouth care every two hours with chlorahexadine teeth brushing every four hours, early removal of the ETT that includes daily sedation breaks, and daily weaning parameters, and considering the use of the newer designed ETT currently available and showing evidence of VAP incidence reduction.

Logic Model

The intent of the evaluation plan on the CP outcomes was to visibly give detail to the underlying association of relationships and a clear understanding of what is necessary to ascertain the indifferent association of relationships. Even before the study on outcomes was planned, the examiner needed to have a visual and mental picture of the outcomes of interest, and the impact it will have on the associated relationships. The use of a conceptual model provided a visual clear detail of association with the practice problem concerns, clinical factors, prevention strategies, and outcomes (Kane, & Radosevich, 2011). Zaccagnini and White (2011) provided the conceptual model used in the CP and the example of a logic model that was the expected model by Regis University to be used in the project (Appendix B). This is an example of the DNP process that did best guide the CP and was designed during the planning phase of the project for evaluation purposes. The logic model contains the inputs outputs and outcomes all parts found in most models and contains the components necessary for connecting the difference parts of the project logically together thus providing an illustration of the progression that the project did and was expected to take.

Appropriate for Objectives and Research Design

The research design was a retrospective data collection method. The data was obtained from the CP conducting facility soon after the IRB of the hospital, and Regis University had approved such. The project was officially declared exempt status by the University on February 18, 2013. The evaluation plan was appropriate for the CP objectives stated above, and the methodology design; a descriptive analysis of retrospective data comparison obtained from the 20 bed mixed ICU. The set period of time January 1, 2011 to December 31, 2011 for the MK ETT and January 1, 2012 to December 31, 2012 for the KCHVLPMC ETT.

To aid in data collection an example of a ventilator QI compliance chart indicating adherence to the VB was made available by the facility where the CP was conducted. (Appendix C). Compliance was documented as a yes or no for each ventilator (QI). Compliance calculations were summarized monthly and data was provided monthly during the nursing staff meeting by the CCU Nurse Manager who compiled the data for the ventilator QI. Compliance on the use of the adopted KCHVLPMC ETT was compiled by the Manager of the Respiratory Care Department and shared at the monthly VAP committee meeting.

Time Frame

The timeframe for the CP started in September 2011 in the DNP program course Theoretical Application for Doctoral Nursing Practice, where the practice issue of concern, the problem identification, PICO format was established and the final question to be investigated and answered was created. Clinical rotations started in January 2012 and were completed this April 2013 where a total of 900 hours were performed in the Application to Practice Clinical Hours courses required in the DNP program. In December 2012 the request for exempt status was submitted to the Regis University IRB as part of the DNP Capstone Project course completed that fall semester, and it was approved in February 2013 in spring DNP Capstone Project course. Approval for data collection was granted in December 2012 by the IRB at the facility where the CP was conducted. Data collection began in February 2013 and is now completed. The timeframe for obtaining the retrospective data collection was from February 27, 2013 until May 31, 2013. The data was collected on time and tabulated with results known as of July 4th, 2013 (Appendix D).

Budget and Resources

The budget issues associated with this CP were approximately \$37,000 which is based on another person conducting such work without being in a DNP program CP. Wages for the 900 hours of clinical alone would have been \$36,000 based on a \$40.00 an hour wage. Another \$1000 in expenses was allotted for travel, meals, library use, stationary and computer use, along with the installation of the SPSS statistical tools, and extra reference books used to achieve the CP literature reviews and additional academic information. The facility where the CP was conducted has already removed the MK ETT from service availability, and had purchased and placed the KCHVLPMC ETT into service availability prior to the project starting. The hospital had completed a VAP timeline and the official change was initiated January 2011. There was no additional education required for the implementation of this product. There were no additional funding sources attached to this CP (Appendix E).

Population/Sampling Parameters

The population of interest for the CP came from a 20 bed ICU and a 150 bed acute care facility. The population was all adult 18 years and older patients who were intubated during their stay in ICU. Cases of VAP incidences were identified using the 2011 CDC criteria. Cases of incidence were also scrutinized by the ID Nursing Department, VAP committee members and the CNO of this facility. The plan for analysis was based on the dependent variable VAP incidence, defined as: pneumonia in an adult patient intubated in ICU, and ventilated at the time of or within 48 hours before the onset of the event. The MV patient had to present with at least one of the following: fever > 100.4 degrees Fahrenheit with no other cause, leukopenia (< 4000 WBC/mm³) or leukocytosis ($> 12,000$ WBC/mm³), and at least two of the following: new onset of purulent sputum, or changes in character of sputum, or an increase in respiratory secretion

needing more suctioning via the ETT or new onset of cough, dyspnea, tachypnea, or rales, or worse gas exchange, oxygen (O₂) desaturation, or increased demand for O₂ or increased demand for ventilator (Center for Disease Control and Prevention, 2011). Chest X-rays were obtained and a newly developed infiltrate suspecting a recently developed pneumonia was given consideration if the case was deemed a VAP. The new guidelines for a VAP according to the CDC as of 2013 were not included in this definition but were compared on the cases deemed a VAP from January 2012 to December 2012. The rate of VAP was defined as the number of VAP cases per/year per/1000 ventilator days. Ventilator days were based on the number of days the patient used the ventilator prior to extubation. Compliance of the VB was done randomly by the nursing staff, and was conducted daily as part of the author's clinical application during the DNP Application to Practice courses. As stated previously, compliance was documented as a yes or no on each ventilator (QI) completed and summarized monthly and the results provided monthly during the nursing staff meetings.

Setting is Appropriate for EBP Project

The setting is appropriate for an EBP project based on the patient population of interest, the final question to be answered, and the evidence gathered (Zaccagnini & White, 2011). There are four outcomes to be achieved, first, the relationship between the KCHVLPMC ETT in a 12 month period compared to the MK ETT in a comparable period on VAP incidence. Second, assess compliance of VAP prevention strategies, included in the VB from ventilator QI data during both time periods of ETT s use. Third, calculate number of ventilator days over the same periods of time. And fourth, calculate number of VAP incidence in the same time periods.

EBP Design Methodology and Measurements Provided

The statistical software SPSS program was used in the predictive analysis aspect of the CP. SPSS is a highly recognized computer program when calculating statistical data and predicting outcomes (Polit, 2010). The two-sample t-tests using a probability value (p - value) based on 0.05 was a feature used on the SPSS computer program and was conducted along with the two-sample t-tests for all data analysis. Ventilator QI and VAP incidence data was provided by the Nurse Manager of the ICU during the time periods of both ETTs.

The two-sample t-test was used on three of the outcomes to indicate the mean of two normal populations are really equal. A p -value of 0.05 results was used to support there was or was not a difference in the two comparative ETTs. A p -value $<$ than 0.05, indicates there was less probability that the ETTs are the same in decreasing VAP. A p -value $>$ than 0.05 p -value indicates a greater probability exist that they are the same. This demonstrates there were no difference in the ETTs and VAP reduction. Data collection results of ventilator QI will not be shown as both 12 month time periods remained at 100%. Therefore a two sample t-test was not conducted. VAP rate/1000 ventilator days were provided by the ID nurse of the CP conducting facility.

Protection of Human Rights procedure complete

In August 2012 a Collaborative Institution Training Initiative (CITI) course was completed and a copy of the completion was provided to the Regis University IRB along with an application for exempt status to conduct the CP (Appendix F). Protection of human rights procedure was completed and approved by the Regis University IRB who granted exempt status in February 2013, and the IRB at the facility where the CP was conducted granted approval for retrospective data collection (Appendices G and H). There was no harm that could come to the

patients the data was collected on as a result of this CP and there was no breach of confidentiality. The source of the data in this CP is also available publically. All data collected was retrospective in nature. In addition, all data provided and collected remained secure within the facility where the CP was conducted in a locked cabinet or password protected computer. Equally important, along with data collection, treatment procedures, and protocols discussed in this project plan and evaluation section, as stated earlier there were no identified issues with feasibility, risks or unintended consequences.

Instrumentation Reliability/Validity and Intended Statistics

For reliability of data, a confidence interval set at a 95% range was implemented. This indicates the data falls between two standard deviations from the mean which is therefore closely banded and signifies no abnormalities. For validity the data collection was validated based on the outcomes results.

Data Collection and Treatment Procedure

This author collected data on VAP rates for years 2011 and 2012 on March 1, 2013 from the ID nurse of the facility where the CP was conducted. In addition the ID nurse provided the ventilator days for 2011 and 2012. The CCU nurse manager provided the ventilator QI data. The MK tube was in practice in 2011, and one VAP incidence was reported. The KCHVLPMC ETT was in practice in 2012, and two VAP incidences were reported in that year. All VAP incidences were on adult ICU patients intubated and MV while hospitalized in the ICU. After the data was provided it was used solely for the purpose of the CP and has since been returned to the facility where the CP was completed, and will remain secure within that facility.

Project Findings and Results

Organized by Objectives

The main goal of the CP was to provide the best EBP interventions possible and assure the most favorable outcome to the intubated and MV adult ICU patient was achieved.

The main objectives were to first, determine if there are decreased VAPs with the KC ETT compared to the MK; second, did compliance to the VB remain 100%; and third, calculate the number of ventilator days over the same time period, and fourth, calculate the number of VAP incidence in the same time period. The outcome plans were to first, evaluate equally the relationship between the KCHVLPKC ETT in a 12 month period compared to the MK ETT in a comparable period on VAP incidence. Second, assess compliance of VAP prevention strategies, which included the VB from the ventilator QI data during both time periods of ETT use. Third, calculate the number of ventilator days over the same periods of time. Fourth, calculate the number of VAP incidence in the same time periods.

Key Elements and Instrumentation Findings and Statistical Data/Reliability of Findings

The methodologies applied on the retrospective CP outcome findings and results were the use of the SPSS program used for the predictive analysis aspect of the project. To support the validity of the findings this included the application of the two-sample t-test, along with a probability value (p value) based on 0.05, and the data results were tabulated on the SPSS program. In addition, the ventilator QI and VAP incidence data were provided by the nurse manager of CCU during the time periods of both ETTs, and was confirmed by the ID department coordinator. Equally important, the confidence interval of 95% was used to aid in the analysis, and supported the reliability of the outcome findings.

Results Discussed According to EBP

The four main objective outcome plans project findings and results arranged in a question format

Outcome 1): was the number of VAPs different with the KC ETT compared to the MK?

Outcome results using the two sample t-test in evaluating equally the twelve month periods the KC and MK showed that there was no significant difference between the two tubes and the number of VAPs/1000 ventilator days, and based on the 95% confidence interval (CI), and the p value of ($p = 0.67$). The two tubes showed also that there was no significant difference in the patient care outcomes.

Outcome 2): Did compliance to the VB remain 100%?

Outcome results on the evaluation of the VB compliance shows that the bundle compliance remained at 100% for both twelve month time periods. Therefore, a two sample t-test was not conducted because the standard deviation is zero for both years, there was 100% compliance year one and year two.

Outcome 3): Was the number of ventilator days different during the two time periods?

Outcome results on the number of ventilator days using the two sample t-test revealed there was a significant difference between the numbers of ventilator days for the two periods, the MK year 2011 is 580 ventilator days, and the KC year 2012 is 821 ventilator days. This was based on a CI of 95% and a p -value of ($p = 0.02$). The results may have been different given more data from previous years. Typically a two sample t-test is used for larger data sets that allow for more variation in the data. The facility where the data was collected reported in 2012 the ventilator days of 821 was the highest recorded data point in their measured history. In addition, the nurse manager of CCU when asked if there was possibly a huge difference in the patient days for 2011

and 2012, offered data that revealed there were approximately 3720 patient days in 2011, whereas the patient days for 2012 were approximately 4660; a difference of approximately 900 more patient days in that year (B. Seward, personal communication, July 1st 2013). The rate ratio was about the same between the two groups $580/3720$ is 0.155 for 2011, and $821/4660$ is 0.176. So the occurrence of MV patients between 2011 and 2012 was really not that huge of a difference.

Outcome 4): Was the VAP incidence different during the two periods

Outcome results on the number of VAP incidence for the two time periods January, 2011 to December, 2011 and January, 2012 to December, 2012. There is no significant difference between the two one year periods, based on the 95% confidence interval (CI), the p value of ($p = 0.67$); the VAP rate/1000 ventilator days was 1.7 for the 2011 period, and was 2.4 for the 2012 period. This outcome measured the difference in the VAP incidence between the two one year periods. If both tubes were used at the same time during both years, there could have been a significant difference between the two tubes. Also, outcome number one and outcome number four have the same results because of the use of the different ETTs during the two one year periods. Again if both tubes were used at the same time the results may be different.

The final question is:

In adult ICU patients undergoing oral intubation while hospitalized in ICU, do patients who are orally intubated with the KCHVLPMC ETT have fewer VAP's than those who are intubated with other commercially designed High Volume Low Pressure ETTs like the MK? From a statistical standpoint based on outcome number one, it indicated there is no significant difference between the two tubes and the number of VAPs/1000 ventilator days, based on the 95% confidence interval (CI), and the resulted ($p = 0.67$). p value. However from a clinical aspect the increase in ventilator days in 2012, the reported increase in CCU patient days, along with some

reported staffing concerns and the credible literature support for the newer designed KCHVLPMC ETT, it is worth stating that along with these findings, perhaps a longer study would change outcome number one differently. Therefore, it is also worth seriously considering increasing the length of the data collection in another future study on this same subject of concern.

Limitations, Recommendations, and Implications for Change

Limitations

There are several limitations identified in the CP. First, this was a small snapshot of two equal 12 month periods where retrospective data was obtained to determine if the design of the KC ETT was better at reducing VAP than the replaced MK ETT. If the time periods would have been possible over a longer period of time, it may have made a significant difference. Yet in prior years when the MK ETT was the main tube used for intubations, there were years when the VAP rates were higher than the reported two incidences during the 2012 calendar year. Add to this, the patient days in ICU for year 2011 when the MK was in place there were approximately 3720 days, and in 2012 when the KC was being used, the patient days were approximately 4660 days. Although this data was not requested as part of the CP retrospective data provided by the facility where the project was conducted it was made available and was recognized as a possible element in the matter. Equally important, both patients who did develop VAP had underlying predisposing issues, and the two pneumonias were based on the old CDC criteria that included the MV patient's temperature graph, the daily complete blood count (CBC), the sputum culture results, and the daily chest X-ray (CDC, 2012). These complex cases had a potential pneumonia diagnosis prior to intubation, which made prevention difficult. However VAP was detected early and appropriate antibiotic therapies were initiated. The first case was a patient admitted with

acute respiratory failure (ARF) due to a trauma incident several days earlier, and suffered multiple broken ribs and was diagnosed with bilateral pulmonary emboli, pneumonia, and had a reported possible aspiration due to the presence of a possible bowel obstruction which was associated with the use of a pain medication given while at home and prior to admission. The second case arrived in the emergency room with ARF and that day failed multiple attempts on Bi PAP to hopefully prevent needing intubated, and also had an underlying pneumonia and possible aspiration prior to admission. These two cases also failed the attempts taken to keep them from needing further ventilator support in the form of intubation and MV in the first place. Every possible early intervention and VAP prevention strategy was adhered to, but in spite of this a VAP did occur. Both cases also required multiple procedures and tests were performed in other departments and required these patients be in the flat position during the time of the tests being performed. There are always going to be cases like these that carry such high risk factors, but hopefully more can be learned as further research into the benefit the newer designed ETT can play in the prevention of VAP is conducted. Nonetheless there remains a growing want to reduce VAP, and a growing need to do so, from both the customer/patient and the healthcare industries as a whole.

Yet another identified limitation during the CP data collection timeframe was that the hospital where the data was obtained went through a merger with another healthcare organization. Although this had no impact on the CP, it did have an impact on the organization as a whole where the project was being conducted. Sorting through the merger process generated higher than average stress and anxiety levels within the healthcare staff. There was a multitude of staffing issues occurring at the same time leaving some unfilled job vacancies. It was during this time period that both VAP incidences occurred. These variables can lead to an unpredictably

higher nursing workload, and can contribute to higher than usual job dissatisfaction. It is well documented these types of issues can show the way for increased HAIs like VAP to occur, and augments job frustration levels (Aiken, et al., 2009).

Recommendations

Based on the findings of the CP, the main recommendations for practice changes are as follows. First, continue a multifaceted VAP prevention approach that includes continuous compliance to VB protocols as stated earlier, along with pharmacological antibiotic support and other general measures such as early extubation, aspiration prevention, and decontamination strategies as simple as proper hand hygiene each time, every time, by everybody. In addition, a multidisciplinary approach that includes continuous education and daily ventilator QI, along with further investigation into newer technologies such as the design of the ETT to prevent contamination and aspiration in the MV patient. Second, continue to use the KCHVLPMC ETT for intubations and MV longer than 48 hours. Based on the outcome of the retrospective statistical data where the results of the two sample t-test showed no significant difference in VAP rates between the MK and the KC tubes, there is really no strong evidence against the utilization of this tube in the prevention of VAP, and there is sound evidence as stated in the literature review in supporting the use of this ETT design. In addition, based on all the statistical outcomes of the CP, in the future the findings from this project will be pursued further. From a clinical standpoint, strict adherence to the VB and other prevention strategies will now include daily surveillance and monitoring of the intubated ICU adult patient starting day one of MV, and consist of observation and collection of the patient's positive end expiratory pressure (PEEP) and fraction of inspired oxygen (FiO₂) levels in hope of recognizing early indications of a developing ventilator associated event (VAE), as defined by the CDC (CDC, 2012).

The implication for change requires putting evidence into practice when things that work are recognized as such. Once areas for improvement are recognized it is essential standards of care, policies, and procedures to prevent infections such as a VAP must be developed and strictly supported and adhered to by all levels of the organization, because preventing HAIs is the responsibility of every employee of the organization.

A multifaceted, multidisciplinary, and multi-professional approach is paramount to move any initiatives forward. It should start with education and reinforcement, and getting all staff involved which may call for hospital-wide reporting of HAI rates and their types. Barriers to change must be anticipated and determined how they will be dealt with. Providing adequate nursing and respiratory staff is very important; and are essential tools to assure the delivery of high quality care to the MV patient. In addition, provide adequate supplies and make them readily available to promote adherence to VAP prevention. Do daily QI monitoring on all MV patients, and perform and document daily surveillance and monitoring of the PEEP and FiO₂ levels starting day one of MV. Equally important, report adherence to the VB protocol and VAP rates monthly at nursing staff meetings. In addition continue to support the utilization of the KC ETT for intubation expected to be longer than 48 hours until further evidence indicates there is a better ETT available that decreases VAP incidences. Last, continue to conduct frequent literature reviews on the subject of VAP prevention and the use the newer designed ETTs in preventing this HAI, to assure that the best evidence based practices are made available to the adult ICU MV patient population.

Summary

The CP was the final step of the DNP program. It reflected a demonstration of synthesis and mastery of an advanced subject within the practice of nursing by the student completing their

final academic steps (Zaccagnini & White, 2011). The purpose of a CP was to improve a practice and or a patient care outcome and also set the tone for continuous improvement through EBP interventions (Zaccagnini & White, 2011).

The purpose of this paper was to provide in writing the CPs problem recognition and definition, review of evidence, project plan and evaluation, project findings and results, limitation, recommendations, and implications for change, and did the use of newer designed ETT like the polyurethane KCHVLPMC ultrathin tube result in a decrease in VAP rates compared to other HVLP like the MK ETT designs. Further investigation into the role the ETT design can play in the reduction of a VAP was pursued. From starting out with the practice issue of concern, and using PICO; a PICO statement was created, and data was collected that supported no changes in practice from the current use of the KCHVLPMC ETT was necessary. The MV critically ill ICU patient is at high risk for developing VAP, and it is evident that better patient care outcomes can be achieved using a multifaceted prevention strategy approach that includes the use of the KCHVLP ETT. The final question was answered, in adult 18 years and older patients undergoing oral intubation while hospitalized in ICU, do patients who are orally intubated with the KCHVLPMC ETT have fewer VAP's than those who are intubated with the MK ETT? The answer was that there was no significant difference in the VAP incidence when the adult patient in ICU was intubated and kept on mechanical ventilation for longer than 48 hours with either ETT the KC or the MK.

VAP is a pervasive and costly HAI greatly associated with the use of instrumentation to maintain the airway and the ETT selected to achieve ventilated passage. Even though many factors contribute to the development of a VAP, a multifaceted prevention approach seems to still be the best strategy. The CP was just a small snapshot comparing two ETTs effectiveness

against VAP and it is apparent from the systematic review that larger RCT before any definitive practice change can be recommended must be accomplished. It is evident further investigation into the role the ETT and other prevention strategies plays in the reduction of a VAP must continue to be pursued.

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Appendix A

Systematic Review of Literature

Article Title and Journal	Author /Year	Database and Keywords	Research Design	Level of Evidence	Study Aim/Purpose	Population Studied/Sample Size/Criteria/Power	Methods/Study Appraisal/Synthesis Methods	Primary Outcome Measures and Results	Author Conclusions/Implications of Key Findings	Strengths/Limitations	Funding Source	Comments
Nursing implementation science: how evidence-based nursing requires evidence-based implementation. <i>Journal of Nursing Scholarship</i> , 40(4), 302-310.	Achterberg, T., Schoonhoven, L., & Grol, R., 2008.	Journal of Nursing Scholarship Diffusion of innovation professional practice, healthcare reform, nursing.	Non experimental	Level-III	Provide introduction and overview of current developments in implementation science and to apply these to nursing.	N/A	Framework for implementation. Use of theory and evidence from implementation science that can facilitate evidence-based implementation	Linking determinants to theory-based strategies. Common determinants for implementation related to knowledge, cognition, attitudes, routines, social influences, organizations, and resources.	More research is needed on effectiveness of innovative strategies directed to patients, individual professionals, teams, healthcare organizations, and finances.	Recognition of more research to be done in this area. This study added heading rather than specific factors of operational methods.	N/A	This study was used as a optional method of framework for implementation of evidence-based practice (EBP) changes.
Association between a silver-coated endotracheal tube and reduced mortality in patients with ventilator-associated pneumonia. <i>Chest</i> , 137(5), 1015-1021.	Afessa, B., Shorr, A., Anzueto, A., Craven, D., Schinner, R., & Kollef, M., (2012)	PUBMED jama.ama-assn.org, silver-Coated Endotracheal Tubes (ETT) and incidence of ventilator-associated pneumonia (VAP)	Prospective randomized single-blind controlled study.	Level-I	To determine if silver-Coated ETT reduce VAP incidence.	9417 adult patients (pt) 18years or greater in age intubated for 24 hours or greater.	Pt were assigned to undergo intubation with a 1 or 2 high volume low pressure (HVLP) ETT similar except for a silver coating on the experimental ETT.	VAP Incidence Based on Qualitative Bronchoalveolar cultures with pt intubated > than 24 hours. Time of VAP onset. Length of intubation, unit stay and hospital stay. Mortality ratio. Adverse events.	Pt intubated with the silver coated ETT had significant reduction in VAP incidence and delayed time in VAP onset compared to uncoated ETT.	Str: Silver coated ETT did show a reduction in VAP incidence which lead to decreased VAP onset, LOS, Mortality and Cost. Lim: Study not double-blinded, different facility sizes used for data collection, antibiotic uses, other co-morbidity factors, VAP incidence with uncoated ETT several started on the first day of intubation. VAP incidence comparisons were marginal.	Research grant from C. R. Bard Inc.	Results came from a large randomized multicenter study and that the silver coated ETT could be beneficial at VAP reduction but not superior to other comparison ETT used in the study.
Decreasing ventilator-associated pneumonia in adult intensive care units using the	Al-Tawfiq, J., Abed, M., (2010)	PUBMED: VAP; Adult ICU; Institution Healthcare Improvement (IHI);	Pre and post intervention trial.	Level-III	To determine if a VAP bundle improves patient care outcomes	An 18-bed adult ICU and a 350-bed with (5) ICU's Mixed ICU, pediatric and	A study was conducted at the adult ICUs on a 18-bed adult ICU and a 350-bed Mixed ICU. A study was conducted at the	Adherence with all the elements of the VAP bundle improved from 20% to 83%. There were 29 VAP events a 9.3 events/1000 vent days pre	In conclusion an adoption of aggressive VAP bundle adherence reduced VAP rates.	Adoption of the IHI VAP Bundle established EBP implementation. There was some confusion over the VAP bundle implementation and	None listed	I feel this article strongly supports the Capstone Project on the definite need to adherence

institute for healthcare improvement bundle, American journal of infection control, 38(7), 552-556.		bundle implementation				neonatal.	adult ICUs on a 18-bed adult ICU and a 350-bed Mixed ICU. It was a preintervention and post intervention study comparing the rate of VAP on a monthly basis over a two year period.	intervention 2006, and 10 VAP events in 2007 3vents/1000vent days and 9 VAPS events in 2008 a 2.1event/1000vent days. Thus the post intervention rate was 2.5/1000vent days		the staff felt the pt could be at risk of adverse events but that was cleared up with further education, the physicians were resistant to the change and required use of a VAP bundle with MV pts.		to EBP VAP bundle compliancy.
Implementing best practice strategies to prevent infection in the ICU. Critical Care Nursing Clinics of North America, 18. 441-452.	Aragón, D., & Sole, M., (2006)	MEDLINE /PubMed: Best practice strategies (BPS) to prevent hospital acquired infection (HAI) Intensive Care Unit (ICU)	Center of Disease Control and Prevention (CDC) guidelines. Literature Review Analysis.	Level-IV	Overview of latest EBP clinical guidelines from CDC to prevent HAI. Promote Quality Indicators Surveillance to aid in reinforcement of BPS.	N/A	N/A	N/A	A multifaceted multiprofessional team approach is key to BPS initiations.	Str: Supportive review of the need to on-going literature reviews on current EBS to prevent HAI. Lim: unknown	N/A	Excellent supportive data in the on-going need to stay vigilant on reducing HAI like a VAP.
Current methods for combating VAP. Nursing Management, 49-52.	Bahrt, G., (2009)	Nursing Management Magazine. Combating VAP	Summary of recommendation guidelines and tech update on the on-going battle to combat VAP	Level-IV	Summary of recommendation guidelines and tech update on the on-going battle to combat VAP.	NA	NA	NA	Advancement in ETT is a continued focus of technology to combat VAP	Str: Supports the need for more research on ETT designs, supports the use of the silver coated ETT in certain cases. Lim: Did not do a comparison with other ETT. Article was not well supported with credible evidence.	NA	Supports the need for more research into ETT designs and also the importance of maintaining EBS in daily practice.
Implementing a unit-level intervention to reduce the probability of ventilator-associated pneumonia. Nursing Research, 59(1S), S40-S47.	Bingham, M., Ashley, J., De Jong, M., & Swift, C., (2010)	MEDLINE /MedPub. Compliance, EBP, infection control, VAP	Two hour observation Compliance checklist survey and the acute physiology and Chronic Health eval/EI	Level-III	Evaluate effectiveness of a unit-specific education intervention and emphasis was on hand washing, hob elevation, oral care to decrease VAP rates and number of ventilator days.	Clinicians at two military centers same city. 450 beds multi ICU units 200 pt sample size. 100 pts met inclusion over the two hour observation period.	Mean age-50 years (SD= 23 years). Rates of VAP are reported per 1000. Compliance of best practice: Hand wash, HOB elevation, and oral care rate over the two hour period.	VAP incidence, Vent days, compliance to EBS.	Str: No demonstration that the three EBS changed the VAP rate. Lim: No change in VAP rate, Different comorbidity with the 100 pt that were involved in the sample size, time factor	Str: No demonstration that the three EBS changed the VAP rate. Lim: No change in VAP rate, Different comorbidity with the 100 pt that were involved in the sample size, time factor	TriService Nursing research Program grant # NO3-P18 Principal Investigators CAPT Patricia Kelley The uniformed Services	Excellent study for EBS compliancy.

			V® tool. Unit specific Interventions were designed and implemented. SPSS analysis tool of descriptive statistics summaries was done on percentages, means, and standard deviation.								universit y of Health Sciences (USUHS).	
Adherence to ventilator-associated pneumonia bundle and incidence of ventilator-associated pneumonia in the surgical intensive care unit. Arch Surg. 145(5), 465-470.	Bird, D., Zambuto, A., O'Donnell, C., Silva, J., Korn, C., Burke, R., Burke, P., & Agarwal, S., (2010)	None given	Prospective collected data from retrospective examination for Infection Control Committee over a 38 month period. Cost of VAP	Level-I or II	To examine the impact of adherence to VAP Bundle to incidence of VAPs in a SICU setting	Two SICU at a tertiary care academic Level 1 trauma. Approx 4000 pts in the 38 month period.	Boston Medical Ctr level 1-2 SICUs daily assessment of bundle compliance and other VAP bundle initiatives from retrospective reviews. Compliance data were summarized weekly. Primary outcomes were the relationship of VAP bundle compliance and VAP incidence rates. Rates of VAP were defined as the number of VAP cases per 1000 ventilator days. Secondary outcome was cost with an estimated cost of	VAP rates went from 10.2 cases/1000 vent days to 3.4 cases/1000 vent days with initiating compliance to the VAP bundle. Cost savings was estimated at \$1.08 million.	VAP bundle compliance is associated with a significant reduction of VAP incidence thus a cost savings is realized by all stakeholders.	STR: Large number of patient studied (4000). The same infection control team was in place for the entire study time. Lim: Did not compare other SICU populations. May have underestimated the VAP bundle compliance scoring tool. There were other studies taking place in the facilities to reduce hospital acquired infections and this may have impacted this study.	None reported	Excellent resource which almost captured the same outcome measure that will be used in the Capstone Project.

							a VAP being \$30,000.					
What is new in the prevention of ventilator-associated pneumonia? Current Opinion in Pulmonary Medicine, 17, 155-159. DOI:	Blot, S., Rello, J., Vogelaers, D., (2011)	PUBMED Bundle, endotracheal tube, prevention, VAP	No research design	Level-VII	To review what new in prevention of VAP that is nonpharmacological.	From Literature source over 120,000 patients in an European study.	Data analysis from literature source.	VAP incidence was 13.6/1000vent days with current vent prevention strategies. There is excess high mortality and morbidity.	New devices and strategies to prevent VAP have been developed and need to be studied further.	The authors of the article are well renowned experts on VAP incidence and feel strongly that further work needs to be done to prevent VAP cases.	None provided	References and recommended reading was encouraged on the Lambert, M. Sue tens, C., Savoy, A. et al outcomes of healthcare associated infection (HAI). Which is a co hurt study about HAI of over 119,699 pts.?
Long-term impact of a multifaceted prevention program on ventilator-associated pneumonia in medical intensive care unit. Prevention, 51(10), 1115-1122.	Boardman, L., Deslandes, E., Lolom, I., Le Corre, B., Mourvillier, B., Regnier, B., Porche, R., Wolff, M., & Lucet, J.C., (2010)	PUBMED Clinical Infection Disease, HAI, VAP prevention, ICU	Setting: Cohort Study using a 1000 bed University Hosp 20 bed ICU. Surveillance of HAI. Implementation of a prevention program.	Level-II-III	VAP prevention stressing increased compliance with sustained preventive VAP measures.	1765 mechanical vented pts for over 48 hours. Implementation of a multifaceted prevention program resulted in a 43% decrease in VAP rates.	VAP rate were monitored over a 45 month period and a 30 month intervention period in a cohort of vented patients. Over 48 hours. The use of a segmented regression analysis and a Cox prop hazard model were the analysis tools to assess the impact of the program to prevent VAPs	1765 mechanical vented pts for over 48 hours. Implementation of a multifaceted prevention program resulted in a 43% decrease in VAP rates.	Prevention program produced sustained VAP rate decreases in the long term but did not eliminate VAPs in the ICU all together.	STR: The study started out with experienced ID staff. A decrease in VAP incidence was realized but not completely eliminated. Limitation: This was a quasi exp prospective study without a control group. The design was complex, time consuming and costly. Data collection was a general collection by many. The Hawthorne effect was also an issue due to VAP definition and diagnosis of a VAP incidence.	None mentioned	A multifaceted approach to prevent VAPs results in a reduction of VAP incidence.
Nurses' implementation of guidelines for ventilator-associated pneumonia from the centers for disease control and prevention. American Journal of Critical Care	Cason, C., Tyner, T., Saunders, S., Broom, L., (2007)	CINAHL CDC Guidelines for VAP	Nurse attended an education seminar and completed a 29 item questionnaire about the type and frequency	Level-II it is a cross-sectional survey	To evaluate the extent to which nurses in ICU implement best practice with vented pts.	1200 nurses working in ICUs completed the survey.	Cross sectional survey a 29-item questionnaire. 82% reported compliance to hand washing, 75% wear gloves, 50% keep HOB at 30 degrees or higher,	As stated above 82% compliant to hand washing, 75% wear gloves and 50% keep HOB up to 30 degrees.	The guideline to prevent VAPs are not consistent and with better compliance and oral care protocols perhaps a VAP reduction could be obtained.	Lim: No formal assessment of the questionnaire, the survey was conducted at one seminar only, self-reported results, no fail safe method in the survey completion.	Littman stethoscope donation from 3M and exhibit space from SAGE Products	The evidence that was provided by this survey is that there is an inconsistency in care delivered to Vented pt and this inconsistent care could contribute to increased VAP

Jan. 2007. 16:1 28-36.			cy of care.									incidences.
Removal of oral secretions prior to position change can reduce the incidence of ventilator-associated pneumonia for adult ICU patients: a clinical trial study, Journal of clinical nursing, 18(1), 22-28	Chao, Y., Chen, Y., Wang, K., Lee, R., Tsai, & H., (2008)	PUBMED: Aspiration secretion; intensive care unit; nurses; nursing; ventilator associated pneumonia	RCT	Level-II	Explore the effects of oral secretion on aspiration and reducing VAP.	Adult general ICU of medical centers in Taipei City, Taiwan	Two group comparison study design. Pt in the ICUs received suction of oral secretion before each position change in contrast with pts in the control group who received routine care.	VAP was found in 24 of 159 (15.1%) of pts in the control group and in 5 of 102 (4.9%) in the study group with a reduction risk ratio of 0.32 (95% CI 0.11-.92). Eight of the 24 VAP pts died in the control group none who developed VAP in the study group expired. An increase of survival was 1.50 (95% CI 1.13-1.99) The LOS in ICU during MV for the study group was reported as less. The cost of tubes to remove secretions was less than SSD ETts.	Removal of oral secretions is effective in reducing the incidence of VAP at a minimal cost.	STR: It is a RCT study that went through approval of the hospital ethic committee A research nurse collected conducted the data and used the SPSS/PC 12. Version. The control group and study group were comparable in size. LIM: Study conducted at one site. A larger sample size could have been beneficial.	None reported	The small study did report that removal of oral secretion before position change can reduce VAP incidence and mortality incidence; all at a low cost. It supports the Capstone in the logic that simple prevention strategies done consistently can reduce VAP incidence and be conducted at minimal cost. It is done routinely anyways why not always prior to position changes.
Modifying endotracheal tubes to prevent ventilator-associated pneumonia, Current opinion in infectious diseases, 24: 157-162.	Coppa doro, A., Berra, L., & Bigatel lo, L., (2011)	CINALH: Aspiration pneumonia ; biofilm; EET coating; ETT cuff; VAP	Retrospective literature review	Level-II	Looking at modified ETT designs and the impact on VAP reduction incidence.	Cardiac surgical pt; pts intubated for > than 24 hrs;	A Phase 1/11 clinical trial on cardiac pts and a phase 111 randomized multicenter trial on 1500 pt intubated > than 24 hrs. with an antimicrobial-coated ETT. A study on ETT with SSD in over 700 cardiac surg. Cases, and in a multicentered trial of 333 pts using the SSD ETT. In a pilot clinical trial of 134 cardiac surgical pts on the polyurethane microcuff.	Antimicrobial ETT- no organized bacterial biofilm and lower colonization rates. SSD- no benefit seen in the use of this ETT in fact possible tracheal damage can occur. Poly ETT- protected against early onset of a VAP and an association to reduction in antibiotic use. No clinical data available on the HVLP Poly ETT.	The use of modified ETT regardless of the design have not decreased VAP incidence, shorter vent days, or higher survival rate.	Good study data strongly supported by experts like Blunt, Deem, Kollef, Kolobow, Lorente, and Rello. Pt population could have been identified specifically in categories of > than 48 hr MV and < than 48 hours. Also were they ICU adult pts etc.	None listed	This article definitely support the PICO healthcare problem of how best to prevent VAPs and the need for further research into the impact newer designed ETT's can have on VAP reduction.
Novel	Coppa	PUBMED:	System	Level-I	Consideration	Mainly	Literature review	Before and after	Many factors	STR: The authors	None	I liked the

preventive strategies for ventilator – associated pneumonia, Critical care, 16(210), 1-6.	doro, A., Bittner, E., & Berra, L. (2012)	VAP; prevention	atic Review of most relevant studies supporting the use of novel	& II	of novel preventive strategies for VAP prevention that have clinical studies supporting their benefits.	Adult ICU intubated MV pts	of credible studies done on VAP prevention strategies.	study Head of bed, oral care with chlorhexidine gel, sedation vacation and vent weaning protocols reduced VAP rate. Early tracheotomy procedure in a RCT did not reduce VAP incidence. RCT using pneumatic devices did not reduce VAP rate. RCT of SSD ETT reduced VAP incidence. RCT of silver-coated ETT compared to standard ETT VAP rates were lower. Retrospective assess with the polyurethane tube vs a standard ETT showed a reduction in VAP rates. Meta-analysis of RCT associated with the use of probiotics reported a reduction in VAP rates.	contribute to the cause of VAP. VAP prevention strategies being used today are still not creating a Zero VAP prevention. Among other prevention strategies that need to be evaluated is the use of modified ETT such as SSD, coated tubes and alternative cuff designs. Pt positioning, kinetic therapy, and probiotic administration must be furthered studied in this on-going battle to reduce VAP incidence.	used well selected studies for their systematic review. LIM: There is room for bias against smaller RCT.	reported	article and the author's conclusion that were based on credible studies. I fully agree that there must be on-going research efforts to find other prevention strategies to reduce the incidence of VAP. This is why I selected VAP prevention as the PICO healthcare issue.
Estimating the proportion of healthcare-associated infections that are reasonably preventable and the related mortality and costs. Infection Control And Hospital Epidemiology, 32(2), 101-114.	Craig, A., Mitchell, M., Doshi, J., Agarwal, R., Williams, K., & Brennan, P. (2011)	PUBMED: Estimating the proportion of HAI	Systematic Review and figures from the National Nosocomial Infection Surveillance (NNIS) System. The National Hospital Discharge Survey and the American Hospital	Level-I-Systematic Review	To estimate the proportion of HAI in the U.S. hospitals that are preventable and has a high mortality and cost factor.	Varied	HAI Incidence, Associated Mortality and Risk Reduction. Systematic Review of interventions to reduce HAI, and ranges of preventable risk reductions, and systematic review of cost factors	As many as 55% of VAP may be preventable with current EBP strategies VAP carries a high mortality and prevention can save considerable costs.	Even with preventable strategies for VAP a zero VAP incidence may not be attainable. Each pt carries a set of unique risk factors. More research is needed on prevention of HAI.	The strength and limitations were not listed out but it is obvious to determine that just doing a systematic review would lend validity to the data. On the other hand there is room for uncertainty in the estimates on the proportion of HAI, there is also not a specific population group, and what determine a preventable HAI death when there could be other risk factors not known. Cost estimates could have been collected from fair to poor designs that the study was concluded on	None listed	HAI may never be totally preventable but with EBP strategies we can hope to reduce these incidences.

			1 Associa tion.									
Prevention ventilator associated pneumonia in adult sowing seeds of change. Chest, 130(1), 251-260. www.chestjournal.org	Craven s, D., (2006)	PUBMED: antibiotics; evidence-based data; guidelines; IHI=Institution for Healthcare Improvement; VAP ventilator associated pneumonia ; intensive care; prevention of hospital-acquired pneumonia (HAP)	Systematic Review that conducted data compiled from the review focused on VAP prevention strategies of adult populations and emphasis is on new concepts.	Level-I-Systematic Review of creditable RCT, clinical studies and experts in the field.	Prevention of VAP and implementation of cost-effective strategies and investigating barriers to their implementation among facilities and healthcare providers.	Adults who are mechanically ventilated.	Retrospective data provided from resources like the IHI, and RCT.	VAP increases possible mortality 20 to 70 % in medical ICU; costs estimated \$40,000/case; and accounts for approx 25% of all ICU infections and > than 50% of antibiotic use.	A multidisciplinary prevention team approach will be led by a Champion is recommended to help set priorities, benchmark goals, analyze data and sow seed for change that promotes risk reduction.	Star: Craven is the head of the ID department at Lahey Clinic Medical Ctr and has written several manuscripts on VAP prevention he is seen as an expert and seeks out other experts as well like Rello. Craven yearns to prevent VAP incidence and reduce occurrence using multiple strategies.	No source listed.	I see Craven as a Champion himself against VAP incidences. I have read other articles written by him. I have also seen his article's information used by other experts such as J. Rollo, M. Kollef, and M. Bonten all experts in their own right on the subject of VAP prevention..
New endotracheal tubes designed to prevent ventilator-associated pneumonia: do they make a difference. Respiratory Care, 55(8), 1046-1055.	Deem, S., & Treggiari, M., (2010)	PUBMED: Systematic review of multiple well designed RCT. Keywords: nosocomial pneumonia ; infection; subglottis endotracheal tube; ventilator associated pneumonia ; VAP; mortality; morbidity.	Literature Review and collection of historical data from the articles results	Level-I-Systematic Review	Pathogenesis of VAP and the role that the ETT plays along with recommended VAP prevention strategies.	ICU patients; size of population varied.	Most data was collected via a varied quantitative method. Examples: A retrospective study on 4543 pt at 59 U.S. hospitals found mortality rate was as high as 29%. Cost for a VAP can be as high as \$48,500/case. A meta-analysis of five studies on subglottis ETT reveals a 50% reduction in VAP incidence. A small RCT on cardiac surgery pt who were intubated with the polyurethane cuffed ETT like the KCHVLP ETT and the Mallinckrodt ETT found that	See above. In addition VAP incidence are expensive, and are largely related to the ETT. The prevention strategies will be most effective when multifaceted approach which includes infection prevention, proper positioning of pt, oral care, and early removal of the ETT regardless of the type. More research into intubation techniques and the effects of the newer designed ETTs.	More studies need to be conducted in a setting that reproduced the actual clinical situation that warrants intubation in the first place and in context with a bundle approach to prevent VAP.	Str: S. Deem and M. Treggiari are affiliated with the Anesthesia Department and both are well respected in the Respiratory Care and Anesthesia healthcare profession. The article which was compiled on a very good source of data adds credibility to the findings which were multicenter, meta-analysis, and RCT sources. Limitations: No actual research was conducted by the authors.	No source listed	Once again these authors references other experts like Rello, Kollef, and Miller. I agree more research into the possible advantages of the ETT to prevent VAPs must be done.

							VAP rate were reduced from 5.5/100 to 2.8/100 vent days. Another randomized trial compared a polyurethane tube, a subglottis tube and a conventional tube and found a significant reduction in VAP from the specialized tubes (22% vs 8%). More research is needed. Antibacterial coated ETT that were in an experimental setting show little benefit to VAP prevention over the other ETTs and actually would cost more.					
Strategies in the prevention of ventilator associated pneumonia. Therapeutic Advances in Respiratory disease, 5(2), 131-141.	Diego, M., & Restrepo, M., (2011).	PUBMED: Hospital acquired pneumonia, ICU-related, preventive measures ventilator associated pneumonia	Evidence based review of literature	Level-I-Evidence – based well conducted systematic review	VAP prevention clinically relevant pharmacological and no pharmacological interventions to prevent VAP. Owing to the importance of this condition the implementation of preventive measures is paramount in the care of mechanically ventilated patients. There is evidence that these measures decrease the incidence of VAP and improve outcomes in the intensive care unit. A multidisciplinary approach,	ICU intubated and mechanically ventilated patients.	Literature review based on EBP outcomes. No pharmacological Measures Evidence grade and Pharmacological Measures Evidence Grade. Standard precautions Level I, Oral decontamination Level II, Hand hygiene Level I, Selective digestive decontamination Level II, Staff to patient ratio Level II, Silver-coated endotracheal tube Level I, Semi seated position Level I, Daily sedation breaks Level II, Adequate Endotracheal	The preventive measures for VAP include four categories: (1) general measures, like infection control (Kollef 1999) (2) early extubation, (3) prevention of aspiration, Measures such as daily interruption of sedation and pursuing a protocol for early extubation are associated with shorter duration of mechanical ventilation [Wood et al. 2007; Horst et al. 1998; Kollef et al. 1997; Saura et al. (4) decontamination. Similarly, a prospective clinical study of critically ill patients, who remained in the semi seated position of 30 degrees for the	The author found based on the evidence related to the pharmacologic and nonpharmacologic therapeutic maneuvers involved in the prevention of VAP. Owing to the high cost, morbidity, and mortality of VAP, preventive measures are paramount in the care of mechanically ventilated patients. There is evidence that these measures decrease mortality and improve outcomes in the ICU, and include general measures, early extubation, aspiration prevention, and decontamination. A multidisciplinary approach, continued education, and	Well reviewed based on the experts on the subject of VAP prevention. Some of the literature was from as far back as 1994 but still very pertinent today based on VAP rates and incidence nationwide and current VAP prevention strategies..	Dr Restrepo was supported by the National Institute of Health and National Heart, Lung and Blood Institute.	This one article supports the need for more research on the prevention of VAP incidence. It was well done and the level of evidence was very strong and therefore creditable. The PICO and healthcare problem for the Capstone stalwartly reflect the outcomes and conclusion.

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					continued education, and ventilator protocol are all essential.	
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<p>cuff pressure Level II, Drainage of subglottic secretions Level II, Avoidance of circuit manipulation Level II, Early extubation Level I Evidence Grade: Level I (high): evidence comes from well-conducted, randomized controlled trials. Level II (moderate): evidence comes from well-designed, controlled trials without randomization (including cohort patient series and case control studies) and systematic analysis not collected in a randomized fashion. Level III (low): evidence comes from case studies and expert opinion.</p>	<p>first 24 hours of mechanical ventilation, and had a lower incidence of VAP compared with patients positioned at less than 30 degrees [Kollef et al. 1999]. Several agents have been studied for oral decontamination. These include use of chlorhexidine, and povidone iodine. It has failed to show any significant benefit over placebo in preventing VAP in a large randomized trial [Kollef et al. 2006]. The association of microaspiration with VAP is clearly established [Valencia et al. 2007; Craven and Steger, 1996; Valles et al. 1995; Mahul et al. 1992; Torres et al. 1992]. The incorporation of an ETT with an ultrathin polyurethane membrane cuff (7 mm compared with 50 mm in the conventional cuffs) that reduces the formation of channels and the escape of subglottic secretions to the distal airway has been used (Kimberly-Clark Microcuff) [Dullenkopf et al. 2003]. When compared with a conventional tube, this modality, in addition to the subglottic secretion drainage, had a significant decrease in the incidence of early and delayed VAP [Lorente et al.</p>	<p>ventilator protocols ensure the implementation of these measures. Future research will continue to investigate cost/benefit relationships, antibiotic resistance, as well as newer technologies to prevent contamination and aspiration in the mechanically ventilated pt.</p>		
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Ventilator-associated pneumonia: current status and future recommendations, Journal of Clinical Monitoring and Comparing, (24), 161-168.	Efrati, S., Deutsch, I., Antonelli, M., Hocke, P., Rozenblum, R., (2010)	CINAHL, VAP, pathogenesis, epidemiology, clinical practice guidelines, prevention technology	Updated review of current literature	Level I-systematic review of well designed RCT	Study aim is to review the pathogenesis and epidemiology and the current and future recommendations on VAP prevention strategies.	NA	References from highly recognized experts on VAP prevention strategies like: Cook, Kollef, Lorente, Rello, to name a few.	Not cited in the article	Strong International and National recommendation for more technological combination of solutions based on the ETT. Subglottis suctioning, optimizing ETT cuff pressure and ultrathin cuff ETT designs.	Supportive evidence for the Capstone PICO but nospecific identified ICU pt population or data from RCT in the article; just general good information.	None listed	Strong support for the PICO and identified healthcare problem which is VAP and way to prevent incidence.
Asking the right question. Journal of Emergency Medicine, 33 (6), 571-573.	Engberg, S., & Schlenker, E., (2007)	Pubmed: Keywords EBP asking the right questions	NA	NA	NA	NA	NA	0	0	NA	No source listed	This was an informative article on asking the right PICO question to obtain the best outcome. This article was most helpful early on the EBP PICO development.
Technology advances in endotracheal tubes or prevention of ventilator	Fernandez, J., Levine, S., and Restre	MD Consult's full-text literature database. Technology	Literature Review	Level I	Review the literature regarding the recent advances in ETT tech. targeted at VAP	M/S ICU pt mechanically ventilated (MV) > than 72 hrs, in Spain,	RCT results from 1994 to 2010; RCT, retrospective controlled, and prospective RC	Most RCT revealed decreased VAP incidences. Kollef et al (2008) using the silver-coated EET cuff concluded VAP	Multiple prevention interventions such as ventilator bundles compliance and the use of newer ETT along with	RCT strongly supports the findings; the systematic review was done including highly recognized	None noted	This is a strong article that supports the Capstone Project and places strong

associated pneumonia, Chest, 142(1). MD Consult full-text database. DOI 10.1378/chest.11-2420	po, M., (2012)	ic Advances in EET for prevention of VAP			prevention.	France, China, The Netherlands and pt MV > than 48 hrs, in China and France, cardiothoracic pt in ICU in the U.S. and Spain. Subglottis secretion devices (SSD) and non SSD, Tapered ETTcuffs and Polyvinylchloride cuff (PVC) cuff, Cylindrical ETT cuffs and PVC, Silver-coated ETT and non silver coated ETT. Sample sizes were from 18 pts Girou et al (2004) to 1503 ptKollef et al (2008).	studies.	trends were delayed and a reduction in VAP incidence with shorter termed MV. ETT colonization of pathogens play a key role in VAP incidence, The newer designed ETT with SSD, polyurethane cuffs, cylindrical tapered and silver-coated ETTs show promise but more studies must be completed and therefore cost-effectiveness of implementation of these newer ETT designed must be given consideration.	pharmacological and non pharmacological strategies must be studied further.	data trials for 1994 to current.		evidence on the need for further research into the prevention role newer designed ETT along with other VAP prevention strategies play in VAP reduction.
Are specialized endotracheal tubes and heat-and-moisture exchangers cost effective in preventing ventilator-associated pneumonia? Respiratory care, 55(2), 184-197.	Gentile, M., & Siobal, M., (2010)	PUBMED: VAP prevention ; heat-and – exchange; polyurethane cuff; endotracheal tube; silver-coated; nosocomial pneumonia	Literature Review of RCT and meta-analyses	Level-I	VAP prevention is a multi-facet priority of the intensive care team and can include the use of specialized airways and heat-and – moisture.	No specifics found in the article	Data retrieved from studies: Six RCT and a meta-analysis of five studies found that SSD found that this type of ETT reduced VAP by nearly half (risk ratio 0.51, 95%CI 0.37-0.71) in a heterogeneous pt population when MV 72hours is required. One study done by Young et al compared HVLP to LVLP ETT	Not well documented but the article does say that VAP prevention may best be achieved with a multifaceted multidisciplinary bundle of simple interventions such as hand hygiene, position HOB elevated, oral hygiene, Studies of these newer devices has been under powered for risk vs benefit, cost effectiveness mortality, safety, and potential injury.	Same as above; current evidence is still inconclusive on the effects of the specialized ETT HME, cost and prevention when it comes to VAP.	STR: The data provided was from well documented and recognized resources such as Lorente, and Kollef. This article set the tone for further investigation into novel prevention strategies to reduce VAP incidence. LIM: None listed but the article itself was not clear and lacked holding interest. It was not well laid out or labeled. Hard to read and follow.	None reported	I don't really have much comment. It was a redundant literature review that offered no new prevention strategies for VAP. Yes it does support the capstone on the sense that more research is needed on the subject of VAP prevention

							stated these ETTs reduced aspiration. A RCT by Lorente et al revealed in polyurethane cuff ETT with no SSD VAP were 31 or 22% of 140 pts compared to ETT with SSD 11 or 8% of the 140 pt population. Silver coated ETT Keller et al report in a multicentre RCT there was a 35.9% VAP reduction in a 2003 pt population MV greater or equal to 24 hours from 54 of the centers, and a 4.8 vs. 7.5% lower VAP incidence among pts incubated for greater than 24 hours. IN a meta-analysis Hess et al found a lower risk of VAP with heat-and-moisture-exchange (HME) than with heat mummification. There was disputed controversy and added risk with all of these ETT and HME methods.	Current evidence is still inconclusive.				and that most of the article reviewed thus far concludes that prevention will probably be achieved more my multifaceted and multidisciplinary measures.
Is there a benefit to multidisciplinary rounds in an open trauma intensive care unit regarding ventilator-associated pneumonia? The American	Johnson, V., Mangram, A., Mitchell, C., Lorenzo, M., Howard, D., & Dunn, E.,	Multidisciplinary rounds (MDRs); VAP	Retrospective chart review	Level - III	To determine the impact of the institution of MDRs in a trauma ICU regarding VAP.	Group 1-Pts with VAP-83 total from 2003 to 2005 before implementation of MDR mean age 40.5, and Group-2 Pts with VAP-49 from 2005	Retrospective data collection from chart review of trauma ICU pts who required mechanical ventilation (MV) from 2003 to 2007 no longer than 48 hours. Using the International Classification of	From 2003 to 2007 there were 805 pt requiring MV and a total of 4508 vent days. Significant difference was seen before MDR and after MDR. Group 1-Pts with VAP-83 total in 2414 vent days show a ratio of 34.3 VAPs /1000 vent days from 2003 to 2005 before	Because this was an open trauma ICU the need for MDR was supported with the information this retrospective data provided. With the need to eliminate VAPs and the impact this disorder will have on future reimbursement the implementation of MDR in the support	STR: The use of retrospective data proved valuable in supporting the need for MDR and the reduction of VAPs in open trauma ICU. LIM: Only done at one facility and only one open trauma ICU. I do feel the results would be close to the same in other	None reported	I really liked this article. It was easy to follow, well laid out to see the results and read the methods used. It also supports the fact that VAP prevention is a multi-facet approach and

Surgeon, 75(12), 1171-1174.	(2009)					to 2007 after MDR implementation mean age 43.3.	Diseases 9th Revision codes and using the center of Disease Control and Prevention (CDC) criteria for VAP.	implementation of MDR and Group-2 Pts with VAP-49 in 2094 vent days show a ratio of 23.4 VAPs/1000 vent days from 2005 to 2007 after MDR implementation. (p = 0.04)	to decrease VAP is evident.	types of ICUs with MDR.		props up the need to look further at VAP prevention strategies those currently practiced and novel ones as well.
Current practice in airway management : a descriptive evaluation, American journal of critical care , 19(2), 168-172.	Kjonegaard, R., Fields, W., & King, M., L., (2012)	From the Journal Airway Management Practice	Descriptive comparative design	Level-V	Validate the need for compliance to EBP's to reduce VAP incidence	41 Registered Nurses (RN) and 25 Respiratory Therapist (RT)	A descriptive comparative design was used on 41 RNs and 25 RT who managed ICU pt on MV. Descriptive and inferential statistics were used to analyze the data collected.	There was significant difference existed between RN and RT for hyper oxygenation before suctioning. RT instilled saline and rinsed the closed system with NSS more than RN. RN gave oral care more than RT.	RNs and RTs differed significantly in the management of pts on the vent. The standard of care should be consistent using EBP interventions.	STR: Over 2/3 of the survey distributed were returned. Lim:The survey was done at one location	None reported	The fact that there is a difference in the care provided to vented pts by RNs and RTs could impact the pt outcome and be a factor in the development of a VAP. This article strongly supports that consistent compliance to VAP prevention strategies by all healthcare members directly caring for the MV pt could reduce VAP incidence.
Silver-coated endotracheal tubes and incidence of ventilator-associated pneumonia, JAMA,300(7), 805-813.	Kollef, M., Beckel e, A., Anzueto, A., Veremakis, C., Kerr, K., Margolis, B., Craven, D., Roberts, P., Arroliga, A., Hubmayr,	PUBMED: Silver coated ETT and VAP incidence	Prospective RCT	Level-I	To determine if VAP incidence could be reduced using the silver-coated ETT thus reduces mortality rates.	A total of 9417 adult pts were screened between 2002 and 2006. A total of 2003 pt expected to be MV for 24 hours or longer were randomized	Pts were assigned to undergo intubation with 1 of 2 HVLP ETTs similar except one was silver-coated.	VAP were 4.8% with pts intubated with the silver-coated ETT and 7.5% with the uncoated ETT	Pt receiving intubation with the silver-coated ETT had a reduction in the VAP incidence.	Str: Very well designed RCT and well supported by statistical data. Safety for both groups was never an issue. Lim: Other factors like secondary problems the pts may have been experiencing that contributed to their MV situation. And, the time of when the respiratory culture was obtained varied with pts.	Research grant from C. R. Bard Inc.	The study was conducted well but there are factors that could have influenced to outcomes. Some pt developed their VAP before the 48 hour period and thus may have had contributing risk factors that made them a VAP regardless of what tube was

	R., Restrepo, M., Auger, W., & Schinner, R., (2008)											use for intubation. I detected some bias in results. The article will support the Capstone in the sense that it supports the need to look closer at the design of the ETTs as a method to reduce VAP incidence.
The ventilator care bundle and its impact on ventilator-associated pneumonia: a review of the evidence. Nursing in Critical Care, 16(5), 222-233.	Lawrence, P. Fulbrook, P., (2011)	PUBMED: Microaspiration, VAP, Nosocomial lung infection, ventilator care bundle	Literature Review from 10 research studies	Level –I	To critically analyze recent research that has investigated ventilator care bundle (VCB) use and the impact on VAP outcomes.	From all the meta-analysis listed the studies were conducted on adult ICU MV pts at multiple times and in multiple facilities.	Retrospective data analyzed from the 10 research articles.	Some studies indicated that the when the VCB was used consistently the VAP incidences were reduced. But, due to identified limitations more thorough evaluation of data collected on each VCB indicator must be more tightly implemented in order to carefully evaluate the effectiveness of the VCB strategies.	This paper strongly supports that there is a lack of standardized care for MV pts with or without the VCB implementation.	STR: The article supports that MV pts are not consistently receiving standardized EBP interventions. LIM: Data was not clearly illustrated in this article Tools that some of the studies used for their data collection were not provided.	None reported	Perhaps a reduction in VAP incidence can be associated with compliance to VCB but the data and method upon which Quality Improvement (QI) is collected must be kept consistent. EBP intervention should be the standard for all MV pts regardless what institution the intubation occurs. This article may not necessarily support the Capstone but it does support the fact that prevention of a VAP starts the moment that pt is intubated regardless of what ETT is used.
Prevention of	Leasure, A.,	Database Cochrane:	Historical	Level-I and II	Examine the effectiveness of	Human subject	Assessment of data extrapolated	The presence or absence of a VAP;	The goal of the study was to	STR: The systematic review	None reported	The systematic

ventilator-associated pneumonia through aspiration of subglottis secretions, a systematic review and meta-analysis. Dimensions of Critical Care Nursing, 31(2), 102-117.	Stirlen, J., Shu Hua Ku., (2012)	Prevention, VAP, subglottis secretions,	Design using systematic review and meta-analysis based on studies that focused on subglottis secretion drainage, used prospective design, sampled only humans, and had a control group		subglottis secretion aspiration in reducing VAP thus reduce VAP rates, and time being MV, mortality, and LOS	hospitalized in an ICU who were intubated and MV.	from the selected studies, and two reviewer independently assess the studies for appropriate methodology, quality, and then used a standardized checklist to appraise and summarize the results. If there were disagreements they were resolved through further discussion of the two reviewers and a third party.	Mortality rate; VAP incidence/1000 vent days; Days to onset of a VAP; Duration of MV; LOS	examine the effectiveness of SSD aspiration on VAP reduction. The findings of the systematic review demonstrated a 50% reduction in VAP rates when an ETT had SSD compared to a ETT without SSD. A two day shorter duration of MV was also seen in most experiment groups than in most control groups across studies.	was well selected by highly recognized RCT. The use of the tables made the article easy to follow. LIM: I see some potential for bias as no articles were selected to show the negative side of SSD aspiration.		review was well done and presented in a clear and logical order in the article. These authors really took some time to prepare the data and made a deliberate effort to remain none bias to the results. However, there are article and studies that dispute the SSD aspiration method. There are also strong indications that even better designed ETT and cuffs may also reduce VAP incidence and cause less risk of harm to the pt. The use of tables in the article made it easy to see the results of the data. I really enjoyed this article. Well done. This supports a Capstone objective of bringing about standardized care to the MV ICU adult population.
Change Theory by Kurt Lewin. Retrieved October 8, 2011, from	0	Retrieved October 8, 2011, from http://currentnursing.com/nursin	No research design but this theory	NA	NA	NA	NA	NA	NA	NA	NA	The Kurt Lewin Change Theory has been widely used in

http://currentnursing.com/nursing_theory/change_theory.html		g_theory/change_theory.html	of change will be used in the implementation of changes to practice based on the results and outcomes identified in the Capstone Project.									changing practices in the nursing profession. It is clear, concise, and easy to understand at most levels of healthcare workers. Unfreeze, move to the new level of change and Refreeze. The plan is to implement this model if change in practice is warranted.
New issues and controversies in the prevention of ventilator-associated pneumonia. Am J Respir Crit Care Med. 182, 870-876.	Lorent e, L., Blot, S., & Rello, J., (2010) -	PUBMED: Issues; controversies; prevention ;VAP; cuff; coated tube; tracheotomy; humidifier	Systematic review of RCT or meta-analyses	Level-I	To review current VAP prevention strategies that were not clearly recommended in the past. and make strong argument for their application in today's practice to prevent VAP.	Some studies stated adult MV population in ICU's some did not clearly specify the population.	Historical retrospective design data critiqued from highly respected studies using the criteria; if the recommendations were supported by a RCT or meta-analysis, and there were no reservations about the benefits, harm, or cost. If the recommendations by RCT or meta-analysis it was defined as more research needed.	Based on the credible studies that met the criteria of the authors a brief summary: ETT with SSD-recommended; ETT with ultra thin cuff and SSD-worth consideration; one study was done by Lorente in 2006. ETT with ultra thin cuff no SSD- worth consideration. Constant pressure inflation cuff-more research needed. ETT with SSD and LVLP constant pressure inflation cuff-more research needed. Device to remove biofilm-more research needed. Saline instillation before suction-more research needed. Early tracheostomy-worth recommendation. ETT silver coated-recommended. Heat moisture exchange (HME)-worth consideration	Obviously more research is needed and should be ongoing on the best approach to VAP prevention. All must consider benefits, harm and cost	STR: definitely looked at the best studies that have been done on MV pts. It was fair and balanced. Very clear, concise in the recommendations and rationale for their recommendations. Where there was some concern on sample size or data results the authors did define that more research is needed. LIM: Lack information on cost effectiveness, mortality, duration of MV, LOS, and specific population.	Stijn Blot did receive \$1001-\$5000 for Covidien and \$1001-\$5000 form Cook Critical Care in lecture fees.	Covidien does manufacture the Mallinckrodt HVLV and Seal Guard ETT's endorse by Lorente and lecture fees were provided to Blot this could lead to a somewhat bias in their opinions and recommendations. One of the studies in the systematic review was conducted by Lorente. The systematic review was well completed and the criteria for the article chosen were very precise. This review definitely supports the Capstone Project in the fact that when

												multi-facet prevention strategies are implemented VAP rate can be reduced. More research is needed to continue the surge toward better VAP prevention healthcare practices. More consideration on ETT selection must continue and further studies on the effects must be done.
A polyurethane cuffed endotracheal tube is associated with decreased rates of ventilator-associated pneumonia. Journal Critical Care, 26(3). 280-286.	Miller, M., Arndt, J., Konkle, M., Chenoweth, C., Iwashyna, T., Flaherty, K., & Hyzy, R., (2010)	CINAHL and PUBMED: VAP; nosocomial infections; MV; ETT	Observational research design	Level-III controlled trial no randomization	To determine whether the use of polyurethane-cuffed ETT use results in VAP incidence reduction.	All adults MV throughout a large academic hospital from 2007 to 2008.	Product replacement of the ETT from a conventional ETT to the polyurethane-cuff (KCHVLPVC) and retrospective appraisal of VAP rates before implementation and after implementation of the new ETT and completing a time-series analysis.	VAP rates decreased for 5.3% /1000vent days before the use of new ETT to 2.8% /1000vent days	Use of the new polyurethane – cuffed tube was associated with a decreased rate of VAP incidence.	STR: The observation data was real-time. The observers were able to collect data at the time and eliminate some extraneous variables. The multi-facet healthcare team can be observed real in real life settings. A generalization based on observation can be more situational this can account for the complexity of multi-group behaviors such as compliance to Vent bundle protocols. LIM: Observation of real practice over many shifts is time constraining. Bias among observers can occur. Subject source may be unequal.	Study partially funded by Kimberly Clark Corp. (KCC) which manufactures the KCHVLPVC ETT. Dr. Hyzy received \$5800.00 consultation fee for KCC and a \$6000.00 educational grant.	The fact that this well done observation study was heavily funded by one of the authors lends itself to a strong bias. The researcher may only see what they want to. See. Source of subjects could be questioned. Any group that is studied especially via observational method can be skewed to some degree. The article did conclude that VAP still hold a high mortality and healthcare cost. If a simple change in ETT use reduces VAP it is worth it. This article definitely supports the Capstone

												Project and I have no conflict of interest or strong bias with any ETT manufacturer. Strong choice of references like Dullenkopf, Lorente, Kollef, and Rello; these are experts on the issue of VAP prevention.
Subglottic drainage of secretions reduces VAP (meta-analysis; review). Critical Care Med, 39(8), 1985-1991.	Muscere, J., Rewa, O., McKenchie, K., Jiang, X., Laporta, D., & Heyland, D., (2011)	PUBMED: Subglottic secretion drainage (SSD); prevention ; VAP; meta-analysis	Searched computerized databases, reference lists and personal files RCT of Mechanical ventilated (MV) pts comparing standard ETTs to SSD ETTs Studies were all meta-analyzed for primary outcomes of VAP and secondary clinical outcomes.	Level-I	Aspiration of secretions containing bacteria pathogens that causes VAP. ETTs with SSD as a prevention of VAP.	PCT equaling N=2442	Literature Review; Study identification: All relevant articles using reputable databases. Study selection criteria: RCT of adult MV critically ill pt ; Data synthesis: Primary occurrence of VAP. Secondary ICU and hospital Length of stay (LOS) mortality, antibiotics, safety data. Primary and secondary analysis: Only studies that met the inclusion criteria and subgroups of high-quality studies using a median score.	13 randomized clinical trials that met the inclusion criteria with a total of 2442 randomized patients. Of the 13 studies, 12 reported a reduction in VAP rates in the SSD arm; in meta-analysis, the overall risk ratio for VAP was 0.55 (95% confidence interval, 0.46–0.66; $p < .00001$) with no heterogeneity ($I^2 = 0\%$). The use of SSD was associated with reduced ICU LOS (1.52 days; 95% confidence interval, 2.94 to 0.11; $p = .03$); decreased duration of mechanically ventilated (1.08 days; 95% confidence interval, 2.04 to 0.12; $p = .03$), and increased time to first episode of VAP (2.66 days; 95% confidence interval, 1.06 – 4.26; $p = .001$). There was no effect on adverse events or on hospital or ICU mortality	In those at risk for VAP, the use of ETTs with SSD is effective for the prevention of VAP and may be associated with reduced duration of MV and ICU LOS.	STR: Well done and well supported by RCT. LIM: Some sources provided minimal data and the majority of studies used only one type of ETT compared to the SSD ETT.	None reported	The use of a systematic review and meta-analysis again show that a multifaceted approach including novel prevention strategies like ETT designs must be given strong consideration.
New tracheal tubes to prevent	Nseir, S., (2011)	MEDLINE : VAP; new ETT; evidence	None noted	Level-IV	Source of evidence that supports the use of newer	None provided	Retrospective literature review supporting evidence.	Silver coated ETT were found to reduce VAP but there is limitation on	Further designed studies are needed before a ETT recommendations	STR: Strong and well stated opinion LIM: The opinion may not be shared	None reported	I do share the opinion of the author and I agree that

ventilator-associated pneumonia: where is the evidence? Critical Care, 15(6), 459.					designed ETTs vs the standard tube MEDLINE: VAP; new ETT; evidence			the studies that made a recommendation only. Same was true for polyurethane cuffed tubes only a recommendation. It is clear that more RCTs need to be conducted on newer designed ETTs.	can become the standard of practice in MV pts.	by those who have put time and effort into the studies that have been conducted.		more research into the best preventive strategies to reduce VAP may lie in the newer designed ETTs. This opinion does support the need for my Capstone focus.
Preventing ventilator-associated pneumonia Does the evidence support the practice? JAMA, 301(23), 2534-2538.	O'Grady, N., Murry, P., Ames, N., (2012)	MEDLINE : Preventing ; VAP	Case study	Level-VII	Strong need for available studies to include interventions that improve patient outcomes before they are implemented as prevention approaches in clinical practice.	A adult ICU pt intubated and re-intubated	Case study done on one MV pt.	Difficulty with diagnosing VAP that resulted in a death.	In spite of VAP prevention bundles VAP is still a leading killer in ICU's. Before clinicians adopt the VAP bundle for all MV pt's evidence needs to be credible and strong based on improved pt outcomes.	STR: Strong food for thought. I to have seen some cases where I did feel the pt had a VAP but it was other risk factors like an aspiration prior to intubation that caused the pneumonia. LIM: This was one case study, I am sure there are others out there to support the need for consistent implementation of VAP prevention strategies like VAP bundles.	None reported	Excellent article. It does support the need for more research to be done on VAP prevention strategies and considering more novel strategies currently not included in VAP bundles like newer ETT designs. This supports my Capstone focus.
Ventilator-associated pneumonia bundled strategies: an evidence-based practice, Worldviews on evidence-based nursing, 5(4), 193-204.	O'Keeffe-McCarthy, S., Santiago, C., Lau, G., (2008)	Cochrane or CINHAL: VAP; methodology; nosocomial infection; intubation. ; adult; ventilator bundles; EBP; restricted to quantitative studies	Systematic Literature Review was conducted in MEDLINE, CINHAL, Cochrane, and PsycINFO	Level-I	To provide a review of literature on VAP bundles, practice, definitions. To discuss knowledge of practice and actual clinical settings promotion. To identify need for further research to prevent VAP.	Critically ill adult pts with VAP	A study was evaluated on certain inclusion criteria: Original quantitative research done in English, bundled practices were examined and clinical outcomes of the critically ill adult with VAP were assessed.	Outcomes: Outcomes that are identified in the majority of studies both clinical and process; VAP rate, frequency, number of ventilator days, ICU LOS, mortality rates, compliance rates. Results: Two studies used the CDC definition for VAP; number of VAP/number of ventilator days x 1,000 and reported a decrease of VAP 0.0-2.7 per 1,000 vent days. . One study reported a strong relationship between VAP rates and compliance; in 21 ICUs that had a 95% compliance rate VAP decrease	Methodologically strong RCT are necessary to determine the effects of EBP. A strong organizational conceptual framework to implement the transformation of knowledge to practice is essential and depends on effective leadership to champion the cause. EBP interventions are decreasing VAP rates and must be continued and closely monitored.	STR: Well organized systematic review with the data coming from studies various databases. Investigators used the interrater reliability The acute Physiology and Chronic Health Evaluation (APACHE) scores were used to assess severity of illness and supported validity of some of the outcomes. LIM: Inconclusive evidence was revealed, methodologies were sometimes inadequate, reporting of data was casual in some	None reported	This was a systematic review (SR) done in Canada. I do agree that the authors conclusion found that RCT do carry the highest level of evidence for practice, it is also important that the data is as strong and correct as possible. What the SR did reveal was that even among facilities and direct care providers there is

								from 6.6 to 2.7 per 1,000 vent days. A general trend seen in most studies was that the number of vent days decreased from 6.1 to 3.5 days. The LOS in ICU was variable as some did not report this data. Mortality rates also were not addressed in the majority of studies. The compliance rate to VAP prevention bundles was increased in most of the studies up 20 % .		studies, inconsistent protocols were seen, study results were careless as in some studies. Internal and external validity compromised.		inconsistency in the practice and interventions that MV pt's receive. It does support the Capstone in the sense that more research is needed to investigate effective strategies that are standardized and do support the reduction in VAP incidence.
Analysis of overall level of evidence behind the institute of healthcare improvement ventilator-associated pneumonia guidelines. Southwest Journal of Pulmonary and Critical Care, 3: 40-48.	Padrnos, L., Bul, T., Pattee, J., Whitmore, E., Iqbal M., Lee, S., Singarajah, C., & Robbins, R., (2011)	PUBMED: VAP; VAP bundle	Systematic review of literature; studies were required to be prospective and controlled in design.	Level of evidence I through IV variable	Assessment of the quality of evidence underlying recommendations from one medical regulatory organization the Institute of Healthcare Improvement (IHI) regarding guidelines for VAP prevention and or VAP bundles.	Each study had a different population size (see results) but combined total of 5097 patients representing 5800 vent days, and each author examined their own ICUs where they worked for evidence of a correlation between guidelines compliance and the development of VAP. IRB approval	Retrospective data collection from individual studies that met the criteria for selection. Studies were required to be prospective and controlled in design. Only studies demonstrating a reduction in VAP were considered. The American Thoracic Society grading system was used to assess the underlying quality of evidence for the IHI VAP guidelines and includes levels 1 high, 11 mod, 11 low, and 1V no evidence of improvement.	Elevation head of bed-31 articles-8 used, level 11- mod recommendations; Daily sedation vacation- 66 articles-4 used-level 111- weak recommendation; Daily readiness to wean or extubate-47 articles-3 used-level 111-weak recommendation; Daily spontaneous breathing trial-29 articles-1 used-level-111- weak recommendation; Peptic ulcer disease-52 articles-9 used-level 1V- weak recommendations; Deep venous thrombosis prophylaxis-14 articles-2 used-level-111-weak recommendation.	As seen above they were unable to show that improved VAP guideline compliance correlated with a reduced incidence of VAP. Agencies like the IHI should show restraint in guideline formation based on the opinion or evidence. Only those with strong backing evidence should be designated as a guideline.	STR: Drakulovic et al. conducted a RCT 86 MV pts on HOB. Kress et al. conducted a RCT on 128 adult pts MV for sedation vacation. The other outcomes did not indicate the study used. A large population was used for this systematic review. LIM: All data came from the Phoenix VA hospitals. No data on negative consequences if the IHI guidelines were not mandated and monitored.	None reported.	WOW this has given me food for thought. This could be bias opinion; as well as selection in the studies used. I do agree that more studies are needed and there has to be more investigation into novel prevention strategies like the ETT designs and to aid in determining the best standardized practice that MV pts should receive. More work need to be done especially when hospital reimbursement is based on prevention. The question is can VAP ever be

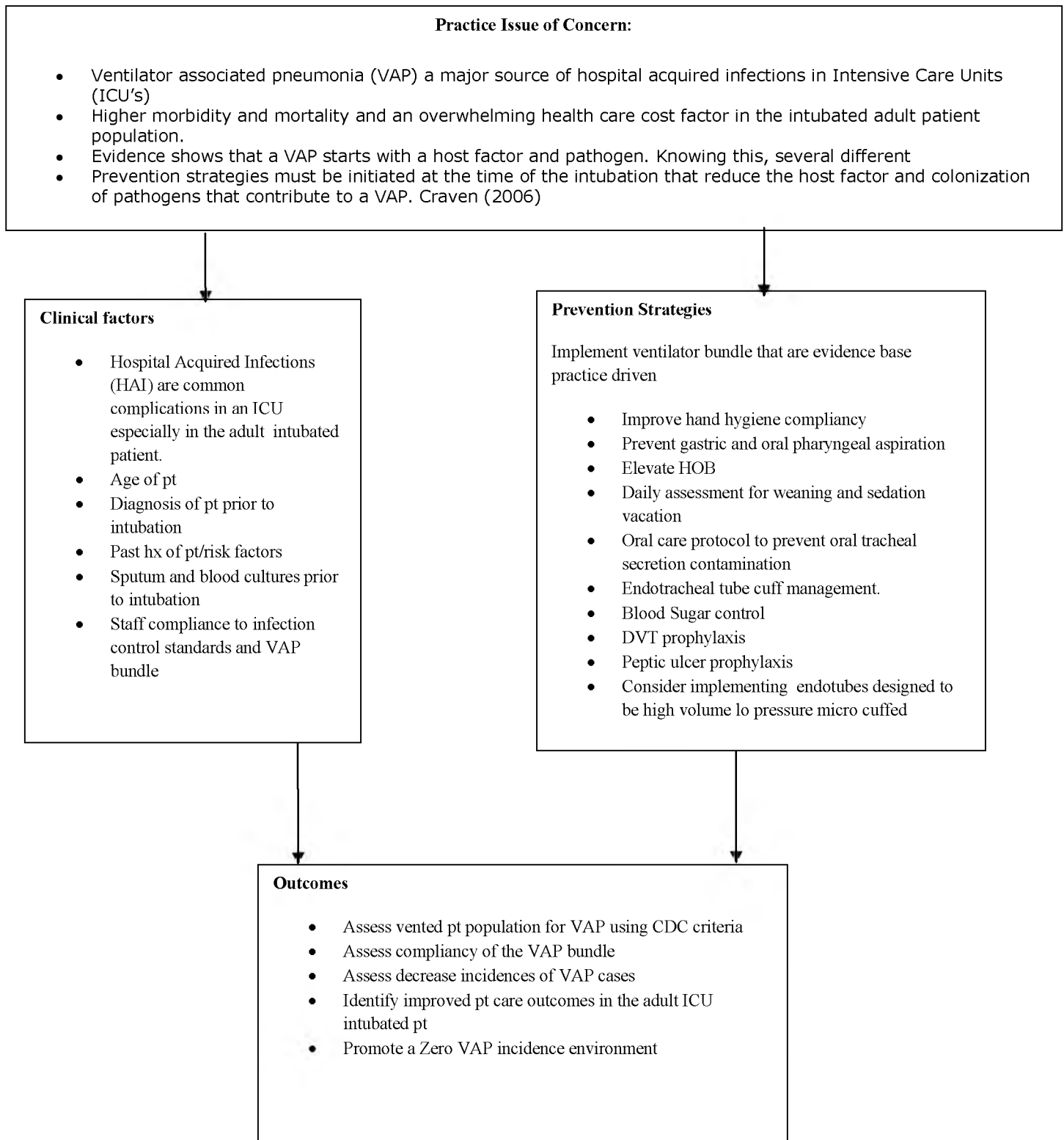
												eliminated. I say no, but it can be reduced.
A randomized trial of dental brushing for preventing ventilator-associated pneumonia. Chest, 136(2), 433-439.	Pobo, A., Lisboa, T., Rodriques, A., Sole, A., Magret, M., Treffler, S., Gomez, F., & Rello, J., (2009)	PUBMED: Downloaded from chestjournal.chestpubs by guest on May 15, 2012 www.chestjournal.org	Single-blind prospective study of standard oral care with 0.12% Chlorhexidine digluconate (standard group) vs standard oral care plus electric tooth brushing (toothbrush group). Level of Evidence	Level-II	Potential relationship of oral care to VAP incidence. The hypothesis was that improved oral care with the electric tooth brushing may help reduce VAP incidence.	A large med/surg ICU at an urban teaching hospital. IRB approval. All adult pts who were intubated without incidence of pulmonary infection and trialed within 12 hours of intubation if expected to be intubated for longer than 48 hours. 147 pts were randomized 74 were in the toothbrush group.	A prospective single-blinded RCT of adult pts intubated for > than 48 hrs. Controlling for exposure to antibiotic treatment, pts were randomized to oral care every 8 hrs with 0.12% Chlorhexidine digluconate (standard group) vs standard oral care plus electric tooth brushing (toothbrush group). VAP was documented by quantitative resp cultures. MV duration, LOS, antibiotic use, and mortality were all secondary outcomes	The groups were comparable at baseline. VAP (20.3% vs 24.7% p=0.55).	Oral care with the electric toothbrush using 0.12% Chlorhexidine is not effective for the prevention of VAP.	STR: First study to evaluate a different oral care protocol. Intervention simple and safe. LIM: Possible type II errors, possible lack of compliance by healthcare staff. A single study. Lack of standard oral care recommendations.	None reported	Very interesting RCT that may put to rest the use of electric toothbrush oral care. Evidence does show that certain oral care guidelines may reduce VAP risk. I am convinced that novel and known preventive strategies such as oral care guidelines will be a factor in VAP prevention strategies in the future.
Using evidence-based practice to prevent ventilator-associated pneumonia. Critical Care Nurse, 32(4), 41-50.	Sedwick, M. Lance-Smith, M., Reeder, S., Nardi, J., (2012)	Retrieved from the actual journal: EBP; VAP; prevention	Review of literature; studies with RCTs, retrospective chart reviews of data from previous trials and meta-analysis.	Levels - I, II, III	To develop a Vent bundle and care practices for critical care nurses to reduce the rate of VAP.	ICUs in Lankenau Hosp. Pa. on 105 staff nurses, a total of 4709 Vent days were audited from Jan 2009 through Dec. 2009.	The IHI protocol for oral care, hand washing, HOB, SSD; compliance audit calculated by electronic feedback was conducted.	Adherence to vent bundles increased. Compliance for peptic ulcer dx prophylaxis, DVT, sedation vacation, and elevated HOB were greater than 98%. Compliance rate for oral care increased from 76% to 96.8%. Readiness for extubation reached 92.4%. VAP decreased from 9.47 to 1.9/100 vent days. Saving from VAP rate decrease was approx. \$1.5 million.	Strict adherence to bundle practices for VAP prevention, interdisciplinary collaboration improved patients' outcomes and produced a marked savings in cost.	STR: Compliance data was collected by QI staff. SMART approach described by Kollef an expert in VAP prevention was used. Education support was a big part of implementation. Computer data completed the calculations. VAP reduction was achieved. LIM: Short time frame but I really don't see too many limitations.	None reported	Well done nurses. I think I could adopt many of the strengths from this article's example for future use. Excellent studies were selected that are consistently referenced by others for a resource and literature reviews. This can support my Capstone by

												strengthening the argument for more compliance to vent bundles and maximizing the ebp strategies we already have.
Endotracheal tube cuff design and function. Anesthesiology news guide to airway management ANESTHESIOLOGYNEWS.COM. 51-56.	Spiegel, J., (2010)	PUBMED: New designed ETT comparison	Literature review	Level-VII	Overview of newer ETT designs	Adults and pediatric population is given is mentioned	None disclosed	None included	Some major recent improvements in ETT cuff design have offered clinicians real choice in device usage. Cuff designs are adding to safety and VAP reductions.	LIM: No real data and statistics to back up opinion.	None reported	A great article and many studies do support that VAP reduction can occur with the use of these newer designed ETT even if it is a small reduction. This is a weak level of evidence source but done better the author could have added greatly to the need to investigate newer ETT designed further in the future to support the evidence for practice.
Pneumonia in the surgical intensive care unit: Is every one preventable? Surgery, 150: 665-672.	Wahl, W., Zalewski, C., Hemmila, M., & Arbor, A., (2011).	PUBMED: Surgical ICU; pneumonia prevention	Retrospective review of all MV pts in mixed surgical ICUs who developed pneumonia from 2006 to 2008.	Level-III	To prove that many acutely injured pts develop pneumonia at the time of injury in spite of measures to prevent it.	There were 208 MV pts who underwent bronchoalveolar lavage (BAL) specimens half of which were performed the first 48 hours of admission. IRB approved.	Retrospective review of these MV pts from mixed ICUs who developed pneumonia from 2006 to 2008 and were vented > than 48 hours.	Of the 208 MV pts who underwent bronchoalveolar lavage (BAL) specimens half of which were performed the first 48 hours of admission. 58% had a positive BAL culture but no VAP. Only 10% of pts studied with early BAL had no growth. 25 pts with a positive BAL on early BAL underwent repeated BAL and 16 (64%) were later diagnosed with VAP.	Many intubated pts in the surgical ICUs had evidence of early pneumonia or bac, growth within 48 hours of arrival to the ICUs. Indicating pt – derived rather than environmental acquired source may add to VAP risks.	STR: The findings seem to indicate that factors of developing VAP can be multiple. LIM: No real deviation of medical and surgical pts. It was a small single-centered study. data that was retrospective.	None reported	I feel the article did lend some merit to the possibility that the bacteria sources that can cause a VAP is not easily contained or isolated. This adds to the vulnerability of pneumonia such as a VAP if MV in the already compromised injured pt.

Brushing teeth with purified water to reduce ventilator-associated pneumonia. Journal of Nursing Research, 19(4), 289-296.	Yoa, L., Chang, C., Maa, S., Wang, C., Chen, C., (2011)	Cochrane: Ventilator-associated pneumonia ; oral care; tooth brushing; oral health; oral hygiene	RCT pilot	Level-II	Study the effects in a neurosurgical ICU brushing teeth twice daily with purified water on MV pts to see if VAP rate were reduced.	N=53 male 64.2% mean age 60.6.	MV support for at least 48 hrs, and no current pneumonia. Both groups received the same oral care. The exp gr received tooth brushing with purified water. The con gr received regular oral care moisturizing of lips.	N=53 after 7 days of tooth brushing method, VAP rate were lower exp gr 17% than in con gr 71% $p < .05$.	Protocol using toothbrush with purified water can reduce VAP and improve oral health and hygiene.	STR: Design was rigorous RCT. LIM: Sample small. One center.	Grants by Taiwan National Science Council and National Health Research Institution.	Results could be seen as bias based on the grants. The small study was interesting and should be studied further. It could become a preventive strategy for VAP if more research is conducted. At this time I see it as a consideration of novel strategies to prevent VAP.
The tracheal tube: gateway to ventilator-associated pneumonia. Critical Care, 15(5), 310-	Zolfaghari, P., & Wynco II, D., (2011)	PUBMED: Trach tube	Viewpoint article	Level-VII	To explore the published data on support for newer ETT and their potential contribution to VAP prevention strategies.	None listed	None listed	None listed	The paradigm of VAP prevention strongly favors multi-faceted strategies aimed at reducing aspiration of oropharyngeal secretions. With the increasing weight of evidence pointing at the role of the tracheal tube design and maintenance of adequate cuff pressures, is it really good medical practice to continue to use standard cuffed tubes?	STR: I do agree with the opinion of the authors LIM: No strong evidence for their opinion was found in the article	PSZ has no competing interests. In the past 3 years, DW has acted as a paid consultant or given lectures on VAP for Covidien, Kimberly-Clark and Bard.	I do question a possible strong bias and influence from one of the authors. The article is not well done. It is clear and concise and I do agree that more research be done on the newer designed ETT and the part they can play in VAP reduction. This is a main thread of my PICO and Capstone. Can using a newer designed ETT reduce VAP and provide better pt care outcomes? I hope to find some evidence of such a possibility.

Appendix B

**Conceptual Model for Prevention of VAP (Kane, 2011)
And
Logic Model for DNP Project (Zaccagnini & White) 2011)**

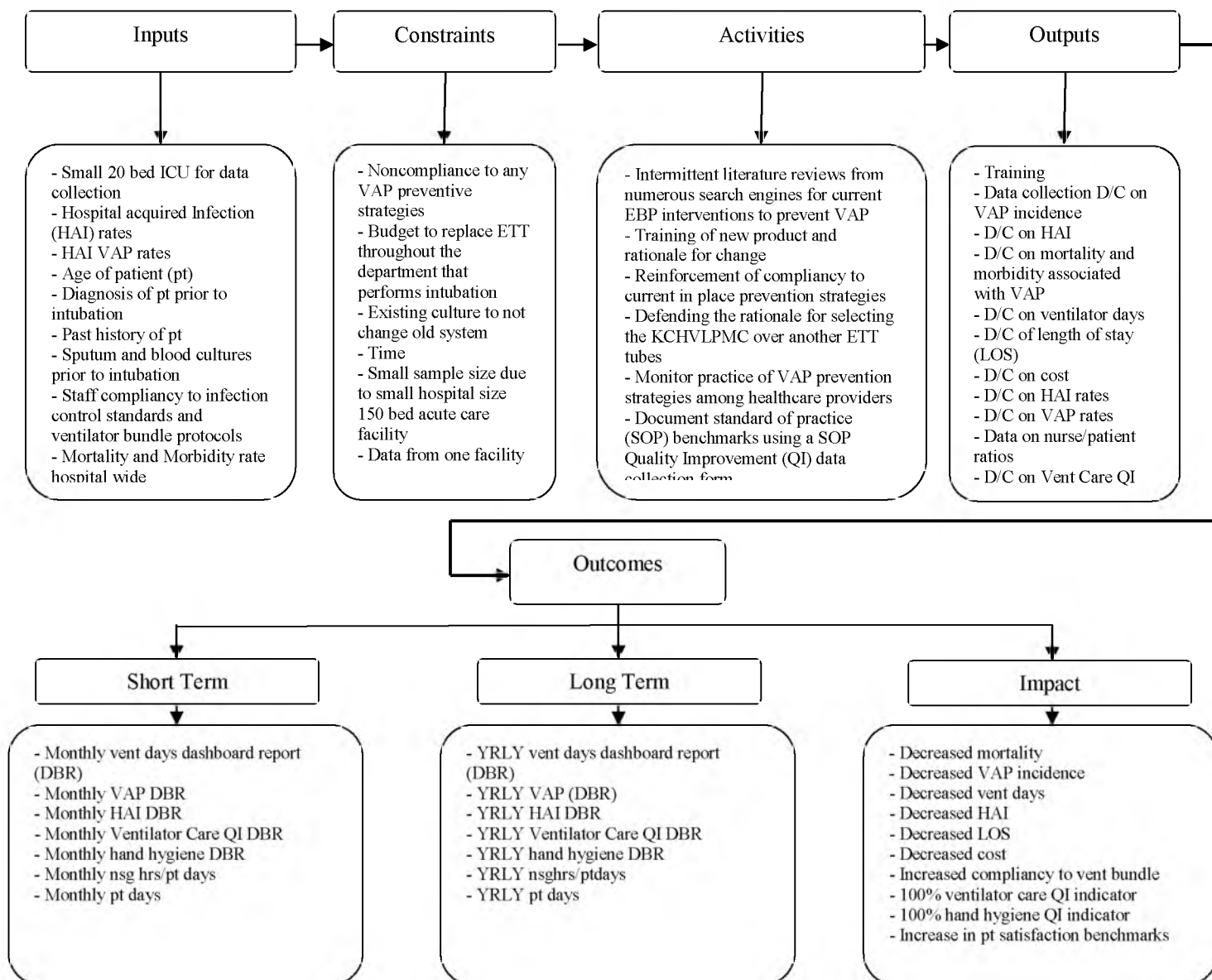


Project

The evaluation of the effectiveness of Evidence based practice strategies in conjunction with the newer designed ETT like the KCHVLPMC tube to reduce the incidence of VAP in the ICU in an adult patient population. A reduction in VAP incidence and improved better patient care outcome are the effective goals to be met.

Problem Identification:

- Increased incidence of VAP in spite of vent bundle protocols and 100% quality indicator (QI) compliance and other evidence based practice (EBP) strategies.



Appendix C

Measurement tool/instrument

Context-Specific Database Draft

Month	# of Patients on Ventilators	Kimberly Clark or Mallinckodt	VAP Compliance QI	# of Ventilator Days	VAP Incidences
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Ventilator QI

Date: _____

Auditor's Initials: _____

Room #								
Medical Record #								
	7a	7p		7a	7p		7a	7p
Assigned RN Initials								
1. Ventilator Order Set on Chart?	Yes No	Yes No		Yes No	Yes No		Yes No	Yes No
2. Ventilator Order Set completed and signed by the physician?	Yes No	Yes No		Yes No	Yes No		Yes No	Yes No
3. Is it documented that the HOB is elevated 30-45 degrees at all times?	Yes No	Yes No		Yes No	Yes No		Yes No	Yes No
4. Is a Sage 24 hr oral care kit in the room?	Yes No	Yes No		Yes No	Yes No		Yes No	Yes No
5. Is mouth care documented every 2 hrs on the CCU flow sheet?	Yes No	Yes No		Yes No	Yes No		Yes No	Yes No
6. Does the caregiver wash hands or use alcohol based hand antiseptic before <u>and</u> after entering the patient's room? (observe one caregiver)	Yes No	Yes No		Yes No	Yes No		Yes No	Yes No
7. Is there documentation regarding daily assessment of readiness to extubate ("sedation vacation")? * See respiratory flow sheet on the clipboard at the patient's bedside.	Yes No	Yes No		Yes No	Yes No		Yes No	Yes No
Comments								

Appendix D

Timeframe

Timeframe

The time frame for the retrospective data collection was from February 27, until May 31, 2013.

The data was collected on time and tabulated with results known as of July 4, 2013.

Appendix E

Budget and Resources Congruent with Objectives and Funding Source Identified

There are no budgetary concerns

- No additional education requirements
- No additional equipment to purchase
- No cost was incurred in the data collection

The KCHVLP ETT is currently implemented into practice (no resource supply issue)

Appendix F

CITI Collaborative Institutional Training Initiative (CITI)**The RCR for Social & Behavioral Curriculum Completion Report****Printed on 9/17/2012****Learner:** Joyce Page (username: jpge)**Institution:** Regis University**Contact Information**Regis University
3333Regis BLVD
Denver, Colorado 80221**The RCR for Social & Behavioral:** This course is for investigators, staff and students with an interest or focus in **Social and Behavioral** research. This course contains text, embedded case studies AND quizzes.**Stage 1. RCR Passed on 09/17/12 (Ref # 8717519)**

Required Modules	Date Completed	
Introduction to the Responsible Conduct of Research	09/17/12	no quiz
Research Misconduct 2-1495	09/17/12	5/5 (100%)
Case Study - Truth or Consequences 2-1217	09/17/12	2/3 (67%)
Case Study - In the Field, No One Will Know 2-1218	09/17/12	3/3 (100%)
Case Study Plagiarism 2-1472	09/17/12	2/2 (100%)
Human Subjects 13566	09/17/12	5/5 (100%)

For this Completion Report to be valid, the learner listed above must be affiliated with a CITI participating institution. Falsified information and unauthorized use of the CITI course site is unethical, and may be considered scientific misconduct by your institution.

Paul Braunschweiger Ph.D.

Professor, University of Miami

Director Office of Research Education

CITI Course Coordinator

Appendix G



Academic Affairs
Academic Grants

3333 Regis Boulevard, H-4
Denver, Colorado 80221-1099

303-458-4206
303-984-5528 FAX
www.regis.edu

IRB – REGIS UNIVERSITY

February 12, 2013

Joyce Page
3120 Schoolhouse Rd.
Dover, PA 17315

RE: IRB #: 13-041

Dear Ms. Page:

Your application to the Regis IRB for your project "Use of High Volume Low Pressure Microcuff Endotracheal Tubes to Reduce Ventilator-Associated Pneumonia" was approved as an exempt study on February 12, 2013. This study was approved under the 45CFR45.101.b exempt study category #4.

The designation of "exempt," means no further IRB review of this project, as it is currently designed, is needed.

If changes are made in the research plan that significantly alter the involvement of human subjects from that which was approved in the named application, the new research plan must be resubmitted to the Regis IRB for approval.

Sincerely,

A handwritten signature in cursive script that reads "Patsy McGuire Cullen".

Patsy McGuire Cullen, PhD, CPNP
Chair, Institutional Review Board
Associate Professor and Director
Department of Accelerated Nursing
Loretto Heights School of Nursing
Rueckert-Hartman College for Health Professions
Regis University

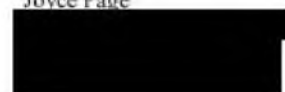
cc: Dr. Alma Jackson

Appendix H



December 28, 2012

Joyce Page



Re: Evidence Based practice study "Reducing Ventilator Associate Pneumonia through Theory-Guided Evidence-Based Practice Changes".

Dear Joyce,

Your request for an extension on your IRB research study has been evaluated by Team and has been granted. Upon completion of the study we expect the results of this study to be presented to the IRB Team within 30 days.

You are hereby granted an additional period of 60 days to complete your project. If more than is required you will need to request a review from the IRB.

Sincerely,



IRB Co-Chair

