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Oral Care and Ventilator Associated Pneumonia Prevention

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Oral Care and Ventilator Associated Pneumonia Prevention

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Acknowledgements

Thank you to my husband who believed in me long before he was even my boyfriend and encouraged me to begin the process of achieving my master's in nursing. Thank you to my biggest fan- my mom. My mother's tale of type-writing her thesis statement when she was achieving her master's in nursing to become a nurse practitioner herself did not go in vain. Here I am following in her footsteps and thankful for all the professors, preceptors, classmates, and patients that have helped me on my journey thus far in order to become a nurse practitioner.

Executive Summary

With rising healthcare costs and increasing demands placed on healthcare workers, it is no wonder that decreasing hospital length of stay for patients is high priority for hospitals today. Hospital acquired infections are one of the culprits keeping so many patients hospitalized. Specifically, in intensive care units (ICU) and intermediate care (IMC) units that care for mechanically ventilated patients, ventilator associated pneumonia secondary to intubation is a complication and cost that is being sought to be avoided. Hospitals have been pro-active to prevent ventilator associated pneumonia from occurring by placing oral care bundles or protocols in place to care for mechanically ventilated patients. With the recent development of the SARS-CoV-2 pandemic, it is a reminder of how vital oral care bundles are to prevent pneumonia. But what is the best practice? Therefore, research had to be done to answer this PICOT question: In mechanically ventilated patients (P), how does routinely scheduled oral care with chlorhexidine (I) compared to other oral care substances, inconsistent**,** or no oral care (C) affect ventilator associated pneumonia (VAP) (O) within hospitalization stay (T)?

Rationale

According to Villar et al. (2016) “VAP is the second most common nosocomial infection in ICUs and the first most common in patients receiving mechanical ventilation.” (p. 1245). Furthermore, it is estimated that 300,000 patients in the United States are mechanically ventilated each year, with up to twenty percent of patients developing VAP (Enwere, Elofson, Forbes, & Gerlach, 2016). Any nurse caring for patients in this patient population group understands the additional cost, length of stay, and overall harm that can occur to the patient as a result of VAP. It is evident that VAP is indeed a critical issue for not only hospitals, but more importantly, the patients themselves facing this complication. Therefore, research has been done

to discover the best way to prevent VAP. Specifically, oral care with chlorhexidine has been studied as a VAP preventative. Chlorhexidine has gained significant attention, and most agree that it is the best source to prevent VAP. Nurses today that are caring for a mechanically ventilated patient will be familiar with that hospital's protocol of performing oral care with chlorhexidine. However, there are discrepancies about what the best chlorhexidine dose, frequency, or application technique is (Villar et al., 2016). Furthermore, there are discrepancies and conflicting research about chlorhexidine really being a significant agent in preventing VAP (Villar et al., 2016).

Literature Synthesis

According to the systematic review and meta-analysis by Villar et al. (2016) it was concluded that chlorhexidine is effective in preventing VAP if using 2% chlorhexidine or administering chlorhexidine oral care four times a day (Villar et al., 2016, p. 1258). The information that led to this conclusion was based on 13 studies, included data on 1,640 subjects who were randomly allocated to chlorhexidine (*n* 834) or control (*n* 806) treatments (Villar et al., 2016). However, it was noted that 2% chlorhexidine caused irritation to the oral mucosa in some patients. The effects were reversible, but still, the researchers cautioned against using 2% chlorhexidine. It was also noted that 2% chlorhexidine is not usually available for typical hospital consumption (Villar et al., 2016). If anything, this research revealed one of the most vital components to preventing VAP- that consistent oral care, performed four times a day, is the key to preventing this infection associated with mechanical ventilation.

Similarly, another study was performed by Özçaka et al., (2012), researching the benefits of preventing VAP with 0.2% chlorhexidine gluconate. This randomized, double-blind, controlled study consisted of a sample size of sixty-one patients that were scheduled for invasive

mechanical ventilation for at least forty-eight hours. Thirty-two patients made up the control group, while twenty-nine patients made up the intervention group receiving oral care with 0.2% chlorhexidine gluconate swabs four times a day. The aim of the study was to determine if using 0.2% chlorhexidine gluconate would decrease the incidence of VAP. Indeed, this question was answered by the evidence. "The VAP development rate was significantly higher in the control group than in the CHX group (68.8% vs. 41.4%, respectively; $p = 0.03$) with an odds ratio of 3.12 (95% confidence interval = 1.09–8.91)" (Özçaka et al., 2012, p. 584). Thus, it was determined that 0.2% chlorhexidine gluconate oral care performed four times a day with an oral swab, should be recommended to ICU's for the prevention of VAP in ventilated patients (Özçaka et al., 2012).

Further research in regard to using 0.2% chlorhexidine was performed by Chacko et al. (2017). The study was undertaken in a 24-bed medical ICU of a 2,600 bed, tertiary care center in South India. Patients were included in the study from January 14, 2014 to December 27, 2014. There were 206 eligible subjects; 104 patients in the experimental group and 102 patients in the control group (Chako et al., 2017). One of the purposes of this double-blind, randomized control trial was to see if a new technique of brushing a ventilated patient's teeth with chlorhexidine 0.2% and suctioning three times a day (with a disposable Yankauer suction catheter) was superior to regular oral care protocols consisting of only swabbing the mouth with chlorhexidine 0.2% three times a day (Chacko et al., 2017). Since this study considered a p-value less than 0.05 to be statistically significant, a p-value of 0.82 representing the VAP significance between both groups concluded that there was no significant difference between the two oral care protocols (Chacko et al., 2017). Thus, in the end, this study concluded that tooth-brushing with chlorhexidine 0.2% is not superior to simply swabbing the oral cavity with a swab soaked in

chlorhexidine 0.2%. But the researchers concluded that meticulous and consistent oral care is key to preventing VAP and that nurses must be taught the importance of complying with oral care bundles established in hospitals (Chacko et al., 2017).

Another article was examined to determine if chlorhexidine really is beneficial in preventing VAP. This time, not only chlorhexidine and tooth-brushing were evaluated, but mechanical tooth-brushing was examined as well. According to the research of Munro, Grap, Jones, McClish, and Sessler (2009), the purpose of their study was to examine the effects of mechanical (tooth-brushing), pharmacological (topical oral chlorhexidine), and combination (tooth-brushing plus chlorhexidine) oral care on the development of ventilator-associated pneumonia (VAP) in critically ill patients receiving mechanical ventilation (Munro et al., 2009). This randomized clinical control trial with a 2x2 factorial design screened 10,910 patients. A total of 1,416 patients met the study criteria, 547 patients ultimately gave consent to participate in the study, and those patients were assigned to randomized group assignments for the study. Patients were randomly assigned to one of four treatments: a 0.12% solution of chlorhexidine gluconate 5ml by oral swab twice a day, tooth-brushing three times a day, a combination of both stated treatments of tooth-brushing three times a day and 0.12% chlorhexidine gluconate every 12 hours, or a control group that received usual care (Munro et al., 2009). The VAP diagnosis was scored by using the Clinical Pulmonary Infection Score (CPIS). It was found that 0.12% chlorhexidine significantly reduced the incidence of pneumonia on day 3 (CPIS $\geq$6) among patients who had CPIS <6 at baseline (P=.006). Furthermore, it was found that tooth-brushing had no effect on CPIS and did not enhance the effect of chlorhexidine. It should also be noted that 0.12% chlorhexidine gluconate was used because the Food and Drug Administration approves of this chlorhexidine strength in the United States (Munro et al., 2009).

Thus far chlorhexidine oral care has been examined as a means of performing oral care to prevent VAP. But other substances should be examined before determining that chlorhexidine is the best oral care substance. A systematic review, "*Oral Hygiene Care for Critically Ill Patients to Prevent Ventilator Associated Pneumonia*," (Shi et al., 2013), examined thirty-five randomized control trials. These thirty-five trials consisted of 5,374 critically ill patients randomly assigned to interventions. The interventions were grouped into four categories to examine different oral care substances and methods: Chlorhexidine mouth-rinse or gel compared to placebo with or without toothbrushing, toothbrushing compared with no toothbrushing, powered toothbrushing compared with manual, and oral care with other substances (saline, bicarbonate, povidone iodine, and triclosan). All studies took place in ICU units in hospitals. Patients were categorized as either medical, surgical, or trauma patients, although thirteen studies did not specify patients according to these categories. Amidst the wide variety of patients, it was determined that there was weak evidence that povidone iodine rinse was more effective than saline at preventing VAP (OR 0.35, 95% CI 0.19 to 0.65, $p = 0.0009$, $I^2 = 53\%$) however there was moderate evidence for the use of chlorhexidine (either as a mouth-rinse or gel) to decrease the odds of a patient developing VAP with an OR of 0.60, 95% CI 0.47 to 0.77, $p < 0.001$, $I^2 = 21\%$, and a NNT of 15 (95% CI 10 to 34) according to Shi et al., (2013). It is also worthy to note that no difference was noted in VAP incidence when chlorhexidine oral care was compared to tooth-brushing with chlorhexidine (Shi et al., 2013)

Finally, amidst the previous systematic reviews and randomized clinical control trials stated above, it is appropriate to examine a retrospective cohort study to see how implementing a chlorhexidine mouthwash bundle in an ICU affected the incidence of VAP. According to "*Impact of Chlorhexidine Mouthwash Prophylaxis on Probable Ventilator-Associated*

Pneumonia in a Surgical Intensive Care Unit" (Enwere et al., 2016), the study took place in a forty-bed surgical ICU. Patients were evaluated prior to chlorhexidine mouthwash intervention from January 1, 2009 to December 31, 2009. Patients were that evaluated post-chlorhexidine implementation from March 1, 2010 to February 28, 2011. In total, 1,780 mechanically ventilated patients were evaluated for inclusions to comprise the pre-chlorhexidine group, while 1,854 mechanically ventilated patients were evaluated to make up the post-chlorhexidine group. In the end, 601 patients ultimately met criteria to be included for evaluation to equal ninety-four patients in the pre-chlorhexidine group, and sixty-four patients in the post-chlorhexidine group. It was noted between the two groups that VAP rate was significantly decreased in the post-chlorhexidine group compared to the pre-chlorhexidine group, (1.85% pre vs 0.81% post, p = 0.0082) according to Enwere et al., (2016).

Stakeholders

Any nurse caring for patients in this patient population group understands the additional cost, length of stay, and overall harm that can occur to the patient as a result of VAP. With a 9-27% risk of contracting VAP after being intubated and a 25-50% mortality risk once VAP is contracted, it is evident that VAP is indeed a critical issue for not only hospitals, but more importantly, the patients themselves facing this complication (Efrati et. al, 2010). Therefore, research has been done to discover the best way to prevent VAP. Chlorhexidine has gained significant attention and is known for outstanding prevention of VAP. Nurses today that are caring for a mechanically ventilated patient will be familiar with that hospital's protocol of performing oral care with chlorhexidine. Despite the nurse's busy schedule of working in an ICU or an IMC unit, it is important to not underestimate the role they play in preventing their patient from developing VAP. Patients and their family members in this population highly value

being able to go home as soon as possible. Nurses can make this possible by preventing complications such as VAP by administering oral care with chlorhexidine.

The major factor that is undeniable in ensuring that this project is implemented is the amount of cost that will be saved by the hospital. It is estimated that VAP costs an additional total of $40,000 to a hospital stay (Efrati et. al, 2010). With a 9-27% risk of VAP occurring after intubation as was stated earlier, this is a significant cost that the hospital could save, not to mention patients' lives (Efrati et. al, 2010).

Implementation

In the twenty-first century nurses are being required to perform more and more tasks for their patients- and also for the hospital. Depending on the day and how busy it is, certain tasks will have to get over-looked or not successfully completed by the nurse. One such task may be oral care for ventilated patients. Sure, it may get completed once a shift or so, but consistency is key to preventing VAP (Enwere et al., 2016).

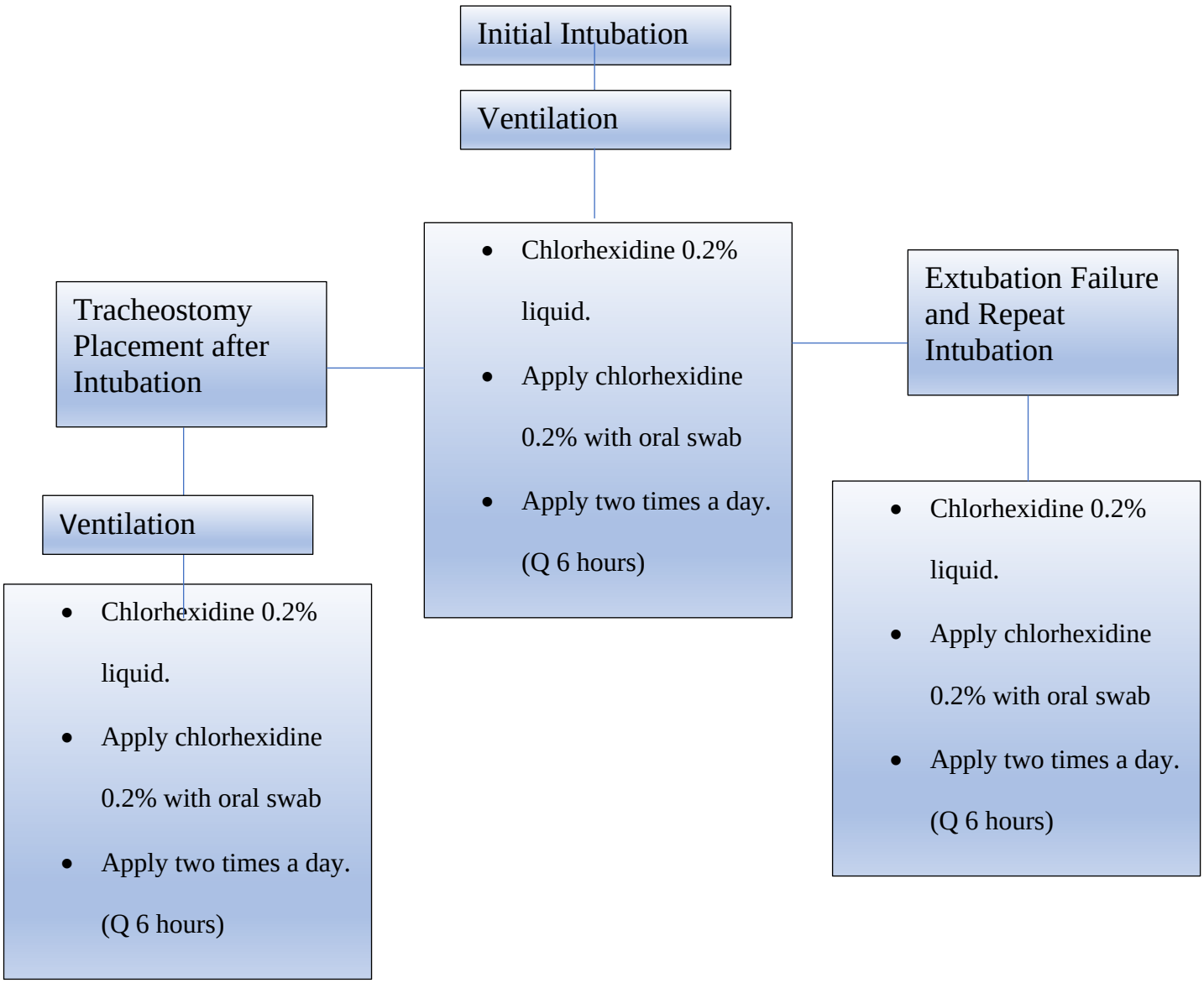
The suggested implementation to prevent VAP per evidence-based practice is:

1. Use chlorhexidine 0.2% liquid.
2. Apply chlorhexidine 0.2% with oral swab as opposed to using a toothbrush.
3. Apply two times a day.

Therefore, the greatest challenge to implementation is ensuring that nurses will perform oral care consistently, twice a day, or two times per a twelve-hour shift. A suggestion to help remind nurses to perform oral care for their patients would be to have a section for nurses to scan in the electronic medical record. Just as other medications need to be scanned before the nurse gives them to the patient, so should the chlorhexidine container and mouth swab be required to have a barcode on it so that the nurse must scan the objects in order to be compliant with caring for the

patient. It has been shown that once nurses are compliant in performing oral care, that pneumonia rates go down significantly (Warren, Medei, Wood & Schutte, 2019).

Timetable/Flowchart



Data Collection Methods

First of all, nurses are vital in implementing this project. Nurses on the designated unit that will be caring for mechanically ventilated patients should be educated on the protocol that they will be implementing. Ideally, this study should be performed in an ICU that cares for one

type of patient such as trauma, neuro, or cardiac, so as to avoid variables. A retrospective study should be completed to evaluate the VAP incidence rate among patients in that ICU for the same time period the year before. Then, a consent form should be signed by the guardian or power of attorney of the patient to give consent for the trial of the evidence based VAP prevention protocol. Of course, the trial should be optional for patients. The trial should take place over five months to ensure adequate data collection from enough patients. The following administration of oral care using chlorhexidine for ventilated patients should be as follows:

1. Use chlorhexidine 0.2% liquid.
2. Apply chlorhexidine 0.2% with oral swab as opposed to using a toothbrush.
3. Apply two times a day (twice a twelve-hour shift).

A VAP prevention coordinator should be assigned to the study and should monitor how many patients develop VAP. The criteria that should be assessed in each patient is fever, tachycardia, oxygen saturation, x-ray and CT imaging noting pneumonia per the radiologist's reading.

Cost/Benefit Discussion

As mentioned earlier, it is estimated that VAP costs an additional total of $40,000 to a hospital stay (Efrati et. al, 2010). Furthermore, a peer reviewed study completed by AACN found that not only does VAP prevention increase the lifespan of an elderly patient by 10.84 years of life but can also reduce the cost of care by up to $150,000 (AACN, 2015). With a 9-27% risk of contracting VAP and a 25-50% mortality risk once VAP is contracted, it is obvious that successfully preventing VAP is a worthwhile endeavor for a hospital (Efrati et. al, 2010). Undoubtedly, VAP prevention is not only for the patient's benefit, but also cost saving for the hospital.

Overall Discussions/Results

After reviewing the oral care interventions that support VAP incidence decrease for mechanically ventilated patients, it is appropriate to propose a VAP bundle based upon the evidence examined. First, chlorhexidine 0.2% should be used. Three out of the six articles studied included evidence of chlorhexidine 0.2% preventing VAP incidence. It was noted that 2% chlorhexidine can cause irritation to the oral mucosa and is not typically available for hospital consumption (Villar et al., 2016), so 2% chlorhexidine should not be recommended. Second, chlorhexidine 0.2% should be applied with an oral swab as opposed to a toothbrush since there is little to no evidence that tooth-brushing provides any better VAP prevention than using a plain swab according to Shi et al., (2013) and Munro et al., (2009). Finally, chlorhexidine oral care should be performed twice a day due to the evidence that Enwere et al., (2016), Munro et al., (2009), Özçaka et al., (2012), Shi et al., (2013) provided. Thus, the preliminary plan to implement change and decrease VAP incidence in ICUs for mechanically ventilated patients can be summarized as:

1. Use chlorhexidine 0.2% liquid.
2. Apply chlorhexidine 0.2% with oral swab as opposed to using a toothbrush.
3. Apply two times a day (twice during a 12-hour shift).

Recommendations

Nurses are vital to this protocol being a success. In order for lives to be saved, length of stay to be decreased, and for money to be saved by the hospital, the hospital needs to help their nurses with this protocol. Throughout the implementation process open communication needs to be available between the nurses and their managers. Undoubtedly, issues and complications may arise. But in order for this protocol to be a success, nurses need to be empowered to bring issues to their manager, coordinator, and even the CEO of the hospital. As was mentioned earlier, the

study by Hui, Kit, & Poh (2016) assessed the implementation of VAP protocols by nurses. It was found that when the nurses were given an audit, feedback, and re-audit strategy, that VAP incidence decreased by 64% (Hui, Kit, & Poh, 2016). During the audit period prior to feedback, it was discovered that nurses were participating in different aspects of the VAP bundle from 0%-47%. After this feedback was given to the nurses, an increase in actually performing essential tasks of the VAP bundle increased from 50%-90%. Which as previously stated, resulted in a 64% decrease in VAP incidence (Hui, Kit, & Poh, 2016). Just as this study showed, it is important for nurses to receive feedback and recognition for the work they are doing so that they know a task in not just extra work- but is an essential and life-saving portion of their job. Nurses are key not only to saving the lives of patients, but also to saving the hospital money.

Conclusion

As the above articles and evidence has indicated, chlorhexidine is indeed effective in preventing VAP in mechanically ventilated adult patients. The key to making this proposed VAP bundle effective, however, is consistency. With nurses being responsible for more and more patients and tasks as the years go by, it is easy for a nurse to overlook tasks that do not seem as vital to helping the patient thrive. Therefore, this information is valuable to pass on to today's nurses. Education should be conveyed so that nurses realize the critical value of oral care, and do not just skip the task or provide it inconsistently. The importance of preventative care for patients at risk for VAP cannot be summed up any better than this phrase: "Risk of VAP starts with intubation; so too should VAP prevention efforts" (Munro et al., 2009, p.436).

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Appendix A: Synthesis/Outcomes Table

Table 1: Interventions

Interventions:	A	B	C	D	E	F
2% CH QID						X
0.2% CH	X					
0.12% BID			X			
0.2%CH BID				X		
Na+				X		
TB w/0.12%CH			X			
TB w/0.2% CH	X					
Manual TB			X		X	
Powered TB					X	
0.12% CH mouthwash BID		X			X	
CH Gel					X	

A=Chacko et al. (2017); B= Enwere et al. (2016); C= Munro et al. (2009); D= Özçaka et al. (2012); E= Shi et al. (2013); F= Villar et al. (2016).

X= indication that intervention was used in study.

BID= twice a day

CH= chlorhexidine

Na+= saline

TB= toothbrush

Appendix A: Continued

Table 2: Design, Sample, Outcomes

Studies Evaluating the Effects of CH:	Design	Sample	VAP Incidence	Ventilator Days	LOS
A	RCT, double-blind study	*N*=206	⬇	⬇	NM
B	Retrospective cohort study	*N*=158	⬇	S	⬇
C	RCT, 2x2 Factorial Design	*N*=547	⬇	⬇	⬆
D	RCT, double blind study	*N*=61	⬇	⬇	⬇
E	Meta-analysis	N=5,374	⬇	S	S
F	Systematic Review, Meta-Analysis, Intention-to-treat analysis	N= 1,640	⬇	NM	NM

A=Chacko et al. (2017); B= Enwere et al. (2016); C= Munro et al. (2009); D= Özçaka et al. (2012); E= Shi et al. (2013); F= Villar et al. (2016).

⬇= decrease

⬆= increase

LOS= length of stay in ICU

N= number of patients in the sample studied

NA= not applicable

NM= not mentioned

S= similar, the same, or little difference